

GEOLOGICAL SCIENCES
UNIVERSITY OF COLORADO BOULDER

Geology News

The last 100 million years of
climate and elevation change
in the western US

Inside on page 7

Editors

Shemin Ge

Dan W. Mitchell

2015 - 2016

Contents

| | |
|------------------------------------|----|
| Letter from the Chair..... | 2 |
| Notes from the Advisory Board..... | 3 |
| Faculty News..... | 4 |
| New Faculty | 6 |
| Faculty Awards..... | 6 |
| On The Cover | 7 |
| CU's Mission to Mars..... | 8 |
| Front Office News..... | 9 |
| Save The Date..... | 10 |
| New Electron Microprobe | 11 |
| Pete Birkeland Scholarship Fund. . | 12 |
| Philanthropy Helps Students..... | 12 |
| Field Trips | 13 |
| Mars Rover / From the Field..... | 15 |
| Graduate Research | 16 |
| Student Activities..... | 17 |
| Mentoring / Publications..... | 18 |
| Student News and Awards | 19 |
| Degrees Awarded..... | 20 |
| Alumni News | 22 |
| In Memorium | 23 |

Letter from the Chair

Shemin Ge

With the support of our staff and faculty, I survived the first year as Dept Chair. The guidance and wisdom from the former Chair Lang Farmer and the assistance from Associate Chairs Greg Tucker and Tom Marchitto were critical to ensure a smooth passing of the baton.

As always, we have much to celebrate with regard to faculty and student accomplishments. Here are a few faculty highlights. Robert Anderson was bestowed one of the four University Distinguished Professorships, the highest honor given to faculty in the University system. Bob was also the recipient of American Geophysical Union's 2015 G.K. Gilbert Award for his remarkable contributions to the field of surface processes. Becky Flowers was selected as one of the three 2015-2016 Mineralogical Society of America Distinguished Lecturers, recognizing her research on relating cratonic surface histories and mantle dynamics, as well as dating the Grand Canyon incision. Chuck Stern was awarded the Herbert Thomas Prize by the Geologic Society of Chile for his outstanding contributions to understanding the geology of Chile by a non-Chilean scientist. Paul Weimer received the Doris Malkin Curtis Medal from the Gulf Coast Section of the Society of Economic Paleontologists and Mineralogists for his career contributions to understanding the geology of the Gulf of Mexico Basin and other basins globally. Professor Emeritus John Andrews is awarded the 2016 Penrose Medal by Geological Society of America. John was chosen for original contributions to understanding the history and dynamics of the Pleistocene ice sheets.

After a distinguished career of 30 years, Roger Bilham was promoted to Professor Emeritus, which has allowed him a greater degree of freedom to chase earthquakes around the globe and further his research on monitoring deformation on plate boundaries. He still retains his privileged position of being the only scientist in the world to

be banned from India for publishing articles on the seismic hazards of the Himalaya and the Indian subcontinent. Dena Smith will depart CU this summer to become a Program Director for the Sedimentary Geology and Paleobiology Program at the National Science Foundation. We extend our best wishes to Roger and Dena. Mary Kraus was appointed Vice Provost for Undergraduate Studies. Lang Farmer was appointed to replace Mary as the Associate Dean for Natural Sciences in the College of Arts and Sciences. Kevin Mahan is successfully promoted to Associate Professor with tenure and Jen Stempien was reappointed as Instructor. We officially welcomed Kristy Tiampo to the faculty in fall 2015. See page 8 for more on her background and future work. We warmly welcome three new faculty to join us in fall 2016: Dr. Sebastian Kopf, a geobiologist; Dr. Boswell Wing, a geobiologist, and Dr. Michael Willis, a geodesist. We will feature them in the next Newsletter, so stay tuned.

The number of Geology majors in Spring 2016 stands at 340, continuing an upward trend that has experienced ~50% growth over the past five years. The field opportunities and experiences the department offers remain a strong attraction for students. The second Global Seminar field course takes place in summer 2016 in southeastern Australia, thanks in part to a generous alumni donation. Students will learn critical geological principles in an international setting that contrasts with the traditional settings in America. Our graduate student population is at 69 with approximately 20% MS and 80% Ph.D.. The graduate student numbers have remained relatively stable in the past 5 years, fluctuating between 60 and 80. In fall 2015, we welcomed 22 outstanding graduate students from a pool of approximately 200 applicants. Lon Abbott and Bob Anderson again led the annual Bradley new graduate student field trip, assisted by continuing graduate students and Advisory Board members Joe Zamudio, Houston Kempton and Dean Miller. We continued the tradition of holding Departmental graduation ceremonies in both winter and spring. Featured speakers, Advisory Board member Cheree Stover in the winter and Professor Bruce Jakosky in spring, were the great hits for the students. For the first time, we held the Spring ceremony in the lawn outside Benson because the record number of attendees exceeded our indoor seating capacity. Although we can no longer claim the outdoor ceremony "homey," we preserved the intimate flavor of the occasion as we later gathered in the atrium in Benson for champagne and conversation.

There are a few changes in our front office. We celebrated Joanne Brunetti's retirement with a great appreciation of her service of 14 years as accountant in Geology. Our new accountant, Marilynn Bender, not just steps into Joanne's big shoes but also handles a much larger and more complex financial system due to our increased research volume. Undergraduate Program Assistant, Kristine Johnson, will soon assume the role of Graduate Program Assistant that was previously held by Susan Pryor and Melissa Green. The Office Manager and Assistant to the Chair, Carmen Juszczak, was promoted to the Coordinator for University's Residential Academic Program. We are pleased to welcome Ruth Mansback to lead the Department office. During these transitions, Kristine Johnson has been a steady and indispensable force that ensured continuity of the office operation.

We welcomed three new Advisory Board members: Florie Caporuscio of Los Alamos National Lab, John Roesink of Jagged Peak Energy Management, and Sean Sundermann of Fugro Consultants Inc. Board member Tyler Kane rotated off. We deeply appreciate his service and the unique contributions of the Advisory Board. Please see more in the letter below from the Advisory Board Chair, Dean Miller.

One of our greatest needs is to enhance our capability to provide graduate fellowships. With the help of the Advisory Board, alumna Dr. Margaret Berry, and the Advancement Office, we established the Peter Birkeland Scholarship Fund, in honor of Emeritus Professor Peter Birkeland for his distinguished career in the field of soil geomorphology and his legacy in mentoring students. Please see the announcement on page 12 for more details.

Reflecting on my first year as Chair, I struggle to adequately express my pride for the accomplishments of our students and faculty, my gratitude for the support from our staff and alumni, and the feeling of privilege to be part of this extraordinary Department. CU-Boulder, once again, was ranked by the World News as the second best global university in Geosciences in the world. The Benson Earth Sciences building, inaugurated in 1997, is an inseparable part of our continued successes. We are planning a 20th anniversary celebration of the Benson Earth Sciences building in fall 2017 (page 10). Finally, we will be thrilled to hear from you, whether it is your career or family news or a donation to your favored funds listed on the back cover of this publication.

Best wishes to all of you.

Notes from the Advisory Board

by Dean Miller

Greetings from the Alumni Advisory Board,

These are exciting times in the Department, with the appointment of Shemin Ge as the new Department Chair, and the arrival of new faculty, staff, and students, as well the continued success of existing members of the Department community. The Board said goodbye to Tyler Kane this spring. We appreciate his service, and hope that he may rejoin the Board when he completes his graduate studies. On the plus side, we welcomed Florie Caporuscio of Los Alamos National Laboratory and Sean Sundermann of Fugro Consultants, Inc. as new Board members.

The Board has enjoyed working with the new Department Chair, Shemin Ge. The Department clearly is in good hands – yet again. As Shemin mentioned in her column, the Department established the Peter Birkeland Geological Sciences Graduate Scholarship Fund in honor of Professor Emeritus Peter Birkeland. Pete is well known to many of you, as he joined the Department in 1967 and retired only a few years ago. Pete inspired and mentored many students over the years, including many who were not geomorphology or soils students. The scholarship fund is a great way to honor Pete's legacy. If you would like to contribute, you can do so through the Alumni/Donations link on the Department website: <http://www.cugeology.org>

The breadth of research being done in the Department is remarkable, from geobiology, planetary geology, and geodynamics, to paleoclimate and deep crustal processes. The Department faculty has been extremely successful, and has a lot to be proud of. For the second year in a row, the University of Colorado was recognized by U.S. News and World Report as number two in the world in geosciences.

As in past years, the Board met with undergraduates in the fall and graduate students in the Spring to discuss the state of the Department. The feedback we received was very positive. However, one issue that is impacting both students and faculty is the increasing real estate values in Boulder, where the average price of a house is close to one-million dollars. This has impacted the ability of both students and faculty to live in Boulder, so they are spread out in the surrounding communities. There is no simple solution to this issue. Boulder is simply a very desirable place to live.

The Board held another career night for undergraduate and graduate students. The depressed state of both the oil and gas and mining industries make these efforts more important than ever. Please let us know if you know of any internships or other opportunities for students.

Last August, the Department once again held the annual Bill Bradley Field Trip for the twenty-two new graduate students that came into the Department. The trip starts off with Department faculty and some Board members introducing 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, which is led by Bob Anderson. This year, we will have a similar number of new graduate students coming into the Department, so it should be a fun trip.

If you have the opportunity to donate to the Department, there has never been a greater need. Less than 6% of the University's annual budget comes from state funding. You would be surprised how much of a difference for students even a small donation can make.

Lon Abbott describes how much fun the new graduate students will have at the 2015 Bill Bradley New Graduate Student Field Trip.



Geological Sciences Advisory Board Members

Andres Aslan
Colorado Mesa University

Sophie Berglund
Williams Energy

Florie Caporuscio
Los Alamos National Laboratory

Patricia Corbetta
BHP Billiton

Gus Gustason
Consultant

Dawn S. Kaback
Geomatrix Consultants

Karen Kelley
USGS Denver

Houston Kempton
Environmental Consultant

Dean Miller - Chair
Davis Graham & Stubbs, LLP

Penny Patterson
ExxonMobil Exploration Company

John Roesink
Jagged Peak Energy Management, LLC

Alan Seeling
Petroleum Geologist

Shannon Cheree' Stover
BP

Sean Sundermann
Fugro Consultants Inc.

Chandler Wilhelm
Shell Exploration and Production Co.

