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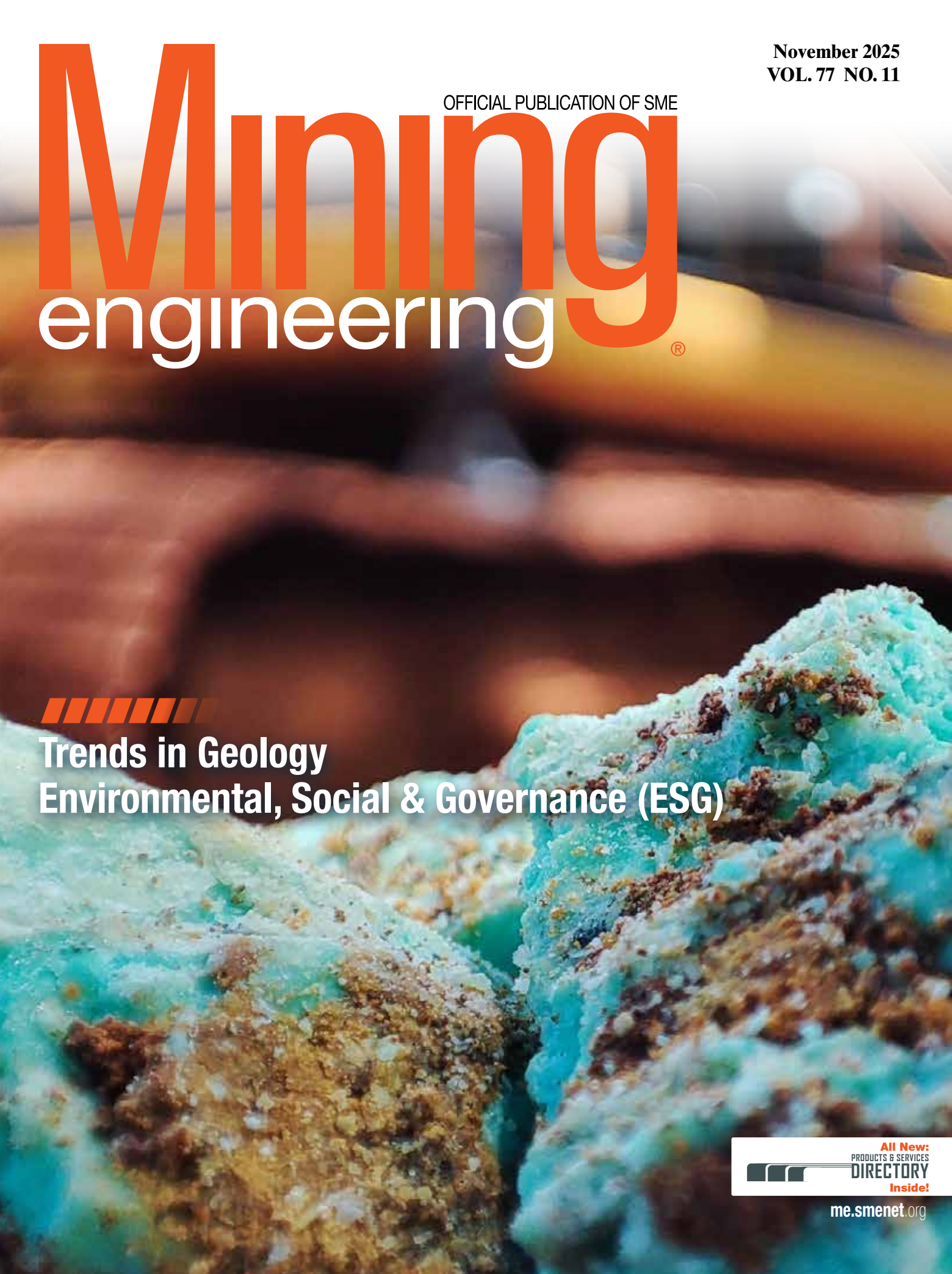

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Feature Articles

Technical-paper Abstracts from *Mining, Metallurgy & Exploration*

(peer-reviewed and approved)

Invited Extended Abstracts

Selected Abstract

SME News

Departments

Cover

The U.S. Geological Survey (USGS) has unveiled the Cooperative National Geologic Map, the most detailed national-scale geologic map of the country to date. The new map provides a regional view of geology both on and beneath the Earth's surface. The map provides both a technical achievement and a practical tool that will help shape future exploration and land-use decisions across the country. Cover image from Shutterstock. Cover design by Ted Robertson.

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A synopsis of a once-in-a-career opportunity;
Actions from Washington could transform mining industry

Bill A. Hancock
2025 SME President

This year's sea change in the federal government's attitude and dramatic positive support for the mining industry has been profound. Several very important Trump executive orders and numerous follow-on actions offer the promise that the United States will have a strong national security supporting domestic mining industry. Legislative actions are taking place in an effort to codify these orders to ensure future permanence.

I asked Debra Struhsacker, a mining and public lands consultant, to provide a synopsis on recent activity out of Washington, DC. SME retained Struhsacker to keep us informed about government policy actions and changes, which this year has been like "drinking from a firehose." She also provides sound advice on effective actions SME can take to support positive policy initiatives. She graciously provided the following high-level summary:

Since taking office on Jan. 20, 2025, President Trump has issued numerous executive orders (EOs) that support mining and policies to streamline permitting. These EOs aim to increase domestic mining and mineral processing to reduce the country's dangerous reliance on foreign minerals, and to remove the regulatory barriers that make securing permits for mining and other infrastructure projects so time consuming, costly and risky.

