Washington University in St. Louis

Department of Earth and Planetary Sciences

Newsletter

Fall 2011 Issue 11

May Field Trip to the Colorado Plateau

Randy Korotev

IN THIS ISSUE...

Department of Earth and Planetary Sciences
Washington University in St. Louis
St. Louis, MO 63130

On May 21st, a group of 31 faculty, staff, and students, led by Professor Robert Dymek, flew to Las Vegas to begin a tour of the geology of the Colorado Plateau. In four vans, we vacated Las Vegas ASAP and spent our first night two hours north in St. George, UT. The next day, en route to Moab, Utah, we stopped at the Kolob Canyons area of Zion National Park and the San Rafael Swell along I-70 west of Green River. The first three nights of camping were at the Gold Bar Campground, a Bureau of Land Management site along the Colorado River near Moab. From there three main attractions were within a short drive. At Canyonlands National Park, which contains the confluence of the Green and Colorado Rivers, we had great views of the river canyons as well as a visit to Upheaval Dome, thought by many to be a highly eroded meteorite impact structure. Dead Horse Point State Park provided great top-down views of the canyon country, including a prominent gooseneck in the Colorado River. At Arches National Park, we visited many of the main attractions, including the Windows, Balanced Rock, Landscape Arch, and Delicate Arch.

Touring with four vans and 31 people set a new record. Yet, the well-planned trip by Bob Dymek, Ryan Zeigler, and Bob Osburn had no logistic problems. Four cooking groups alternated culinary preparations. The weather was different issue. Throughout our stay at Moab, rain clouds were visible somewhere on the horizon nearly continually. Cloud cover kept the temperature down, but we were rained and even hailed upon during some of our hikes. During two days, after visiting the parks, we arrived at the campsite to find tents blown down by strong winds through the canyon.

The next stop was Dinosaur National Monument on the Utah-Colorado border, where we camped for another 3 nights. The highlight was a float trip through Split Mountain on the Green River. During the winter, Utah and Colorado had had a terrific mountain snow season, which resulted in a large snowmelt cascading down the Green River in May. The river was flowing at ten times its normal rate for this time of year. That meant that there were no exposed rocks to avoid, but that the river was fast and had a few deep "holes" at locations where we couldn't see the submerged rocks and which had colorful names like Moonshine Rapids and SOB Rapids. We did the river trip with four rafts, the requisite number of paddles and life jackets, and experienced helmsmen provided by the raft company. One raft briefly lost a few occupants who were tossed overboard on the way through rapids. Later, another raft went vertical, dunking all nine tourists (but not the helmsman) into the chilly river. Given that everybody who got wet was a graduate student, all too smart to not follow directions, occupants of the faculty raft could only conclude that the students arranged the experience deliberately. The trip ended at our campsite. Everyone was wet, but even the faint of heart who had some serious misgivings

Great Basin National Park May 2011, Tents at 7 a.m. (top) and 1 p.m. (bottom).

Continued on page 2

Overview

Douglas Wiens

Greetings from the Department of Earth and Planetary Sciences at Washington University. Many exciting things happened during this last year, including the appointment of two new faculty members and the announcement of our building dedication date. Most of these developments are described elsewhere in this newsletter, but I will highlight a few items here.

The department carried out a search for a petrologist with planetary interests to fill the new Rudolph Chair in Earth & Planetary Sciences, and selected Brad Jolliff. Brad is not new to the department, as he has been a Research Professor here for many years. However, as the Rudolph Chair, Brad will be able to enlarge his research program in lunar and martian petrology and teach classes in petrology and planetary materials.

We are also looking forward to the arrival of Assistant Professor Alex Bradley in summer, 2012. Alex was selected after a national search in biogeochemistry and global change, and has started planning for his laboratory on the first floor.

This is the last letter I will be writing from the generically-named Earth and Planetary Sciences building, as the building will be dedicated as Scott Rudolph Hall on May 4, 2012. More details about the building dedication will be forthcoming.

This year we said "goodbye" to Frank Podosek and Joyce Brannon, who retired and moved to Texas. Frank has been a part of the department for longer than anybody here can remember. Through the years he contributed greatly to the department's growth, through his pioneering research in cosmochemistry and by teaching a wide range of classes. We also said farewell to Jan Amend, who departed for a new and challenging position as professor at USC and associate director of the Center for Dark Energy Biosphere Investigations (C-DEBI).

I hope that you as alumni and friends will maintain or renew your involvement with the department. Please send us any updates to your family or professional life by email, and join us for the alumni reception at the 2011 Fall AGU meeting in San Francisco. We always enjoy hearing from you!

Continued from page 1

before the trip admitted that it was fun. Also at Dinosaur NM we saw fossil dinosaur bones in-situ in the Morrison Formation and some fine petroglyphs. The next day we toured the high country in the Colorado side, seeing the stunning views at Rainbow Park, Harper's Corner, and Echo Park.

