

MINES MAGAZINE

For Colorado School of Mines Alumni and Friends • Winter 2023



Managing the **FUTURE OF WATER** —in the West and beyond

As water sources, such as the Colorado River Basin, dry up, Mines alumni and researchers are providing solutions to the West's water problems.

PLUS:

Mines' world-class research equipment and instrumentation is now available for shared use—including for Mines alumni.

The Mines football team makes history with their first trip to the NCAA Division II National Championship.

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Mines welcomed a new class of alumni in December 2022 with 277 Orediggers graduating with bachelor's degrees, 239 with master's degrees and 83 with doctoral degrees. Blaster even got into the Commencement spirit in his own cap and gown.

- ➔ Follow Mines on social media for more great shots of the Mines community and Golden and to keep up with everything happening with your fellow Orediggers.





MANAGING THE FUTURE OF WATER—IN THE WEST AND BEYOND

As water resources become scarcer in the West, posing problems for hydropower and other water systems, Mines alumni and researchers are working on finding solutions through mitigation, water reuse, alternative energy systems and more. **18**

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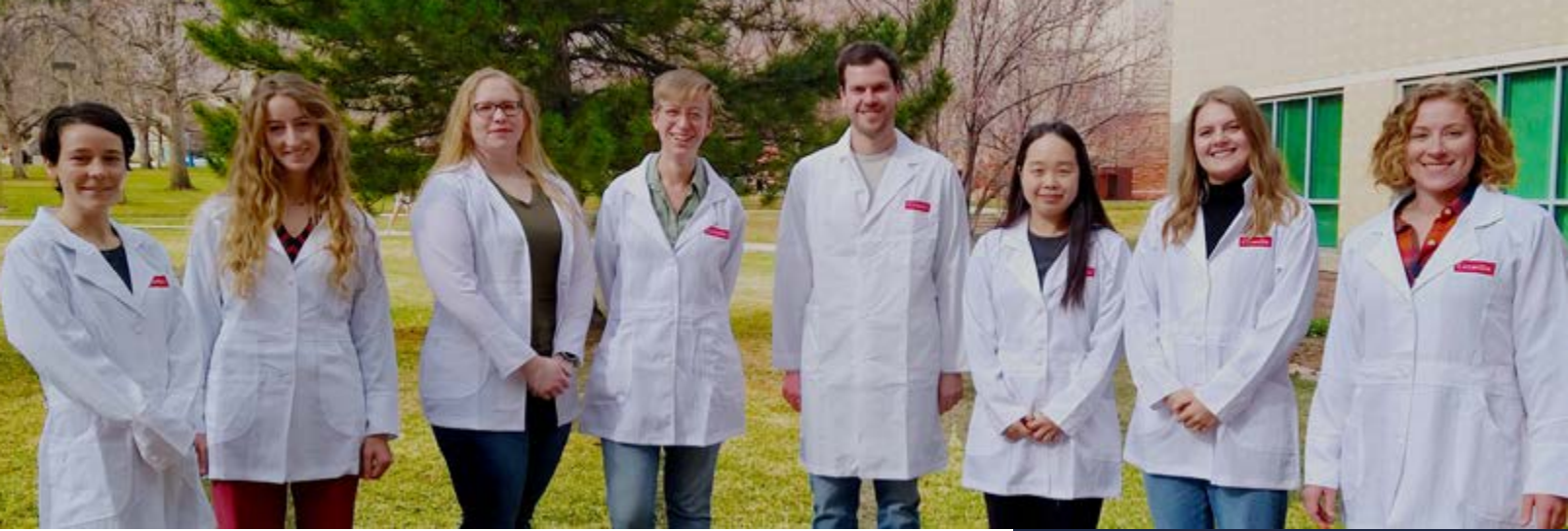
Kurtis Griess '08, MS '10 is helping expand higher education opportunities for underrepresented students. **28**

SKILL SET



An industry expert and entrepreneur shares insights into adding value to the energy market. **30**

On the cover: Geology and Geological Engineering Assistant Professor Adrienne Marshall, PhD student Arielle Koshkin and postdoctoral researcher Jongeun You take measurements and test the water in Clear Creek. Photo by Cyrus McCrimmon



Graduate Fellowships Fuel Mines' Impact

Master's and doctoral students are pivotal to the impact Mines can make on the world.

They are future leaders who will wield their expertise to solve the toughest challenges in industry, government and society; next-generation scholars who will advance the boundaries of science and engineering; and future professors who will educate undergraduates to come.

And they are the lifeblood of the flourishing Mines research enterprise.

Award-winning faculty, nationally ranked programs and an R1 Carnegie research designation make Mines stand out, but we face stiff competition for the smartest, most ambitious graduate students.

“Graduate school is an opportunity cost for students,

with many leaving a career and taking a pay cut to get this incredible education and research experience,” said Dr. Junko Munakata Marr, head of Civil and Environmental Engineering. “Fellowships that provide long-term support helps us attract the best students to Mines.”

These merit-based awards attract people who can make a substantial impact in their field. Some awards provide long-term, complete support: tuition, fees, insurance and stipends over multiple years. Others fund short-term projects, bridge the summer funding gap or address other pressing student financial needs.

Privately funded fellowships are the ultimate investment in Mines graduate students.

To learn how you can help, contact csmfoundation@mines.edu.


The Power of Fellowships

- Raise Mines' presence on the world stage
- Recruit trailblazing graduate scholars and faculty
- Give students freedom to push the envelope and become world experts
- Build industry partnerships that help satisfy demand for qualified professionals and accelerate graduates' careers

“External funding makes the life of a graduate student and their advisor much easier—more time spent on research, less on getting funding. This ultimately results in better and more impactful research.”



Gabriel Plummer
PhD '22,
Former
CoorsTek
Fellow

Scan to learn how graduate fellowships benefit students like Gabriel. 



SHRED THAT POW— OREDIGGER STYLE

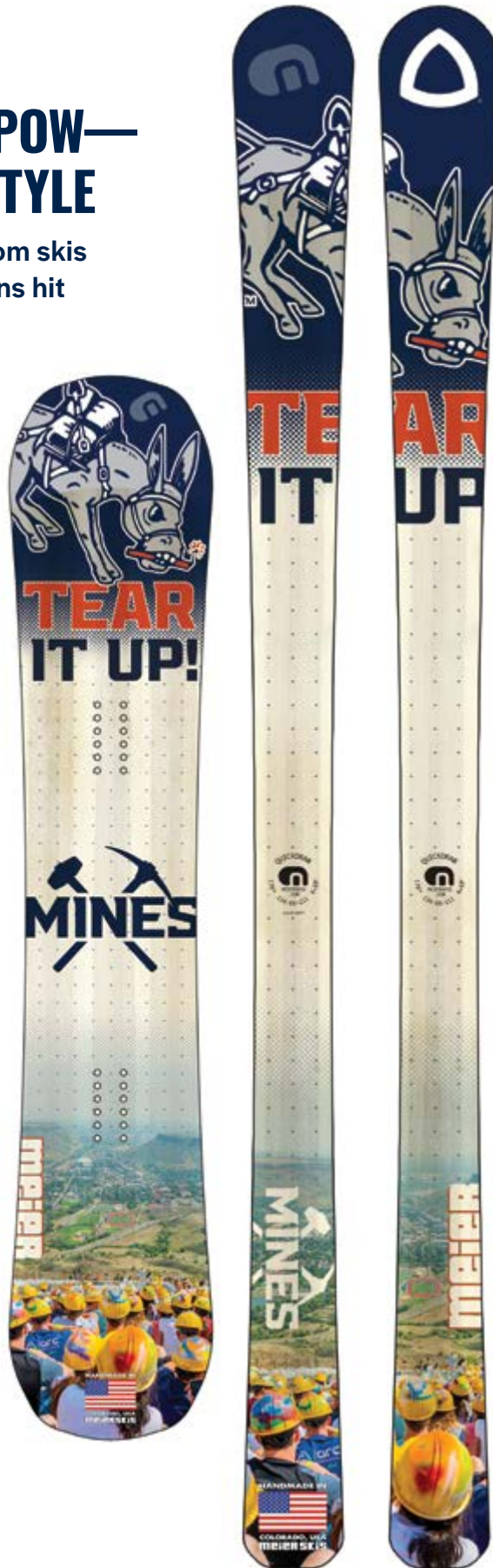
First-ever Mines custom skis
and snowboard designs hit
the slopes

Mines partnered with Colorado company Meier Skis to create a custom ski and snowboard design so Orediggers can show off their school pride on the slopes.

Made from Colorado trees and eco-friendly materials, Meier Skis makes high-performance, handcrafted products with respect for the environment. The Mines design features Blaster on the tips and the beloved M Climb on the tails. Each item includes a two-year warranty, and shipping is available throughout the U.S.

Sales from the skis and snowboards go back to Mines to support the university and its programs.

→ Shop the products at meierskis.com and search “Colorado School of Mines.”



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MUCH TO CELEBRATE

Taking a look back at 2022

2022 was a big year for Mines. It would be impossible to cover all of the accomplishments, celebrations and new additions to campus, but here is a sampler of the many things we accomplished:

- Mines is now one of the 146 U.S. universities with a Carnegie R1 “very high research activity” classification.
- The Petroleum Engineering Department celebrated its 100th anniversary this year and its inaugural Hall of Fame class.
- Mines was featured in an episode of *The College Tour*, a TV series that gives an in-depth, insider look at colleges and universities around the world.
- New academic degree and certificate programs were launched at both the undergraduate and graduate level.
- Construction began on the 37,000-square-foot Labriola Innovation Hub and the 31,000-square-foot Beck Venture Center—two key components of Mines’ growing Entrepreneurship and Innovation Ecosystem.
- We welcomed our largest incoming class in Mines’ history in Fall 2022 with 1,665 first-year and transfer students.
- We welcomed more than 30 new faculty to Mines, one of our largest cohorts ever.
- Mines teams excelled at national and international student competitions.
- Mines Athletics had its most successful fall season ever, with all fall sports advancing to the post-season. Mines Football even made it to the national championship game for the first time in school history. (Check out more on page 42).
- Many of our student-athletes garnered significant individual recognition with Dillon Powell placing first in the men’s national cross-country championship and outdoor 10K championship races, football quarterback John Matocha winning the Harlon Hill Trophy and other national awards, and distance runner Zoe Baker being named a Top 9 finalist for the NCAA Woman of the Year. (Read more about her on page 10.)

We’re clearly on a roll, and 2023 is going to be another exciting and busy year as we advance the initiatives,



projects and programs begun under our MINES@150 strategic plan and Campaign for MINES@150 fundraising efforts. Plus, it’s time to start planning 150th anniversary celebrations.

If you’re wondering how to get involved, please reach out. Leveraging alumni expertise, knowledge and experiences is a MINES@150 goal, and there are many ways to connect and engage through our degree programs and courses, alumni interest groups, student mentoring and more.

Best wishes to all of you for a happy, healthy and productive 2023. Go Orediggers!

Paul C. Johnson
President and Professor

➔ Follow our progress at mines.edu/mines-at-150.



PROUD TO BE AN OREDIGGER

The Mines cheerleading team is dedicated to boosting the Oredigger spirit

BY ASHLEY SPURGEON

Pride. Spirit. An overwhelming sense of enthusiasm for one's alma mater. Whatever you call it, you can bet Orediggers have it in abundance when it comes to Mines. And no one knows that better than the Mines cheerleading team.

First formed in 1969, the Mines cheerleading team has become a stalwart part of upholding what it means to be an Oredigger—and encouraging their peers to show off their school pride and maintain the close camaraderie that Mines students and graduates share. The first team consisted of only six students but kicked off an indelible legacy that underscores Mines' renown in the classroom and on the field.

"Mines has a reputation that's known worldwide, and you have to feel like you're a part of that," said Pam Tittes '72, MS '77, who was a founding member of the school's first cheer team.

Today, the 26-person coed team often makes appearances at home football, soccer, basketball and volleyball games and is now in their second year as a competitive team. And while being part of the team often gives students a break from their studies and enables them to pursue other interests beyond the classroom, they still put 100 percent into the program to make it the best it can be.

"The energy our team brings to Mines sporting events and anything else we attend is irreplaceable," said James Ho, a current Mines cheerleader. "Every person on this team is extremely hard working and motivated toward our goals. Every day I practice with this team, I see my teammates giving their all in our stunts and cheers while still enjoying every bit of it, which, in my opinion, is what the Mines experience is all about."