Two of these EOs, Unleashing American Energy (EO 14154) and Declaring a National Energy Emergency (EO 14156), were signed on Inauguration Day and form the foundation for the energy, mining and permitting policies in subsequent executive orders. EO 14154 includes a specific section on minerals entitled "Restoring America's Mineral Dominance" that directs the Secretaries of the Interior and Agriculture to identify and eliminate all agency actions that burden domestic mining and mineral processing and to reassess the mineral potential of withdrawn public lands. EO 14156 defines energy to include critical minerals and underscores the need for reliable and affordable energy.

President Trump subsequently issued an executive order to create the National Energy Dominance Council in the Executive Office of the President to advance his energy and minerals agenda, and EO 14241, "Immediate Measures to Increase Domestic Mineral Production," which includes numerous directives designed to restore America's position as a global hard-rock mining powerhouse. He has also developed executive orders to reinstate coal as an important fuel source for U.S. power plants and to accelerate the development of nuclear power. In aggregate, President Trump's energy and minerals executive orders are intended to make America energy and minerals dominant.

Turning to Capitol Hill, Congress has been busy considering bills dealing with energy, mining, and permit streamlining. For example, H.R. 4090 would codify many of the mineral policies in EOs 14154 and 14241 to ensure their future durability. This is important because subsequent administrations can rescind or modify a previous president's executive orders. In H.R. 4776, Congress is proposing significant improvements to the National Environmental Policy Act (NEPA), which is

(continued on page 14)

Safety Share | In November most of the Northern Hemisphere turns clocks back an hour for wintertime or standard time. Although most of us appreciate the extra hour of sleep, not everyone feels the benefit of the time change. Operations that work 24 hours have night-shift workers that may be required to work an extra hour to maintain the regular shift change rotation. For these workers, fatigue can be an issue that leaders need to monitor.

Many employees will see themselves driving to and from work in the dark. Depending on someone's role, this could mean that they see little or no sunlight during the winter months. Not having the opportunity to get natural light increases a person's fatigue risk and that could increase their safety risk both on and off the job.

Industry leaders need to be aware of the increased risks the reduced daylight has on employees and actively manage fitness for duty evaluations and have management processes in place to respond to fatigued employees that do not put them at increased risk of injury. Understanding the reality of elevated fatigue risks during the winter months and the impact it can have on the safety risk of operations is the driver for implementing comprehensive fatigue management programs to protect miners. ■

Tailings Resources

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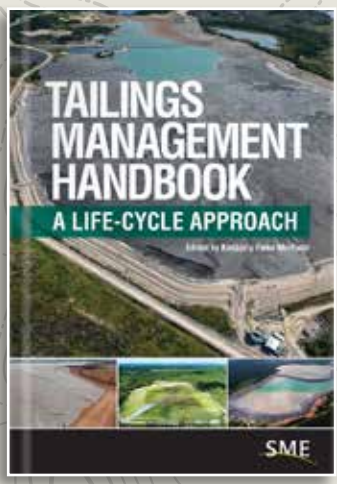

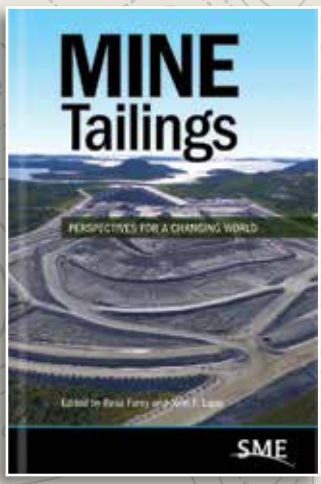

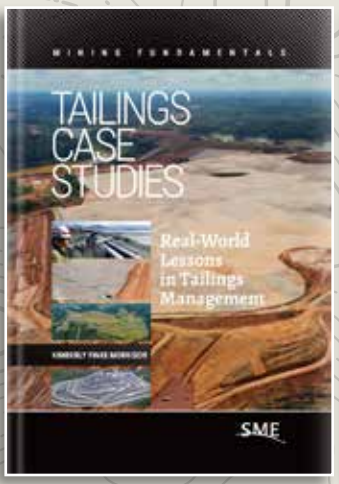

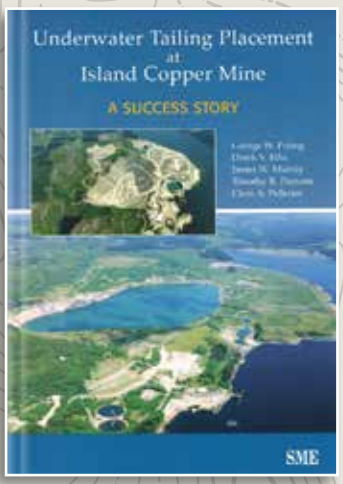

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Critical mineral firms boost Washington lobbying

CRITICAL MINERAL companies are boosting lobbying efforts in Washington, hoping to share in the ambitious investments that U.S. President Donald Trump has pledged to firms deemed essential to national security, a *Reuters* review of public records and interviews with executives and officials showed.

At least a dozen companies — including lithium, copper, rare earths and geothermal firms — have signed with major Washington lobbying firms since January, the review found.

There has been a sharp uptick in influence campaigns aimed at securing federal investment, permitting support and long-term procurement guarantees.

The White House has pivoted from a historical focus on industry subsidies to one focused on partial ownership of MP Materials, Lithium Americas and other companies to counter China's dominance in critical minerals.

"Once the U.S. government started giving money away earlier this year, every minerals boardroom in America started to think, 'What about us?'" said Ken Hoffman, a commodity strategist with mining investment bank Red Cloud Securities and a former mining industry consultant.

Even with recent moves by JPMorgan to invest up to $10 billion in critical minerals and other industries, Hoffman said government funding is crucial as many private investors remain anxious about funding junior miners and novel processing technologies.

The shift has sent stock prices soaring across the sector as companies scramble to align themselves with Washington's industrial strategy. The Sprott Lithium Miners ETF, for instance, has jumped more than 35 percent.