On the long trip to our next camp, we stopped at the Bingham Copper Mine near Salt Lake City, Utah. The Bingham open-pit mine is the largest man-made excavation in the world and is visible with the naked eye from space. Besides copper, the mine produces silver, gold, lead, molybdenum, platinum and palladium. While the sheer size of this mine was awe-inspiring, we were eager to get to Great Basin National Park in Nevada, where we planned a two night stay. The itinerary was to take the tour of Lehman Caves and then head up Wheeler Peak to see alpine lakes, a glacier, and bristlecone pines, all at 7,000-10,000 feet elevation. Approaching the park, the mountain was covered with clouds and it was sprinkling. It was raining at the campground but we hardy geologists pitched camp. We voted (unanimously) to forego cooking in the rain and head down the mountain to the small town of Baker for dinner. It was still raining when we got back to camp. The next morning there was four inches of snow on the ground and on our tents. Hoping the snow would stop, we took our tour of the caves. The tour was drier and warmer than our campsite and we saw massive displays of stalagmites and shield formations. When we emerged from the cave around noon, there was at least 12 inches of snow on the ground! We were escorted back to our campsite by park personnel. Many of the tents were flattened by the snow. After a brief consult, we decided to pack up and leave. We planned to make Las Vegas for our last two nights. It was a five hour drive.

Heading south, the weather improved, as did our spirits. About 2.5 hours from Las Vegas we passed a sign for Kershaw-Ryan State Park near Caliente on the Great Basin highway. To our astonishment, even though it was Memorial Day weekend, there was room available for us to camp. The sun was shining. We dried out and had our last great road dinner, steak and shish kebobs. The next morning we gave our remaining propane, food, and big coolers to the delighted campground host. We saw some nearby geology and headed to Las Vegas.

Our last stop was Valley of Fire State Park, just west of Lake Mead. The weather was stunning, but hot, and everyone enjoyed the 3 hour tour of red sandstone formations and petroglyphs. In Las Vegas we were thrilled to get cleaned up at our swanky (but cheap!) hotel. But, even at dinner that night, we were formulating where we were going to go next time.

To view all the pictures of the Great Basin trip go to http://epsc.wustl.edu/~rlk/UTNV2011/index.htm

Brad Jolliff named Scott Rudolph Chair in Earth and Planetary Sciences

After a long search and involving interviews of several senior candidates, the department is delighted to name petrologist Brad Jolliff as the Scott Rudolph Chair in Earth and Planetary Sciences. Professor Jolliff received his undergraduate degree, B.S. in Geology, at Furman University and a Ph.D. in geology from the South Dakota School of Mines and Technology in 1987. In between, he served 5 years on active duty in the U.S. Army as a combat engineer in Germany. After graduation, he was hired by Professor Larry Haskin for a postdoctoral research associate position at Washington University in St. Louis. He took a short leave from the university in 1990 to work as a topographic operations officer in the U.S. Army at Ft. McPherson, GA during the Persian Gulf Crisis. In 1991 he returned to Washington University and worked with Prof. Haskin and Dr. Randy Korotev as a senior research scientist and fellow of the McDonnell Center for the Spaces Sciences. In 2001 he was added to the faculty as a research professor. He served recently on the NASA Advisory Council, and serves currently on the Curation and Analysis Planning Team for Extraterrestrial Materials (CAPTEM). His expertise is using sample analysis, remote and in-situ sensing, and laboratory and field studies of terrestrial analogs to understand planetary processes, the distribution of rocks and minerals, and the geologic history of the Moon, Mars and the rest of the inner solar system. He was the recent Principal Investigator on the recent New Frontiers "Moonrise" proposal that was one of three in the final competition. Professor Jolliff uses the electron microprobe and laser Raman spectroscopy to determine mineralogy and mineral chemistry, and took the lead in acquiring the department's newest electron microprobe and technical staff to manage the probe lab.

In his new position Professor Jolliff will teach planetary science courses that focus on mineralogy and petrology at the undergraduate and graduate levels. His expertise in mineralogy and petrology will provide a unique perspective on rock-forming processes as revealed by Apollo samples and lunar and martian meteorites. "We are greatly pleased to have Brad join our mission of educating our students about the formation of rocks on Earth and other planets. Brad is a pre-eminent mineralogist and researcher. His work with the Mars Exploration Rover and Lunar Reconnaissance Orbiter has made him a leader in the planetary geology community," said Doug Wiens, chair of Earth and Planetary Sciences.

ALUMNI UPDATE CARD

Let us know what you are doing now.

Name: _____

Address: _____

Phone: _____ Email: _____

Year graduated/degree: _____

Advanced degree(s): _____

Current Employer: _____

Other news for the next newsletter: _____

_____

_____

Either send an email to mueller@wunder.wustl.edu or fill out this card and send it to: Washington University in St. Louis, Department of Earth & Planetary Sciences, Margo Mueller, Campus Box 1169, One Brookings Drive, St. Louis, MO 63130.

Squeezing Rocks *Philip Skemer*

Rocks are hard. In our everyday experience, rocks may seem as inflexible as a dean with an austerity plan. However, deep within the Earth and other rocky planets, elevated pressure and temperature transform rigid rocks into soft, viscous blobs. These viscous blobs, while still technically crystalline and solid, are capable of flowing just like a fluid, albeit over much longer time scales. These flowing rocks transport mass and energy throughout the planet, transforming the surface and the environments in which we live.

