

MINES MAGAZINE

For Colorado School of Mines Alumni and Friends • Winter 2026

ONE STEP AHEAD

Mines' quantum programs are developing the next generation of industry-ready leaders

PLUS:

Mines alumni are using their talents to support others and build community.

Mines researchers and alumni work together to find mutually beneficial solutions and drive innovation forward.

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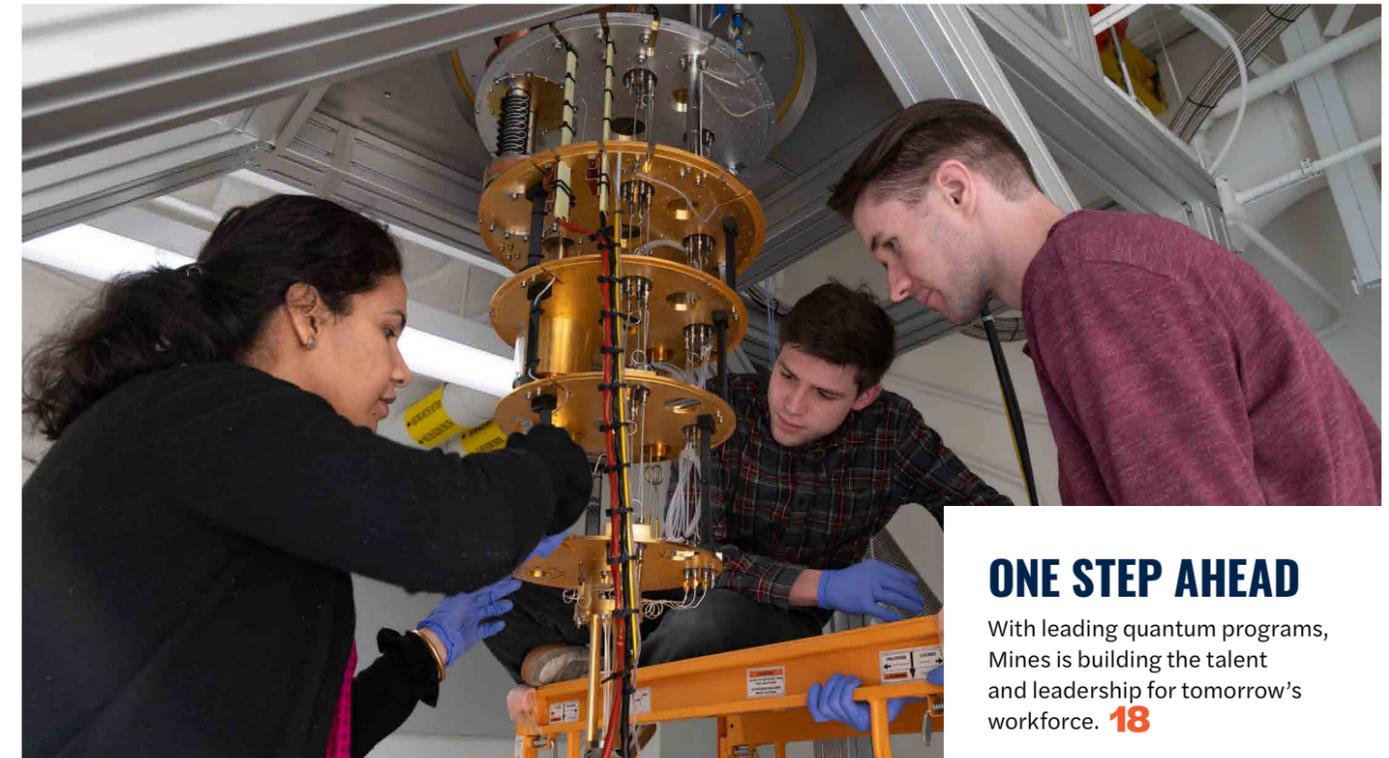


@COLORADOSCHOOLOFMINES 

During the widespread aurora borealis display across Colorado in November 2025, the Mines campus enjoyed a front-row seat. Tim Flynn, assistant athletic director for communications at Mines, captured this spectacular view from Marv Kay Stadium.

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

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Hello World,
I'm Sorry



HELLO WORLD, I'M SORRY

Watch professional improvisers play a Mines faculty-designed tabletop role-playing game that teaches robot ethics

What happens when a robot's best intentions collide with the limits of its design?

That question drives *Hello World, I'm Sorry*, an educational role-playing game co-created by Tom Williams, associate professor of computer science and director of the Mines Interactive Robotics Research Lab. The game explores inherent tensions in the robotics field, specifically looking at the gap between the vision of robots as independent, benevolent helpers and the reality where they are often constrained by their designers' limitations, sometimes causing unintended social harms despite their best efforts.

In the game, players are robots that can sense, think, act and socially interact. But each robot was also created by a human designer and is owned by someone who acquired and deployed them for a particular reason. Williams led a group of improvisers—Mia Paris, Dan Richard, Matt Rodriguez and Jared Schroder—through a story where their technical capabilities are also their greatest risks.

→ Watch a recording of the full gameplay to see if Williams' players can navigate through the story and "do good" without causing harm or if their best efforts are destined to fail.



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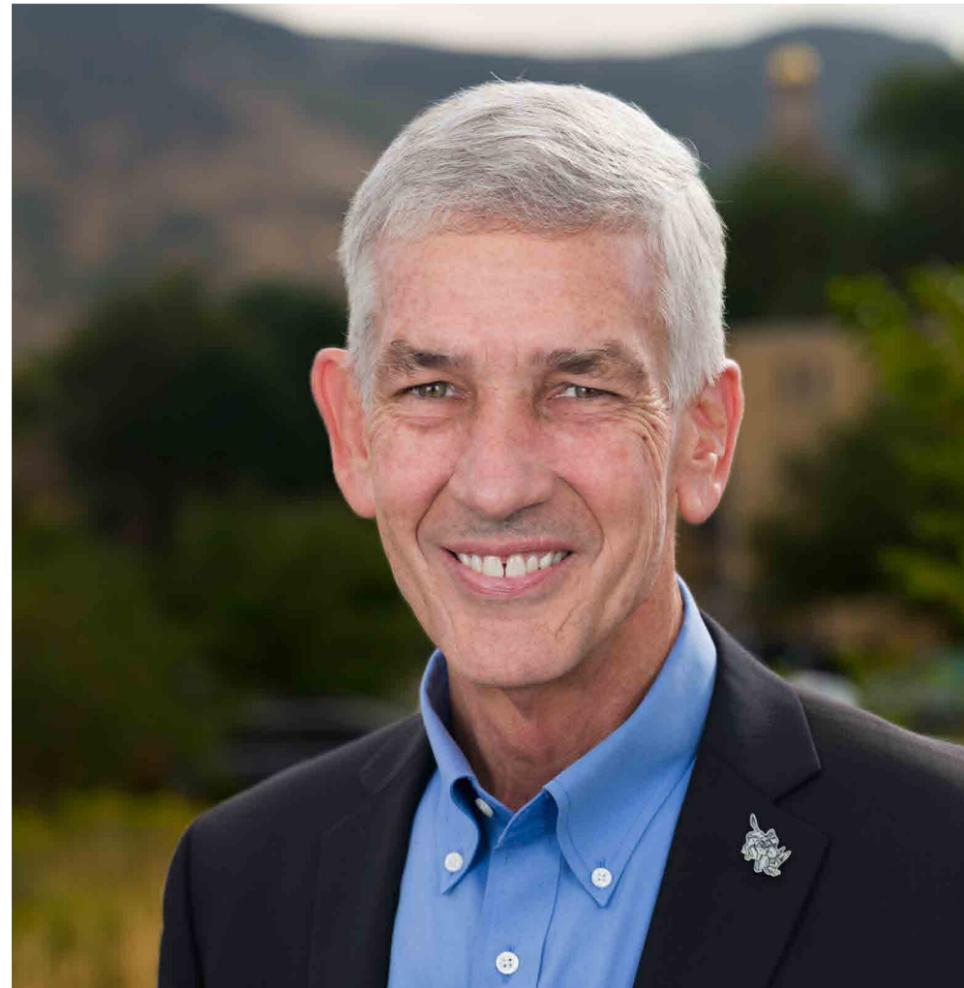
BUILDING ENGINEERING SKILL SETS

Mines continues to grow its academic offerings to meet industry and professional needs

We are living in a time of extraordinary change across technology, industry and education, a moment that calls for institutions to both anticipate the future and prepare leaders to shape it. At Mines, that's what we strive to do every day.

At the start of 2026, Mines launched a Bachelor of Science in Quantum Systems Engineering, a program designed to equip students with the technical depth and creative problem-solving skills needed as quantum technologies and systems become central to operations across a wide range of industries. This undergraduate degree represents the next step in engineering education and is a direct response to the evolving needs of our global partners.

The development of this program would not have been possible without the insight, collaboration and support of industry leaders who helped shape it from the start—many of them Mines alumni leading quantum companies or working in fields that increasingly rely on quantum expertise.



These close partnerships ensured the curriculum is grounded in real-world challenges, aligning what we teach with the skills employers and innovators are seeking today. Their engagement also underscores Mines' fundamental strength in fostering collaboration that drives meaningful impact for students, industry and society. I encourage you to read more about the new quantum systems engineering program and how it came to be on **page 18**.

Mines remains at the forefront of innovation by staying rooted in our mission to prepare adaptable and highly capable graduates.

I'm grateful for the ongoing support of our alumni, whose success reflects the enduring value of a Mines education, even as technology and industry changes and grows.

Go Orediggers!

Paul C. Johnson
President and Professor

TAKING GOLDEN TO GUAM

BY EMILIE RUSCH

An additional Mines location on Guam will confer mechanical engineering bachelor's degrees with a focus on additive manufacturing

Mines will open its first additional location in 2026 on Guam as part of a major initiative to build additive materials and manufacturing capacity in the U.S. island territory.

Located on the grounds of the University of Guam, the Mines campus in Guam is the first-ever additional location of a mainland U.S. university on island. Mines will confer a Bachelor of Science in Mechanical Engineering with a focus in additive manufacturing, allowing students in Guam and across the Pacific to complete a four-year mechanical engineering degree without leaving the island.

Supported by an educational partnership with the University of Guam, Mines-Guam is a key component of the Applied Science & Technology Research Organization of America (ASTRO America) Guam Additive Materials & Manufacturing Accelerator (GAMMA) initiative, backed by the U.S. Navy's Maritime Industrial Base (MIB) Program office and BlueForge Alliance.

"We're excited for this new partnership because of what it offers students, the universities and the U.S. military," said Mines President Paul C. Johnson. "The students receive the opportunity to earn a Mines degree in Guam, and the



Officials from the University of Guam, Guam Economic Development Authority, Applied Science & Technology Research Organization of America and Mines gathered on the University of Guam campus last fall to discuss plans for the satellite campus.

University of Guam and Colorado School of Mines benefit from the investment in state-of-the-art advanced manufacturing facilities and closer ties to the U.S. military and supporting industries in the Pacific—both of which will benefit from the graduates, innovation and capabilities that grow out of this strategic partnership. Mines is a leader in additive manufacturing, and this partnership builds on that and extends the global reach and impact of that program."

"This collaboration between a top-tier mainland university and a leading Guam institution brings a premier engineering program to the island while supporting a strategic workforce need for the U.S. Navy's maritime industrial base and beyond," said Neal Orringer, president of ASTRO America. "Colorado School of Mines is a recognized leader in mechanical and manufacturing engineering, and together with a crucial foundational component offered by the University of Guam, these colleges' dual presence will provide the next generation with world-class instruction in technologies that are reshaping defense and industrial production worldwide."

Through the educational initiative, the University of Guam will provide the first two years of engineering

education, and Mines will provide the final two years of education and degree conferral on island. Students will have the opportunity to specialize in additive manufacturing through technical elective courses from the Mines Additive Manufacturing Interdisciplinary Graduate Program.

