ALUMNI NEWSLETTER
2014

From Our Department Chair 2

Faculty
News.......................................................... 4
Research grants........................................... 9
Visiting scientists and staff................................ 10
Study abroad program................................. 11
News releases.............................................. 15

Visiting Speakers 16

Field Camp
Field course..................................................... 17

Students
Undergraduate research program.................. 19
Geology club..................................................... 20

Photo Gallery
Chile study abroad........................................ 21
Field trips....................................................... 22
Field camp...................................................... 23
Research......................................................... 24

Students
Undergraduate degrees, awards and scholarships.......................................................... 25
Student chapter of AEG-AAPG.................. 26
Graduate degrees............................................. 27
Graduate scholarships, grants and awards.... 28
Student awards.............................................. 29
Publications and presentations...................... 31

Development Activities
Contributions..................................................... 33
Endowments...................................................... 35
Enhancement/retention awards..................... 37
Board members................................................. 38
From our board chair...................................... 39

Alumni
News.......................................................... 40
In memoriam.................................................. 42

Study Abroad Program
Spain 2016.................................................... 44

Roster

Assistant Professors
John W. Huntley (Virginia Tech, 2007)
Paleontology and Paleocology
James D. Schiffbauer (Virginia Tech, 2009)
Paleontology and geochemistry

Associate Professors
Martin S. Appold (Johns Hopkins University, 1998)
Hydrogeology
Robert L. Bauer (University of Minnesota, 1982)
Precambrian geology
Francisco G. Gomez (Cornell University, 1999)
Paleoseismology and neotectonics

Professors
Cheryl A. Kelley (University of North Carolina, 1993)
Aquatic geochemistry
Mian Liu (University of Arizona, 1989)
Geophysics
Kenneth G. MacLeod (University of Washington, 1992)
Paleontology and biogeochemistry
Peter I. Nabelek (SUNY, Stony Brook, 1983)
Trace-element geochemistry
Eric A. Sandvol (New Mexico State University, 1995)
Seismotectonics
Kevin L. Shelton (Yale University, 1982)
Economic geology
Michael B. Underwood (Cornell University, 1983)
Sedimentology
Alan G. Whittington (Open University, 1997)
Crustal petrology

Director of Field Studies
Miriam Barquero-Molina (University of Texas, 2009)
Field methods

Professors Emeriti
Raymond L. Ethington (University of Iowa, 1958)
Conodont biostratigraphy
Thomas J. Freeman (University of Texas, 1962)
Carbonate petrology
Glen R. Himmelberg (University of Minnesota, 1965)
Chemical petrology
William D. Johns (University of Illinois, 1952)
Clay mineralogy

Staff
Tammy Bedford, office support assistant IV
Marsha Huckabee, business support specialist II
Carol Nabelek, research chemist
Stephen Stanton, library information specialist II

On the cover: Master’s student, Jamie Russell, surveying the geology of Chile on the road to El Salvador.
From Our Department Chair . . .

The MU geology department continues to be an exciting place. As I begin my 13th year on the faculty, and my first as department chair, I have been reflecting on how things have changed over the past decade. I’ll take the opportunity to share some highlights here, which might explain my optimism for the next decade.

Our undergraduate program now has approximately 70 declared majors, more than at any point in the past 12 years, and we are starting to encounter the welcome problem that some courses need to be moved into bigger classrooms. The departmental scholarship funds that our alumni have supported are vital in allowing us to recruit and retain some of the best students on campus. In addition to the departmental scholarships, the department’s undergraduate research program supports several students every year as they work on senior theses.

For example, during spring break undergraduates Jordon Beem and Timothy Robertson conducted complementary senior thesis research projects at the Holocene lava flows of the Cima volcanic field in California’s Mojave Desert. Jordon is working with Paco Gomez on 3-D mapping of the flows, while Tim Robertson is doing experiments to determine the physical properties of the lavas. Another four undergraduates and the two graduate student development board members came out to assist, and afterward, Paco took the group to Death Valley National Park. Everyone learned a lot about the regional geology and about surviving in the desert.

Since it was established in 2007, the undergraduate research program has enabled many of our best undergraduates to pursue independent research projects that allows them to work closely with an advisor in the same way as our graduate students. This kind of experience is increasingly important in the graduate school application process, and many of our senior thesis students have gone on to enter top graduate programs around the country—including our own, naturally! Students write a proposal for up to $3,000 in research expenses, which comes from the generous donations of our alumni and friends, and allows them to conduct one- or two-semester projects without requiring the long and uncertain process of seeking external funding.

Our graduate program continues to recruit top talent from universities around the nation and the globe. This year’s incoming graduate students completed their previous degrees in California, China, Kentucky, Minnesota, Missouri, New York, Spain, Tennessee and Turkey. We now have about a 50-50 mix of doctoral and master’s students, which is a big change over the past decade. Some of this is due to graduating master’s students continuing directly into the doctoral program, which three students did this year. The growing number of doctoral students in the department reflects the faculty’s increasing research intensity and their success in securing external funding. It also results in a slower turnover of the student population and more time for students to write scientific papers based on their results. The long list of student-authored publications on Page 31 is a significant pride point for the department, especially given the quality of the journals. In addition to the many poster presentations given at national conferences, many of our doctoral students are being selected to give oral presentations, which is a great way for them to achieve national visibility and reflects the quality and importance of their research.
Most master’s students and some doctoral students are supported on teaching assistantships, which we supplement with graduate student scholarships made possible by the generous support of alumni and friends. These scholarships enable us to compete successfully with our peer universities and recruit great students. Our graduate students have always done well finding jobs in industry and academia. Last academic year in the department, we had four recipients of the Huggins scholarship – highly prestigious and competitive university-wide awards offered to exceptional incoming doctoral students. Our doctoral graduates this past year included Savas Ceylan, now a postdoc at Southampton University in the UK; Frank Calixto Mory, now a postdoc at the University of Alberta; Geneviève Robert, now assistant professor of geology at Bates College in Maine. This year we are advertising to hire a tenure-track assistant professor in the general area of structural geology and tectonics. We are seeking an individual whose research will complement and expand upon one or more of the department’s existing strengths in solid-earth processes including geodynamics, igneous and metamorphic petrology, neotectonics and seismology. The department has built a strong reputation for research and student training in structural geology and tectonics, and this hire should ensure continuity well into the future.

At the undergraduate level, our reputation stems primarily from the Branson Field Camp, which we are all proud to report won the 2014 GSA/ExxonMobil Field Camp Excellence Award (Page 18). Our camp attracts students nationwide, including schools in California and New York, as well as our more traditional recruiting grounds in the midwest and Texas.

We are currently raising funds for a new automobile bridge at camp, which will be able to accommodate Lander’s fire trucks. We have too big an investment to risk losing it to another fire in the canyon, as nearly happened in 2013. Through a recent alumni bequest, gifts to the Camp Branson improvement fund will be matched 1 to 1, through the end March, 2015. Thank you to donors to our Camp Branson funds who enable us to keep it a premier destination for geologic field training!

In short, the department is thriving. This is no mean accomplishment in the current fiscal climate, and it would not be possible without the help of our alumni and friends. On behalf of the students, faculty and staff I would like to thank every one of you who continue to support the department through your annual gifts.

On a personal note, I would also like to thank outgoing chair Kevin Shelton, both for his 10 years of service to the department, and for teaching me the ropes and helping to make the transition as seamless as possible.

I hope you enjoy the Newsletter. Please keep us informed of your activities, and please “like” us on Facebook at “MU Geology” and “MU Geology Field Camp” to get more frequent updates on our activities.

Sincerely,

Alan G. Whittington
Chairman and E.B. Branson Professor

Alan hunting for magmatic enclaves in the Graniteville Granite, Elephant Rocks State Park, Mo.
Faculty News
(In their own words)

Martin Appold’s research is focused on numerical modeling of subsurface fluids and analysis of fluid inclusions to understand the origin of mineral deposits. Doctoral student Ajit Joshi completed a study of the origin of overpressure in sedimentary basins and its implications for the formation of solitary waves. New master’s student Bulbul Ahmmed began a project modeling the effects of injecting CO2 into a hydrocarbon reservoir in the Farnsworth field in northern Texas as part of an enhanced oil recovery and carbon sequestration effort. New doctoral student Joshua Field began a study of fluid inclusions in trace occurrences of Mississippi Valley-type Zn-Pb mineralization in the U.S. mid-continent in an ongoing effort to identify factors that control large-scale ore formation. Abdelsalam Hassan completed his master’s degree and a study of fluid inclusions in the Vazante non-sulfide zinc deposit in Minas Gerais, Brazil. Undergraduate student Emma Rosenow spent the summer building a 3-D geologic model of the Beowawe, Nevada geothermal field that will be used to build a reactive transport model. Martin taught Groundwater Hydrology, Groundwater Modeling, and Principles of Geology last year. In addition, with the help of graduate student Elizabeth Gammel, he continued work on redesigning the online version of Principles of Geology.

Bob Bauer worked in the field with students and continued to teach at Camp Branson this past summer. He spent three weeks working in the field with graduate student Jamie Russell, who is completing his master’s thesis, and undergraduate student Sam Glasscock, who completed his senior thesis in the Wind River Range last spring and served as Jamie’s field assistant. Jamie’s work involves geologic mapping and structural analysis of Lander-Hudson Dome and fracture modeling associated with the deformation that produced Hudson Dome and a series of folds that refold the northern part of Hudson Dome. Sam’s senior thesis involved fracture analysis across Derby Dome and part of the Dallas Dome–Derby Dome interchange. Jamie’s research was supported by a grant from the U.S. Geological Survey and a department award from the Keller Opportunities for Excellence Fund. Sam’s work was funded by the department’s undergraduate research fund. Bob continues to serve as the department’s director of graduate studies, and coordinated graduate recruiting and applicant admissions. We continue to attract highly qualified international and domestic applicants across the spectrum of our geology sub-disciplines. Bob’s courses last year included Structural Geology, Advanced Structural Geology and Field Camp. This fall Bob is teaching Continental Tectonics. Bob has also been actively involved in the MU Campus Writing Program, serving as the chair of the MU Campus Writing Board for the past year, and presenting workshops for faculty members who are new to the program. Last spring Bob and two other professors received a grant to set up a year-long system of mentoring for new faculty to assist in their development of upper-level writing-intensive courses.

Miriam Barquero-Molina had a very busy (and, she’d like to think, productive) 2013-14 year in our department. During the fall semester she taught Planet Earth and co-taught, with Bob Bauer, our study abroad course on Volcanology and Mountain Building Processes in Chile. Although teaching the class was a significant time commitment, managing the logistics for the actual trip to Chile kept Miriam on her toes, and on the phone, for most of the fall semester. Turns out making hotel reservations for 25 people in far flung corners of the planet can be a bit of a challenge. Our study abroad to Chile extended into Winter Intersession 2014, when the actual trip to Chile took place, and Miriam, Bob, 18 undergraduates and five graduate students flew from the cold, bleak Midwestern winter and into the sunny, ocean kissed, geologic wonder that is Chile (and it didn’t hurt that it was summer down there). The class, and the trip, were a fantastic learning experience for all involved. We saw a range of geologic features that we never could have reached in the U.S. or anywhere in the world, for that matter. We witnessed firsthand the importance that geologic resources (particularly copper mining) have in the overall economy of Chile. We visited the largest open-pit copper mine in the world. We learned about the indigenous people of Chile, their history and their struggles, past and present. We experienced the warmth, humor, generosity and willingness-to-help of the Chilean people. We learned to appreciate pisco sour. We fell in love with Chile. You can read more about our Chilean adventure on our account of the semester-long class and trip that follows in this Newsletter.

