Geosciences

FALL/WINTER 2016
NEWSLETTER

Chair's Letter

Dear Alumni and Friends,

Since our last newsletter there are several significant changes in the Department to report. During the last three years we have had exceptionally large undergraduate classes graduate (~20 each year), which has reduced the number of majors in our program to about 100 from a high of 160 three years ago. At the same time our graduate program is growing. This year 13 new students started graduate studies. This is the largest new graduate cohort we have had matriculate in geosciences in the last decade.

We hired **W. Payton Gardner** as an Assistant Professor in the Department starting fall semester 2015. Payton is a hydrogeologist who received his doctoral degree from the University of Utah, conducted post-doctoral studies with CSIRO in Australia, and most recently worked as a scientist at Sandia National Labs in New Mexico before joining us. Payton already has several graduate and undergraduate students working with him on research projects and is teaching a graduate level course in Subsurface Transport this semester. Payton is a Geosciences alumnus (B.S. 2004) and has continued in the Bill Woessner tradition of teaching Hydrogeology starting at 8:00 A.M. on Tuesdays and Thursdays.

Geophysicist **Hilary Martens** joined us in geophysics at the beginning of fall semester 2016 as an Assistant Professor. Hilary's primary areas of study are earth deformation and seismology. She completed her doctoral studies at the California Institute of Technology this spring and is transitioning into the role of full-time faculty member this fall. Hilary is a Missoula native and UM alumna (B.A. Physics and B.A. Music, 2008). Hilary will teach her first graduate seminar in the department in Geophysical Theory and Methods spring semester 2017.

Andre Umansky is the Manager of the Environmental Biogeochemical Laboratory (EBL) in the Department. Andre began his career as a chemist in the San Francisco Bay area. He completed his M.S. in Analytical Chemistry at UM in 2012 and then moved to southern California where he worked for Shimadzu Scientific Instruments. He moved back to Montana in 2014 and was a lecturer in chemistry at Flathead Valley Community College before joining the EBL in February 2015.

The last departmental change I want to update you on is we gained approval for and started teaching our new undergraduate curriculum fall semester 2015. This curriculum has a course balance between our program focus areas of water and solid earth science. We eliminated some courses and restructured others as part of the process. While most of our majors elect to study a balanced geoscience curriculum that covers aspects of both focus areas, the opportunity exists for students to specialize in water/climate science or to follow a geology curriculum as an undergraduate should they decide to do so. I encourage everyone to go to **http://www.umt.edu/catalog/colleges-schools-programs/humanities-and-sciences/geosciences/bs/default.php** and review the course requirements for our current Bachelor of Science degree.

Four events have occurred in Geosciences since our last newsletter that I want to mention specifically. First, in March of 2015 the UM Geosciences team won the regional **AAPG Rocky Mountain Section Imperial Barrel Award Competition** in Denver. The students involved were **Anna Phelps, Brianna Berg, Cody Bomberger, Clayton Schultz**, and **John Zupanic**. Each competing team was provided with a real petroleum exploration data set (two- and three-D seismic, drilling data, well logs, thermal maturity data, etc.) and over eight weeks was required to analyze and interpret the data, develop drilling prospects, and estimate recoverable resources and do an economic

risk assessment on each prospect. After winning the regional competition the team competed in the **IBA International Competition** at the end of May 2015. While our team didn't place first, second, or third in the International Competition they represented us very well and we are all proud of their accomplishments on our behalf.

Second, during Homecoming Weekend fall 2015 **Dr. John P. Grotzinger** received a **UM Distinguished Alumni Award**. John received his M.S. from UM in 1981 and worked with Don Winston. John is the Fletcher Jones Professor of Geology at the California Institute of Technology and from 2006 to 2014 was Project Scientist of the Mars Science Laboratory mission.

Third, during spring break 2016 twelve students participated in a week-long field course sponsored by SM Energy. The group headed to the **Book Cliffs** in eastern Utah. The goal was to provide students with a hands-on experience studying rocks in the field and applying geologic concepts learned in the classroom. The course was designed to provide an in-depth look at Cretaceous fluvial-deltaic systems in eastern Utah and was a great success.

Fourth, two new student scholarships in geosciences have been pledged/established through the UM Foundation during the last year. They are the **NewFields Environmental Geoscience Scholarship** and the **DeDominic Geoscience Scholarship**. These generous gifts will enable students to pursue geoscience careers.

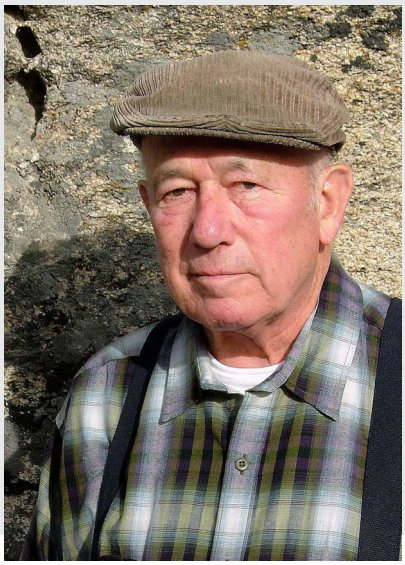
As always, the financial situation at UM is of concern for all of us. In the Department we continue to subsidize teaching assistant stipends to make them nationally competitive, we have had to start subsidizing class field trips to continue to make them possible, and we have had to make substantial infrastructure investments for our new faculty hires. All of this has been accomplished with funds donated to the UM Foundation by you. For us to maintain a dynamic, high-profile geoscience program we need your continuing help. You have been generous in your support of our program and I urge you to continue to do so going forward. I also urge you to discuss corporate donations with your employers. In most instances, the best way to help us meet our operating challenges is to contribute to the Geosciences Department Unrestricted Fund via the UM Foundation.

In closing, achievement in scholarship and research continues at a high level in the Department and I encourage you to read through this newsletter to learn about recent faculty and student activities and accomplishments.

Best wishes,

Jim Staub

In Memoriam



Dave Alt - Geosciences Professor Emeritus

David D. Alt passed away on April 26, 2015. We will long remember Dave for his witty, engaging lectures and his endlessly creative ideas about how geology works. A geochemist, Dave took pride in calling himself a 'general geologist' with interests ranging from earth history to asteroid impacts and Lake Missoula's 'humongous floods'. Through his yearly graduate seminars, fondly called 'lunch with Dave' and his lectures in the field, Dave influenced generations of UM geology graduates. Through his popular roadside geology books, Dave reached out to the lay public throughout America.

Introducing Our New Faculty

Payton Gardner

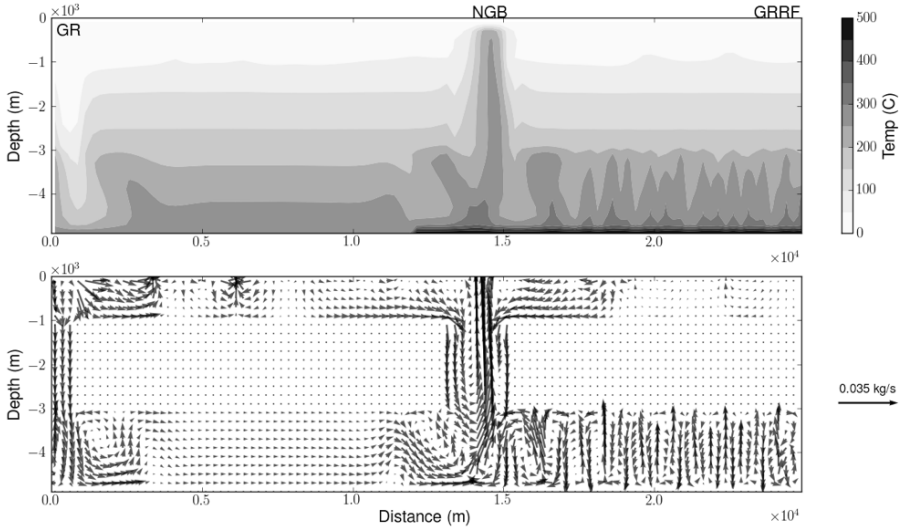
Circumstances of my arrival had changed quite a bit. Rather than having all my worldly belongings in the back of Toyota 4x4, I drove down the Clark Fork and out into the Missoula Valley in a large U-Haul with family in tow. In August of 2015, after an eleven-year hiatus, I had returned to Missoula and the UM Geosciences Department for the second time. What a long, great trip it's been.