The roster of lobbying firms includes Ballard Partners, run by Trump ally and top Republican fundraiser Brian Ballard, who helped raise more than $50 million for Trump's 2024 campaign.

Another prominent firm, The Bernhardt Group, is tied to David Bernhardt, who in Trump's first term ran the U.S. Interior Department, a key player in permitting critical mineral projects.

Bernhardt and Ballard did not respond to requests for comment.

Understanding the complex sector can require detailed knowledge of scientific arcana, geopolitics, trade and procurement, so lobbyists often see themselves as educators for the 535 members of Congress and hundreds of executive branch offices.

"You need to have someone on the ground in Washington educating lawmakers on what you're doing and the science behind it," said Jim Sims of NioCorp. The company is developing a Nebraska scandium mine that has received $10 million from the Pentagon and is under consideration for an $800 million loan from the U.S. Export-Import Bank.

In April, NioCorp tapped the lobbying firm Navigators Global, whose roster includes Secretary of State Marco Rubio's former legislative staffer Cesar Conda.

Some companies that recently hired lobbyists are in talks with the administration or have landed deals.

Lithium Americas hired lobbying firm Guidepost Strategies in July and reached a deal this month to give Washington a 5 percent equity stake in the company and its Thacker Pass project with General Motors in exchange for access to a $2.26 billion loan. ■

US postpones Wyoming coal leases after Montana auction

THE TRUMP administration has postponed a scheduled sale of coal leases on federal lands in Wyoming two days after a disappointing auction in Montana, an Interior Department spokesperson said, *Reuters* reported.

The Bureau of Land Management (BLM), a division of Interior that manages 245 million acres of federal lands, had been expected to keep processing permits and leases for oil, natural gas and coal operations during the government shutdown, according to contingency plans published.

A sale of 3,508 acres of federal coal reserves in Wyoming's Campbell and Converse counties had been scheduled. The lease area contains 365 million tons of recoverable coal. Interior said it would post a new date for the sale but did not give a reason for the postponement.

The BLM held a lease sale for 1,262 acres in Big Horn County, MT, that attracted one bid from the Navajo Transitional Energy Co. (NTEC), which operates the nearby Spring Creek Mine.

The bid of $186,000 for a lease with an estimated 167.5 million tons of recoverable coal equates to less than a penny per ton. The Interior Department blamed the administrations of former Presidents Joe Biden and Barack Obama for the weak industry interest.

"While we would have liked to see stronger participation, this sale reflects the lingering impact from Obama and Biden's decades-long war on coal which aggressively sought to end all domestic coal production and erode confidence in the U.S. coal industry," the Interior Department said in a statement. "Fortunately, President Trump and his administration are rebuilding trust between industry and government as part of our broader effort to restore American energy dominance."

Obama and Biden had toughened environmental regulations on coal to reduce pollution and climate impact, and encourage a transition to renewable energy sources.

The BLM has not yet accepted the NTEC bid because under the leasing process it first must determine whether it represents fair market value.

NTEC had argued in sale documents that the fair market value of the coal should be close to the minimum bid of $100 per acre required by law. The company did not respond to requests for comment. ■

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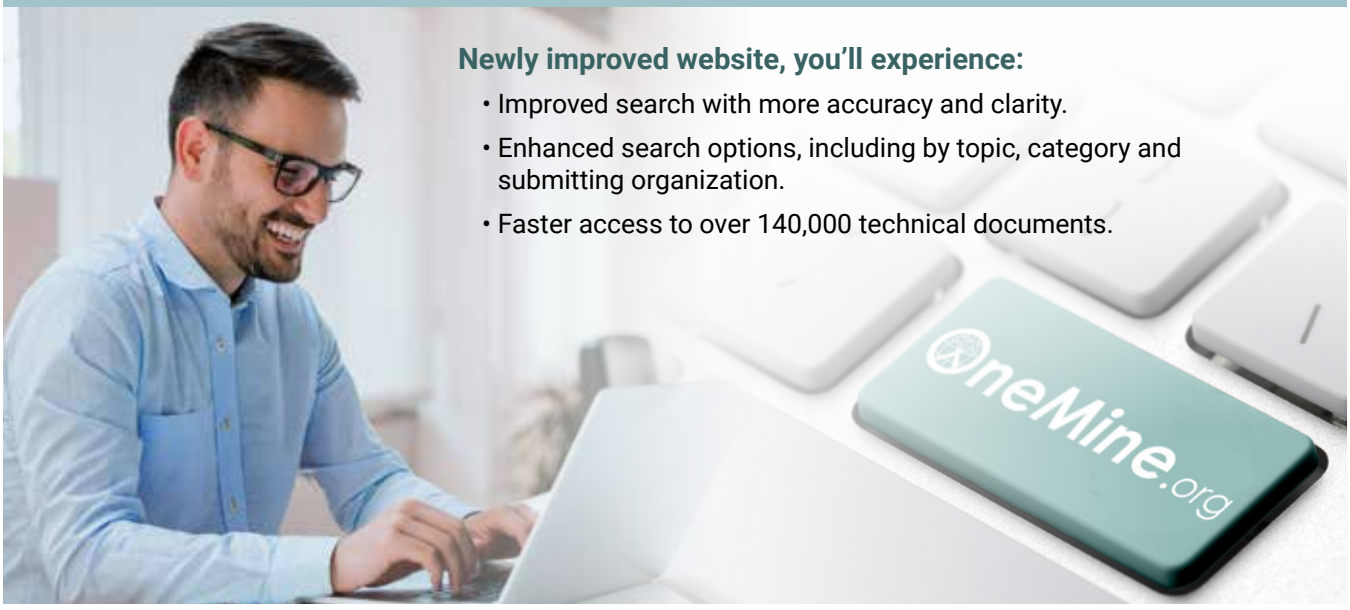

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JPMorgan to invest up to $10 billion in companies
vital to US national security as part of $1.5 trillion pledge

JPMORGAN CHASE announced plans to hire bankers and invest up to $10 billion in U.S. companies critical to national security and economic resilience as part of a broader $1.5 trillion pledge, *Reuters* reported.