Ray Ethington and collaborators from elsewhere continue to revise a projected manuscript dealing with the conodonts from the Lehman, Watson Ranch and Crystal Peak formations that underlie the widespread Eureka Sandstone in the Utah-Nevada border region. The original intent was to identify a horizon that could be used as a local boundary between the Sauk and Tippecanoe sequences. Additional sequences made this year to fine-tune our data caused us to widen the objective of the project and we hope to finish it soon. Work continues on collections from the Midwest, Rocky Mountains and Great Basin as time and commitment permit. In mid-September Ray and Dave Clark, a colleague of 50 years, headed out near the foot of the
Oquirrh Mountains in central Utah and revisited an unfinished project begun 60 years ago. And yes, 2014 has provided numerous opportunities to rain on the parade of people who asked for confirmation that they had found dinosaur bones or fossil eggs in Boone County, Missouri.

Tom Freeman will be assisted by both sons (of Polaris and Trade Wind Energy) and attend the Geological Society of America meeting this fall in Vancouver. Tom has provided an exhibit booth at several meetings featuring his manual, Geology Field Methods. It has been a pleasure meeting and visiting with students and teachers who have used his manual. In addition, John Wiley & Sons continues to handle Geoscience Laboratory 5ed and Environmental Geology 2ed, the latter of which is now the first to include a sensible approach to illustrating climate change.

Paco Gomez and his neotectonics research group had a busy year. In the classroom, Paco taught his regular courses on physical geology (for undergraduate science and engineering majors) and surficial geology (undergraduate), as well as a “Themes in Geology” section about the pros and cons of earthquakes and volcanoes. Doctoral student Sean Polun started his research on extensional tectonics in the Afar, and master’s student Sarah Smith is constructing a 3-D structural model of the southwestern Palmyride Mountains in Syria for her thesis research. Two new master’s students are joining the group this fall: Ramazan Ertugrul (sponsored by the Turkish Petroleum Company), and David Horrell. Also, Jordon Beem, an undergraduate student, is conducting undergraduate thesis research on microtopographic roughness of lava flows using aerial photos and radar imagery. Field work over the past year has involved a number of domestic sites including the Mojave Desert (lava flows) and Yellowstone National Park (geyser deformation). In addition, Paco has been conducting field work on rock falls, landslides and rock glaciers in Colorado in collaboration with colleagues from the department of civil engineering.

Glen Himmelberg reports that he is still in the math department.

John Huntley has had a successful year for research. A study quantifying time averaging on the modern Brazilian shelf with American and Brazilian colleagues was published earlier this year in Quaternary Research. A stratigraphic paleoecological analysis of a candidate Middle Pleistocene GSSP in the Crotone Basin of southern Italy was published with Italian colleagues in Palaeogeography, Palaeoclimatology, Palaeoecology. A new analysis of the modern geographic and environmental distribution of parasite and predation traces on mollusks of the northern Adriatic and the implications for temporal trends of biotic interactions with an Italian colleague has been available online in Paleobiology beginning in September. Through the kind support of the University of Missouri Research Council, John was able to conduct fieldwork in Italy with colleague Daniele Scarponi at the Università di Bologna. They collected Pleistocene mollusks in the foothills of the Apennines as well as living and somewhat recently dead mollusks along the Po Delta, Venice Lagoon and tourist beaches. Additionally, through the support of the Alexander von Humboldt Foundation, John was able to spend eight weeks in Erlangen, Germany, working with colleagues Kenneth De Baets and Franz Fürsich. During this time John wrote and submitted a manuscript analyzing parasitism of Holocene bivalves and the implications for the future of disease in the context of anthropogenic climate change, submitted a NSF CAREER proposal, began writing an invited manuscript for a special issue of Advances in Parasitology, initiated a collaborative database on the Phanerozoic record of parasitism, made plans for studying parasites of Paleozoic sharks, and examined for parasitic traces the extensive collection of exquisitely preserved Lutetian mollusks in Paris’ Museum National d’Histoire Naturelle. He is now focusing on instructional themes. John’s three-year-old daughter Lydia began preschool this fall, leaving her parents both proud and a little teary-eyed.

Bill Johns has lived in Minneapolis for the past year and is very happy there. Minneapolis is a fun city with cultural happenings every day and evening. Bill says to come and visit when you can.

Cheryl Kelley and graduate student, Claire Beau-doin, have stayed busy researching the microbial processes occurring in hypersaline ecosystems. In March, Claire traveled to Baja, California with colleagues from NASA Ames Research Center to conduct experiments to further explore methane oxidation rates in these salty places. She presented some of that work at the Midwest Geobiology Symposium held in Chicago in September. While in Baja, along with being busy sampling salt ponds, Claire also went on a whale-watching trip to see the large number of gray whales that use the Laguna Ojo de Liebre as a nursery for their young. Hundreds of whales and their babies in one small lagoon is quite a sight! Claire is currently writing her thesis, which she hopes to defend by December. Cheryl has been busy writing, too. She presented some of the 13C-labeled methane isotope work in June at the Joint Aquatic Sciences meeting in Portland, Oregon and will present
more methane data at the fall AGU meeting in San Francisco in December. In the classroom this past year, Cheryl enjoyed teaching Global Water Cycle and Low Temperature Geochemistry in the fall semester and an honors section of Earth Systems and Global Change in the spring.

Mian Liu and students have been working on earthquakes and active tectonics in China, Japan and the U.S. On April 20, 2013, an Mw 6.6 earthquake ruptured the southern segment of the Longmenshan fault, killing 200 people and injuring thousands. The central and northern segment of the same fault ruptured in 2008 in the Mw 7.9 Wenchuan earthquake, killing about 90,000. Mian and students reviewed the hazard assessments conducted by various research teams in the world following the Wenchuan earthquake. They found that the commonly used methods, relying mainly on earthquake-induced stress changes, do not produce a satisfactory forecast for the 2013 Longmenshan earthquake. A better assessment would have been made by combining stress analysis with a balance of seismic moments on the fault. In another study, Mian and Cheng Jia, a visiting scholar, studied the impact of the 2011 Tohuku, Japan, earthquake (Mw 9.1) on seismicity in eastern China. They found that in spite of the significant coseismic crustal displacement in much of eastern China, seismic activity there changed little by the Japan earthquake. On the student side, Feng Lin finished a master's degree on numerical modeling of continental extension in North China, and has moved to Houston to join the petroleum industry. Jiyang Ye is finishing his doctoral dissertation on the geodynamics of faulting and fault evolution in California and China. He will start his postdoctoral work at the University of Alberta at Edmonton, in January! Bring a thick blanket, Jiyang. Megan Brown is making good progress in her study of injection induced seismicity in Utah, and will present her results at the AGU meeting in San Francisco this fall. This year, four visiting scholars (Yujun Sun, Cheng Jia, Chen Shi, and Xiaojun Cai) finished their work here and returned to China, while Yuhang Li has arrived here from China Earthquake Administration’s Geodetic Center in Xi’an, and another Chinese scholar will arrive soon.

Ken MacLeod continues to work on paleontological problems informed largely by stable isotopic analyses. Ordovician field work in Alabama with Page Quinton and students and colleagues from LSU and George Mason University spanned the range from urban (working the Red Mountain Expressway road cut in Birmingham) to rural (the Tidwell Hollow section near Oneonta), and resulted in the collection of an excellent suite of samples. The first results from this work will be presented at GSA in Vancouver. Upcoming Cretaceous fieldwork with Shannon Haynes and colleagues from the Smithsonian Institution will extend the range of Ken’s recent field experiences to rural SE Tanzania. The stable isotope lab also continues to generate excellent data. All instruments are showing their age and increasingly need pampering and maintenance. However, through the efforts of Cheryl Kelley, Shannon Haynes, Ken, students, service technicians, and helpful Ace Hardware workers, we muddle along in adapting 21st century American hardware to replace worn 20th century German parts. Ken’s students have been quite productive in the past year. In addition to the above mentioned fieldwork, Page spent a week in the field in Iowa and Minnesota, passed her comprehensive exam, published a first authored paper, has a second in review, was invited to give a colloquium at George Mason University, and will give a talk at the GSA annual meeting. Shannon passed her comprehensive exam, spent two weeks in Ellen Martin’s lab at the University of Florida measuring neodymium isotopes on Late Cretaceous fish debris, has a first authored paper in press, and will also give a talk at GSA. Damon Bassett continues to teach at Missouri State University and our field camp. He presented at last year’s GSA meeting in Denver. Finally, undergraduate Gretchen O’Neill completed a senior thesis supported by both the department and the A&S undergraduate research mentorship. Her topic was temperature change across the Cretaceous/Tertiary boundary, and she presented her results at the Missouri Academy of Sciences meeting last spring.

Peter Nabelek continued modeling studies of metamorphic fluid flow in contact and metamorphic regional terrains. He also collaborated with colleagues from the Geological Survey of Canada to study the consequences of metamorphic CO2 degassing during sill emplacement into a Proterozoic sedimentary basin on Victoria Island in the Canadian Arctic for global climate changes in the past. Peter’s graduate students continue to do exciting igneous and metamorphic research. Yanying Chen is doing her doctoral dissertation to model metamorphism and deformation of contact aureoles in the Mesozoic White-Inyo magmatic arc in California. Elizabeth Gammel transitioned from her master’s thesis on the roles of Li, B and other fluid-soluble elements on crystallization of pegmatites to study the petrogenesis of calc-alkaline plutons in the White-Inyo Range for her doctoral dissertation. Ashraf Gafeer, for his doctoral dissertation, is using trace element and isotope chemistry to determine the sources of Tertiary lavas in Libya, including the deep Sahara desert. New master’s student, Eric Nowariak, who came from Winona State University, and Antonio Manjón-Cabeza Córdoba, a Fulbright scholar from Spain, will pursue
metamorphic studies on the margin of the Wyoming Archean province.

Eric Sandvol and the seismology research group have continued working on the large amounts of data from Northern China, Andean and Tibetan plateau. They have continued to service and maintain our 71 seismic broadband network in central Turkey as a part of the Continental Dynamics Central Anatolia (CDCAT) project. Savas Ceylan, Katrina Burch, and Eric worked with colleagues from the University of Arizona over the past year in order to make sure that all of the seismic stations are running properly. This past year he had three students successfully defend doctoral theses. Savas Frank Calixto-Mori defended his thesis in February and moved on as a lecturer at the University of South Hampton. His thesis developed some new images of shear wave velocity for the eastern half of the Tibetan plateau. These models are helping us to better understand the mechanisms for the uplift and growth of the Tibetan plateau. In addition to this work, Savas has done important theoretical work on the resolution capability of recent surface wave tomography methods. Savas has found that we are able to resolve structure that is a fraction of the wavelength of teleseismic surface waves. Gleb Skolbeltsyn defended his thesis work on putting together a new model for the evolution of the eastern Anatolian plateau. Gleb has also finalized his work on analyzing shear wave splitting data in Turkey, Georgia, and Azerbaijan and has found that the slab he has apparently discovered is having a significant effect on mantle flow. Frank Calixto-Mori defended his thesis on seismic wave imaging of the PUNA array. He has also finalized his work on the seismic attenuation of the Peruvian crust. This work is very important for determining the seismic hazard of this very tectonically active country.