Joe Zamudio
ITT Visual Information Solutions

Faculty News

Becky Flowers

Over the last year the CU TRaLL (Thermochronology Research and Instrumentation Lab) produced 100s of (U-Th)/He analyses for internal and external projects, and hosted numerous lab visitors. Prof. Becky Flowers and Dr. Jim Metcalf (research associate and (U-Th)/He lab manager) were recently awarded an NSF Instrumentation and Facilities grant to obtain a quadrupole ICPMS with which to further expand the lab's capabilities. 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. Congratulations to Dr. Jess Stanley who completed her PhD thesis in fall 2015, and will begin a postdoc position at the University of Potsdam this fall. Congratulations also go to Dr. Rachel Landman who completed her PhD thesis in 2015. PhD student Jacky Baughman recently submitted her first paper, focused on her method development work of the titanite (U-Th)/He thermochronometer using samples from southern Africa. Jacky also passed her PhD qualifying exam, and helped successfully mentor undergraduate Ryan Stoner to completion of an honors thesis that investigated radiation damage in southern African zircons using Raman spectroscopy. Colin Sturrock is a new PhD student working on a funded NSF project in collaboration with Prof. Shijie Zhong (Physics Dept) to decipher the history and causes of continental interior elevation change histories. Rachel Havranek is a new MSc student studying the thermal evolution and erosion history of the three Colorado Front Range fourteeners using zircon (U-Th)/He thermochronology. Dr. Nigel Kelly continues his (U-Th)/He work on lunar zircons. Dr. Lon Abbott and undergraduate Jamie Glass are collaborating in the lab on a sample suite from the eastern Australian margin. Flowers and Metcalf continue to lead the EarthScope AGeS program, which during its second proposal cycle saw 40 proposals submitted by graduate students to work in geochronology labs across the nation. Flowers was a Mineralogical Distinguished Lecture for the 2015-16 academic year, and visited 9 different institutions over the course of the year. This spring she was awarded a Humboldt research fellowship, which will help support her during her sabbatical at the University of Tuebingen in Germany next year.

Mary Kraus

Mary was named vice provost and associate vice chancellor for undergraduate education by Provost Russell Moore. Mary will assume this position effective June 1, 2016. As part of this position, Mary will lead many key campus student initiatives and be involved in the development of recruitment and student support strategies that will enable CU-Boulder to recruit and retain a highly competitive and diverse undergraduate student body. She will also oversee campus-wide academic programs, including the Special Undergraduate Enrichment Programs, the Leadership Residential Academic Program and its partner Ethnic Living and Learning Community, the Top Scholarship Advising and Campus Assessment Office, the Office of International Education, the Student Academic Success Center, the Presidents Leadership Class and three ROTC programs. Prior to accepting this position, Mary served as senior associate dean in the College of Arts & Sciences and associate dean for natural sciences in the College.

Gifford Miller

Although the Canadian Arctic has been warming at an exceptionally rapid rate over the past several decades, Baffin Island bucked the trend during the 2015 summer, much to the consternation of Giff Miller's research team that spent most of August on Cumberland Peninsula, eastern Baffin Island. With CU PhD students Simon Pendleton and Sarah Crump, along with Jason Briner (Buffalo, CU PhD) and Nicolas Young (LDEO), the team holed up in a small cabin in Maktak Fiord for a week waiting for the weather to allow helicopter support to arrive. They eventually settled on "Plan B": traverse the stormy seas with an Inuk colleague in his ocean-going canoe in order to reach some early Holocene glacier moraines that were not originally targets. On the moraines they sampled the surfaces of stable boulders for cosmogenic exposure dating, despite the unfavorable weather. All bad things end eventually, and the helicopter finally arrived, providing access to our primary moraine targets and chasing away polar bears wandering the nearby shores. The second half of the season went so smoothly that despite the shortened timeline, they managed to achieve all of their objectives and even complete some unexpected additional sampling, including dead plants emerging from beneath retreating glaciers that are beyond the range of radiocarbon dating. These plants have been

entombed by ice for over 50,000 years, but are now being exposed as glaciers retreat under the exceptionally warm summers of the past 50 years.

Julio Sepúlveda

The Organic Geochemistry Lab (OG Lab) moved to the new SEEC building in East campus in April. Although half of the OG Lab will undergo further renovations, the first new instrument — a gas chromatograph-triple quadrupole-mass spectrometer — is scheduled for delivery and installation in late June. It is anticipated that the entire OG Lab will be completed by the end of August, in time for the arrival of the second new instrument, a high performance liquid chromatograph-quadrupole-Orbitrap-mass spec. A third new instrument contributed by Sebastian Kopf, a gas chromatograph interphase to an isotope ratio mass spec, will be installed in early fall. An official opening of the OG Lab will be announced in fall 2016.

Dr. Nadia Dildar is the new lab manager of the OG Lab since March 2016. Nadia obtained her PhD in Analytical Chemistry from the Organic Geochemistry Unit at the University of Bristol, England. She comes to CU after working as a postdoctoral researcher in the Department of Earth Sciences at the University of Western Ontario, Canada. Nadia has extensive experience in the isolation, and chemical and isotopic characterization of organic molecules from environmental samples as well as microbial cultures.

Garrett Boudinot became the first graduate student to join the OG Lab in fall 2015. Garrett graduated from the College of Charleston with majors in Geology and Religious Studies, and a minor in Environmental Studies. He's currently working on an NSF-Earth Life Transitions project studying how marine ecosystems and nutrient cycling responded to environmental perturbations caused by extreme climate change during the mid-late Cretaceous. Garrett has recently obtained funding from the American Association of Petroleum Geologists Foundation and the Spetzler Award from our department to support part of his research. Lina Pérez-Ángel will join the OG Lab as a PhD student in the fall 2016 after graduating from the University of Los Andes, Colombia with a major in Geosciences and a minor in photography. She will be co-advised by Julio Sepúlveda and Peter Molnar while studying the climatic and vegetation evolution of the Sabana de Bogotá in the Eastern Cordillera of the Andes since the Pliocene. Lina's work will include close collaboration with Katie Snell.

Geology and Chemistry major Michael "Avi" Gross received a UROP award in Spring 2016 to work in the OG Lab. Avi is currently studying the distribution of polycyclic aromatic hydrocarbons (PAHs) in several Cretaceous-Paleogene (K/Pg) boundary sections to assess the role of wildfires in the associated mass extinction event. He expects to present the results of his research at the 2016 GSA Meeting in Denver, and will continue working with us during his senior year at CU. The OG Lab has also hosted seven undergraduate students through the Work-Study Program over the last year.

Dr. Lily Momper will join the OG lab in Spring 2017 after being awarded a NASA Postdoctoral Program Fellowship. She obtained her PhD in Biology from the University of Southern California working under the supervision of Prof. Jan Amend. Lily will be co-advised by Julio Sepúlveda and Alexis Templeton, and also by Prof. Roger Summons at MIT. Her work seeks to study biomarker fingerprints of microbial

communities associated with the low temperature serpentinizing systems of the Samail Ophiolites in Oman. Her work will unite the research areas of two NASA Astrobiology Institutes (NAI), the Rock Powered Life NAI at CU Boulder and the Foundations of Complex Life NAI at MIT.

Marwa Baroumi visited the OG Lab from September 2015 to February 2016 as a recipient of a travel award from the European Association of Organic Geochemists, the first one ever awarded to a Muslim female. Marwa is a PhD student at the University of Tunis El Manar, Tunisia working under the supervision of Prof. Hedi Negra and under the co-advising of Julio Sepúlveda. During her visit she worked on the processing of biomarker data from Cretaceous-Paleogene (K/Pg) sections from northwestern Tunisia. Raman Umamaheswaran, a Geology senior in the Department of Geology at the University of Delhi, India will visit the OG Lab in summer 2016 as a recipient of the distinguished S.N. Bose Scholars Program. Raman will work under the supervision of Julio Sepúlveda and Karen Chin, and will perform organic geochemical analyses of Cretaceous dinosaur coprolites collected from Montana and Utah.

Paul Weimer

Paul taught two graduate classes in AY 15-16 (Applied Sequence Stratigraphy and Basin Analysis, and Petroleum Systems of Deepwater Settings), and one upper division field geology class for stratigraphic sciences.

In fall 2015, he received the Gulf Coast Section SEPM Doris M. Curtis Award "for outstanding contributions to understanding the Gulf of Mexico Sedimentary Basin and other basins worldwide." In 2016, he will receive the Gulf Coast Association of Geological Sciences Outstanding Educator Award for "outstanding contributions in the education and training of geologists." In 2015, he received Honorary membership in the New Orleans Geological Society.

A special issue of the AAPG Bulletin will be published later this year dedicated to results of an EMARC Gulf of Mexico research consortium. Paul continues to serve as the chair of the 100th Anniversary Committee, which culminates at the April 2017 Annual Convention. He co-organized the Discovery Thinking Sessions at the 2015 and 2016 Domestic and International Conventions of the AAPG. He also serves as Trustee for the American Geosciences Institute Foundation (AGI), and on the RMAG Corporate Advisory Board.

The major animation efforts of the Interactive Geology Project (IGP) for public outreach culminated at the June 2015 AAPG Convention, when their 25-minute video, "A Brief History of Colorado Through Time," was shown as a part of the Opening Ceremony. Visit <http://igp.colorado.edu>. The decrease in commodity prices has made fund raising moot for the time being, and the project is now called "Suspended Animation." Project restart should happen as soon as commodity prices rebound. Paul's research efforts involve Gulf of Mexico, Offshore Peru, eastern Mediterranean, and Piceance Basin, with upcoming projects planned in the deepwater Malvinas and Madagascar.