The 10-year initiative aims to facilitate, finance and invest in industries central to the growth of the U.S. economy, including defense, energy and manufacturing.

Shares of the largest U.S. bank climbed more than 2 percent after the announcement.

JPMorgan said it will deploy the $10 billion through direct equity and venture capital investments.

U.S. President Donald Trump is looking to modernize infrastructure and reduce dependence on foreign supply chains of rare earth minerals.

Trump has criticized JPMorgan and its rivals for "debanking" clients — cutting ties with certain customers by closing their accounts or refusing to do business with them — for their political or religious beliefs.

JPMorgan chief executive officer Jamie Dimon said the investments were not driven by the Trump administration.

"This is a JPMorgan initiative," Dimon told journalists on a call in which he was asked several times about the government's involvement. He emphasized that the investments would be "100 percent commercial" and not philanthropic.

Trump revived a trade war with Beijing in October, ending an uneasy truce between the world's two largest economies with promises to sharply hike tariffs after China expanded its rare earths export controls. However, he later struck a more conciliatory tone, saying he hoped the dispute would be "short-lived" and that he remained open to negotiating with Chinese leaders.

"It has become painfully clear that the United States has allowed itself to become too reliant on unreliable sources of critical minerals, products and manufacturing — all of which are essential for our national security," Dimon said in an earlier statement.

JPMorgan said its new "security and resiliency initiative" would facilitate financing and investment across four strategic sectors: supply chain and manufacturing; defense and aerospace; energy independence; and frontier technologies such as artificial intelligence and quantum computing.

The firm said it had already planned to facilitate and finance about $1 trillion over the next decade to support clients in these industries, according to previously undisclosed internal figures, but it would increase the size by 50 percent.

"JPMorgan's move should promote goodwill with both the administration as well as the business sector," Michael Ashley Schulman, partner and chief investment officer at Running Point Capital Advisors, wrote in a note. "The other major U.S. banks already funnel oceans of credit into defense, energy and advanced manufacturing, but JPMorgan stitched the activity into one big patriotic umbrella with an advisory council and a headline number that grabs cameras."

Some analysts disagreed.

"This initiative is different and unique in terms of the magnitude and the time commitment relative to what I have seen from other banks. This is a newer direction for sustainability initiatives," Wells Fargo bank analyst Mike Mayo said. ■

Newswatch contents

Barrick to sell Tongon gold mine
in $305 million deal with Atlantic Group

BARRICK MINING said it will sell its interests in the Tongon gold mine and certain assets in Ivory Coast to Atlantic Group for up to $305 million as the Canadian miner looks to strengthen its balance sheet, *Reuters* reported.

The deal with Abidjan-based Atlantic is part of Barrick's plan to monetize noncore assets in markets with rising operational costs, a strategy it has undertaken since its 2019 merger with Africa-focused Randgold Resources.

The company has instead been pivoting toward high-margin, long-life assets, with a growing focus on copper and strategic operations in Africa and the Middle East.

The deal comes as gold prices hover around $3,900 an ounce, supported by safe-haven flows from broader economic uncertainty, as well as prospects of further Federal Reserve rate cuts.

The Tongon Mine, which began production in 2010, has had its life extended beyond the originally scheduled 2020 closure through Barrick's successful exploration, the company said.

The deal includes a cash payment of $192 million, which covers a $23 million shareholder loan repayment to be made within six months of closing, with the proceeds helping Barrick strengthen its balance sheet, the company said. ■

US government takes 5 percent stakes in Lithium Americas and Thacker Pass joint venture with GM

THE U.S. DEPARTMENT of Energy has taken a 5 percent stake in Lithium Americas and a separate 5 percent stake in the company's Thacker Pass joint venture with General Motors (GM) that is set to be the largest lithium source in the Western Hemisphere, *Reuters* reported.

The deal, announced by Lithium Americas, marks the latest private-sector investment by U.S. President Donald Trump's administration. It follows U.S. government acquisitions in Intel and MP Materials, as the government attempts to boost industries it considers vital to U.S. national security.

Reuters reported that administration officials were in discussions with Lithium Americas about an equity stake as they renegotiated the terms of a $2.26 billion government loan for the Nevada-based mining project.

The Vancouver-based company said it has finalized an agreement with the Energy Department to initiate the first $435 million draw from a previously announced $2.26 billion loan to support development of the Thacker Pass Mine, which is under construction and set to open by 2028.

The U.S. government will acquire the stakes via warrants with an exercise price of a penny.

"We greatly appreciate the support of the administration, General Motors and our partners," Jonathan Evans, chief executive officer of Lithium Americas, said. GM, which invested $625 million in the mine last year for a 38 percent stake, has the right to buy all of the project's lithium from its first phase and a portion from the second phase for 20 years.

"We're confident in the Thacker Pass project, which will reduce U.S. dependence on imported lithium and can support domestic manufacturing across many industries," said Shilpan Amin, who oversees GM's supply-chain procurement.

"Despite having some of the largest deposits, the United States produces less than 1 percent of the global supply of lithium. Thanks to President Trump's bold leadership, American lithium production is going to skyrocket," U.S. Energy Secretary Chris Wright said. "Today's announcement helps reduce our dependence on foreign adversaries for critical minerals by strengthening domestic supply chains and ensures better stewardship of American taxpayer dollars. President Trump promised to do both and he is delivering." ■

Codelco will test CAT's innovative system
for transferring electrical power to moving trucks

CODELCO ANNOUNCED plans to test the Cat Dynamic Energy Transfer (DET) system with its fleet of diesel-electric haul trucks at the Radomiro Tomic Division. This initiative is part of the company's commitment to decarbonization and sustainability, seeking to reduce its carbon footprint through the use of innovative technologies and electrification solutions.