After completing a major in Geology and minor in Mathematics at the University of Montana, my wife and I set sail from Missoula in the summer of 2004. I had a dream of going to graduate school, and becoming a researcher and professor. We loved Missoula, but we knew we wouldn't be coming back. I started graduate school at the University of Utah that fall, and began a career trajectory that took me all the way around the world, ending back in Missoula. So much for forecast confidence.

I completed my Ph.D in Geophysics in 2009 from the University of Utah, where I studied the hydrothermal system which fed Norris Geyser Basin and the role of the shallow groundwater in recharging the deep hydrothermal system. I used special isotopic and chemical tracers which can tell us where and when groundwater comes from. The use of these tracers is complicated in a place like Yellowstone, where water boils and heat drives water as much as topography (see Figure 2 below for a snapshot of what I think the hydrothermal and local groundwater circulation system looks like around Norris Geyser Basin). I had a fantastic Ph.D project, hiking all over back country Yellowstone, sampling springs, running samples in a world class mass spectrometry lab and modeling hydrothermal fluid circulation on the world's largest volcanic caldera. I learned a lot - including humility.

After my Ph.D, I took a postdoctoral fellowship in a famous isotope hydrology laboratory at CSIRO in Adelaide Australia - almost directly across the world from Salt Lake City, Utah. I was responsible for the calibration, maintenance and operation of a new noble gas isotope analysis machine built by my advisor, and the application of this technique to a variety of groundwater research projects. I helped pioneer some new isotopic techniques for detecting old, deep groundwater discharging to rivers, and for determining upward leakage to the

The supporting crew. My wife Lindsey, daughter Nova (9), son Canon (6) and I.



A model of regional groundwater and heat flow on the Yellowstone Volcanic Plateau, across Norris Geyser Basin. This model was informed by local geology, seismicity, and inferred processes from noble gases and other tracers. The top panel is the temperature distribution. The bottom panel is the fluid velocity vectors. The down-well groundwater flow adjacent to the ascending hydrothermal plume at Norris, entrains lots of locally derived water, and was a key finding of my dissertation work.

surface from the Great Artesian Basin – one world's largest groundwater flow systems. My work took my all over that beautiful country. I bumped around the outback in Land Cruisers and helicopters, and I traded crocodiles for grizzly bears as animals above me on the food chain in the field.

Following my postdoc, we came back to the U.S. where I started as a Senior Member of the Technical Staff working at Sandia National Labs. At Sandia, I worked on a variety of different groundwater transport problems. I used super-computers to model groundwater flow and radio-isotope transport at large scales, for nuclear waste repository safety assessment. In the laboratory, I developed a new mass-spectrometry technique for measuring noble gases released from rocks as they break. This new work is breaking ground for a new technique to monitor stress and strain in the earth, and perhaps someday, the use of the noble gases in the groundwater system as an early warning signal for earthquakes and mine failure.

I was enjoying my career, completing a 6-month stint as an in house expert consultant to the International Atomic Energy Agency in Vienna Austria, when I got word UM would be hiring a hydrogeologist. I loved my work at Sandia, but I couldn't pass up the opportunity to return to my alma mater and continue the hydrogeology tradition at UM. I decided to apply for the job. Three months later, I was sheepishly asking my wife to move yet again.

After 11 years, and a wealth of wonderful experiences working on hydrogeological problems all over the world, my family and I have returned to the University of Montana for good. I am thrilled to join the faculty and build my lab and my research program here. My Lab will continue to work on developing new isotopic methodologies to solve a variety of hydrogeological problems.

For now, I am looking to develop better understanding of regional groundwater flow in the mountains, and the role of mountain block circulation in stream water generation, and river discharge. This will help us make better models of groundwater and stream water in Montana, and develop a more robust understanding on the effect of climate on water resources in Montana and beyond. I will continue to work on noble gas tracers of mechanical deformation, with a long term goal of using the noble signature in groundwater and stream water to monitor changes in stress and strain in the crust. I am excited to develop these tools and use them to understand more about hydrogeological systems in Montana and abroad.

Hilary Martens

Greetings alumni and friends. Thank you for welcoming me as the newest member of the UM Geosciences faculty. Since starting here in August, I have been impressed by the enthusiasm of our students as well as by the commitment of our department to fostering an engaging and comprehensive learning experience. I myself am a UM alumna (B.A., 2008) and thus care deeply about investing in the success of our students and in the progress of UM as an institution.

I am also a fourth-generation Montanan and a native Missoulian, so the opportunity to teach and conduct research at UM, in the community that I call home, is special to me in more ways than one. As a way of coming full circle, some of my earliest motivations for pursuing a life-long career in science were sparked by excellent teachers and experiences that I had while attending the local public schools.

Growing up in Montana, I naturally developed an affinity for the outdoors as well. My family and I enjoyed camping in Glacier and Yellowstone National Parks, canoeing the beautiful rivers and lakes across the state, and exploring trails and forests around Missoula. Ever since I can remember, I have been fascinated by Earth's natural environment and evolution, as well as by the broader space and planetary environments of our solar system, no doubt inspired by my childhood years spent discovering Montana's wild and open spaces.

After graduating from Sentinel High School in 2003, I attended UM on a full-ride academic scholarship awarded through the Davidson Honors College. From the beginning, I knew that I wanted to develop a strong foundation in the natural sciences, with a focus on the physical sciences. In my

sophomore year, I decided that I could not allow my passion for music to fall by the wayside either. Thus, in addition to a physics major and mathematics minor, I pursued a second major in music, with concentrations in violin performance and composition.

Beyond the classroom, I benefited greatly from UM's excellent opportunities for civic engagement and undergraduate research. In particular, studying social justice issues in Latin America inspired me to partner with a girls' elementary school in Guatemala to establish its first-ever library. Furthermore, under the guidance of Prof. Dan Reisenfeld in UM's Dept. of Physics and Astronomy, I worked with NASA scientists to investigate populations of energetic ions in Saturn's magnetosphere using data collected by the Cassini spacecraft. The undergraduate-research experience opened doors for me to study abroad in England, to present my results at scientific conferences across the US, and to be part of an international team of scientists and engineers devoted to pioneering the exploration of the solar system. My holistic education at UM paved the way for new opportunities as a graduate student. With funding from a Marshall Scholarship, I completed a Master's degree in Space Science at University College London (UCL). Moving from Missoula directly to London proved to be an adjustment at first, but afforded me a fresh perspective on the world and a deeper appreciation for international cultures. As part of the course, my colleagues and I designed a CubeSat space mission to study Earth's aurora and I worked independently on a project to study Saturn's rings. During my second year as a Marshall Scholar, I completed a master's degree in Geophysics at the University of Cambridge. In Cambridge, I worked with Prof. Robert White on a remarkable sequence of micro-earthquakes recorded in Iceland that delineated an active intrusion of magma into the mid-crust. Interpreting seismic data and participating in fieldwork in the Icelandic highlands renewed and strengthened my interests in Earth-system processes.

I then returned to the US and started a Ph.D. in the Seismological Laboratory at the California Institute of Technology (Caltech). In collaboration with Prof. Mark Simons, I investigated global-scale Earth deformation caused by surface mass loading. Since the response to loading is governed by the material properties of Earth's interior, a combination of high-precision geodetic observations and numerical simulations may be used to probe the elastic and density structure of the crust and mantle. While at Caltech, I also continued to work on data from the Cassini mission and, in partnership with international colleagues, became the first to map the spatial distribution of enigmatic ice boulders on the surface of Saturn's moon Enceladus.

Outside of research, I worked for four years as a Resident Associate in Caltech undergraduate housing, which I found to be one of the most meaningful experiences of my graduate-school career. In close collaboration with the Caltech Deans' Office, Diversity Center, and Counseling Center, I provided emotional and academic support to individual residents, mentored student leaders, and actively promoted a positive and inclusive community. I also enjoyed playing violin with the Caltech/Occidental Symphony Orchestra.