James D. Schiffbauer and his students have had a busy and productive year with research. Back in the spring, they drove more than 21 hours straight in pouring rain for nearly 800 miles, to the 10th North American Paleontological Convention in Gainesville, Florida, where each gave successful and well-received presentations. This summer, Jim sent his current master’s students, Tara Selly and incoming student Gretchen O’Neil (BS, 2014) to Las Vegas to work with a colleague at UNLV through generous assistance from the Richard P. Frey Memorial Paleontology Fund. This work was preliminary field assessment for Gretchen’s proposed master’s thesis, studying some of the earliest biomineralizing animals known from the fossil record - tube worms found in the 555 million-year-old Esmerelda Group in Nevada. Jim’s doctoral student, Jesse Broce, has published his first, first-author paper this year in the Journal of Paleontology, a thematic issue on the Ediacaran–Cambrian transition edited by Jim and Shuhai Xiao from Virginia Tech. This special issue has received great attention and publicity across the paleobiological sciences and beyond. In fact, a university press release on Jesse’s paper made the rounds at all of the major news outlets, from NBC News to the Huffington Post and the Association of American Universities news outlet, Futurity. Jim and Jesse even had a short spot on NPR. This past summer, Jim and Jesse, along with colleagues at the University of Delaware and Virginia Tech assembled a review paper on the process of fossil preservation through phosphatization, one of the only pathways to preserve subcellular structures, which will appear in the Paleontological Society’s Special Papers, volume 20, slated for release in October. Both Jesse and Tara are working on manuscripts at the moment, so the group is hopeful they will have more exciting news to report in the near future. In addition, Jim is mentoring current undergraduate student Teresa Avila on her senior thesis research - an exciting project on eophenotypy. Since the start of 2014, Jim has had a total of 11 manuscripts accepted for publication or published, another three currently in review, and a few more in various stages of writing, with topics ranging from description of late Ediacaran trace fossils and embryos to melt inclusions and Missouri ore deposits. At home, Jim’s son, PJ, now 2-1/2, has continued his vocabulary growth - from his favorite word reported last newsletter as dinosaur to his new favorite, Pachycephalosaurus. Even with such a great foundation in paleontology, PJ seems to be most excited these days about playing with drums and trucks.

Kevin Shelton completed his second five-year term as department chair and is on a well-deserved research leave during the 2014-15 academic year. He is spending his leave working on several manuscripts and conducting fieldwork in northern Canada and southern Missouri. Master’s student Danielle Cavender spent the summer in Houston as an intern with Conoco-Phillips and returns to complete her studies of unusual Cu-Zn-rich ores in southeast Missouri. Kevin thanks the department office staff (in particular Marsha and Tammy) and alumni and friends of the department for the generous support he received as chair the past decade. He is especially grateful to his spouse, Lois, for her warm spirit and gracious good nature while hosting alumni dinners in their home. His daughter, Emily, graduated from MU in May and is enrolled in a master’s program in education while teaching second grade in Ashland, Missouri. His son, Ben, and daughter-in-law, Sarah, continue to thrive in Austin, Texas.

Mike Underwood devoted another year to the Nankai Trough Seismogenic Zone Experiment,
serving as a member of the project management team and specialty coordinator for lithostratigraphy and sedimentary petrology. IODP Expedition 348 was operational from late September 2013 into January of 2014, reaching a new world’s record for scientific ocean drilling of 3,056 meters below seafloor. One of our graduate students (Chen Song) sailed on the historic expedition as a sedimentologist. She was one of only three students from the United States to participate. Drilling to the plate interface (>5000 mbsf) is expected to resume in 2016. Mike attended various meetings in exotic places and taught three courses: Tectonics & Sedimentation, Physical Geology for Scientists and Engineers, and The World’s Oceans.

Alan Whittington started the year by spending a week in England celebrating his parents’ 50th wedding anniversary and 75th birthdays. In the fall, Alan co-taught Solar System Science. Emma Rosenow finished her senior thesis research on xenoliths in the 2010 lava flows at Pacaya volcano, Guatemala, and was one of many MU students to present at the GSA meeting in Denver. In January, Alan returned to Pacaya, with doctoral students Arianna Soldati and Alex Sehlke, and collected samples of active lava flows for comparison with the 2010 eruption. They then visited alumnus Geoffroy Avard (PhD 2010) who now works for the Costa Rica volcano observatory, and collected samples from Poás and Arenal volcanoes. This included an ascent of Arenal via the active fumarole field, which meant being blinded and choked by hot gas while trying to climb on crumbling altered lava. In the spring, Alan taught undergraduate Igneous and Metamorphic Petrology, and graduate Igneous Petrology. He spent spring break in the Mojave Desert with the family, Paco and many students. The family enjoyed a couple of nights in Death Valley afterwards. Late spring was busy with defenses, including Geneviève Robert (PhD) and former undergraduate major Tony Bollasina (MS). Geneviève (Geeves) is starting a faculty position at Bates College in Maine, and should be well prepared after getting a graduate minor in College Teaching as part of her studies at MU. Over the summer, Alan led the Yellowstone trip in the middle of field camp, again bringing the family, followed by a two-week tour of Wyoming, Utah and Colorado. In the first week Angela fell out of a raft in rapids on the Shoshone River, and in the second week she jumped out of an airplane over Moab, her first skydiving experience. They also saw a lot of dinosaurs and fantastic geology. August saw a quick trip to the Upper Peninsula of Michigan and the Kapuskasing zone of Ontario, with doctoral student Jesse Merrill, to collect some Archean lower crust. Master’s student Aaron Morrison joined the group in August 2014. Alan’s son, Hamish (7), went from being a non-swimmer to being a confident diver over the summer, while his son, Xander (10), just worked on improving his cannonball.
Graduate student Tara Selly conducting field work in Nevada. Tara is working on her master’s degree under the direction of Jim Schiffbauer.

### Active Research Grants

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<thead>
<tr>
<th>Organization</th>
<th>Name</th>
<th>Amount</th>
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<tbody>
<tr>
<td>American Chemical Society</td>
<td>Jim Schiffbauer</td>
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<td>Consortium for Ocean Leadership</td>
<td>Mike Underwood</td>
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<td>Department of Energy</td>
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<td>MU Research Council</td>
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### National Science Foundation

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<tr>
<td>Paco Gomez</td>
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<td>Paco Gomez</td>
<td>$290,000</td>
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<tr>
<td>Paco Gomez</td>
<td>$25,000</td>
</tr>
<tr>
<td>Paco Gomez with MU Geotechnical Engineering</td>
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### UM Research Board

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### U.S. Geological Survey

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Visiting Scientists

Laura Sanchez, from the Universite Blaise Pascal Clermont Ferrand is conducting research with Alan Whittington on the rheology of lava erupted in the Massif Central.

Yuhang Li, from the Geodetic Center of CEA is working with Mian Liu on crustal strain patterns and seismicity around the southern margins of the Ordos Plateau in China.

Office Staff

Marsha Huckabey and Tammy Bedford enjoy time at the fall welcome reception held in the department. Marsha recently celebrated her 28th year at MU. As a business support specialist II, she continues to excel at running the fiscal aspects of the department. She also works with our geology development board in their many activities throughout the year. Tammy joined us in February as our office support specialist IV. She balances a variety of tasks including monitoring grants, travel expense reimbursement, and assisting Bob Bauer, our director of graduate studies, and Miriam Barquero-Molina, our field camp director.
Variations in Mountain Building and Volcanism along the Chilean Andean Margin
by Miriam Barquero-Molina

It was early in the afternoon of Jan, 3, 2014, the second day on our Chilean trip. We spent a happy morning looking at highly sheared Jurassic granitoids along the coast. We were driving east towards the High Andes Batholith for the night. We were navigating our way through the town of Ovalle, slightly sleep deprived, unfamiliar with the town and not yet clued in to the Chilean affinity for one-way streets. So it came to be that we found ourselves, all 25 of us in our caravan of five vehicles, going down a very narrow street with a big black bus coming straight at us. And said bus was going the right way. But there was no honking, no yelling, no screaming (well, I may have muttered some choice expletives). The bus driver calmly got off the bus, came over to us and asked us where we were going. He drew a map for us on a piece of paper to get us out of town. He helped block traffic while we turned around. He wished us luck, and he went on his way, no fuss, no worries. Welcome to the country with the nicest people on Earth: Chile. But I am getting ahead of myself.

It is often said that the best geologist is the one who has seen the most rocks and there is likely much truth to it. At the very least, looking at rocks is just a lot of fun. And while there are many examples of great geologic features throughout the continental U.S. As geoscientists, the Earth is our playground, and, if looking at rocks is what we have to do to become better geologists, we must travel outside our national borders. It is thus that the idea for creating a Study Abroad Program in geology in our department was born.

Chile is, geographically and geologically, an astonishing country. It stretches north-south for more than 2,500 miles. Its western boundary is the Pacific Ocean, and its eastern boundary, no more than 130 miles away, is the Andean Cordillera, with elevations reaching over 22,000 feet. Climatic variations reflect this extraordinary topography. The north is characterized by the Atacama Desert, the driest place on Earth. The south is in the temperate rainforest zone. Chile's geological evolution has resulted from the effects of east-directed subduction of Pacific Ocean floor beneath the South American plate. Subduction is ongoing, and it is a seismically and volcanically active country.

Chile seemed like an excellent choice for our first iteration of a Geology Study Abroad—and boy, was it ever. We ran our program in coordination with the International Student and Scholar Center at the University of Missouri, which allowed us to use 100% of the tuition revenue from the course (six credit hours per student, 18 undergraduates, six graduate students) to finance our field trip to Chile. Airfare was not included in the program, but almost all of our students received scholarships from alumni-endowed accounts from our geology department, which allowed many to participate in this class for a maximum of $1,000 after tuition, fees and airfare, and some to take the class with no extra costs at all other than personal expenses.

Fall 2013

The first half of the semester was devoted to lectures reviewing the spatial and historical progression of structural features and plutonic-magmatic events, including both arc volcanism and superimposed caldera-ignimbrite events. During the second half of the semester, students gave class presentations on specific tectonic or volcanic processes or locales we would later visit during our trip. Students also wrote short, outcrop-based descriptive research papers that constituted the basis for our field trip guide, and would serve as the backbone for each student’s individual field presentations while in Chile.

In an attempt to make the narration of our Chilean sojourn more geologically meaningful, here is a brief (very, very brief) summary of the tectonic evolution of the Chilean Andean-style subduction margin:

-The formation of the Andes began in the Jurassic, as a result of the breakup of Gondwana (following the breakup of Pangea), and it’s manifested as long-lived (Jurassic to present), east-dipping subduction along the western side of South America.