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

New Faculty

Kristy Tiampo

Dr. Kristy Tiampo received her BSc in Civil Engineering from Tufts University, and her MSc in Civil Engineering from Stanford University. She obtained her PhD in Geophysics from the University of Colorado at Boulder, after practicing as a construction engineer for the US Army Corps of Engineers for almost 10 years, during which time she earned her certification as a Professional Engineer. In 2003 she was appointed Assistant Professor of Geophysics at Western University, Canada, and was the NSERC and Aon Benfield/ICLR Industrial Research Chair in Earthquake Hazard from 2006 through 2011. Today she is Professor and Director of the Earth Science and Observation Center (ESOC) at the Cooperative Institute for Research in Environmental Sciences (CIRES) at the University of Colorado. Dr. Tiampo's research program aims to provide a comprehensive understanding of the processes which govern natural and anthropogenic hazards and, in particular, those which generate earthquakes, and thus improve the associated estimates of the regional seismic hazard. This is accomplished through the integration of large quantities of remote sensing data such as space-based Global Positioning System (GPS) data, differential Interferometric Synthetic Aperture Radar (DInSAR), seismicity and gravity, in order to provide critical information on the nature and scale of these hazards. Her research program includes improvements into the nature and quantity of that data, innovative analysis techniques, accurate models of the potential geophysical sources, and timely and appropriate assimilation into various computational models. Significant contributions from her research group include development of the first of a new generation of seismicity measures and effective inversions for the sources of surface deformation associated with earthquake and volcanic hazard as well as anthropogenic signals.



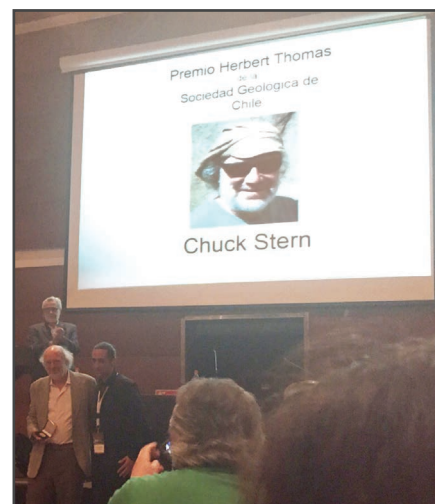
Faculty Awards



Robert S. Anderson is one of four new University of Colorado Distinguished Professors. The Distinguished Professorship is the highest faculty honor at the University of Colorado's four campuses. The honor recognizes faculty members who demonstrate exemplary performance in research or creative work, a record of excellence in classroom teaching and supervision of individual learning, and outstanding service to the profession, the university and its affiliates. Bob also was awarded the G.K. Gilbert Award in Surface Processes.

Chuck Stern

In October at the 14th Chilean Geologic Congress in Serena, Chile, Chuck was awarded the Herbert Thomas Prize by the Geologic Society of Chile for outstanding contributions to the understanding of the geology and the development of geological sciences in Chile by a non-Chilean scientist. Chuck continues to go back and forth to Chile a few times a year to work with Chilean geologists on problems related to the generation and eruption history of Andean volcanoes, and with geoarchaeologists on the location of the sources and the distribution of obsidian artifacts in Patagonia. In June he will present results from his obsidian research at the First International Obsidian Conference in Sicily.



Paul Weimer received the Doris Malkin Curtis Medal from the GCSSEPM, which recognizes geologists for their career contributions in the development of new concepts for understanding the geology of the Gulf of Mexico Basin and other basins globally. He also received Honorary membership in the New Orleans Geological Society.

On The Cover.....

By Katie Snell

Cover photo: Outcrops of Neogene paleosols from southwestern Kansas
Credit: Kevin Uno (Lamont)

The last 100 million years of climate and elevation change in the western US

Terrestrial basins record the substantial climatic and tectonic changes that have occurred throughout earth history. Much of my research focuses how terrestrial ecosystems responded to and recorded these changes in the western United States over the last ~100 million years. Temperature and hydrologic changes, based on stable isotope analyses of carbonate minerals preserved in terrestrial environments like ancient soils and lakes, are key pieces of this climatic evolution. In addition, a comprehensive spatial and temporal framework of temperature and hydrology may make it possible to separate the overprint of elevation changes on these records from the changes that resulted from global climate change. Two projects are currently underway that address some of the many outstanding questions about the climatic and tectonic evolution of the western US. In addition to the specific motivating questions, the results from these projects will greatly contribute to this evolving framework of temperature and hydrology in western US.

Early Cretaceous climatic and tectonic evolution of the Sevier Hinterland

This project, recently funded through the NSF Tectonics program, will probe the evolution of paleoenvironments represented by the Newark Canyon Formation of central Nevada. This Early Cretaceous formation has recently yielded dinosaur fossils, and was likely a piggyback basin immediately east of a large structural culmination that formed as an early part of the Sevier Orogeny. For years, many scientists have drawn parallels between the Sevier orogenic belt of the western US during the Cretaceous and the modern Andes. However, recent work has suggested that substantial surface uplift of the modern Andes and Altiplano may have postdated the interval of major crustal thickening. Our study will estimate the ancient elevation of the Newark Canyon Formation, in order to explore whether this phenomenon extends to other orogens besides the Andes. In addition, the data produced for this study will add critical paleoclimatic information about continental interiors during times of global warmth, and insights into dinosaur paleoecology in a unique environment.

Neogene evolution of C4 grasslands in the Great Plains and effects on faunal change

This project was funded by the NSF Earth Life Transitions program, to explore the factors that led to dominance of C4 grasses in the Great Plains grasslands. The cause of this dominance, in the Great Plains and other regions of the world, is still uncertain. The expansion of C4 grasses likely had major effects on the grazing fauna as well. This project is a collaborative effort that brings together researchers from six institutions with expertise in a broad range of

geochemical tools for reconstructing paleoclimate: paleontologists with expertise in small mammal faunal evolution and reconstructing ancient diet and ecology; and sedimentologists with expertise in reconstructing ancient soils and terrestrial ecosystems. The team has completed two field seasons and recently met in Minneapolis to bring the broad range of datasets together. In addition to the interesting implications these data have for the evolution of grasses and small mammals, we've learned a great deal about how each record reflects environmental change in different ways. These results will be extremely useful for improving how these tools will be applied in other studies.

For more information about these and other projects, please contact
Katie Snell (kathryn.snell@colorado.edu)
or visit www.snelllab.com



Screenwashing for vertebrate fossils, Newark Canyon Fm. in central Nevada. photo by Katie Snell

Sampling paleosol carbonate from Neogene paleosols in southwestern Kansas.

photo by Kevin Uno - Lamont



Microdrilling Neogene paleosol carbonate for "clumped" isotope analysis. photo by Anne Fetrow - CU

CU's Mission to Mars Achieves its Science Objectives

by Bruce Jakosky

CU's MAVEN spacecraft mission to Mars, led by geology professor Bruce Jakosky, successfully completed its one-year primary mission and successfully achieved its scientific objectives. MAVEN, the Mars Atmosphere and Volatile Evolution mission, went into orbit in September 2014. After a two-month commissioning phase, it began its primary science mission in November 2014, and completed it in November 2015. MAVEN is now in an "extended mission", continuing to make science observations, and has enough fuel that it could last for as long as another decade (see Figure 1).

The goal of MAVEN is to understand why the Mars climate changed through time. The geomorphology and geochemistry of the surface indicate that liquid water was present early in Martian history, but today's climate is too cold and dry to allow liquid water to be stable. Early Mars must have had a thicker atmosphere that could provide greenhouse warming, and MAVEN seeks to determine where that early atmosphere went. MAVEN is exploring the role played by loss of gas from the atmosphere to space, driven by the solar ultraviolet light and the solar wind.

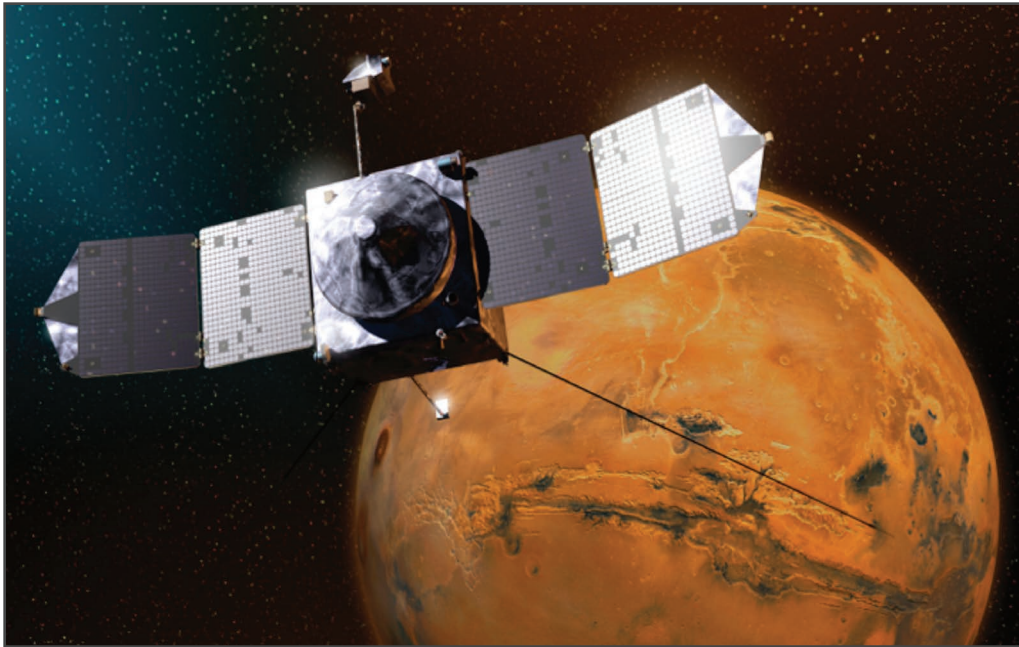


Figure 1. Artist's rendition of the MAVEN spacecraft in orbit around Mars.

MAVEN observed the energy inputs from the solar wind and the response of the upper atmosphere. Measurements of the flow of ions in the upper atmosphere (see figure 2) show that loss to space could account for the loss of the early atmosphere. In addition, measurements of stable isotopes in gases in the upper atmosphere show a distinct enhancement of the heavier isotopes that is indicative of loss of gas to space. Modeling of the loss again suggests that loss to space was a major process in changing the planet's climate.

In addition to addressing the specific question of loss of Martian atmosphere to space, MAVEN results show a remarkable coupling between the tenuous upper atmosphere of the planet and the climate and its influence on the geology and geochemistry of the surface. Mars truly has a complex environmental system that couples all aspects through the gases in the atmosphere. This coupling extends from the deep interior to the surface, to the polar caps and atmosphere, and to the upper atmosphere where it connects to the Sun and the solar wind.

In addition to Jakosky, who leads the project as Principal Investigator, there are four other tenure-track faculty members at CU Boulder and fifteen Ph.D.-level researchers working on MAVEN, along with more than fifteen undergraduate and graduate students.

