

GGPE

Geosciences and Geological and Petroleum Engineering | Missouri S&T | 2017



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HIDDEN GEMS

Head down the hall in McNutt's first floor and you will stumble upon a hallway dedicated to minerals. First opened in 1904, geosciences and geological and petroleum engineering's Mineral Museum is an exhibit of gems, gold, fossils and meteorite fragments totaling over 3,500 samples from 92 countries.

One of the largest collections of minerals in the state, Missouri S&T's Mineral Museum dates back to the 1904 World's Fair in St. Louis. After the fair, exhibitors did not want to face the costs of shipping a large collection of minerals back to their original homes. The collection was donated to the care of Dr. **George E. Ladd**, director of the Missouri School of Mines and Metallurgy between 1897 and 1907.

Cryloite from Ivigtut S.W.
Greenland. Donated by
Dr. Hans Pauly.



DEAR ALUMNI, COLLEAGUES AND FRIENDS

Welcome to the GGPE department's 2017 newsletter! We bring together one of the most unique and compelling combinations of geologic and petroleum engineering and geosciences in the country, and I can't wait to help each of our programs flourish and grow.

A bit more background about the new guy. I received my bachelor's degree in geology and geophysics from what was then the University of Missouri-Rolla in 1995. I moved on to the University of Michigan and graduated in 1997 with an M.S. in economic geology. Then came five years in industry, first as an exploration geologist with ASARCO, and later as a project scientist and site manager with Black & Veatch in Kansas City.

I returned to school to get my Ph.D., specializing in geochemistry, at the University of Notre Dame. I followed this with a stint as a Mendenhall Postdoctoral Fellow at the U.S. Geological Survey in Denver, before moving to an academic position at the University of Texas at El Paso. I spent six years at UTEP before moving to the University of Louisiana at Lafayette in 2012 to become the inaugural director of the School of Geosciences. My move to Missouri S&T to become your department chair is not only exciting for me, but also promises to be a great move for my wife Peggy and our three children. Peggy is actually from Rolla and also graduated from S&T.

My research and teaching interests are primarily in the areas of water resources and petroleum geochemistry. I routinely teach courses in petroleum geochemistry, mineral exploration and aqueous geochemistry (sometimes including geomicrobiology). My research dealing with water resources has been funded by the National Science Foundation, USGS and many local and state agencies. Focus areas have included the Rio Grande Basin, the Gulf Coast and the Mississippi River Alluvial Aquifer system.

My petroleum geochemistry research focuses on hydrocarbon source rock analysis. I've worked on projects dealing with rocks in Southeast Texas (Eagle Ford), and the Appalachian (Marcellus) and



Permian (Spraberry) Basins. This work has included much collaboration with petroleum engineers.

I'm grateful for the opportunity to tell you a bit about myself and am looking forward to hitting the ground running this fall. I also want to thank Franca Oboh-Ikuenobe for her good work as interim chair and for making it such a smooth transition.

As an alumnus myself, I have a strong bond with our university and a great desire to champion who we are and what we do. It's a priority for me to develop relationships with alumni, so feel free to contact me anytime with suggestions on how to help support our department, programs and students (borrokd@mst.edu).

David Borrok, Ph.D.
Gulf Oil Foundation professor and chair,
geosciences and geological and
petroleum engineering



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Thank you to our alumni, employees and companies for their support.

Rickey Hendrix, third from the left, with S&T students at SPE meeting in Oklahoma City.



GGPE ALUM RETURNS AS PETROLEUM ENGINEERING LECTURER

After nearly 20 years in the petroleum industry, **Rickey Hendrix** joined our GGPE family in 2016 to teach drilling engineering courses as a lecturer, a return to the campus where he earned two master's degrees as well as his Ph.D.

Hendrix, MS GeoE'04, MS PetE'06, PhD PetE'13, taught four undergraduate and graduate courses: Pet Eng 4210, Drilling Engineering and Well Design; Pet Eng 4211, Advanced Drilling Technology; Pet Eng 4811, Offshore Petroleum Technology; and Pet Eng 6001, Special Topics: Well Plugging and Abandonment.

His first year teaching in the department was an active one, both inside the classroom and beyond. A regular attendee at Society of Petroleum Engineers meetings, he accompanied SPE on a trip to Oklahoma City, which included a visit to Devon Energy

headquarters and a rig visit with Helmerich & Payne Drilling as well as the group's regional conference.

He revived and advised the American Association of Drilling Engineers chapter here at Missouri S&T, traveling with students to the national AADE technical conference in Houston. There, he joined two of our star petroleum engineering graduate students, Abo Taleb Al-Hameedi and Husam Alkinani, who were honored with medals as winners in research presentation competitions.

Hendrix also advised the inaugural Drillbotics student design team for

Missouri S&T. Drillbotics is an international design competition to design, build and operate an autonomous drilling rig given weight, economic and many other design constraints. One of the students, chief technology officer Jana Hochard, presented the drilling automation design to Missouri legislators in Jefferson City for Capitol Day, highlighting the value that our university brings to the state.

After completing his doctorate in 2007, Hendrix worked as a Chevron drill site manager and drilling operations performance engineer for six years in Thailand. His industry experience also includes research and development of advanced sand control completions technology; supervising 120 employees on an offshore drilling rig and platform; and, as a drilling engineer, promoting drilling efficiency and developing advanced software and best practices for drilling rig scheduling and rig-to-platform compatibility.



THANK YOU

With my tenure as interim department chair having ended on July 31, I want to thank my faculty colleagues, staff, students, alumni and the university administration for their support. The leadership team of associate chair **Dave Rogers** and assistant chairs **Ralph Flori** (petroleum engineering), **Katherine Grote** (geological engineering), and **John Hogan** (geology and geophysics) helped steer the department on a positive trajectory during the 2016–2017 academic year. The trio of **Patty Robertson**, **Sharon Lauck** and **Wendy Albers** provided able leadership on the administrative side, and also took excellent care of our faculty and students' needs. Provost **Robert Marley** and former Interim Vice Provost and Dean of Engineering and Computing **Richard Brow** also provided support for the department, for which I'm grateful.

I am very excited that **David Borrok** is our new department chair. Through his work as director of the School of Geosciences at the University of Louisiana at Lafayette and industry experience, Borrok brings a wealth of experience to his new job. His prior connections to Missouri S&T as an alumnus and former chair of the Geology and Geophysics Advisory Board strengthen his ability to foster the relationships the department built with various constituents over the years. It is my hope that he will enjoy as much alumni support as I did in two years and seven months on the job.

This fall, **Abdulmohsen Imqam** joins the department as an assistant professor of petroleum engineering after a national search. Imqam is a 2015 Ph.D. graduate of S&T, and was a postdoctoral associate before his hiring. We were sad to bid farewell to **Peyman Heidari**, assistant professor of petroleum engineering, who in June left academia for a job in the industry. I wish him success in his new endeavor.