The Guam program will prepare students and engineers to design, fabricate and test components where they are needed, right on island. The educational initiative will be complemented by a strong research partnership with the Alliance for the Development of Additive Processing Technologies (ADAPT), Mines' additive manufacturing research center and industry consortium.

"Collaboration with the University of Guam and the GAMMA Applications Center offers an exciting opportunity to expand the breadth and impact of our additive manufacturing research," said Joy Gockel, associate professor of mechanical engineering and executive director of ADAPT. "Together, we can advance application-driven innovations that enhance supply chain resilience and accelerate the development of next-generation additive manufacturing technologies."

Academic planning is underway for the first cohort of students, with classes expected to begin in Summer 2026.

MINES AND ARAPAHOE COMMUNITY COLLEGE TO OFFER SEAMLESS TRANSFER PATHWAY WITH NEW MINES ACADEMY

Engineering students at Arapahoe Community College (ACC) now have a direct pathway to a bachelor's degree at Mines, thanks to a new partnership between the two institutions. The new Mines Academy at ACC will provide an innovative model of engineering education and a student-centered transfer option for ACC students to pursue bachelor's degrees at Mines.

"We are thrilled to collaborate with Colorado School of Mines on this innovative partnership to provide ACC students with unprecedented academic opportunities to continue their STEM education at one of the world's foremost engineering and applied science institutions," stated ACC President Stephanie J. Fujii.

"I like the Mines Academy model because it provides students with the confidence, clarity and connection they need to reach and succeed at Mines and beyond in their professional careers," said Mines President Paul C. Johnson. "I look forward to a long and successful partnership with ACC and celebrating the accomplishments of our shared graduates."

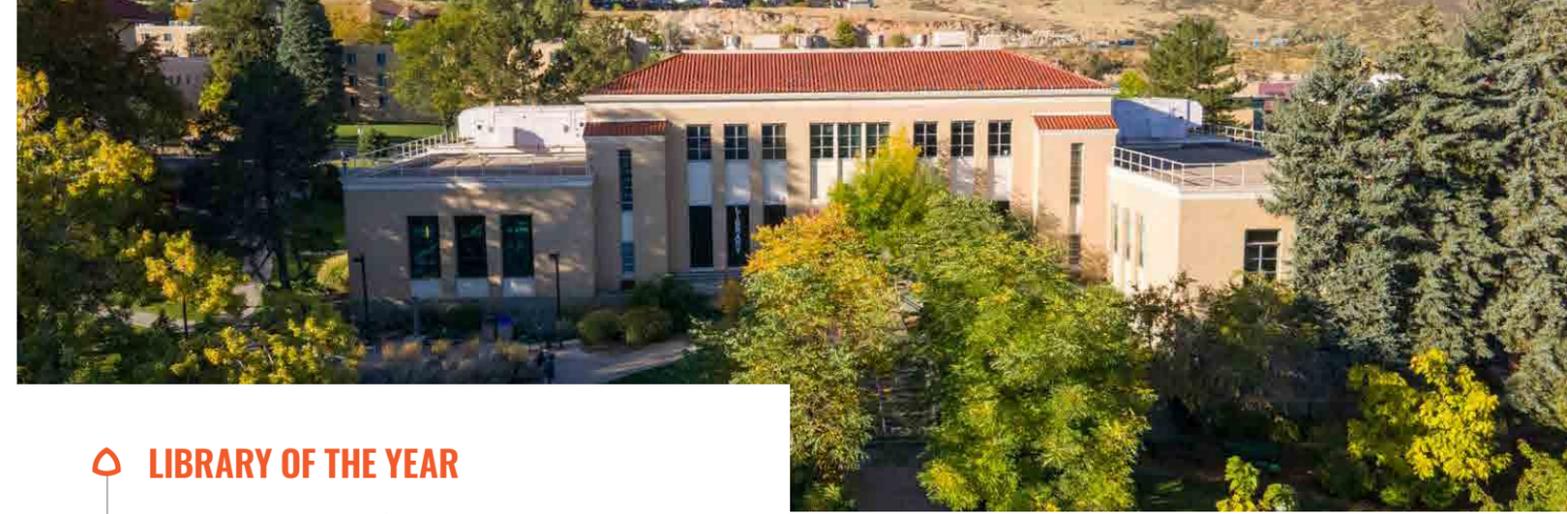
Through the Mines Academy, qualified ACC students complete the majority of Mines' core curriculum at ACC while pursuing their Associate of Engineering



Science degree. Those credits directly transfer toward the bachelor's degree program of their choice at Mines, paving the way for a smooth transition between the two schools.

In addition to guaranteed admission into Mines, students accepted into the Mines Academy at ACC will receive additional academic support at ACC and broad access to Mines' student services through specialized workshops and tours. Students will be expected to meet regularly with their academic and transfer advisors, as well as maintain a certain GPA.

The Mines Academy at ACC will begin with a soft launch during the Spring 2026 semester.



LIBRARY OF THE YEAR

Arthur Lakes Library was named the 2025 Federal Depository Library of the Year by the U.S. Government Publishing Office. The Mines campus library was selected for its significant role in increasing access to and preserving government information, including making publications from the United States Geological Survey (USGS) easily accessible to the public in digital formats.

"Arthur Lakes Library truly is a leader among libraries," said GPO Director Hugh Halpern. "The staff at this library is dedicated to advocating for and practicing preservation of government information. We are grateful to this library for helping GPO deliver on its vision of an America Informed and congratulate them on this well-deserved high honor."

"Arthur Lakes Library is honored to be recognized as Library of the Year by the U.S. Government Publishing Office," said Jack Maness, University

Librarian at Mines. "Colorado School of Mines has long partnered with the federal government in efforts to engineer a better world, and access to information has always been a part of that. I'm particularly proud of our coordinator, who has undertaken all this work with eagerness and passion, engaging students in high-level activities that help them better understand the importance of the FDLP."

Arthur Lakes Library serves as a cataloging and metadata contributor, creating catalog records for digital publications from USGS, such as bulletins, water supply papers and professional papers. Since 2014, Mines added nearly 14,000 records to the Catalog of U.S. Government Publications (CGP). Arthur Lakes Library has served as a preservation steward since July 2018 preserving publications from the War Department, the National Aeronautics and Space Administration (NASA), the Bureau of Mines, USGS and more.



NEW ENDOWED CHAIR TO LEAD CONSTRUCTION ENGINEERING AT MINES

Mines received a \$4.3 million gift from Kiewit Corporation and Bruce Grewcock '76, Mines Board of Trustees chair and chairman of Kiewit Corporation, to establish the Kiewit Corporation Endowed Chair in Construction Engineering. This investment will accelerate the growth and national stature of Mines' new Construction Engineering program, equipping future engineers to lead the design, management and construction of the nation's most complex infrastructure projects.

The endowed chair will provide visionary academic and industry leadership for the Construction Engineering program, guiding its teaching, research and outreach efforts to benefit the entire construction

sector. The chair will collaborate with a broad network of companies to ensure the curriculum and research reflect the needs of a rapidly evolving industry.

"This investment is exactly what we need at this time to accelerate the growth of our new construction engineering program," said Mines President Paul C. Johnson. "We want it to quickly become one of the premier construction engineering programs in the world—known for its engagement with industry, its distinctive graduates and its contributions to the evolution of and impact of the construction industry. The new Kiewit Chair will attract the experienced and visionary thought leader we need to ensure our program attracts top students and is aligned with the current and future needs of the construction industry."

Kiewit's support establishes funding to attract and retain an accomplished faculty leader. The Kiewit Chair will be an

educator and connector, bridging classroom learning with real-world application and engaging companies across the construction ecosystem.

"Kiewit and I are excited to provide this support to help Mines continue to guide and teach outstanding engineers who are prepared to make an immediate yet lasting impact in the construction industry," said Grewcock. "Our industry is evolving rapidly, requiring new skills and pragmatic, real-world experience from those looking to build the world's future infrastructure and energy projects. This program will play a notable part in helping Mines deliver on its goal to educate and equip the best engineering talent for the next phase of their lives."



AT THE TOP OF THEIR GAME

Mines women's teams make history with national titles, conference crowns and historic finishes

WOMEN'S CLUB RUGBY

The Mines Orediggers women's club rugby team has made history, capturing the program's first-ever national title.

The Orediggers beat defending champion Endicott College 38-29 in the final of the National Collegiate Rugby Division III Championship in Houston on Dec. 7 to claim the 2025 title.

Sophomore Piper Lee was named the Championship MVP for her four

conversions and one try in the final, which featured back-and-forth momentum swings before Lee delivered the decisive try and conversion with just minutes left.

"This team has put their blood, sweat and tears on the line, and seeing all that work finally pay off is incredibly rewarding," said Lee, also a finalist for the Division III 2025 Women's Player of the Year Award. "In past years, we've gotten so close to the top, always right there but never quite finishing it. Finally breaking through shows the true perseverance and grit this team has. It wasn't luck—it was years of growth, commitment and belief."

The Orediggers made the national finals for the first time in program

history in 2024, falling to Endicott in that match before reversing the outcome this year to lift the trophy for Mines.

"This has been our goal since the beginning of the season," team captain Aliya Lynn said. "As the clock was counting to zero, I just felt such pure joy for our coach, my teammates, alumni and everybody who has supported our program. It was a moment to be grateful for the entire season, and honestly unexplainable."

"This has been a historic season, and speaking for our seniors, it was the best last ride that we could've asked for," Lynn said. "This is one of the best programs to have been involved in at Mines and has made my experience so much better."



WOMEN'S SOCCER

The Mines women's soccer team captured the program's 11th Rocky Mountain Athletics Conference Women's Soccer Championship title in the fall 2025 season over top seeded Colorado Mesa University.

Playing nearly the entire match down a player after an early red card, the Orediggers showed grit on both ends of the field. Callie Fuhr converted a second-half penalty kick for the match's lone goal, while goalkeeper Allie Lundgren turned in a heroic performance, anchoring a defense that refused to break under pressure. The championship victory capped a resilient postseason run and underscored the Orediggers' ability to rise to the moment, celebrating a title earned through discipline and a last-minute change in strategy with a final score of 1-0.

WOMEN'S CROSS COUNTRY

The Mines women's cross country team delivered an impressive performance at the 2025 NCAA Division II Cross Country



LaMena, Lexi Herr, Sierra Wall and Margaux Basart earned All-American honors to secure the podium finish. All five scoring runners placed inside the top 40 in a highly competitive national field.

The historic finish for Mines' women adds to a run of high-level success which started with the Orediggers' first team podium in 2019. Since then, the Mines women have finished third in the nation three times, in 2019, 2022, and 2023. They first qualified for the NCAA meet as a team in 2003 and have now appeared at 10 consecutive NCAA championships and 14 total. This marked the 20th straight appearance for Mines' men at the DII race. There was no NCAA Division II Cross Country Championship race in the fall of 2020.

➔ For more on Mines Athletics, visit minesathletics.com.



UNLOCKING COSMIC MYSTERIES AND IMPROVING QUANTUM COMPUTERS BY JENN FIELDS

A Mines researcher is exploring the intersections of quantum computing and particle physics in underground labs built for ultra-sensitive research will help inform the United States' domestic critical minerals production

Deep in Colorado's mountains, a Mines researcher is preparing two unique underground laboratories to answer fundamental questions about the origins of the universe and the future of quantum computing.

Wouter Van De Pontseele, an assistant professor of physics who leads the Quantum Technologies at the Sensitivity Frontier research group, is interested in both particle physics and quantum sensing and computing. His research pursues rare particle interactions that might hold the keys to understanding the origins of the universe. In developing ultra-sensitive instruments for subatomic measurement, his work is at a convergence point where fundamental particle physics and quantum computing meet.

"To perform measurements to test scientific hypotheses and advance quantum computers, we need to build extremely precise detectors to sense things that have never been accessible before," Van De Pontseele said. "This will let us better understand what limits quantum computing while also probing the mysteries of the universe."