A video produced by the MAVEN science team to show how the atmosphere can be stripped to space recently won a "data-stories video" contest run by the American Association for the Advancement of Science, which publishes Science magazine. The winning MAVEN video can be found at their web site, at <http://www.sciencemag.org/projects/data-stories/winners>.

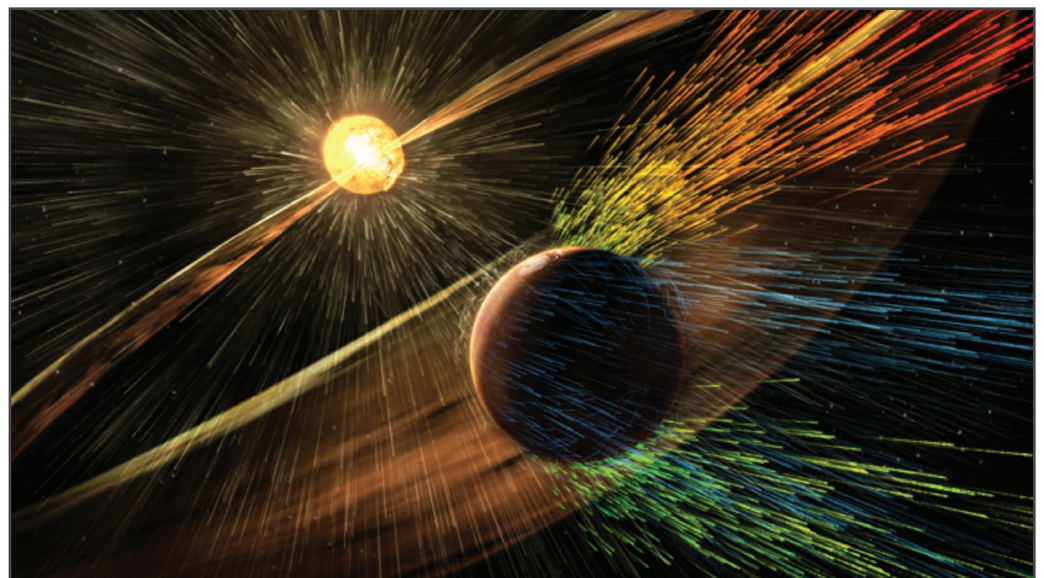


Figure 2. Artist's rendition of solar storms stripping gas from the Mars atmosphere, based on data returned from the MAVEN mission.

Front Office News

by Ruth Mansbach

Geological Sciences could not function properly without the key personnel in the staff office. This past year has come with significant changes to the front office staff.

Marilyn Bender has performed well as our new Accounting Tech! Marilyn works hard to ensure the tracking of finances, travel and purchasing. She has been extremely valuable to the Department and faculty in managing the financial activities.

Melissa Green served for six months as our Graduate Program Assistant. She managed the myriad of responsibilities for new students, continuing students, and their advisors. She also helped keep the department on track with curriculum management and often provided assistance with day-to-day front office operations. Melissa has moved on to greener pastures effective May 27, 2016.

Kristine Johnson has served well as the 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. Kristine has taken on multiple responsibilities in the front office and on July 1, 2016 will become our new Graduate Program Assistant.

Ruth Mansbach joined the Department as the Office Manager in May of this year and has been working hard to prepare for the upcoming Fall 2016 semester. Ruth comes to us from Evolutionary Biology and brings a background in accounting and finances.

The Geological Sciences departmental office can be contacted at:

Phone: 303.492.8141
Fax: 303.492.2606
Email: geolinfo@Colorado.edu

Office Manager - Ruth Mansbach

Phone: 303.492.2330
Email: Ruth.Mansbach@Colorado.edu

L-R: Ruth Mansbach, Marilyn Bender, Melissa Green and Kristine Johnson



www.cugeology.org

left to right: Shemin Ge, Ryan Stoner (geology major), Steve Marks (CU alumni), Barbara Perin (Advancement) at the A&S scholarship celebration.



**Geological Sciences
Alumni Reception**
at the
2016 GSA Annual Meeting
in Denver, CO
Monday, September 26th, 2016
7:00PM - 9:30PM
Hyatt Regency Denver
at CCC, Centennial Ballroom D-E

Save the Date: BESC@20

Mark your calendars:
September 15th, 2017: BESC@20



The Department moved in to the Benson Earth Sciences Building (BESC) in September 1997, which means that we are fast approaching the 20th Anniversary of our home. In recognition of the event, we have scheduled a gala celebration for Friday evening, September 15th, 2017, followed by field trips on Saturday and Sunday. This is barely a year away, so mark your calendars now!

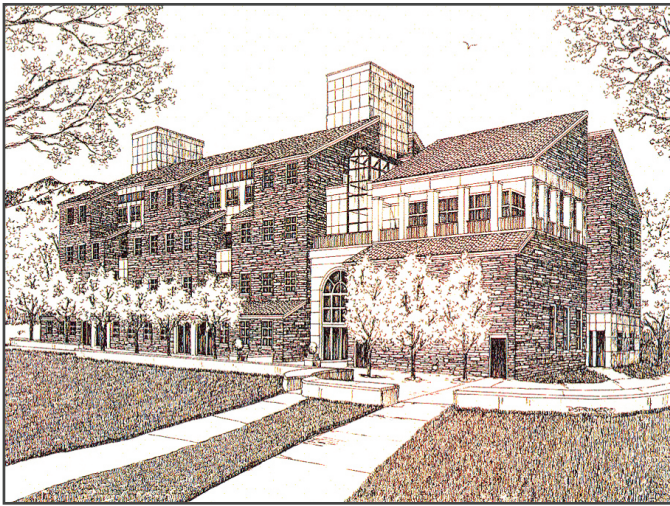
The Program Committee plans to offer lab tours in late afternoon, with food and adult beverages in the Atrium starting about 6 PM, followed by testimonials and general fun talks in the adjacent Auditorium beginning at 7 PM. It's a Home Game for the football team (Northern Colorado), so we expect many Alumni will be in town. Bruce Benson has already inked the date in his calendar, and we expect several of the Boulder senior administration to be present. The celebration will be early in the fall, so access to the high country should be possible, with the Aspen in full color; we plan a range of field trips to accommodate all levels of fitness.

Geological Sciences is not the same department it was when we moved from Old Geology to our new home. And the building itself has been a major factor in defining the Department's transition. Our ability to hire the very best young faculty, and to recruit top students from around the country has been greatly enhanced by the infrastructure and appearance of BESC. Come help us celebrate two decades of education and research, and a bright future.

REQUESTS OF ALL ALUMNI The Program Committee plans to run a looped slide show before and after the formal talks, and subsequently on our website, so we are requesting alumni send in their favorite images of their time at CU...field trips, lab activities, 4th floor FAC, etc. Dig through those old 35 mm slides for a few treasures. You can send the slides or prints to us and we will digitize them and return them to you with the digital version as well. We would also like short (as in really short) little video clips of your reminiscences of your time at CU. Set up your smartphone and let it shoot a little story of something special to you about your years in the Department. We'd like to run those clips that are acceptable to an adult audience during the celebration.

You can upload your video's to:
<http://www.cugeology.org/besc20>

BESC@20 Program Committee:
Giff Miller, Mary Kraus, Lang Farmer



Conceptual drawing of the Benson Earth Sciences building.



The Pleistocene returns!
Snapshot of one of the globes at the entrance to Benson Earth Sciences building on a winter day in 2016.
photo by alum Wes Horner MS '54

New Electron Microprobe JEOL-8230!

by Julien Allaz

The department of Geological Sciences was awarded a Major Research Instrumentation (MRI) grant by NSF in Summer 2014 to purchase a new electron microprobe, a JEOL JXA-8230 equipped with LaB6 electron gun (PIs K.H. Mahan, J.M. Allaz, and G.L. Farmer). Electron microprobe analysis is a sensitive technique for non-destructive quantification of the chemical composition of in situ micrometer volumes of solid material (minerals, alloys, ceramics, glass, etc.). This new instrument will replace the aging JEOL JXA-8600 installed in 1988, and will offer superior quality analysis, both in term of precision and accuracy. This new 5-spectrometer instrument will considerably enhance our spatial resolution (beam size ca. 0.2-0.7 μm) and our analytical capabilities, notably in term of trace element analysis, thanks to many large-area monochromators. We expect to reach 1-10 ppm range for detection limit for most elements, which will allow us to perform trace element analysis in sulfide for rare and precious elements (Au, Ag, Te...), trace element analysis in beam sensitive material, including carbonate, titanium analysis in quartz for thermometry, U-Th-Pb dating of monazite, etc.

The new instrument and lab will be incorporated into a variety of teaching activities including a graduate level course on analytical methods (taught by Dr. Allaz) and several undergraduate courses. Activities for the latter will be facilitated by technological enhancements such as a large wall-mounted monitor for viewing of activities by standing groups of 7-10 students, a web-cam for remote viewing of lab activities during lecture classes, and remote access to one of the operational computers for viewing of activities during lecture classes, or for remote analytical work on the instrument. In the future, we anticipate designing an intensive 2 to 3-day workshop to train students and other researchers on the use of the new instrument. This workshop will permit students and researchers to use the instrument with minimal assistance from the laboratory manager. The online laboratory access will also permit students to eas-

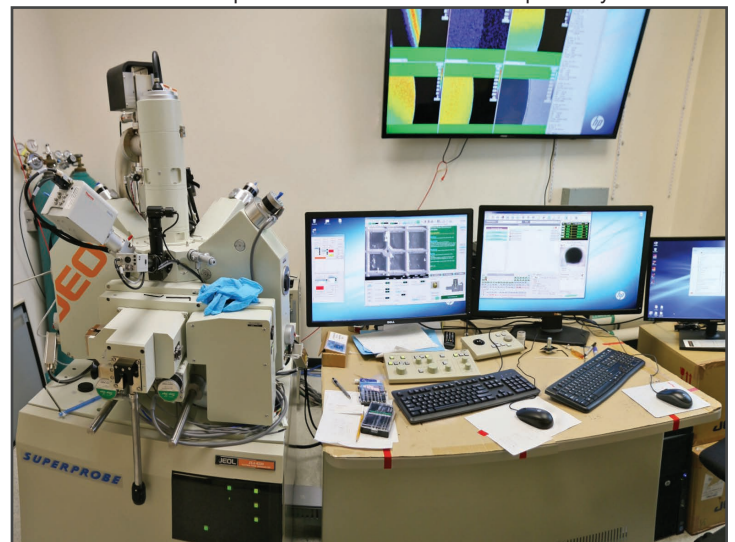
ily access the instrument without being physically present, thus enlarging the impact of students who could not otherwise use such an instrument.