GGPE students continue to attend professional conferences, such as the Society of Petroleum Engineers Annual Technical Conference and Exhibition, American Association of Petroleum Geologists (AAPG) Annual Convention and Exhibition, and Geological Society of America annual meetings, represent the university in various competitions, and receive recognitions for their research efforts. Our students participated in AAPG's IBA (Imperial Barrel Award), PetroBowl, and various design team competitions. During the spring semester, the student leadership council (comprising the presidents of GGPE student organizations, chair and associate chair) hosted a Friday afternoon social hour for students and faculty. Our students were also actively engaged in the department's recruitment efforts, such as open houses and high school visits, as enrollment figures trended slightly downward. While geological engineering held steady mostly through transfer admissions, student enrollments in geology and geophysics and petroleum engineering fell slightly last year. The department is making efforts to reverse this downward trend.

As in previous years, Phonathon calls took place in mid-September. Sincere thanks to all alumni and friends who have given generously to support all three programs, especially with declining public support of higher education. The quality of our students' education depend in part on the hands-on experiences they receive through field trips and travels funded by alumni donations.

Lastly, please stop by to say hi if passing through Rolla.

Francisca Oboh-Ikuenobe, Ph.D.
Professor of geology and biological science

RECENT GRAD EARNS SCHOLARLY HONORS FROM COLLEGE OF ENGINEERING AND COMPUTING

Cory Reed, a 2017 geology and geophysics graduate of Missouri S&T from Union, Missouri, was one of 10 doctoral students honored in the spring by the College of Engineering and Computing as a Dean's Ph.D. Scholar.

The award winners were nominated by professors in their home departments and honored at an end-of-semester campus reception in May. The recognition follows the launch of similar CEC awards in the 2016–17 academic year for top faculty researchers and those who excel in the classroom.

Reed was honored for his research into seismic investigations of a massive rift in Africa that is slowly splitting the continent.

"Graduate students are vital contributors to the Missouri S&T research and teaching mission," says John Myers, associate dean for academic affairs and a professor of civil, architectural and environmental engineering. "We wanted to recognize the top doctoral students as they prepare to launch their own careers in public service, industry and academia."

As a group, the 10 winners produced a total of 152 technical publications and reports, Myers notes, with another 26 publications under review. The cohort has collectively accrued 35 external awards and served on 30 different technical society committees.



YANG-LED PROJECT RECEIVES \$2.1M NATIONAL SCIENCE FOUNDATION GRANT TO STUDY EARTH'S GREATEST MASS EXTINCTION

Wan Yang, associate professor of geology and geophysics, has devoted his academic career to unlocking the mysteries of the Permian mass extinction more than 250 million years ago. That geological odyssey now finds Yang leading an 11-institution consortium that in July was collectively awarded a \$2.1 million National Science Foundation research grant.

Each summer for the past 15 years, Yang has collected rock samples that predate dinosaurs by millions of years in the high desert Bogda Mountains of northwest China, near the massive country's borders with Kazakhstan, Mongolia and Russia. The Xingjiang Uygur autonomous region – which includes parts of the famed Silk Road trading route – is also the area where Yang was born.

The field sedimentologist and stratigrapher is the principal investigator for a collaboration that will also involve scientists from Southern Methodist University; the University of Texas at Dallas; University of Washington; Boise State University; Colby College; Shandong University of Science and Technology in China; the University of Freiburg in Germany; the Nanjing Institute of Geology and Paleontology in China; the Institute of Vertebrate Paleontology and Paleoanthropology in Beijing, a branch of

the Chinese Academy of Sciences; and two of our country's most prominent natural history museums: the California Academy of Sciences in San Francisco and the Field Museum of Natural History in Chicago.

The research team will document the detailed evolution of land animals and plants before, during and after the extinction event and analyze evidence of ancient climatic, atmospheric, environmental, tectonic and other ecosystem changes to find the causes, timing and pace of the extinction and ensuing recovery.

The two science museums will assist with a public outreach effort that includes a series of education videos for "The Brain Scoop," the Field Museum's educational YouTube channel. Colby College in Maine and UT Dallas will offer summer workshops for high school science teachers.

While the most well-known mass extinction occurred with the demise of dinosaurs at the end of the Cretaceous Period, the planet's largest mass extinction happened approximately 251 million years ago at the end of the Permian Period, when more than 70 percent of the Earth's land species vanished on the supercontinent Pangea.

Unlike the demise of marine life in that era, which is well-documented, the terrestrial track record is less known, Yang explains, with land records harder to preserve since they are exposed to the elements. The project will examine well-exposed sedimentary rock successions that formed in lakes, rivers and ancient soils, enabling a precise documentation of the sequence of events on land and an investigation of how terrestrial animals and plants responded to these changes.

The results will determine if extinctions on the continents occurred at the same time as those in the ocean and what conditions existed that may have caused such large-scale changes.

"The findings will provide critical insights into ongoing extinctions and the likelihood of similar global scale mass extinctions in the near future," Yang notes. "A comprehensive, multidisciplinary investigation of critical intervals of Earth history offers the best insights into the conditions that prevailed before, during and after major biotic crises."

Yang's research team includes three paleontologists, a geochemist, geochronologist, paleomagnetist and ecosystems modeler. His share of the three-year NSF grant is \$369,368.

FIELD CAMP ENDOWMENTS HONOR PAIR OF GGPE ICONS: GRANT AND LAUDON

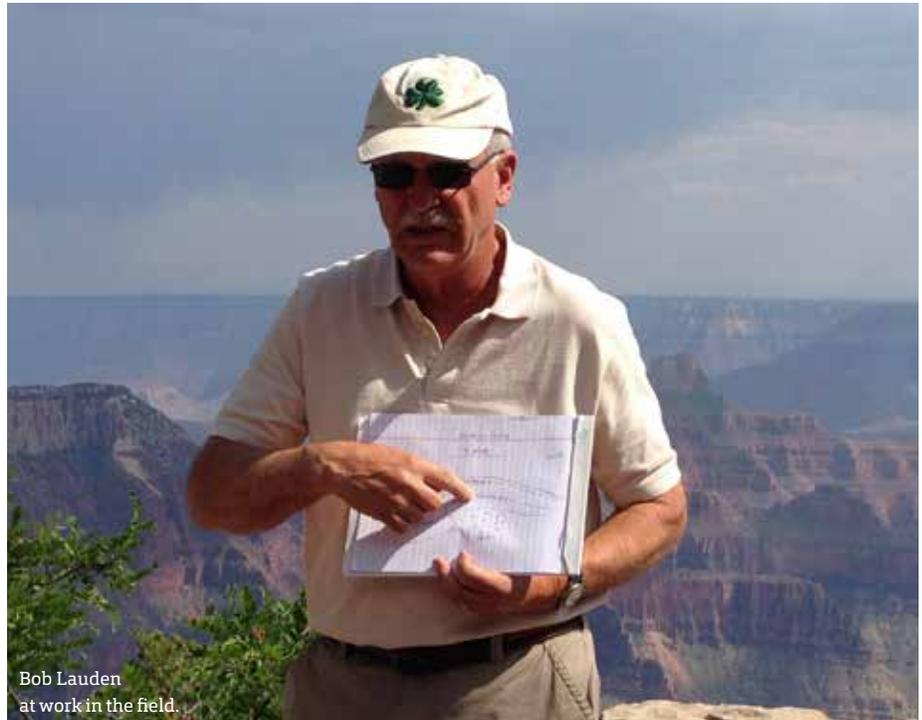
By Suzan Wiemers, GGph'86

I had two influential professors during my undergraduate years in Rolla: **S. K. "Kerry" Grant**, who helped me enroll for my geoscience classes three decades ago and who guided me to a U.S. Geological Survey internship that evolved into a growth opportunity for numerous professional and personal achievements; and **Robert "Bob" Laudon**, whom I looked up to as a mentor when I was considering a career in the oil and gas industry and who advised me during selection of a graduate program.