One of Van De Pontseele's primary research projects seeks to understand neutrino interactions and mass. Neutrinos are minuscule subatomic particles produced by nuclear reactions in the sun, or the explosion of a star. They travel near the speed of light and have a mass near zero. Trillions pass through your body

Assistant Professor Wouter Van De Pontseele assembles wiring for cryogenic equipment that will be installed in a cryostat to read superconducting sensors.

every second, but because they interact infrequently and weakly with other particles, they're difficult to detect. But detection could unlock the fundamental physics of how the universe evolved. "They're important for understanding how big clusters in the universe formed," Van De Pontseele said.

Muons are also abundant subatomic particles that penetrate Earth's atmosphere, but in the quest to study neutrinos, the heavier muons can get in the way. "Muons are interesting, but these particles are

an annoyance for our experiments," Van De Pontseele said. "We see the muons, but we can't see the neutrinos."

His approach to detection relies on a phenomenon known as superconductivity, where certain materials, when cooled to temperatures near absolute zero, lose all electrical resistance.

"This quantum effect allows us to build detectors with incredible sensitivity," Van De Pontseele said. "At that scale, even the normal movement of atoms is a source of noise. By getting super cold, we create an environment quiet enough to see things we couldn't see before, like the tiny energy signature of a single subatomic particle."

His team is developing cryogenic detectors that use superconducting crystals made from materials like zinc. "My goal is to see how a neutrino's interaction deposits energy in these materials so we can build and scale-up detectors," he said. This work, he added, could help determine how many types of neutrinos there are and what they weigh, opening a new window in particle physics. Though the research is fundamental, the underlying science has broad potential for real-world applications, such as using quantum computing to simulate chemical interactions for medication discovery or developing quantum encryption for cybersecurity.

Now he's taking that research underground. Van De Pontseele will be among the first researchers conducting experiments in the two new laboratories slated for the new Colorado Underground Research Institute (CURIE) inside Mines' Edgar Experimental Mine. This space is proving ideal for the sensitive quantum instrumentation his research team is using—and developing themselves—to listen for the faintest signals.

The first of these lab spaces, dubbed the Subatomic Particle Hangout, is currently equipped with a motorized muon telescope and neutron detectors to characterize the lab, which has about 200 meters of rock overhead shielding it from many of the cosmic rays that constantly bombard Earth and interfere with neutrino detection. Early experiments show the benefits of the lab's unusual location: instruments have measured 700 times fewer muons than what's typically measured aboveground. Such ultra-low-background environments are also ideal for quantum computers, which are so sensitive they can be destabilized by minor temperature fluctuations, vibrations or even stray cell phone signals—factors that can be easily controlled or are naturally reduced underground.

Cryolab 1, the second of CURIE's two lab spaces, will be a clean room and house the ultra-cold refrigerator needed for this work. Van De Pontseele's team has partnered with Maybell Quantum for the specialized cryostats that achieve these temperatures.

Van De Pontseele hopes CURIE can eventually provide an underground benchmarking facility for Mines' partners. "Companies could plug in and deploy their novel quantum devices and study to what extent they are affected by noise sources we can control and eliminate at CURIE. This also enables an apples-to-apples comparison between companies and technologies," he said. "It could help the quantum ecosystem in Colorado and beyond, creating a synergistic quantum test facility."

He hopes to conduct the first quantum experiments in CURIE in two years. "But the faster the better, because quantum is a fast-moving field."

COLORADO UNDERGROUND RESEARCH INSTITUTE (CURIE)

The Colorado Underground Research Institute—known as CURIE—is transforming part of the historic Edgar Experimental Mine, a teaching and laboratory space long used by Mines students and researchers for hands-on mining education, into a one-of-a-kind setting for cutting-edge quantum research.

Shielded by roughly 200 meters of rock, CURIE offers a shallow underground laboratory environment that blocks some of the cosmic radiation that hits Earth's surface. This helps facilitate low-background physics research, that is, experiments that require ultra-low levels of radiation to detect extremely rare events, such as searching for dark matter or studying nuclear decay. Inside this research hub, scientists are developing next-generation quantum detectors and exploring the properties of neutrinos and dark matter. In spaces like Cryolab 1, systems will operate just a fraction of a degree above absolute zero. These ultracold conditions are key to advancing superconducting and quantum technologies that could power the next wave of quantum computing, communication and sensing.

→ Read our Q&A with Kyle Leach, associate professor of physics and CURIE's science director, where he explains what makes this underground facility a unique asset for Mines and how it's helping define the future of quantum research.





SEARCHING FOR FRESH WATER BENEATH THE OCEAN FLOOR

A Mines-led expedition moves closer to understanding the hidden aquifers of the continental shelf

In the 1960s, scientists analyzing marine data stumbled upon a surprising discovery: vast reservoirs of fresh or “freshened” water sitting beneath the ocean floor. For decades, the existence of these offshore aquifers remained an intriguing, unexplored anomaly. How did the water get there, and how long has it been there?

An ambitious international exploration co-led by Brandon Dugan, professor and associate department head of geophysics at Mines, is finally bringing those answers to the surface. After completing a landmark offshore drilling phase in summer 2025, the team is closer than ever to unlocking the mysteries of these hidden sub-seafloor water systems.

THE PROJECT

The initiative, known as Expedition 501 “New England Shelf Hydrogeology,” is a groundbreaking collaboration between the International Ocean Drilling Programme (IODP3) and the U.S. National Science Foundation (NSF). Its primary goal is to investigate

the hydrogeology of the New England Shelf, a region offshore from Massachusetts where preliminary surveys suggested the presence of significant freshwater reserves, and understand this offshore aquifer system.

The key priority for researchers is to gain more knowledge about the origin of freshened groundwater in offshore aquifers so that they can confirm or dismiss the existing hypotheses. For example, current hypotheses are that the water could have charged the aquifers at a time when sea-level was 100 meters lower than it is today, or perhaps it was generated under an ice sheet or pro-glacial lake during a glacial period such as existed approximately 450,000 and approximately 20,000 years ago.

“To date, we know very little about the dynamics of these shoreline-crossing groundwater systems and the age of the water in these systems, and even less about their influence on cycling of nutrients and trace elements and their isotopes,” said Karen Johannesson,

Members of IODP³-NSF Expedition 501 “New England Shelf Hydrogeology” hold the final core from the final hole drilled during the international expedition's offshore operations. From left, the Boart Longyear team Chris Redding, Co-Chief scientist Brandon Dugan, Chandler Maine, Nick Boehne and Lalo Aguilar. (Photo by Everest@ECORD_IODP3_NSF)

a professor of geochemistry at the University of Massachusetts Boston and co-lead on the project.

The expedition launched in May 2025 aboard a specialized platform, the liftboat L/B Robert, equipped with a small drilling rig. Over the course of 74 days, the team executed a complex operation to recover water and sediment samples from depths of up to 550 meters below the seafloor.

By the time the offshore phase wrapped up in August 2025, the mission had exceeded expectations. The team successfully collected 718 cores totaling nearly 872 meters of material from three distinct locations. The expedition also conducted groundwater pumping tests—a first for scientific ocean drilling—which allowed researchers to capture water samples directly from sandy aquifers and clayey aquitards.

“We set out with lofty goals to understand the origin and age of this offshore freshened groundwater system through sampling of sediment and water in a difficult drilling environment consisting of sand and mud. With great teamwork among the science team, the technical staff and the drilling crew, we managed to get great samples including through multiple groundwater pumping tests,” Dugan said. “Those tests were critical to the expedition and a first for scientific ocean drilling. And we did it! Now we have the samples for the science team to really dive into the data and understand the system, which will be helpful for understanding other offshore freshened groundwater systems around the world.”

THE RESEARCH TEAM

The project is a large global undertaking, involving 41 science team members from 13 nations, including Australia, China, France, Germany, India, Italy, Japan, the Netherlands, Portugal, Sweden, Switzerland, the United Kingdom and the United States. Dugan leads this group, serving as co-chief scientist alongside Johannesson.

With the offshore operations complete, the scientists will reconvene in early 2026 at the Bremen Core Repository at the University of Bremen in Germany to split, sample and analyze the sediment cores and water collected during the summer voyage. The collected cores will also be archived and made accessible for further scientific research after a one year-moratorium period. All expedition data will be open access in the IODP³ MSP data portal in PANGAEA, and resulting outcomes will be published.

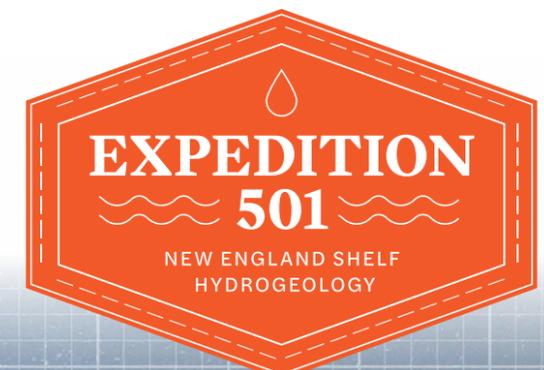
THE IMPACT

Seventy percent of the Earth's surface is covered with water, but water also flows beneath its surface. Most coastal communities rely on traditional onshore aquifers for freshwater, however, in many locations worldwide onshore aquifers may have an offshore component where freshened water exists under the ocean floor. The findings from the expedition could be critical for coastal communities worldwide. With strain on traditional freshwater sources, offshore aquifers could represent a vital new supply.

The team believes that the data acquired will help to better understand the processes that lead to the emplacement of freshwater lenses in offshore coastal plain sediments and why this freshened water is present. The findings will be relevant for the hydrogeology of the New England Shelf and for multiple similar settings elsewhere around the world.

The research is essential for a better understanding of the biogeochemical and elemental cycles in the continental shelf environment and will support a focus on the protection and sustainable management of offshore freshwater systems.

“It is exciting to use established scientific ocean drilling approaches with modern data analyses to provide direct tests of our hypotheses,” Dugan said. “Overall, this work offshore New England will help us better understand offshore freshened groundwater around the world.”





BEYOND 99.99%

Why billion-dollar PFAS cleanup must account for airborne byproducts

BY EMILIE RUSCH

New technologies that tout their ability to destroy per- and polyfluoroalkyl substances (PFASs) need to be evaluated not only for their effectiveness and efficiency but also for the byproducts they might release into the air.

The airborne byproducts of PFAS destruction technologies—known as products of incomplete destruction (PIDs)—have the potential to be just as problematic as the so-called “forever chemicals” from which they are derived, said Christopher Higgins, AMAX Distinguished Chair in Civil and Environmental Engineering at Mines.

“We’re about to embark on billions of dollars in cleanup of PFAS-contaminated sites, where the goal isn’t just removing the contaminants from the water or soil but destroying them,” Higgins said. “If we aren’t putting adequate controls on what we’re potentially emitting into the air, we may cause additional problems for those communities handling the waste or our local communities if destruction is done in a distributed manner.”

“From a technical perspective, PFAS-derived PIDs for all intents and purposes are still PFASs—they have the potential to be very, very persistent and just as problematic,” he said.

A large class of synthetic organic chemicals, PFASs have been widely used in industrial processes and consumer products since the 1940s—in everything from waterproof textiles and nonstick cookware to the firefighting foams used at airports and military installations. But the chemical and thermal stability that makes them useful in so many applications is also

Jesse Rocha of Alliance Technical Group prepares to conduct air emission monitoring on several PFAS destruction technologies being tested side by side at Peterson Space Force Base during the summer of 2025. The Mines-led project was the first “apples to apples” assessment of destruction technologies conducted on PFAS-impacted sediment and researchers also gathered data on each technology’s air emissions.

what enables them to persist in the environment for as long as they do.

Current technologies use a variety of approaches to degrade PFASs, with varying degrees of success. Many achieve destruction and removal efficiencies of more than 99.99 percent—but that metric does not account for the formation of airborne PIDs, researchers say.