-The position of the Andean volcanic arc has migrated eastward over time: during the Jurassic the volcanic arc was located along today’s Chilean coastline; by the Cenozoic the volcanic arc it had migrated to its present location along the Andean Cordillera.
-Subduction processes are certainly not continuous in time and space: there were (and are) complex variations in the angle of subduction both over time and along strike that produced complicated lateral variations in uplift, igneous activity and regional climactic responses.

Here is an outline of the main tectonic provinces that we visited in northern Chile, from west to east, and each province’s role in the geologic evolution of the Chilean Andean-style subduction margin:
- Coastal Cordillera: amalgam of Paleozoic and Mesozoic terranes, intrusive bodies, and Jurassic to early Cretaceous intrusive bodies that belonged to the late Jurassic-early Cretaceous Andean volcanic arc
- Atacama Fault Zone (AFZ): developed as a left-lateral strike-slip fault system during late Jurassic to early Cretaceous Coastal Cordillera volcanic arc, and re-activated as a normal fault system during Miocene to present uplift and extension
- Central Depression: separated from the Coastal Cordillera by the AFZ, it acted as a back-arc basin to the Coastal Cordillera arc (late Jurassic to early Cretaceous) and as a forearc basin to the Miocene to present volcanic arc (Andean Cordillera)
- Precordillera: short-lived late Cretaceous to Oligocene volcanic arc; the Precordillera is the host to some of the most important mineral belts and deposits in Chile, most of them associated with the Domeyko Fault Zone (DFZ)
- Domeyko Fault Zone (DFZ): active strike-slip system during Eocene to Oligocene magmatic belt of the Precordillera, resulting from a highly oblique angle of subduction, and reactivated as a normal fault system during the Miocene to present volcanic arc of the Andean Cordillera. It hosts the largest porphyry copper deposits on Chile
- Pre-Annean Depression: forearc basin to the Miocene to present volcanic arc
- Andean Cordillera: it comprises the Miocene to present volcanic arc. During our trip we stayed within the Central Volcanic Zone (CVZ), as the segment of the Andean Cordillera is referred to in northern Chile.

Day One: Getting there

In the early morning hours on Dec. 31, 2013, we left Columbia, Missouri, and flew to Dallas, and, after ringing in the New Year somewhere over the Pacific Ocean, we arrived in Santiago, Chile, on Jan. 1. We spent 10 hours at the airport attempting to secure vehicles. Our car reservations, made months in advance and confirmed umpteen times, had mysteriously never materialized on Chilean soil. We found ourselves, and 99% of our gear (one bag and one passport did not make it), packed into five four-wheel drive vehicles heading to the coast. Things were looking up.

Days Two through Seven: Santiago to Antofagasta, Coastal Cordillera (mostly) with forays into the High Andes Batholith and the Pre-Annean Depression

Believe me, if you ever find yourself needing to travel from Santiago de Chile to Antofagasta (one does never know) and have a few days to spare, do yourself a favor and rent a car to drive north along the Coastal Highway. It will take your breath away.

The morning of our second day found us in the town of Papudo, located on the Pacific coast. Papudo was not a geologic destination per se, but it had cheap accommodations. After dipping our winter-pale toes in the mighty Southern Pacific Ocean for a bit, and purchasing some groceries for lunch, we headed towards our first geology stop of the trip: Jurassic orthogneisses and migmatites of the Coastal Cordillera entrenched in the Atacama Fault Zone that crops out along the beach in the town of Zapallar.

Following our encounter with highly sheared Jurassic granitic rocks, we continued on our northern pilgrimage along the Coastal Cordillera, before turning east and heading towards the High Andes Batholith (a short-lived Permian volcanic arc that pre-dates long-lived onset of Andean-style tectonics in the Jurassic), where we would spend the night. Along the way, we stopped in Valle del Encanto, where we learned about the El Molle people, who lived in the area 1,900 to 1,300 years ago, and were quite fond of petroglyphs (and hallucinogens).

We welcomed day three in the Hacienda Los Andes, in the Hurtado River Valley, on the foothills of the High Andes Batholith (HAB). After a short hike around the Hacienda looking at volcanic and volcaniclastic rocks
related to the HAB, we had our first experience of high Andean desert and dirt-road driving as we crossed over the batholith. Eventually headed back to the coast (and through Chilean wine country) to the town of La Serena, which would be our home for the night.

During our fourth day, we continued north along the Coastal Cordillera and on day five we would head towards the Precordillera and associated Domeyko Fault Zone (DFZ) and the Pre-andean Depression, in what would become our first taste of highly deformed rocks, high altitude, salars and mining in Chile.

Day Five: We left our hotel in the mining town of Copiapó and headed east into the Punta del Cobre Mineral Belt, where ore body mineralization (principally copper) is associated with fold-and thrust belt style-deformation of the Domeyko Fault Zone (DFZ) that is contemporaneous with the late Cretaceous to Oligocene volcanic arc of the Precordillera. We abandoned the Precordillera and its mineralization, and headed into the Pre-andean depression and the Nevado Tres Cruces National Park, right along the border with Argentina. At the park we drove along the Maricunga Salar (a salar is a salt lake, or playa lake) while we gazed at Nevado Ojos del Salado (the highest volcano in the world at 22,615 feet) and at Nevado Tres Cruces (a 22,142 foot summit), both smack in the middle of the present day Andean volcanic arc.

From the national park we headed back into the Precordillera and into another mining town of El Salvador, and on day six we left the baking interior once again seeking the comfort of the Pacific Ocean and the Coastal Highway, heading north towards a fishing village that would be our refuge for the night, Taltal. On our way to Taltal we stopped at the National Sanctuary of the Orbicular Granite, and ogled the most amazing granites we had ever seen in our lives. The outcropping of orbicular granites is only about 30 square meters, yet we stayed there for several hours. Those rocks are just that cool.

On the final day of our northwards coastal pilgrimage arrived at Antofagasta, a large industrial city that is the main shipping hub for all the ore mineral in Chile's interior. It was also the largest city we had seen since Santiago, and we were all slightly shell-shocked. The main geologic attraction in Antofagasta is the Mejillones Peninsula. This little clam-shaped (mejillón = clam) spit of land, regularly battered by earthquakes (it sits on the Atacama Fault Zone) contains: Proterozoic-Cambrian basement rocks isolated within, and sometimes sheared by the AFZ; Jurassic volcanic andesites of the Coastal Cordillera; Plio-Pleistocene marine planation surfaces offset by normal motion on the reactivated AFZ. And these are just the things we got around to seeing, the Mejillones Peninsula is the gift that keeps on giving. The peninsula is also Antofagasta's main drug gateway, and the place was teeming with Carabineros (Chile's federal police force) armed to the teeth and riding off-road motorcycles at 100 mph.
generally ignoring all road signs. It was fun and slightly terrifying.

Days Eight through 11: Antofagasta to Calama, Central, Depression and Precordillera

We devoted a couple of days to learning about copper mining in Chile. We were able to arrange visits to two of the most important copper mines in Chile: Chuquicamata and El Abra, located right next to, and about 50 miles north of Calama, respectively. Mineralization in both mines is controlled by faulting in the Domeyko Fault Zone, along which emplacement of porphyritic bodies (mainly dioritic) took place during igneous activity associated with the Precordillera arc (late Cretaceous-early Oligocene). The DFZ also localized the fluids that later altered and mineralized the diorite porphryies.

Chuquicamata is the largest open pit copper mine in the world, with a production of 530,000 metric tons of Cu-cathods with 99% purity. That’s an awful lot of copper, folks. Chuquicamata is owned and operated by Codelco, the Chilean national copper company. During our tour of the mine we had a chance to also visit Campamento (Camp) Chuquicamata, the mine-owned town where all miners and their families lived prior to 2008, when the camp was finally closed down due to changes in mine-land regulations. The mining camp was established by the Guggenheim brothers in 1912, mine owners at the time, and life at the camp is remembered quite fondly by most who lived there.

El Abra mine is a smaller operation majority owned and operated by Freeport-McMoran. Their operations date back to 1996, but what makes their mining operation most appealing is the ingenuity, and efficiency of their ore recovery methods, and the fact that they operate at elevations of 10,500 to more than 14,000 feet. Not for the faint of heart (or the short of breath).

Days 12 through 14: San Pedro de Atacama, Andean Cordillera

The last stage of our trip was arguably the most breathtaking. We were in the Atacama Desert proper. The driest place on Earth, which boasts decadal precipitation rates of less than 2mm/10 years and an average humidity of 10%. Using San Pedro de Atacama as our home base, we undertook daily excursions from the Precordillera to the high Andes and back. Stunning scenery, incredible desert colors, bright blue sky and volcanoes as far as the eye could see. Oh, and no bugs. We loved San Pedro.

From San Pedro we visited the Cordillera de La Sal, a Neogene thin-skinned fold and thrust belt in the inner forearc of the Central Volcanic Zone (CVZ), which contains evaporite units up to 9,000 feet thick. We drove to Laguna (Lake) Chaxa, in the heart of the Salar de Atacama (largest salar in Chile and third largest in the world), whose basin once acted as the back-arc to the Precordillera Tertiary arc, and is now a forearc basin to the present-day arc. We drove high into the Andes to take a look at Lascar Volcano, which at 18,340 feet is the most active volcano in the Andean Cordillera. We spent a happy day shuffling (because you are expected to move at elevations over 17,000 feet) through La Pacana Caldera, in the heart of the Altiplano-Puna Volcanic Zone (APVZ) in the CVZ (Chilean geology is full of acronyms). The APVZ represents a zone of concentration of highly explosive volcanism and caldera-forming events most likely related to some form of localized delamination of the lower crust underneath the Andean Cordillera. La Pacana Caldera, 4 million years old, is, at 40x20 square miles, one of the largest and best exposed resurgent calderas in the world.

Days 15 through 17: San Pedro to Antofagasta, heading back home

The moment came when we had to say goodbye. After driving back to Antofagasta, returning our rental cars, and spending one day shaking sand out of every article of clothing in our suitcases, we piled into several taxi cabs on our way to the airport in Antofagasta.

We went, we saw, we learned. And we came back better geologists, and even better people, for it. To all of you who made this trip possible because of your donations to support student scholarships, we thank you, truly, deeply, from the bottom of our hearts. We could not have done it without you.
MU Researchers Find Rare Fossilized Embryos More Than 500 Million Years Old

The Cambrian Period is a time when most phyla of marine invertebrates first appeared in the fossil record. Also dubbed the “Cambrian explosion,” fossilized records from this time provide glimpses into evolutionary biology when the world’s ecosystems rapidly changed and diversified. Most fossils show the organisms’ skeletal structure, which might not give researchers accurate pictures of these prehistoric organisms. Now, researchers at the University of Missouri have found rare, fossilized embryos previously believed to be undiscovered. The researchers’ methods of study might help with future interpretation of evolutionary history.