Just a few months ago, in June 2016, I graduated from Caltech with a Ph.D in Geophysics and a minor in Planetary Science. Now back in Montana, I am continuing to investigate the complex interactions between the solid Earth and fluids loading the surface. Specifically, I have started exploring the effects of non-tidal oceanic, atmospheric, and hydrologic loading on geodetic time series of surface displacements. In addition, I aim to determine the theoretical sensitivities of spheroidal Earth deformation to three-dimensional variations in structural properties.

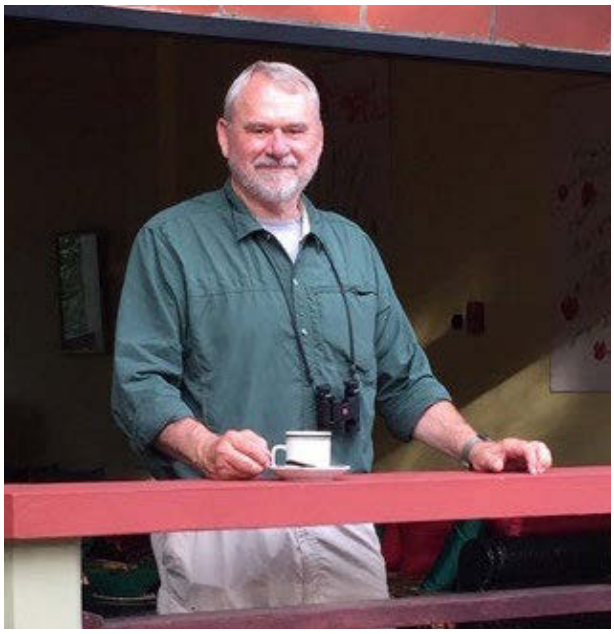
Furthermore, over the next few years, I plan to build a seismic network in western Montana from the ground up. The campaign-style network will consist of state-of-the-art portable seismic sensors that will supplement the existing Montana Regional Seismic Network. The broadband sensors will monitor regional and global teleseismic events, as well as detect local micro-earthquake activity that can shed light on local fault structure and stress state. I hope to have lots of student involvement in the early stages of network design and deployment, as well as in the later stages of ongoing data analysis and interpretation.

In my spare time, I enjoy playing the fiddle with local bluegrass bands, composing chamber music, marathon flatwater canoeing with my family, camping in the national parks, traveling abroad, Nordic skiing, and stand-up paddle boarding on Montana's rivers and lakes. I sincerely look forward to supporting our undergraduate and graduate students through their individual scientific journeys in the months and years to come. I also look forward to interacting further with our UM Geosciences alumni and advocates, some of whom are good friends of mine already from years past. Thank you for your continued interest in, and support of, the activities and mission of our department.

Emeritus faculty updates

Johnnie Moore

The last year as an Emeritus Professor has been enjoyable and productive. Prof. Joel Harper offered me a space in his Quantitative Study of Snow and Ice group in the relatively new Interdisciplinary Science Building. Check out their research at **http://hs.umt.edu/qssi/research.php.** It is a great group of faculty and students and I have really enjoyed interacting with them all. I am on a couple of graduate committees and am advising one undergraduate student for a senior thesis, otherwise I am just conducting my own research. My main emphasis now is on the controls and fate of Great Basin closed basin lakes (those with no outlets). This work is driven by the importance of these lakes to migrating water fowl and shorebirds. I just published a paper on Lake Abert in southern Oregon which is a critical link in the global migration of shorebirds within the Pacific Flyway **(http://www.sciencedirect.com/science/article/pii/S0048969716303722)**. I am also working with Dr. Nick Silverman, a Post-Doctoral Researcher in College of Forestry and Conservation, on the climate that allowed large lakes to form in the Nevada Desert



Moore on the veranda at Cuffee River EcoLodge, Tobago

Basins during the Late Pleistocene. That work feeds into a better understanding of how the present closed basin lakes will respond to future climate change. I also have a joint project with my colleague Prof. Jack Schmidt at Utah State University looking at controls on channel narrowing along the Green River in Canyonlands National Park. This involved some great detailed stratigraphy-sedimentology in a large trench in the floodplain in Mineral Bottom and associated hydrology and climatology in Canyonlands.

My wife Lynn and I have also kept busy with some travel, mostly in the western U.S. deserts and mountains, but also recently two weeks in Trinidad and Tobago. Lynn recently left her job with National Audubon and now works as a consultant to travel companies, mostly helping organizing international birding trips and helping with conservation and citizen science programs. So, I got to tag along to the Asa Wright Nature Center, where we met with staff and did lots of birding. On Trinidad and Tobago, I saw 102 new species of birds, including the amazing oilbird, which is a nocturnal, echo locating, fruit eating, bird that nests in caves—how weird is that! We also saw the golden headed manikin, which is famous for his "moonwalk" mating dance, not as good as his cousin the red-capped manikin's, but still impressive. (if you haven't seen them check them out on YouTube: "moonwalking manikin bird"). Also saw 20 of the endangered Trinidad Piping Guan (only about 160 left on Trinidad). Lynn is helping with trips all over the world, so I am hoping I get to tag along if she gets to continue to go to exotic places.

So, all in all, retirement is treating me well and I am keep busy. It would be great to hear from old acquaintances, so drop me an email if you get a chance.

Bill Woessner

I retired at the end of the 1st semester of 2014 and have been fortunate to remain active in the discipline. Starting in earnest in 2012 Mary Anderson (U of Wisconsin) and I recruited Randy Hunt (USGS-Madison) and we rewrote our 1992 text book Applied Groundwater Modeling. It was published by Elsevier in August 2015. Though listed as a second edition we fully updated and expanded the original work. I also presented seminar talks at Baylor University and Simon Frasier University where I served as an external reviewer for a Ph.D. exam. Prior to retiring I became involved in an EPA funded STEM high school curriculum development project headed by my spectrUM Discovery Area colleague Dr. Beth Covitt. We are using groundwater science as a tool to teach investigative science. We refer to the project as the Montana Groundwater Academy and its three day curriculum includes a ½ day field trip to Greenough

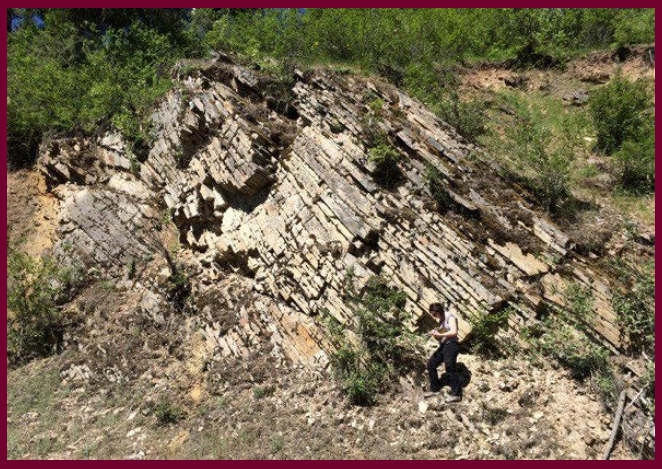
Woessner teaching measurement techniques and 3D interpretation of a water table (above ground), Greenough Park (http://www.umt.edu/groundwateracademy/)

Park where we have constructed a field site with 15 monitoring wells and 5 creek stage sites. Five hundred local high school science students have participated in the program. Post retirement Beth also included me on a large multi university NSF education grant called COMPHYDRO where in a number of regions across the US a two week curriculum for high school science classes is being developed using hydrological science as its base. Our course objectives include understanding groundwater occurrence, flow, contamination and remediation, and uses computational science (some groundwater modeling) to interpret and forecast. The great thing about these projects is the interaction with colleagues and old students now contributing time, suggestions and resources. I also have found time to fish a little more, visit grandchildren and travel with Jean. Please let me know what you are doing these days.

