UC DAVIS

EARTH AND PLANETARY SCIENCES

2013 NEWSLETTER VOLUME 10

UNLOCKING CLIMATE SECRETS

in this issue:

UCDAVIS
DEPARTMENT OF EARTH AND PLANETARY SCIENCES

Table of Contents

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CHAIR'S WELCOME

Dear Friends, Colleagues, and Alumni:

It's an exciting fall for the department, with a new department name (Earth and Planetary Sciences) and the addition of a new major, Coastal and Marine Science, to our degree programs in Geology and in Natural Sciences. The transition from Department of Geology to Department of Earth and Planetary Sciences reflects the extraordinary breadth of intellectual activity in the department, including growing programs in cosmochemistry, planetary geology, oceanography, paleoclimate, and active tectonics, along with our outstanding programs in geology, geochemistry, paleontology, and geophysics. As I write this letter, more than a dozen UC Davis Earth and Planetary Science faculty and students are in Denver, presenting their cutting-edge work at the 125th anniversary meeting of the GeoIogical Society of America meeting.

The new Bachelor of Sciences degree in Coastal and Marine Science is the first intercollege major at UC Davis and involves faculty and classes from Mathematical and Physical Sciences, Biological Sciences, and Agriculture and Environmental Sciences. The program draws on our long-standing connections with the UC Davis Bodega Marine Laboratory and will have its home in the Department of Earth and Planetary Sciences.

The retirement of Professor Emeritus Jeff Mount leads us to a new faculty search this year, as we seek to fill the Roy J. Shlemon Chair in Applied Geosciences. This important position will bring an outstanding scholar who is also engaged in the development of public policy.

This year's newsletter highlights the department's field programs. We start with a visit to Tessa Hill's lab at Bodega Marine Laboratory, where she is unlocking the secrets of climate change and ocean acidification. You'll also find a conversation between two experienced field geoscientists, Kari Cooper and Sarah Roeske, about what it takes to do field work in remote locations like Alaska. One of the highlights of our major in geology is the Summer Field class; this year, we're experiencing it from a graduate teaching assistant's point of view. Andrew Fowler talks about teaching and learning in the field. His story accompanies a collection of photos from the 2013 class.

I am back in the role of Acting Chair for the 2013-2014 academic year, having served previously as Chair from 2000 to 2009. Professor Howie Spero completed his term as Chair in June. He has been awarded a distinguished Humboldt Fellowship and is conducting research in Germany this fall. Our incoming chair, Professor Dawn Sumner, has a scheduled field season in Antarctica during the astral summer, our winter. She will take the reins in Fall 2014.

I want to express my gratitude to Howie Spero, for his service as Chair, and to all the individuals who shepherded the name change proposal and the new major from developing the initial ideas to campus approval, especially Dave Osleger, Tessa Hill, Howie Spero, and Jim McClain. Thanks to all who contributed to the newsletter as well, and to Janice Fong for putting it together, and for designing the department's new website!

I would like to hear from our alumni and friends as we go forward into this new and exciting phase. Let us know what you are doing. We are grateful for your support!

Best wishes,

Louise Kellogg

UNLOCKING CLIMATE SECRETS in the Hill Laboratory

Tessa Hill asks:

"Can we use rapid climate change in the geologic record to predict how anthropogenic climate change will impact marine environments in the future?"

Featured Faculty Tessa Hill writes:

My laboratory is busy with several exciting projects these days that keep me on my (scientific) toes! My work on climate records from the California margin, the subject of a recently awarded National Science Foundation CAREER award, aims to understand the marine ecosystem response to abrupt climate change. In other words: can we use rapid climate change in the geologic record to predict how anthropogenic climate change will impact marine environments in the future? To address this question, I have been working with Ph.D. student Sarah Moffitt to reconstruct the complete protistan and metazoan faunal assemblages in a Late Quaternary glacial-age sediment core from Santa Barbara Basin. Our excitement about the results of this project has motivated my desire to expand this detailed microfossil analysis to a suite of cores from the North Pacific; this project will keep my students and me busy for several years to come.

Inspired by the question of whether the paleo record can directly inform our management of climate change, I worked with a focused group of students as part of GEL 232 (*The Oceans & Climate Change*) during Winter Quarter 2013. For this course, we gathered available paleclimate data for ocean oxygen during the most recent deglacial interval (~10,000-20,000 years ago). We then developed geospatial maps to describe how oxygen concentrations in the ocean plummeted during this dramatic interval of climate warming. The students are currently writing up the results of our analyses as a review paper for publication (hopefully hitting your desk very soon!).