This new acquisition would not have been possible without the help of 38 researchers throughout Colorado and beyond that supported our proposal. We are extremely thankful to them. We also acknowledge financial support from CU for providing the required 30% cost-share on the instrument, and granted us additional funds for laboratory renovation. The new instrument is currently being installed in room 125A (adjacent to the old microprobe), and we will update you when the instrument is opened to researchers and other outside users. As usual, we will welcome work from private corporations! An open-house will be organized as soon as the new instrument is up and running. We will keep you informed!

Julien M. Allaz (julien.allaz@colorado.edu)
& Kevin H. Mahan
<http://geode.colorado.edu/~jallaz/index.php?page=microprobe>

The new electron microprobe lab.

photo by Julien Allaz



Peter Birkeland Scholarship Fund

We are pleased to announce the formation of the Pete Birkeland Scholarship Fund in the University of Colorado Boulder Department of Geological Sciences in honor of Emeritus Professor Pete Birkeland. This honor is a well-deserved honor. Pete not only is a leader in the field of soils geomorphology, his legacy reaches across a variety of geology disciplines. Pete inspired both undergraduate and graduate students through his remarkable teaching and guidance. This scholarship will ensure that Pete's legacy will provide tangible benefits for generations of students.

The funds generated by the Birkeland Scholarship will be used to support graduate students in the Department with tuition, fees, research-related expenses, as well as support for mentoring, travel grants, and other awards. Once the fund reaches \$25,000, we can implement the endowment and be able to make the first award. Our goal is to raise twice this amount before the 20th anniversary of the Benson Earth Sciences Building in the fall of 2017.

A contribution in any amount is welcome. If you would like to help get the Birkeland Scholarship Fund off the ground, simply go to: http://www.cugeology.org/contrib_home.htm; the link to the Birkeland Scholarship Fund is in the second row.



Peter Birkeland enjoying a Department of Geological Sciences function.

Geology Buff's work spans globe, philanthropy helps students

Dale Grant, who has 'always been a Buff,' has moved to establish a major scholarship for geological sciences students

by Clint Talbott

Dale Grant's career and travel have spanned the world—and included jobs in Eastern China and Saudi Arabia—and now his geology training helps quickly alert the world where, how big and how damaging severe earthquakes are.

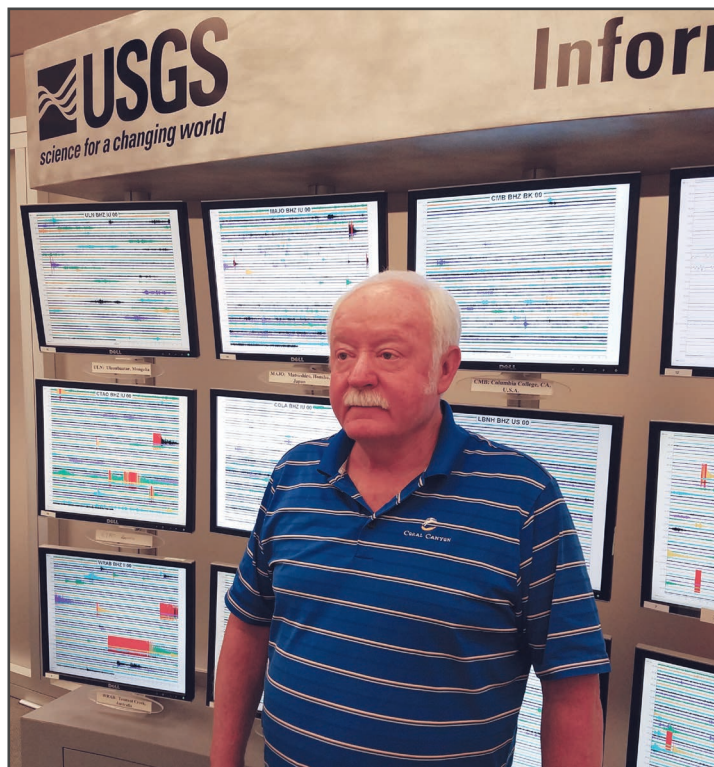
At the University of Colorado Boulder in the 1970s, Grant became energized by the great outdoors, and his career "seemingly fell in front of me." Now, the man who says he's "always been a Buff" has moved to establish a significant scholarship with his estate for geological sciences students.

Grant's career, both in college and beyond, has been far-flung and meaningful. He hopes his scholarship fund helps enable future students to find similarly rewarding careers.

His degree from CU-Boulder became the "means to my career," Grant notes, adding that there was never any question about where he would study. CU has always been "my school," he adds. "That's where I always wanted to go. There was never anywhere else."

Born in Caspar, Wyo., Grant grew up in Denver. Attending CU-Boulder seemed a foregone conclusion. "On Saturdays, we'd get around the radio and listen to the Buffs games back in the '50s and '60s."

That deep connection is one reason he plans to endow a scholarship fund in geological sciences. "That's where I'd like to see people study, because it's something in my heart, something I always enjoyed. And also think it's the future, because the environment is so trashed right now that if we don't have people who are knowledgeable and concerned about it, I don't see any way out of it."



Dale Grant

Download the complete article by Clint Talbott from: <http://www.cugeology.org/philanthropy.pdf>

Visit all of our funds at
www.cugeology.org/donate



In a field trip early in summer 2015, members of the geomorph team traveled to Ship Rock, on the Navajo Nation, to seek inspiration for how landscapes evolve when the rocks vary significantly in their erodibility. There, several kilometer long dikes that radiate from Ship Rock were emplaced in Cretaceous shales of the same vintage as those on which the CU campus is built. The dikes baked the adjacent shales in a thermal boundary layer of a couple meters wide (illustrated by the lighter scaly rock on which graduate student Billy Armstrong and past undergraduate Liz Van Diepen are standing, and scaled by Billy's wingspan).

We surmised that it is the chips of this harder baked shale, and the blocks derived from the dike, that mantle the adjacent ramped hillslope, effectively propping it up to maintain significant local relief. No blocks exist beyond the base of the ramp. Our hypothesis is that the presence of blocks on the slope both stalls the weathering of the shale beneath them, and interrupts the creep of soil derived from

Billy Armstrong and Liz Van Diepen by the southern dike radiating from Ship Rock.



the weathering of the shale. This has inspired graduate student Rachel Glade to construct a numerical model of how hogbacks form, of which our own Dakota Ridge is a world-class example. The detailed straight-to-concave profiles of the topographic ramps, the sizes of the blocks, and the degree of weathering of the blocks all serve as constraints on these models. Other landscape features we wish to probe with such models that require treating the roles of blocks in the landscape include flatirons and escarpments.

In Fall 2015, Professor Brian Hynek led a graduate-level planetary field geology course to Greater Canyonlands,

Utah. The five day field trip focused on Mars analogs: eolian processes and resultant sedimentary rocks, hydrology in arid environments, tectonics and salt tectonics, erosion and its link to uplift, and biosignatures of past life. 20 students from Geological Sciences, Astronomy, Physics, and Aerospace Engineering participated in this 2-credit course.



Planetary geology students hoping to find a way out of a tight slot canyon.

Last summer, Profs. Lon Abbott and Lang Farmer took a set of CU and University of Iceland students on a two-week excursion around southern and central Colorado in the inaugural “Geology of Colorado” undergraduate field class. This was the reciprocal class to the joint CU/Univ. Iceland field course that we ran in Iceland in 2014. All of the University of Iceland students who participated in that class trekked to Colorado for this adventure. The course itself was a great success. The students performed exercises in Precambrian geology, salt tectonics (with Prof. Karl Mueller), gold ore deposits, the “ignimbrite flareup”, alpine glacial geomorphology (with Prof. Bob Anderson) and the origin of the Royal Gorge. Some of the geology was familiar to the CU students, but they nevertheless enjoyed seeing it all through the “new” eyes of their Icelandic cohorts. For their part, the Icelanders were ecstatic about the geology, but perhaps a little less enthusiastic about the southern Colorado environment (replete with hailstorms, scorpions, rattlesnakes and cholla). Because of the success of this program our hope is to continue these joint classes in the future, the next possible iteration being in Iceland in the summer of 2017.



Sampling acid mine drainage water coming from the Big five mine tunnel, near Ward, CO. photo by Gordon McCurry



Bob Anderson pointing out the Arkansas River. photo by Sigrún Tómasdóttir

Field Hydrogeology Course Flowing Strong by Gordon McCurry

The field hydrogeology course was offered last spring in response to a large demand. Twenty-one upper level Geology students did field and laboratory assignments on key aspects of this discipline, including understanding how to use grain-size distributions, geophysical log interpretation, and aquifer slug, pumping and tracer tests to estimate the hydraulic conductivity of saturated soil or rock. Field labs also included water quality sampling at a former hard rock mine site, water level mapping and a demonstration of well drilling and borehole sampling techniques. Springtime in Colorado can be a challenge for field courses but according to instructor Gordon McCurry, one of Shemin Ge’s earlier students, this class got lucky with the weather with only one field trip in snow. The course will be offered again in Fall 2016, so warmer and drier conditions await the next round of students!



Students mapping in northern Death Valley with a sandstorm brewing in the distance.

Active Tectonics field mapping group on active domino fault scarp, Panamint Valley, California.

Mars Rover Tests

by Brian Hynek

Professor Brian Hynek, along with Geology graduate students Sarah Black and John Gemperline and post-doc Rebecca Thomas, recently participated in Mars rover analog field tests in remote Utah. This NASA-sponsored project seeks to test two modes of rover operations and determine which driving mode provides maximum science return from a time- and resource-limited robotic mission on Mars.

The approaches used to robotically explore planetary field sites are an outgrowth of geologic fieldwork on Earth. On recent Mars missions, the rovers have generally operated in linear traverses; moving forward along a path to the key science targets within reach and conducting limited operations along the way. Conversely, a field geologist on Earth often arrives at a new site and conducts a walkabout to determine the complexity and diversity of materials in the area as

Geology graduate student Sarah Black, human rover, collecting VNIR hyperspectral data of a Jurassic microbialite.



well as to provide context. After the walkabout, they focus in on the most important materials for further study. In an effort to assess the science return (and time required) from a linear versus walkabout rover traverse, Professor Hynek has led several recent tests in Mars analog environments.