“Numerous existing and emerging technologies can effectively eliminate commonly measured PFASs. What is less well known is what compounds are produced in the process,” said Detlef Knappe, S. James Ellen Distinguished Professor of Civil, Construction, and Environmental Engineering at NC State University. “By applying new analytical methods, researchers are making significant progress in understanding PID formation and emissions from destruction methods. These efforts are enabling decision makers to select technologies that can safely destroy PFASs.”

Researchers suggest the use of a broad set of analytical methods to comprehensively characterize PIDs and thereby minimize airborne emissions. Otherwise, airborne PIDs can be transported over long distances in the atmosphere, broadening the potential for environmental impact and the risk of human exposure through inhalation or ingestion of contaminated air, water and food.

“The issue with an incomplete understanding of PFAS and PID emissions is that once they have inadvertently escaped into the atmosphere, they are nearly impossible to retrieve,” said Jens Blotevogel, Principal Research Scientist at Australia’s CSIRO. “Fortunately, our rapidly emerging understanding of destructive PFAS treatment is giving us the confidence that, if done right, it can be achieved in a safe and effective way.”

→ You’ve been exposed to PFAS—watch a video about what Mines is doing about it.



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BUILDING THE CASE FOR GEOTHERMAL ENERGY

The inaugural Mines Geothermal Solutions Symposium brings policy, industry and research together

The Payne Institute for Public Policy hosted the first annual Mines Geothermal Solutions Symposium in December 2025.

The event convened academia, industry, non-profit organizations, regulators and policymakers to discuss advancing geothermal technology and accelerating project development. With bipartisan support for geothermal energy, coupled with technological advancements in next-generation geothermal systems, the campus-wide initiative intends to address technical, regulatory and policy challenges while leveraging the expertise of departments across campus actively engaged in geothermal research. Sessions included discussions on identifying key challenges in geothermal



Colorado Governor Jared Polis was a keynote speaker at the first annual Mines Geothermal Solutions Symposium.

development, land use and policy, whether geothermal is scalable within the U.S. energy portfolio and more

→ Learn more about how Mines is leading geothermal energy research, development and deployment at payneinstitute.mines.edu/geothermal.

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Tucker Briggs '25 uses a high-resolution digital microscope to inspect samples in a clean room in the nanofabrication lab on the Mines campus.

ONE STEP AHEAD

Mines quantum programs build leaders for the future of the industry

BY JASMINE LEONAS

The Quantum 2.0 race is on, and Colorado School of Mines is ready to compete.

While the so-called second generation of advancement in quantum is increasingly becoming a crucial part of technological progress around the world, Mines has long been ahead of game in quantum education. The first quantum engineering graduate program in the nation launched at Mines more than five years ago and, currently, the university is still one of just a handful of institutions that offers a graduate degree in the field.

“We’re really well positioned in quantum because, especially through the Physics Department, we started to invest specifically in the field about 10 years ago,” said Fred Sarazin, department head and professor of physics who is leading quantum efforts at Mines. “We created one of the very first quantum engineering master’s degree programs in the country.”

Soon, Mines will have a unique quantum offering for students with a new undergraduate degree program—the first of its kind in the United States.

It’s an ambitious undertaking, but Mines has all the right elements to both spearhead and lead the way in undergraduate quantum education. The bachelor’s degree program, which will focus on quantum systems engineering, aims to begin enrolling students in fall 2026.

“We expect the program to have national appeal, so there could be students from around the country looking to come to Mines specifically to study quantum,” Sarazin said. “There’s no other program like it in the nation.”

Because the future of quantum is interdisciplinary, the program will draw on the strength of Mines' programs across departments—from physics, computer science, electrical and mechanical engineering, and engineering design to start—to build a comprehensive experience for those enrolled. In speaking with current Mines students, Sarazin said he found they have strong, broad interest in quantum-related jobs after graduation.

But he says the demand is coming not just from students who are interested in pursuing a career in quantum. Industry is hungry for more talent, and a lot of those companies are right here in Colorado.

"It turns out Colorado has the highest concentration of quantum companies anywhere else in the country," Sarazin said. "There's a lot of expertise available with so many quantum and quantum-adjacent companies based here. Colorado owns a significant fraction of the supply chain, so those companies are going to need a workforce."

A GOLDEN LOCATION

According to Elevate Quantum, a regional consortium of more than 150 organizations in Colorado, New Mexico and Wyoming, current efforts in the Mountain West are leading the way—the area contributes 3,000 commercial quantum jobs and is the home to about 50 percent of the U.S.'s critical supply chain for major quantum modalities. Mines is a key partner in Elevate Quantum, as well as Quantum Commons, a 70-acre research park currently under construction that will serve as a hub for the quantum community and support the growth of quantum technologies. Quantum Commons, located in Arvada about 11 miles north of the Mines campus, will be owned and operated by Mines and is being designed and developed with Elevate Quantum partners.

Mines' strong presence in the quantum community and ties to local industry have been instrumental in the success of the graduate program. Those local partners

have also been valued partners in building the future bachelor's degree program. Even the program's name—Bachelor of Science in Quantum Systems Engineering—was informed by input from those leading the field, both in the United States and around the world.

"Mines has a long tradition of connecting with industry, and quantum is no different," Sarazin said. "Those partnerships are why we are focusing the program on preparing students to be industry-ready engineers that basically understand the whole process from start to finish, front to back. They'll be able to work equally well with both research and development people on the physics as well as the technicians building the products."



Mines President Paul C. Johnson and Maybell Quantum CEO Corban Tillemann-Dick discuss the Maybell Big Fridge that was temporarily housed in a space inside the Labriola Innovation Hub on the Mines campus during the final stages of qualification.

TRUSTED INDUSTRY PARTNERS

Corban Tillemann-Dick, founder and CEO of Denver-based Maybell Quantum Industries, started his quantum company after leading quantum computing strategy work as a partner at the Boston Consulting Group. He said the industry has a line of sight on where quantum can take technology, and with partners like Mines, the timeline will be shorter than previously imagined.

"Mines works with industry better than any other school I've seen. It's a university that works at the speed of industry," he said. "It's an R1 university that focuses on research and education in the way a university should but isn't caught up in bureaucracy when trying to solve problems. Mines is a partner that understands how to build things quickly."

Tillemann-Dick said he's constantly hiring Mines graduates, because he finds that they not only understand quantum principles but have the hands-on experience to create solutions.

"Mines has been at the forefront of quantum," he said. "They're training people who know how to actually solve problems and can tackle them from lots of different angles. Mines is by far the top university we hire from because they're teaching the right things, in the right way."

Along with frequently hiring Mines graduates, Maybell also tests and ships dilution refrigerators at the Labriola Innovation Hub on campus. These devices

can maintain the ultra-low temperatures needed to house quantum computers. Maybell initially rented space in Labriola to fill a short-term need for additional manufacturing footprint and continues to use the space even after growing their off-campus footprint because of the benefits they see from being integrated into the Mines community.

"Mines is one of the most important partners for both Maybell and Elevate Quantum," Tillemann-Dick said. "The thoughtfulness of the work and the leadership at Mines is exceptional."

These kinds of well-established ties with industry partners are part of what has helped Connor Denney '23, MS '24 chart the course of his career in quantum.

As an undergraduate majoring in electrical engineering at Mines, he joined a quantum research project led by Meenakshi Singh, associate professor of physics and quantum engineering program director. That experience led him to the master's degree program in quantum engineering.

Now, Denney has partnered with his former Mines labmate Logan Pauli MS '24 to start Bifrost Electronics, a Colorado-based company that will build essential components for quantum computing. He credits not only his Mines education but mentorship from Tillemann-Dick to take what started as an idea in a study session with Pauli and turn it into a business.

Electrical engineering graduate student Steffen Kross uses a visible laser to align to a microwave photonic chip.



“[Tillemann-Dick] is very generous with his time. We knew that our investment deck was half baked, and our business plan wasn’t where we wanted it, and he was more than happy to give us critical feedback that really helped,” Denney said. Now, nearly two years later, Bifrost Electronics has secured around \$4 million in investment that will help the company scale up.

Along with getting Bifrost moving along, Denney is currently working on his PhD in electrical engineering at Mines, focusing on low-temperature quantum devices, work that directly relates to his position at Bifrost as head of research and development.

THE FUTURE OF QUANTUM

According to Massachusetts Institute of Technology’s Quantum Index Report, demand for quantum-related jobs began to take off in 2018, and there’s an overall

upward trend of quantum skills being increasingly important in the labor market. There’s a global focus on quantum as well, and, besides the United States with its priority trending toward quantum computing, both China and Europe are emerging as future leaders in different quantum fields.

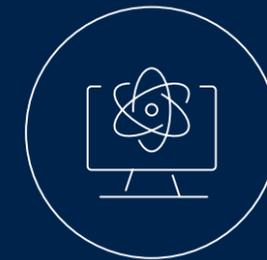
With an established graduate program, and soon an undergraduate program as well, Mines is well-positioned to educate students that will lead the way in quantum, no matter where they end up geographically.

“Mines is prioritizing quantum, and we’re well-positioned to do so,” Sarazin said. “Our master’s degree program is growing, and the bachelor’s degree is a continuation of these efforts. Quantum needs people who will understand the physics at a deeper level and then all the way through the engineering aspect and how to make a product deployable.”

“When we looked at everything we do here at Mines and where our strengths are, we know we can create a successful program for our students that will prepare them for the future of quantum,” he said.

Invoking Silicon Valley and its importance as the epicenter of the tech boom, Tillemann-Dick said Colorado will be the same kind of place for the quantum industry—and Mines will be at the forefront.

“We have the right partners to make it happen here in Colorado, and Mines is going to find itself at the very center of that in the next 50 years,” he said. “I can envision a future where people talk about Mines for quantum.”



Physics Associate Professor Meenakshi Singh works on the dilution refrigerator in one of the quantum labs on the Mines campus.

THE NEXT ERA OF QUANTUM TECHNOLOGY

Quantum science isn’t just for the lab—it will power the next purpose-built quantum systems. These emerging technologies promise to unlock capabilities not possible with today’s tools, powering breakthroughs in:

Quantum computing

Rather than using linear systems to solve problems like today’s computers, quantum computing can explore many possible solutions at once, enabling faster and more complex computing.