“Before the Ediacaran and Cambrian Periods, organisms were unicellular and simple,” said James Schiffbauer, assistant professor of geological sciences in the MU College of Arts and Science. “The Cambrian Period, which occurred between 540 million and 485 million years ago, ushered in shells. Over time, shells and exoskeletons can be fossilized, giving scientists clues into how organisms existed millions of years ago. This adaptation provided protection and structural integrity for organisms. My work focuses on those harder-to-find, soft-tissue organisms that weren’t preserved quite as easily and aren’t quite as plentiful.”

Jim and his team, including Jesse Broce, a Huggins Scholar doctoral student in the Department of Geological Sciences at MU, are now studying fossilized embryos in rocks that provide rare opportunities to study the origins and developmental biology of early animals during the Cambrian explosion.

Jesse collected fossils from the lower Cambrian Shuijingtuo Formation in the Hubei Province of South China and analyzed samples to determine the chemical makeup of the rocks. Soft tissue fossils have different chemical patterns than harder, skeletal remains, helping researchers identify the processes that contributed to their preservation. It is important to understand how the fossils were preserved, because their chemical makeups can also offer clues about the nature of the organisms’ original tissues, Jim said.

“Something obviously went wrong in these fossils,” Jim said. “Our Earth has a pretty good way of cleaning up after things die. Here, the cells’ self-destructive mechanisms didn’t happen, and these soft tissues could be preserved. While studying the fossils we collected, we found over 140 spherically shaped fossils, some of which include features that are reminiscent of division stage embryos, essentially frozen in time.”

The fossilized embryos the researchers found were significantly smaller than other fossil embryos from the same time period, suggesting they represent a yet undescribed organism. Additional research will focus on identifying the parents of these embryos, and their evolutionary position.

Jim and his colleagues published this and related research in a volume of the Journal of Paleontology which he co-edited. The special issue, published by the Paleontological Society, includes several papers that analyze fossil evidence collected worldwide and includes integrated research focusing on this time frame, the Ediacaran–Cambrian transition. Jim and Jesse’s research, “Possible animal embryos form the lower Cambrian Shuijingtuo Formation, Hubei Province, South China,” was funded by the National Science Foundation.

Story by Jeff Sossamon
Visiting Speakers

A rich and varied program of visiting speakers was funded by our Williamson Family Endowment Fund. Last year’s Williamson Family Colloquia and other seminars included:

William Barnhart, USGS
Phantom Earthquakes and the Punctuated Growth of Mountains Belts

Miriam Barquero-Molina and Robert Bauer, MU Geological Sciences
Chile Field Trip Presentation

Peter Clift, Louisiana University
The Asian Monsoon and its Links to Cenozoic Orogenesis and Global Climate Change

Harmony Colella, Miami University of Ohio
Sucked In: Unlocking the Hidden Secrets of Subduction Zone in Processes

Brett Denny, Illinois Geological Survey
Ultramafic Rocks are Rare Earth Elements associated with the Illinois-Ketucky Fluorspar District and Hicks Dome

Genet Duke, Arkansas Tech University
Cretaceous-Eocene Mid-Continent Alkaline Magmas—Hot Spot or Not?

Carl Fiduk, WesternGeco
AAPG Distinguished Lecturer
The Influence of Salt Structures & Salt Deformation on Petroleum Exploration in the Deep-Water Northern Gulf of Mexico

Mark Frank, N. Illinois University
Exploring the interiors of Icy Planets

Patricia Gregg, College of Earth, Ocean, and Atmospheric Sciences
Frontiers in Volcano Modeling: Gaining Physical Insight into Active Magmatic Systems

Christian Klimczak, Carnegie Institute of Washington
Thrust Fault Tectonics on Earth and Mercury

Si-Yong Lee, Schlumberger, Ltd.
Uncertainties in Geologic CO2 Sequestration: Examples in Storage Capacity Estimation and Risk Assessment

Jeff Mauk, Denver Geological Survey
New Zealand Epithermal Deposits: Geological, Geochemical, Mineralogical, and Geophysical Records of Large-Scale Mass Transfer in the Shallow Earth Crust

Webster Mohriak, University of Rio de Janeiro
AAPG Distinguished Lecturer
Birth and Development of Continental Margin Basins: Analogies from the South Atlantic, North Atlantic and Red Sea

Ingrid Ukstins Peate, University of Iowa
Large Igneous Provinces

Christine Regalla, Hobart and William Smith Colleges
From Slabs to Alluvium: Integrating Structural and Geomorphic Records of Active Faulting over Multiple Scales.

Kevin Shelton, MU Geological Sciences
How do Large Gold Deposits form in Greenstone Belts that contain relatively Small Volumes of Mafic Volcanic Rocks?

Alicia Wilson, University of South Carolina
Ecohydrology of a Salt Marsh: Some insights from the U.S Southeast

David Wronkiewicz, MU of Science & Technology
Biomineralization Processes at Storr’s Lake San Salvador Island, The Bahamas
A Second Century of Camp Branson

Summer 2014 was a great year at Camp Branson. We gathered students from 15 schools: University of Missouri, Missouri State, Texas Christian University, Wayne State, Sam Houston State, SUNY Potsdam, University of Northern Iowa, Sonoma State, Kansas State, Central Michigan, Middle Tennessee State, University of Nebraska-Omaha, Eastern Michigan, Austin Peay State and California Lutheran University. After significantly raising our academic requirements, we were pleased that six out of our 43 students qualified for scholarships from our alumni contributions to the camp’s scholarship funds (see photo). If you have a chance, visit our field camp website (http://fieldcamp.missouri.edu/), which is the main venue through which potential students learn about our camp. You can also “like” us and follow us on Facebook at https://www.facebook.com/Camp.Branson.

Our projects in field camp are diverse and highlight a broad range of geological field experiences, including sedimentology, stratigraphy and sedimentary environments, geologic mapping of folded and faulted sedimentary rocks, structural analysis of metamorphic rocks, surface and groundwater hydrogeology, and reflection and refraction geophysics. We were able to work with a group of exceptional field instructors with expertise in all of the disciplines that the students are exposed to at Camp Branson. Damon Bassett, an instructor at Missouri State University and a paleontology and sedimentology expert. Jon Mies, a structural geologist at the University of Tennessee at Chattanooga, worked with Miriam on the field mapping projects on Dallas and Derby Domes. Alan Whittington accompanied the students on a four-day field trip to Yellowstone and the Tetons national parks. Eric Carson (University of Wisconsin) led a glacial deposit mapping project in Sinks Canyon during the fifth week of camp. Ed Romanowicz and Dave Franzi (SUNY-Plattsburgh) oversaw our revamped surface and groundwater hydrology projects. And Eric Sandvol took charge of all the geophysics projects.

Our advanced projects in hydrogeology and geophysics once again proved to be very popular options amongst our students during the sixth and final week of camp, when students have the freedom to choose their final project in the course. For our advanced geophysics project, we used a total of 104 geophone channels composed of 2-16 channel Missouri GEODES and 3-24 channel GEODES on loan from the Incorporated Research Institutions for Seismology (IRIS) Program for Array Seismic Studies of the Continental Lithosphere (PASSCAL) instrument center. Our equipment allowed the students to run seismic lines nearly 500 meters long and record 72 shots (several of them with stacked data lines) in two days.

Our advanced hydrogeology projects were completely redesigned for this summer. We have hired a new faculty member in our camp, Dave Franzi, from SUNY-Plattsburgh, to co-lead our ground and surface water hydrogeology projects with Ed Romanowicz, also from SUNY-Plattsburgh, during the last two weeks of camp. Ed and Dave are full of energy and enthusiasm, and have started to collaborate with Eric Sandvol, our geophysics guru, so that some of our advanced groundwater and seismic projects in the sixth week are closely tied together.

In addition to our faculty, we were once again lucky to be able to count on a strong supporting staff that made camp instruction happen and camp facilities run smoothly. Our Teaching Assistants: Angie Van Boening, Claire Landis, Tyler Miller, Levi Crooke, Joe Boro, Josh Hale and Hal Johnson. Jill McKenzie,
Camp Branson wins the GSA/ExxonMobil 2014 Field Camp Excellence Award

For the past four years, the GSA Division in Education and Outreach and ExxonMobil have partnered to recognize a field camp that distinguishes itself above all others based on safety awareness, diversity and technical excellence. The winning field camp receives an award of $10,000 to assist with their summer season, and is to be recognized at the President’s Awards Banquet during the GSA Annual meeting in the fall.

This year the University of Missouri’s Camp Branson was chosen as recipient of this award. The award recognizes the many years of hard toil and the many people who have worked tirelessly to make Camp Branson into a beacon of field education in the geosciences: field camp directors and department chairs (past and present), faculty, teaching assistants, staff and student workers, students and, of course, our incredibly supportive alumni, without whom we simply could not be where we are at. This award is yours.
Undergraduate Research Program

Several years ago we began a departmental undergraduate research program. The program is funded from four Opportunities for Excellence in Geology Endowments (the John and Betty Marshall, Gene and Thelma Schmidt, Walter D. Keller, and Norman E. Smith funds). Last year we funded undergraduate projects at about $3,000 each that led to senior theses. This year we have several students pursuing senior theses.

The intent of the program is to provide funds to enable undergraduates to conduct meaningful field- and laboratory-based research as part of their MU education. There are a number of benefits to such a program:
(1) It encourages and rewards research starting early in our students’ careers.
(2) It is a great tool to attract students to our program.
(3) Our students will be more competitive and better prepared for graduate school and the work force.
(4) The program increases our department’s visibility on campus and beyond.
(5) It integrates meaningful research into our undergraduate curriculum and allows us to create a unique role relative to other state-funded universities in Missouri.

We are extremely grateful to the donors to the Opportunities for Excellence in Geology Endowments who have provided research opportunities for these students.

Austin Savage deploying radar equipment to study a rock glacier on Mount Mestas, southern Colorado.
The Geology Club has been very busy this past year. In fall 2013, six of our members attended the annual GSA conference in Denver. Students listened to presentations and networked with fellow students and professional geologists. We also explored a wild cave in Missouri, and took a trip to Arkansas to float down the Buffalo River.

We started off this semester with about 20 active members and lots of ideas for the upcoming year. Our first planned event was a camping trip during the weekend of Oct. 4 at Finger Lakes State Park. Later this semester, we are taking five members to the annual GSA conference in Vancouver. Our annual Youth Night is coming up in November, and we are already planning fun activities to help teach Boy Scouts and 4H members about geology. We continue to serve food at home football games to raise funds for the club. We are planning to have new T-shirt designs soon, and a new website is in the works. Be sure to like our Facebook page, “Mizzou Geology Club,” to follow all of our activities.

Geology Club members hosting youth night in the Geology Building attended by Scouts and 4-H members. This has been an ongoing community service project for the group.

Geology Club members at a recent club meeting.
At the El Abra copper mine.

In front of Lascar volcano.

Driving past the Monjes de la Pacana, inside La Pacana caldera.
Spring 2014 petrology field trip on Banded Iron Formation at Pilot Knob in the Arcadia Valley, Southeast Missouri.

Fall 2013 surficial geology students quantifying weathering rates of limestone gravestones in Columbia, Missouri.

Spring 2014 regional geology field trip on top of Black Butte, Arizona.
Field Camp students relaxing after the ascent to George.

Norris Geyser Basin, Yellowstone National Park, June 2014.