In these tests, we use a human rover that has the suite of functionally-equivalent instruments available to our current rovers on Mars. We chose not to use real rovers given the cost and technical/logistical constraints and the fact that our tests solely seek to test rover science methodologies and protocols. In our most recent field test outside of Green River, UT, we had two human rovers that were each commanded by a separate science backroom (Mission Control). Mission Control told the rovers where to go and what datasets to collect at each stop (e.g., panoramic or microscopic imaging, mineralogy, etc). After each set of observations, the data from the rover were “downlinked” to Mission Control, who then used that data to plan the next targets of interest and which data to acquire at those sites. One rover moved along a linear traverse, never returning back to a previously-visited site. The other completed a walkabout survey before focusing in on the most important targets to fulfill the mission goal of identifying biosignatures.

At the end of the mission, the two Mission Control teams used the returned rover data to attempt to reconstruct the geologic history of the region and identify biosignatures reflecting past life. We compared the science return from each team, accuracy of their geologic interpretations, and assessed how many days on Mars (sols) it would have taken each rover to complete their mission. The results of these studies are feeding directly into the Mars rover Curiosity’s operational planning to maximize the science return from Mars.

From The Field

by Gifford Miller

Although the Canadian Arctic has been warming at an exceptionally rapid rate over the past several decades, Baffin Island bucked the trend during the 2015 summer, much to the consternation of Giff Miller’s research team that spent most of August on Cumberland Peninsula, eastern Baffin Island. With CU PhD students Simon Pendleton and Sarah Crump, along with Jason Briner (Buffalo, CU PhD) and Nicolas Young (LDEO), the team holed up in a small cabin in Maktak Fiord for a week waiting for the weather to allow helicopter support to arrive. We eventually settled on “Plan B”: traverse the stormy seas with an Inuk colleague in his ocean-going canoe in order to reach some early Holocene glacier moraines that were not originally targets. On the moraines we sampled the surfaces of stable boulders for cosmogenic exposure dating, despite the unfavorable weather. All bad things end eventually, and the helicopter finally arrived, providing access to our primary moraine targets and chasing away polar bears wandering the nearby shores. The second half of the season went so smoothly that despite the shortened timeline, we managed to achieve all of our objectives and even complete some unexpected additional sampling, including dead plants emerging from beneath retreating glaciers that are beyond the range of

radiocarbon dating. These plants have been entombed by ice for over 50,000 years, but are now being exposed as glaciers retreat under the exceptionally warm summers of the past 50 years.

From left to right: Simon Pendleton, Nicolas Young, Sarah Crump, Jason Briner take a break on the canoe trip to the Railroad Moraines. photo by G. Miller Aug 2015



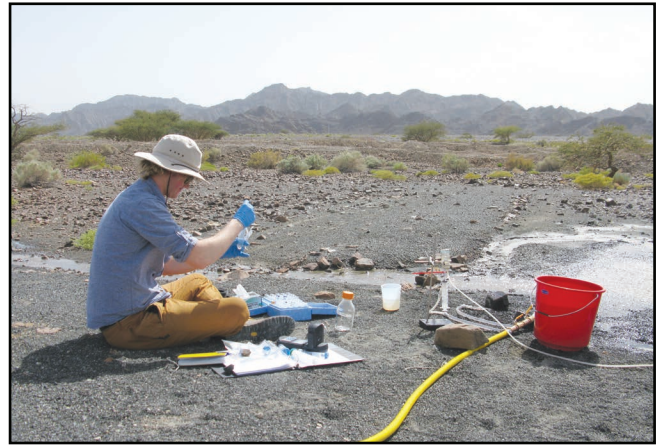
Graduate Student Research...

Understanding the geologic evolution of South Africa from the Archean through the present - Jacky Baughman

Thermochronometry is a powerful tool for deciphering thermal histories and therefore is applied to help understand a diverse array of temperature-dependent processes. My research, under the supervision of Prof. Flowers, focuses on better characterization and method development of thermochronometric rock dating techniques. I also utilize many of these dating tools to access a wide-range of temperatures in order to determine a detailed time-temperature history of the Archean Kaapvaal Craton, which encompasses the majority of South Africa. The Kaapvaal Craton formed and initially stabilized in the Archean, ca. 3000 Ma, and later at ~100 Ma, during the Mesozoic era, the craton experienced significant surface uplift with the rise of the Southern African Plateau. There is a significant time-temperature gap between these endmember events, my research works to fill this gap and best understand the burial and exhumation history of the Kaapvaal Craton. Thermochronology can identify mountain building events, significant basin burial and formation, faulting, river incision and general rock exhumation.

This project enables me to cultivate international relationships, interact with students from underprivileged backgrounds, and collaborate with South African academic and industry researchers. I conduct fieldwork throughout much of South Africa, and have had a range of important scientific and personal experiences. I have had significant aid from not only academic and government geologists, but many of the villagers, land owners and locals of the areas I work in. It can be a difficult country to travel though, but overall it has been a pleasure to interact with all types of people with a variety of backgrounds and has challenged me as a scientist and as a global citizen.

Fieldwork at the Spitskop Carbonatite Complex, 175 miles north-east of Johannesburg, South Africa. Special thanks to my incredible field assistants for the day - Dineo, Dimpha and Promise, pictured below. I could not have found the outcrops I needed without them!



Microbe mineral interactions and subsurface carbon cycle - Daniel Nothaft

Daniel Nothaft is a first-year PhD student in the Templeton Lab at CU studying how microbe-mineral interactions affect the subsurface carbon cycle of ultramafic rocks in Oman. These magnesium- and iron-rich rocks are a focus of carbon dioxide (CO₂) capture and storage research because they possess the chemical potential to transform CO₂ into carbonate minerals. This could provide a safe and secure way to reduce atmospheric CO₂ levels that contribute to climate change. These rocks also harbor a diverse microbial ecosystem. The effect of these microorganisms on natural carbon cycling within these rocks, let alone their effect on a potential CO₂ injection, remains an open question. There has been concern that microorganisms could convert additional CO₂ into methane, another greenhouse gas, thereby negating the climate change mitigation goals of carbon storage. On the other hand, some microorganisms are thought to remove the shell of water molecules surrounding metal ions in solution, so that they react to form carbonate minerals faster. Daniel is currently investigating these interactions through cultures of well water collected from Oman (see photo above).

Blocks control hillslope evolution in layered landscapes Rachel C. Glade

Rocky hillslopes dotted with large blocks and covered by a thin, non-uniform soil are common in both steep landscapes and arid environments, as well as on other planets. While the evolution of soil-mantled, convex hillslopes in uniform lithology can be well-modeled, the influence of lithology and geologic structure on hillslope form and evolution has yet to be properly addressed. Landscapes developed in layered rocks feature landforms such as mesas and hogbacks that exhibit steep, linear-to-concave ramps with scattered blocks derived from the resistant rock layers. Rachel and Profs. Robert Anderson and Greg Tucker have developed a numerical model to show that interactions between resistant blocks and underlying easily weathered rock explain the form and evolution of a hogback. The presence of blocks also contributes to the development of relief and persistence of topography over time. Their results illuminate

previously unrecognized hillslope feedbacks, improving our understanding of the detailed geomorphology of rocky hillslopes and the large-scale evolution of layered landscapes.



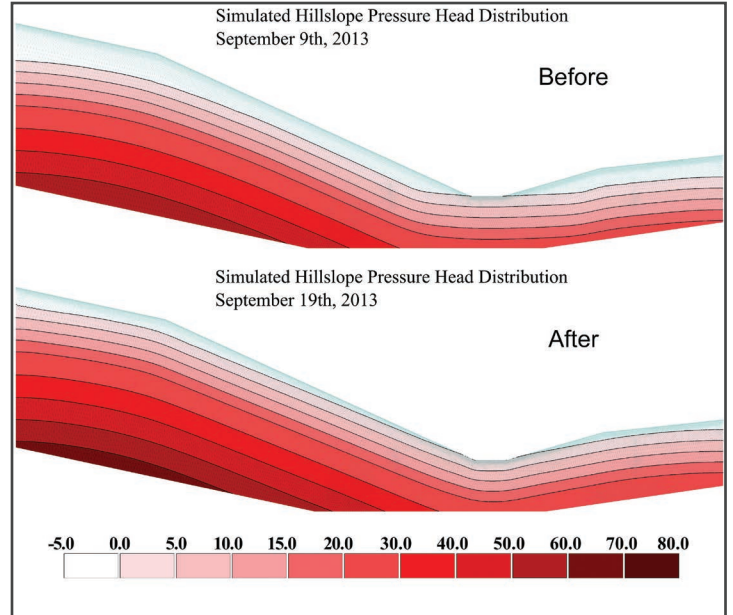
Photo of a hogback near Morrison, CO. Resistant Dakota Sandstone overlies softer Morrison shale. Note the concavity of the hillslope.

Understanding how intense precipitation affects subsurface hillslope hydrologic systems

- Steven Henning

Steven Henning is a second-year master's student working in the hydrogeology research group. His current research seeks to understand how intense precipitation affects subsurface hillslope hydrologic systems. Ground-

water flow is modeled in both the saturated and unsaturated portions of a two-dimensional representative hillslope cross section (660 m x 75 m) and compared to an observed hillslope response during the 2013 flooding in the Colorado Front Range. These models can lead to the better understanding of how precipitation reaches the groundwater table and the hillslope's role in storing and releasing water, both during and after heavy storms.



These figure show the modeled location of the groundwater table before and after intense rains between September 11th and 15th that caused the 2013 Front Range floods.

Student Activities...

PhD Student Megan Brown (center of right photo) with Team Colorado in Washington, DC at AGU's Congressional Visits Day. AGU invited geoscientists from Colorado, New York, Texas, and California to travel to Capitol Hill and advocate for geoscience. Participants met with the staff of their state's Representatives and Senators. Megan and the Colorado team met with staff from four Representatives and the two Senators. The Colorado Team also included from left to right: Carissa Bunge (AGU), Dr. Michael Wiltberger (High Altitude Observatory of the National Center for Atmospheric Research), Dr. Timothy Dittrich (CU-Boulder and Los Alamos National Lab), and Dr. Allen Pope (National Snow and Ice Data Center, CIRES). Megan also participated in the AAAS Catalyzing Advocacy in Science and Engineering Workshop, which brought approximately 90 students to DC for a three-day workshop to learn about science policy and effective science communication.



