

MINING ENGINEER

Mining and Explosives Engineering | Missouri S&T | Fall 2019

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YOUR HANDS
AND YOUR MIND

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NO ONE KNOWS MINERS DIG DEEPER BETTER THAN WE DO

In mining engineering, digging deeper is a way of life. Because it's hard work to tap natural resources with the potential to transform lives. From rock mechanics and explosives to environmental reclamation, our students are learning the skills that drive innovation and next-generation leadership.

Your annual support of the mining and explosives engineering programs makes a difference in many ways. And helping Miners dig deeper is one. Because every dollar you contribute supports scholarships and field trips to the mining operations where students see theory put into practice.

So next time you receive a phone call from a mining engineering student eager to share what's happening in our department and on campus, we hope you'll take time to connect and catch up. We also hope you'll mine the possibilities by giving back.

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Mining and Explosives Engineering

mining@mst.edu

Mining ventilation expert **Guang Xu**, an associate professor of mining engineering at S&T, works in the Experimental Mine's newly renovated Mining Ventilation Lab, thanks to funding from our alumni and Doe Run.

DEAR ALUMNI, FRIENDS AND COLLEAGUES

We are glad to present another edition of the *Mining Engineer*. In this edition, you will read about things our students, staff and faculty have been doing in the past year to carry on the tradition of mining engineering at Rolla.

As you will find in these pages, we have been very busy this year. Our students have been engaged in many activities, and our faculty have continued to mentor them — and also engage in world-class research that enhances our reputation. Our staff, with dedication, have continued to support the faculty and students. I hope, after reading through this newsletter, you will agree that we are moving in the right direction.

As some of you might have heard, Drs. **Paul Worsey** and **Grzegorz Galecki** retired Sept. 1, 2019. Please help us thank them for their years of dedicated service to our programs. Dr. **Kyle Perry** was promoted to associate professor with tenure on Sept. 1. Dr. **Guang Xu** joined us as an associate professor of mining engineering Sept. 1, too. He will be our resident ventilation expert. We are excited to have Guang on board from the WA



School of Mines, Curtin University, Australia. As we go through this renewal within the faculty, we believe we are in a position to be a leader in mining and explosives engineering education.

In the coming year, we will work to educate excellent mining and explosives engineers for industry and conduct research that improves how we do business in our industry. We will also be diversifying our graduate certificates for distance education to give working professionals more options to enhance their skills.

We look forward to partnering with you to accomplish our goals. If you are ever in town, please stop by the department office or the Experimental Mine. We will love to talk to you about the programs and your accomplishments.

Kind regards,

Kwame Awuah-Offei, PhD, PE
PhD MinE '06
Interim Program Director



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S&T STAFF COUNCIL THANKS DEPARTMENT

Although the event was held on April Fools' Day, Staff Council members weren't kidding when they thanked the mining and nuclear engineering staff for all their work during a reception at McNutt Hall on April 1.

The thank-you reception is an initiative by Staff Council's Involvement Committee to show appreciation to departments throughout S&T.



REMEMBERING A BELOVED SON, BROTHER AND FRIEND

Kay Beasley remembers her son, Patrick Beasley, MinE'19, as someone who delighted in bringing home rocks.

"As a kid, he would pick them up and my pockets would be full," she says. "He still has rocks lining the window ledge in his room. Not long ago, he brought home the Missouri state mineral."

"Galena," adds Patrick's father, **Wayne Beasley**, CSci'85. "He was so excited to find it."

The Beasleys' 23-year-old son died in his sleep on April 28. On May 17, his father and brother, **Matthew Beasley**, MinE'15, accepted his diploma on his behalf.

With the support of family, friends and the community, the Beasleys have established the Patrick Beasley Memorial Scholarship Endowment to support students majoring in

mining engineering, explosives engineering or geology. Also contributing are members of the S&T Greek community. Patrick and Matthew are Kappa Sigma members, and their father is a member of Sigma Nu.

"We wanted to create something lasting in honor of Patrick," says Wayne, a retired Air Force officer who is now a pilot for American Airlines. "Patrick was an outdoor enthusiast — he loved hiking, skiing, hunting and just being outdoors. This led to his strong interest in the environmental side of mining engineering."