Head coach Irene Franek has seen this dedication firsthand. "The common theme at Mines is that we have to keep going, and we have to keep getting better," she said. "I've coached kids with that mentality in the past, but I've never had a whole team like that. It took me a bit to understand that, and once I did, I had to step back and think about how I can coach differently to help support how they learn."

And getting involved on campus—especially in something like cheerleading—has proven beneficial, not just for building community and pride among Orediggers, but also for giving students skills and experiences that will help them in their lives beyond Mines.

"It broadens your base," said Tittes. "It makes you more versatile and useful in your professional life. You understand that there's more than just your field, and it opens your eyes to different aspects of life."

No matter what someone's interests may be or how involved someone is on campus, cultivating a sense of pride is an important part of being an Oredigger—but it goes beyond enthusiasm for the school itself.

"Oredigger spirit is not just about being proud of the school we attend but being proud of the community and symbol that is Mines," said Ho. "I think the Oredigger spirit is just really being proud of this mindset and the accomplishments of the Mines community."

NEW BACHELOR'S DEGREE OPTION IN ADVANCED CERAMICS

A new bachelor's degree launching at Mines in fall 2023 will prepare engineers for careers working with one of the world's most versatile materials—ceramic and glass.

The Bachelor of Science in Ceramic Engineering will bring the total number of ABET-accredited ceramic engineering undergraduate programs in the U.S. to three—currently, only two other U.S. universities offer ceramics degrees at the undergraduate level: Alfred University, a private university in New York; and Missouri University of Science & Technology, a public university in Rolla, Missouri. At the high point in the 1960s, there were 14 ceramic engineering programs in the U.S.

“The specialty in ceramics has been lost in the U.S. with a couple of exceptions, but it's definitely needed again,” said Brian Gorman, professor of metallurgical and materials engineering. “There's a huge need for ceramics engineers and demand is significantly outpacing supply.”



The program will build on the university's long-standing expertise in materials science and engineering, as well as Mines' cutting-edge ceramics research and facilities and strong relationships with industry, including CoorsTek, which is also headquartered in Golden, Colorado, and endows a graduate fellowship in ceramics at Mines.

At the undergraduate level, students will receive hands-on training in ceramic processing, sintering, glass science, and thermal, mechanical and electrical properties. Four core

laboratory classes starting in students' second year will ensure robust hands-on experience with the materials. Students will also have access to innovative undergraduate research opportunities and makerspaces, including Mines' on-campus glass hot shop.

Developed in consultation and partnership with industry, the program will have a strong focus on the newer technical ceramics and glass. But the knowledge and experience gained by students in the program will prepare them for careers in both technical and traditional ceramics.

HIGHLIGHTS FROM AN OUTSTANDING FALL 2022 ATHLETIC SEASON

Cross Country

- Men's cross country won their third NCAA Division II national championship since 2015
- Women's cross country finished third in the nation
- For the first time in program history, all seven of Mines' men

earned USTFCCCA All-American status by virtue of top-40 finishes

- Dillon Powell became the first runner in program history to win individual gold
- Zoe Baker became the first three-time cross country all-American in program history.

Men's and Women's Soccer

- Midfielder Michael Sprauer was named First Team Academic All-America for the second time in his career in addition to being named RMAC Academic Player of the Year, a First Team All-RMAC pick and a First Team Academic All-RMAC honoree.

CONNECTIONS

- ▶ Have you run into a fellow Oredigger in an unusual place? Gone on a trip with classmates? Visited campus to share your expertise? We want to know all about it! Send us your connections at minesmagazine.com/connection.

MINES LAUNCHES UPWARD BOUND MATH SCIENCE PROGRAM

Mines and Jeffco Public Schools' Alameda International Junior/Senior High School are launching a new federally funded college preparatory program to encourage more low-income and first-generation students in Colorado to continue their post-secondary education by helping them strengthen their skills in math and science. As part of the program, two Mines employees will be embedded at Alameda, leading instruction and activities on site for 60 students.

Funded by the U.S. Department of Education's TRIO Programs, Upward Bound Math Science (UBMS) at Mines will provide academic support, test and college preparation, and summer programming for high school freshmen through seniors interested in science, technology, engineering and math to prepare them for post-secondary studies.

"Mines is excited to play a vital role in Alameda student success and even more excited to see these students go on and be successful in college," said Lori Kester, associate vice provost of enrollment management. "As the top STEM institution in the state, Mines has an important role to play in encouraging more students from all backgrounds to pursue secondary education in STEM, here at Mines or at any other institution of higher education in the Centennial State. Through this new program, Mines is taking a big step forward in leading the charge on how to help high school students with math and science."



MINES GRADUATE STUDENT NAMED ONE OF 100 GLOBAL INSPIRATIONAL WOMEN IN MINING

Juliet Akamboe, a graduate student in the Mineral and Energy Economics program at Mines, was recognized as one of the 100 Global Inspirational Women in Mining in 2022 by Women in Mining UK.



The biennial publication—now in its fifth edition—highlights the diversity of talent in mining and celebrates women who go above and beyond and serve as role models for future generations of women in the mining sector. A total of 491 women from 61 countries were nominated for the honor this year.

Akamboe is an experienced corporate and investment banker with more than 15 years of experience across global/financial markets, sales and risk management in mining. She was head of Mining & Metals West Africa for the Standard Bank Group, leading many landmark transactions and serving in an instrumental role in changing perceptions about mining finance. She led the bank to become the first financial institution to be recognized by the Ghana Chamber of Mines, receiving the inaugural Financial Deal of the Year award at the Ghana Mining Industry Awards.

Akamboe said of the recognition, "Your dreams are valid, dream out loud, the universe is waiting to help you climb every mountain and Colorado is the best place to live this!"

- Defender Katie Koehler was named First Team Academic All-America.

Looking for news about Mines Football? Check out **page 42** to read about their journey to the NCAA Division II national championship.



- Penny Pettigrew '92, space station payload communication manager, met Gen. James Dickinson MS '96, commander of the U.S. Space Command, at NASA's Marshall Space Flight Center in August 2022 when Dickinson toured the Payload Operations and Integration Center.

AHEAD OF THE GAME

Three-time RMAC Champion is the first Mines athlete to reach the Top 9 for the NCAA Woman of the Year

BY SAM BOENDER AND EMILIE RUSCH

Cross-country and track and field star Zoe Baker is one of the Top 9 honorees for the 2022 NCAA Woman of the Year award. Baker, a 2022 CoSIDA Academic All-American of the Year and three-time RMAC Champion in cross-country and track and field, is the first Mines athlete to reach the Top 9 for the prestigious national honor.



The NCAA Woman of the Year recognizes graduating female student-athletes for excellence in academics, athletics, community service and leadership. A single winner—selected from the pool of 30 honorees representing Division I, II and III athletics, 10 from each division—will be announced in January 2023 at the NCAA Convention in San Antonio. A total of 577 athletes across all three divisions nationwide were nominated for the award this year.

“Mines is ecstatic to see Zoe recognized as one of the Top 9 Honorees for the 2022 NCAA Woman of the Year award,” said Mines President Paul C. Johnson. “Zoe is well-deserving of this national recognition as she represents the ideal of the true collegiate student-athlete, which is what

our athletics program is built to support. We are proud of Zoe and are excited to see her being recognized at the national level for the amazing student-athlete that she is.”

ACCOMPLISHED ON THE TRACK, COURSE

Baker began her collegiate running career at Mines in 2018 and quickly became one of the most decorated Orediggers in program history. She is a nine-time U.S. Track & Field

and Cross-Country Coaches Association All-American, including seven first-team honors. She finished third in the 5,000 meters at the 2021 NCAA Division II Women’s Indoor Track and Field Championships and contributed to a third-place team finish at the 2019 cross country championships. A three-time RMAC individual champion, Baker won the cross-country title in 2020, the 3,000 meters (indoor) in 2020 and the 10,000 meters (outdoor) in 2021. She holds four program records and two facility records at Mines.

Baker was also recognized for her combined achievements as a student and athlete. She was named CoSIDA Division II Academic All-America Team Member of the Year for Division II women’s track and field/cross country in 2022, while also earning first-team honors in 2021 and second-team honors in 2020. She is a two-time NCAA Elite 90 Award recipient, presented to the student-athlete with the highest grade-point average competing at an NCAA championship finals site. In total, she boasts eight First-Team All-RMAC awards, nine USTFCCA All-Region awards and more than 30 awards for her combined athletic and academic performance.

“When Zoe came to Mines, she made an instant impact and changed the program,” said Mines Cross Country Head Coach Chris Siemers. “Before she came here, the women’s cross-country team had never been on the podium at the NCAA Championships. Now, we’re one of the top teams in the country, and a lot of it has to do with Zoe coming to Mines, doing what she does every day and doing it with passion.”

PACESETTER IN THE CLASSROOM, LAB

Baker’s accomplishments in the classroom set a high bar among all Mines students, not just student-athletes.

Baker graduated summa cum laude in May 2022 with dual Bachelor of Science degrees in computer science and applied mathematics and statistics. She was named the Outstanding Graduating Senior in the Department of Applied Mathematics and Statistics, as well as one of two winners of Mines’ most prestigious student honor, the William D. Waltman Award, which is presented to the graduating seniors who have consistently demonstrated the utmost integrity, scholarship and citizenship in and out of the classroom throughout their collegiate career.

During her rigorous course of studies, Baker carried a 4.0 GPA through her senior year and was recognized with a 2020 Barry M. Goldwater Fellowship, the

CONNECTIONS

▶ Andy Nord '03 and Josh Hodsdon '03 of Dagger Contracting frequently work together on city projects in Denver. ▲

preeminent undergraduate award of its type in natural sciences, engineering and mathematics.

Outside the classroom, she served as an Honors TA for first-year students, mentored fellow undergrads as a resident advisor, worked as a high school tutor in math and computer science, and frequently presented at diversity-focused events.

During all four undergraduate years at Mines, Baker also served as a student researcher, working with Computer Science Associate Professor Hua Wang on the use of machine learning to solve problems in human health. During the COVID-19 pandemic, that included significant contributions to the development of an algorithm to help healthcare professionals efficiently identify high-risk patients—in spite of potentially missing or incomplete patient data—using multiple-instance learning techniques and low-rank data imputation to predict clinical outcomes of COVID-19 patients.

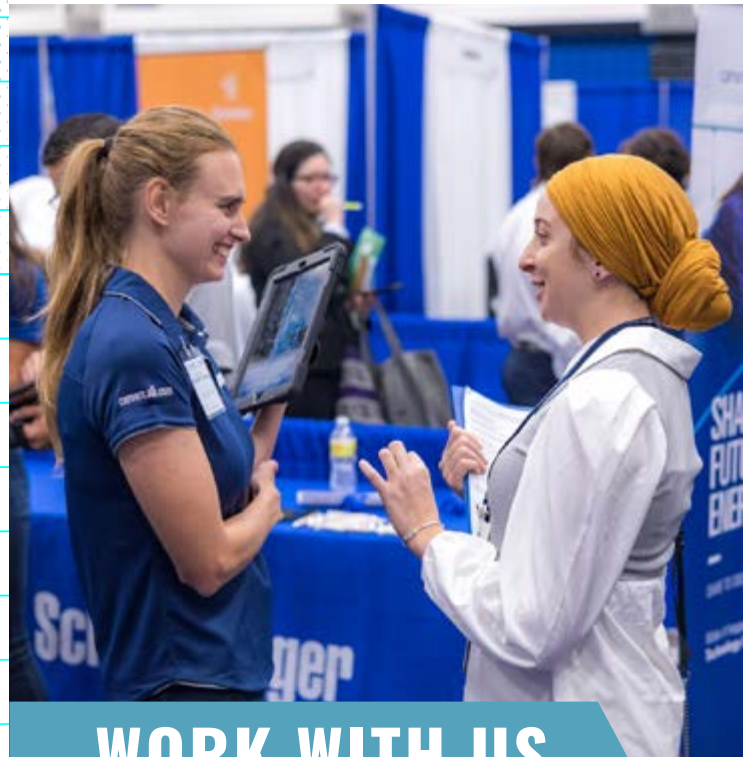
“Zoe Baker’s potential to contribute to this vital research area is boundless,” Wang said. “Her sustained, compelling work has produced essential contributions and earned her co-author credits on six published research papers with my team, all in prestigious conferences and journals. This publication record shines among top undergraduate researchers worldwide. Zoe is one of the most prolific and impactful undergraduate researchers that CS@Mines has had the good fortune to nurture.”

In recognition of her contributions in the lab, she was a finalist for the 2022 Outstanding Undergraduate Researcher Award from the Computing Research Association, as well as a finalist for the 2022 Collegiate Award from the National Center for Women & Information Technology.