Steve Sheriff

Contrary to the woes of some, and also negating a long time elders' myth, I detect no problem keeping entertained in retirement. Semesters, this is my 7th with no course load, are not as hectic as they once were. Yet it is always a trial to get enough powder days, extend the spring ski mountaineering trips through one more week, watch the trails dry out while anticipating mountain biking, work around hot, wet, or cold weather to log enough time under the backpack, and finally try to remember why a bunch of partners only want to go on weekends. Summits then measure the passing year: powder snow, corn snow, hot and dry, then finished with vibrantly colored fall. And I even fit in some geophysics. In the summer of 2015 NSF put me on the coast of the Bering Sea for ten days working on site characterization and layout for an ancient Native American village. Turns out galvanized wash tubs got real popular right after European contact, one such tub essentially delineated the position of each of many long disused pit houses. Anomalies with amplitudes of hundreds of nanoteslas tend to obscure subtle signals but they do provide some interesting excursions in filtering and interpretation; and we just moved a bunch of those tubs – physical filtering I guess. This summer, on the shores of Yellowstone Lake, a detailed magnetic study led to archaeological test units that dropped into fire hearths nearly a meter deep and delineated a curious mound constructed well before European contact. So, small projects, great colleagues, interesting results but a little frustration with not getting enough funding to return to answer bigger questions. All in all though, the whole package is fun, hope you're having fun too.

STUDENTS IN THE FIELD



M.S. student Nora Dwyer

Faculty updates

Julie Baldwin

The highlights of this past year include seeing my first Ph.D. student Liane Stevens land her first tenure track teaching position at Stephen F. Austin State University in Nacogdoches, Texas. Liane conducted her dissertation work in the Priest River area in northern Idaho and we published a paper earlier this year in *Lithos* on the magmatic history of this region. My field research is currently split between the Clearwater area of north-central Idaho, where I am working with colleagues from Washington State and Idaho Geological Survey on an NSF-funded project to understand the significance of these rocks for the early assembly of the North American continent. We spent a fair bit of time in the field there this summer and even got Don Winston to join us for a day to look at some of the Belt rocks. I also have active projects southwest Montana in the Ruby and Highland Mountains looking at the Precambrian history of the western North American craton. My new M.S. students Nora Dwyer and Sara Stotter are working on projects in the Clearwater and Ruby areas, respectively. My colleagues and I led a field trip and technical session for the Rocky Mountain GSA meeting in Moscow, Idaho this past spring where we looked at some of the Precambrian Belt and basement rocks in the Marble Creek area of the Clearwater Mountains. I also stay busy managing the department's scanning electron microscope facility, where interesting projects both geological and non-geological happen each day. Our most interesting and unique material that we've analyzed to date are imported fireworks powders to look for potential impurities that make them more unstable and unsafe for sale in the U.S. I also am continually working to improve our teaching facilities and we've been fortunate to acquire a number of new tools in the past year, including a suite of new rock saws, a new polisher/grinder, and several new microscopes that improve our ability to teach mineralogy and petrology and conduct undergraduate research projects in the department.

Julie Baldwin (third from left) along with Nora Dwyer (MS student), Megan Dolan (IFG student), and Sean O'Callaghan (IFG student) on the May 2016 Rocky Mountain GSA field trip.

Rebecca Bendick
- Bendick research group

Three students in the Bendick research group successfully defended M.S. theses this academic year. Each focused on different aspects of active tectonics using different techniques and approaches. Dylan Schmeelk completed a study of tectonic surface motions throughout the northern Rockies using GPS time series. His work shows that gravitational collapse of high elevations produces deformation everywhere between the Snake River Plain and the Canadian border, but the collapse is directed toward the west in the Centennial Tectonic Belt and toward the east north of the I-90 corridor. His work also shows that fault slip rates estimated from elastic loading are much faster than previously estimated for Montana, raising the likelihood of rare large earthquakes in our area. Carson MacPherson-Krutsky created an online tool, HazardReady (see **hazardready.org**) to communicate this earthquake risk, plus information about other natural hazard risks, for any geographic location, with a pilot implementation for Missoula County. Its purpose is to make cutting-edge hazard science accessible to non-scientists, and to help people take steps to prepare for natural disasters in advance. Finally, Cody

Damage from the Gorkha, Nepal 2015 earthquake near Kathmandu, Nepal

Bomberger did an analysis of characteristic scaling in the topography and strain rates of the western U.S., looking for the signatures of crustal faulting and other deformation mechanisms in the landscape. These results provide constraints on the material properties of the North American continent that will help us to understand the dynamics of tectonics in continents. Ellen Knappe continues her Ph.D. studies of the East African Rift system, with a successful field expedition in Ethiopia in early 2015. We also welcome a new Ph.D. student, Mason Perry, who will work on the geodynamics of the Hindu Kush and Pamir ranges of Central Asia.

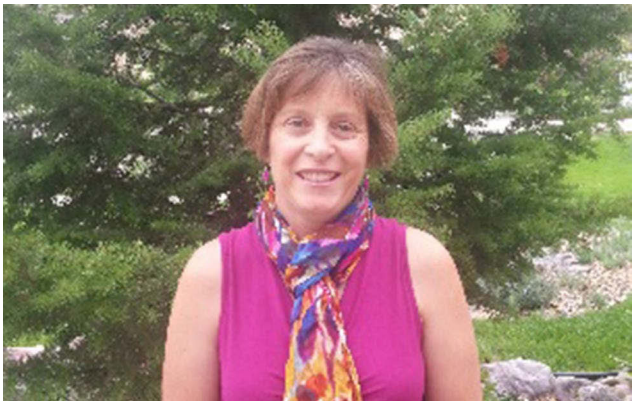
Joel Harper

For the first time in years, the glaciology group did not spend the summer conducting a major borehole drilling campaign in Greenland. We still did two trips to Greenland, one in April and one in August, but we were there to collect data and maintain instruments rather than drill holes and install new instruments. Over the last several years we have instrumented a 700x700x700 m block of Greenland ice with about 1000 sensors. We are measuring internal deformation of the ice with tilt sensors, as well as heat flow through the block and water conditions at the bed. We have sensors in ten boreholes extending all the way through the block to the bed of the ice sheet, and in too many shallower holes to count. Now we sit back for a couple of years and harvest the data stream. Not drilling this year was life changing. We did not spend the entire spring in the lab making instruments and planning field logistics, and we got to experience much of Missoula's summer.

Patrick Wright defended his master's thesis last spring and published it in Journal of Geophysical Research. He is now working for the Teton Avalanche Center in his hometown of Jackson, Wyoming. Caitlyn Florentine and Ben Hills continue their Ph.D. and M.S. work respectively, on Greenland datasets. Toby Meierbachtol has transitioned into an Assistant Research Professor and we are busy writing grant proposals for the next big project. All three were asked to give talks on their work at the upcoming AGU.

Kathleen Harper

This year I am continuing to teach intro geology courses and coordinate the geology labs. I have been also been teaching a section of GEO101 online most terms. Last year, I added a lab course to our online geology offerings, making it possible for students to complete their Gen Ed Lab Science requirements with Intro Geology classes online. The students have their own rock and mineral sample kits and other materials



to work with at home. Many of the students taking online classes are in Missoula, but choose to take the class online because of their busy schedules and other commitments. The best part about the online class is that I hear the voice of every student through the online discussions, something which never happens in my face-to-face intro class. There are always a group of students who will speak up in the classroom, but even more students who will never say a word in class! The variety of perspectives, life experience, and diversity of interests among the students in the online class is nice to see! I also actually have more insight into what topics they find most challenging to understand, and what they find most engaging. I rounded out the year with summer trips to some very interesting places, including my first trip into the Bob Marshall Wilderness with a volunteer trail maintenance crew (amazing geology!), as well as hiking in Glacier Park and in the Italian Alps.

Slogging back to the ride home, Greenland ice sheet on a cold April day.

Marc Hendrix (far right) with colleagues doing field work in southern Tanzania. To the left of Hendrix are Cassy Mtelele and Nelson Boniface from the University of Dar Es Salaam, and Eric Roberts (UM MS, 1997) and Hannah Hilbert-Wolff, both from James Cook University.