How do we know how rocks behave deep within the Earth? The deepest hole ever drilled made it a mere 12.2 km into the crust, less than two tenths of percent of the distance to the center of the Earth. Geology, geochemistry, and observational geophysics provide many clues about Earth's interior, but cannot uniquely constrain the physical properties of rocks at great depths. For answers, we turn to the world of experimental rock deformation.

Experimental rock deformation provides the tools for understanding the properties of deforming rocks and minerals at conditions inaccessible to direct observation. In our lab, we subject samples of rocks to tremendous pressure and temperature, to test how their physical and mechanical properties change as a function of these conditions. Our primary focus is on the minerals olivine and pyroxene, which make up the bulk of planetary mantles. However, we also conduct experiments on a wide assortment of other materials, from granites and mica-schists, to water ice. We are equal opportunity rock squeezers.

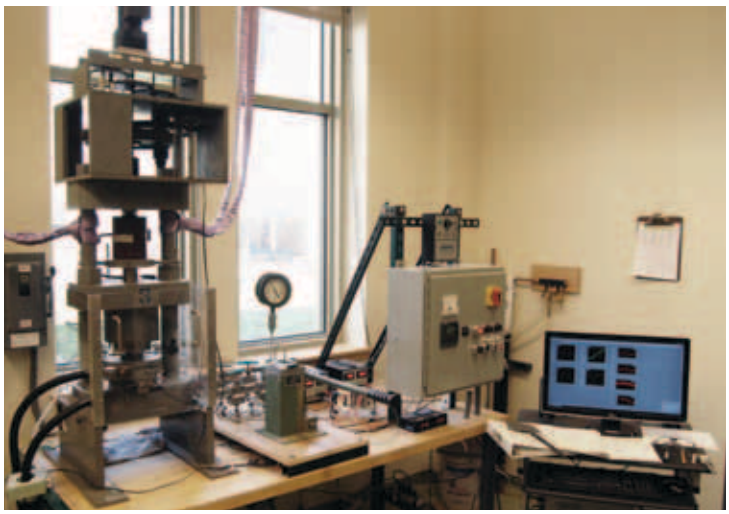

Figure 1: Recommissioned Griggs apparatus.

Our workhorse high pressure apparatus is one of the original Griggs apparatus (Fig. 1), built by David Griggs and his students at UCLA in the 1960s. This apparatus, in its earlier life, played a pivotal role in working out the rheology of granites and dunites, the phenomenon of hydrolitic weakening, and many of the processes behind crystal plastic deformation at high pressure. After traveling across the country a couple of times, we have recommissioned it here at Wash. U. with updated hardware and electronics. At this time, it is capable of deforming rocks that are a quarter inch in diameter at confining pressures of 1 GPa, and temperatures of greater than 1200°C. High pressures are generated with hydraulics and contained within a hardened steel pressure vessel. High temperatures are produced by running electrical currents through a graphite resistance heater, which is contained in series of concentric ceramic parts (Fig. 2). Deformation is induced by running a piston into the sample at a constant rate. During these experiments we measure the viscosity of the rocks by monitoring the force required to induce changes in the sample's shape. After the experiments we use optical and electron microscopy to see how grain-scale microstructures have evolved. Features on the micron to millimeter scale may seem insignificant in comparison to a planet that is over ten thousand kilometers in diameter. However, these microstructures provide essential data that are used to constrain geodynamic models, or to interpret geological and seismological observations.

One of our main research objectives is understanding the microphysical processes that cause ductile deformation to become localized. Localized deformation occurs along mechanical heterogeneities where large amounts of strain are concentrated, for example at plate boundaries. Although localized deformation is ubiquitous, its origins are unclear. Over the last few years we have begun to appreciate that weakening requires complex feedbacks between several rheological and microstructural processes. Of particular importance is the mechanical interaction of olivine and orthopyroxene. Olivine, on its own, resists localization through grain-growth and other dynamic hardening processes. Indeed, the dynamics of a hypothetical mantle made only of olivine would be quite different from a mantle with just 25% orthopyroxene. Understanding the processes by which olivine and orthopyroxene become mechanically mixed is challenging, because of the size and temporal limitations of laboratory experiments. We are currently developing new techniques for synthesizing

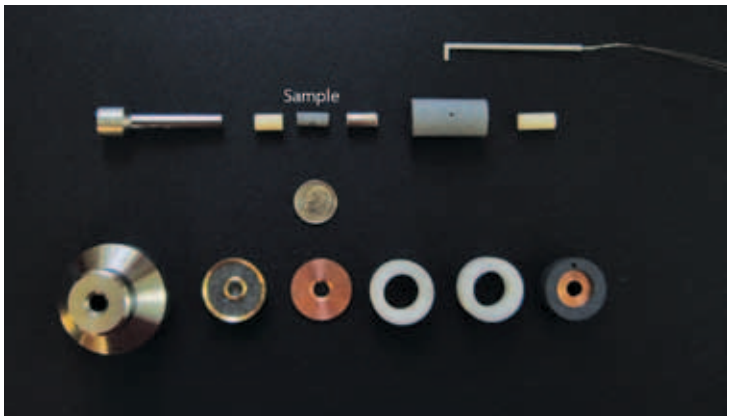

Figure 2: Experiemental assembly to deform rocks at high temperature and pressure.

artificial olivine-orthopyroxene mixtures that allow us to evaluate microstructural and rheological evolution under geologically appropriate conditions.