As part of the CAREER award, I have begun to work closely with the Math and Science Teaching (MAST) program at UC Davis, which aims to encourage and prepare undergraduates for careers in K-12 teaching. Working with MAST colleagues Howard Day and Mary-Betty Stevenson, and MAST undergraduates, we will develop curricula on climate change for local classrooms. Another exciting benefit of this research program is the opportunity to collaborate with experts in marine paleoecology and conservation, including Peter Roopnarine (UC Davis Geology, Ph.D. 1994) and Lance Morgan (UC Davis Ecology, Ph.D. 1997).

The focus of a new, NSF-supported collaborative project between my laboratory, geology researcher Ann Russell and post doc Jennifer Fehrenbacher is to improve paleo reconstructions by studying modern species. As part of this project, we are working with Ph.D. student Catherine Davis to collect modern foraminifera and culture them under controlled laboratory conditions (temperature, pH, seawater chemistry) at Bodega Marine Laboratory (see update from Ann Russell in this issue).

Finally, much of my time is now spent with one foot in the "modern" ocean to understand climate change and ocean acidification, via collaborations with the Bodega Ocean Acidification Research (BOAR) group. Since 2010, I have been engaged in fieldwork every 6 months in coastal Washington, Oregon and California in an attempt to understand the modern variability of marine chemistry, and place predicted anthro-

Tessa at UC Davis Bodega Marine Laboratory thinking about echinoderms with Peter Roopnarine (UC Davis Geology, Ph.D. 1994) and future earth scientist Philip Roopnarine.

pogenic changes in context. This work requires a team of BOAR faculty and staff to visit 47 field sites in less than 1 week! These sites are supported by the deployment of sensors (pH, pCO2, temperature, salinity) at selected locations that record high-frequency variability in marine chemistry. I am also leading a new university-industry partnership inspired by ocean acidification: BOAR has been working extensively with the owners of Hog Island Oyster Company (http://www.youtube.com/watch?v=9j8KEhpEg0s&feature=youtu.be) to understand and predict the negative impacts of acidification on the sustainable aquaculture industry. Having one of your field sites at a local oyster farm has its perks…climate, and ocean chemistry, is a moving target, changing each year – thus time series like these become increasingly important to provide a basis for future comparisons, predictions, and management decisions.

All of my work in marine paleoclimate and geochemistry is supported by a growing and strengthening group of marine scientists at UC Davis. I enjoy collaborations with many marine scientists on the UC Davis campus and at Bodega Marine Laboratory, and find these collaborations critical to the success of my research. I am thrilled by the development of a new Coastal and Marine Sciences Institute (http://cmsi.ucdavis.edu) at UC Davis, which will provide enhanced opportunities for collaboration and education among marine scientists. As part of CMSI, Founding Director Rick Grosberg anticipates novel research enterprises, expanded opportunities for engagement with the public and 'stakeholders', and new curriculum programs for undergraduates and graduate students.

Sometimes marine science takes place on land…Tessa sampling marine geochemistry out of the back of a van, somewhere on the Washington coast.

Marine and Coastal Science at UC Davis

The Department of Earth and Planetary Sciences is excited to be involved in a proposal for a new undergraduate major in Marine and Coastal Science (MCS), a cooperative effort between faculty in Earth and Planetary Sciences, Bodega Marine Laboratory, and five other UC Davis campus departments. The proposed major is currently under review by the Academic Senate, but should be ready to go within the next year or so. The Marine and Coastal Science major is the first cross-college major on campus, incorporating the strengths of three colleges at UC Davis to offer an interdisciplinary program that emphasizes hands-on learning and the development of career-relevant skills for future scientists.

Dr. Tessa Hill, an oceanographer and biogeochemist in the Earth and Planetary Sciences Department and Bodega Marine Lab, was instrumental in creating the curriculum with colleagues and guiding the proposal for the major through the labyrinth of committees from the various colleges. The major is rigorous, with preparatory courses in calculus, physics, chemistry, biology and earth science followed by a variety of upper-division courses that provide the student with both broad exposure to several facets of marine and coastal science, as well as mastery of their chosen area of focus. Students entering the major through the Earth and Planetary Sciences Department will do coursework leading to a focus in Oceans and the Earth System. Faculty in the Earth and Planetary Sciences Department are an integral component of the major since they teach a variety of classes that span physical and chemical oceanography, as well as geological and biological oceanography. Majors will have ample opportunities to become involved in oceanographic research guided by Earth and Planetary Sciences faculty, post-docs, research scientists and graduate students, both within the Earth & Physical Sciences building as well as at Bodega Marine Lab. Majors in Marine and Coastal Science will be well prepared for careers in academic science, government agencies, policy creation and the private sector. The new MCS major builds upon a popular minor in Oceanography offered by the Earth and Planetary Sciences Department since 2010.