Patrick was to have begun work with Kiewit Mining Group's San Miguel Lignite

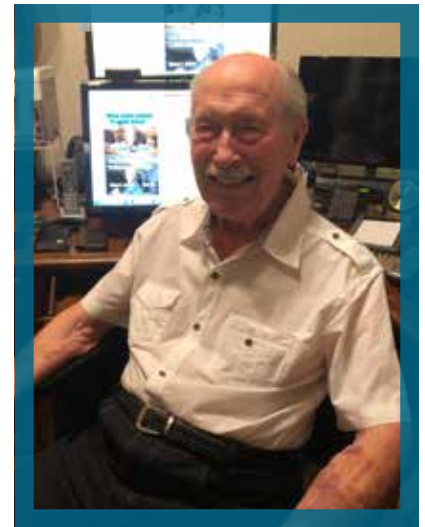
Mine in Christine, Texas. He recently received the Watchman Award presented by the Old Timers Club, a national honor established in 1938 by coal mining executives. More than 40 S&T students have been recipients.

Miner pride runs deep in the Beasley family. Patrick's uncles, **Bruce Berwick**, EMgt'87, and **Carl Berwick**, MinE'97, are Miners, as well his late great-great-uncle, **John Berwick Jr.**, MetE'39, and Wayne and Kay's godson, **Joe Haas**, MinE'07.

For Wayne and Kay, Patrick described himself best in a paper he wrote in 2014 for his freshman engineering class: "I believe that I exemplify the stereotypical engineering student. I would rather solve a math problem or play with rocks than write a short paper such as this one."

"That's who Patrick was, and that's the kind of student we're hoping to assist with this scholarship," Wayne says.

For more information on the Patrick Beasley Scholarship Endowment, contact John Held at heldjohn@mst.edu or 573-341-6533.



BULLOCK PUBLISHES MEMOIR

Richard L. Bullock, MinE'51, MS MinE'55, DE MinE'75, released an online memoir series titled *From Hard Knocks to Hard Rocks: A Journey in My Shoes*.

The two-book series describes Bullock's journey from an impoverished life on an Ozarks hill farm to life as a world traveler. It includes stories of Colorado avalanches and a Death Valley hike as well as his time in the Andes Mountains of Peru and the excitement of being the first engineer to evaluate a world-class gold mine in the Chilean Andes, at nearly 16,000 feet.

Bullock, an active mining engineer for 47 years, started his career on the S&T faculty, where he served for nearly 20 years.

"As a mining engineer, over a period of about 10 years, I was involved in making many very successful mining developments that helped to change our industry for the better and led to the mechanization that had to take place before the current trend of automation could commence," says Bullock.

He was instrumental in the creation of the "new" Viburnum, Mo., and to this day, he is proud of the experience.

"We built an entire town and mining-milling complex from scratch in the wilderness of the Ozarks and the Clark National Forest at a time just before the eco-activists were stopping all mining's progress," Bullock says. "Yet the area has not been harmed one bit in the last 40-plus years."

Bullock's second book focuses on his world travels.

EPIROC DONATES DRILL RIG TO S&T EXPERIMENTAL MINE

Epiroc, a leading productivity partner for the mining and infrastructure industries, donated a FlexiROC T20 R drill rig and consumables to the mining engineering program at Missouri S&T. The drill rig replaces outdated equipment at the Experimental Mine, where students gain valuable hands-on experience with real equipment and mining practices.

At the Experimental Mine, students get first-hand experience in surface and underground methods, blasting, ground control, ventilation, pyrotechnic displays, and extensive research in air blast and ground vibrations. Mine equipment, however, was becoming outdated.

"There was a dire need to update our drilling equipment so we could train our mining and explosives engineering students on a machine used in the industry today," says **Kyle Perry**, associate professor of explosives engineering. "The FlexiROC T20 R drill rig will make a night-and-day difference compared to what we have been using."