Another important objective of our research is understanding the relationship between the textures produced by deformation and seismic anisotropy. Seismic anisotropy is our main tool for constraining the kinematics of flow in the convecting mantle. However seismic anisotropy does not directly image mantle flow. Rather, seismology detects the presence of elastically anisotropic structures. To interpret anisotropy in terms of mantle flow, it is necessary to understand the relationship between the anisotropic structure and the kinematics of deformation. In most of the Earth, seismic anisotropy is caused by the deformation-induced lattice-preferred orientation (LPO) of individual grains, averaged over hundreds of kilometers. In our lab, we conduct experiments to understand the relationships between deformation kinematics and the orientations of these grains. Our recent findings have shown that LPO is strongly influenced by pre-existing textures in rock. This means that in complex dynamic settings like subduction zones, there will be a considerable lag between changes in kinematics and modification of the LPO and consequent seismic signature.

PHD's Awarded 2011

Selby Cull
The water cycle at the Phoenix Landing Site, Mars

David Heeszel
Surface wave derived shear velocity structure of the Gamburtsev Subglacial Mountains, Transantarctic Mountains and West Antarctica and shallow seismicity of the Mariana and Tonga subduction zones

Alexander Bradley to join EPS department in 2012

Dr. Alex Bradley, currently at Harvard University, will join our department as Assistant Professor in the area of biogeochemistry starting July 1, 2012. Prof. Bradley grew up just outside of Boston, Massachusetts. He received his undergraduate degree in Earth and Planetary Sciences from Harvard University, and a M.S. in paleontology from the University of Michigan in Ann Arbor. After taking a break from academia to spend some time in the world of consulting, Alex returned to Cambridge to complete his doctoral studies in geochemistry at the Massachusetts Institute of Technology under the supervision of Roger Summons. His dissertation focused on using biomarker compounds to understand carbon cycling in hydrothermal ecosystems, with a focus on the Lost City hydrothermal field near the Mid-Atlantic Ridge. Subsequent to finishing his Ph.D., Dr. Bradley moved back to Harvard for post-doctoral work studying microbial genetics and physiology in order to better understand the nature of geochemical biomarkers. His research will focus on understanding the co-evolution of life and the Earth, and on how biological information is archived in the rock record. He has received numerous awards and honors and is a member of the Geological Society of America, the American Geophysical Union, the Geochemical Society and the American Society of Microbiology. Alex and his wife, Marianna, are looking forward to life in St. Louis, although they will remain unabashed Red Sox fans.

Steve Fossett Postdoctoral Fellowship

In September of 2011 the Earth and Planetary Sciences Department announced a new position called the Steve Fossett Postdoctoral Fellowship. The Fellowship, which begins in academic year 2012-13, will be awarded for one year with the opportunity to be extended a second year. A national search is underway. The Fellowship is supported by funds donated through the estate of the late Stephen J. Fossett, investor, aviator and alumnus of Washington University. For more information, see the department web site, eps.wustl.edu.

Iron and Manganese Minerals in Caves as Natural Water Filters

Andrew J. Frierdich

The Environmental Geochemistry and Mineralogy Group, led by Prof. Jeff Catalano, is actively investigating the distribution and cycling of major and trace elements in aquatic systems through a combination of field-, laboratory-, and synchrotron-based techniques. The group is particularly interested in iron (Fe) and manganese (Mn), as these elements form abundant, highly reactive oxide minerals that affect the fate and transport of trace elements, many of which are contaminants and micronutrients. The following article highlights a recent field project in Pautler Cave, southwest Illinois, where Fe and Mn minerals in the subsurface were studied to better understand how these materials affect the mobility and fate of trace elements in karst systems. Pautler Cave is an Illinois Nature Preserve and, under the Illinois Groundwater Protection Act, water recharging in such preserves is designated as special resource groundwater. Therefore, data on the distribution and mobility of potentially toxic trace elements and micronutrients is desirable for future management of the aquatic biota and regulatory strategies for the cave's groundwater system.

Caves Provide Unique but Difficult Access to the Subsurface

Caves provide direct entry into subterranean environments although access is often technically and physically challenging (Fig. 1). Pautler Cave's six miles of passages are no different as the entrance is privately owned, thus requiring owner permission and state-issued research permits prior to admittance. The physical challenges of working in a cave are numerous. For example, navigating through cold, dark, and confined spaces is a slow process and requires caution as numerous hazards exist (e.g., unstable rock above your head and below your feet). Sometimes working in a cave is downright uncomfortable and involves crawling through sticky clay and murky water. Despite these challenges, field work in such an environment is rewarding. This project has resulted in the discovery of numerous mineral seeps and other depositional environments that are ideal for studying the environmental geochemistry of iron and manganese.