- Dave Osleger

TO THE FIELD! Sarah Roeske's Extreme Road Trips!

Sarah has extensive experience working in remote areas of Alaska and Argentina. Top photos, from left to right: on a Denali highway, Alaska; traveling by mule train in Argentina, hitting the open road in the UCSB Natural Reserve camp on Santa Cruz Island. Bottom photo: Sarah and Casey Huff (UC Davis Geology, M.S. 2012) in Alaska.

An edited version of a conversation between Kari Cooper (on behalf of the newsletter) and Sarah Roeske about what it takes to do field work in remote locations.

KC: What does it take to get into the field? How far in advance do you need to start planning? What are the biggest logistical challenges?

SR: In Alaska, the big challenge is transportation. Roads are few, so field work usually requires transport by a helicopter or fixed-wing aircraft (small plane); once I used llamas! For helicopter work, you have to start getting that set up early, and usually have to try multiple companies at once. Most companies work on month-long contracts or on contract to cruise ships, so we have to squeeze in where they have a day here or there. Usually this involves having a long list of helicopter companies, and you just keep contacting them until something opens up. You want to look for a moderate-size company that has several "ships" on a project at the same time, so that you can get some time on the helicopter that they use to rotate in for servicing the rest of them. And you need to fly with a reputable company; otherwise, you end up with unsafe pilots. And then there's the weather, which can always cause a last-minute change in plans – if you have a day scheduled and it's bad weather, you don't fly, and then the next day they may have other commitments so it takes a while to get back on their schedule again. In Argentina, other than reserving a truck in advance, it's actually easier to set things up on site. You head off in your 4wd truck and hike in from a road or go to a small village and rent horses or mules on site to pack in some place.

KC: So how long does it typically take to get from Davis to where you're actually doing the field work?

SR: Back in the day, when I was younger and also had less money for field work, we might spend several days to hike in (hence the llamas, to help carry gear). With 25+ years of experience now, and usually bigger budgets, we can go from Davis to doing field in Alaska in 36 hours, but more typically it takes 2-3 days once you take time for travel and for buying weeks to months of food and getting everything packed up and organized. If we are in remote areas for a while, we need a lot of food, which requires enough bear barrels to keep the camp safe. Actually, the biggest critter problem is rodents – the arctic ground squirrel is our nemesis. These guys will chew tents, boots, socks, anything with salt, any kind of food. They have no fear. One colleague woke up in the cook tent to find a ground squirrel chewing on his boot while it was still on his foot! In Argentina the travel takes longer, ~36 hours of flying/driving to get to our base town, then another 2 days to rent a truck and and buy food. But our most recent field area is only a 2-hour drive from town, so the whole process doesn't take much longer – providing the road isn't washed out. In 2010 it took 3 people to clear out a path through a road washout, which ended up meaning that we took longer to drive in it would have taken to walk in. But we couldn't walk in because we couldn't carry enough water – it's really dry there. We have considered using dirt bikes or mountain bikes or horses/mules instead of a truck. If we had helicopters there, it would be relatively easy – but despite being a modern country in many ways, there is no helicopter rental, so we are still stuck in 1930s methods to get into the field area.

"Geology: it's not a job, it's not even a career, it's a lifestyle. Non-geology friends shake their heads, as clearly it borders on a religion." - Sarah Roeske

KC: What would you say is the key to doing remote field work successfully?

SR: Remember these rules:

1. things rarely go according to plan.
2. keep things flexible (see #1).

This includes both the logistics and the science – usually once you're in the field, the testable hypothesis that you put in the proposal has to be modified greatly, sometimes tossed out. The goal is to figure out what is the most important scientific problem that you can solve with the observations you are making. The stakes are high, both in terms of investment of time and money, so you have to be flexible and make something work out. Usually we can find the interesting question that the rocks are posing, but where it gets stressful is when there's a Master's student who only has one field season, and you're going into a new area. You never know what you're going to find, but we've always been able to make it work.

KC: Given that field work often doesn't go exactly as planned, what's the biggest unexpected thing that you've had to deal with while in the field?