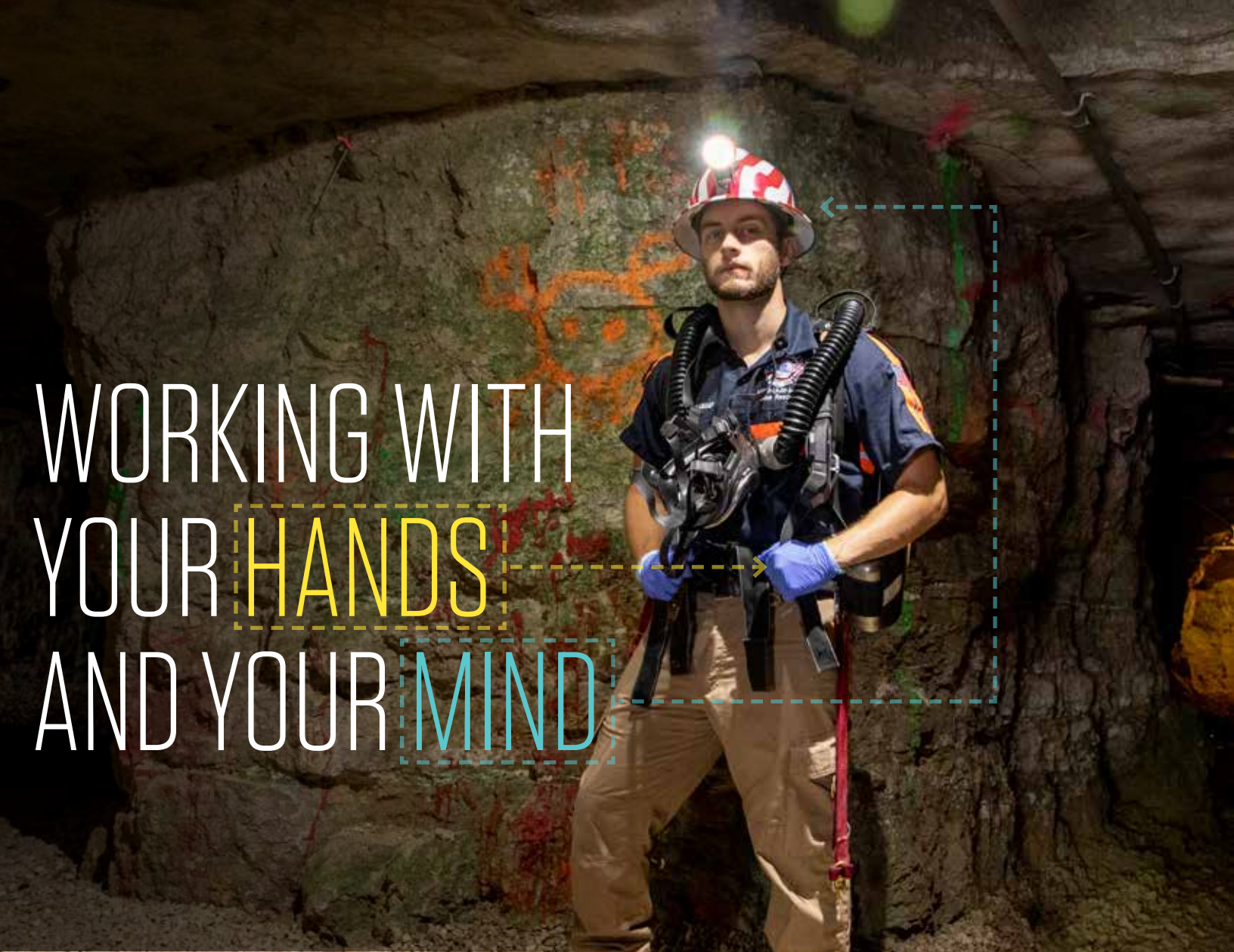
The donation was facilitated by **Chris Upp**, MinE'96, vice president and general manager at longtime Epiroc customer Conco Companies and a member of the development board for the S&T mining and explosives engineering programs.

"I have great appreciation for Epiroc and the folks that made this happen, because it means a lot to the university," Upp says. "Epiroc did a great job of following through on this donation, and it's going to be an excellent tool for the university."

DWYER INDUCTED INTO ACADEMY

Donald Dwyer, MinE'02, of Elko, Nev., mine manager at SSR Mining's Marigold Mine, was inducted into the Academy of Mines and Metallurgy in April.

Before joining SSR, Dwyer spent 11 years at Barrick, working in both underground and surface operations at the Goldstrike and Cortez properties. At Barrick, he served as mining engineer, front-line supervisor, general foreman, maintenance superintendent and open pit manager. He also spent a year abroad as an area manager in the construction of mines in Chile and Argentina. Dwyer also worked for Teck Cominco American at the Pend Oreille underground operation in Washington in the roles of mining engineer and front-line supervisor. He is active in the Society of Mining, Metallurgy and Exploration through participation on committees and most recently as the secretary for the Mining and Exploration Division.