Figure 1. Entry into Pautler Cave is difficult and requires a vertical decent followed by a horizontal crawl through a narrow pipe.

Iron and Manganese Minerals Form in Multiple Cave Settings

Caves are uniquely conductive to iron and manganese oxide mineral formation because they introduce oxygen into typically oxygen-free aquifers. This results in large chemical gradients at the walls of the cave and causes the oxidation (often microbially-mediated) of dissolved Fe^{2+} and Mn^{2+}, producing iron and manganese oxide minerals, respectively. These minerals form in two distinct settings: precipitation of iron and manganese where groundwater enters the cave passage (seep deposition) and direct deposition in the streams that run along the floor of the main cave passages. Both iron and manganese oxides are found

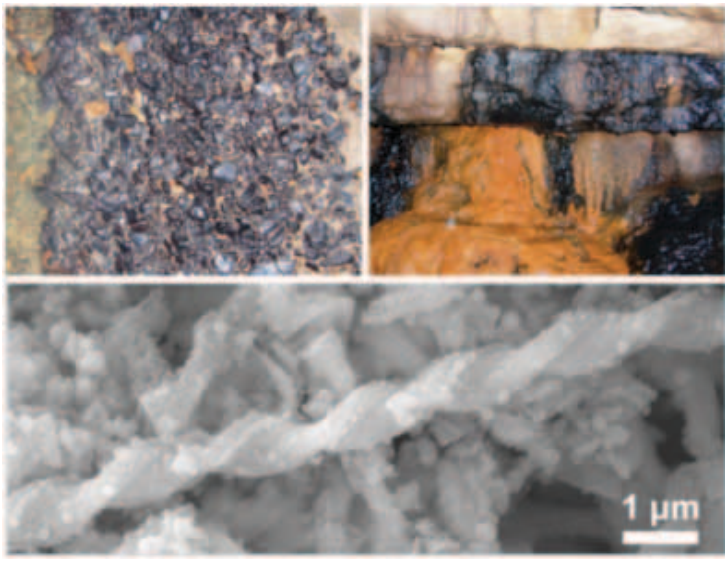

Figure 2. Manganese oxides are commonly found as coatings on chert stream cobbles (upper left). Iron and manganese are both deposited where groundwater enters the cave along limestone bedding planes (upper right). Bacterial stalks of the genus Gallionella (a known Fe^{2+} oxidizer) are found in Fe oxide deposits.

at seep deposits as granular masses whereas only manganese precipitation is apparent near cave streams, typically as coatings on stream cobbles (Fig. 2).

Stable isotope measurements of seep and stream water show that the two waters' sources are ultimately derived from local meteoric precipitation; however, seep water remains in the subsurface for several years prior to entering the cave whereas stream water has a subsurface residence time of less than one year. Differences in fluid chemistry also exist between seeps and cave streams. Seep water has a lower pH and dissolved oxygen content than cave stream water but has higher concentrations of dissolved iron and manganese. Trace element contents in water samples show little variability regardless of location. Conversely, substantial compositional differences are found in mineral samples depending on mineral type and depositional environment.

Water Filtration by Iron and Manganese Oxides

We have found that iron and manganese oxides in the cave are scavenging trace elements, many of which are natural water contaminants, from water flowing into the cave at groundwater seeps and along the cave streams. The manganese oxides contain greater quantities of trace elements than iron oxides. The manganese oxides in the cave differ depending on where they form, with those found at seep deposits being more crystalline but having lower trace element contents compared to those formed along the cave stream. The differences in crystallinity and trace element contents between manganese oxides formed in seep and stream deposits can be traced to differences in water chemistry at these two sites. Waters at the seep deposits have greater concentrations of dissolved Mn^{2+}, which reacts with the manganese oxides in a way that alters their structure and reduces their capacity to bind trace elements. The manganese oxide minerals along the cave steams have the greatest effect on the water composition, filtering out many trace elements before the cave stream exits the karst system as a spring.

Further reading

Frierdich, A. J., Hasenmueller, E. A., and Catalano, J. G. (2011) Composition and structure of nanocrystalline Fe and Mn oxide cave deposits: Implications for trace element mobility in karst systems. *Chemical Geology* 284, 82-96.

Figure 3. EPS graduate student Alison Beehr examines some unusual speleothems.