Marc Hendrix

Life continues to be good, despite the annual acceleration of time and the 'only 24 hours' problem. The past couple of years, I've developed several new research fronts that are now beginning to bear fruit. Of these the most far-traveled is a project to document the history of rifting and sedimentation in the Rukwa Rift Valley of southern Tanzania. Along with Eric Roberts (1997 UM MS, now at James Cook University in Australia) and students, I had the chance to visit the Rukwa basin in 2013, and our first papers from this work are just now coming out in print (Mtelele et al., JSR, 2016). In addition to this new project, I've finally begun to do some work on the Belt Supergroup. Working with Don Winston as an advisor and a crew of undergraduate students, I've been focusing on the youngest part of the Belt (upper Missoula Group) primarily from the standpoint of petrographic characterization and detrital zircon geochronology. This work has suggested that the upper Missoula Group is Neoproterozoic, not Mesoproterozoic, in age. On the more applied side, I continue to be involved with work on a variety of US unconventional hydrocarbon plays and their analogs. To that end, three MS students that I co-advised have recently finished their theses: Anna Phelps (Sappington, Bakken equivalent), Clayton Schultz (Sappington), and John Zupanic (Frontier Formation) all have graduated recently, and all three are now working for SM Energy. I also continue to be involved in work on the Phosphoria Formation and will run a field trip across the Phosphoria basin for the next AAPG-RMS meeting in Billings. I hope to see some of you there!

Marco Maneta

Year 2015-2016 was exciting for our research group, and we are truly breaking the disciplinary limits of classic hydrology by working with ecologists, economists, and agronomists to provide rigorous insight into how the hydrologic cycle affects and is affected by ecologic changes, as well as by the increasing demands for food, energy and water from a fast growing population. We are teaming up with collaborators at the University of Montana, Virginia Tech, Montana State University, and the Spanish Research Council to develop state-of-the-art integrated methodologies capable of providing insight into this complex problem. These methodologies leverage new and long-running NASA earth observing missions, Google data-processing algorithms and computational capabilities, and advanced physically-based numerical models to provide unique research tools to advance science. These methodologies also provide the next generation of decision support tools for natural and water resources management. Code resulting from this research will be available to the public in our web page next year.

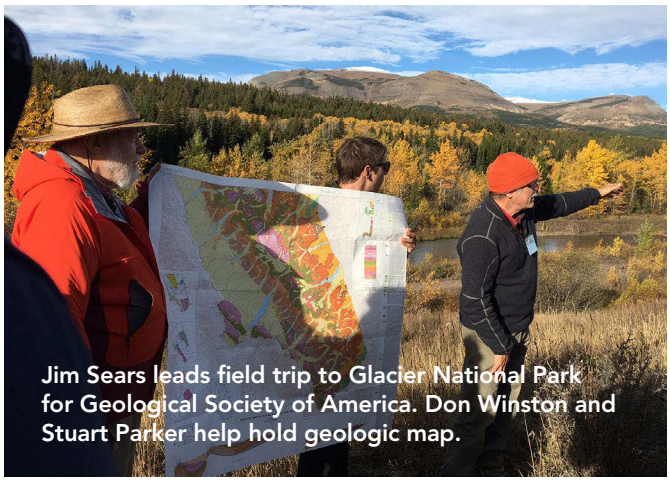
Also, this year we have released the first beta version of our ecohydrologic model (**https://goo.gl/Sz7Rpp**).

This is part of our continuing effort to provide high-quality, open-source software implementing the original models we use for research. Executable and source code, as well as sample datasets, are released so the model can be further used, inspected, and verified by the scientific community. We are always looking for collaborators and new users, so please contact us if you find this model of interest.

Our research is being funded by new or continuing contracts with NSF, USDA and NASA and is providing support for five new graduate students, two of them, Patrick Wurster (M.S.) and Caelan Simeone (M.S.), working directly under my supervision. We are planning to grow our research group in the future, so if you are thinking of graduate school and have an interest in computational hydrology stay tuned and check the page of the Regional Hydrology Lab for further information **(https://goo.gl/rRVSeZ**).

Jim Sears

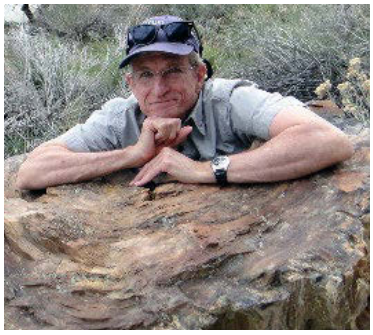
One highlight of the year was a winter raft trip through the upper Grand Canyon with Geosciences alum Johnny MacLean. Johnny is now a geology professor at Southern Utah University in Cedar City and an avid river rafter. It was 20 degrees when we set off from Lee's Ferry on December 18. It stayed quite cold down through shady Marble Canyon, but we thawed out on some sunny stretches near Unkar Rapids. On Christmas eve, I hiked out from Phantom Ranch through mud, ice, fog, and snow. This fall, with Johnny Maclean and Geosciences alum Stuart Parker, I led a pre-meeting geological field trip across Glacier National Park for the Geological Society of America. The trip was well attended. UM Emeritus Prof Don Winston was a participant and led animated conversations at several of the locations. I taught a three-week geology field course in an Arizona caldera during the winter recess, and a five-week geology field course in southwest Montana in May-June.



Jim Sears leads field trip to Glacier National Park for Geological Society of America. Don Winston and Stuart Parker help hold geologic map.

George Stanley

I was again active doing field work, attending meetings, directing the Paleontology Center, teaching courses in paleontology and the History of Life and working with my doctoral students. Amy Singer is researching a doctoral project on the Carboniferous age Bear Gulch fauna of central Montana. My student Montana Hodges graduated in 2016 under the UM Individualized, Interdisciplinary Doctoral Program. Together we conducted field and museum research in Alaska, Nevada and Sonora, Mexico on the collapse and recovery of ancient corals and reefs that survived a global catastrophe at the end of the Triassic, about 200 million years ago. During this notable extinction event, evidence points to massive global climate change and ocean acidification that devastated the world's oceans but isolated refuges help explain survival. We had a lead research article on this topic in the October 2015 GSA Today magazine.



I was an invited speaker at many venues, including in Poland, Austria, China, Mexico, Florida and Hawaii. I was honored during Fall semester, 2015 as the UM Provost's Distinguished Faculty Lecturer, with my topic: "Mass Extinctions in Geologic Time and the Implications for the Past, Present and Future." View a video of my lecture at:

https://www.youtube.com/watch?v=uSD-abBcPQc&feature=youtu.be

In 2015, I was named a Fellow of the American Association for the Advancement of Science and also last year, under my appointment as a Smithsonian Research Associate, I visited and lectured at the Natural History Museum in Washington, D.C.

Finally, this summer, 2016, I was invited to south China as a foreign expert to tour and evaluate Triassic fossil excavation sites located in the fantastic geological karst landscape of Guizhou Province. The sites are being proposed for a UNESCO World Natural Heritage site and World Geopark.

I'm co-author on a new Springer book "Reefs at the Crossroads" which is the first single volume in 35 years to examine reefs from a wide variety of perspectives, including environmental degradation of reefs past and present.