SR: In 1989 we had six weeks of field work lined up in East Chugach Range, a remote part of Alaska, with an ambitious field campaign – four people in two camps. In week 1, the student and faculty member in the other camp came back from the field to see the back end of a grizzly sticking out of the kitchen tent. It was clear that the grizzly now considered their camp his 'kill' and was in no hurry to move on. This was 150 miles from anything and before days of satellite phones, so they couldn't contact anyone – they had a radio, but it was in camp. And they had a .44 on them, but their shotgun was in camp too. So they sat on a nearby moraine and waited. Fortunately it was summer in Alaska, so almost 24 hours of daylight, and it was unusually warm. We in the other camp got concerned after they missed two radio checks and called the fixed-wing pilot to check on them. He couldn't make it until that evening (24 hours after they got back and saw the bear) but he buzzed the camp to scare away the bear, and then got them into the plane, took them to a rustic lodge, leaving everything behind. They returned briefly the next day to clear out their camp and once that was done the graduate student announced he'd had enough fun and went home (having been subjected to stories about bear encounters before doing field work, an actual bear encounter put him over the edge). So we went from four to three people and two field parties to one. The rest of us (all faculty) sat down with maps and revised the plan by half. In the end, we got enough data to get funded the next year. We also ended up with an extra person's worth of food, so we had some room for experimentation in cooking, and we generated the GSA field cookbook as a result. Moral of the story: do not tell bear stories to students before field work. And always go out for the day with enough food and clothing to survive the night.

KC: What is your most memorable moment from doing remote field work?

SR: The bear in camp (above) is definitely up there. Other stressful events were two times in west-central Alaska where we got stuck at the end of the field season for 3-4 days because the helicopter couldn't come get us due to bad weather. We were rationing food, down to lentils and crackers, and considering how long it would take to hike to the Yukon River, where there was boat traffic. We were really hungry, but fortunately in each case the helicopter was able to get back to us in time to avoid having to abandon camp. But most of all, each year there are the times when it's just spectacularly beautiful and field work is going well and you find something that no one has ever seen before and you just think "wow, I get paid to do this".

And a final trivia tip: the word for "jack" in Spanish is "Gato" (cat), because they hang out under trucks.

Sarah in the Nenana glacier region of Alaska.

TEACHING (AND LEARNING) IN THE FIELD: The TA's Perspective

"The UC Davis geology summer field course is based in Bishop, California. The area is a fabulous geology classroom, with classic examples from practically every geological discipline one could imagine."

- Andrew Fowler

Ph.D. Geology Grad Student Andrew Fowler (UC Davis Geology, M.S. 2012) writes:

As an undergraduate, I remember the feeling of panic while standing in front of an outcrop when the TA asked our group during a field camp: "Is this a fold or a slump? Remember when we discussed this in class?" My TA was met with a few vaguely perceptible mumbles, so he proceeded to explain the features of the slump we were staring at.

Fast-forward to my experience as a teacher assistant for sedimentary stratigraphy in the UC Davis geology (now earth and planetary sciences) department. I was in front of a classroom describing the difference between a slump and a fold to a group of students. In my mind's eye, I saw the slump my TA described to me in the field. I realized that it was my field experiences that solidified many of the basic geological concepts with which I am now familiar.

The UC Davis geology summer field course is based in Bishop, California. The area is a fabulous geology classroom, with classic examples from practically every geological discipline one could imagine. The west is the best, at least when it comes to field examples for geology. If a slump was to be found, surely it was out here somewhere.

As luck would have it, Bruce Pauly (UC Davis Geology, Ph.D. 2011) who taught the volcanology portion of summer field this year, led us right up to a beauty of a slump during a summer field exercise at the Black Point volcanic area near Mono Lake. I found myself staring at it with the same students from my sedimentary stratigraphy lab. Hopefully my questions didn't instill the sense of panic I got from my TA's questions. But I am sure that if these students ever have to identify or explain a slump in the future, it will be the Black Point slump they see in their mind's eye, not the one I drew on the board in the classroom.

Maya Wildgoose (UC Davis Geology, M.S. 2013), a veteran UC Davis summer field TA for the Poleta field mapping portion of the course, acknowledges the value of such a geologically diverse outdoor classroom: "I become a better teacher out there in Bishop, because I can use the geology around us to explain a complicated idea or problem. It doesn't get better than explaining a plunging syncline while you are standing on one." This idea is echoed by Allie Rubin, a TA for this year's volcanology portion of Summerfield, "It's a great opportunity for students to learn mapping and on-the-spot problem-solving skills. I like to see how engaged students can be when they're challenged to think and act like professional geologists."

The 6-week UC Davis geology summer field course isn't only about being exposed to incredible geology. Students complete a series of assignments related to a range of different geological problems. Unlike a classroom setting, students have the opportunity to work with their TAs from project start to end. This gives students the unique opportunity to learn project management skills that will serve them well in their future professional and academic careers. Allie recognizes that students develop important professional skills and relationships also. "I like interacting with the students and watching them grow professionally throughout the course."