For more information about the department and a listing of our faculty go to eps.wustl.edu

Credits

Editors

Margo Mueller • Doug Wiens

Contributors

Andrew Frierdich • Doug Wiens
Randy Korotev • Philip Skemer

Podosek retires

Dr. Frank Podosek, Professor in Earth and Planetary Sciences, retired from active teaching on June 30, 2011 and is now a professor emeritus. Even though he and his wife, Joyce, have relocated to Texas, Frank will continue to serve as the executive editor of *Geochimica et Cosmochimica Acta*. Frank graduated from Harvard College in 1964 and went on the complete his doctorate degree in physics at the University of California, Berkeley in 1969. After 4 years as a research fellow in physics and senior research fellow in Planetary Sciences and Physics at the California Institute of Technology, Frank joined the faculty at Washington University as an assistant professor in 1973. Dr. Podosek has had a long and illustrious career in isotope geochemistry and cosmochemistry. He is a world-renowned expert in the field and has taught at institutions in Japan, Britain, Germany, Switzerland and France as a visiting professor or scientist. Frank was elected as a fellow of the Meteoritical Society and is a veteran of numerous NASA review panels. Fortunately for us, he plans to continue his cosmochemistry collaborations with Fred Moynier so we will see him in the future.

Morris named adjunct professor

Richard V. Morris has been named an adjunct professor in the department of Earth and Planetary Sciences. Since 1973 Dr. Morris has been employed at the NASA Johnson Space Center where he established, manages, and conducts research in the Spectroscopy/Magnetics Laboratory. His current focus is on the chemical and mineralogical state of the martian surface and its evolution through time using spacecraft observations and laboratory analysis of Mars analogue samples. As a Co-Investigator on the MER 2003, MRO CRISM 2005, Phoenix Scout 2007, MSL CheMin, and MSL SAM 2011 missions, Dr. Morris is active in the robotic exploration of Mars. Mission activities include pre-launch flight instrument calibration (including use of analog samples), landed operations, and data analysis. His studies of lunar samples resulted in development and measurement of the de facto standard index for lunar soil maturity (Is/FeO). Dr. Morris has received the NASA Outstanding Achievement Medal (2010) and the NASA Outstanding Scientific Achievement Medal (2011) for his contributions to Mars geosciences. In our department he heavily collaborates with Profs. Ray Arvidson and Brad Jolliff on Mars research from the MER mission and the MRO mission.

Fike wins award at GSA

David Fike received a 2011 Outstanding Contribution Award from the Geobiology and Geomicrobiology Division at the Geological Society's annual meeting in Minneapolis this October. The award was given for exemplary scientific contribution for using stable isotope analyses to improve our understanding of ancient and modern environments.

Wang is co-convener for conference

Alian Wang was one of the two co-conveners for a new conference held in October in Beijing, China. "2011 International Forum on Planetary Sciences and Explorations" was sponsored by the China National Aerospace Administration, Ministry of Land Resources of China, the Chinese Academy of Engineering and the Chinese Academy of Sciences. The conference was a great opportunity for the Chinese planetary science community to exchange ideas, experiences and future plans with planetary scientists of other countries. The invited speakers were from the United States, France, India and Japan and included our own Brad Jolliff, the Rudolph Chair in Earth and Planetary Sciences.

Moynier wins Nier Prize

Frederic Moynier was notified in August that he has been chosen by the Meteoritical Society to receive the Nier Prize for 2012. This award is given for outstanding research in the field of meteoritics and allied fields by a young scientist. It will be awarded at the annual meeting in Cairns in August, 2012.

Skemer invited to be workshop instructor

Philip Skemer was invited to be an instructor at a short-course for graduate and postgraduate students on texture analysis in Tromso, Norway. "Texture Analysis and Orientation Imaging" was the name of the workshop held October 10-14, 2011 at Tromso University. Phil lectured on texture development of olivine and seismic anisotropy of the upper mantle.

Arvidson keynote speaker at Terrain Vehicle Systems Conference

Ray Arvidson, the James S. McDonnell Distinguished University Professor, gave the St. Christopher Lecture at the 17th International Society of Terrain Vehicle Systems Conference in Blacksburg, VA. His lecture was entitled, "The Opportunity Mars Exploration Rover: Science and Mobility Highlights." Arvidson is the Deputy Principal Investigator for the Mars Exploration Rover Mission which is in its 7th year of operation on Mars.

Book Published

Bruce Fegley and Katharina Lodders have published their second book, *Chemistry of the Solar System*. The research book, which includes basic facts about the chemical composition of the solar system, will be published by the Royal Society of Chemistry. It will be distributed in the United States by Ingram Publishing Services.

Fabien Maillot, *Postdoctoral research associate*

Fabien Maillot spent his childhood in the suburbs of Paris, France. He received his master's degree in material science and inorganic chemistry from the University of Paris 6 Pierre and Marie Curie and Ecole Normale Superieure. Fabien will have just finished graduate studies also at Paris 6 University in physics, chemistry and materials in October of 2011. His concentration is in "environmental mineralogy." What Fabien likes best about being a researcher is having a "problem" and then finding the explanation. He enjoys solving the puzzles of those problems even though at times it can be frustrating. Come November 1, 2011 he will be working with Jeff Catalano studying the interaction of uranium and phosphate with various common soil minerals and determining their potential applications in cleaning up polluted areas. He is looking forward to learning new research methodologies and broadening his scientific knowledge in environmental mineralogy. In his spare time he enjoys playing games especially chess and poker.