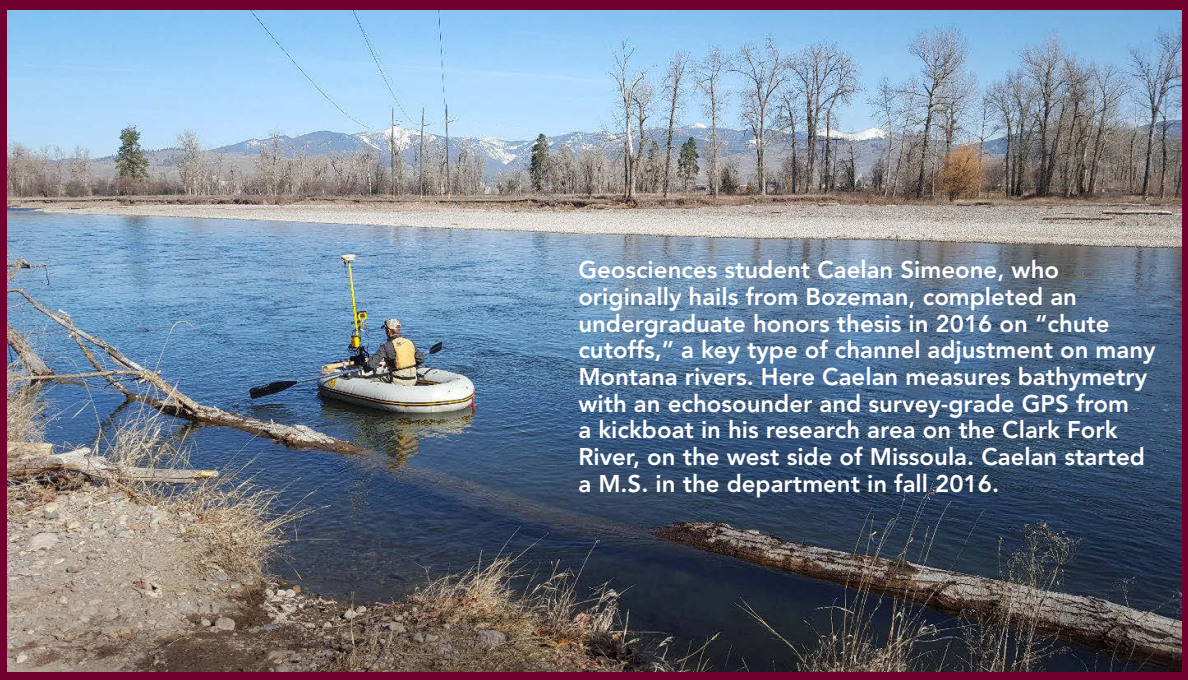
I enjoy hiking, my 130 pound dog and playing guitar. Visit some of my YouTube STEM videos to learn about mass extinctions and hear original fossil music:

https://www.youtube.com/watch?v=BUm_D8tD6_U&feature=youtu.be

Andrew Wilcox

It's been a fun and productive year! I've had the opportunity to work with new collaborators on several projects. I am part of a synthesis group on dam removal science (part of the USGS Powell Center for Analysis and Synthesis) that has brought together researchers that have studied dam removals around the country, and we have published several papers from this effort that pool knowledge about what we have collectively learned, including my group's work on the Milltown dam removal near Missoula. I also worked with an international group (Chilean, French, Italian) to study extreme flooding in the Atacama Desert in northern Chile; I started this work during a Fulbright visit to Chile in spring 2015. In addition, I have developed new collaborations across campus and Montana on research proposals, with topics ranging from the food-energy-water nexus, to hillslope-channel sediment connectivity, to hazards prediction. I've also continued to work with graduate students, including those new to my lab this year and former students with whom I maintain collaborations. I've enjoyed investigating Montana geomorphology and landscapes by bike, foot, ski, and boat with my family.

STUDENTS IN THE FIELD

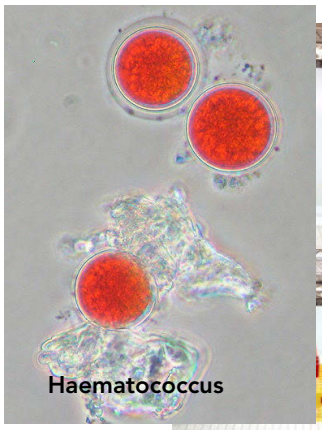


Geosciences student Caelan Simeone, who originally hails from Bozeman, completed an undergraduate honors thesis in 2016 on "chute cutoffs," a key type of channel adjustment on many Montana rivers. Here Caelan measures bathymetry with an echosounder and survey-grade GPS from a kickboat in his research area on the Clark Fork River, on the west side of Missoula. Caelan started a M.S. in the department in fall 2016.

Research faculty

Carrine Blank

In the last year, I worked with Nancy Hinman and a local biotech company (Blue Marble Biomaterials) on a DNRC-funded grant to study how microalgae can be used to treat acidic industrial wastewaters. This work resulted in a new patent (pending) and two publications. I worked in the lab with a talented Sentinel High School student Lindsey Roosa (see photo) to study how microalgae are able to produce



Haematococcus

Sentinel High School student Lindsey Roosa

biomass and natural pigments using wasteproducts as a feedstock (mushroom waste, shellfish waste). Most recently, we have just wrapped up experiments documenting how growth of the microalga Haematococcus on waste chitin and chitosan results in a marked enhancement in the production of an important natural red pigment (astaxanthin; image shown). I also worked with collaborators at University of Idaho to reconstruct the evolution of cyanobacteria and their phenotypic and ecological traits through the Precambrian (just published). Finally, I have had the privilege of working on a wonderful NSF-funded, interdisciplinary team of information scientists and microbiologists to generate two new software tools: MicrO and MicroPIE. MicrO is an ontology (a formal, hierarchical, logically defined database of terms and term synonyms collected from a large corpus of published taxonomic descriptions of microbes, published this year) and MicroPIE is a natural language processing algorithm that takes the natural language in a taxonomic description and extracts character information so that the evolution of those characters and character states can be studied in more detail (publication in review). These tools will help us massively scale up the study of the evolution of microbial traits through time, and to better understand how these traits have influenced the changing chemistry of the Earth through deep geologic time.

Toby Meierbachtol

Seven years after embarking on my Ph.D here in the Geosciences Department, I am pleased to be writing a personal update now as a newly minted Research Assistant Professor. Following completion of my dissertation, focused on ice-water dynamics along a study transect on the western Greenland Ice Sheet, I continued as a postdoctoral researcher in the department with Prof. Joel Harper for two additional years. This last year has been a busy one, and I'm also happy to report it was a success.

In the summer of 2015 we completed our final hot water borehole through the Greenland Ice Sheet to measure ice temperature, deformation, and basal conditions. By the numbers, our borehole drilling campaign has been a great accomplishment: two grant cycles, 37 holes totaling more than 14 kilometers, and zero field accidents! Our most recently completed field campaign has resulted in comprehensive measurements yielding unique constraints on basal conditions and how the ice sheet is deforming and sliding over its bed. In addition to grant proposal writing for the next project, I continue to work on the data we've collected and was fortunate to travel to Iceland to present one aspect of this research on subglacial drainage conditions at our field site, which resulted in publication.

Staff

Aaron Deskins

Happy fall everyone. We are off to another solid academic year here in the Department. It is exciting to see the students using and pushing the computing software and hardware we have to offer. I chuckle when I arrive at work and see evidence of the late night endeavors in the computer lab, equations scribbled on the board, empty pizza box, cheap coffee cup, ternary plot on the board, and a computer with a note taped to the monitor "DO NOT TOUCH, Model in Progress." Looking forward to the winter, I will be updating our open lab, re-organizing my Hyper-V server cluster, expanding our AWS computing, and most certainly making some maps. On the home front life is just as busy and exciting. The children are growing, active, and happy. These are the good old days!

Deskins family summit shot on Trapper Peak, MT 45.8899° N, 114.2976° W

Christine Foster

I am happy to be here supporting students, staff, and faculty! There is always enough going on in the department to keep me interested and busy. I look forward to each new year and helping to navigate whatever challenges come our way.

STUDENTS IN THE FIELD

Anna Phelps (left) and Clayton Schultz (the giant hulk on the right) recording observations on the Devonian Sappington Formation. Both students recently completed their MS on the Sappington Formation. Anna's work is coming out soon in the AAPG Bulletin, and Clayton won the 'best SEPM poster' award for his work at the 2016 national AAPG meeting in Calgary.

Graduate students enjoy a hot tub on the Greenland ice sheet. All drilling fuel must be used up at the end of the season, to avoid the expense of transporting it back, so there is no choice but to take a hot tub!

Facilities updates

The **Environmental Biogeochemistry Laboratory** (EBL) has had a great year. The laboratory is headed by Andre Umansky and Matt Young as research assistant.

In the last 15 years the laboratory has played a crucial role in providing environmental contamination data to private industry, faculty, and local government agencies. Currently, the environmental analysis climate has shifted to toxicology. We are seeing more researchers focusing on how the established physical environment contamination is affecting biological organisms. Some examples of the EBL's toxicological analyses include establishing heavy metal toxicology in human blood, bird blood, turtle blood, nymph tissues, and squirrel bodies.