Now in her final season of NCAA eligibility in cross country (she has two more years of eligibility in track and field), Baker is currently working toward her master’s degree in computer science at Mines. Earlier this year, she won a coveted National Science Foundation Graduate Research Fellowship to help fund her studies.

“Mines has basically given me every opportunity I’ve asked for. They’ve given me a launching pad for so many different ambitions of mine, running-wise, school-wise, career-wise,” Baker said. “I’m just so incredibly thankful for Mines and hoping that I can pay it back in some way.”

➔ For more on Mines Athletics, visit minesathletics.com



WORK WITH US

Did you know Mines alumni can engage with the Career Center in many ways?



Hiring for internships or full-time positions?

We can connect you with current students to meet your business needs.



Interested in volunteering?

The Career Center would love to hear your career journeys and how they might inspire students.



Looking for your next career move?

The Career Center serves recent graduates for the first two years beyond graduation and partners with the Alumni Job Center to serve alumni for a lifetime, including full access to our renowned Career Days.

➔ [MINES.EDU/CAREERS](https://mines.edu/careers)



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SIMPLIFYING SHARING RESEARCH EQUIPMENT—FOR CAMPUS AND BEYOND

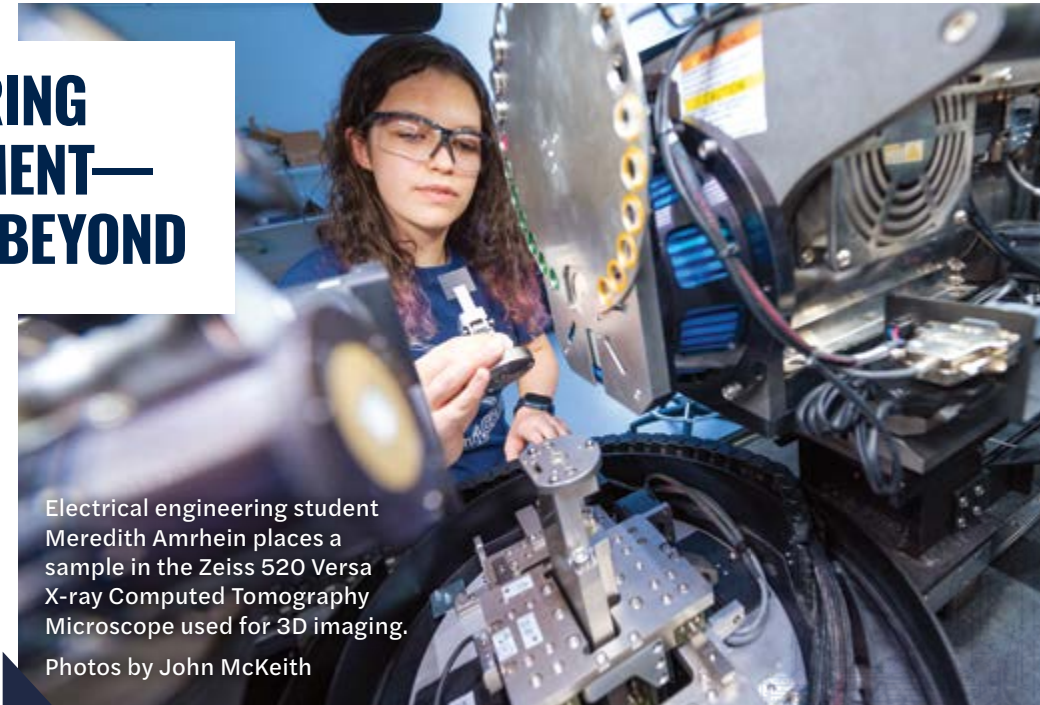
Mines' Shared Instrumentation Facility centralizes access to cutting-edge research equipment

BY JASMINE LEONAS

Mines is home to world-class research equipment and instrumentation and the technical experts to run them. Now, that equipment and expertise is available to not only the Mines community but also external partners—including alumni.

The Office of Research and Technology Transfer has created a Shared Instrumentation Facility (SIF) at Mines. Since launching a little over a year ago, SIF has provided the framework for Mines' research instrumentation to be made available for shared use, giving access to anyone who might need that equipment for their research.

"Providing access to the tools that enable research insights and discoveries is central to the advancement of the science and technology enterprise," said Walter Copan, vice president for research and technology transfer. "Through the SIF and its dedicated professionals, Mines supports the efficient availability of leading-edge instrumentation, accelerating research and fueling innovation here on campus."



Electrical engineering student Meredith Amrhein places a sample in the Zeiss 520 Versa X-ray Computed Tomography Microscope used for 3D imaging. Photos by John McKeith

Currently, Mines' SIF encompasses equipment in the following areas:

- Electron and scanning probe microscopy
- Mass spectrometry
- Mechanical testing
- Nanofabrication
- Surface characterization
- Thin film deposition
- X-ray diffraction and computed tomography
- X-ray photoelectron spectroscopy

"Mines was recognized as an R1 research university in early 2022, and initiatives like SIF are evidence of the quality of work capable of being supported here—even though we're not as big as other R1 schools," said David Diercks, director of the Shared Instrumentation Facility.

More than 70 instruments are currently included in SIF, with more in the process of being added. Those who currently utilize SIF resources include professors from

departments across campus, researchers from 12 other universities, three government laboratories and 28 industrial companies. Access to these instruments is vital to completing important work across multiple disciplines, Diercks said.

"Some of the instruments aren't unique to Mines but are necessary for doing high-quality research. Others are in the more unique and specialized categories and can be difficult or expensive to acquire," Diercks said. "Through SIF, researchers can use this equipment without a long contracting agreement and with pricing in line with the market."

Mines alumni are one group that could stand to benefit greatly from SIF, Diercks said. Many work for smaller companies or for themselves, and SIF gives them access to things their companies may not have and at a reasonable price.

CONNECTIONS

- ▶ Thorn Svendsen '11 recently attended the Mines Evening of Excellence and greatly enjoyed seeing the impact of the incredible alumni who choose to give back to Mines year after year. ▲

Casey Davis '14, PhD '19 is one of them. She works in engineering consulting for Exponent, and while the company does have similar resources at other locations, having access to a local facility was more convenient. She used SIF frequently in early 2022 to complete research for her clients.

"A lot of labs allow you to send in samples to analyze, but if you want to do the analysis yourself because of your expertise or maybe it's client confidential, SIF is a great option," Davis said.

"I'm familiar with the SIF equipment and the people who run it already from when I was a student at Mines, so I know how useful of a resource it is."

Hands-on experience can be valuable for early career researchers, SIF administrator Anne Steputis said.

Instead of sending their material away to a lab for testing and then waiting for results to be sent back, researchers can be present for testing, as well as gain first-hand knowledge of how the instruments work.

"PROVIDING ACCESS TO THE TOOLS THAT ENABLE RESEARCH INSIGHTS AND DISCOVERIES IS CENTRAL TO THE ADVANCEMENT OF THE SCIENCE AND TECHNOLOGY ENTERPRISE."

—Walter Copan, Vice President for Research and Technology Transfer

"Our users can sign up on our website to have a research tech assist in doing the analysis they need or be trained on the instrument themselves," Steputis said. "They're involved in the data collection and

gain expertise that will help them with future projects and grants down the line in their careers."

For Ty Porter '12, PhD '19, who also works at Exponent, accessing SIF as an alum gave him more

exposure to one of Mines' most valuable resources: faculty.

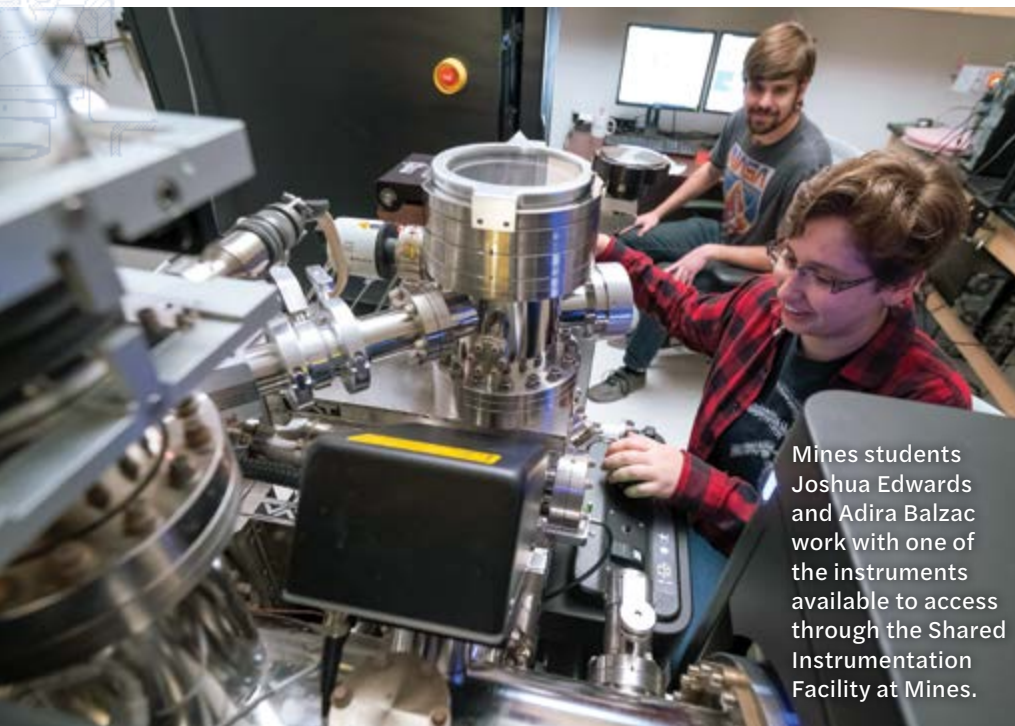
"It's really the faculty that makes the difference," Porter said. "There are dozens of options for access to laboratories with equipment similar to SIF's, but the Mines supporting faculty are an invaluable

resource that I don't always get with other labs. The SIF and faculty who support it are absolutely critical to the world-class research that comes out of Mines."

Mines' SIF is also part of Front Range Core Facilities, a group of public universities across the Front Range that promotes collaboration through the shared use of instruments in the region. Of the universities in the network—Mines, University of Colorado, Colorado State University, University of New Mexico, University of Wyoming and University of Montana—Mines has the smallest student enrollment.

"We'll often have visitors from other universities who see the facilities and instruments we have here, and they're surprised," Diercks said.

"They don't expect a school the size of Mines to be so well equipped. Not only do we have high-quality instruments, but we also have a dynamic team of experts constantly working on expanding our capabilities, and we expect to only keep growing in the future."



Mines students Joshua Edwards and Adira Balzac work with one of the instruments available to access through the Shared Instrumentation Facility at Mines.

► Mines alumni headed out to Marv Kay Stadium in mid-November 2022 to cheer on the Oredigger football team at the last tailgate of the regular season. ▲

HELPING MINING COMPANIES DO THE MATH

Mines and Virginia Tech are determining the carbon sequestration potential of ore deposits

BY MINES STAFF

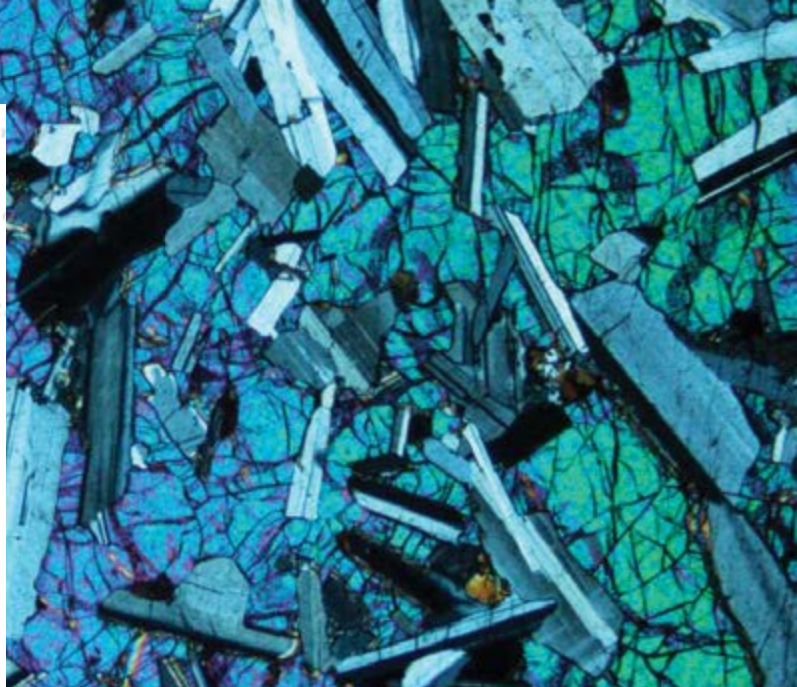
Researchers at Mines and Virginia Tech were awarded \$1.15 million by the U.S. Department of Energy for research that will aid in the development of new technology that will enable mining companies to quantitatively model the carbon sequestration potential of copper-nickel-platinum-group element ore deposits.