The Cat DET system consists of several integrated components: a power transfer module that converts power from the site's electrical source to the required voltage, an electrified rail system to transmit the power, and a machine-connection system to transfer power to the truck's drivetrain. This system transfers electricity directly to the machines while they are in motion, including both current and future battery-electric trucks. By utilizing Cat DET, the site will consume less fuel, reduce greenhouse-gas emissions, and extend the life of the trucks' engines.

"We are steadily advancing toward the mining of the future," said Felipe Lagno, Codelco's corporate manager of innovation and technology, who explains that, according to preliminary calculations, truck emissions could be reduced by between 60 and 70 percent. "We have the opportunity to reduce our environmental impact and extend the useful life of our trucks without compromising productivity. Every project linked to technological innovation brings us closer to our goal of being a cornerstone of sustainable development for Chile and the world."

"This pilot program is the result of an extensive collaboration between Codelco, Finning SA and Caterpillar, and will allow Caterpillar to continue refining and improving the design and functionality of our Cat DET system, incorporating the voice of the customer," said Marc Cameron, senior vice president at Caterpillar. "Together, we are not only transforming the way fleets operate on site, but also paving the way for a more sustainable tomorrow."

The pilot is scheduled to begin in the second quarter of 2026 in openpit operations. The test, expected to last approximately one year, will involve Cat 798 AC trucks and the installation of rails on one of the ramps where the machines operate.

Cat dealer Finning SA will be assisting with the installation and maintenance of the Cat DET system.

"For Finning, this industrial trial — made possible thanks to the strategic alliance that Codelco has consolidated with us over the years — represents a significant opportunity to advance the integration of cutting-edge technologies in mining. It marks a milestone in driving innovation through sustainable practices and reinforces our commitment to environmental stewardship, with a view to the future," said Juan Pablo Amar, president of the company. ■

New copper demand drivers from US, India
to emerge over the next decade as China juggernaut slows

COPPER CONSUMPTION in the United States and India is set to emerge from China's shadow over the next decade as demand growth in the world's largest consumer of the industrial metal slows, *Reuters* reported.

Beijing's industrial and infrastructure expansion has helped fuel a rally that has seen copper prices rise to above $10,000/t from $1,500/t 25 years ago. But while China is forecast to remain the largest market for copper into the next decade and beyond, analysts expect other demand and price influences to increasingly come into play. Changing regional policies, infrastructure cycles and geopolitical shifts are likely to mean producers, consumers, traders and investors need to adapt to a market that has many different drivers.

"China will reduce its rate of copper consumption and stockpiling. We are going back to old-fashioned drivers of copper, which is basically replacement cycles outside China," said Panmure Liberum analyst Tom Price. T

The impact has yet to be seen, but moves by the United States and other countries to promote local manufacturing also mean China's export machine and manufacturing activity is expected to slow and weigh on its demand for refined copper, estimated at around 15 Mt this year.

Meanwhile, the data centers needed to support artificial-intelligence technology and upgrades to power grid infrastructure mean copper demand growth outside China will become the driving force for prices.

"China has built its infrastructure, including its power distribution grid. Its activity will drift to a lower level to match (its) requirement," said Price, who forecasts Chinese demand will be 6 percent lower in 2031 than in 2026.

Price predicts China will account for 52 percent of global consumption of primary copper, at around 27 Mt, in 2031 compared with 57 percent in 2026. He expects U.S. copper demand of 2.2 Mt in 2031, up nearly 50 percent from 2026. For India, he forecasts copper demand to rise above 1 Mt, a rise of more than 30 percent.

Analysts also expect U.S. President Donald Trump's imposition of 50 percent tariffs on copper pipes and wiring to help encourage local production. For China, the likely outcome is the loss of a major market for its exports of copper pipe.

Trade Data Monitor ranks the United States as China's fourth biggest market for the product. Last year, it imported 14.4 Mt of copper tubes and pipes directly from China and in the first seven months of this year these totaled some 8 Mt, TDM data show, underlining the potential loss of a major market for Beijing. ■

Trump, Australia's Albanese sign critical minerals agreement in their first White House summit

U.S. PRESIDENT Donald Trump and Australian Prime Minister Anthony Albanese signed a critical minerals agreement aimed at countering China, *Reuters* reported.

China loomed large at the first White House summit between Trump and Albanese, with the U.S. president also backing a strategic nuclear-powered submarine deal with Australia to bolster security in the Indo-Pacific.

Albanese and Trump signed a minerals deal that Trump said had been negotiated in recent months. Albanese described it as an $8.5 billion pipeline "that we have ready to go."

A copy of the agreement released by both governments said the two countries will each invest $1 billion over the next six months into mining and processing projects as well as set a minimum price floor for critical minerals, a move that Western miners have long sought.

A White House statement on the agreement added that the investments would target deposits of critical minerals worth $53 billion, although it did not provide details on which types or locations.

"In about a year from now, we'll have so much critical mineral and rare earths that you won't know what to do with them," Trump told reporters.

The U.S. Export-Import Bank, which acts as the U.S. government's export credit agency, later announced seven letters of interest totaling more than $2.2 billion to advance critical minerals projects in Australia.

It said the letters went to Arafura Rare Earths, Northern Minerals, Graphinex, Latrobe Magnesium, VHM, RZ Resources and Sunrise Energy Metals.

EXIM said the projects span a range of critical minerals essential to advanced defense systems, aerospace components, communications equipment and next-generation industrial technologies.

The investments would help support the re-industrialization of America's high-tech manufacturing base, while helping to "counter China's export dominance and ensure Western supply-chain resilience," it said.

Additionally, the Pentagon plans to build a gallium refinery in Western Australia. China blocked gallium exports to the United States last December.