Quantum sensing

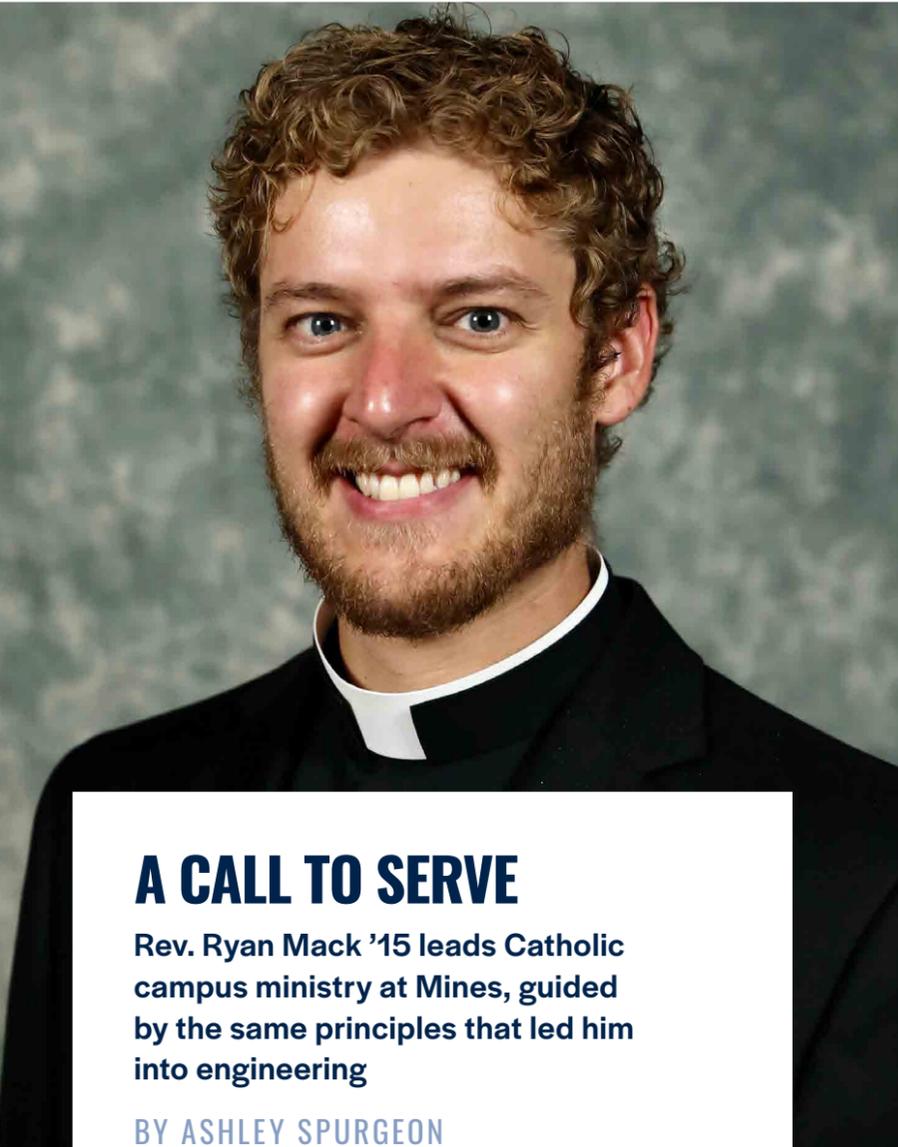
Quantum sensors are more sensitive and don’t require calibration, providing ultra-precise measurements of gravity, motion and magnetic fields. For example, precise positioning would be possible in GPS-denied environments like space or deep within mines.

Quantum communication

Communication channels can become more secure—information can be transmitted in a way that makes eavesdropping physically impossible. These technologies could reshape cybersecurity for government, finance and critical infrastructure.

Quantum imaging

Surpassing classical limits in resolution and sensitivity, these techniques promise advances in medical imaging, non-invasive diagnostics and the detection of objects or features that are otherwise invisible using conventional methods.



A CALL TO SERVE

Rev. Ryan Mack '15 leads Catholic campus ministry at Mines, guided by the same principles that led him into engineering

BY ASHLEY SPURGEON

When Rev. Ryan Mack '15 walks across the Mines campus today, the experience is both familiar and entirely new. As an undergraduate student, he spent four years immersed in engineering classes, late-night study sessions and weekend adventures in the nearby mountains. Now, a decade later, he has returned to campus but this time as the university's Catholic chaplain, supporting students as they navigate their own formative years at Mines. And Mack sees his engineering and religious experiences as closely linked.

Mack always had a clear sense of curiosity about how the world worked, so a STEM career path seemed like a no-brainer. "I knew pretty early on that I wanted to go into engineering," Mack said. "When I was really young, I wanted to be an inventor,

and then, eventually learned that inventors are just engineers."

By the time he toured colleges, he knew Mines was the right place for him. "I loved that Mines was fully devoted to engineering. The whole campus is built for forming engineers," Mack said. "I liked working with physical systems, especially things that I could get my hands on and work with. I went into engineering very much to build cool things."

After graduating, he began a career with Western Industrial Contractors, designing steel support structures for large material-

"BUT IT WASN'T AS MUCH OF A STRAIGHTFORWARD COMPARISON OF AN ENGINEERING CAREER VERSUS A MINISTRY CAREER. IT WAS VERY MUCH AN EVALUATION AND PRAYERFUL DISCERNMENT OF WHAT STATE OF LIFE GOD WAS CALLING ME INTO."

handling systems. He enjoyed the work, but he also began discerning a new calling.

"A lot of people say to me, going from engineering to priesthood is a huge career switch," Mack said. "But it wasn't as much of a straightforward comparison of an engineering career versus a ministry career. It was very much an evaluation and

prayerful discernment of what state of life God was calling me into."

Despite this career shift, Mack's engineering mindset is still in play. As he worked through his seminary studies in philosophy and theology, he found similar patterns to those he knew from his engineering background. "I found a lot of crossover," he said. "The type of philosophy and theology we were doing was very systematic. I loved studying engineering because I wanted to figure out the way that the world worked, and there was something really similar in studying systematic philosophy and theology of being able to dive into the way creation works.

"In engineering at Mines, I was studying the physical world and the way cause and effect work in our physical

experience. Our philosophy studies were strongly metaphysically based, and metaphysics is another level of understanding how natural beings in the world exist and are constructed on a philosophical or metaphysical level. When you take that into theology, a lot of the way that we study how God supernaturally redeems and sanctifies creation is looking at the way that He takes the natural structures that He's built into the physical world and elevates that into a supernatural plane while paralleling the natural structures on the physical plane. To be able to layer those systems all the way down and more deeply understand what God was doing on a supernatural plane from analogies made from the natural world and from my own understanding of the natural world, even from an engineering background, was a really cool parallel for me."

In 2023, Mack received his first assignment as a priest—one that brought him back to Golden. Today, he oversees a broad network of Catholic life on the Mines campus. "I'm responsible for the umbrella institution of campus ministry," he explained, including FOCUS ministries, the Catholic Men's and Women's houses, and student clubs. He also teaches study groups, prepares students for sacraments and spends countless hours meeting with students.

"It has very much been a kind of coming home in this first assignment," he said. "It's a community that I know well. I love the campus. It's amazing to be back there again."

He sees in today's students the same intellectual drive that shaped his own college years. Many of them approach faith with an engineer's instinct for understanding. "You have a lot of students who are on a really intentional and deep search for explanation and believe there's truth out there to be discovered," Mack said.

Mack understands how transformative that combination of curiosity and community can be for students. He grew up practicing Catholicism but discovered the depth of his faith in college. Now, he hopes to help others find a similar sense of community and faith and support students as they navigate their Mines experience and deeper questions about meaning and purpose.

For Mack, returning to Mines is not just a professional assignment but a continuation of the same curiosity and commitment that first brought him to campus. "Engineers are my people," he said. "It's a community that I feel very comfortable with. I'm very much at home."



WORK WITH US

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COLORADO SCHOOL OF
MINES

Petroleum engineering student ambassador Rylie Ward shows several Mines alumni around a lab space on campus.



A NETWORK THAT WORKS

BY ASHLEY SPURGEON

Mines researchers and alumni are advancing industry-driven research together

At Mines, collaboration with industry is embedded in the university's DNA. For generations, Mines has maintained close ties with industry partners, many of them companies led and staffed by alumni. Those connections often translate directly into research opportunities that benefit both Mines and industry, shaping solutions to real-world challenges, driving innovation and preparing skilled Orediggers to get the job done.

Mines alumni frequently take on leadership, technical and advisory roles at companies around the world and use their influence to champion Mines and the work happening on campus. When that influence flows back to the university, it helps shape

research agendas, fund cutting-edge projects and support students. The result is an engagement model that advances Mines' research missions while delivering tangible value to industry.

Two long-standing examples of this model in action are the Fracturing, Acidizing Stimulation Technology (FAST) Consortium and the Advanced Steel Processing and Products Research Center (ASPPRC), commonly known as the Steel Center.

ALUMNI AS INDUSTRY CHAMPIONS

Founded in 2004, FAST was built around a clear mission to conduct applied, industry-driven research in oil and gas well stimulation. From the beginning, its success depended

on close collaboration with industry—and on alumni who understood both the technical demands of research and the realities of industry practice.

“At that point in time, there weren't a lot of government opportunities,” said Jennifer Miskimins MS '00, PhD '02, petroleum engineering professor and FAST director. “It made a lot more sense for me to seek out industry funding. There also weren't a lot of graduate students being trained with advanced degrees in this particular area, so that was a driver in my own mind—to give an opportunity for students to do research in this area.”

As FAST took shape, alumni became essential advocates inside their companies who understood Mines' research strengths and could translate industry needs into meaningful research projects.

“Having a champion who understands Mines' capabilities, someone who understands what our research capabilities are, both from a laboratory standpoint and an expertise standpoint is really important,” Miskimins explained. “I can see that difference when talking to an alum about potentially joining FAST. It's a lot different than when I talk to somebody who's not. The conversation can be a little bit more targeted with an alum.”

One of those champions is Brent Kebert MS '20, PhD '22, who was introduced to FAST as a graduate student while working under Miskimins and later returned as an industry representative. Today, he helps guide FAST projects on behalf of Chevron.

“We're able to help direct where projects go and have a say on what type of work the students are

working on,” Kebert said.

That guidance helps ensure FAST research remains immediately relevant. “It gets the topics that people want to see or might be experiencing issues with that they really need to have solved,” Miskimins said. “And because of that, not only are we working on topics that are relevant, but my students are also working on topics that are relevant, which gives them more opportunity to get hired. There's a real win-win in that.”

For many industry partners, FAST's value lies in access to Mines' expertise and facilities. “The research facilities, the type of projects going on, the faculty that teach there are top-tier globally, so to be able to leverage those resources and maintain those relationships and reap the benefits of the work that goes on at Mines has been significant for sure,” Kebert said.

Alumni engagement, he added, plays a critical role in shaping research outcomes. “Alumni engagement is very critical to university research,” Kebert said. “Having that consistent alumni interface with people who are actually working and saying these are the problems we're trying to solve, and these are the kind of boundary conditions we actually have to work with, that really starts to shape the minds of young students to see how things are going to be versus just what's in a textbook.”

OPPORTUNITIES FOR UP-AND-COMING TALENT

While faculty researchers and industry benefit from these collaborations, students also gain significant advantages that help prepare them for careers in industry. Through ASPPRC, students work closely with industry

sponsors over multiple years, gaining insight into both technical challenges and professional expectations.

“If students are doing a master's or PhD, they have two to four years or so to get to know the sponsors, see what they're doing and if that might be of interest to them and vice versa,” said Kip Findley, professor of metallurgical and materials engineering and ASPPRC director. “Then we have alumni who are part of these companies who are, in turn, recruiting students for advanced degree positions at their companies.”

Mentorship plays a key role in that process. “Every project that we have in the Center has multiple industrial mentors,” Findley said. “Often, that mentor list consists, at least partly, of Mines alumni who have gone through the program and are now working in industry and leading research and development or product development or product application programs, and they're bringing that expertise back and helping facilitate research center efforts.”

Because those mentors understand Mines' curriculum and capabilities, they help shape projects with both academic and industry impact. “The Mines alumni mentors know exactly the training the students have and the capabilities we have access to, so they can gear their mentorship towards what they know students can do,” Findley explained. “They understand what kind of projects would fit the Center really well and the type of projects that would have high impact for industry and then marry those things together effectively.”

That engagement often extends beyond research alone. “Sometimes these research partnerships are also synergistic with other partnerships

that Mines develops with alumni,” Findley said. “There are a lot of examples of Mines alumni who are not only participating in the research process but might also serve on department advisory boards and committees. They're also thinking about the educational processes and strategic initiatives. I think the benefits really extend broadly across the university.”

Matt Merwin PhD '97, a longtime representative for U. S. Steel, has seen the value of that continuity firsthand. “It's been my pleasure to be able to maintain that relationship,” he said. “U. S. Steel has been a sponsor continuously of the program for more than 30 years at this point.”

For Merwin, the consortium model was attractive from the start. “As an undergraduate wanting to pursue graduate school, the consortium structure and constant engagement with industrial sponsorship was one that was really compelling to me,” he said.

He credits Mines faculty with making those partnerships work. “Corporate engagement is a real strength of the university,” Merwin said. “Faculty understand the challenges corporations might have in funding research and limitations and IP and how all those aspects can really complicate such relationships. Mines faculty are really experienced with that and find solutions that are mutually acceptable.”