WORKING WITH YOUR HANDS AND YOUR MIND

Growing up in the rural Missouri farming town of Princeton, **Joshua Schoonover** developed a healthy respect for manual labor and a love of nature and outdoor activities. In school, a love of math and science led to a passion for engineering.

When it came time to pick a university, and a future career, Schoonover sought a program that combined his two passions. He found that in mining engineering at Missouri S&T.

"I was looking for a field of study that balanced manual labor and outdoor work with design and engineering challenges," Schoonover says. "To me, mining is the perfect balance. This has been the type of work I have seen myself enjoying and being around, and that idea has been reinforced through my internship experiences."

This past summer, Schoonover interned at Cleveland Cliffs, an Ohio-based iron ore mining company. He worked at the company's Hibbing Taconite Mine near Hibbing, Minn.

"I was looking for a field of study that balanced manual labor and outdoor work with design and engineering challenges."

Schoonover says mining is one of the most underrated industries, but he hopes to change that.

"Public knowledge regarding mining appears to be lacking," he says. "Most people do not understand the importance of mining economies, infrastructure and technology. I want to help bring awareness of the importance of mining to as many people as I can, and becoming a part of the mining industry is the best approach."

When he graduates, Schoonover plans to get a job as a mining engineer. In the meantime, he's soaking up all the experience he can get. He's immediate past president of the S&T student chapter of the Society for Mining, Metallurgy and Exploration, and he's a member of the Mine Rescue Team.

"I am the first aid position on the Gold Team," says Schoonover, who previously served as captain of the Black Team. "I am on the team to get more involved in the department and learn more about mine

THE MORE YOU KNOW

In January 2019, **Joshua Schoonover** started writing music with his good friend **William Lorey**, CpEng'19, and before long the two, who had each been playing music since elementary school, formed a band called Schoonover & Lorey.

"Our genre is closest to acoustic folk music with some blues and country influence," Schoonover says. "I primarily play what is called a cajon. It's essentially a wooden box with snares inside that you sit on and slap the front. There are many different ways to hit the cajon to obtain several types of sounds."

Schoonover handles any percussion you can hear in their music, and he plays harmonica and provides back-up vocals. Lorey handles guitar and lead vocals.

This past June, Schoonover & Lorey released its first EP, titled "Content." It is available on Spotify, Apple Music and YouTube Music for streaming.

rescue operations. It exposes me to industry teams and MSHA (Mine Safety and Health Administration) personnel as well."

Schoonover's hard work is already paying off. This fall, he received the Allen J. Hale scholarship for the second consecutive year.

The scholarship, which was established in 2008 in memory of Hale, is for undergraduate students in mining engineering, or another engineering program, who seek a minor in explosives engineering. Hale, who died in 2007, worked for Dyno Nobel Inc. His son, **Joe**, Mine'02, is assistant superintendent of Bussen Quarries.

Schoonover says the more he learns about mining engineering, the more excited he gets about the opportunities in Rolla and beyond.

"This industry is the perfect blend of working with your hands as well as your mind," Schoonover says. "It's an industry I am excited to become a part of, and one that the country relies on more than most know." □



NEWMONT, MISSISSIPPI LIME HELP FUND SCHOLARSHIPS, EQUIPMENT, LAB

This past year, Colorado-based mining company Newmont Ventures Limited donated \$31,000 to mining engineering, and Mississippi Lime gave another \$15,000.

The gifts helped fund scholarships, student recruitment efforts and equipment, as well as **Lana Alagha's** Mineral processing lab (MPL), which serves the needs of mining engineering courses and research at both the undergraduate and graduate levels.

"The mission of MPL is to produce high-quality trained mining engineers by providing hands-on laboratory experience and developing practical skills," says Alagha, an associate professor of mining engineering. The practical skills involve basic test techniques for mineral sampling and characterization, mineral classification and physical beneficiation, and basic hydrometallurgy.

Graduate students at the master's and Ph.D. levels use the MPL to carry out research projects in the field of mineral processing and extractive metallurgy, Alagha says.

"Mineral processing laboratory equipment includes a bench-scale jaw crusher, laboratory ball and rod mills, a hydrocyclone classifier, a shaking table, a spiral concentrator, an optical microscope, sieve sets and shakers, mortar grinders, a pH meter, analytical balances, a vacuum filter, and different bench scale flotation cells.