The United States has been looking to boost its access to critical minerals around the world as China takes steps to strengthen control over global supply.

Trade tensions between the United States and China have escalated ahead of Trump's meeting with Chinese President Xi Jinping in South Korea. ■

Barrick and Newmont CEOs separately depart
in major mining leadership shakeup

BARRICK MINING appointed veteran executive Mark Hill as interim president and chief executive officer (CEO) following the sudden resignation of Mark Bristow, who led the Canadian miner for nearly seven years after its merger with Randgold Resources, *Reuters* reported.

On the same day, rival Newmont said CEO Tom Palmer will be replaced in January by insider Natascha Viljoen, who will become the first female CEO of the world's biggest gold mining company.

The timing of the statements appeared to be coincidental.

The global mining industry has experienced a period of significant transition as an investor push for stronger growth and returns has driven leadership changes across the sector. Rio Tinto earlier this year appointed a new CEO, and the world's largest mining company BHP is also preparing to replace its chief.

In a note, analysts at Citi said that while Palmer's departure from Newmont was "well flagged" and unlikely to spark a major stock reaction, the Bristow announcement was "more surprising."

Bristow, who became CEO in 2019 when Barrick acquired Randgold, oversaw the integration of the two companies and steered the miner through a period of significant portfolio reshaping and debt reduction.

He said in May he would stay in his current role until 2028, which would have allowed him to oversee the development of the company's Reko Diq copper and gold project in Pakistan.

The news of his departure therefore "comes suddenly," RBC Capital Markets analyst Josh Wolfson said, and in the near term could overshadow Barrick's update on its Fourmile discovery in Nevada, which the company said has potential to become one of the world's leading gold assets.

"Barrick CEO succession has been a consistent investor question for some time," Wolfson said in a note. "Following today's news, we believe the strategic outlook of Barrick is less certain."

Hill, who will also continue to serve as group chief operating officer, takes charge immediately as the board begins a global search for a permanent CEO with the help of an external firm, named by one source as Egon Zehnder.

The board has been looking at succession planning for some time, driven, the source said on condition of anonymity, by the business's underperformance compared to competitors in the past five years.

Shares in Barrick, which owns 13 mining assets across Africa, Asia, Latin America and North America, have risen by 37 percent since 2020 compared to a 110 percent climb in shares of fellow Canadian miner Agnico Eagle. Gold prices have been at record highs.

The company will consider both internal and external candidates, the source said, adding it was not clear if Hill would put himself forward as permanent CEO.

Known for his mercurial leadership style, Bristow's tenure at Barrick was focused on integrating assets that Barrick owned in some of the volatile regions of the world.

He has been known for his tough negotiating tactics, with some wins and some losses. ■

Perpetua Resources in talks with Glencore
and others for US antimony processing

PERPETUA RESOURCES said it is in talks with Glencore, Trafigura and others about a partnership to refine antimony in the United States, part of a push to boost Western supplies of a critical mineral whose exports China has blocked, *Reuters* reported.

The company, which counts billionaire John Paulson as its largest shareholder, received permission from the U.S. government to begin construction of its antimony and gold mine about 138 miles (222 km) north of Boise in Idaho.

The mine will be the largest U.S. supplier of antimony, which is used to make bullets, solar panels and other goods. There are no current U.S. sources of the metal.

Perpetua plans to extract the metal but not refine it, fueling a push to find partners for the necessary step.

The company said in a statement to *Reuters* that it is in talks with Glencore, Trafigura, Clarios and Sunshine Silver about a refining partnership and plans to seek proposals in the coming weeks with a decision expected by the end of the year. "We are encouraged by emerging opportunities to expand domestic mineral processing capacity in America and intend to make well-informed, market-based decisions when selecting a partner," said Jon Cherry, Perpetua's chief executive officer.

Glencore declined to comment. Sunshine Silver, Clarios and Trafigura did not immediately respond to requests for comment.

Perpetua's mine site has estimated reserves of 148 million pounds of antimony and 6 million ounces of gold.

The project has faced legal opposition from Idaho's Nez Perce tribe, which is concerned the mine could affect the state's salmon population.

Separately, United States Antimony, which controls two North American antimony refineries, earlier secured a contract worth up to $245 million from the U.S. Defense Logistics Agency to supply antimony metal ingots. ■

Bolivia's new president rekindles cautious hope for long-stalled lithium dreams

BOLIVIA'S ELECTION of centrist Rodrigo Paz is raising \ hopes that a more market-friendly leader could pave the way for international investment in the country's ample lithium reserves after years of false starts under two decades of socialist rule, *Reuters* reported.

Bolivia holds the world's largest resources of the ultralight metal used in electric vehicle batteries, but development has been hamstrung by political opposition and a law mandating state control of the sector that has chilled broad investor interest.

Lithium deals under outgoing President Luis Arce with companies from allies China and Russia were blocked in Congress, and Paz has said he would scrutinize the contracts to ensure transparency, a move that could create fresh opportunities but also spark investor jitters.

Paz's campaign focused less on lithium than on other priorities such as maintaining cash transfers to the poor, decentralizing government and private sector-led growth, part of an effort to not alienate former supporters of leftist Evo Morales who founded the ruling MAS party.

In that vein, Paz has also vowed not to "sell out" the vast Uyuni salt flat famed for its dazzling fields of white salt, a nationally beloved symbol of Bolivia's national sovereignty and Indigenous heritage.

Beyond calling for foreign investment that benefits the local Potosi region, he has not discussed a policy plan for Bolivia's 23 Mt (25.3 million st) of lithium resources.

Diego von Vacano, a Bolivia expert at Texas A&M University, said Paz needs to announce details within the first few months of his presidency for the global mining community to take him seriously.

"Otherwise, investors will say, okay, it's more of the same … and Bolivia might be seen again as having missed the boat," he said.