From both of these men, I have gained appreciation for university loyalty and the value of giving back to our department — in particular to honor two GGPE icons.

I have been contributing to the S. K Grant Field Camp Scholarship for some time. I feel a responsibility to help the next generation of geoscientists gain opportunities like I had.

So when an endowment effort was recently initiated to similarly honor Laudon, I thought it complementary to the Grant recognition, since these two leaders collaboratively and in each their own way have shaped what remains for Missouri a leading, nationally recognized summertime institution: geology field camps.



Bob Laudon
at work in the field.

I was extremely pleased to hear that **J. Michael Party**, GGph'78, this year donated full funding to establish a Laudon endowment. With this generous gift, alumni can not only provide financial support to create an outstanding educational field experience for students but also help recognize one student attending the advanced field camp with the Robert Laudon Advanced Field Camp Award.

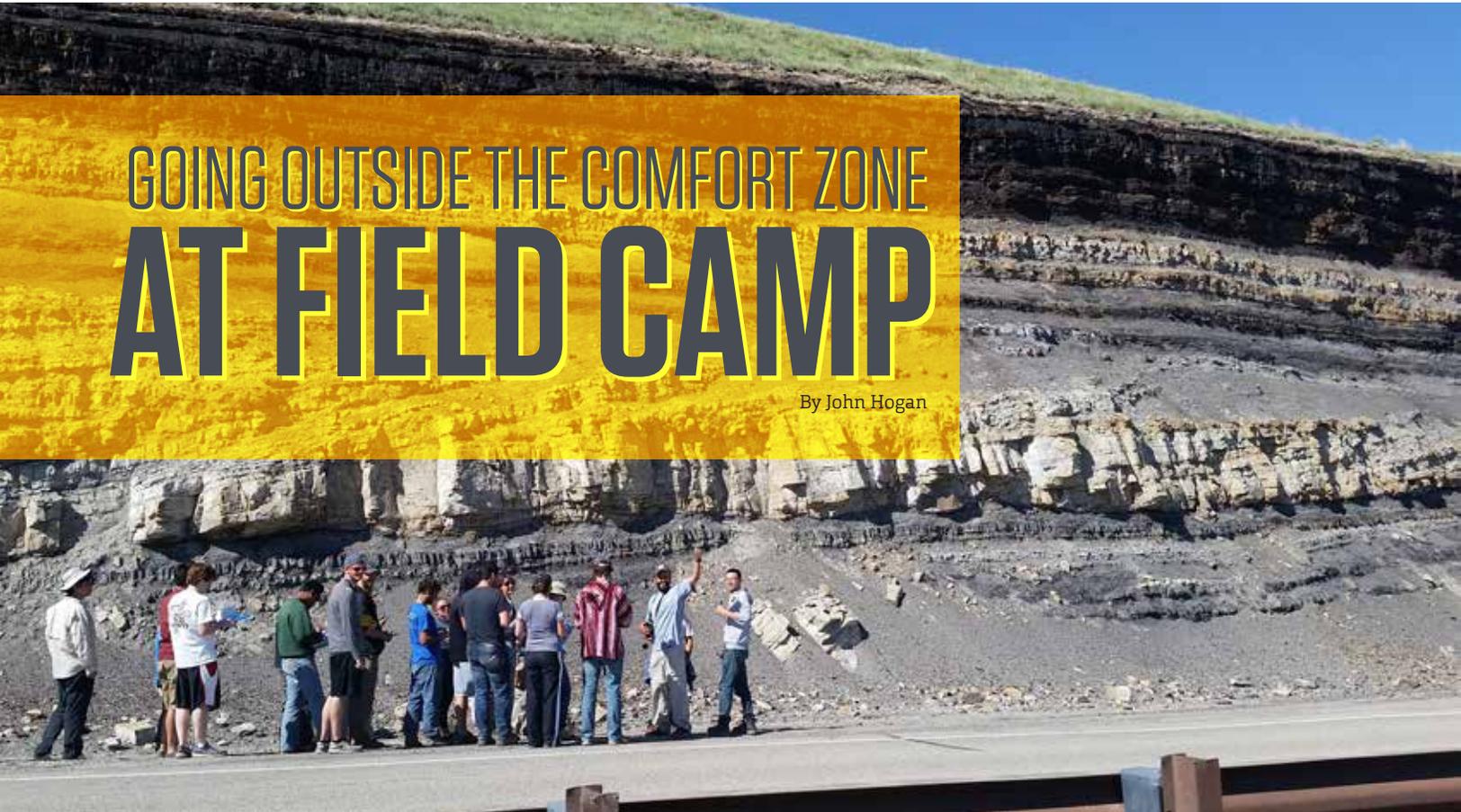
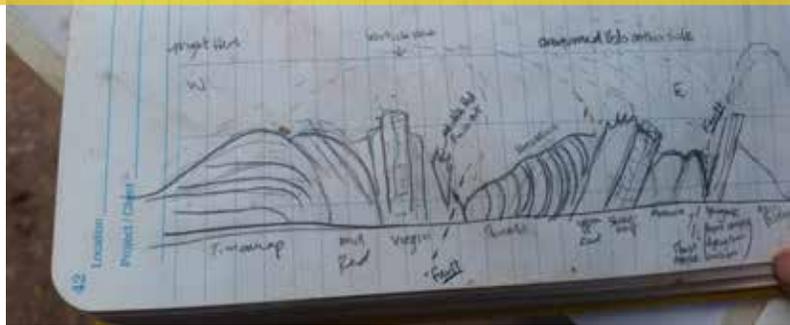
As a student in 1985, I was able to attend Bob's field camp. Thirty years later, I was back.

It turns out Bob had always wanted to conduct an Alumni Field Camp. We talked about this a lot in 2013 when my tenure as Geology and Geophysics Advisory Board chair began. By the end of that year, we had a healthy alumni commitment to enable us to start securing travel arrangements and coordinate logistics while Bob began work on a comprehensive field guide. It was a labor of love on both our parts, and together we mapped out a five-day road trip to Nevada, Utah and Arizona. The trip was a huge success: a comfortable, unforgettable experience for 28 participants (alumni, friends and family — even Bob's family participated) with no safety issues, and

we raised a little money to contribute to the Grant endowment.