Yanli Lu, *Laboratory assistant*

Yanli Lu spent her childhood in Dandong, in the Liaoning province of China. Dandong, a city of approximately 2.5 million people, is on the border between China and North Korea, separated by the Yalu River. She graduated with a bachelor's degree in physics from Liaoning Normal University. Yanli started working for Alian Wang in the planetary materials lab in February of 2011. What she likes best about her job is working with all the people in her group. Everyone is very cooperative and friendly. When asked what she likes best about St. Louis, she replied "the quiet." In comparing her former Chinese cities with St. Louis she finds the level of noise and congestion here much more to her liking. Being relatively new to St. Louis, she and her husband, Chuanxi Xiang, have yet to find a favorite place. In addition they have just welcomed Jack (Ru Xiang) into their lives so they are very busy with their newborn. When she is not otherwise engaged in child care, Yanli likes to shop for clothes and watch television.

Jolien Linckens, *Postdoctoral research associate*

Jolien Linckens grew up in Woerden, a small city about 10 miles west of Utrecht, Netherlands and about .9m below sea level. She attended Utrecht University where she studied Earth Sciences and received her master's degree in 2006. She completed her doctoral degree in geological sciences at Bern University in Switzerland in November of 2010 and started working for Phil Skemer in the rock deformation lab in January, 2011. Jolien especially enjoys working with the lathe and looking at microstructures of rocks. When conducting rock deformation experiments she likes reviewing the microstructure changes. Since she has been here about a year, her favorite places to visit in St. Louis are Forest Park, Kayak's and the City Museum. When Jolien is not crushing rocks, she loves looking at the squirrels in Forest Park, reading books and watching movies.

Hongwei Du, *Postdoctoral research associate*

Hongwei Du received his bachelor's degree in Chemistry in 1990 from the University of Petroleum, Shandong, China. After completing his master's degree in Applied Chemistry in 2001, he worked for three years as a materials research scientist in the Department of Chemistry at the University of Petroleum. Hongwei spent a year as a visiting scholar at the University of New Brunswick, Canada. He received his doctoral degree in Engineering with Micro/Nano- Fabrication and Micro/Nano- Electronic Devices emphasis from Louisiana Tech University, Ruston, LA, in November 2007. In 2008, he accepted a position at the Washington University Medical Center as a Postdoctoral Research Associate. Hongwei will join Alian Wang in November where he will assist in the development of hardware for the Mars Microbeam Raman Spectrometer (MMRS) to be proposed for a future mission to Mars. He will also join the planetary materials lab using the Raman for subservice environment and life investigation in the Chilean Atacama Desert. His favorite things about St. Louis are jogging in Forest Park, fishing, and working in the garden. When he is not working, he likes to work out in the gym, or play table tennis and basketball with his friends. He and his wife, Lanxiu Lu, have two children, a son, Zhongnan Du and a daughter, Annie Du.

Alumni News (or where they are now)

Harald Drewes (AB '52) of Lakewood, CO wrote to say he has been retired from the USGS for many years but had a career devoted to field studies in 6 western states and 2 foreign countries. Currently he does some teaching of local students and gives general public presentations.

Maurry Tamarkin (AB '61) will be retiring in May 2012 from Clark University where he has been teaching Finance since 1981. He remembers the EPS program of the 1950's and the concern shown for students during his time. He still has a fondness for the program.

Richard Young (PhD '66) the distinguished service Professor of Geological Sciences at SUNY Genesco is still working on the Grand Canyon/Colorado Plateau research that started with his dissertation in the 60's. His work has been featured in portions of two documentaries (National Geographic's "Naked Science" series and History Channel's "How the Earth was Made"). He also teaches a "Planetary Geology" course and keeps up with the entire Washington University faculty who are publishing such interesting planetary studies. Cheers to all his WU colleagues who share those years in the department.

Alumni: Join the alumni facebook page and communicate with old friends. Go to Facebook and search for Washington University Earth & Planetary Sciences.

Michael Fix (AM '75) was selected by the University of Missouri St Louis to receive the Emerson Outstanding Teacher Award in November of 2010. He is an Associate Professor of Geology in the Department of Physics and Astronomy at UMSL. He has taken part in a documentary titled "Prehistoric Chicago", a series that deals with prehistory of major US cities, and which has aired on the Discovery Channel, the Science Channel and Planet Green.

Mike Botts (AM '79) has left the University of Alabama in Huntsville after almost twenty years as a Principal Research Scientist. He is now working in his own business, Botts Innovative Research, Inc, on contracts to implement Sensor Web Enablement (SWE) within the defense and intelligence communities.

Patricia Jacobberger (PhD '82) has left her position as Chief of Global Change R & D for USGS and has taken the position of Senior Advisor for Inter-organizational Environmental Science at NASA where she works to coordinate international and interagency Earth Science activities. In her new post she led a team to develop the first draft of an Integrated Climate Observation Plan for the nation. Currently she is leading a self-study of the international Committee of Earth Observing Satellites (CEOS).