Measuring paleocurrents in the Nugget sandstone.
Geoffroy Avard (PhD 2010 and former development board student member), and current doctoral student, Alex Sehlke on the summit of Arenal volcano in January, 2014. Alex is working with Alan Whittington, studying the rheology of lava flows. Geoffroy works for the Costa Rica volcano observatory.

Claire Beaudoin at the El Tatio geyser field, Atacama Desert, Chile. El Tatio is the largest geyser field in the Southern Hemisphere (third largest in the world). Claire is working on her master’s degree with Cheryl Kelley.

Yanying Chen and Elizabeth Gammel watching a sunset in the White-Inyo Range, California. Yanying and Elizabeth are both doctoral students working with Peter Nabelek.
Undergraduate Degrees

Bachelor of Science

Kaitlyn Brooke Compton (magna cum laude)
Gretchen Rose O’Neil (with honors)

Ellen Michelle Clippard
Meghan Lynn Howard
Cody William Jaeger
Howard Lee Loftis
Shane Patrick Martin
Laura Elizabeth Perry
Michelle Lynn Rathe
Jennifer Dawn Taylor
Nolan Andrew Walla

Senior Theses

Gretchen R O’Neil
Phosphate δ18O Measurements at the Cretaceous-Paleogene Boundary
Advisor: Ken Macleod

Emma Rosenow
Magma Mixing in the May 2010 Strombolian Eruption of Pacaya Volcano, Guatemala.
Advisor: Alan Whittington

Scholarships

AAPG L. Austin Weeks Scholars
Meghan Howard
Emma Rosenow

Raymond E. Peck Undergrad Scholars
Teresa Avila
Daniel Gregory
James Smith
Jake Splinter

Edmond & Mary Raymond Scholar
Jordyn Cloud

Pearl T. Sando Scholars
Teresa Avila
Tyler Adelstein
Ronald Stuart

Gene Schmidt Scholar
Samuel Glasscock

Fred Strothmann Scholars
Alex Cavalco
Jordyn Cloud
Grant Elliott
Samuel Glasscock
Nicklos Marti
Avery Peneston
Timothy Robertson
Allison Roebuck
Clark Thomas
Cory Williams

Awards

Estwing Hammer Award
Jordyn Cloud

Geology Development Board Outstanding Undergraduate Award
Teresa Avila
The American Association of Petroleum Geologists (AAPG) chapter of the University of Missouri began in 2010. We are a strong student chapter, composed of graduate and undergraduate members, guided by our faculty advisor Francisco “Paco” Gomez. The purpose of the AAPG is to advance the professional development and secure the professional well-being of student geologists, particularly those whose interests relate to professions within the petroleum and energy mineral industries. In April 2013, the AAPG chapter, through popular support from chapter members and department students, annexed a charter group of the Association of Engineering and Environmental Geologists (AEG) in order to expand professional outreach for student members focused on careers in the engineering or environmental industries. The group now collaborates with the AEG St. Louis professional chapter in addition to our connection with the national AAPG organization.

The newly formed AEG-AAPG has experienced early momentum. Within the first two weeks of the semester, nine students traveled to St. Louis for an AEG meeting and short-course on widely used, geophysical tools in the engineering and environmental industry. Eight students traveled to Houston for short-courses and job/internship interviews with oil and gas companies at the AAPG Fall Student Expo. The Association also hosted Tim McIntosh — a former recruiter for a staffing firm for the energy, environmental and engineering industries — on Sept. 4 to offer advice on how students could boost their resume appeal and marketability to industries in need.

Looking forward, the chapter is planning a revival of the annual silent auction fundraiser, which will offer geology and earth-science themed prizes in early November. Additionally, the chapter will invite a speaker from the AAPG speaker series to talk in the spring and will send students to more local AEG meetings and to the annual AAPG National Convention and Exhibition in Denver.
Graduate Degrees

Master of Science

Anthony Bollasina
The May 2010 Eruption of Pacaya Volcano, Guatemala: An Experimental Study of Subliquidus Magma Rheology
Advisor: Alan Whittington

Elizabeth Gammel
Evolution and Role of lithium- and Boron-Bearing Fluids in Alteration Reactions in Granitic Miarolitic Pegmatites, San Diego County, California
Advisor: Peter Nabelek

Ashraf Gafeer
Petrogenesis of the Main Petrologic and Chronologic Volcanic Phases in the Gharyan Province, NW Libya
Advisor: Peter Nabelek

Abdelsalam Hassan
Geochemistry of Fluid Inclusions in the Vazante Zinc Deposit, Minas Gerais, Brazil
Advisor: Martin Appold

Michael Hilmes
2D and 3D Modeling of the Laramide Fold Geometry of Derby Dome and its en Echelon Interchange with Dallas Dome, Southern Wind River Basin, Wyoming
Advisor: Robert Bauer

Feng Lin
Two Phases of Extension in North China since the Mesozoic: A Numerical Study
Advisor: Mian Liu

Rayan Yassminih
Crustal Stress across the Northern Arabian Plate and the Relationship with the Plate Boundary Forces
Advisors: Francisco Gomez and Eric Sandvol

Doctor of Philosophy

Frank Calixto
Seismic Studies in the Southern Puna Plateau and Peru
Advisor: Eric Sandvol

Savas Ceylan
Two-Plane Seismic Tomography and Lithospheric Structure Beneath Eastern Tibet
Advisors: Eric Sandvol

Genevieve Robert
The Effect of Volatiles on the Viscosity and Heat Capacity of Calc-Alkaline Basaltic and Basaltic Andesite Liquids
Advisors: Alan Whittington

Gleb Skobeltsyn
Upper Mantle S Wave Velocity Structure of the Eastern Anatolian-Caucasus Region
Advisors: Eric Sandvol

Savas Ceylan and Metin Kahraman at one of our installed seismic stations in central Turkey. The volcano Hasan Dagh can be seen in the background.
**Scholarships**

**Boyd Scholars**
Jesse Broce    Aaron Morrison
Eric Nowariak  Sara Smith

**Davies Memorial Scholar**
Gretchen O’Neal

**Ethington Geology Scholar**
Shannon Haynes

**Freeman Geology Scholar**
Brittany Cavender

**Graduate School Fellow**
David Horrell

**GSSF Scholars**
Eric Nowariak
Aaron Morrison

**Himmelberg Geology Scholar**
Yanying Chen

**Johns Geology Scholar**
Ajit Joshi

**Hal and Ruth Johnson Scholar**
Ajit Joshi

**Walter D. Keller Scholars**
Jesse Broce    Megan Brown
David Horrell  Stuart Kenderes
Jesse Merriman

**Craig Russell Knotts Scholars**
Laura Perry
Sean Polun

**Knox Geology Scholar**
Brittany Cavender

**Miles Geology Scholar**
Laura Perry

**Rexroad Geology Scholar**
Jesse Broce

**Staley Geology Scholars**
Joshua Hale
Sara Smith

**James H. Stitt Geology Scholar**
Shannon Haynes

**M. Ray Thomasson Scholar**
Megan Brown

**Tlapek Geology Scholars**
Elizabeth Gammel
Jesse Merriman
Robert Russell

**Viele Geology Scholar**
Katrina Burch

**Grants and Awards**

**AGU Outstanding Student Paper Award**
Arianna Soldati

**Fulbright Scholar**
Antonio Manjon-Cabeza Cordoba

**GSA Student Research Grant**
Tara Selly

**Houston Geological Society**
Danielle Cavender

**Huggins Graduate Fellowship**
Jesse Broce

**James H. Stitt Graduate Teaching Award**
Elizabeth Gammel

**Outstanding Graduate Student Award**
Frank Calixto-Mory

**Houston Geological Society**
Megan Brown
Joshua Field
Jordyn Cloud received the Estwing hammer from Miriam Barquero-Molina. This award honors the top undergraduate student to attend field camp.

Teresa Avila received the 2013-14 Geology Development Board Undergraduate Award from board chair, Gary Mitchell.

Elizabeth Gammel received the 2013-14 James H. Stitt Graduate Teaching Award from our Director of Graduate Studies, Bob Bauer.
Abdelsalam Hassan presenting his poster at the PACROFI conference in Denver, June 2014.

Genevieve Robert presenting her poster at the AGU Fall meeting in San Francisco, December 2013.

Tony Bollasina presenting his poster at the GSA Annual meeting in Denver, October 2013.
Student Journal Publications


Oral Presentations


**Poster Presentations**


**Hassan, A.,** Appold, M. S., 2014. Geochemistry of Fluid Inclusions in the Vazante Zinc Deposit, Minas Gerais, Brazil: Pan American Current Research on Fluid Inclusions.


**Lin, Feng** and Mian Liu, Two modes of extension in the North China Craton: Insights from numerical modeling: American Geophysical Union.


**Ye, Jiyang** and Mian Liu, Formation of the Salton Sea: A Numerical model of fault interaction: American Geophysical Union.
Investments in the Future

We gratefully acknowledges the financial support of alumni and friends who promote the recognition, welfare and progress of the Department of Geological Sciences and the University of Missouri. The University of Missouri’s Jefferson Club recognizes donors whose cumulative cash gifts or pledges to MU, including corporate matching contributions, total a minimum of $25,000 or whose deferred gifts total $50,000 or more.

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Mr. Tom Ware

Panorama of Holocene cinder cones and lava flows in the Mojave desert, spring 2014.
2013-14 Contributors
(through Aug. 31, 2014)

Henry W. Allen
David C. Baker
David K. Baumann
Merrilee N. Barta
Marilyn Beil
Michael J. Bernthal
William K. Berthold
Richard S. Bishop
John F. Blount
Joseph F. Born, Jr.
David K. Brezinski
Elaine R. Burgess
Mary A. Burst
William T. Caneer
Wayne F. Canis
George T. Cardwell
George F. Carini
Cynthia J. Carroll
Anna M. Cruse
J. Torrey Curtis
Calvin C. Czeschin
Anthony D. Daus
Ruth Davies
Anthony R. Dincau
Richard DeCamara, Jr.
John G. Elliott
Stanley C. Fagerlin
Juliana Fahy
Robert L. Foster
James R. Frank
Thomas J. Freeman
LeLant C. Fuerst
David A. Fulton
Richard J. Gentile
Martha George
Walter W. Giffhorn
Edward A. Goodrich
Mary L. Harres
Robert G. Heidlage
John B. Hendren
Glen Himmelberg
Harry C. Hixson
Richard D. Hoare
Elsie Hofstetter
F. Holland, Jr.
Ann E. Holmes
William C. Hood
Bruce E. Hunter
Ellen M. Jacobson
William Johns
Eloise F. Johnston
Eugene J. Kinney
David T. King, Jr.
Arthur Kassey
Larry M. Knox
Henry H. Krusekof, Jr.
Roger G. Kussow
Michael C. Larsen
M. Patricia Laughlin
Chipp R. Leibach
C. Frederick Lohrengel, II
Stuart A. Maier
John H. Marshall, III
George Z. Marshall
Nina H. Marshall
Earl F. McBride
Timothy R. McHargue
Ellen H. Mclain
Peter McMahon
Jeffrey L. McManus
John C. Miller
Jim P. Miller
Joseph G. Minke
Gary C. Mitchell
George E. Moore, Jr.
Susan C. Murphy
William J. Neal
Paula Nishibayashi
Dennis R. Ojakangas
John M. Opich
Hank Ott
Evelyn Otto
William D. Payne
Stephen T. Phillips
Alice K. Phillips
Charles L. Pritchard
Michael W. Quearry
Terry P. Quirin
Scott H. Raymond
Robert L. Rayl
Arthur L. Reeseman
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David D. Rockemann
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Gene W. Schmidt
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Kevin Shelton
Marjorie C. Smith
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Richard A. Tudor
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Marjorie K. Unklesbay
John Van Brahana
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Robert E. Warmbrodt
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- Glen Himmelberg Geology Student Scholarship Fund
- Wallace B. Howe Fellowship in Geology
- William Johns Geology Student Scholarship Fund
- Clayton H. Johnson Memorial Scholarship Fund
- Hal and Ruth Johnson Fellowship Fund
- Walter D. Keller Scholarship Fund
- Craig Russell Knotts Scholarship Fund
- Knox Family Geology Scholarship Fund
- Maurice G. Mehl Memorial Scholarship in Field Geology
- Miles Family Geology Scholarship Fund
- Mitchell Family Endowment Fund
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- Raymond Outstanding Achievement Fund
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- Schmidt Undergraduate Scholarship Fund
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Geology Faculty Retention Award
Mitchell Family Camp Branson Fund
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Cache Creek Exploration Co. Scholarship Fund
Norman & Shirley Jeffries Graduate Fellowship
Robert W. Quearry Scholarship Fund
Carl R. Swartzlow Memorial Geological Sciences Endowment Fund
Robert and Sue Weiser Bequest
Ed and Connie Williamson Bequest