"A beauty of a slump!"

Maya also acknowledges that the experience creates collaborative opportunities, and "allows for bonding and friendships amongst both the students and the TAs that might not otherwise form. I think when students first arrive, they're sad to be away from Davis, and have a hard time adjusting to the schedule and expectations. But by about 4 days in, they always seem like they're ready to stay for the long haul and are having the time of their lives. It leads to students having a summer of geology they'll never forget."

Summerfield is a rewarding experience for TAs also. Spending a week at a time with students teaches us how to be more effective in our jobs. When we get back to the classroom at the end of fall quarter, the experience makes us more confident TAs. No matter how many times you visit the same place, you learn something new every time. Having the perspective of the students and new TAs with different backgrounds teaches us new ways to look at things, and we become better geologists.

Summer Field 2013

top photo: *back row:* Bruce Pauly (instructor), Will Havard, Benjamin Blumenfeld, Mark Stelten (TA), Bryce Russell, Kate Sharp, Daryl Berberi-Hill, Sasha Leidman, Daniel Hodges, Amanda Benbow, Nicolas Vrdoljak, Rebecca Rodd, Lauren Sipich, Kevin Pfeiffer; *middle row:* Adam Aleksinski, Jennifer Berjikian, Allie Rubin (TA), Paul Edwards, Kaelynn Rose, Marissa Leever; *front row:* Jan Weninger, Athena Phan, Marisol Juarez Rivera, Victoria Blanchard, Ingrid Dittmar

right photo: Andrew Fowler in the field.

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Your charitable, tax-deductible gift to the UC Davis Department of Earth and Planetary Sciences is greatly needed and appreciated. Your donation will be used to support the highest priority projects in the department: our undergraduate and graduate geology students, departmental programs and facilities.

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Contributions can also be mailed to the department in the enclosed envelope.

Checks should be made out to the Regents of the University of California, Davis. For more information, please contact Julia Prather at (530) 752-3668 or japrather@ucdavis.edu

You may chose to donate to one of seven funds:

- Geology General Support
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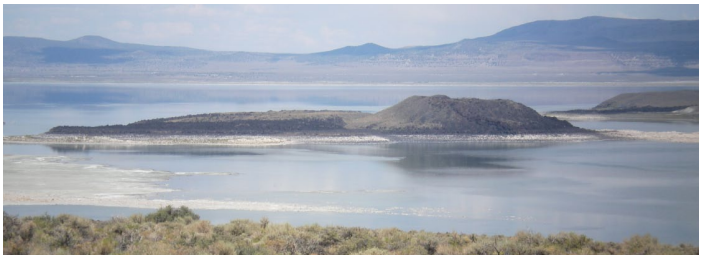
- Earth and Physical Sciences Building Educational Enhancement Fund
- Moores Distinguished Speakers Series
- Rand Schaal Field Fund
- Robert Matthews Memorial Endowment

If you wish to specify a fund, please be sure to note your preference with your donation. We especially appreciate unrestricted donations to the Geology General Support Fund, which provides the department with flexibility to support our highest annual priority projects.

Thank you for your support!

SUMMER FIELD 2013



SANDY CARLSON

Sandy Carlson's research focuses on brachiopod (bivalved marine invertebrates) evolutionary biology and paleobiology: how and why have brachiopods evolved in the ways that they have, and what evidence does the fossil record provide? She has been working on an NSF-funded project to test the assumption, widely held among paleontologists, that the shell morphology of living and fossil brachiopods is an accurate source of information on evolutionary (phylogenetic) relationships. By comparing patterns of morphological evolution with patterns of molecular evolution determined from the roughly five percent of brachiopod species living today, she and post-doc Holly Schreiber (UC Davis Geology, Ph.D. 2011) are determining which shell characters in extinct species are trustworthy guides to their evolution, and which appear to be related instead to their function and behavior. This year, they published a morphological analysis of the Recent rhynchonellides, and are now working on a combined analysis of morphology and molecular sequence data for these taxa, and have been invited to present their results at the Society for the Study of Evolution meetings in June 2014. In addition, they have found that in one species of rhynchonellide, the changes in shape that individuals of different ontogenetic ages exhibit, as they increase in size, is comparable to the changes that adults in species from three different superfamilies exhibit -- revealing very interesting and unexpected relationships between size and shape in ontogeny and phylogeny. Sandy was the only brachiopod worker invited to establish phylogenetic definitions for *Brachiopoda*, *Pan-Brachiopoda*, *Neoarticulata*, and *Pan-Neoarticulata* for *Phylonyms*, the Companion Volume to the PhyloCode, a recently developed system of phylogenetic nomenclature that names clades (systems of common ancestry) that explicitly acknowledge phylogenetic relationships. Sandy and Holly are working with department illustrator extraordinaire Janice Fong to develop a website of images generated from 3D microCT scans of brachiopods, that can be manipulated and analyzed in 3D.