"Moreover, a laboratory scale cone crusher was purchased through a generous donation from Newmont Ventures Ltd.," Alagha says. "And a new crushing work station was built through another generous donation from Mississippi Lime, USA."

THE END OF AN ERA

This year, mining engineering bids farewell to two longtime faculty members.

Greg Galecki, associate professor of mining engineering, director of the Waterjet Laboratory and senior research investigator in S&T's Rock Mechanics and Explosives Research Center, joined S&T in 1985. His research has focused on mineral processing, new methods of comminution, nanomaterial processing and mining processes supported by waterjets.

Paul Worsey, professor and associate chair of explosives engineering, director of the Experimental Mine and director of online programs for mining engineering, joined S&T in 1981 to perform explosives-related research. Today he is an internationally recognized explosives expert. Under his tenure, S&T developed the nation's first master's degree in explosives engineering, and then followed it up with the first Ph.D. program in the field and the first master's in explosives technology.

We wish them well in their retirement.

PYROTECHNICS PASSION IGNITES A PARTNERSHIP



Jerry Vaill, CE'77, MS ExpE'12, had just retired from the U.S. Geological Survey after a 30-year career as a hydrologist when he caught an episode of "The Detonators" on the Discovery Channel in 2009. He was surprised to find that the hosts of the documentary series, **Paul Worsey** and **Braden Lusk**, MinE'00, PhD MinE'06, had ties to his alma mater.

But what caught his attention was something else: the university offered a certificate program in explosives engineering — and had just launched the nation's first master's degree.

"Within a few weeks, I was enrolled," says Vaill. "Every kid loves fireworks, and some of us never grow out of it."

Matt Coy, MinE'10, MS ExpE'14, PhD ExpE'17, seconds that. As a teenager, he helped his dad put on Fourth of July fireworks shows for the local Masonic lodge. In high school, attending S&T's Jackling Institute, he toured the Experimental Mine.

"That was right up my alley," says Coy, who was assisting in pyrotechnics classes by his senior year and went on to redesign the Proximate Pyrotechnics course as a graduate

student. "Dr. Worsey let me write new course materials to improve the class and make it one of the most hands-on courses in the country," he says.

Coy's passion for pyrotechnics took a high-profile turn when a national visual effects company, Image Engineering, found his résumé on LinkedIn and contacted him about handling pyrotechnics for a client, the Kansas City Chiefs. Coy met with company representatives and agreed to take the job with one requirement: "I'll need my buddy Jerry to help me."

For the past four years, Coy and Vaill have produced the pyrotechnics for the Chiefs' home games in Arrowhead Stadium. Coy creates the flame effects on the field — including the tallest flame in the NFL at 80-100 feet — and Vaill handles the aerial displays from the roof.

"We are probably the best-educated explosives team in the nation," says Vaill. "I don't think there are any other teams with licensees who hold graduate degrees."

As S&T adjunct faculty members, Coy and Vaill bring the advantage of professional experience to pyrotechnics classes, where

"We are probably the best-educated explosives team in the nation."

hands-on training is essential. "You can learn from books and lectures, but you really don't know what's going on until you do it," says Vaill.

"Handling a flamethrower with 1,200 PSI of pressure is not exactly like standing there with an aerosol can," Coy says. "I think the biggest strength of our explosives program is the way we teach responsibility. Coursework and technology come and go, but responsibility is here to stay."

S&T OFFERS TRAINING IN REGULATORY STANDARDS

This past spring, S&T offered professional development for geoscientists and mining, geological, metallurgical and other engineers to comply with new ethics and regulatory standards set by the U.S. Securities & Exchange Commission's (SEC) updated mining property disclosure rules.

"This course work is designed to help professionals comply with industry standards, particularly the SEC's Regulation S-K subpart 1300," says **Kwame Awuah-Offei**, associate professor and interim director of mining engineering, who led the course. "At the end of the course, participants will be able to report exploration results, mineral resources and mineral reserves per the new SEC standards."

Awuah-Offei worked with the SEC from early February 2015 to mid-August 2016 to craft guidelines on disclosures on mine property and payments by publicly traded mining companies. The past mining property disclosure rules had been in place for 30 years, and the new ones — designed to bring the United States more in line with international standards — should last at least that long, according to Awuah-Offei.