**Charitable Remainder Trusts**

John & Betty Marshall Opportunities for Excellence in the Geological Sciences
Jack & Mildred Schindler Geological Sciences Endowment Fund

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Master’s student, Chen Song (lower right) posing with fellow shipboard scientists after setting the all-time record for depth of penetration below seafloor by scientific ocean drilling. Chen Song is working on her degree with Mike Underwood.
Geology Faculty Enhancement and Retention Funds

We are fortunate to have loyal alumni and friends who have supported many aspects of the academic mission of our department (e.g. student academic scholarships and Camp Branson). Our department is stronger than ever.

Our students’ lives have also been shaped by caring faculty mentors in the classroom, in the laboratory and in the field. To continue this legacy, we ask you to help us recognize and maintain the high quality of the faculty of our department.

Toward this end, two new funds have been established through lead gifts from members of our Geology Development Board: 1) the Geology Faculty Enhancement Endowment and 2) the Geology Faculty Retention Awards Fund.

It is possible to donate to either the principal or distribution side of these endowments. An advantage of a gift to the distribution is that your gift is available for immediate use.

I am pleased to announce that this year, we were able to make awards from these funds to six of our faculty members: Martin Appold, Mian Liu, Ken MacLeod, Peter Nabelek, Eric Sandvol and James Schiffbauer. We are proud of their accomplishments and we hope that they will remain at MU for many years to come.

We hope that alumni and friends will recognize the value of supporting our faculty and contribute to these funds.

**Geological Sciences Faculty Enhancement/Retention Awards**

- Mian Liu
- Peter Nabelek
- Eric Sandvol

**Kent Kreh Faculty Enhancement Award**

- Jim Schiffbauer

**Raymond Faculty Enhancement Award**

- Ken MacLeod

**Ed and Connie Williamson Faculty Retention Award**

- Martin Appold

Eric Sandvol preparing for the geophysics project at Camp Branson.
Geology Development Board
Membership, 2014

Mike Quearry, Chair
Chevron
Houston

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BHP Billiton
Houston

Carey Bridges
Department of Natural Resources
Jefferson City, Missouri

Mary S. Clark
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Littleton, Colorado

Arianna Soldati
University of Missouri

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Consulting geologist
Tulsa, Oklahoma

David J. Steyaert
Impact Energy Resources
Denver

Ed Williamson
BP Amoco (retired)
Houston
Greetings from the incoming development board chair!

I am honored to assume the role of chair of the Geology Development Board and I want to recognize Gary Mitchell, our outgoing chair, for his work and dedication. Thank you, Gary.

Kevin Shelton has “retired” from his role as department chair and Alan Whittington has assumed the role. Consequently, congratulations are in order. On behalf of the development board, I want to sincerely thank Kevin Shelton for his many years of energetic and tireless work as chair. Kevin, we also thank you for maintaining a close working relationship with the board, thus allowing us to assist in a number of fundraising projects and to enjoy meaningful relationships with the faculty. We would be remiss if we did not thank Lois Shelton for her selfless support over the years, welcoming the board into their home for many dinners and being involved in every board meeting.

Alan, welcome to your new position as department chair. You have big shoes to fill, but there is no doubt you are up to the task. We wish for you added strength, dedication and foresight as you assume this important job. The board looks forward to a fruitful relationship with you and requests that you not hesitate to ask for our assistance at any time. We also are keen to get to better know your wife, Angela, in the years ahead.

Faculty, the board will continue to be of service to you. That is our mission, to be of service to the department and that is YOU! Let us know how we are doing.

Fellow board members, I encourage you to attend all the board meetings that you can. I hope each of us feels like a contributing member of an active organization. Please contact me and/or other board members with any ideas or concerns you may have regarding the operation of the board.

To our fellow alumni and other friends of the department, I invite you to take the opportunity to double your contributions to Camp Branson. Through the end of 2014 your donations to Camp Branson will be matched. If your employer has a matching gifts program, your gift will have even more impact. The bridge at camp still needs to be replaced so your gift can go toward much needed improvements. If you have a desire to become a board member, please contact me, and I will be happy to discuss what being on the board is all about. If you have not visited the Mizzou campus recently, I encourage you to come and visit. Walk the halls of the Geology Building and recall those good times of years past. Then, stroll through campus and look for memories and discover what has changed over the years. Come and enjoy all Mizzou and Columbia has to offer! See you on campus.

Best regards,

Mike Quearry

Gary Mitchell (left), and Mike Quearry (right), accepting their plaques on behalf of the department for their dedication to the Geology Development Board as chair and vice-chair from 2012-2014.
Alumni News

Kathleen Abel (MA ‘78) resides in Peoria, Illinois.

Clifford A. Balster (Instructor 1950-51) says that the year he spent at MU was memorable for him. He writes, “Dr. Keller was great!”

Rachel Barker (FC ‘07, BS ‘08, MS ‘12) reports that she is working as an intern at Newfield Exploration in Tulsa, Oklahoma.

Bret S. Beall (FC ‘81, BS ‘82) reports that after 26 years in Chicago he moved to Portland, Oregon.

Charles Beierle (FC ‘62, BA ‘64, MA ‘77) writes that he still does some geophysics consulting work and that he is active in the Austin Geological Society.

Jack Berkley (MA ‘72) presented at the 60th institute on Lake Superior Geology in Hibbing, Minnesota in May. The presentation focused on his thesis and Glen Himmelberg was mentioned throughout.

Bill Berthold (FC ‘84, BS ‘85) reports he and his wife are happily living on their little farm in Eureka, Missouri.

William “Bill” Bridges (FC ‘55, BA ‘56, MA ‘58) writes, “Still enjoying retirement.”

Joseph Born Jr (MS ‘68-’70) writes that he is working in the Fort Worth Basin for Brigadier Oil & Gas.

Vincent Buening (FC ‘89, BS ‘90) continues his work at TRC Environmental in Michigan.

Jack D. Burgess (MS ‘55) is retired and resides in Dallas, Texas.

W.T. “Ace” Caneer (FC ‘51, BA ‘52, MA ‘56) writes, “I often think of Camp Branson with a smile on my face. It was a great experience!”

Wayne Canis (MA ‘63, PhD ‘67) reports that he now lives less than a mile away from the USGS in Reston, Virginia.

Cindy Carroll (MA ‘83) works as an Energy Specialist at the Missouri Department of Economic Development in Jefferson City, Missouri.

Randy Cox (PhD ‘95) reports that he and Angie still reside in Memphis, Tennessee. He writes that he was promoted to professor in the Earth Sciences Department at the University of Memphis.

Ansley B. Davies (FC ‘94) resides in Los Angeles, California and works as a curator for the Los Angeles County Parks & Recreation.

George Davis (FC ‘86, MS ‘89) writes that he still enjoys his work at the Missouri Department of Transportation. He is very active in AIPG and AMG and last fall presented a paper on the new Grapevine Hill Fault at the national AIPG meeting in Colorado.

Tony Daus (FC ‘80, BS ‘81) is working at GSI Environmental and reports that he recently changed positions there.

Elizabeth Drummond (FC ‘97) is working as a geologist for Geotechnology, Inc. in St. Louis.

Robert Foster (FC ‘60, MA ‘62, PhD ‘66) writes that he continues to evaluate the Stonehenge gold prospect in Lander County, Nevada. He writes, “A new discovery with a similar structural setting, stratigraphy, alteration pattern and geochemical signature of Goldfield, Nevada.”

Richard Gentile (BA ‘56, MA ‘58) is an emeritus professor at the University of Missouri in Kansas City.

Barry Goldstein (MA ‘77) writes he is still enjoying his position as the lead regulator for petroleum, geothermal and gas storage in South Australia.

Dick Hagni (PhD ’62) writes, “Although I have been retired for 14 years, I remain active in research, writing papers and presenting at professional geological meetings.” Dick has been studying sulfides from the Decaturville meteorite impact structure. He is also studying the origin of the bauxite deposits in Jamaica with his daughter, Ann.

Larry Heflin (FC ‘59, BA ‘59, MA ‘61) reports that he is still self-employed and working close to home. He says this allows him to spend more time “paddling the Potomac in Cabin John, Maryland.”

F.D. Holland, Jr. (MA ’50) continues his work at the University of North Dakota. He expects to have an extensive paper published about his research in the upcoming year.

John Hubert (Faculty 1958-1970) is an emeritus professor at the University of Massachusetts Amherst. He
writes, “I have particularly fond memories of interacting with Walt Keller.”

Eloise Johnston (FC ’79, BS ’79) writes that she is doing well and still working in IT in Fort Smith, Arkansas.

Art Kasey (Grad Student ’65-’70) writes, “Teaching for almost 44 years has been a fantastic experience.” Art says he will retire in June, 2015 with many wonderful memories.

David King, Jr. (PhD ’80) continues his work at Auburn University. He writes, “In addition to our work on impacts and impact stratigraphy, we have been working on the Mesozoic and Cenozoic stratigraphy of the northern coastal plains of Belize; both surface and subsurface studies.”

Diane Krueger (PhD ’02) continues her environmental consulting work in Farmington Hills, Michigan.

Brice Lambert (MA ’74) and wife, Lois, have retired from the newspaper business, the Ekalaka Eagle weekly paper, after 29 years at the helm.

Roger Kussow (PhD ’71) writes that he is greatly enjoying the freedom that comes with retirement. Roger recently visited Patagonia and Antarctica.

Mike Larsen (FC ’77, BS ’78) reports that following a 30-year career in both the mining industry and state service, he was appointed by Jay Nixon to the Missouri State Mining Commission in December, 2013.