The laboratory has also been a major resource for local green products industry. We are very excited about being a big part of process validation for this industry. Finally, the EBL has had a relatively good financial year. We were able to double our revenue from the previous fiscal year. The laboratory continues to be able to support its staff directly from revenue.

We look forward to expanding on one of the main purposes of this laboratory, student education. We have hosted several undergraduate and high school student groups this year. In addition to a brief instrument function overview, the students were shown chemistry in action. We demonstrated the "elephant toothpaste" and sodium metal in water reactions. Both were very well received.


EBL Students

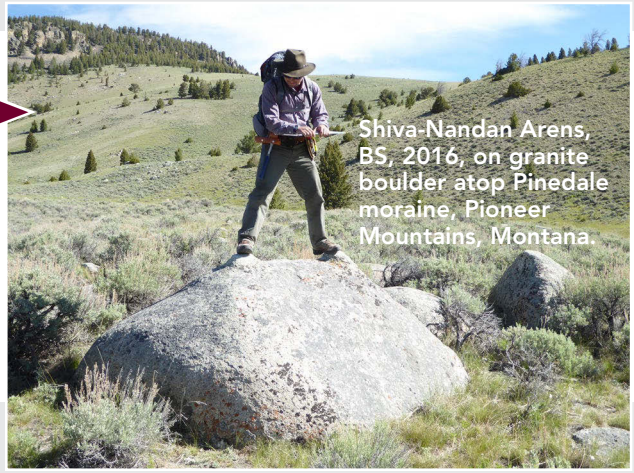
The **UM Paleontology Center** (UMPC) has been busy this year. Beyond the many local school tours that welcome hundreds of K-12 students into the department each year, the UMPC has participated with Montana in the Classroom through the MonTec Inspired Classroom, a distance learning facility, to reach students all across Montana. Even more far-reaching was Collections Manager, Kallie Moore's interview with Hank Green on the SciShow Talk Show. This video, available on YouTube, has passed over 100,000 views since March. The goal to increase awareness and accessibility to the collection continues with an upgrade to the online database. Once upgraded, the digital collection records will be uploaded to the iDigBio.org Portal, joining the ranks of museums like the Field Museum of Natural History, Yale Peabody Museum, and the Royal Ontario Museum. In addition, the type publication count increased to over 250 manuscripts associated with specimens from the UMPC. More recently, the UMPC hosted the annual National Fossil Day Celebration on October 12th. This event brought in around 100 people from the campus and community, including the special guest – Greg Liggett, Montana State Paleontologist, who did a series of mini-lectures throughout the event. Another 50 people toured the facilities a few days later as part of the Family Weekend festivities. Plus the Smilodon skeleton (on loan from UC-Berkeley) will be featured on a BBC documentary about UM Professor Doug Emlen's new book, "Animal Weapons", and is set to air in April 2017.

Kallie Moore talks to guest about the UMPC collection during the National Fossil Day Celebration. Photo by Matthew Dustin.

Our Students Conducting Internships

Cliff Clark, a senior Geoscience major, had a summer internship with the Whitefish Lake Institute in Whitefish, Montana. His project involved measuring and characterizing the water quality of Whitefish Lake and Tally Lake in northwestern Montana. Cliff will be continuing to analyze the Tally Lake data as part of his senior thesis describing the hydrology of Tally Lake.

Shiva-Nandan Arens, a Geoscience major working with Marc Hendrix and Michael Hofmann, had an academic year internship with AIM GeoAnalytics working to analyze lithology, sedimentary structures, bioturbation, and diagenetic structures in rock cores. Shiva also gained experience working doing XRD, EDS and SEM analysis.



Shiva-Nandan Arens, BS, 2016, on granite boulder atop Pinedale moraine, Pioneer Mountains, Montana.

Caitlyn Florentine, a Ph.D. candidate working with Joel Harper, spent the summer working for the United States Geological Survey in Glacier National Park as a Physical Science Technician. Florentine is studying the mechanics of mountain glacier retreat as part of her dissertation research, and was thrilled to have the opportunity to work on this project with a federal agency. Although much of her summer was spent banging out code in the office, she also did some work in the field assisting USGS scientists service weather stations and make measurements on Sperry Glacier.

Shane Fussell, a M.S. student working with Jim Sears, had two internships this spring and summer; one with ExxonMobil in Houston, Texas, working with 3D seismic data, and the other working with SM Energy doing primarily combining well log data with 2D and 3D seismic data for reservoir mapping.

Students Conducting Internships **continued**

Ellen working on a Plate Boundary Observatory GPS installation on Augustine Volcano in the Aleutians.

Ellen Knappe, a Ph.D. student working with Rebecca Bendick, had a break from her usual field locations in Ethiopia, during a summer internship working with UNAVCO in Alaska. Ellen deepened her electronics and troubleshooting skills working on installing and maintaining GPS networks in remote locations.

Stuart Parker, an M.S. student working with Jim Sears, spent spring semester working on co-authoring a GSA field trip on the structural geology of the Glacier National Park region with Jim Sears, including constructing balanced cross sections of the area. Stuart then helped to lead the field trip, which preceded the 2016 GSA Annual meeting in Denver.

STUDENTS IN THE FIELD

As part of a field trip for a Fluvial Geomorphology graduate course, Geosciences students visited sites along the Clark Fork River in the vicinity of campus, traveling between sites along the Kim Williams trail by bicycle. Here students inspect woody debris deposits along a point bar.

Select Department Achievements

A group of Geosciences faculty, including **Payton Gardner, Marco Maneta**, and **Andrew Wilcox**, recently landed a $3 million grant from the National Science Foundation to develop graduate training at the food-energy-water nexus. (UM press release link: **http://news.umt.edu/2016/10/101916nsfg.php**; Missoulian link: **http://missoulian.com/news/local/um-lands-a-million-national-science-foundation-grant/article_c4b8f501-42db-5fb9-b0e0-36e22936befe.html**.

Marco Maneta published a paper with **Nick Silverman** on the detectability of change in winter precipitation within mountain landscapes (Water Resources Research, 2016, 52(6):4301-4320)/.

Toby Meierbachtol and **Joel Harper**, along with Geoscience Masters student **Patrick Wright**, published *Mechanical forcing of water pressure in a hydraulically isolated reach beneath Western Greenland's ablation zone* in Annals of Glaciology. Using novel, in-situ ice borehole experiments and measurements of ice velocity, they found that the pressure in the basal water cavities fluctuate in response to small changes in volume associated with mechanical forcing from the overlying ice sheet.

Julie Baldwin and colleagues at WSU and the Idaho Geological Survey led a field trip to the Marble Creek area of the St. Joe National Forest as part of the Rocky Mountain GSA meeting in Moscow, Idaho in May 2016. Julie also organized a technical session for the meeting on the Precambrian assembly of North America.

John Grotzinger, who received his M.S. degree in geology from UM in 1981, was honored with a Distinguished Alumni Award in the fall of 2015. John's academic history consists of B.S., Hobart College, 1979; M.S., University of Montana, 1981; Ph.D., Virginia Polytechnic Institute and State University, 1985; Post-doc, Columbia University, 1985-1987; Professor, Massachusetts Institute of Technology, 1987-2005; Fletcher Jones Professor of Geology, California Institute of Technology, 2005-present. Among many notable achievements Grotzinger was the Project Scientist of the Mars Science Laboratory (MSL) mission from 2006-2014. John continues to support the MSL as a strategic route planner (find out more on his web site).


Grotzinger

A team of University of Montana geosciences graduate and undergraduate students won the American Association of Petroleum Geologists' Imperial Barrel Award on March 14. Students **Anna Phelps, Brianna Berg, Cody Bomberger, Clayton Schultz** and **John Zupanic** presented their analysis to a panel of industry experts who selected the winner based on technical findings and presentation quality. In their first attempt at the competition, the UM students defeated seven other Rocky Mountain region institutions, including Brigham Young University, Idaho; Colorado School of Mines; New Mexico Institute of Mining and Technology; University of Utah; Utah State University and the University of Wyoming. The team of UM students was mentored by UM geosciences Research Assistant Professor **Michael Hofmann**. They attributed their success, in part, to collaboration with UM alumni, especially **Dave McGee**, who volunteered his time as a project consultant remotely from Denmark.