Although I have kept in touch with Bob over the many years through occasional AAPG conventions, student recruiting interfaces and personal contact, it was the two-year effort to create and execute an inaugural Alumni Field Camp that was the best of all the time we have shared. Working as a team, we put our hearts, our souls and a whole lot of personal time in that labor of love to achieve a common goal! Bob was enjoying retirement and at times had to be coaxed back into the office for deadlines, and I had my full-time day job. While challenging to plan, it was extremely rewarding to step off the bus each day of the trip and again explore each impressive stop. And what I observed during this entire experience was just how much the field means to Bob. He is so committed, so passionate, so enamored with going to the outdoor classroom and teaching others. This new endowment named in his honor is appropriate for what Bob stands for and what he values most. It is who he is.

Won't you please honor Bob Laudon today and support a legendary field camp and a legendary man of the field!



GOING OUTSIDE THE COMFORT ZONE AT FIELD CAMP

By John Hogan

The blessing is outside your comfort zone.

Spiritual guides, marathon coaches and yes, field camp professors preach this mantra. Faced with the mental and physical challenges of constructing a geologic map, the ability to persist, keep frustration in check and follow the scientific method (and, per Twitter, #fieldcamp rules) will lead you to the promised map (yours). It can also keep you from temptation (aka Google search).

Jonathan Obrist-Farner joined the field camp faculty this year to help “push” students towards their personal “Ah-ha!” moments. His and Mike Wizevich’s expertise in clastics was essential. We erected a primitive camp on federal Bureau of Land Management land and measured stratigraphic sections in Capitol Reef National Park; a project developed by Jason Kaiser.

The transition from a floodplain with meandering streams to the shoreline to the pro-grading delta front (with some spectacular storm deposits amid piles of shale) was amazing — we’re coming back.

Out on an old favorite “The Red Hill,” new discussions regarding paleosols while looking right at the rocks were stimulating. I can always learn new things even in a field area I have been to many, many times.

We push the students to “map as they go” and construct schematic geologic cross-sections in their field book as they map (Rule 41). Many of them want to wait to do this at night in the dorms because “in the field” working outside their comfort zone (swatting bugs, tired from carrying loads of water, etc.). It’s very rewarding when they

realize #fieldcamp Rule 41 and hard work pay off! The geologic structure along the leading edge of the fold and thrust belt in Spring Creek comes alive when adhering to #fieldcamp Rule 41.

Field camp visited many spectacular geologic sites including Arches, Zion and Bryce, as well as a long “geologic shortcut” along dirt roads (which we shared with a cattle drive) through the Grand Staircase — Escalante National Monument to see deformation bands in the East Kiabab Monocline on our way to Mesa Verde National Park.

The long drives reminded me of field work in Africa. In Mesa Verde, the road-cut through the migrating point bar of a meandering stream complete with coal bed was perfect! But the real reward at the end of field camp is recognizing you now have developed the “grit” needed to seek more geologic blessings.



LOUISIANA SCHOLAR NAMED GGPE CHAIR

David Borrok, a professor of geosciences and director of the School of Geosciences at the University of Louisiana at Lafayette, is our new chair of geosciences and geological and petroleum engineering. His appointment took effect August 1.

Borrok was inaugural director of the Louisiana geosciences school, which consists of undergraduate and master's programs in environmental science and geology.

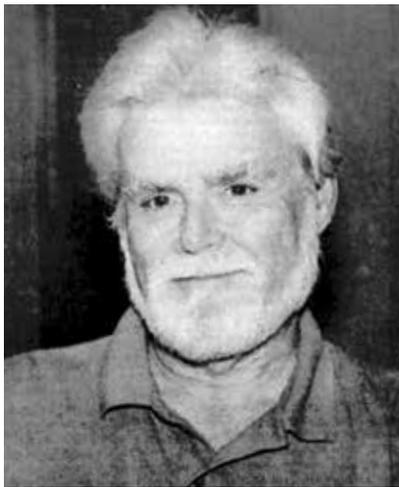
He was previously on the geological sciences faculty at the University of Texas at El Paso and also served as interim director of the Institute for Coastal Ecology and Engineering (now known as the Institute for Coastal and Water Research) at Louisiana-Lafayette.

The Kirksville native returns to both his Missouri and Rolla roots, having received a bachelor of science in geology and geophysics from Missouri S&T. He then earned a master of science in economic geology from the University of Michigan and a Ph.D. in geomicrobiology and geochemistry from the University of Notre Dame.

In addition to his academic career, Borrok spent several years in the private sector, working as a mineral exploration geologist in the United States, Europe and South America and as a site manager and project scientist for a consulting company. He has also worked as a postdoctoral fellow with the U.S. Geological Survey.

"My new department is home to one of the most compelling and unique combinations of geology and petroleum engineering and science programs in the country," Borrok says. "I plan to find and create opportunities to elevate each of the programs individually, and the department collectively.

"I couldn't be happier to lead such an exciting and dynamic department. And returning to Rolla, where both my wife Peggy and I received our undergraduate degrees, makes the move that much more attractive."



IN MEMORIAM

RICHARD D. REHTIEN, ASSOCIATE PROFESSOR EMERITUS OF GEOPHYSICS, 1933-2016

Richard (Dick) D. Rehtien died in Waveland, Mississippi on Saturday, October 22, 2016 at the age of 83.

An accomplished geophysicist, Dick worked at Missouri S&T, then the University of Missouri-Rolla, from 1966 until 1992. After retirement, he continued to teach geophysics part-time for several years. Dick's specialty was seismology, and he worked on numerous projects for NASA and the U.S. Army and was principal investigator on several projects published by the Missouri Water Resources Research Center.

Dick was one of the world's leading experts on the use of seismic waves for the detection of subterranean tunnels. He and his loving wife, Pat, were active members of St. Patrick Catholic Church in Rolla before moving to Mississippi. He is survived by Pat and three sons.

SOME PERSONAL EXPERIENCES IN THE GEOLOGY DEPARTMENT IN THE LATE 1950'S AND 1960'S

By Bruce L. Stinchcomb, GGph'61, PhD GGph'78

First order of importance might be to mention that geology requires a broad and rigorous background in all of the sciences and that Rolla's "Missouri School of Mines" involved all the basic sciences, which have always been strong on our campus. A classical geology program also meant exposure to "hands-on" geologic fundamentals, which included field trips as well as exposure to lots of rocks (and fossils); in fact, it's been said that, "the best geologists are those who have seen the most rocks." With the department's 1950's and later occupation of expansive Norwood Hall, there was ample room for lots of rocks and fossils. One of my earliest paleontological specialties was to open up old newspaper-wrapped collections of fossils and curate them. This included not only cleaning and organizing, but most importantly, included the copying of information from fragmented, yellowing labels which had been partially eaten by silverfish, primitive insects which seem to be especially attracted to labels on fossils (my main specialty) as they were often attached with hide glue.