Led by Thomas Monecke, professor of geology and geological engineering at Mines, the project is receiving funding from the DOE's Advanced Research Projects Agency-Energy (ARPA-E) Mining Innovations for Negative Emissions Resource Recovery (MINER) program. MINER funds technology development and research that increases the mineral yield and domestic supply of copper, nickel, cobalt and other critical elements, while decreasing the required energy—and subsequent emissions—to mine and extract these energy-relevant minerals.

“This is a great opportunity to demonstrate and advance our collective expertise in the geology and mineralogy of ore deposits and carbon sequestration,” Monecke said. “We have assembled a team of experts from Mines and Virginia Tech to develop a technological solution that will allow mining companies to quantitatively evaluate whether adaption of net-zero or net-negative emission technology is economically feasible. We envision that this evaluation could become an integral part of feasibility studies that mining companies conduct prior to making an investment decision.”

For this project, the research team at Mines and Virginia Tech will work closely with industry partner MINALYZE AB, a provider of cutting-edge continuous X-ray fluorescence core scanning technology. Based on the geochemical analysis of drill core, the team will devise machine-learning algorithms that will allow quantification of the relative proportions of CO₂-reactive minerals contained in the core.

A thermodynamic modeling algorithm will then be developed that determines the amount of CO₂



This thin section of a mafic rock, shown under cross-polarized light, came from the Duluth Complex, one of the world's largest undeveloped deposits of copper, nickel and platinum metals.

Image by Erik Tharalson

that can be sequestered into rock formations of variable mineralogy. As a final step, the research team will develop a methodology for block modeling to determine the total amount of CO₂ that could be sequestered into an entire ore deposit hosted in mineralogically heterogeneous host rocks.

The work will combine expertise in ore deposit geology, petrology and mineralogy, and thermodynamics and carbon sequestration with spatial subsurface modeling and mining engineering.

“Mines and Virginia Tech are really well positioned to be significant players in boosting domestic critical mineral supplies while deploying net-zero or net-negative emission technologies in the mining sector,” said co-PI Katharina Pfaff, research associate professor at Mines. “Over the past years, we have built strong ties between both universities allowing us to tackle a range of use-inspired research problems that mining companies face.”

Co-PI Erik Westman, professor at Virginia Tech, added: “It is particularly exciting for me as a mining engineer to contribute to a project that has the potential to transform the way we evaluate the feasibility of a mining operation by considering how much CO₂ can be sequestered into ore and waste. This is an important project as it is at the forefront of green mining.”

CONNECTIONS

- ▶ The Entrepreneurship and Innovation interest group hosted an evening presentation and Q&A with petroleum industry entrepreneurs in November 2022. ▲

The Mines Foundation recognizes the generosity of loyal donors at all levels through Giving Societies

President's Council - \$1K+ annually

MINES@150 Visionaries - \$1M+ in Campaign

Mines Century Society - \$100K+

Partners@150 – \$150K+ Current and estate plan in Campaign

Mines Heritage Society – Estate plan

Infinite Miners – \$25K+ Endowment created in Campaign

Members of Giving Societies make possibilities real for Mines students, such as:

President's Council donor Justin Dvorak '16 was a Harlon Hill Trophy winner and All-American on the football field while a student and continues to lead by example after graduation. Justin rallied many of his teammates to create the Lone Star Football Scholarship, which supports student athletes from Texas. He was also named the Young Philanthropist of the Year in 2022.

The family of Christian and Ruth Fuchs became Infinite Miners by establishing a scholarship in their honor to support students from rural Colorado who would not otherwise be able to attend Mines. Christian and Ruth came from humble means and raised six children in the small town of Eaton, Colo. The Fuchs instilled in their

children the importance of giving back and the value of an education, leading to five proud Mines graduates in the family including two in-laws.

Steve Lambert '75 and his wife Dee established the Dee and Steve Lambert Endowed Scholarship Fund to provide financial assistance to students from Alaska. The Lamberts have given to Mines consecutively for 36 years, and Chevron has matched many of their gifts. In 2019, they added the fund to their will, which placed them in the Heritage Society. A Mines education is out of reach for many students who are 3,000 miles away in his home state, and Steve wants to make it possible.

See Justin's inspiring acceptance speech and read more about the impact of these three donors.



Justin Dvorak '16



Christian and Ruth Fuchs



Steve Lambert '75



MAKING SENSE OF BIOLOGICAL SYSTEMS

Mines is stepping up to solve some of today's biggest challenges in the biosciences

BY SARAH KUTA

Because of scientific and technological advancements over the last decade or so, such as genomic editing and DNA sequencing and synthesis, researchers believe they are now on the cusp of solving some of the world's most pressing medical and environmental problems.

Doctors may one day offer personalized medicine based on patients' genetics and possibly even modify their genes to prevent diseases or halt the progression of cancer, for instance. Researchers are also pursuing enzymes that can degrade plastic waste, and entrepreneurs are developing sustainable products like lab-grown meats and clothing made of mushrooms.

But to achieve these and other bioscience-related feats that have the potential to improve the health of humans and the planet, industry and academia need curious, outside-the-box thinkers who can untangle massive amounts of data and have a deep understanding of biology, chemistry and physics.

Mines is meeting these needs by training the next generation of biological engineers who are skilled in both bioscience and computer science via its new undergraduate Quantitative Biosciences and Engineering (QBE) degree. Quantitative biology is characterized by its use of mathematical and computational methods to analyze and model biological systems. It is a rapidly growing field that is transforming our understanding of complex biological processes from the molecular level to the level of entire ecosystems. The program, which began enrolling students in Fall 2021, also helps meet student demand for careers in medicine, pharmaceuticals and emerging biotechnology fields.

"Students graduating with a QBE degree will have a strong biological understanding, coupled with a strong computational toolkit to tackle complex biological systems," said Teaching Associate Professor Josh Ramey, who directs the new program. "The data being generated from biological systems is growing exponentially, and being able to manage and model that data is an essential skill set for the next generation of biologists. QBE graduates will be distinct from other biology majors in their preparation with regards to their quantitative skill sets of computer programming and computational modeling."

Faculty from multiple departments, including Chemical and Biological Engineering, Civil and Environmental Engineering,

Quantitative Biosciences and Engineering student Arabella Quintanilla works on a lab project in the CBEN110 lab during the Fall 2022 semester.



Mines undergraduate students Daniel Lewis, Emma Gaviola and Mitch Wernlein work on a lab project focused on the transformation of *E. coli* with the recombinant green fluorescent protein gene from the jellyfish *Aequorea victoria*.

CONNECTIONS

- ▶ Alumni attended the November Lunch Bunch event to hear from Lakshmi Krishna about the Office of Undergraduate Research Scholars. ▲

Mechanical Engineering, Applied Mathematics and Statistics, Metallurgical and Materials Engineering, Chemistry and Physics are all teaching classes within the interdisciplinary program.

By the end of the 2022-23 school year, Ramey expects an estimated 180 undergraduates to declare their major in the Quantitative Biosciences and Engineering program. Some of those students will go on to medical school and train to become doctors, while others will pursue careers in research, Ramey predicts. Many students will also enter the workforce directly, pursuing roles in bioinformatics and data science at companies with a biological focus; since the field is so novel, there will also be ample opportunities for entrepreneurship.

Many Mines undergraduates already enroll in medical school after graduating with existing degree offerings. The university has offered biology courses for 25 years, and a growing number of faculty are researching bioscience-related topics. But the new program will help set Mines' pre-med students apart, offering a unique path to careers in medicine ranging from oncology to immunology to genetics. Combined with the core tenets of a Mines education—teamwork, problem-solving, hands-on experiences and deep technical knowledge, to name a few—the program will prepare graduates well for the rigorous, fast-paced medical environment.

No matter which path they choose, graduates will also benefit from a robust understanding of complex biological systems. The Earth is a living system, as is the human body—and students who earn a QBE degree will be well-suited to tackle wide-ranging problems related to both.

“We desperately need individuals who understand how all of the pieces of the puzzle work together to generate the overall function of the system, whatever that system is,” said Joe Gray ME '68, a professor emeritus of biomedical engineering at Oregon Health and Science University and professor emeritus of laboratory medicine at the University of California San Francisco. “It’s really hard to understand the big picture just by studying parts and components—we need people who also understand how the parts interact with each other.”

A new approach to controlling cancer, for instance, might involve thinking beyond drugs that only target cancer cells and instead contemplating solutions that factor in the entire cancer environment, from immune cells and blood vessels to structural fibroblasts.

“There’s a real need to take quantitative biosciences and bioengineering approaches and apply them to cancer,” said Gray, who has spent his career researching and developing innovative solutions for cancer. “It’s becoming apparent that you can’t just think about killing the cancer cells, you also have to figure out how they engage with the rest of the cells in a tumor so that you can not only kill cancer cells but also change the environment so that it’s anti-tumor. That’s easy to say, but actually very difficult to do.”

Mines graduates will also be at the forefront of as-yet-unexplored realms of science, medicine and even ethics.

Ramey said, “Even things that happen today seem like science fiction, so thinking about the potential future impacts of biotechnology on people’s lives, it’s nothing but miraculous, really.”



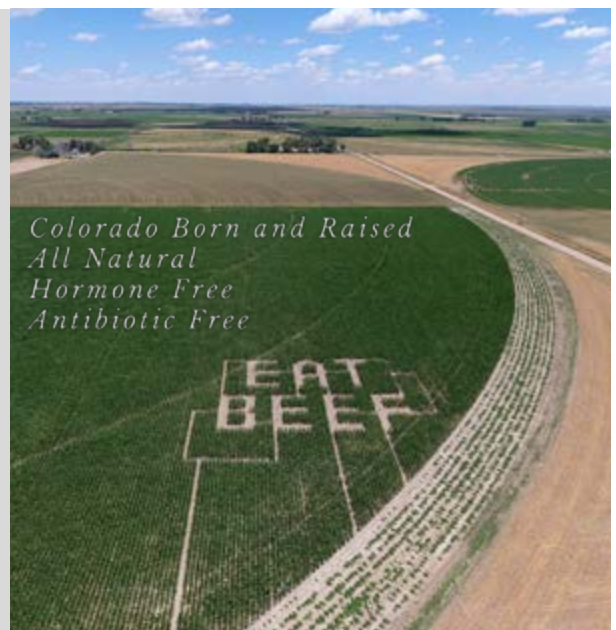
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Ryan Hemphill, Owner
CSM '02





Managing the **FUTURE OF WATER** —in the West and beyond

As the Colorado River Basin dries up, Mines alumni and researchers are working on providing solutions to the West's water problems

BY JEN A. MILLER

The Colorado River is the lifeblood of the southwestern U.S., with nearly 40 million Americans in Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming relying on the Colorado River System for drinking water and to support farming and recreation. However, the Colorado River Basin water supply is dwindling, leading to water management challenges and an uncertain future of water in the West.

This isn't just a water problem for millions of people, but a power problem, too. Hydropower generated here and elsewhere is an important player in the country's power needs.

Mines alumni and researchers are at the forefront of working with water in this new reality, whether that's through mitigation, water reuse, new water systems or alternative renewable energy systems.

Postdoctoral researcher Jongeun You, PhD student Arielle Koshkin and Geology and Geological Engineering Assistant Professor Adrienne Marshall take measurements and test the water in Clear Creek.

Photo by Cyrus McCrimmon



“We’ve got supply problems and demand problems, and the fundamental fact is that those are not matching up very well,” said Adrienne Marshall, assistant professor of geology and geological engineering at Mines.

It’s not exactly a new issue either, she added. The Colorado River Compact, an agreement among seven states that allocated river resources between the upper and lower basin states, was first signed—in 1922. A century later, things have gotten worse, Marshall said, due to increased demand coupled with historic drought, made worse by climate change.

While local governments continue to squabble on how to divvy up water resources as they currently are and will be, scientists continue to work on solutions.