For alumni looking to get involved with research at Mines, Merwin encourages them not to wait. “I'd certainly encourage them to reach out and see what opportunities exist.”

➔ Learn how you can get involved with research at Mines by emailing rtt@mines.edu.

CHAMPIONING PEOPLE AND PROGRESS IN PHYSICS

Cathy Mader '87, MS '89 helps physicists pursue bold questions, collaborate across fields and advance discovery

BY JENN FIELDS

At every important step in her career as a physicist, Cathy Mader '87, MS '89 jumped at an unexpected opportunity. As an undergraduate at Mines, a professor opened the door to graduate studies, which she hadn't considered as a possible pathway for herself. Upon completion of her PhD at Michigan State University, Mader applied to a physics faculty job outside of the usual hiring cycle at Hope College, which became her professional home for 30 years. When a position opened on the Experimental Physics Investigators (EPI) Initiative at the Gordon and Betty Moore Foundation, Mader jumped one more time.

Now, she supports opportunities for other scientists, overseeing grants that let physics researchers explore bold ideas that would be challenging to pursue without long-term support or access to the initiative's collaborative community. In addition to funding, the EPI brings grant recipients together annually to create cross-pollination of ideas across fields.

"Physicists don't work in a bubble," said Mader, now working as a program officer for the EPI. "It's really rewarding to see people from different subfields go off to work on projects together because they've found a creative way to tackle a problem."

Mader herself hasn't worked in a bubble. Going all the way back to her education at Mines, mentors and collaborators in the scientific community played a vital role in her success. She arrived at Mines as an undergraduate with no previous knowledge of higher education. As a first-generation college student, she often felt she was missing "insider" info. Near the end of her senior year at Mines, she was studying in the physics building when F. Edward Cecil (now an emeritus professor of physics) asked everyone what they were doing after graduation.



"I said, 'I don't know, I am probably going to work in the factory with my dad again this summer,'" Mader said. "He said, 'No, you need to go to school.' If it weren't for Ed Cecil, I wouldn't have gone to grad school."

Cecil was one of many people who helped her navigate academia, and she has spent her own career paying that forward.

"There were so many things I didn't know being a first-generation American and first-generation college student that other people thought were normal," she said. "So then, as a faculty member, you spend time making sure everyone gets that information before it's too late."

Her role at the Moore Foundation is the next step in this work supporting up-and-coming physicists. The foundation takes a strategic approach to science philanthropy, tracking the pulse of the physics

"PHYSICISTS DON'T WORK IN A BUBBLE. IT'S REALLY REWARDING TO SEE PEOPLE FROM DIFFERENT SUBFIELDS GO OFF TO WORK ON PROJECTS TOGETHER BECAUSE THEY'VE FOUND A CREATIVE WAY TO TACKLE A PROBLEM."

community and seeking out gaps in support. They offer grants in important corners of physics that aren't well funded elsewhere, such as emergent phenomenon in quantum systems. "That's a place where our investment in material synthesis and quantum materials has made a huge difference, because it's not an area that's usually funded by federal sources," she said.

The Moore Foundation also noticed that while early-career researchers had abundant funding opportunities, less was earmarked for mid-career investigators. EPI developed a grant to fund these researchers over five years—a stretch beyond the typical three-year federal research grant that gives investigators more freedom.

Mines physics professor Kyle Leach, whose research uses radioactive isotopes in superconducting quantum sensors to explore fundamental questions about subatomic physics, is part of the inaugural cohort

of recipients of EPI's grant for mid-career researchers, and Mader oversees his grant. "They're all supporting students and post-docs, and being mid-career, these researchers can take on leadership roles, too," Mader said. "So not only is Kyle doing amazing research, he's also able to connect people. It's helping advance the field as a whole."

Supporting researchers like Leach is only one facet of Mader's role. She is equally passionate about spreading the word about all the possibilities a physics degree can offer—possibilities that help advance knowledge and the future of physics. "You don't have to become the investigator leading a lab research team. There are a lot of other ways you can be contributing to research," she said. "You can be involved in the private philanthropy sector or at the federal level, and your knowledge can still contribute to science."



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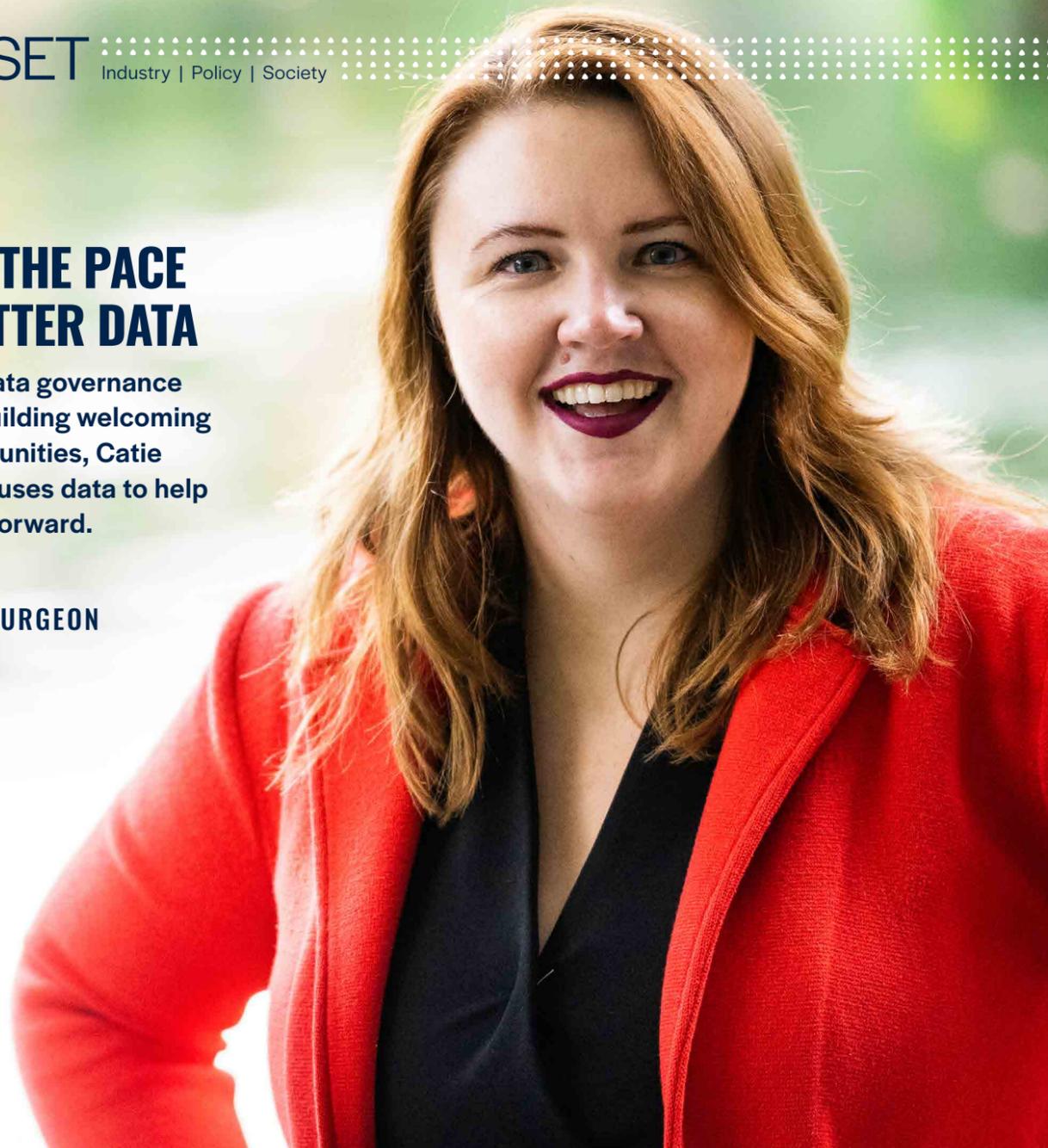
Donation Type	Stock Value	Capital Gains Tax Paid	Mines Receives	You Deduct
Cash (from sold stock)	\$5,000	\$750 (15%)	\$4,250	\$4,250
Direct Stock Donation	\$5,000	\$0	\$5,000	\$5,000



SETTING THE PACE WITH BETTER DATA

From global data governance at ASICS to building welcoming running communities, Catie Crossman '14 uses data to help people move forward.

BY ASHLEY SPURGEON



Have you ever been shopping for a product online—say, a pair of running shoes—and noticed the product description was incorrect? Or maybe when you filtered the shoe brand’s inventory by color or cushion thickness, the results just weren’t quite right, and it was difficult to find what you were looking for. This is often due to a lack of data governance, meaning the roles and responsibilities that ensure a website’s data shows up in the correct way and is useful for a customer is either not in place or insufficient.

Catie Crossman '14 is currently helping sportswear company ASICS avoid such data missteps as their global data governance officer. Working from The Hague in the

Netherlands, she is establishing processes that ensure data flows through the company in the right way and can be used reliably across the business. Her work touches nearly every corner of the company.

“The cool part of my role is that I work very closely with our IT department, as well as the business side. I’m kind of a spider in the web, connecting the business with IT,” she said. “I get to know how the company works end-to-end, from creating the product, to developing the product, to actually selling the product.”

That end-to-end view is essential for making sure ASICS’ data is entered consistently and accurately, whether that’s the technical specifications of a new shoe or the

product details customers rely on when shopping online. And this work has taken on new urgency as the role of data evolves in both retail and performance tracking.

“What’s cool now is it’s really transforming,” Crossman said about how data use is expanding with new technology. “Now we’re talking about data and analytics governance and AI governance. Within data governance, I’m also involved in those conversations, because without having the right data and ensuring that it can be trusted, you’re then creating AI solutions that are feeding the wrong information or putting together reports based off incorrect figures. It’s really the base of everything.”

That connection between data and real-world applications is what motivates Crossman every day. “You really get to see the connection between technology, data and the human side,” she said. “Every day when I go work, I’m inspired by actually seeing what we’re doing around me. There’s the whole ASICS Frontrunner community, which is people who are actually wearing the shoe and normalizing what a sound mind, sound body looks like. I find that really inspiring to follow. I can really see that what I’m doing has an impact on the world around me, whether it’s within the company or outside the company. If what we’re doing from a data perspective is not correct or doesn’t fit the needs of the business, it can impact our customer, it can impact the athlete who’s wearing the shoe at the end of the day.”

That human impact has also shaped the work she does outside ASICS to support her local running community. For Crossman, running began as a way to reclaim her well-being during a period of burnout early in her career, eventually leading her to train for and complete the 2019 Chicago Marathon. From there, she said, her confidence grew, and she realized she wanted to help others through similar experiences.

That desire became Run to Empower, a running community she leads in The Hague. Women gather regularly for group runs, one-on-one coaching with Crossman and the chance to build confidence together in a supportive environment. Crossman’s goal was to create the kind of no-pressure running environment she once struggled to find herself. Having often felt left behind in traditional running clubs, she set out to build a different kind of space where runners of all paces can feel welcome, empowered and connected.

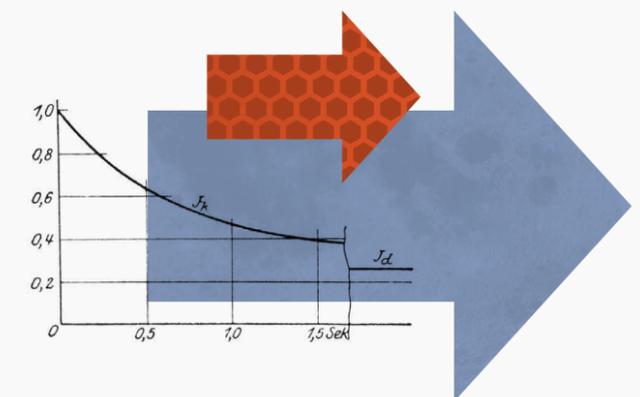
That ethos also guides her work as a board member for Run Her Way, a nonprofit working to make running safer for women. The organization takes a data-driven approach to identifying risks and designing solutions, another place where she sees her ASICS experience directly complementing her community work.