Among other issues, Paz faces a decision on whether to modify a Bolivian law dictating that only the state can extract lithium, which has cramped investor interest both locally and abroad. Changing it would require constitutional referendum or reform. Paz and his advisors have yet to weigh in on the question.

There are technical challenges, too, in tailoring extraction technology to the exact composition of the salty brine deposits that hold Bolivia's lithium. Past efforts with traditional evaporation ponds proved inefficient due in part to high naturally occurring concentrations of magnesium. ■

US eyes stake in Critical Metals Corp, a company developing a rare earths mine in Greenland

TRUMP ADMINISTRATION officials have discussed taking a stake in Critical Metals Corp, four people familiar with the discussions told *Reuters*, which would give Washington a direct interest in the largest rare earths project in Greenland, the Arctic territory that President Donald Trump once suggested buying.

If finalized, the deal would mark the latest political twist for the Tanbreez rare earths deposit, which former President Joe Biden successfully lobbied to have sold to New York-based Critical Metals for far less than a Chinese firm was offering. Washington has recently taken stakes in Lithium Americas and MP Materials, underscoring Trump's desire for the United States to benefit from growing production of minerals used across the global economy.

Details of the discussions about Washington's interest in an equity stake in Critical Metals have not previously been reported. The four sources declined to be named, citing the sensitivity of the negotiations.

"Hundreds of companies are approaching us trying to get the administration to invest in their critical minerals projects," a senior Trump administration official told *Reuters* in response to a request for comment. "There is absolutely nothing close with this company at this time."

Critical Metals did not respond to repeated requests for comment. Greenland is a semiautonomous part of Denmark, and the Danish Embassy in Washington did not immediately respond to a request for comment.

Rare earths offer strong magnetic properties critical to high-tech industries ranging from electric vehicles to missile systems. Their importance is spurring an intense push for fresh supplies by Western countries looking to lessen their dependence on China's near total control of their extraction and processing.

Critical Metals, which agreed to buy Greenland's Tanbreez deposit last year for $5 million in cash and $211 million in stock, applied in June for a $50 million grant through the Defense Production Act, a Cold War-era piece of legislation aimed at boosting production of goods for national security purposes.

The administration has begun discussions with the company about converting the grant into an equity stake, three of the sources said. If the deal goes through, a $50 million conversion would mean a roughly 8 percent stake in the company, although negotiations are not final and the final size of the stake could be higher or the deal itself could collapse, the same three sources said.

Administration officials have considered reallocating $2 billion from the CHIPS Act to fund critical minerals projects, *Reuters* reported in August. The law, formally known as the CHIPS and Science Act, was signed into law by then-President Joe Biden in 2022 and aims to lure chip production away from Asia. The Critical Metals investment discussions were delayed by the administration's negotiations for a 5 percent stake in Lithium Americas, two of the sources said. The U.S. government shutdown is not expected to affect the negotiations, given that high-level staff involved in the discussions are considered essential government workers, two of the sources said. Part of the discussion centers on how warrants would be issued to give Washington the stake, one of the sources said. Warrants give their holders the right to buy stock at a set price. The equity stake would be separate from a $120 million loan the U.S. Export-Import Bank (EXIM) is considering to help the company develop Tanbreez, according to two of the sources. An EXIM spokesperson was not immediately available to comment.

The Tanbreez project is expected to cost $290 million to bring into commercial production, the company had said. The EXIM loan would be used to fund technical work and get the mine to initial production by 2026.

Once fully operational, the mine is expected to produce 85 kt/y (93,700 stpy) of rare earths concentrate. The site also contains gallium, which China subjected to export restrictions last year, and tantalum. ■

President's Page: Time to capitalize on opportunity

(continued from page 4)

the law that requires federal agencies to prepare environmental assessments and environmental impact statements. This bill includes judicial reforms to rein in NEPA litigation and codifies the Supreme Court's May 2025 unanimous decision in the Seven County Coalition v. Eagle County, CO litigation. This landmark NEPA case confirms that NEPA is a procedural law that does not require any specific environmental outcome. (Environmental protection mandates are in other federal statutes like the Clean Water Act and the Clean Air Act — not NEPA). The Supreme Court's ruling also clarifies that NEPA does not require federal agencies to consider speculative future or geographically distant impacts or impacts outside an agency's regulatory jurisdiction.

Taken together, President Trump's executive orders and the minerals and permitting bills that Congress is considering create a once-in-a-career opportunity for the mining industry to support policies that will enable the United States to capitalize on our mineral endowment to provide the minerals we need for our economy and national security. Because we do not know how long this opportunity will last, time is of the essence for the industry to work constructively with this administration and Congress to put as many favorable policies in place as possible. SME, through its Government and Public Affairs Committee (GPAC), is actively engaged by providing technical input to the administration and Congressional lawmakers.

Deep Enough! ■

Trump orders permits for Alaska mining road,
US takes stake in possible developer Trilogy Metals

U.S. PRESIDENT Donald Trump said he had signed an executive order directing his administration to permit an access road to the Ambler mining district in Alaska to unlock domestic supplies of copper and other minerals, *Reuters* reported.

The White House also announced a $35.6 million investment in Canada's Trilogy Metals, one of the region's possible developers. The investment makes the U.S. government a 10 percent shareholder in the company and includes warrants to purchase an additional 7.5 percent stake.

"This partnership represents a strong vote of confidence in the Ambler Mining District and is a major step forward for domestic mineral development that's fundamental to America's security and economy," said Kaleb Froehlich, managing director of Ambler Metals, a joint venture between Trilogy and Australia's South32 Limited.

Trump's order reverses the Biden administration's rejection of a 211-mile (340-km) road intended to enable mine development in the north-central Alaskan region.

The Biden administration's Interior Department in 2024 had cited risks to caribou and fish populations that dozens of native communities rely on for subsistence.