Water resources in the West are drying up

Climate change has shifted where water lives and falls. While some places, such as western Washington State, are getting more water each year, most of the West is parched.

The Colorado River Basin is experiencing its worst drought in 1,800 years, according to the Bureau of Reclamation. With lower forecasted amounts of snowfall each year and smaller snowpacks, meaning less water running downstream in the spring to replenish the basin, it’s not a problem that’s expected to resolve itself anytime soon.

For example, Lake Powell and Lake Mead, the two largest reservoirs in the U.S. and part of the Colorado River watershed, are dangerously close to reaching “dead status,” according to the United Nations Environment Program, meaning there’s not enough water to flow and produce hydropower. And the energy generated at Arizona’s Glen Canyon Dam provides water and electricity to agriculture and tens of millions of people but could drop below power generation levels as soon as June 2023.

“There’s less water than the system has been built to depend on,” said Ryan Gilliom MS ’17, PhD ’20, a project hydrologist at LRE Water.

Hydrologists are looking at anything and everything for how to plan for that future reality. Gilliom, for example, does decision-support through various

The Colorado River Basin is a significant water source for drinking water, agriculture and recreation for seven states in the southwestern U.S. and is also a major source of hydropower for the American West.

types of hydrologic modeling, supply and demand planning, water quality management, and looks at how changes in reservoir management and infrastructure operations impact watersheds.

That’s not always easy with the future still unknown. Because of climate change, “the kind of hydrological modeling relationships and expectations—that we have this much snow translated to that much stream flow—are changing,” she said. That makes her job, and that of thousands of other hydrologists, more challenging.

Solutions being considered and implemented

To start, managing water on the supply side is critical and going to become even more so, said Marshall. “In western watersheds, we manage water for both flood control and water supply. If runoff comes earlier in the year, you might need to release that water to maintain space in your reservoir or you end up with less to work with later in the summer when you need it,” she said. Advanced modeling, for both what snowpack will look like in the future and near-future weather forecasts, can help.

Gilliom’s kind of modeling can also assist water providers working with land managers, giving them a picture—even if it’s bleak—of the future water supply they’ll have. LRE Water pulls together data on things



such as streamflow, reservoir levels, groundwater levels, temperature and water quality parameters to create custom dashboards that give water managers an interactive visualization that helps them optimize use of available supplies and make plans for a day, month or further in the future.

Having this information at their fingertips can lead to zoning changes that limit things like the amount of decorative turf grass allowed in both public and private spaces. In November 2022, for example, Castle Rock, Colorado, passed a law limiting the number of lawns around new homes, starting in January this year. The town is also looking for alternative water sources to move away from relying on nonrenewable ground aquifers, as it mostly does today.

This kind of forecasting can also lead to better understanding of existing groundwater resources, determine if they're potentially contaminated and

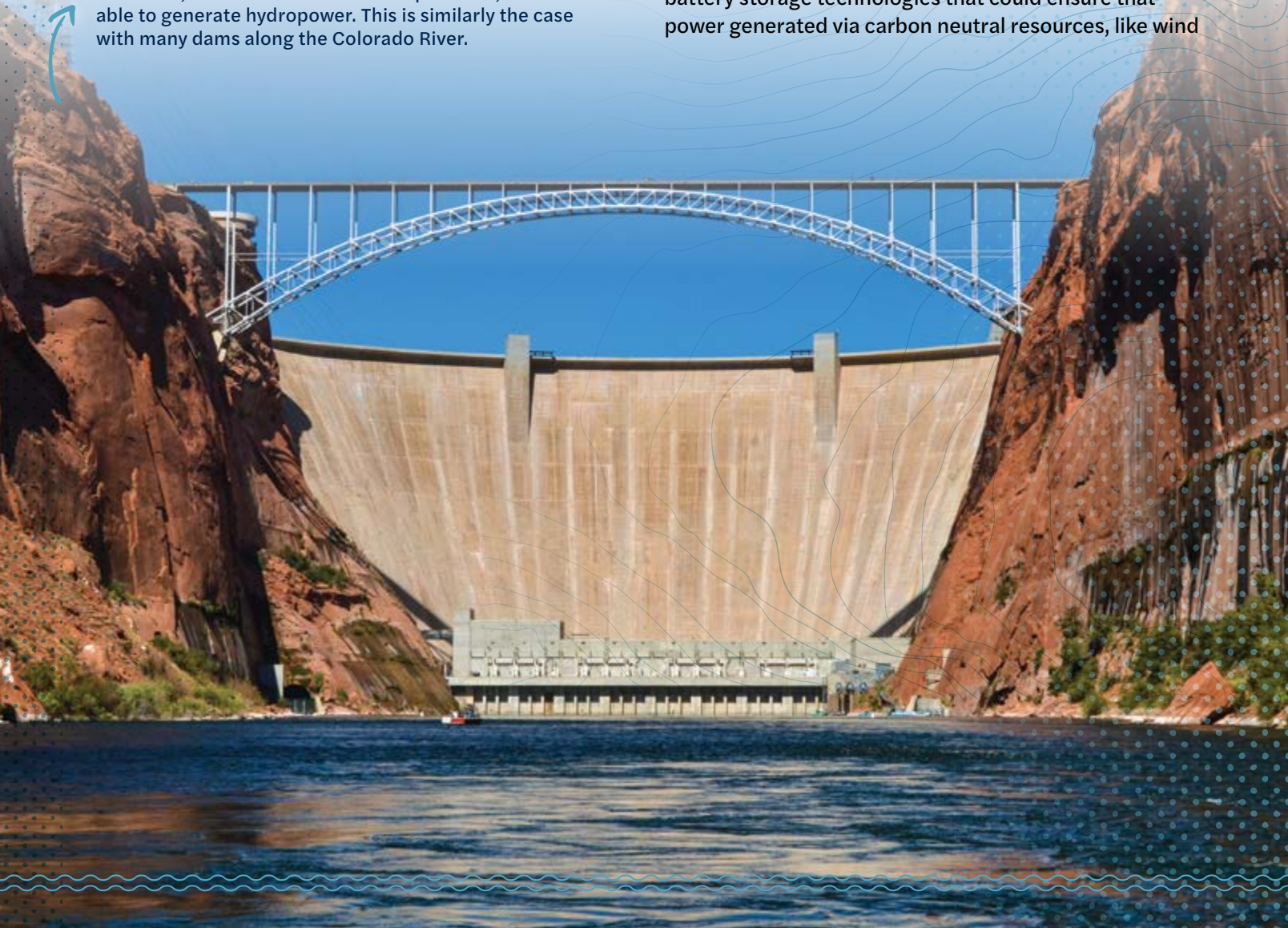
The Glen Canyon Dam supplies electricity to Wyoming, Utah, Colorado, New Mexico, Arizona, Nevada and Nebraska, but if the water levels drop too low, it won't be able to generate hydropower. This is similarly the case with many dams along the Colorado River.

figure out how to tap groundwater without pulling contaminated water towards drinking water in general.

That's what Savannah Miller MS '16 does in her role as a hydrologist at environmental firm Brown and Caldwell, where she helps facilities, municipalities and small governments work with water. "If you're dealing with water in the future, understanding scarcity and understanding how we share water and how we deal with too much water or contaminated water will never not be an issue," she said.

In only five years on the job, her work has already changed due to the world changing around her. Now she's "not just trying to get an answer. I'm trying to understand what I'm doing and why I'm doing it," she said. "I'm trying to focus on the big picture of what I'm doing."

At the same time the mechanics of hydropower are having to change, it's also being seen as an increasingly important source of renewable and decarbonized power, Marshall said. While water in dams and reservoirs can be managed as a source of power storage, researchers are working on creating grid-scale battery storage technologies that could ensure that power generated via carbon neutral resources, like wind



and water, can be saved and redistributed when necessary. “Batteries could be particularly useful if hydropower declines,” she said.

Advances and the expanded use of pumped storage hydropower can also help better manage a dam’s output. These are made by connecting two reservoirs, one at a higher altitude than the other. The water is released through a turbine that then spins a generator and creates power. Pumped storage hydropower makes up 93 percent of the country’s grid-scale energy storage today, according to the National Renewable Energy Laboratory.

As the size of that kind of storage expands, more and better pumped storage hydropower could play a role in supplying power to the West.

What the future of water management will look like

In the future, water managers are going to be looking for ways to manage a limited resource more effectively by balancing risks with benefits and in some instances, taking on more risk, said Ken Brettmann ’84, chief of hydrology at the U.S. Army Corps of Engineers’ Seattle district.

While western Washington State, the region he covers, is generally fairly wet, it still has its own drought problems. Its droughts aren’t as extreme as in the Southwest, but it’s still something they must plan for.

“My job is managing risk, looking at the probability of something happening and the consequences,” he said.

At Howard Hanson Dam near Seattle, Brettman and his team re-evaluated the relationship between water stored in the reservoir for drought mitigation and the associated risks and benefits of when to release that water. His team realized that past operations were based on a very conservative and risk adverse approach, which mandated saving a significant volume of water in the reservoir each year in the rare event that the typical summer dry season extended into late fall. While the availability of stored

water would be beneficial in that case, it would be more beneficial to release that stored water earlier in the year during the typical summer dry period.

Brettman’s team made similar changes to how water is managed at the Ballard Locks in Seattle. Previous operations limited releases from the project during the summer dry season for fisheries purposes based on a concern that available reservoir storage could become limited under fall drought conditions. Modified operations in recent years release more water during the summer to benefit fish while assuming an increased risk that storage could become limited in the event of a severe fall drought. The team concluded that this is an acceptable trade-off since the benefits outweigh the risks in most years.

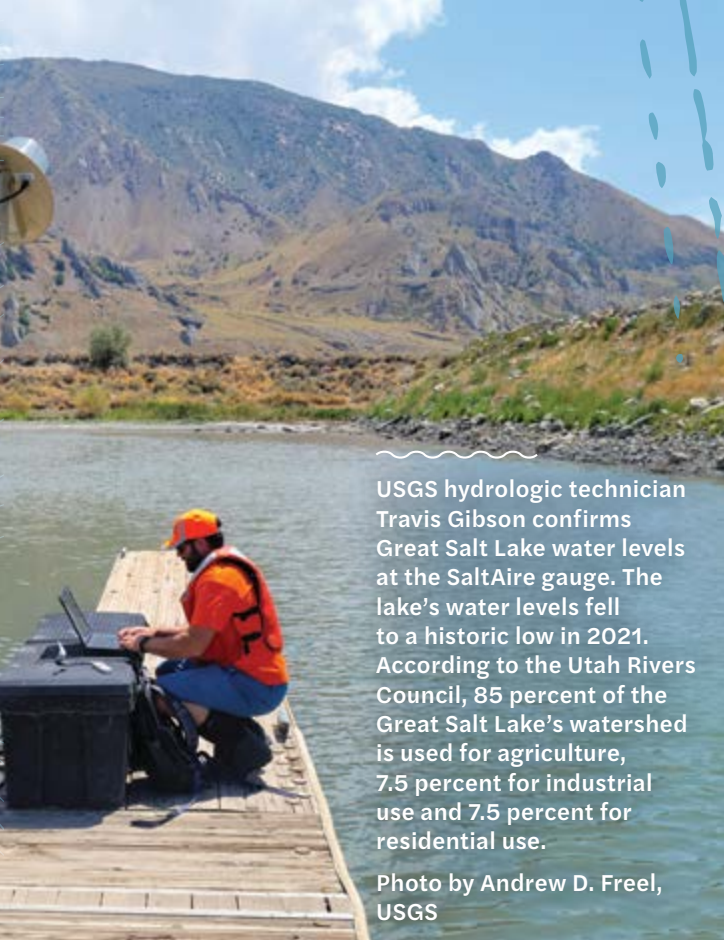
To further mitigate these risks, Brettman’s team also created a water conservation plan that can be implemented in the event of a severe fall drought. This plan was used successfully to avoid a water shortage during a severe drought several years ago.

These kinds of changes in water management are most likely to evolve in the future, he said, as he doubts there will be much construction of new dams or reservoirs. “We aren’t just focused on making physical changes at dams and reservoirs,” Brettmann said. “We are looking at how we manage them to see if there are operational changes that can help provide resiliency to short-term climate variability and longer-term climate change.”

The imbalances of water-related weather events, sometimes happening at the same time, can also help to maximize the use of hydropower, added Marshall, by supplying power to an interconnected electric grid. That means that droughts in one part of the country could be offset by other areas of the country experiencing ideal power-generating conditions.