Rachel Havranek and Jacky excited for field work on Pike's Peak!



2015-2016 Undergraduate Mentoring Program

| Mentoree | Mentor | Title |
|------------------|-----------------------------|--|
| Brandan Chase | David Budd | Analyzing the pore systems of the Cretaceous Lincoln Limestone, Denver Basin. |
| Natalie Cristo | Lang Farmer | Assessing the source and transport of surface water contamination through the use of chemical and strontium isotopic data |
| Paulo Coutinho | Charles Stern | Petrogenesis of Andean volcanoes |
| Claire Czarnecki | Eric Small Emily Fairfax | Hydrologic and geomorphic affects of beaver dams: Characterizing dam geometry using LiDAR data |
| Dina Fieman | Jaelyn Eberle | Quantitative analysis of the shark teeth in Eocene Arctic Banks Island |
| Anna Klein | John Andrews | Laboratory quality control and Data Analysis |
| Griffin McMullin | Karl Jules Mueller | Mapping of offset alluvial fans using high resolution lidar, Death Valley National Park. CA |
| Eric Gunderson | David Harning | FTIRS-measured biogenic silica in a Holocene lake sediment record from Skorarvatn, NW Iceland |
| Chrissie Nims | Megan Brown Shemin Ge | Historical aquifer test database compilation and reanalysis |
| Ryan Stoner | Jacky Baughman | Characterizing radiation damage and its effect on titanite and zircon (U-Th)/He thermochronology utilizing the Raman Spectroscopy and Thermochronology |

Graduate Student Publications

William Armstrong, Robert Anderson, Jeffery Allen, and Hari Rajaram, Modeling the WorldView-derived seasonal velocity evolution of Kennicott Glacier, Alaska, in press with the *Journal of Glaciology*.

Ball, J.S., O.A. Godin, L.G. Evers, and C. Lv (2016), Long-range correlations of microseism-band pressure fluctuations in the ocean, *Geophys. J. Int.*, published online March 23, 2016, doi:10.1093/gji/ggw110.

Ball, J.S., A.F. Sheehan, J.C. Stachnik, F-C Lin, W.L. Yeck and J.A. Collins (2016), Lithospheric shear velocity structure of South Island, New Zealand from amphibious Rayleigh wave tomography, *J. Geophys. Res.*, accepted April 26, 2016.

Evans, S. G., Ge, S., and L. Sihai (2015), Analysis of groundwater flow in mountainous, headwater catchments with permafrost, *Water Resources Research*, 51, 9564–9576, doi:10.1002/2015WR017732.

Foster, M.A., and Anderson, R.S., 2016, Assessing the effect of a major storm on 10BE concentrations and inferred basin-averaged denudation rates: *Quaternary Geochronology*, v. 34, p. 58–68, doi: 10.1016/j.quageo.2016.03.006.

Miller, Hannah M., Matter, Jürg M., Kelemen, Peter, Ellison, Eric T., Conrad, Mark E., Fierer, Noah, Ruchala, Tyler, Tominaga, Masako and Templeton, Alexis S. (2016) Modern water/rock reactions in Oman hyperalkaline peridotite aquifers and implications for microbial habitability. *Geochimica et Cosmochimica Acta*, 179, 217–241. (doi:10.1016/j.gca.2016.01.033).

Schnepf, N. R., A. Kuvshinov, and T. Sabaka (2015), Can we probe the conductivity of the lithosphere and upper mantle using satellite tidal magnetic signals?. *Geophys. Res. Lett.*, 42, 3233–3239. doi: 10.1002/2015GL063540.

D. J. Weller, C. G. Miranda, P. I. Moreno, R. Villa-Martínez, C. R. Stern, 2015, Tephrochronology of the southernmost Andean Southern Volcanic Zone, Chile, *Bulletin of Volcanology*, Volume 77, Number 12, Page 1.

Matthew Weingarten, Shemin Ge, Jonathan Godt, Barbara Bekins, Justin Rubinstein, 2015, High-rate Injection Is Associated with the Increase in U.S. Mid-continent Seismicity, *Science*, 19 June 2015, Vol 348, Issue 6241.

Eric W. Winchell, Robert S. Anderson, Elizabeth M. Lombardib, Daniel F. Doak (2016), Gophers as geomorphic agents in the Colorado Front Range subalpine zone, *Geomorphology*, Volume 264, 1 July 2016, Pages 41–51, doi:10.1016/j.geomorph.2016.04.003.

News and Awards

Undergraduate Awards for Spring 2016

| AWARD | RECIPIENTS |
|--|--|
| Bruce Curtis Scholarship, Outstanding Junior | Christine Nims Brett Oliver Cole Pazar |
| Johnston Memorial Scholarship | Travis Payeur Natalie Tanski |
| Kolber Award | Stephanie Junior Jamie Glass |
| Assoc. of Woman Geoscientists | Anissha Raju |
| RMAG Outstanding Senior Award | Ryan Stoner |
| T. Keith Marks Scholarship | Claire Czarnecki Coleman Hiatt |



2016 student awards

Shell Exploration & Production Graduate Research Awards



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

Sarah Evans
Rachel Havranek
Katherine Kravitz
James Mize

Your generous gifts make many of these student awards possible

Graduate Awards for Spring 2016

| AWARD | RECIPIENTS |
|-----------------------------|--|
| Marks Research Scholarship | Jason Fredrick |
| Department Research Award | Kelly Kochanski |
| Spetzler Award for Research | Garret Boudinot Megan Brown Sarah Crump Emily Fairfax |

Other Awards

Justin Ball and Jefferson Yarce
2nd Place in SEG Challenge Bowl Finals, 2015 SEG Annual Meeting, New Orleans, LA

Melissa Foster
International Association of GeoChemistry Student Research Grant in the summer of 2015.

David Harning
RANNIS Doctoral Student Grant from the Icelandic Research Center which will support his continued research on Holocene climate and glacier evolution in NW Iceland. He also received a Geological Sciences Mentorship Grant

Kelly Kochanski
Kelly received offers for three national fellowships, and accepted the Computational Science Graduate Fellowship from the Department of Energy.

Charlie Shobe
The Robert K. Fahnestock Award for best grant proposal in fluvial geomorphology, from the Geological Society of America. He also received an Outstanding Student Paper Award from the American Geophysical Union.

Rebekah Simon
RMAG's Norman H Forster Memorial Scholarship

Derek Weller
Dudley and Marion Bolyard Graduate Student Award through the Rocky Mountain Association of Geologist (RMAG)

2015 Fall graduation



Degrees Awarded

(Fall 2015- Spring 2016)

B.A. Geology Majors

| | | | |
|-----------------------------|-------------------------|--------------------------|----------------------------|
| Abdullah Faisal Alhawaj | Jared Alexander Ellis | Mark Gregory Leonard | Max Rosenbloom |
| Richard Arnett | Ty Aaron Gallaway | Jonathan Clayton Lindner | Aaliyah Lorena Santillanes |
| Daniel Bettinger | Skylar Theresa Georgius | Nathan J. Malefyt | Richard Schader |
| Bradley Joseph Boileau | Daniel Scott Gleason | Emily Bond Marcheschi | Alexander R. Scherer |
| Lilianna Regina Broussalian | Joseph Gradone | Mitchell T. May | Garrett Masaru Schlag |
| Gordon Hall Bowman | Gage Duane Hamel | Ryan Messett | Jessica Joy Shuster |
| Michael Ray Brooks | Spencer Potter Hankin | Griffin Scott McMullen | Brandon Snyder |
| Zachary Brown | Merrick Harris | Madison Jack Miller | John Alexander Sterling |
| Michael James Bryant | Harrison Marshall Hirsh | Naomi Elaine Ochwat | Garrett L Stoll |
| John Patrick Castellano | Bradley James Horvath | Travis Payeur | Ryan Stoner |
| Brandon Chase | Zachary Miller Hyden | Cole Christian Pazar | Drew Tatman |
| Donggeun Choi | Mark Jones | Jon Mitchell Petruska | Bradley D. Trotter |
| Natalie P. Cristo | Stephanie Junior | David R. Prater | John Paul Tuso |
| Christopher George Dehoyos | Ryan Adham Khamis | Morgan Pratt | |
| Kathleen T. Denniston | Anne June Klein | Elise Pressprich | |

Undergraduates graduating with honors

| | Advisor | Thesis Title |
|------------------------------------|-------------------|--|
| Brandon Chase - cum laude | David Budd | Variability of Nanopore Systems in the Lincoln Limestone, Denver-Julesburg Basin, Colorado, U.S.A. |
| Natalie Cristo - cum laude | G. Lang Farmer | Surface Water Geochemistry and Strontium Characteristics of Colorado Creeks |
| Dina Fieman - cum laude | Jaelyn Eberle | Comparing Body Size of the Sand Tiger Shark <i>Striatolamia Macrota</i> From Eocene Localities in the Eureka Sound Formation, Banks Island, Northern Canada, and the Tusahoma Formation, Meridian, Mississippi |
| Joe Grandon - magna cum laude | Nicole Lovenduski | Surface Chlorophyll Variability in the Drake Passage Region of the Southern Ocean |
| Stephanie Junior - magna cum laude | Charles Stern | Petrological Conditions Surrounding Gold Deposition at Browns Creek Skarn, Australia |
| Anna Klein - magna cum laude | Gifford Miller | Lateral Variations in Sediment Provenance and Grain Size along the Baffin Island Slope |
| Cole Pazar - summa cum laude | Robert Anderson | Late Pleistocene Glaciations and Catastrophic Glacial Floods of Central Colorado |
| Ryan Stoner - summa cum laude | Rebecca Flowers | Investigating Radiation Damage in the Zircon (U-Th)/He Thermochronometer with Raman Spectroscopy |

M.S. Candidates Graduating with Degrees

| | Advisor | Thesis Title |
|----------------|-----------------|--|
| Wesley Ball | David Budd | Influence of Lithologic Variability on Nanopore Systems, Niobrara Formation, Denver-Julesburg and Piceance Basins, Colorado, USA |
| Jennika Greer | Stephen Mojzsis | Archean Granitoid Gneisses and Supracrustal Enclaves of the Southern Inukjuak Domain, Quebec (Canada) |
| Aaron Hantsche | G. Lang Farmer | Hafnium Isotope Evidence on the Sources of Grenvillian Detrital Zircon Deposited at the Great Unconformity |