Simplified, the new rules state that a mining company must disclose specified information in its SEC filings concerning its mineral resources, in addition to its mineral reserves and exploration results. Current commission rules and guidance permit the disclosure of non-reserve estimates only in limited circumstances. Requiring the disclosure of mineral resources in addition to mineral reserves will provide investors with important information concerning the registrant's operations and prospects.



RESEARCHERS BUILD CANNON TO TEST SEALS IN COAL MINES

Kyle Perry and **Ethan Steward** spent the summer loading an 8-foot canon with projectiles like hard hats, bolts and hand tools, and then shooting them at concrete seals in S&T's Experimental Mine.

Perry, an associate professor of explosives engineering, and Steward, his master's student, built the canon to test the impact of projectiles on the seals in an effort to improve their design and keep miners safe. They hope to determine the size and speed required for a projectile to damage the seal.

Their research is funded through a \$249,000 grant from the Alpha Foundation for the Improvement of Mine Safety and Health.

"We started loading the cannon with light things that a miner might leave behind such as a hard hat, water jug and hand tools," says Perry. "The hard hat and jug didn't do anything to the seals, but the hand tools took a good chunk out of the concrete, and the roof plates put pretty good gouges into the seal."

Using a regular camcorder and two Go-Pros, the researchers document each test and then slow the video to study the impacts. Strain gauges on the seals also tell them what the seal is experiencing.

Steward says the seals are rated to withstand certain pressure levels, but the seals have never been tested for projectile impact.

"What we don't know for sure is if these projectiles can damage the seals enough to make them fail for the pressure they're rated for," says Steward.

Atlanta-based Strata Worldwide, a mining safety services provider, built two concrete seals for project testing — one a 120 psi (pounds per square inch) design and one a 50 psi.

Perry says if an explosion happens in a sealed-off area of a mine, the seals need to withstand the pressure and any projectiles that hit it without serious damage because there's a chance of a second explosion. A fractured seal could allow methane to leak from the sealed areas and create a potentially explosive environment in active mining zones.

"If another explosion makes the seal fail, that could put the miners in jeopardy," says Perry. "I'm more worried about hitting the seal so hard that it fractures and cracks."



PRIVATE FUNDING HELPS DRAW VENTILATION EXPERT TO S&T

This fall, **Guang Xu**, an expert in mine ventilation and former senior lecturer in mining and metallurgical engineering at the Western Australian School of Mines, joins our department as associate professor of mining engineering.

And thanks to a \$45,000 donation from Doe Run and gifts from five alumni, he will lead a newly renovated Mining Ventilation Laboratory designed to give students hands-on experience in managing underground airflow, which is vital to any mining operation.

Xu is an expert in mine ventilation and safety, dust and DPM control, and underground battery vehicle firefighting techniques. An internationally recognized researcher, he has supervised four Ph.D. and two master's students, published 40 peer-reviewed papers and led over half a million dollars in funded research. He holds a Ph.D. in mining engineering from Virginia Tech and a bachelor's degree in mining engineering from China University of Mining and Technology.

"My initial research focus at Missouri S&T will be developing a new dust suppressant to effectively control various mining-induced particulate matter," says Xu. "I will also start an investigation of the underground battery vehicle fire hazard and its control techniques.

"In addition to building a mine ventilation lab that serves teaching and research purposes, the Experimental Mine is a unique asset that can be used for mine ventilation teaching to expose students in real work place conditions, and conduct large-scale research experiments and computer model calibration."

Additional funding for the laboratory upgrades was provided by **Greg Lang**, MinE'78; **Paul Lang**; **Stephen Lang**; **Diana Tickner**, MinE'79, and **Richard Bullock**, MinE'51, MS MinE'55, PhD MinE'75.

JOHNSON PARTNERS WITH VA ON EXPLOSIVES RESEARCH

With funding from the Harry S. Truman Memorial Veterans Hospital in Columbia, Mo., explosives engineering assistant professor **Catherine Johnson** is partnering with neuroscientists from the University of Missouri-Columbia to stand up an open-field blast core facility that mimics military blast conditions for use by the U.S. Department of Veterans Affairs research scientists.

Johnson studies a life-threatening ailment that can impact members of the military both in combat and in training — blast-induced traumatic brain injury, or TBI.