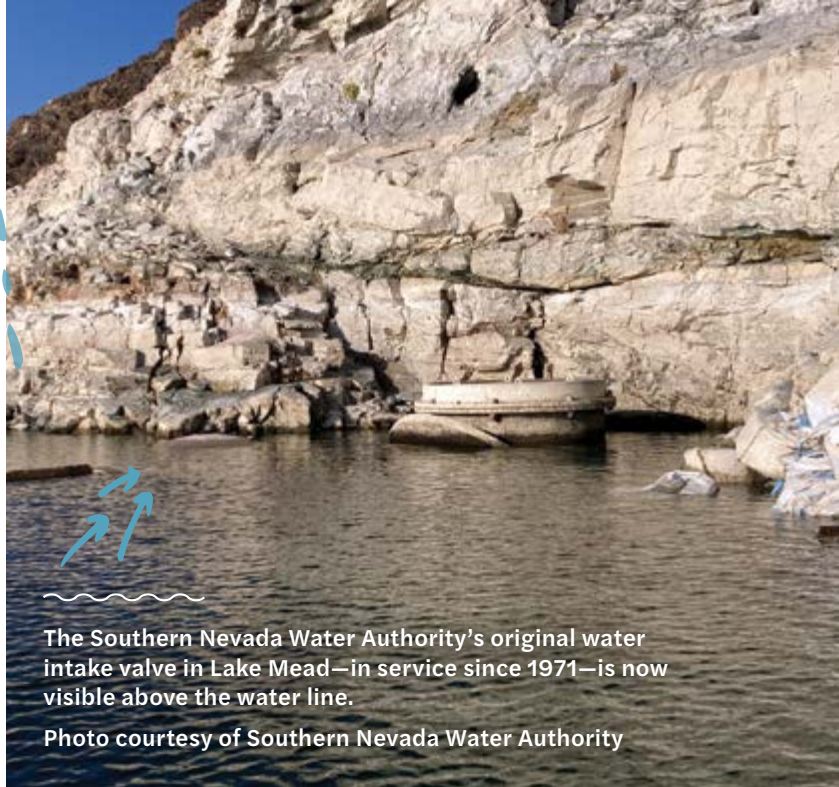
“There are opportunities to manage water better,” said Marshall, even if what happens with water is not entirely in hydrologists’ control. “There’s the adaption side, but there’s the climate mitigation side where, to the extent that we can reduce burning fossil fuels, we will help our water system.”





USGS hydrologic technician Travis Gibson confirms Great Salt Lake water levels at the SaltAire gauge. The lake's water levels fell to a historic low in 2021. According to the Utah Rivers Council, 85 percent of the Great Salt Lake's watershed is used for agriculture, 7.5 percent for industrial use and 7.5 percent for residential use.

Photo by Andrew D. Freel, USGS



The Southern Nevada Water Authority's original water intake valve in Lake Mead—in service since 1971—is now visible above the water line.

Photo courtesy of Southern Nevada Water Authority



In September 2020, USGS tested ground-penetrating radar (GPR) mounted on a cableway over the Gunnison River in Colorado. USGS has been testing use of the GPR to map river bathymetry, or profiles of water depth along the river. They are also using GPR to map the shallow subsurface geology below the stream to gain a better understanding of the movement of water between the ground and the stream, which is important for understanding groundwater-surface water interactions that can affect water quality and availability.

Photo by David M. Rey, USGS



Salina Derichsweiler '02 has always carved her own path. It hasn't always been smooth sailing, she confessed, but it has given her a unique perspective on life and business that has served her well. Most recently the CEO of the clean energy company Transitional Energy, Derichsweiler is a successful entrepreneur and self-described agent of change who believes firmly in the power of education and the value of personal agency. "I've always been the person trying to save the world," she said.

A first-generation college student and Iñupiaq, Derichsweiler embraced school as her way up and out of poverty. "My parents were addicted to drugs and alcohol and had mental health issues—I was even homeless for a time," she said. "I remember as a seven-year-old saying to my second grade teacher, 'I don't want to live like my parents,' and she replied, 'Then educate yourself.'" Derichsweiler listened, earning her bachelor's degree from Mines and her MBA from Pepperdine University.

After enjoying many successful years as a reservoir engineer in the oil and gas industry, Derichsweiler began looking for opportunities in the growing field of green energy. "In recent years, I've watched public sentiment shift toward clean energy and witnessed people in our industry struggle to find a place to belong," she explained. "I believe in community, and I'm a problem solver at heart, so I felt I could help in finding ways to drive change in the oil fields in an inclusive way."

Derichsweiler said she was also pulled toward the green energy movement by her children. "They didn't like that I worked in the oil fields, and as an energy professional, I felt a responsibility to address their concerns."

CARVING A NEW PATH

Solving problems and driving change—in energy and her personal life—has long been the focus for Salina Derichsweiler '02

BY LORI FERGUSON

CONNECTIONS

- ▶ Mines hosted a launch party on November 21, 2022, at the Meier Skis manufacturing facility and showroom in Denver to showcase the first-ever Mines custom skis and snowboard. ▲

In 2020, Derichsweiler founded Transitional Energy, a company dedicated to converting the heat waste common to oilfields into clean power using geothermal energy engines. “Working in water flooding management, I was focused on extracting all the resources possible,” she explained. “With our new company, we’re making that extraction process less punitive and giving a whole new life to older active oil wells through the use of technology. We’re transforming heat waste, a common problem in oil fields, into a positive as a potent source of clean power.”

Pushing change in her industry has had its challenges—Derichsweiler admitted she’s often the only woman in the room—but she insists that many men have been generous mentors. Being a first-generation college student has also proved useful. “I can connect with many different people—I have no ‘this is how life has to be,’ mindset,” she said. “I honestly believe that when everyone succeeds, everyone wins.”

Derichsweiler said her Mines education has also proved invaluable through her entrepreneurial journey. “The school gave me a degree in problem solving,” she said. “When I graduated, I was prepared to tackle real-world problems and come up with practical solutions.”

“I BELIEVE IN COMMUNITY, AND I’M A PROBLEM SOLVER AT HEART, SO I FELT I COULD HELP IN FINDING WAYS TO DRIVE CHANGE IN THE OIL FIELDS IN AN INCLUSIVE WAY.”

Now she is turning her prodigious talents to a new challenge. She recently stepped down as CEO of Transitional Energy to spend more time with her teenage children. “Building the company has been a lot of work and it has pulled me away from my family, so now I want to focus on helping my kids build their future,” she said.

Derichsweiler recently joined the board of directors for Colorado Young Leaders, an organization committed to helping kids find new ways to lead. “I’m in exactly the right place,” she said. “I believe there’s value in viewing the world in a different way like I do, and I’m finding passion through service and working with youth to change the world.”

It’s a new year.

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Contact the Mines Foundation to create or update your will or other estate plans.



For more information, go to plannedgiving.mines.edu





NOTHING BUT MINES PRIDE

The Mines community came together to celebrate Homecoming 2022

Homecoming 2022 was jam-packed full of events and celebration of the Oredigger spirit. Mines alumni came back to campus for all the big traditions, including the football game, the annual Homecoming 5K, class reunions, alumni party, a talk from Homecoming Distinguished Lecturer Daymond John and more.

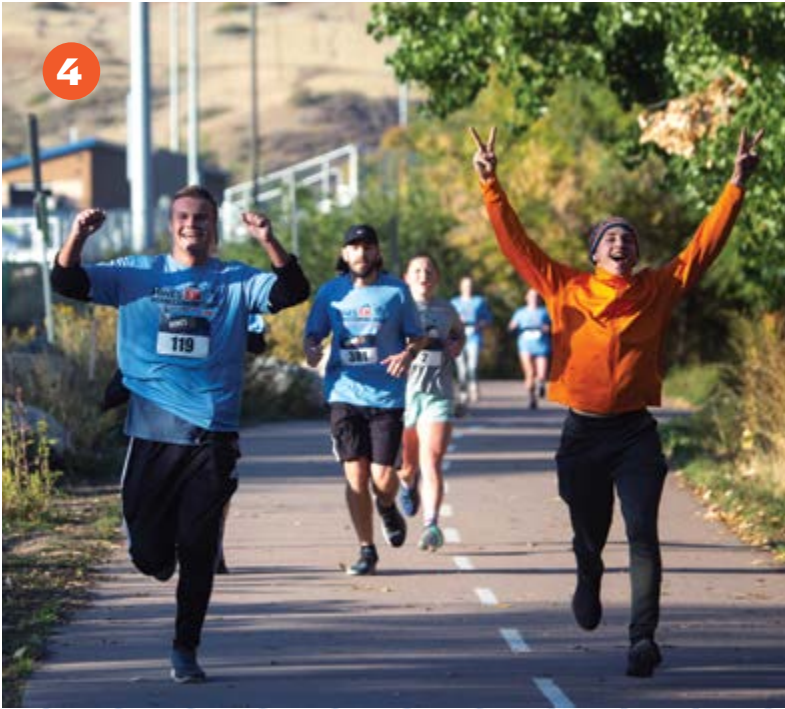
Here are some of our favorite shots from the weekend.

- 1 Oredigger crowd and Blaster at the Homecoming football game
- 2 Class of 1972 50th reunion
- 3 Homecoming Distinguished Lecturer Daymond John, CEO of FUBU and star of *Shark Tank*
- 4 Homecoming 5K
- 5 2022 Mines alumni award winners
- 6 Mines alumni gathered at the Boots & Barrels alumni party



CONNECTIONS

▶ President Paul C. Johnson joined Houston-area alumni for the Houston Holiday Party on December 1, 2022. ◆



4



5



6



HONORING PETROLEUM ENGINEERS

Mines' new Petroleum Engineering Hall of Fame welcomes its first class of inductees

In celebration of the Petroleum Engineering Department's 100th year at Mines, the university hosted the inaugural Petroleum Engineering Hall of Fame event in fall 2022 in celebration of the department's 4,900 graduates. The event also honored 12 awardees who were inducted in the new PE Hall of Fame in recognition of their legendary contributions in the industry and department.

2022 PE HALL OF FAME INDUCTEES:

- Victor Alderson
- Steve Chesebro '64
- DeAnn Craig '73, '80, MS '02, PhD '05, MS '06
- L.B. Curtis '49
- R.C. "Chuck" Earlougher '36
- Lincoln Elkins '40
- Lloyd Elkins Sr. '34
- Dennis Gregg '50
- Hugh Harvey '74, MS '80
- Ted Nelson '30
- Ralph Schilthuis '30
- Russell Volk '26, MS '31

▶ More than 400 local alumni and friends attended the Denver Holiday Party at the Denver Aquarium on December 7, 2022, to celebrate the season. ▲



Photo by Elliot Nahm

MAKING HIGHER EDUCATION ATTAINABLE FOR ALL

Kurtis Griess '08, MS '10 is helping expand opportunities for underrepresented students to pursue a college education

BY LORI FERGUSON

Since graduating from Mines, Kurtis Griess '08, MS '10 has carved out an impressive career in educational enterprises: six years as the founder and director of Compassion by the Book, a nonprofit he launched to cultivate a philanthropic mindset in college students; two years as a mathematics teacher with Denver Public Schools; six years as director of two federally funded Upward Bound Math and Science programs in Albuquerque, New Mexico; and now director of TRIO Student Support Services at State Fair Community College in Sedalia, Missouri. It's somewhat surprising, therefore, to learn he never envisioned a career in education.

"I had done private tutoring from high school all the way through college, and I loved it. I thought I might pursue education in retirement, but never imagined I would start my career in the field," he said. "I envisioned employing the problem solving and critical thinking skills I gained as a math major to a field of my choice."

But during his master's program, Griess had a change of heart. "I felt pulled to service in nonprofits and education, so I went with it," he said.

Griess never looked back. Indeed, over the years, his enthusiasm has only grown. As director of Compassion by the Book, Griess learned that you don't have to have millions of dollars to make an impact. And through his work with Upward Bound, he discovered the profound rewards of assisting underrepresented, low-income and first-generation high school students to complete their secondary education and then earn a college degree. "I loved seeing these students and helping them realize what they could become," he said.

CONNECTIONS

- ▶ Mines alumni attended the December Lunch Bunch event to hear all the latest news about Mines from President Paul C. Johnson. ▲

Through Upward Bound, students in need gain access to tutoring, one-on-one mentoring, college visits and cultural activities to increase their proficiency in math, laboratory science, composition, literature and foreign language, Griess explained. Given Mines' outstanding reputation in science, technology, engineering and math, bringing a program to the university seemed to him like a natural next step.