2013 American Geosciences Institute's Geosciences Congressional Visits Day: Kevin Milner, USC graduate student in seismology, Sandy and San Jose State University geology emeritus faculty John William.

Sandy has been serving as the President of the Paleontological Society since November 2012, in the first year of a two-year term. She has been working with the PS Council to increase funding opportunities for members, and evaluate strategies for the continued health of PS publications (*Journal of Paleontology* and *Paleobiology*)

Sandy represented UC Davis and the Paleontological Society at the 6th Geosciences Congressional Visits Day (September 2013) in Washington, D.C., organized by the American Geosciences Institute. She and other California geoscientists met with congressional staff from the offices of Senators Dianne Feinstein and Barbara Boxer, as well as U.S. Representative (to California's 3rd Congressional District, which includes Davis) John Garamendi, to encourage them to continue to support steady federal funding for geoscience research and STEM-related education, particularly in these difficult budgetary times.

KARI COOPER

Kari Cooper's research continues to explore processes beneath volcanoes at different locations around the world. Current Ph.D. students include Mark Stelten, who is in the last stages of his Ph.D. research examining magma storage and evolution beneath Yellowstone Caldera; Allie Rubin, who is continuing work on the timing and conditions of silicic magma generation and storage at Okataina Volcanic Center in New Zealand; and incoming Ph.D. student Kevin Schrecengost, who will begin his research looking at magma mixing at Lassen Volcanic Center, CA. Incoming M.S. student David Houchins will be working on refining techniques for U-Th dating of carbonates and applications to speleothem studies (continuing a collaboration between Cooper's group and Isabel Montañez and her research group). Kari spent some time in the field at Lassen this summer, and in Florence, Italy, for the Goldschmidt geochemistry conference, and is looking forward to more travels (Australia and New Zealand) during an upcoming sabbatical quarter in winter!

Kari in front of Chaos Crags, Lassen Volcanic Field during summer 2013 field work to collect samples for a project designed to compare magma mixing in the 1,100 year old Chaos Crags eruption with mixing in the 1915 A.D. eruption of Lassen Peak, in order to understand the controls on mixing of mafic and silicic magmas at arc systems.

MICHAEL OSKIN

High-resolution lidar (light distance and ranging) topography continues its invasion through Mike Oskin's research program. His two current Ph.D students, Austin Elliott and Jacob Selander, are using this revolutionary data in a component of their theses research to understand landscape change and deformation due to active faulting. They are joined by a new Ph.D. student, Alex Morelan, who will be developing ways to use lidar to quantify distributed deformation and the probability of fault linkage during earthquakes. A fourth student, Scott Bennett, graduated with his Ph.D. in March of 2013. Though his thesis on rifting and strike-slip in the Gulf of California did not involve lidar, he, too, has caught the lidar bug at his new position as a Mendenhall post-doctoral fellow at the USGS in Golden, Colorado. Active tectonics research with lidar is now international. In September 2013, Mike co-led a week-long lidar workshop in Tokyo, Japan. Plans are being formulated for a similar workshop in Beijing, China, where his collaborators at the China Earthquake Administration will soon have several terrestrial laser scanners for use in faulting and geomorphology research.

Rapid Holocene canyon incision, Qilian Shan, China

One of their young scientists, Hui-Ping Zhang, spent three months with Oskin's research group at UC Davis, working on the interplay of glaciation and tectonics on the margin of the eastern Tibetan Plateau. Mike and Hui-Ping spent a week together in the Qilian Shan (northeast of Tibet) in August examining evidence of rapid (>1 cm/yr) climate-driven canyon incision that has formed spectacular, narrow gorges in the past 6,000-12,000 years.

DAVID OSLEGER

Dave Osleger's primary focus in the department is on the vitality and success of our undergraduate majors. In collaboration with a few local, private companies and government agencies, he's established an internship program where our students can gain experience in the applied geosciences. Any alumni in the Sacramento-Davis area are welcome to contact him to participate in this program and provide greater opportunities for our students. As vice chair of the department, he's pushed along the departmental name change proposal through the serpentine network of administrators and committees – you should be seeing this noteworthy name change on the front page of this newsletter. Dave has created an assessment program (oh joy) to ensure sure our learning objectives are being met by graduates in the major.