Harold Levin (FC ’50, BA ’51, MA ’52) is an emeritus professor at Washington University in St Louis and is currently working on a trade book about the history of life.

Amanda Lough (FC ’07, BS ’07) reports she is working on final revisions of her doctoral thesis from Washington University. She will begin her post doctoral in the fall at the Department of Terrestrial Magnetism at the Carnegie Institute for Science.

Stuart Maier (FC ’76, BS ’77) writes, “You know you have been a geologist for a long time when you see shales turn into reservoir rocks from sources and seals.”

Earle McBride (FC ’54, MA ’56) reports that with 50 years of experience with sedimentary rocks he was able to identify two samples sight unseen!

John C Miller (FC ’65, MA ’68) went to Bosque del Apache in January to see thousands of snow geese and sandhill cranes migrating. In February he went on a birding cruise in the Caribbean. Most important was a trip to Iceland this past summer for birds, volcanoes and to straddle the North American and Eurasian continental plates.

Joseph Minke (PhD ’69) is conducting research on the mining history for South Park City Museum and Park County local history archives in Fairplay, Colorado. He also continues to review Park County groundwater quality studies for the water preservation coalition.

Gary Mitchell (FC ’67, BS ’70, MA ’71) reports that retirement is great! He is very involved in Civil War reenactments and living histories, as well as several organizations honoring Veteran’s past and present. He writes, “To all veterans...HUZZAH and stay safe.”

Tola Moffett (MA ’73) reports that he is still consulting in hydrogeology part-time and continues to “consult on a 700 acre TCE plume that is managed via wetlands treatment, institutional controls and modelling/monitoring.”

Thomas Moore (MA ’81) has set up a consultancy to do unconventional reservoirs and training gigs in the Waynesburg, Pennsylvania area.

William Neal (MA ’64, PhD ’68) hopes to see some of our Mizzou alums at the fall GSA meeting in Vancouver, Canada. He writes that he is still writing a bit on coastal topics and issues, and is also participating in a study of sea-level rise impact on Puerto Rico’s offshore isles.

John Nold (FC ’62, BA ’63, MA ’64) is an emeritus professor at the University of Central Missouri in Warrensburg, Missouri. John writes that he is enjoying bicycling on the Katy Trail and his grandchildren.

Hank Ott (FC ’52, BA ’53, MA ’58) writes that he is “still kicking, but not very high.”

Richard Pearl (MA ’63) is enjoying retirement in Lakewood, Colorado.

John Reader (FC ’81, BS ’82, MA ’84) reports that he and Jane recently moved to Lake Conroe in Montgomery, Texas. John is a geologist with BHP Billiton in Houston. He writes, “Hi to all field campers.”

Eugene Schweig (FC ’74, BS ’76) writes, “The worst of our sequestration hits are past, I hope. Great science is going on in our group. Six years after moving to Colorado, we are still loving it.”
Cecil Slaughter (FC '76, BS '76) works as a hydrologist at the Office of Surface Mining Reclamation in Washington, DC. He writes that his job is very challenging and that he loves it.

Virginia Smoot (FC '53, BA '55, MA '58) resides in Eau Claire, Wisconsin.

M. Ray Thomasson (FC '50, BS '52, MA '53) writes, “Thomasson Partner and Associates, Inc. and Thomasson Petroleum E&P are going strong with activities in nine states. TPA continues to entertain us with high risk exploration.”

Richard Tudor (FC '63, BS '64) works as a Port Engineer at T-Solution Inc. in Aiea, Hawaii.

Pat Vezeau (FC '78, BS '80) is now a senior partner in his oral surgery practice. He writes, "Life on the Great Plains is good!"

Bob Warmbrodt (FC '73, BS '74, MA '75) retired from Newfield Exploration as of January 2014 and resides in Houston.

James H. Williams (FC '50, BA '51, MA '52) writes, “It was a difficult year for science and education in the Missouri legislature. I am a member of the Missouri Geologists consortium with volunteers from three Missouri geology organizations. We monitor and testify about proposed bills that would harm publication and geologists.”

Ed Williamson (MA '73) writes, "Still hangin' out on the great plains of Katy, Texas. It's great to visit Mizzou each year and see how the department is progressing. Connie says hi, too!"

In Memoriam

Aline Brewen, former field camp cook, passed away on Jan. 7 2014. She worked for 27 years in the food service area on campus and retired in 1992.


Donald S. Garvin (FC '50, BA '50, MA '51) was a devoted friend of the department and of Camp Branson. He was a former Geology Development Board member ('86-'92, '96-'98) and also established a substantial field camp scholarship fund. He supported the renovation of several cabins at Camp Branson. After graduation he took a job as a geologist with Texaco in Shawnee, Oklahoma. The family later moved to Oklahoma City, where he established a successful career as a consultant geologist and independent oil and gas producer, with operations in both Oklahoma and West Virginia.

Matilda Tillie Looney received a bachelor's degree in Library Sciences in 1936 from the University of Illinois. She worked as a librarian at the University of Missouri from 1936 to 1948. It was here she met her future husband, Hugh M. Looney. Hugh and Tillie spent more than 60 years together with a short stay in Wichita, Kansas followed by many years in Texas in Fort Worth, Midland and Houston. Hugh and Tillie Looney were life long friends of the department and their legacy will continue through a generous gift to our department’s development fund.

John Marshall (FC '49, BA '49, MA '50) See Page 43.

George Moore (FC '35, BA '36, MA '38) was not only a graduate of MU but also worked as an instructor in the geology department in 1947.

Robert L. Rayl (FC '50, BA '51, MA '52), a former geology development board member passed away on Feb. 21, 2014. Robert worked at Phillips Petroleum for 34 years. He retired in 1986 and settled in Denver.

John Sanders (FC '47, MA '48) attended the University of Missouri after world War II, where he earned a master's degree in geology and paleontology. In 1948, he began a career as a petroleum geologist.

James Tyrer (BS '58) passed away on Jan. 26, 2014. James was born in St. Joseph, Missouri on May 23, 1936. He graduated from Central High School in 1954 and attained his geology degree from MU in 1958. He then served his country in the U.S. Army in Korea. He was a civilian worker for the U.S. Air Force (NGA) as a cartographer for 32 years.
MARSHALL JR., JOHN HARRIS born to Jessie Elizabeth Mosley Marshall and John Harris Marshall, Sr. on March 12, 1924 in Dallas, and passed away April 3, 2014 in Dallas.

John had an amazing life! He was raised in a small country town, Charleston, Missouri. After high school he attended the University of Missouri. He was drafted into the army during WWII where he served in three military campaigns in Europe with the 8th Armored Tank Division as an M-7 tank commander and was awarded three battle stars for his service. At 19, he was a tank commander, and out of 269 privates he was the first promoted to sergeant.

After the war, John attended Southeast Missouri State in Cape Girardeau where his heart was captured by the “sparkle in her eyes,” his wife of 55 years, Betty Zarecor Marshall. He returned to the University of Missouri where he majored in geology and received his bachelor’s and master’s degrees. He was awarded his Doctor of Humane Letters from Garrett-Evangelical Seminary in 1996. John started his geology career in Jackson, Mississippi with Magnolia Petroleum and spent the bulk of his career working for Mobil Oil. He worked in many geological positions at Mobil, which took him and his family all over the United States. He became the Chief Geologist worldwide and finished his career at Mobil as the Exploration General Manager for the Western Hemisphere. He then created MEI, a worldwide oil and gas consulting and production company.

Geology was not only John’s chosen profession but also his hobby. He would encourage young people to find their passion and would tell them, “I can’t remember a day that I didn’t want to go to work. I am amazed that they pay me for working.” He enjoyed worldwide travel, family gatherings across the country, playing games (especially pinochle) and a challenging debate about religion or politics.

John was a councilman for Warr Acres, OK, served on multiple boards at the University of Missouri, and served as chairman of the Foundation for Evangelism of the United Methodist Church. John was a lifelong Methodist and served many positions of leadership as a member in 11 United Methodist churches. Following in the footsteps of his parents, he believed in being an example for service and giving to others.

John was preceded in death by his first wife, Betty Z. Marshall; parents, John H. and Jessie Elizabeth Marshall and sister, Nannetta M. Brame.

John is survived by his wife, Lois Slingerland Marshall who gave him great happiness in his last four years. Also survived by sons, John H. Marshall III (Christine) of Centreville, Virginia, George Z. Marshall (Jane) of Parker, Texas and daughter Jacqueline M. Leibach (Chipp) of Boise, Idaho; 10 grandchildren, Timothy, Amy, Ryan, Trevor, John Robert, Chelsey, Sydney, Caitlin, Kendall and Caroline; 11 great grandchildren; brothers, Herbert A. Marshall (Nina) and Jesse M. Marshall (Alma), brother-in-law William E. Brame, and numerous loving nieces, nephews and extended family members.
Variscan and Alpine Geology in northern Spain: Pyrenees and Cantabrian Cordillera

Considering the success of our study abroad class to Chile, we have decided to run a second study abroad class, this one to Spain. We will once again run this course as a hybrid model. A significant portion of the course will take place during the regular 2016 spring semester at MU, and the abroad (field site) component of the course will take place during the summer session term in 2016, after our field camp ends. The program will once again be a 6-credit hour, 4000/7000-level course for upper level undergraduate and graduate students in geological sciences.

We are hoping to be able to team-up with faculty colleagues at the University of Tennessee at Chattanooga (UTC), Drs. Jon Mies and Ann Holmes, to teach this class. This would be an MU course, and the UTC students would register as visiting students (much as non-MU students do when they sign-up for our field camp). All four faculty, Miriam Barquero-Molina, Ann Holmes, John Mies and Bob Bauer would share the teaching load and would participate in the field trip. Lectures would take place simultaneously in both institutions, with students and faculty remotely connecting via video conference with one or the other campus, depending on who is lecturing. We hope to collaborate with the IT departments in both institutions to work this out.

Miriam is familiar with the geology and geography of the Pyrenees, where she spent many summer vacations in her childhood hiking around, and also the Cantabrian Cordillera, where she did most of her field work associated with her undergraduate geology degree, which she completed at the University of Oviedo, situated at the foothills of the Cantabrian Mountains.

We plan to be in Spain for about two and a half to three weeks, during which students and faculty will see a variety of geology associated with the Variscan and Alpine orogenies. The Variscan Orogeny is the European continuation of the Alleghenian Orogeny of the eastern U.S., and resulted from the collision of Laurasia and Gondwana in the late Paleozoic. The Cantabrian Mountains were first elevated during the Variscan, and many structures were later re-activated during the Cenozoic Alpine Orogeny. The Pyrenean Mountains are the westernmost end of the Alpine-Himalayan collisional system, and can boast of excellent preservation of foreland basin deposits, as well as a classic collisional fold and thrust belt.

Añisclo Anticline, Ordesa and Monte Perdido National Park, Central Pyrees. The Añisclo Anticline is located in the Eocene Ainsa Basin, which is dominated by kilometer-scale thrusts and folds that have trends at ca. 70° to that of the main Pyrenean structures and have been interpreted to have formed as orogen-parallel structures and later became highly oblique through clockwise vertical-axis rotation.