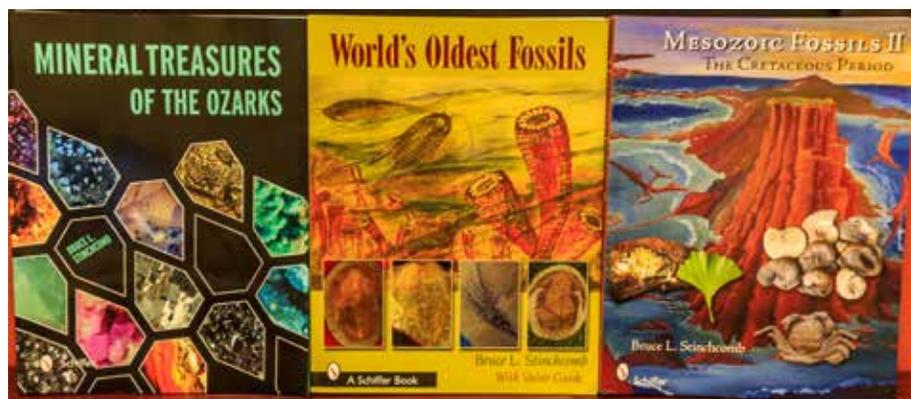
Previous to Rolla, as a high school student, I had done this on a collection given to the St. Louis Academy of Science — a 19th century fossil collection of Lundsford J. Yandell of Louisville, Kentucky. Doing a similar thing at Rolla, Al Spreng led me to newspaper-wrapped fossils stored in the attic of Norwood Hall, where I found a scenario similar to that with Dr. Yandell's fossils — fossils wrapped in yellowed 1920's newspapers rather than the pre-Civil War vintage wrappings of Dr. Yandell's fossils. The 1920's Norwood Hall collections were made by former faculty members Josiah Bridge, E.O. Ulrich and Charles. L. Dake, all previously involved with unraveling the challenging Cambrian and Lower Ordovician geology of the Missouri Ozarks. What I found out later about the Yandell collection was that Yandell was a friend of and geologic guide in 1847 to Charles Lyell, often considered, along with James Hutton, as the founders of modern geology — so both of the collections I worked on were definitely made by competent geologists.

“... one of my earliest paleontological specialties was to open up old newspaper-wrapped collections of fossils and curating them.”

In the 1950's the northern part of Rolla was bounded by U.S. Route 66, north of this was only rough terrain and woods. Al Spreng, who often invited me on excursions related to his interest in Mississippian age rock of the western Ozarks, had shown me a collection from the outliers to the north of town. Serious collecting from these outliers became a focus, and over many weekends, a sizable accumulation of them was acquired. What seemed especially interesting was that the fauna from these outliers was sufficiently different from similar age fossil occurrences around St. Louis, with the Rolla fauna being especially rich in mollusks. When odd Devonian fossils in quartzite, originally found and described by Josiah Bridge also occurred northwest of town, Ozark fossil-bearing outliers became even more interesting. Later, upon obtaining a teaching position in geology at St. Louis Community College at Florissant Valley (and its accompanying increase in financial resources), I investigated what is known as the Chronister vertebrate-fossil site, which is a Mesozoic (Late Cretaceous) age outlier in Bollinger County. Getting to know

the landowner, Ole Chronister, quite well, I bought the site and its investigation by two former students has been an ongoing project, which is also responsible for Missouri's state dinosaur *Hypselibema missouriensis*.

Other connections to Missouri paleontology and Rolla came through former department paleontologist Don Frizzell. I became interested in Ozark Cambrian fossils and Frizzell's focus on taxonomic legalities and protocol came in handy in working with puzzling cone and spoon-shaped fossil mollusks known as monoplacophorans. Specifically, this was because taxonomic confusion existed in abundance with these fossils but with help from Frizzell, became less of a challenge. I could mention other icons of Missouri geology who had influence on me like O.R. Grawe and Tom Beveridge, the latter who offered me, as a tender undergraduate, summer employment with the Missouri Geological Survey doing reconnaissance geology in some southern Ozark counties bordering on Arkansas, but that's another story!





HINKLE HONORED BY S&T WITH PROFESSIONAL DISTINCTION AWARD

Delores James Hinkle of Houston, PetE'75 and retired director of corporate reserves for Marathon Oil, received an Award of Professional Distinction during spring commencement ceremonies in May. The award recognizes outstanding Missouri S&T graduates for professional achievement.

A 1971 graduate of Clinton (Mo.) Senior High School, Hinkle was the feature twirler for the Marching Miner Band, a Society of Petroleum Engineers officer, a member of Pi Epsilon Tau, a committee chair for the Student Union Board and president of the Women's Residence Hall Association, serving as a residence assistant for two years. She was granted a four-year Union Oil academic scholarship and also holds an MBA from the University of Alaska-Anchorage.

During her 38-year career in the oil industry, she worked in various production and reservoir positions for Sun, ARCO and Marathon in Alaska, Wyoming, Oklahoma and Texas. She retired in 2013.

A member of the Missouri S&T Academy of Mines and Metallurgy, Hinkle is vice president of the Miner Alumni Association. She was active in the Society of Petroleum Engineers, serving on numerous committees for a variety of technical symposiums and

workshops, chaired the Oil and Gas Reserves Committee, participated in the development of SPE's Petroleum Resource Management System, served as the bureau vice chair of the UNECE Ad Hoc Group of Experts, and was a technical editor for the Oil and Gas Journal. She received the Gulf Coast Section Reservoir Description and Dynamics Award in 2014 and the Society's Distinguished Member Award in 2015.

Hinkle has served on the board of the San Jacinto Council of Girl Scouts for eight years, currently as vice chair. Nominated for president and chair-elect for the upcoming term, Hinkle is a member of the Executive and Finance committees and former chair of the Properties Committee that oversaw renovation and redevelopment of one of the council's camps. Hinkle and her husband, Dan, a 1973 engineering management graduate of Missouri S&T, are members of the Order of the Golden Shillelagh.



NEW FACULTY PROFILE: ABDULMOHSIN IMQAM

Abdulmohsin Imqam joined the petroleum engineering program as an assistant professor in August after receiving his Ph.D. degree from here in 2015, followed by two years as a postdoctoral fellow.

He previously worked as a petroleum engineer at Suncor Energy and has four years of experience in the oil industry. Imqam is teaching the petrophysics course during the fall semester and well logging in the spring semester.

His research interests include cementing and wellbore integrity; enhanced oil recovery in unconventional and conventional reservoirs; and hydraulic fracturing and reservoir geomechanics.

Imqam has published more than 25 papers and technical reports. He is looking forward to collaborating with faculty members in all the three GGPE programs to develop new research directions for undergraduate and graduate students.



WAN YANG: KEEPING THE WONDER ALIVE

Thirty-seven years after becoming fascinated with the Earth in my first geology class, I am still learning new things every day in the field, lab, classroom and many other places.

It is especially rewarding to interact with the young minds of our undergraduate and graduate students and early-career colleagues. In them, I often see the reflections of my younger self.

Our research team has expanded traditional field, petrographic and subsurface methods to inorganic and organic geochemical, detrital zircon geochronological, and ecosystems approaches in our studies of sedimentology, stratigraphy, paleoclimatology, and petroleum geology.