On the education front, Dave is boldly (read: blindly) entering the wide world of online education. In collaboration with colleagues at UC Santa Cruz and UC San Diego, he is working to develop an online hybrid class on the Geology of National Parks that would be available

for credit to all UC students. In a related fashion, Dave is translating his class in Big History (GEL 120 – Origins: From the Big Bang to Today) to a hybrid format combining online instruction with interactive discussions for UC Davis students. Dave is also working

Dave's departmental duties include cooking.

to develop a new major in Earth System Science in unison with the Department of Land, Air and Water Resources.

On the research front, Dave traveled to Australia recently to deliver a talk on Pennsylvanian sea-level history. This past summer, he visited several national parks in Utah and Colorado as part of his ongoing work writing a textbook on the geology and landscapes of America's national parks.

PETER SCHIFFMAN

Since retiring in Spring 2011, Peter has been working towards creating an NSF- and industry-sponsored Center for Geothermal Resources at UC Davis (in conjunction with the University of Nevada). The proposed center would focus its efforts on research topics with a high potential for successfully addressing industry-identified major challenges, as well as to provide educational opportunities for students to develop interest and expertise in geothermal studies.

DAWN SUMNER

Since late July 2012, Dawn has been almost entirely focused on helping to run NASA's Mars Science Laboratory. On August 5, 2012, the rover Curiosity landed in Gale Crater on Mars. In the past year, Curiosity has collected hundreds of thousands of temperature, wind and radiation measurements; tens of thousands of images; thousands of chemical analyses; a couple dozen mass spectrometer measurements of the atmosphere and gases released by samples; and several x-ray diffraction mineralogical analyses. Each one of these had to be planned, implemented and interpreted by the MSL team. Dawn's role in the mission has dealt with each of these and has ranged from helping decide where the rover should drill a sample to choosing a name for the rock to analyze. She also helped write up the first geological results for *Science*, which were the interpretation of rounded conglomerate pebbles as fluvial deposits. Much to her pleasure, identification of these river deposits on Mars required only the types of observations GEL 109L students make in their first lab on the characteristics of sedimentary grains!

Bob Varga (UC Davis Geology, Ph.D. 1980), Peter, and Lori Bettison-Varga (UC Davis Geology, Ph.D. 1991) enjoy the bench Bob and Lori donated in honor of Peter.

Williams, R.M.E., J.P. Grotzinger, W.E. Dietrich, S. Gupta, D.Y. Sumner, R.C. Wiens, N. Mangold, M.C. Malin, K.S. Edgett, S. Mauice, O. Forni, O. Gasnault, A. Ollila, H.E. Newsom, G. Dromart, M.C. Palucis, R.A. Yingst, R.B. Anderson, K.E. Herkenhoff, S. Le Mouélic, W. Goetz, M.B. Madsen, A. Koefoed, J.K. Jensen, J.C. Bridges, S.P. Schwenzer, K.W. Lewis, K.M. Stack, D. Rubin, L.C. Kah, J.F. Bell, J.D. Farmer, R. Sullivan, T. Van Beek, D.L. Blaney, O. Pariser, and R.G. Deen, 2013. Martian fluvial conglomerates at Gale Crater. Science, v. 340, p. 1068-1072. DOI:10.1126/science.1237317

Taken by Sanjeev Gupta in the long term planner room at JPL about 45 days after Curiosity landed. Dawn was in a tag-up meeting with strategic planners to develop the "sol path" leading to the first solid sampling on Mars. The white board notes include a possible sol path with sol numbers listed and abbreviations for activities.

Geerat on a field trip to the Sulphur Mountain Formation (Early Triassic) in the Kananarsis Valley, Alberta, Canada. The formation is extremely finely bedded siltstone.

GEERAT VERMEIJ

Geerat Vermeij has been busy writing papers on a wide variety of topics, ranging from the complex geological history of tropical America (with Egbert Leigh and Aaron O'Dea) to a study of bivalve shell margins, photosynthetic bivalves, hermit crabs that modify either the inside or the outside of their shells (but never both), and an analysis of the process of enemy-driven evolution that he calls escalation. He has also worked with his former student Peter Roopnarine on a paper on the Red Queen, an evolutionary metaphor that implies all sorts of things that aren't correct; they therefore urge her retirement.

ROBERT ZIERENBERG

Robert Zierenberg is continuing to work with other faculty at UC Davis and the University of Nevada at Reno to initiate a Geothermal Research Center to support student research in the broad field of geothermal energy. Emeritus Professor Peter Schiffman is leading the effort to initiate an industry/university co-operative research center with support from the National Science Foundation. Rob is advising graduate students and undergraduates who are working on geothermal systems in Iceland, the Philippines and Surprise Valley in northeastern California.