“I believe in empowering people through movement,” Crossman said, a value that unites her work in business, sport and community building.

Crossman sees her community work and her ASICS role as deeply intertwined. Both rely on listening, meeting people where they are and building systems

“THE COOL PART OF MY ROLE IS THAT I WORK VERY CLOSELY WITH OUR IT DEPARTMENT, AS WELL AS THE BUSINESS SIDE. I’M KIND OF A SPIDER IN THE WEB, CONNECTING THE BUSINESS WITH IT,”

that help others thrive. In her running communities, that means creating spaces where women feel safe and supported. In corporate settings, it means designing data structures and systems that give teams the clarity and confidence to make effective decisions across the company. Whether she’s guiding a company-wide data transformation or helping someone train for their first marathon, Crossman’s goal is the same: to help people move forward with purpose.





This image shows an industrial mine waste dam, which is typically an earth-fill embankment dam used to store byproducts of mining operations after separating the ore from the gangue.

FINDING OPPORTUNITY IN MINING WASTE

With IronTech Resources, David Scriven '70 is extracting minerals from mine tailings, opening up potential opportunities for future resource recovery

BY SARAH KUTA

David Scriven '70 never set out to be an entrepreneur. But with a knack for turning challenges into opportunities, it's no surprise he ended up becoming one.

Today, Scriven is channeling his innovative spirit into his role as co-founder and chief executive officer of IronTech Resources. The Minnesota-based company uses Scriven's patented process to extract minerals from mine tailings, transforming waste into a valuable resource while also reducing environmental impact and restoring natural landscapes.

Scriven originally developed the technique to recover uranium, but he has since applied it successfully to iron ore. Looking ahead, the company hopes to expand the technology even further to recover other high-value minerals around the world, including gold, lithium, copper, phosphate and rare earth metals.

"We can liberate minerals from just about any kind of rock," he said. "We see a big future in our technology, especially with a lot of the critical minerals."

During his decades as an engineering consultant, Scriven has used his diverse background and deep knowledge base to guide clients toward creative solutions, often helping them save time and money in the process.

It was his work with uranium mining clients in Wyoming decades ago that initially planted the seed for his proprietary mineral recovery process, which he calls "dynamic hydro liberation." Over the course of several projects, he identified a broader mining industry challenge—how to affordably, efficiently and sustainably extract valuable materials from already mined ore—and realized he might be able to help overcome it.

"I was driving down the highway and thinking to myself about how uranium deposits are formed," he said. "I was thinking about how, when uranium precipitates out [of groundwater] on sandstone, it doesn't penetrate the sand grains. It's a coating. If we could knock that coating off the sandstone, we could screen it out and extract it."

After years of experimentation, fine tuning and collaboration, Scriven is bringing his idea to life with IronTech Resources. With his technique, tailings—or the

materials that are left over from mining—are combined with water to form a slurry. The substance is then pumped through specialized nozzles into the chambers of a machine that's about the size of a Ford F-150 truck. Inside, high-velocity water breaks the particles apart, producing a high-grade concentration of the target mineral.

"IT'S A TWO-STEP PROCESS, BUT ALL WE USE IS WATER," SAID SCRIVEN. "WE HAVE A COUPLE OF DIFFERENT WAYS OF ADDING ENERGY INTO THE PARTICLES TO MAKE THE PARTICLES BREAK ALONG THE MINERAL BOUNDARIES. IT'S VERY, VERY EFFICIENT."

-David Scriven '70

In trials with iron ore tailings in northern Minnesota, for instance, this technique produced a premium, 65 percent iron concentrate, according to the company. IronTech Resources' machines can process roughly 50 tons of slurry per hour, meaning users will be able to quickly convert legacy tailings into profit.

According to Scriven, the technique uses much less energy than the typical mineral recovery process, which involves crushing and grinding ore using a ball mill.

"It's a two-step process, but all we use is water," said Scriven. "We have a couple of different ways of adding energy into the particles to make the particles break along the mineral boundaries. It's very, very efficient."

The company is still in the early stages of commercializing the technology and is currently building a demonstration plant near Biwabik, Minnesota. They plan to scale up the business from there.

Scriven and his IronTech Resources colleagues believe their technology could be instrumental in the push to boost the domestic production of critical minerals—those that the United States' government has deemed essential to the nation's economy or security and at high risk of supply chain disruption. Supporting critical minerals production is also an effort many researchers are working on at Mines. Recent research led by Mines' Elizabeth Holley suggests one promising path forward is to extract

critical minerals from already mined ore, a finding that reaffirmed Scriven's mission and vision at IronTech Resources.

"My whole philosophy is: How can we take this waste and make it valuable?" said Scriven. "What can we do with this waste and how can we make this work? That's the attitude we have to take in the U.S. going forward."

Scriven originally entered Mines on a football scholarship, but he was also fascinated by the idea of becoming an engineer, he said. Even now, more than 50 years after graduating, Scriven still sees clear echoes of his time at Mines in his professional success today.

"All ideas are iterative," he said. "You don't just get the lightbulb. It comes from years of experience and knowledge, until all of the pieces line up together. But the pieces have to be there first."

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CONSIDERING AN MBA?

An Engineering and Technology Management master's degree might be a better option

BY JASMINE LEONAS

After Colby Frias '24, MS '25 graduated with his bachelor's degree in civil engineering, he decided he needed something more to help make his career dreams a reality. Specifically, dreams of a future C-suite position.

"During my time at Mines and at internships, I realized that even engineers will get to a point in their careers where they will want to advance within their company," Frias said.

Enter Mines' Engineering and Technology Management Program, a one-year master's degree tailor-made for STEM professionals who want to broaden their career options by developing their business and technology management skills.

"Having a background in business will help me get there," Frias said.

WHAT IS ENGINEERING AND TECHNOLOGY MANAGEMENT?

Designed for STEM graduates who want to learn skills for jobs in business management,

the Engineering and Technology Management Program at Mines is a one-year master's degree ideal for those who want to broaden their options. Building on the STEM degrees students earned as undergraduates, the program equips its graduates with the knowledge of how to use those skills to improve business operations and organizational processes to keep up with rapidly changing technology. Students can complete the program in-person or online, but a STEM bachelor's degree is required.

"Students in the program, with their STEM backgrounds, have an analytic mindset, and we are teaching them how to apply that to business. We strengthen their mathematical understanding with business tools and methods, while challenging their mindset on the management-side of business that is not a one answer solution," said Crystal Dobratz, director of the Engineering and Technology Management Program.

HOW DOES ENGINEERING AND TECHNOLOGY MANAGEMENT COMPARE TO A MORE TRADITIONAL MBA?

A master's in business administration, or MBA, is a common route for those looking to pivot their careers

into a more business-focused track. Programs typically take a broad look at business as a whole and can be pursued by graduates with any academic background.

On the other hand, Engineering and Technology Management is a business program specifically tailored to STEM graduates who want to develop quantitative-based analytic skills. Unlike an MBA, the program is designed to be a bridge for STEM-minded professionals to use their previous education to make an immediate impact after graduation.

"We want to get these STEM students to a place where they feel comfortable talking to executives and being able to promote themselves in a way that allows management to understand their career goals. We want them to learn how to think outside the box and set themselves up for advancement," Dobratz said.

Often taking two years to complete, MBA programs traditionally offer a curriculum of general business courses, applicable to small franchises up to large multinational corporations.

The one-year Engineering and Technology Management master's degree is more focused, with two specialization options: Technology Management and Innovation or Engineering Management and Optimization. Students in the program do not need to choose a track, but rather they can select the courses that truly allow them to have a customized experience that fits the needs of their career goals. The courses specialize in either optimization and operations decision making or effective management of large engineering projects. All students in the program graduate knowing how to match organizational management with the modern, technologically evolving business landscape.

WHAT CAREER OPPORTUNITIES CAN I PURSUE?

Program graduates are working in an array of roles, including operations manager, client services analyst and project leader, and across industries, from governmental agencies to international corporations.

Holden Murphy MS '25 used the Engineering and Technology Management program to position himself for a career where he could use his communication skills more, without leaving his engineering background behind.

"I wanted to expand into the business world, and being a very social person, I wanted a job where I was not sitting behind a desk all day. I want to be talking to people," Murphy said. "ETM is setting me up for success by opening up my options and making it easier for me to pursue that kind of career."

Murphy now works for engineering company KBR in Colorado Springs as a junior sustainment test and evaluation engineer.

WHAT ARE THE COURSE REQUIREMENTS FOR ENGINEERING AND TECHNOLOGY MANAGEMENT?

The Engineering and Technology Management curriculum consists of a set of core courses along with a variety of electives, so students can mold the program to their interests and strengths. With 15 credits of core courses and 15 credits of electives, students in the program get a strong mix of base knowledge and specialization. If a desired course of study is not available, there is flexibility in the program to do an independent study and connect with other departments at Mines.

The program's co-curricular requirements outside of the classroom include an executive-in-residence seminar series, a communications workshop, a Python software engineering workshop, and a leadership and team-building event.

"We focus heavily on teamwork, whether it be in person or online, because we want students to experience working with individuals who may not be thinking the same way as them, for whatever project you're working on," Dobratz said.

WHAT KIND OF HANDS-ON EXPERIENCES CAN I EXPECT IN THE PROGRAM?

Mines' entrepreneurship and innovation landscape offers students in the Engineering and Technology Management program a variety of opportunities.

Through the Beck Venture Center and the National Organization of Business Engineers, students can connect through a due diligence committee to evaluate actual entrepreneurs seeking funding, providing documentations and giving presentations on where the entrepreneurs are at in the funding process. In conjunction with the McNeil Center for Entrepreneurship and Innovation, program electives allow students to explore taking an idea and making it come to life.



32,1	575,1	0,7746	1,3531	319,0	652,2	0,001395	0,02096	333,2	1,261	3,5
39,7	582,7	0,7915	1,3382	329,1	648,2	0,00142	0,0185	319,1	1,367	3,9
23,3	596,3	0,8235	1,3091	348,6	638,6	0,00148	0,0139	290,0	1,578	5,05
37,9	608,9	0,8555	1,2800	368,1	628,0	0,00153	0,0093	270,0	1,793	6,41



Mines Undergraduate Student Government leaders traveled to Washington D.C. in Fall 2025 for the American Student Government Association's National Student Government Summit. Mines student leaders joined peers from across the country to exchange ideas and gain actionable tools to strengthen Mines' student government and campus community. The group also visited Capitol Hill, meeting with Congresswoman Brittany Pettersen's staff to learn more about Congress and the role of science and technology in policymaking.

During their visit, the students joined the local M Club for lunch, connecting with D.C.-based Mines alumni.

1970s

John Belcher '71 has opened Halcyon Coffee in Seattle. Halcyon Coffee is offering free coffee to anyone who visits and states they are a "Helluva Engineer."

2010s

Governor Jared Polis appointed United Power's energy solutions director **Tyler Bain '13** to the Colorado State Electrical Board in 2025. The board is responsible for the licensing, registering and regulating of electricians, apprentices and electrical contractors, as well as adopting and revising rules and regulations concerning wiring apparatus and equipment for electric light, heat and power. Its mission is to enforce the state's electrical statutes and protect the health and safety of Colorado residents. The board is made up of nine professional and public members. Bain joins the board as a representative for electrical utilities.

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.

Neal Matosky '13 and his wife Kelsey welcomed baby boy Eli Matosky in early December 2025. Eli looks forward to wearing all of his Oredigger swag and learning the fight song as soon as possible.