To list a few, shale sedimentology and stratigraphy are intriguing and challenging. Outcrop surface model using data captured by unmanned aerial vehicles sets up a multi-scale framework to place petrographic data in order to document and explore the controls of sandstone reservoir heterogeneity.

Microbes are probably the culprit in the formation of a series of magnificent lacustrine carbonate mounds.

Biomarkers as environmental and paleo-atmospheric proxies are being tested in a sedimentological and cyclostratigraphic context. The 3-D seismic data from Sirte Basin, Libya, may reveal the stratigraphic architecture and evolution of carbonate platforms, where some of the largest petroleum reservoirs reside.

Among all these fun research interests, a major endeavor has been the construction of a cyclostratigraphic architecture of the Permo-Triassic fluvial-lacustrine deposits in the Bogda Mountains of northwest China, to decipher the paleoenvironmental and paleoclimatic changes before, during and after the end-Permian mass extinction.

This framework will set up the foundation for vigorous multi-disciplinary studies on the tempo, effects and causes of terrestrial mass extinction in northeast Pangea and the world. This has been a 15-year adventure involving several former and current

students and colleagues from the U.S. and China. It has finally culminated in a three-year National Science Foundation-funded project (see page 4)

Just imagine the excitement and logistical nightmare next summer when I will be leading a team of geologists from eight U.S. and two Chinese institutions for fieldwork in the high desert. However, I am somewhat at ease for a good reason — I will have the help from a brilliant young paleobotanist, Mingli Wan from Nanjing Institute of Geology and Paleontology, a postdoctoral fellow on our team. I have learned from and been rejuvenated by working with him. His knowledge, work ethic and drive have prompted me and other team members to strive even deeper.

In the classroom, assistant professor Jonathan Obrist-Farner is taking over the petroleum geology class, which I inherited from Bob Laudon in 2010. So I can now focus on five upper-level sedimentology and stratigraphy classes. However, I miss teaching physical geology, where I had entertained and enticed many freshmen to pursue a geology major and career.

Rolla has been such a pleasant place to live and work, and is one of my favorite places in the States. I cannot thank enough our alumni, friends and colleagues for all the support to me and our students over the years. When you have a chance, drop by and visit us.



AVERY WELKER: RESERVOIR RESEARCHER

An internship with Devon Energy in downtown Oklahoma City this past summer helped transform **Avery Welker**, PetE'16, from a student with a passion for petroleum engineering into a professional with the skills and experiences to take on industry challenges.

"I was absolutely floored by how respected I was by the other employees," says Welker, who is pursuing his Ph.D. in petroleum engineering at S&T. "Everyone was so helpful and encouraged me to contribute to the discussion. Devon really fosters a wonderful internship program."

As a reservoir engineering intern, Welker helped evaluate field performance by simulating field tests using a specialized modeling software. He credits three

petroleum engineering courses — Applied Reservoir Simulation, Reservoir Engineering and Mechanical Earth Modeling — with helping him be prepared for the experience. It's the type of work he hopes to return to after graduation.

"Without the software experience I had from classes, I may not have gotten the position at all — or at least I would have been very lost for a few weeks," he says. "Learning how to intelligently pick parameters to

change in the software was definitely a learning curve but using what I learned in the class helped me solve problems."

Despite having a solid educational foundation going into the internship, Welker says the experience also taught him that you have to be open to new ideas and learning new things.

"The industry is ... constantly evolving, so what is the best practice to do something now may be out of date in a year," he says.

Welker applied for the internship after talking with **John Hogan** and **David Wronkiewicz** and was hired after the company recruited on campus.

"When I got to Devon, they told me that I was the first student from Missouri S&T to be hired by Devon in a petroleum engineering role," he says. "I was very honored to hear that and was glad to show Devon how I could apply the education I have received from S&T to real-world problems."

Welker says his internship also taught him to apply practicality to problems.

"Not everything that you do will be absolutely perfect — knowing what is good engineering work and using good engineering judgment will go a long way," he says.

RAINY BRITISH FIELD TRIPS,
ADVANCED MECHANICAL EARTH MODELING
AND THE ALLURE OF FOLDING:

A FEW OF ANDREAS ECKERT'S FAVORITE THINGS

This is my ninth year at Missouri S&T — the time goes so fast and many things happen along the way. I still teach Finite Element Analysis and Mechanical Earth Modeling to undergraduates, as well as Geodynamics and Advanced MEM to graduate students.

In 2016, I received a Missouri S&T Outstanding Teaching Award, which I really appreciate, because I know that my classes are quite challenging for our students. Our program's MEM initiative is still strong, and actually growing, as we participated in a collaboration with Louisiana State University initiated by Chevron. Part of this initiative was an exchange in remotely-taught classes: students from LSU could take my FEA class, while our students could take a Well Plugging and Abandonment class offered by LSU. As an additional aspect of this collaboration, my Ph.D. student Vincent (Weicheng) Zhang, who is working on a Chevron-funded project on "Numerical simulation of Micro-annuli initiation," has been named "Chevron Doctoral Scholar of Mechanical Earth Modeling."

After my promotion to associate professor in 2016, I also was offered a joint appointment in the geology and geophysics program, which now allows me to supervise G&G graduate students who want to work in my field of expertise. This was really helpful to me as most of my current research is focused on numerical simulation of folding processes, a typical topic in structural geology. In the past few years, graduate student Darcy (Xiaolong) Liu and I have published six papers on the topic of buckle folding, with hopefully more to come.

As part of our focus on folding, I have co-chaired two sessions on "Folding and fold related processes" at the two most recent Geological Society of America annual meetings. Folding has proven to be a very captivating and creative research topic. If only I had known this 13 years ago as a graduate student, when I was part of a rainy field trip in southwestern England thinking, "Who cares about all these folds?" Well, I have learned my lesson.

"The most gratifying part of my job is the fact that most of my graduate students have been able to obtain high-quality jobs and contribute to their profession."

In summary, I am very happy to be part of the GGPE faculty for the last nine years and happy about the accomplishments along the way. The most gratifying part of my job is the fact that most of my graduate students have been able to obtain high quality jobs and contribute to their profession. Lastly, I would like to thank my graduate students for their dedication and hard work, and our undergraduate students, our staff members and my colleagues for making GGPE at S&T a fun place to work.





LESLIE GERTSCH: MINING WATER IN SPACE

Associate professor Leslie Gertsch is wrapping up a research project that baked asteroid-like materials in a vacuum to capture the water that is part of some minerals.

It's all part of learning how to produce consumable materials in space instead of pushing them up from the Earth's surface. To investigate the possibility of this industrialization for space travel and exploration, Gertsch heated real and artificial meteorites in a vacuum chamber to simulate the conditions of space. When gases are released from the samples, they are collected and analyzed.

Space mining and processing are part of what NASA calls in-situ resource utilization —

collecting natural resources from asteroids, comets, the moon, or even Mars, and manufacturing things like spacecraft fuels and propellants from those resources.