The S&T-Columbia team has also received funding for three years through the Department of defense to explore how explosions affect the brain's wiring.

"This sort of brain trauma is extremely difficult to diagnose," she says. "Experimental models can provide insights into the basic mechanisms underlying what for many remains an 'invisible' injury."

MODELING DIGGING FOR KOMATSU

Mining engineering Ph.D. student and graduate research assistant **Atta Ur Rehman** spent his summer moving around 30 tons of rock — all in the name of science.

Rehman was interning with Komatsu Mining Corp. gathering data for a project titled "Understanding the effect of digging parameters on excavation forces using discrete element method." Rehman is the lead researcher, working with **Kwame Awuah-Offei**, interim program director and associate professor, **Samuel Frimpong**, the Robert H. Quenon Chair and professor, and **Taghi Sherizadeh** and **Nassib Aouad**, both assistant professors, all in mining engineering.

Rehman used Komatsu's scale-model digger to conduct around 4,500 experiments to provide data for the project, Awuah-Offei says. Now he is working to build computer models of the excavation process, validate the models with the experimental results and use the models for predictive analysis on future designs.

"The end goal is to give Komatsu a simulation model for understanding penetration and resistive forces the digging tool incurs," Rehman says.

A native of Pakistan, Rehman began his Ph.D. studies in June 2017. He earned bachelor's and master's degrees from the University of Engineering and Technology, Lahore. When he isn't in the lab, Rehman is active in several activities, including serving as president of the Pakistan Student Association and playing intramural badminton and cricket.

STUDENT TEAM SUCCESS

MINE DESIGN TEAM

Missouri S&T's Mine Design team traveled to the 2019 Society of Mining, Metallurgy and Exploration Conference on Feb. 23 to present its design to industry professionals as part of the national finals in a design competition.

Missouri S&T's team finished as one of the top teams in a first-round design competition and was selected as one of six teams to present at the national conference. Their goal at the first event was to design a chalk mine in Alabama that would be used to supply a cement plant. Teams were given the task and supporting data and had 21 days to create a feasibility study on the mine. This is the first time in eight years that Missouri S&T has qualified for the national conference.

At the conference, judges change a portion of the prompt and student teams are given a brief amount of time to change or correct their designs and then give a 30-minute presentation about their design.

Missouri S&T's design team, competing under the name "Green Gold Consulting," conducted geologic modeling, life of mine analysis and site development for the mine. The team also had to consider such things as safety and environmental factors, economic impacts, and public relations duties.

MUCKING TEAM

In March, a group of S&T mining engineering students traveled to the University of Nevada-Reno for the 41st annual International Intercollegiate Mining Competition.

Missouri S&T student teams competed against other collegiate teams from around the world in events based on mining techniques used in the late 19th and early 20th centuries. Students competed in timed events like gold panning, surveying, hand-mucking, hand-steeling, track-standing, Swede sawing and jackleg drilling.

First held in 1978, the games were created to honor 91 miners who died in a fire at Idaho's Sunshine Mine in 1972. The mine was quickly filled with carbon monoxide and smoke, and it became one of the worst disasters in Idaho's history.

The competition celebrates traditional mining practices and helps create a global community of mining students. Mining colleges and universities around the world rotate hosting the competition. Approximately 200 students competed at the March 2019 event.

MINE RESCUE

Two teams of mining and explosives engineering students from S&T competed against teams of professional miners in the 37th annual Missouri Mine Rescue Association Mine Rescue Contest at Missouri S&T's Experimental Mine Sept. 30–Oct. 3.

The S&T Gold Team placed 9th and the S&T Black Team placed 18th.

The competition, which is designed to simulate a mine emergency, includes a written skills test; two hands-on simulated underground mine disasters; a first-aid portion with a written test, hands-on CPR and a first-responder scenario; and a team technician portion with a written test and technical troubleshooting of breathing apparatuses and gas instruments.

The U.S. Department of Labor's Mine Safety and Health Administration (MSHA) and Missouri Department of Labor Cave and Mine Safety judged the competition.





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It's easy to stay in touch with your department. Just say hello when a student representative calls from Phonathon or drop us a note at mining@mst.edu. Tell us how you're doing with a degree in mining or explosives engineering so we can feature your accomplishments among our alumni achievement stories.

**With your support,
there's no limit to
what we can achieve.**