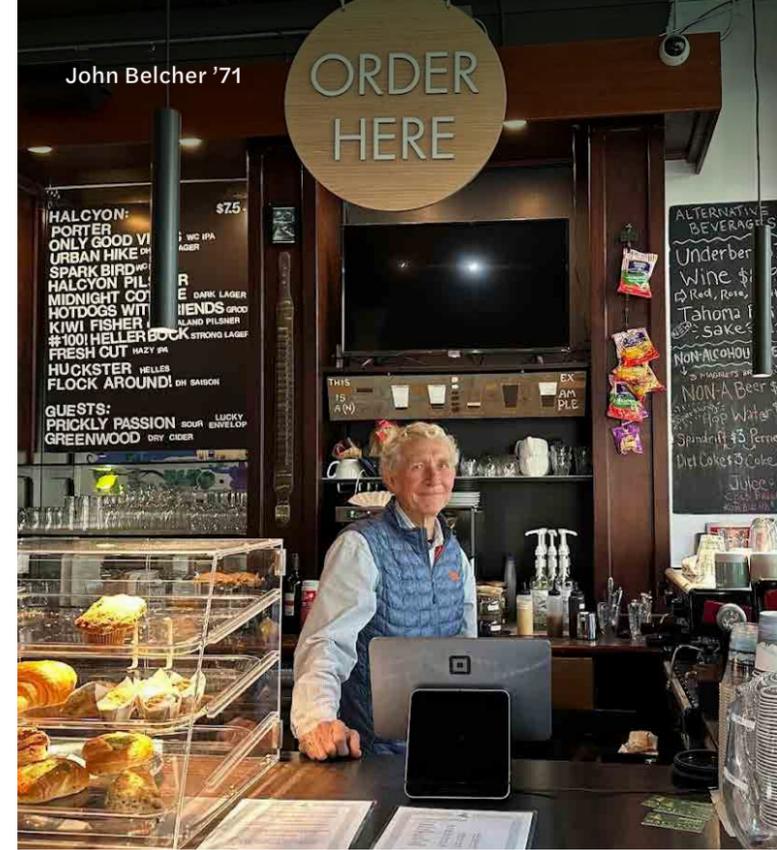
Arlen Kostival '14 and his wife Rachel welcomed their first child, Emma, into to world in March 2025.

Josh Stanley '14 and his wife Kayla welcomed their first baby, Landon James, on December 5, 2025.

Paige Husa '18, MS '19 and **Tyler Evans '18, MS '19, PhD '25** were married in Elizabeth, Colorado, on October 5, 2025. Many Mines alumni attended the wedding, including Paige's teammates from the Mines women's basketball team. The couple got engaged in Steamboat Springs during the Yampa Valley Balloon Rodeo.

2020s

Hanzelle Kleeman '21 and **Conall Saxena '22** were married on September 14, 2025, in Keystone, Colorado. Fourteen alumni attended the wedding, including Benjamin Abueg '22; Arvid Veidmark IV '22, MS '23; Zachary Hoffman '22, MS '23; Madison Heeg '21; Kathleen Tomon Veidmark '21, MS '22, PhD '25; Olivia Kovar '21; and Julia Hylton '21, PhD '25. The couple met at Mines while serving in student government.

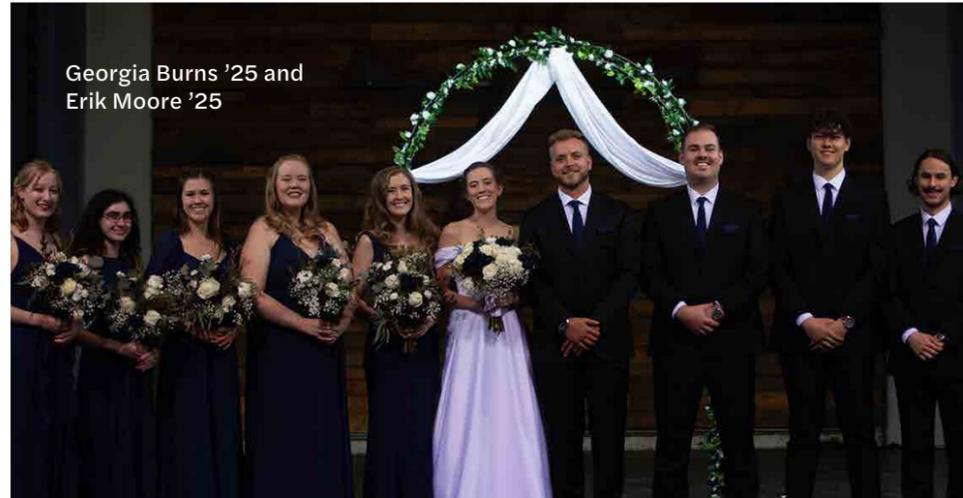


Heather Slomski '22 and **Tim Bond '23** tied the knot on October 10, 2025, after meeting during their first year at Mines. They celebrated surrounded by the amazing friends they made at Mines. There were more than 12 Mines alumni in attendance, including the best man Nick Karst '22, groomsman TJ (Torre) Brown '22 and Tim's aunt Meredith Bond '88.

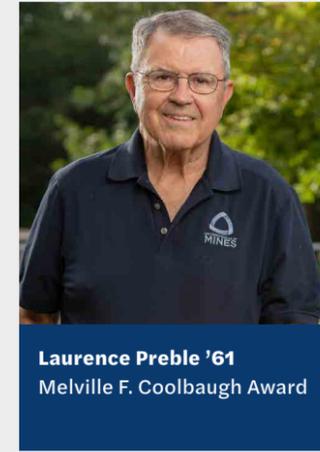


Heather Slomski '22 and Tim Bond '23

Georgia Burns '25 and **Erik Moore '25** were married on March 15, 2025, after Georgia accepted Erik's proposal on the bridge overlooking Clear Creek in Golden, Colorado. Several Mines alumni were in attendance, including groomsmen Juan Bolaños '25, Max Pizzimenti '24 and Everett Urban '23. The couple enjoyed a honeymoon in Costa Rica.



Georgia Burns '25 and Erik Moore '25



Laurence Preble '61
Melville F. Coolbaugh Award



Delbert Grotewold '83
Outstanding Alum Award



Mitch Kruse '85
M Club Leader of the Year



Bailey Burns '18, MS '21
Alumni Academic Involvement Award



Bridget Monroe, Class of 2026
Alum of the Future



Jackie Simens Gant '13, MS '15
Young Alum Award

Mines presented the 2025 Alumni Awards at the Denver Holiday Party on December 2, 2025. The recipients embody the highest ideals of Mines' mission through their leadership, service, innovation and unwavering commitment to the community. Candidates are nominated by their peers, as well as Mines faculty, staff and students. Through professional achievement, academic involvement, community leadership or student impact, the nominees represent the diverse and inspiring ways Orediggers lead with purpose. Awardees are selected by a volunteer selection committee, led by Tiffany Brewster '07.



Jennifer Miskimins MS '00, PhD '02, professor and head of the Petroleum Engineering Department at Mines, became the 2026 president of the Society of Petroleum Engineers (SPE), the premier global organization for oil and gas professionals. Miskimins is only the third SPE president from academia and the sixth woman to hold the position.

She has over 35 years of experience in the petroleum industry, starting with Marathon Oil Company as a production engineer and production supervisor. Miskimins began teaching

at Mines in 2002 and has held various appointments since then. From 2013 to 2015, she held a part-time appointment at Mines while working at Barree & Associates. In 2016, she returned full-time to the university and has served as the department head since 2019.

As part of her presidential duties with SPE, Miskimins recently visited Saudi Arabia for a conference in Dammam and got the chance to meet up with several Mines alumni while there—many of whom are her former students.

MISKIMINS IS ONLY THE THIRD SPE PRESIDENT FROM ACADEMIA AND THE SIXTH WOMAN TO HOLD THE POSITION.



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IN MEMORIAM

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

Charles "Charlie" L. Brokaw '94 died November 18, 2025. Born in 1970, Charlie was a member of the Beta Theta Pi fraternity and spent his professional career as an electrician and contractor.

Javaid Alamgir Durrani PhD '80 died November 16, 2025. He was born in 1946 and earned his doctorate from Mines through a Fulbright Fellowship. He had long and successful career in oil exploration and is the holder of numerous scientific patents.

Raymond W. Govett '52 died January 26, 2025. Born in 1930, Ray attended Mines with a football scholarship and was involved in a number of athletic teams and student organizations, including the

Kappa Sigma fraternity. He served as a second lieutenant in the U.S. Army in the Korean War. He then worked in the oil industry across Oklahoma and Texas before forming his own consulting company, Strike Resources Inc. He also taught geology classes at Texas A&M University-Corpus Christi until his retirement in 2001.

Henry H. Gruver '57 died March 17, 2025. Born in 1935, Henry started his career as a petroleum engineer with Pan American Petroleum in West Texas. He later worked for Core Labs studying reservoirs in Saudi Arabia and then joined Cabot Corporation as an assistant to the vice president of their oil and gas division. He then worked as the company's gas marketing division manager and vice president. His final position was president of Cordova Corporation.

Harry A. Hokanson '58 died Oct. 17, 2025. Born in 1935, Harry began his career at Hamilton Standard, where he worked on electron

beam welding technology, before moving to Miami, where he lived and worked for the remainder of his life. He worked for Aerodex before spending 15 years at Eastern Air Lines, rising to vice president of engineering. He retired as a partner at Propulsion Technologies Manufacturing International and continued consulting in the airline industry until age 85.

Richard "Dick" P. Kellenbenz '58, age 89 of Houston passed away peacefully on Thursday, July 10, 2025. Born in 1936, Dick began his professional career as a chemical engineer for Texaco. He spent 35 working in the petroleum refining and petrochemical industries in engineering, domestic and international marketing, and management positions. Most of his career was with Texaco. Prior to his retirement in 1993, he was the vice president of the Plaza Group.

Robert "Bob" R. Morgan '59, MS '69 died October 6, 2025. Born in 1935, Bob served in the U.S. Army

in Ethiopia. He consulted for Esso Eastern in Denver, Colorado, and subsequently took a job with them in Houston. He later returned to consulting and ultimately accepted a job with Aramco in Saudi Arabia for 12 years.

Daniel J. Riedel '98 died November 22, 2024. After serving in the U.S. Army, Dan worked as a production engineer, project manager, consultant and entrepreneur. His oil and gas career took him to far corners of the globe, including the Arctic Circle, Europe, Africa, the Middle East and across the United States.

➔ 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.

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THE NEXT CHAPTER

Celebrating the scholarship and service of the latest Mines graduates

In December 2025, the Mines community came together to celebrate a new cohort of graduates ready to shape industry, advance research and start a new chapter in their lives. Here's a snapshot of the impact, leadership and scholarship represented at the 2025 Midyear Commencement.



UNDERGRADUATE COMMENCEMENT

→ What makes the undergraduate journey at Mines unique? Hear what members of Fall 2025 undergraduate class have to say about their four year “symphony” of growth, challenge and community.



96
DOCTORATES



GRADUATE COMMENCEMENT

301
MASTER'S DEGREES

DISTINGUISHED SPEAKER:

DAVID LAWLER '90

1 STUDENT COMMISSIONED AS SECOND LIEUTENANT IN THE UNITED STATES ARMY



3 STUDENTS COMMISSIONED AS SECOND LIEUTENANTS IN THE UNITED STATES AIR FORCE



293
BACHELOR'S DEGREES



DR. BHAKTA RATH AND SUSHAMA RATH RESEARCH AWARD WINNER:

XUE WANG,
PhD in chemical engineering

The Rath Research Award recognizes the Mines doctoral graduate whose thesis demonstrates the greatest potential for societal impact. Wang's dissertation, “Understanding of Plasma Surface Interactions During Plasma Etching of Silicon-Based Dielectrics for Semiconductor Device Fabrication,” directly addresses the challenge associated with the fabrication of next-generation computer chips—chips expected to have features smaller than two nanometers, or less than ten atoms across.

→ What does it look like to be a well-rounded engineer at the graduate level? Hear from Fall 2025 master's and PhD graduates as they discuss their life-changing Mines experiences.





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