Some asteroids contain up to 22 percent water; not as ice, but locked within the minerals themselves. This research measured how much water can actually be extracted. The answer is: quite a lot! Depending on the materials tested, between 40 percent and 80 percent of the water bound in minerals like serpentine and smectite can be recovered by

this process. That means a 10-meter diameter asteroid (of the right type) could produce up to 270 metric tons of water. That's 270 fewer tons to be launched from Earth at \$10,000 per kilogram. Why carry all your fuel from home when you can use a local gas station?

Gertsch has been active in the ISRU community since the late 1980s. She and other Missouri S&T faculty plan to continue research in this field to support human landings on Mars in the 2030s and return trips to the moon even sooner.

This latest project, titled "Laboratory Demonstration and Test of Solar Thermal Asteroid ISRU," was one of 11 university-led proposals funded by NASA as \$500,000 Early Stage Innovation Research Grants (nasa.gov/directorates/spacetech/strg). The funding is provided to study innovative early-stage technologies that address high-priority needs of America's space program.

Gertsch collaborated on this project with NASA Kennedy Space Center, NASA Glenn Research Center, Colorado School of Mines, the University of Hawaii and Integrated Concurrent Systems Associates Inc.

DISPATCHES FROM MACHU PICCHU, PERU

By Neil Anderson

During their tenure at Missouri S&T, most undergraduate geological engineering students spend a spring break in the Cusco-Machu Picchu area of Peru, immersed in past and present Andean cultures. This past spring break was no exception.

On March 24, 11 geological engineering undergraduates and four graduate students joined volunteer Maribel Cruz and myself on flights to South America via Atlanta. Our group landed in Lima just after midnight and was shuttled to a hotel in the lovely Miraflores district. The hourlong ride gave the students the opportunity to view weekend nightlife in Lima through the comfort of a bus window.

The highlight of the trip was time spent exploring fabled Machu Picchu.

Early the next morning, we were ferried back to the Lima airport and for a flight to Cusco, capital of the fabled Inca Empire. We arrived late Saturday morning and were immediately transported to the town of Urubamba. The plan was to give our bodies some time to acclimatize. Accordingly, we

would spend our first few days visiting archaeological structures at lower elevations (approximately 7,500 feet above sea level) before returning to Cusco, which sits at more than 11,000 feet.

On Sunday morning, we rose early, drove to the town of Ollantaytambo and hiked up into the towering mountains, a five-hour excursion. Our group visited a long-abandoned Inca granite quarry and respectfully viewed an open Inca cairn, complete with a half-dozen skeletons. Our guides explained how the Inca quarried and transported large stone blocks down the mountainside and across the Urubamba River without either horses or oxen.

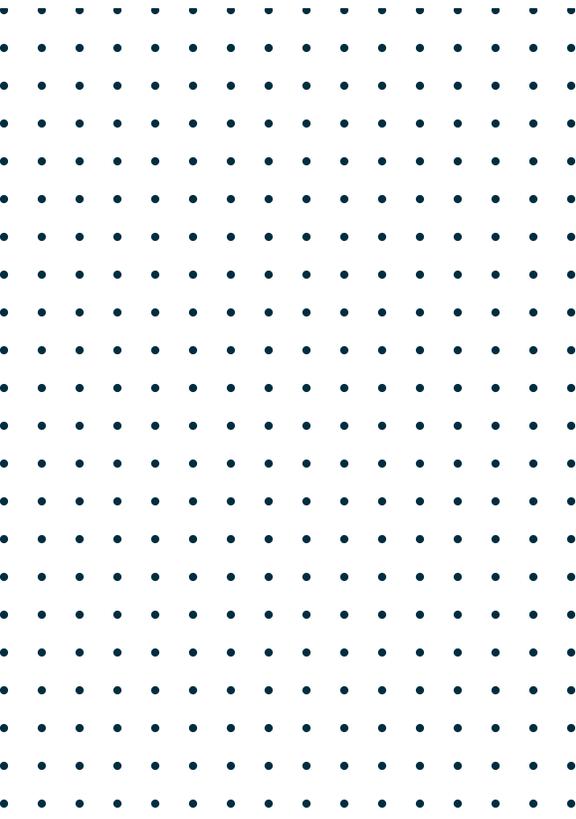
In the afternoon, we visited the Ollantaytambo Inca archeological site. Marveling at the earthquake-proof structure

while learning how the Inca cut, polished and set large building stones (without any metal tools) so perfectly that a sheet of paper cannot be inserted between the interconnected blocks.

On Monday morning, we visited the Inca salt mines of Maras and the circular experimental agricultural terraces of Moray. (It's amazing to think the Inca developed more than 3,000 varieties of potato). Monday evening was spent on the night train to the lovely town of Aguascalientes, located on the Urubamba at the base of Machu Picchu. Our group rose early on Tuesday, bused up the switchback road to the near top of the mountain, and spent the entire day exploring this awesome Inca World Heritage Site. Everyone hiked to the top of Huayna Picchu and enjoyed a most spectacular view of Andean mountains towering above the tropical rainforest. The Wednesday morning slow-speed train transported our group back to waiting buses in Ollantaytambo.

Our group visited the salt mines of Maras. The mines predate the Inca and are still operating today.

The railroad followed the winding Urubamba River valley; for much of the daytime ride we were treated to spectacular views of the raging river, the towering mountains and Inca agricultural



terraces that extended from the valley floor to the mountain tops. A couple hours later we were in Cusco.

During the next few days, we visited the Inca archeological sites of Tipon, Pisac, Koricancha and Sacsayhuaman, and learned how the Inca harnessed springs and diverted streams to support agriculture. We also visited the pre-Inca archaeological site of Piquillaqta and the magnificent Andahuaylillas Catholic Church.

On Saturday, April 1, our group rafted down a segment of the Urubamba River upstream from Cusco. The rapids (up to class III) were not overly wild, but they were continuous, so there was never a dull moment. The water was cool, but the skies sunny and the air warm. At the end of the ride, we were treated to an outdoor barbecue on the banks of the Urubamba. It was a wonderful way to effectively say goodbye to the Andean mountains. Early the next morning, we flew back to Lima to spend the day sightseeing in the heart of the old city. For many, the highlight was our visit to the catacombs of the San Francisco Monastery; for others, it was an evening spent relaxing on the rocky Pacific Coast beach, watching the sunset. Just after midnight, we boarded our flight home. We were headed back to the real world, most of us with dreams of returning to Peru.