"After writing my first successful Upward Bound Math and Science grant, I was convinced that Mines should have this program," Griess said. "I knew both the students and the university would benefit. Students can discover that careers in STEM fields are attainable, and Mines faculty can encourage greater diversity in higher education through interactions with students from diverse racial and socioeconomic backgrounds."

Griess recently helped Mines write a winning grant to create a program between the university and Jeffco Public School's Alameda International Junior/Senior High School. It launches in spring 2023 and will enable two Mines employees to work on-site at Alameda with 60 students.

"I LOVED SEEING THESE STUDENTS AND HELPING THEM REALIZE WHAT THEY COULD BECOME."

"Everyone benefits," Griess said. "Mines faculty and staff will empower students who are underrepresented in higher education and in STEM, and students will serve as mentors and advocates for the next generation."

Now, in his new role as director of TRIO Student Support Services for a community college, Griess finds himself at the next level of the academic pipeline, providing leadership and oversight of services and activities for low-income and first-generation college students and students with disabilities to help them successfully complete their programs and transfer to four-year colleges and universities.

"I'm not sure what the future holds. Working with students feeds my soul, but consulting and grant writing allow me to broaden my reach. I want to continue finding ways to serve," he said. "Mines gave me the ability to look at problems and find solutions, and that's the lens I apply to all issues. I'm not satisfied with anything less than my best."

SHERIDAN ROSS PC

ATTORNEYS AT DIFFERENT PERSPECTIVES



Patent



Trademark



Commercial
Litigation



IP Litigation



ADDING VALUE TO THE ENERGY MARKET

Building a business in energy technology requires looking ahead and weighing the impact of your solutions

Sustainability is often top of mind for entrepreneur and philanthropist Rick Tallman '85, MS '93. For the past 15 years as founder and partner at Renova Capital, a Denver-based private equity firm that invests in renewable energy assets, Tallman has worked with dozens of companies to bring new sustainable technologies to market. And through that process, he

has focused on ensuring his business not only supports these new products but also has a positive impact on the environment and society.

“That’s my little contribution to getting through the energy transition,” Tallman said.

We sat down with Tallman to hear a little more about his approach to running a business, sustainable development and the challenges he’s overcome along the way.

CONNECTIONS

▶ Alumni in the Washington D.C. area gathered for some holiday cheer on December 11, 2022, at Aslin Beer Company. ◀

MINES MAGAZINE: MUCH OF YOUR WORK HAS BEEN CENTERED AROUND SUPPORTING SUSTAINABLE DEVELOPMENT AND NEW ENERGY TECHNOLOGIES. WHY IS THIS WORK IMPORTANT TO YOU?

Tallman: When I was trying to decide to go back to grad school and get a technical degree after leaving the Army after the Persian Gulf War, I talked to Frank Schowengerdt, who was the dean at the time. He pulled out a chart that showed the human population and how it's grown without constraints for the last 100 million years. Now, in the course of a couple generations, everything that humans are about is going to be challenged, because we have to change and work against our human nature, to flatten the curve and get society to a place where we can live with restrained resources. He said it was the mission of Mines to provide the technical leadership to get through that curve and get us on a new trajectory as a society. And that really struck me.

Then I was taking a class from Keenan Lee, and he laid out climate change. He put a decision matrix up on the board and said "Either global warming is real or it's not, and either we do something about it or we don't. And in three of those cases, we're better off. If we work to clean up our air and water, we're in a better place. But in the last case, if it's true and we don't do anything about it, we're in serious trouble."

That hit me like a ton of bricks. I just decided at that point that I was going to use my technical degree and my knowledge from Mines to work in those areas.

MM: WHY DID YOU DECIDE TO BECOME AN ENTREPRENEUR?

Tallman: I feel like an entrepreneur is, in simpler terms, a problem solver. And the key to success as an entrepreneur is to really understand the problem you're solving, and the bigger problem you solve, the greater value for your company and your investors.

The good news is, if you're looking to be an entrepreneur, there's lots of problems to be solved right now.

I also feel like the solutions aren't just purely technical. They're cultural. They're political. And it's

only by bringing all those things together where it satisfies everyone is when you've got an idea that's going to work. That's my approach.

MM: WHAT CHALLENGES DID YOU FACE—AND PERHAPS STILL FACE—AS AN ENTREPRENEUR IN THIS FIELD?

Tallman: The biggest challenge is the status quo. Getting people to change their minds about how things are done is really challenging, and it's not for the weak of heart or the impatient. It takes time and persistence.

When I first talked to J.P. Morgan about banking a solar project, I was literally laughed at. At the time, they banked coal and natural gas, and that was their whole power portfolio. Yet, five years later, they announced a complete reversal.

So for me, it's not a matter of making things happen, but trying to have a good view of where things are going. And if you can really think realistically about where we're headed and separate all the noise from the facts, a lot of times the path becomes clear. And if you follow that path and believe in it, things will come around.

MM: YOU HAVE EMBEDDED CORPORATE SOCIAL RESPONSIBILITY PRACTICES INTO YOUR COMPANIES. WHY IS THIS IMPORTANT FOR YOUR BUSINESS GOALS?

Tallman: I run my companies on a triple bottom line. We keep track of our financial success, and we also keep track of our environmental success and the success we have socially. It's really understanding how the business you're starting or the product you're selling is not only going to make money but how it's going to impact or improve society and the environment. At the end of the day, you'll make more money if you pay attention to how you're impacting the environment and society. Smart business pays attention to those things.

You also have to think about it from the very beginning. You have to ask the hard questions of what impact is this product or company going to have, positive and negative. It goes back to understanding the problem you're solving and the value you're creating by solving that problem and for whom.



EXPAND YOUR NETWORK

The Mines community can help you gain valuable connections

The Oredigger network is expansive and offers many unparalleled opportunities—if you’re prepared to take advantage of it. But where do you start? Luckily, there are many ways to connect with faculty, students, alumni, Mines’ partners and more to help you expand your network and achieve your personal and professional goals. Here are a few ideas.

VISIT CAMPUS AND ATTEND MINES EVENTS.

There are many events and opportunities to come back to campus and take part in all the exciting activities happening at Mines. Whether you’re engaging with an interest group, attending a talk on campus or even cheering on one of Mines’ sports teams, you can connect with other members of the Mines community and pick up new skills.

→ Check out the latest events at weare.mines.edu/events.

VOLUNTEER—ON CAMPUS OR IN YOUR LOCAL AREA.

Whether you’re looking to share your time by mentoring students, connecting with your fellow alumni in your local community or becoming a Mines ambassador, there are numerous ways to get involved and expand your network.

→ Learn more at volunteer.mines.edu.

CONNECT WITH YOUR LOCAL M CLUB.

With nearly 50 M Clubs across the globe, there’s a good chance you can connect with a group of other Mines alumni in your local area. M Clubs not only provide a sense of community even when you’re not near the Mines campus, but they also give you the chance to network and socialize with fellow Orediggers.

→ Find an M Club near you at weare.mines.edu/mclubs.

FIND YOUR FELLOW OREDIGGERS AND MINES PARTNERS ON LINKEDIN.

LinkedIn is a great place to connect with Mines alumni and partners—especially when you’re looking to expand your professional network. Whether you’re following Mines’ official account or are part of the Mines alumni group, you can find all the latest news, mentorship and more to advance your personal and professional life.

→ Find the Mines alumni group on LinkedIn by searching for “Colorado School of Mines Alumni.”

CONNECTIONS

▶ Thirty-five Orediggers joined the Order of the Engineer this fall, in dedication of upholding devotion to the standards and the dignity of the engineering profession. ▲



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Justin Maham '14

Lew Mologne '83

Mike Scherrer '83

Emily Townsend '19

SAVE THE DATE:

Houston - April 21, 2023

Golden - June 8, 2023

Proceeds support student scholarships at Mines.



THE ROLE OF THE ENTREPRENEUR IN OIL AND GAS

To meet growing energy demands, new ideas for the petroleum business will be paramount

In an industry with a deep-rooted legacy such as oil and gas, striking out on one's own with an independent business venture may seem far more difficult than starting up a company in, say, a tech field. But in fact, entrepreneurship in oil and gas may play an important role in the future of petroleum and meeting energy demands today and in the future.

We talked to Steve Enger '81, former president and CEO of Denver-based private upstream oil company Edge Energy, about what entrepreneurship looks like in the industry today and the value independent ventures can bring to the future of the business of energy. Here were some of our takeaways.

THERE IS SPACE FOR ENTREPRENEURSHIP IN THE UPSTREAM BUSINESS—IF YOU'RE WILLING TO TAKE THE RISK.

The upstream oil and gas business is one of the most lucrative and critical components of the world's energy supply today and is made up of large companies with enormous capital. That can make it difficult to see where startups or other independent ventures can fit into that landscape and be competitive. For people entering the workforce today or who are only a few years into their

career and looking to start their own business, it is going to be harder to compete with those larger, established companies—but it's not impossible.

"There is still opportunity for small companies and entrepreneurs—whether individuals or small teams—to get involved in the upstream oil and gas business. I do think it's more challenging than it was five or 10 years ago, but those opportunities still exist," Enger said. "You might have to be more creative and perhaps take more risks as an entrepreneur to be able to find a spot in the landscape. If you've got the spirit, you have the right idea and sufficient seed capital, you can get your idea to the point where you can prove it has value. Of course, the market will ultimately let you know if your idea is good enough."

ENTREPRENEURSHIP AND INNOVATION WILL LIKELY PLAY A LARGER ROLE IN IMPROVING TECHNOLOGY AND PROCESSES TO KEEP OIL COMPETITIVE AND EFFICIENT.

By bringing new operational ideas and technologies to the oil fields, new business ventures can make a big impact in how the petroleum industry meets energy demands while simultaneously meeting the

CONNECTIONS

- ▶ Approaching Mines' 150th anniversary in 2024, university leaders are celebrating the impact Mines has made over the years by visiting with Orediggers in cities across the U.S., starting with Midland, Texas in January 2023. ▲

environmental constraints companies contend with today.

“Where I really see opportunity for entrepreneurs is in the service side of things,” Enger said. “That can be software. It can be someone who has a better mouse trap for how something is done in the back office. It can be an improvement to any of the many processes that are involved on the business side of things.”

Improvements to operational abilities such as the drilling of wells, production processes, facility designs, software and more that are generally more environmentally friendly while maintaining a high level of output can help the industry move forward in a positive way.

“There are things we can do to keep oil and gas as economically competitive as it currently is, because energy prices matter to consumers, and we can also be better citizens,” Enger said. “I think that we’ve made considerable progress in the last five, maybe 10 years in many of those technology areas.”

And people with ideas from beyond the petroleum industry might also prove to be beneficial and provide unique insights into building a bright energy future.

“We’ve always been good at drilling wells and have focused on doing it faster and getting more oil out of the ground and improving fracturing technologies over the last few decades. But some of the processes and logistics and transactional efficiencies we can borrow from other sectors of technology,” Enger said.

GRADUATES ENTERING THE WORKFORCE WITH A STRONG BUSINESS SENSE AND ENTREPRENEURIAL SKILLS WILL HAVE A LEG UP WHEN IT COMES TO LEADING THE FUTURE OF THE OIL AND GAS INDUSTRY.

While all Mines graduates start their professional lives with a stellar education, supplementing that technical knowledge with more business and innovation skills will only add to the unparalleled reputation Mines graduates have in the workforce today. That’s where the opportunities enabled by Mines’ new entrepreneurship and innovation ecosystem will come into play.

“Historically, Mines made us hard workers and problem solvers who are stubborn and relentless. Those are important qualities for entrepreneurs,” Enger said. “Now, we can layer that with some specific curricula focused on business fundamentals. For those interested in entrepreneurship in oil and gas, you’ve got to know the fundamentals and have the technical foundation, especially for the core upstream business. And then you have this opportunity to take advantage of this specific business and E&I coursework and resources on campus, which are going to be a big advantage relative to those of us who graduated decades ago.”

And Enger sees oil and gas playing a big role in the world’s energy future, in concert with the many new technologies coming on the market today—and today’s graduates are going to lead that future.

“I don’t see oil and gas production declining in my lifetime. And I hope that other energy sources prove to be more economic and more important supplements to that over time,” Enger said. “It’s going to be a very long multi-decade transition, whatever the new future of energy is.”

Hiring and HR Experts in Mining & Green Energy

- C-suite executive recruiting
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- Human Resources services





For those who didn't travel to McKinney, Texas, for the NCAA Division II National Championship football game, Mines alumni, students, faculty and staff gathered for several watch parties around the Denver area to cheer on the Orediggers.