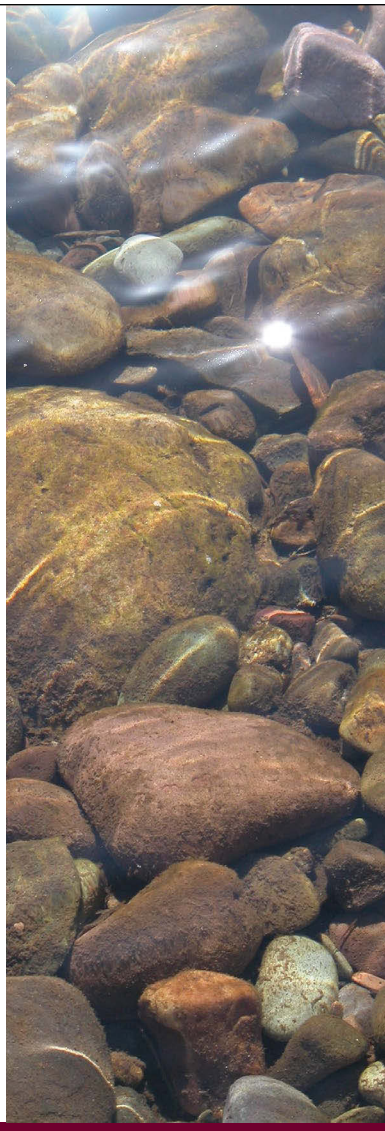
Congratulations to our Graduates 2015-2016

Undergraduate Students

Year	First Name	Last Name	Option
2015	Tait	Aune	Geosciences/Honors
2015	Nicholas	Banish	Interdisciplinary
2015	Briana	Berg	Geosciences/Honors
2015	Brian	Crail	Geosciences
2015	Timothy	Driscoll	Geosciences
2015	Justin	Enger	Geosciences
2015	Enger	Justin	Geosciences
2015	Steven	Long	Interdisciplinary
2015	Stacia	Martineau	Geosciences/Honors
2015	John	Orton	Geosciences
2015	Hannah	Ralston	Geosciences
2015	Hannah	Rosenkrans	Geosciences/Honors
2015	Andrew	Seegraber	Geosciences
2015	Amelie	Stolle	IFGD/Honors
2015	Jason	Subatch	Interdisciplinary
2015	Hannah	Sylling	Environmental Geology
2015	William	Wagner	Geosciences
2015	Michael	White	Geosciences/Honors
2015	Max	Yzaguirre	Geosciences/Honors
2016	Shiva-Nandan	Arens	IFGD/Honors
2016	Michael	Arthur	Geosciences
2016	Amber	Blodgett	Geosciences
2016	Kyle	Brangers	Geosciences
2016	Benjamin	Broman	Geosciences
2016	Darik	Coppedge	Geosciences
2016	Brooke	Hess-Homeier	Geosciences
2016	Theodore	Lewis	Geosciences
2016	Jessica	McCartney	Geosciences/Earth Sci. Ed.
2016	Tara	Mitchell	Geosciences
2016	Jordan	Rogers	Geosciences
2016	Caelan	Simeone	Geosciences/High Honors
2016	Stephen	Strehl	Geosciences
2016	Annika	Tostengard	Geosciences

Graduate Students

Year	First Name	Last Name	Degree	
2015	Yelebe	Amere	Ph.D.	The Use of Three-Dimensional GPS Observations for Tectonics and Hydrology in Northeast Africa
2015	Sharon	Bywater-Reyes	Ph.D.	The Influence of Pioneer Riparian Vegetation on River Processes from the Plant to Reach Scale
2015	Lindsay	MacKenzie	Ph.D.	Taphonomy of the Chengjiang Biota: Using a Combination of Sedimentology, Geochemistry and Experimental Taphonomy to Determine Preservation
2015	Liane	Stevens	Ph.D.	Pressure-Temperature-Time Constraints on Metamorphism, Anatexis, Magmatism and Exhumation in the Priest River Complex, Northern Idaho and Comparison with Geodynamic Models
2015	Martin	Cramer	M.S.	Proterozoic Tectonometamorphic Evolution of the Ruby Range, SW Montana, USA: Insights from Phase Equilibria Modeling and in situ Monazite Petrochronology
2015	Kurt	Imhoff	M.S.	Sediment Routing through Channel Confluences: Particle Tracing in a Gravel-Bed River Headwaters
2015	Michael	McTee	M.S.	The Biogeochemistry of Elemental Sulfur Contaminated Soils: Insights into Effective Remediation
2015	Anna	Phelps	M.S.	Facies, Architecture and Sequence Stratigraphy of the Devonian-Mississippi Sappington Formation, Bridger Range, Montana
2015	April	Sawyer	M.S.	Flood Duration and Chute Cutoff Formation in a Wandering Gravel-Bed River
2015	Patrick	Wright	M.S.	Temporal Evolution of Basal Water Pressure and Ice Velocity Along a 50 Km Flow Line Transect of Western Greenland
2016	Dylan	Schmeelk	M.S.	Kinematic Constraints on Tectonics of the Northern Basin and Range



Great thanks to our Donors **during the 2015 and 2016 fiscal years. We offer our sincere gratitude to others who have donated outside of this time window and do not appear on the list.**

2015

- Apache Corporation
- Richard and Betty Berg
- Fredrick and Diane Bodholt
- Mary Ann Brockway
- Stephen Buckley
- James and Charlene Castro
- Rodney Flynn and Cathy Connor
- ConocoPhillips Matching Gift
- Gary Cropsey and Paula Waid-Cropsey
- D.A. Davidson
- Peter and Cathy Dea
- EnCana Oil & Gas (USA) Inc.
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- Kathleen Ort
- George Shurr
- Paul Singer
- SM Energy
- Luther and Emily Strayer
- Carl Swisher
- Paul and Susan Taucher
- Eleanor Weidman
- Michael Whalen
- Barbara Williams
- Don and Bente Winston

2016

- Fredrick and Diane Bodholt
- Mary Ann Brockway
- Stephen Buckley
- Lane Coddington and Darci Thorsrud
- Michael and Leslie Collins
- Rodney Flynn and Cathy Connor
- ConocoPhillips Matching Gift
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- Scott and Cora Helm
- Barry and Vicki Henderson
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- William Hood
- James Horn
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- John Jens
- Peter Johnson
- Dave Leppert
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- Kathleen Long
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- Natalie Morrow
- Christopher Murray
- Sonia Nagorski
- Matthew O'Brien
- Kathleen Ort
- George Shurr
- SM Energy
- James and Nell Staub
- Luther and Emily Strayer
- Paul and Susan Taucher
- Lane Coddington and Darci Thorsrud
- Eleanor Weidman
- Michael Whalen
- Barbara Williams
- Don and Bente Winston
- Katrina Zigan

Help Us Provide the Best Possible Geosciences Education

Geosciences Department Unrestricted Funds: This fund allows us the maximum flexibility in spending in support of operations, equipment purchases, and assisting students.

Geosciences Student Research Fund (Advancing Geosciences in the 21st Century): This fund provides scholarships to deserving Geoscience students in need of resources to complete their proposed research.

Geosciences Department Restricted Funds: Donors who want to restrict funds to a particular purpose can donate to this fund and designate how their donation should be used.

Don Winston Excellence in Field Geology Fund: This fund is used to support field-based learning and research.

Robert and Eleanor Weidman Scholarship: Established in 1994 in support of junior and senior undergraduates in Geosciences. Funds are used for student fees, tuition, enrollment in a summer field course, and field-based independent study.

Patrick J. McDonough Memorial Fund: Established in 1979 by Patrick's friends and colleagues to honor his dedication to the responsible development of energy resources in Montana. The fund is used for student research in the development and utilization of resources.

Norman Knapp Scholarship in Geosciences: Montana high school graduate majoring in geosciences. Financial need and academic performance will be considered in the selection, with preference given to student with financial need. Recipient must be of junior standing and may receive the scholarship in his/her senior year provided that he/she continues to meet the criteria and funding is available.