GGPE STUDENTS CLUBS

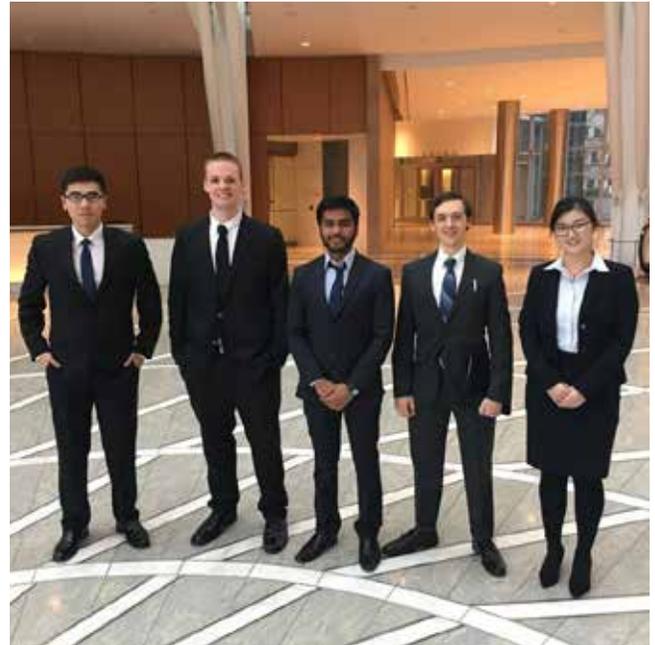


DRILLBOTICS

One of the newest student design teams on campus is the Drillbotics team. Each year, team members design and build a small-scale drill rig to autonomously drill through an unknown rock sample. The goal of the competition is for the next generation of engineers to develop a deeper understanding of the drilling process.

The team competes against other universities as part of the Society of Petroleum Engineers Drilling Systems and Automation Technical Section. The focus in the fall semester is on design, with five teams nationwide advancing to Phase Two, the build phase. In the spring semester, judges travel to the five selected universities with an unknown rock sample. The drill rig is scored based on its build quality, data collected and quality of the hole drilled.

Participants come from across campus, not just our petroleum engineering program. Mechanical engineers are needed to design the frame and all moving components. Geologists are sought for their expertise in rocks. And electrical engineers and computer programmers are needed to design the control system and software used to operate the drill.



AAPG STUDENTS COMPETE FOR IMPERIAL BARREL AWARD

The American Association of Petroleum Geologists organizes a yearly competition — the Imperial Barrel Award — where geoscience and petroleum engineering graduate students get an opportunity to perform a prospective basin evaluation.

The 2017 Missouri S&T IBA team — composed of Tianze Zhang, Avery Welker, Avikant Dayma, William Chandonia and Yani Lin — represented Missouri S&T at the regional competition in Oklahoma City, presenting their work and recommendations to industry experts on a prospect evaluated in northern Spain.

The team represented Missouri S&T well and the experience will better prepare its members to succeed in the oil and gas industry. Such experiences are invaluable to students from Missouri S&T and also help showcase the talent and strengths of our GGPE program. The Missouri S&T IBA team was proud of what it accomplished and received praises from the evaluating panel as well as from professors and students from other universities. The team was advised by Jonathan Obrist-Farner.



SPE UPDATE

Throughout the 2016–2017 academic year, our chapter worked diligently to improve student involvement and provide more opportunities for students to have access to the oil and gas industry. We held two open forums to allow students to voice their opinion in an open discussion setting about possible improvements that could be made to the petroleum program and SPE. Topics covered included lab improvements, curriculum updates, and adding the option to select an emphasis area. This discussion encouraged student involvement in the program and allowed students to feel like their opinions mattered. We plan to continue to host open forums in an effort to continually improve our program and organization.

The Oklahoma City SPE section has worked with the chapter to help coordinate two trips for students to attend conferences, visit with different companies, and tour several facilities. On the fall trip, students were able to tour Devon Tower and meet with employees from multiple disciplines to discuss what they do on a day-to-day basis. We were also able to go on tours of a Helmerich & Payne rig, a pipeline facility in Kushing, Oklahoma, and a Halliburton rock testing lab. In the spring, 24 students were invited to attend the Oklahoma City Symposium where there were technical paper presentations and an exhibition floor. This enabled networking opportunities and expanding knowledge of current research in the industry.

Overall this school year has contained a multitude of opportunities and achievements within our chapter. We have continued to expand on events with industry involvement and looking for ways students can help our chapter to be successful. With help from our alumni and department, we were able to plan and execute so many successful events and trips this year!



SPE ENERGY SYMPOSIUM AND BANQUET

For the seventh straight year, the Society of Petroleum Engineers was proud to hold our annual Energy Symposium in April. Speakers came from far and wide to present on technical topics ranging from “Reducing Costs and Optimizing Completion Practices Using Completion Diagnostics” to “The Intersection of the Environment and EOR: How Carbon Capture is Changing Tertiary Recovery.” Through these talks, students were able to gain industry insight and increase their petroleum knowledge. We would like to give a special thanks to each of our speakers: Brad Aman, Jing Zhang, Dan Scott, Chad Senters, Robert Balch, Ty Wright and Byron Cottingham.

The symposium also featured a “soft skills” panel. One prominent piece of advice that was echoed among the panel members was the importance of networking early in your collegiate career. As the industry is still in the works of returning from a downturn, this panel was a great tool to encourage students to utilize their resources and keep their hopes up in searching for a job or internship.

Graduate and undergraduate students got to show off their research and compete in a poster competition. Topics presented include Differential Permeability Reduction of CO₂ and Water by Polymer Gel in Sandstone Rocks During WAG Process, Comprehensive Guidelines for the Application of Gel Treatments, and the winner of the competition: Improving Supercritical CO₂ Flooding Conformance Control Using Micro-Particle Gel by Sherif Fakher.

The symposium concluded with the petroleum engineering program’s banquet. Graduating seniors were honored with a slideshow presentation showcasing their achievements as well as their future plans. Students were also recognized for their academic achievement, outstanding service and exceptional leadership within the program.

PETROBOWL

Missouri S&T’s PetroBowl team competed in the event’s regional qualifiers in early February at the North America Student Symposium in Denver. Placed in a tough bracket with schools University of Tulsa, Colorado School of Mines and the University of Oklahoma, the Missouri S&T team represented the university well, though it did not advance. With a relatively young squad, the PetroBowl team is in an ideal position to strengthen its abilities as a team, and hopefully advance in next year’s competition. A special thank you goes out to Drake Randall, PetroBowl chair in the months leading up to the competition.



STUDENT CLUB: ASSOCIATION OF ENVIRONMENTAL & ENGINEERING GEOLOGISTS

Members of the Missouri S&T chapter of AEG like to dedicate their time to bettering the community and the surrounding environment. Every semester, AEG plans a highway cleanup on Kingshighway where students pick up trash. Members of AEG also had the opportunity during the spring semester to spend a work day helping to clean up the Goodwin Pit Sinkhole in Laclede County.

During the school year, AEG meets every other Friday afternoon. Professors and industry professionals, speak about numerous topics ranging from investing

and research to industry life. Once a month, our student group is invited to attend the St. Louis AEG meeting, which not only provides insight into current professional projects but also a chance for students to network with professionals and learn about their employers.

AEG contributes to Missouri S&T every semester by selling rock kits to students enrolled in the physical geology course. This fundraiser benefits both the organization and students who can buy their needed rock kits at an affordable price. By setting up a booth

and poster at first-year orientation, AEG recruits students to become involved with not only our club but also the geosciences, geological engineering and environmental engineering programs on campus.

When the members of AEG aren't attending meetings and participating in cleanups, they enjoy some well-deserved fun. In the past year, AEG held a bowling social, where friendship met competition, spent an afternoon exploring the beauty of Clifty Creek and hiked around Maramec Spring to the beauty of nature.

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129 McNutt Hall
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