1970s

Deborah Peacock '78 was re-elected to the board of directors of Westwater Resources, Inc., a graphite processing company making materials for the energy transition, including electrical vehicle batteries.

1980s

George Saunders '81 published a new short story collection titled *Liberation Day* in October 2022 and was featured in an interview with *Time* magazine to discuss the book and optimism in writing.

Jay E. Valusek MS '84 published a book titled *Girl of Light and Shadow* in November 2022 in memory of his daughter, Beth, who died from suicide in 2018.

Steve Biagiotti Jr. '86 was promoted to chief engineer at Dynamic Risk, an industry leading pipeline integrity management firm, in August 2022.

Tina Stegman-Faraca '87 was recently promoted to president of U.S. natural gas for TC Energy.

2000s

Travis N. Attanasio '02 was installed as the 110th President of the American Society of Civil Engineers Texas Section in September 2022.

Steve Beach MS '00 was appointed as one of five inaugural members of Archer Exploration Corp.'s technical advisory committee in December 2022.

Robert Michael Gower '04, an assistant professor of chemical and biomedical engineering at the University of South Carolina, received a CAREER Award from the National

Science Foundation to develop tissue engineering and drug delivery technologies that interface with adipose tissue.

Luka Dale Gower joined a family of Orediggers on August 16, 2021, including his parents **Robert Michael Gower '04** and **Eileen (McFadden) Gower '04**, engineers-in-training big brothers Owen (5) and Elis (3), grandfather Dale McFadden '76 and great-uncle Gene McFadden '73.

2010s

Following a beach proposal in Puerto Rico, **Jeevak Mattamana '10** and Jane Alookaran were married in Tampa, Florida on September 24, 2022, a few days before Hurricane Ian made landfall in the state. Half a dozen alumni attended the wedding, including groomsmen Chris Leyboldt '10 and Richard Vidal '10.



We're proud of Mines alumni. We want to cheer you on and celebrate your accomplishments. Tell us about your recent wedding, a new baby or your new job. Share a personal or professional accomplishment, volunteer activity or your favorite Mines memories. Stay connected to the Oredigger family.

➔ Submit a class note at minesmagazine.com/classnote.



Adrien Perinet '18
and Joy Cotie '19



Rowyn Spurgeon



Vincent Briar
Svendsen

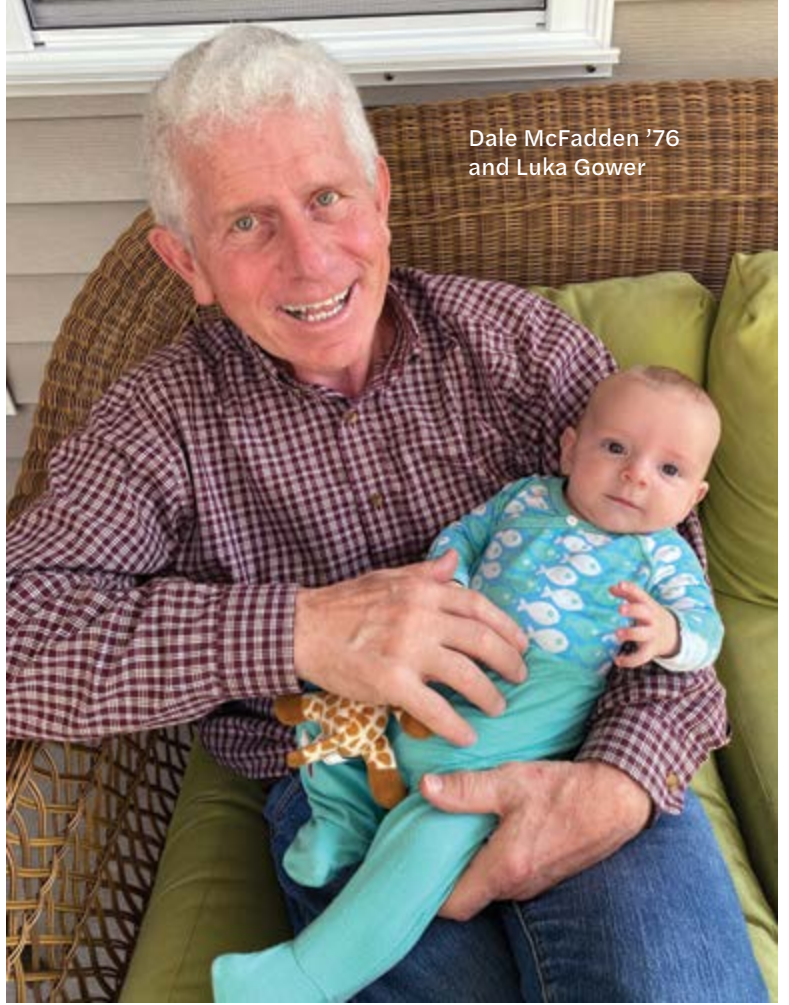


Lorae Tracy '12 and Bart Long

Chelsae Cameron '16
and Cameron Mollard



Dale McFadden '76
and Luka Gower



Beckett William Sullivan



Jeevak Mattamana '10
and Jane Alookaran





Kaitlyn Sengenberger '19 and Riker Johnson '20

Lorae Tracy '12 and Bart Long were married on September 25, 2021, at Lorae's parents' home in Golden, Colorado. Sixteen Mines alumni attended the wedding. The couple welcomed their first child, a baby girl, on August 5, 2022.

Thorn Svendsen '11 and **Chelsey Svendsen '12** would like to announce the birth of their son, Vincent Briar Svendsen. Vincent joined brother Xavior (5) and sister Aribella (3) on September 15, 2022.

Patrick Sullivan '14 and **Becca (Wienand) Sullivan '14** welcomed their first child, Beckett William Sullivan, to their family on July 29, 2022.

Evan Manning '15 and **Keaton Looney '17** were married on November 12, 2022, in Coppell, Texas. Several Mines alumni attended the wedding, and Brandon Rodriguez '14, MS '15 and Spencer Wells '15 served as groomsmen.

Taylor Spurgeon '15 and **Cole Spurgeon '16** welcomed a new child on May 23, 2022. Rowyn joins her sister Ryman (2) and brother Link (2) to make the Spurgeons a busy family of five.

Nicholas Wilkins '15 won a best poster award at the 14th Fundamentals of Adsorption conference held in Broomfield, Colorado in May 2022 for his research titled "Nitrogen Rejection From Natural Gas Streams Using a Nitrogen Selective Metal Organic Framework." He also recently defended his PhD thesis on June 6, 2022, from the University of Alberta.

Steven Mollard '15 and **Chelsae Cameron '16** welcomed a baby boy to their family. Cameron Mollard arrived on July 2, 2022.

Adrien Perinet '18 and **Joy Cotie '19** were married in Golden, Colorado on July 3, 2022. The couple met in indoor soccer class at Mines. Fifteen

percent of the people who attended their wedding were Mines alumni, including best man Rob Jones '19, MS '21 and maid of honor Natalie Kalin '19, MS '20.

Kaitlyn Sengenberger '19 and **Riker Johnson '20** were married in Foxfield, Colorado on June 4, 2022. More than 23 alumni were in attendance, including best man Aaron Guillory '20, groomsman Dylan Sanchez '20, maid of honor McKinlee Neubauer '18 and bridesmaids Cat Wylie '19 and Summer Camerolo '20, MS '22.

2020s

Zhenyu Zhang PhD '21 made the Forbes 30 Under 30: Energy List for 2023, a selection of young, "low-carbon visionaries" who are "powering the future of energy and sustainability."

Kate Fiore '22 is the newest addition to the Barr Engineering Company's team as an environmental engineer.

Evan Manning '15 and Keaton Looney '17



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IN MEMORIAM

Remembering Orediggers who have passed away but will always remain part of the Mines community

S. Peter Bickley, Jr. '53 died in June 2022. Born in 1931, he joined the U.S. Army Corp of Engineers and then worked for Shell Oil. He also served as a New Mexico state commissioner as part of the Public Service Commission to help regulate energy and served as a regent for New Mexico Highlands University.

William E. "Bill" Bruce '59 died October 30, 2022. He was born in 1936 and spent his career with the U.S. Department of Labor, specifically the Bureau of Mines, which later became the Mine Safety and Health Administration. He retired in 1992 as chief of the ventilation division of MSHA's Denver branch.

Oliver J. Darling '15 died October 29, 2021. Born in 1992, Oliver worked with a small start-up engineering firm designing and building 3D printers.

Joseph M. Keating '61 died December 2, 2022. Joseph was born in 1937. He was a member of the U.S. Marine Corps Reserve for many years and spent his career as an engineer and consultant.

Heather T. Mergentime '15 died November 10, 2022. Heather worked as a project engineer in Denver, Colorado, but also had engineering experience in transportation, commercial construction, underground construction, oil and gas and environmental compliance, among others.

Grant G. Owen '64 died August 6, 2022. Born in 1941, Grant spent 40 years working as a metallurgical engineer with Alcoa in more than half a dozen facilities across several states, as well as overseas assignments in Wales and Australia.

Steven E. Sondergard '76, MS '79 died October 6, 2022. Steven was born in 1954 and built his professional career as a process engineer for TRC, Asamera Oil, Colorado Refining Company, TOTAL, Ultramar Diamond Shamrock and Suncor. He retired as executive vice president for Sinclair Corporation in Salt Lake City in 2022.

M. Donald "Don" Wagner '56 died October 1, 2022. Born in 1933, he started his career with Mobil Oil and served for six months as a Second Lieutenant in the U.S. Army. He later worked for Baker Oil Tool Company. In 1969, he changed careers to selling mutual funds. In 1972, he started ranching near Wellington, Colorado.

Adolfo R. Zambrano MS '69, PhD '71 died in March 2022. A metallurgical engineer, Adolfo worked for 25 years in the research lab at M.A. Hanna Mining Company in Minnesota and afterward as a consultant. Adolfo obtained a number of mining patents and published articles on his research. He also professionally mentored graduate students embarking on metallurgical careers.

- ➔ To submit an obituary for publication in *Mines Magazine*, visit minesmagazine.com/obituary.
- ➔ Memorial gifts to the Colorado School of Mines Foundation are a meaningful way to honor the legacy of friends and colleagues while communicating your support to survivors. For more information, call **303-273-3275** or visit weare.mines.edu/givingguide.

MINES FOOTBALL MAKES HISTORY



A look at the Orediggers' first time at the NCAA Division II football national championship

Mines football made history in 2022—in more ways than one. The Orediggers advanced to the NCAA Division II national title game for the first time in the program's 131-year history. Although the Orediggers ultimately lost out on the national championship to Ferris State University, they finished the season with some major records and awards.

- Quarterback John Matocha won the Harlon Hill Trophy, considered the Heisman of Division II football. Matocha is the third Oredigger to win this award since it was established in 1986. He was also named the Ron Lenz National Player of the Year.
- Matocha and Center Matt Armendariz were named to the Associated Press First-Team All-America list. Wide Receiver Max McLeod and Cornerback Mason Pierce earned Second-Team All-America honors.
- Head coach Brandon Moore was named Coach of the Year by the All-National Football Foundation Colorado Chapter. Matocha was also named Offensive Player of the Year by the organization.
- Linebacker Ben Fuchs won the Elite 90 Award, presented to the student-athlete with the highest cumulative GPA participating at the finals site for each of the NCAA's 90 championships.
- Defensive Tackle Jack Peterson was selected as one of Mines' Fall 2022 President's Senior Scholar-Athletes.
- 17 members of the team celebrated their graduation from Mines this semester.



Prior to the championship game, the Mines football team visited students at Glen Oaks Elementary School in McKinney, Texas.



Mines students, faculty, staff and alumni made the journey to McKinney, Texas and filled the stands at McKinney ISD Stadium to support the Orediggers.



The Mines football team made it to the NCAA Division II football national championship this year—a first in the program's 131-year history.

Photos by Sam Boender, Ben Funk and Ben Torres



Mines alumni showed up in force for the fan tailgate outside McKinney ISD Stadium to cheer on the Orediggers.



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Water levels in Lake Mead stand at their lowest since April 1937, when the reservoir was still being filled for the first time. As of July 18, 2022, Lake Mead was filled to just 27 percent capacity. This poses a significant challenge for millions of people across seven states, tribal lands and northern Mexico. Fortunately, Mines alumni and researchers are working on solutions for water reuse, mitigation, alternative energy and more to help the West's water problem. Learn more about this issue and the solutions being considered on page 18.

Photos courtesy of NASA Earth Observatory



Lake Mead on July 3, 2022