Ph.D. Candidates Graduating with Degrees

| | Advisor | Thesis Title |
|---------------------|-----------------------------------|---|
| Evan Anderson | Dena Smith | Understanding Soft-bodied Taphonomy: an Integrated Approach Incorporating Theoretical, Fossil, and Experimental Studies |
| Justin Ball | Anne Sheehan | Passive Seismoacoustic Imaging from the Seafloor to the Lithosphere: Methods and Applications to New Zealand and Ascension Island |
| Christopher Florian | Gifford Miller | Multi-proxy Reconstructions of Holocene Environmental Change and Catchment Biogeochemistry using Algal Pigments and Stable Isotopes Preserved in Lake Sediment from Baffin Island and Iceland |
| Melissa Foster | Robert Anderson | From the Mountains to the Plains: Constraining the Evolution of Front Range Surfaces Through Quaternary Dating |
| Rachel Landman | Rebecca Flowers | Thermochronologic Investigations of Cenozoic Unroofing and Surface Uplift in the Southern Rocky Mountains and High Plains |
| Colin Lindsay | Scott Lehman/ Thomas Marchitto | Carbon Dynamics of the Deglacial and Contemporary Ocean Inferred from Radiocarbon Measurements in Foraminifera, Seawater and Atmospheric Carbon Dioxide |
| Colin O'Rourke | Anne Sheehan | Imaging and Investigating the Crust of Wyoming Using Multiple Seismic Sources and Techniques |
| Jessica Stanley | Becky Flowers | Discerning Erosion Patterns and Mantle Sources of Topography Across the Southern African Plateau from the Shallow and Deep Records of Kimberlites |
| Matthew Weingarten | Shemin Ge | On the Interaction between Fluids and Earthquakes in Natural and Induced Seismicity |
| Daniel Zietlow | Anne Sheehan | Four Brothers and a Waka: Investigating Accommodation of Shear and Convergence Underlying the South Island of New Zealand |



2016 Spring graduate students
photo by Kyren Rix Bogolub

2016 Spring graduation



Alumni News

Cal Stevens (BA 1956; MA 1958) is still actively studying the geology of eastern California and recently published a paper on nodules in the Minturn Formation in central Colorado in the Mountain Geologist.

Last year he also published a book entitled *On the Other Side of Brokeback Mountain* in an attempt to more accurately portray the life of a cowboy in the middle and latter part of the 1990s. This book is available through Amazon.

Alumni Receive Awards

Two of our students received top awards at the 2015 Geological Society of America meeting in Baltimore. One award, the Kirk Bryan Award, given for a paper of distinction in Quaternary geology and geomorphology, was presented to Dan Muhs. Although Dan was a geography student, Pete Birkeland was his advisor. The other award, the Farouk El-Baz Award for Desert Research, was awarded to Marith Reheis. In previous years, Marith received the Kirk Bryan Award, and Dan received the El-Baz Award. They and one other person are the only winners of both awards.

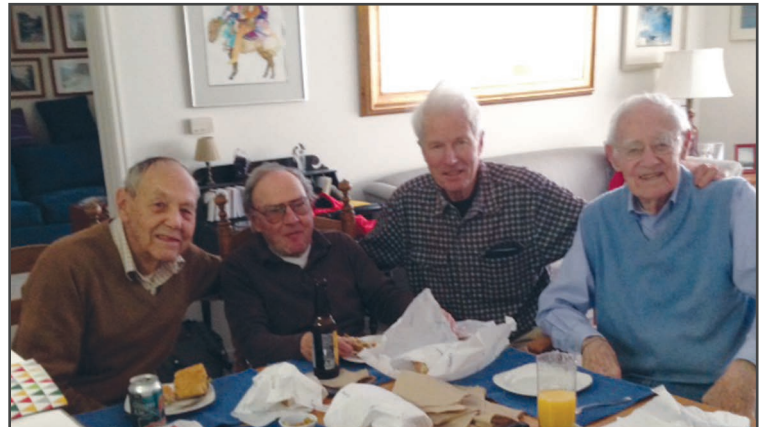
The Kirk Bryan Award has been awarded to many other former students and professors in the department. Gerry

Richmond (Ph.D. here, worked for USGS) started it all and he was followed by John Andrews, Steve Colman, Pete Birkeland, Art Dyke (geography student advised by John Andrews), Vance Holliday, and Rich Reynolds. Undergraduate students who later were awarded the Kirk Bryan Award include Hal Malde, Bill Bull, and Jim Benedict. This is probably the highest number of awards in Quaternary geology/geomorphology associated with a single department.

There also is an inter-department award. In the 1970s, Pete would lecture on the research of the Kirk Bryan Awardees, and praise them, so a group of students felt sorry for him for not getting the award, and decided he should get his own award. At a gathering of Pete and students, the Kirk Bryan Award kept being mis-pronounced as the Herb O'Brien Award, after a TV actor (actually Hugh) who played Wyatt Earp, and the name stuck. The awarding group was called the soil circle, an informal group of all of Pete's students and former students. The first award certificate was drawn by fellow student Alison Conn. Now all department students who receive the Kirk Bryan Award also receive their own Herb O'Brien Award certificate. Later, Marith Reheis sewed a cloth doll of Herb O'Brien, which hung in the soil lab for years. Besides the certificate, everyone who gets the combined Bryan/O'Brien awards gets to take care of "Herbie" until the next CU awardee.



Dan Muhs, Margaret Berry, Jeff Pigati, and Marith Reheis at 2015 GSA in Baltimore.
photo by Janet Slate



Professor Emeritus Bill Bradley, Ed Larson, Pete Birkeland, and Ted Walker enjoying a lunch gathering.
photo by Wes Masurier

Shemin Ge with Vic and Pauline Baker in Tucson Arizona.



Submit your alumni news to
www.cugeology.org/alumnews

In Memoriam

William J. Brennan (Geol'68)

Eric K. Ericson (Geol'51)

Jan R. Fink (Geol'80)

Sumner B. Hixon (Geol'52)

Herbert H. Inouye (Geol'50)

Stephen J. Kridelbaugh (PhDGeol'71)

George P. Merk (MGeol'62)

Felicie C. Williams (Geol'75)



William J. Brennan, a Ph.D. in Geological Sciences from C.U. Boulder, and Professor Emeritus of Geological Sciences at SUNY Geneseo, New York, died on April 11, 2016, of a sudden relapse of non-Hodgkin's lymphoma, which he had apparently overcome more than eight years earlier. He is survived by his wife of 51 years Sandra F. Brennan, of Geneseo, daughter Christine E. Brennan (Craig S. Feder) of New Jersey, and two grandchildren. Bill was 78, was born in St. Louis, Missouri in 1938. A Memorial Service was held in Geneseo.

Bill became interested in the earth sciences in his youth, and graduated with a Bachelor of Science and a Master of Science in the Geological Sciences from Washington University in St. Louis. In 1964 he married Sandra Fox in Tulsa, OK.

Bill entered CU Boulder in 1963. His doctoral thesis, on structural and surficial geology of the west flank of the Gore Range, advised by Prof. Ted Walker, was submitted in 1968.

Upon leaving C.U., Bill joined the Geological Sciences Department at SUNY Geneseo, where he remained until retirement in 2003. At SUNY Geneseo, Bill taught struc-

tural geology, tectonics, and implemented the geophysics degree program in the Geological Sciences Department. He was a significant force in the evolution of a high-quality earth-sciences program at the school.

Although Bill's initial specialties were in the fields of engineering geology, paleomagnetism, and geophysics, he had broad interests and experience in related disciplines. He participated in the NASA-funded Apollo Research project early in his Geneseo career and studied volcanic rocks in the West, including publications on the Peach Spring Tuff in western Arizona. Bill also consulted with private and governmental agencies on seismology, groundwater, and solution mining of salt in western New York state. In his "spare time", he undertook property appraisals and served on local government bodies in western New York.

After retirement in 2003, Bill pursued his lifetime interests, including hunting (both bow and gun), and volunteering for community organizations. He looked forward to returning annually to Colorado and the West for outdoor adventures with his former C.U. grad-school colleagues. Bill Brennan embodied the true scientist, with agile inquiries into many aspects of theoretical and applied earth sciences. Memorial contributions may be forwarded in Bill's name to The Geneseo Foundation, 1 College Circle, Doty Hall 244, Geneseo, New York 14454.

Geological Sciences Alumni Reception

at the

2016 GSA Annual Meeting
in Denver, CO

Monday, September 26th, 2016

7:00PM - 9:30PM

Hyatt Regency Denver
at CCC, Centennial Ballroom D-E

We would like to thank ALL of our faithful and generous donors.
Words can hardly express our gratitude for your continued support and encouragement to the Department of Geological Sciences.
We would not be the first-class program that we are without your support.

Our sincerest thanks
from the faculty, staff and students.

Geological Sciences
University of Colorado Boulder
399 UCB
Boulder, CO 80309-0399

NONPROFIT ORG.
US POSTAGE
PAID
BOULDER, CO
PERMIT NO. 156

Thank you
for your
continued
support!



Bill Braddock



Peter Birkeland

Gift Information

Check, Credit Card or Cash

Amt: \$ _____

Credit Card

Type & # _____

Exp Date: ____/____/____

Phone: _____

Cardholder signature

Please distribute this gift to: read more about these funds or donate online @ www.cugeology.org/donate.htm

GeoEnergy Initiative

Amt: \$ _____

Peter Birkeland Geological Sciences Graduate Scholarship Fund

Amt: \$ _____

Bruce Curtis Graduate Student Fellowship in Geological Sciences

Amt: \$ _____

Bill Braddock Geology in the Field Endowment

Amt: \$ _____

Geological Sciences Department

Amt: \$ _____

TOTAL: \$ _____

Additional Gift Information:

This gift is in memory of _____

This gift is in honor of _____

**Leave a
LEGACY**

Have you considered leaving a legacy with a "Planned Gift"
read more at <http://cu.planmygift.org/>

*Checks should be made payable to: **University of Colorado Foundation**

*Please mail all donations to:
Geological Sciences
University of Colorado Boulder
399 UCB
Boulder, CO 80309-0399

My name may be listed
in appreciation of my donation
in future newsletters.

I prefer to be listed as anonymous