Shelley Petroy (PhD '91) is now a Senior Manager, Business Development with Ball Aerospace in Boulder, CO and is supporting mission development for intelligence, surveillance, and reconnaissance (ISR) systems. Her husband, **Dave Petroy (MS '88)** has accepted a position with Golden Aluminum of Ft. Lupton, CO as Energy Efficiency/ Sustainability Manager. This new position combines his experiences working in the renewable energy field and his passion for environmental conservation.

Richard H. Becker (AM '94) is now an Assistant Professor at the University of Toledo in the Department of Environmental Sciences. His research interests include environmental applications of remote sensing and GIS including: land subsidence, toxic algal blooms and groundwater resources.

Lisa-Anne DeGregoria Kelly (AB '95) is a Conservation Education Research Scientist at the Chicago Zoological Society's Brookfield Zoo.

Ellen Wilson (AB '98) has joined the faculty of the University Library at the University of South Alabama in Mobile, AL. This year she was awarded the Excellence in Librarianship award at USA. Ellen's article "Integrating Information Literacy Instruction in an Upper-Division Writing Intensive Course" was published in the Fall 2010 issue of The Southeastern Librarian.

Ian Clark (AM '98) is still pursuing his passion for teaching. He is in his fourth year at Hopkins School in New Haven, CT. He recently joined the science faculty there after teaching mostly math. He is teaching earth science to 7th graders and intro to physics and chemistry to 8th graders.

Erin Marnocha (AB '01) is working as a postdoctoral researcher with the Institute of Ecological Monitoring and Management at San Diego State University.

Nigel Davies (AB '03) finished his Masters Degree from Western Washington University in 2011 and is currently a Scientific Instructional Technician in Geology at Eastern Washington University in Cheney, WA, teaching undergraduate geology students. He loves the northwest and living close to Spokane.

Bethany Ehlmann (AB '04) is now an Assistant Professor of Planetary Sciences in the Division of Geological and Planetary Sciences at the California Institute of Technology, Pasadena, CA. She also has a joint appointment as a Planetary Scientist at the Jet Propulsion Laboratory.

Ryan Zeigler (PhD '05) has recently left his research scientist position at Washington University for warmer environments. In September of 2011 he accepted a position with the NASA Johnson Space Center in Houston, TX, working as a planetary scientist in the astromaterials acquisition and curation office.

Frank (PhD '05) and **Kim Seelos (PhD '06)** are still gainfully employed at JHU/APL in Maryland in the guise of planetary scientists. This year they accepted NASA Group Achievement Awards for their tactical and science team involvement with the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) project. They welcomed daughter #2 into the family, Lydia, who was born in Nov., 2010. Her big sister, Eleanor, is turning three this year.

Aine Steiner (AB '07) completed her Master's Degree in Geotechnical Engineering at the University of California Berkeley in May. She is working for Cornforth Consultants, a company in Portland, OR that specializes in landslide hazard assessment and remediation.

Johanna Kieniewicz (PhD '07) has left academia (Denison University) and is pursuing a career at The British Library in London, UK. Her position involves building relationships with research councils, government officials, academics and others in environmental sciences to deliver improved online access to environmental science information. While she loves London, she admits the winters are very dreary.

Emily Park (AB '08) is finishing her master's program in geophysics at Boise State University and job hunting in Cleveland, Ohio. She and Brian Lewis (also Wash U) got married this past June and are living in Cleveland where he is attending medical school.

A. J. Singletary (AB '08) is working as the International Advisor for Energy and Environment at the US Federal Aviation Administration in Washington DC. He is reviewing sustainable fuels for aviation, aircraft fuel efficiency, international air emission standards, noise regulations at airports and international negotiations on climate change mitigation.

David Mayer (AM '09) moved to Worcester, MA and began working on his PhD in Geography at Clark University. His research integrates remote sensing and field-based biogeochemical observations to improve our understanding of feedbacks between permafrost and climate in eastern Siberia. This summer he went with his advisor on board the US Coast Guard icebreaker, *Healy*, as part of the NASA ICESCAPE mission to study the biogeochemistry of the Chukhi and Berfort Seas. It was an amazing experience to spend time in the Artic polar cap.

Manavi Jadhav (PhD '09) accepted a postdoctoral research fellowship at the Hawai'i Institute of Geophysics and Planetology in September of 2010. Her work involves isotope analyses of presolar grains in order to better understand their stellar origins.

Brittany Huhmann (AB '10) started her master's in Environmental Engineering and Science at the University of Iowa this fall. After graduating from Wash U., she spent time on an organic farm in Pennsylvania and volunteering at a Catholic worker house in Youngstown, OH. In May, 2011 she spent two months in Ecuador working in a local organic agriculture collective.

ALUMNI, VISIT US THIS DECEMBER

Fall AGU Meeting
San Francisco
Department and Alumni Reception
Jillian's@Metreon

101 Fourth Street
San Francisco
Tuesday
Dec. 6, 2011
5:30 to 7:30 PM

Washington University in St. Louis

Department of Earth & Planetary Sciences
Campus Box 1169
One Brookings Drive
St. Louis, Missouri 63130