Rob is also the faculty advisor for the UC Davis student chapter of the American Institute of Professional Geologists. The AIPG group took a one-day field trip to the Sutter Buttes area, with access provided by the Middle Mountain Foundation. Our guide was Dr. Brian Hausback, California State University, Sacramento (far left, standing next to Rob). We were fortunate to also be joined by Distinguished Emeritus Professor Eldridge Moores (front and center) who added to our understanding of enigmatic Sutter Buttes in terms of the "Big Picture" of California geology.

UC Davis student chapter of the American Institute of Professional Geologists on a field trip to the Sutter Buttes.

RESEARCH SCIENTISTS

SARAH ROESKE

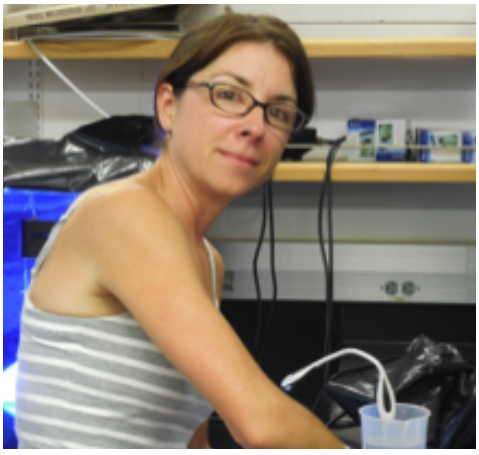
Sarah Roeske's year included several firsts – first time to participate in Jeff Mount's Grand Canyon Class (his final class as a UC Davis prof, but surely not his final trip with UC Davis people), and first time to supervise a VERY local M.S. project. The Grand Canyon trip was in March, the weather gods smiled, and they had no rain (or snow!). The trip was all geologists this year (except Carson Jeffres, their fish whisperer), and the grad student lectures on all aspects of the geology of the Canyon were truly memorable (Kate's dance of the Paleozoic worms may show up on YouTube some day). Leslie Moclock, who is currently finishing up her M.S. thesis, was one of the lucky lottery winners so she did the whole trip as well (see photo of Sarah behind her on the oars, Marble Canyon stretch of the Grand Canyon). Leslie's M.S. is on the Bear Mountain fault zone, exposed in the Sierra Nevada foothills about five miles from Sarah's house. So Sarah had the rare opportunity to do field work with no advance planning required, and enjoyed the chance to explore an amazingly well exposed cross-section of a major fault zone with Leslie. Part of Leslie's field site has become one of the undergraduate structure exercises; it's that good of an area.

Sarah and Leslie on the Grand Canyon trip.

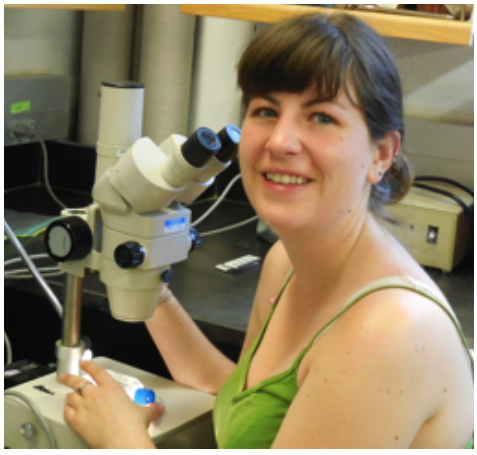
ANN RUSSELL

This summer, grad student Catherine Davis, postdoctoral scholar Dr. Jennifer Fehrenbacher, and Associate Research Scientist Dr. Ann Russell cultured non-spinose, thermocline-dwelling foraminifera in the laboratory to quantify relationships between shell geochemistry and ocean temperature in *Neogloboquadrina dutertei*. In other experiments, they explored the fundamental mechanisms by which trace metals are incorporated into shell calcite, including the role of light in the uptake of Mg, an important paleothermometer. These experiments will improve the accuracy of geochemical proxies in foraminiferal calcite by identifying and quantifying the environmental and biological controls over metal uptake. Similar experiments will be conducted over the next three years in a new foraminifer culture facility in Professor Tessa Hill's laboratory at the Bodega Marine Laboratory. Their research, funded by a new NSF grant to Drs. Russell, Hill and Fehrenbacher, will expand the range of oceanic depths that can be probed with geochemical proxies, improving our ability to investigate environmental changes in the ancient ocean below the surface mixed layer, where most previous research has focused, and increase the level of confidence with which these geochemical proxies are applied.

Ann Russell



Jennifer Fehrenbacher



Catherine Davis

CONGRATULATIONS TO THE CLASS OF 2013!

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