"This is something that should have been long operating and making billions of dollars for our country and supplying a lot of energy and minerals and everything else that we are talking about," Trump said at a signing event in the Oval Office.

The Alaska state agency that proposed the project had appealed the Biden administration decision. ■

US judge set to approve Rio Tinto's $138.75 million
Oyu Tolgoi copper and gold mine settlement

A U.S. JUDGE said he was ready to approve Rio Tinto's agreement to pay $138.75 million to settle a lawsuit that accused the Anglo-Australian mining giant of defrauding investors by concealing problems with its $7 billion underground expansion of the Oyu Tolgoi copper and gold mine in Mongolia.

Rio Tinto had reached a preliminary settlement with shareholders of the former Montreal-based Turquoise Hill Resources in June, pending approval from Manhattan-based U.S. District Judge Lewis Liman.

Liman at a hearing said he was ready to approve the settlement, but did not sign off on it yet because he was waiting for the shareholders' lawyers to inform him of what they planned to do with any funds left after initial distributions.

Rio Tinto did not admit wrongdoing in agreeing to settle.

The lawsuit sought damages on behalf of Turquoise Hill shareholders between July 2018 and July 2019, when that company, then listed in Toronto, was majority-owned by Rio Tinto.

Shareholders were led by funds advised by Chicago-based Pentwater Capital Management.

Pentwater said in a Sept. 10 court filing that the settlement amount represented between 34 percent and 43 percent of the damages it believed it could prove at trial, describing it as reasonable given the risk of continued litigation.

Turquoise Hill had been a single-asset company owning 66 percent of the Oyu Tolgoi Mine, with the government of Mongolia owning 34 percent. ■

Sandvik launches DataDrive'31, a new technology
aimed at accelerating the digital future of mining

SANDVIK HAS launched DataDrive'31, a major new technology program aimed at accelerating mining's digital transformation through data-driven innovation.

The six-year program has a total budget of €80 million. Business Finland has granted €16 million in reseach & development (R&D) funding for the first three-year phase, with the option to grant an additional €16 million for the subsequent phase. The remaining funding represents a significant direct investment by Sandvik, underscoring a long-term commitment to technological development and accelerating digitalization. A mid-term review will be conducted after three years to evaluate progress before proceeding to the second phase.

DataDrive'31 focuses on developing new data-driven technologies and solutions that enhance productivity, safety and sustainability across the entire mining value chain. Key objectives include enabling new services and products through data utilization and commercialization; integrating data-driven technologies into equipment, operations and aftermarket services to deliver end-to-end digital solutions; and building predictive and prescriptive operating environments to support smarter, safer and more sustainable mining.

"DataDrive'31 is at the forefront of the technological transformation of the mining industry," said Mats Eriksson, president of mining at Sandvik. "Business Finland's support accelerates our planned R&D work in key technology areas and strengthens our competitiveness in global markets. ■

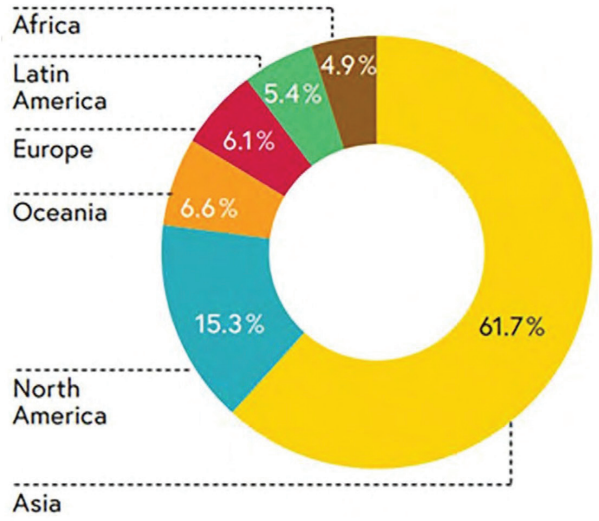
Inclusive mining for sustainable development: Promoting diversity and inclusion through corporate volunteering and the SDGs

by Mónica Campos, María Fe Campos and José Mujica

The extraction and processing of metals and other minerals have played an important role in economic, political and social development worldwide, from the early stages of prehistory to the present day (Gosner, 2020). Mining has been a fundamental part of human civilization, providing the raw materials necessary for technological, infrastructure and industrial advances. As society progresses, the importance of mining continues to grow, supporting the development of everything from the smallest electronic devices to the tallest skyscrapers (Escamilla, 2024). The economy of a nation is connected to its extractive industries (Moreira and McMahon, 2014), which have seen dramatic growth in recent years (Pietrobelli et al., 2018).

Figure 1

Total mining production, 2022, by continents.



In a context of increasing demand for natural resources, driven by the development of emerging technologies, the expansion of infrastructure and the foundation of engineering achievements for the coming decades (Minerals Education Coalition, 2024), mining should focus efforts on global development, requiring a comprehensive approach to sustainability that addresses the planet's needs and protects the well-being, primarily, of the communities and environments where mining operations take place (Figari, 2024). In these areas, diversity and inclusion should be promoted, thus fostering equitable and sustainable development.

The sustainable development goals (SDGs), also known as the global goals, could serve as a key framework for fostering a strong social management culture in mining. The SDGs were adopted by the United Nations (UN) in 2015 as a universal call to end poverty, protect the planet, and ensure that all people enjoy peace and prosperity by 2030 (United Nations Development Programme, n.d.).

Companies have compelling reasons to align their actions with the SDGs, as their long-term success depends on healthy communities. This is a major challenge that requires collaborative efforts (Singh and Rahman, 2021). As Fraser (2021) mentions, achieving more sustainable outcomes may involve mining companies and communities working together collaboratively.

This article proposes an innovative approach: Inclusive mining for sustainable development, which aims not only to maximize economic profitability but also to promote social and environmental well-being by integrating the UN's SDGs, primar)ily focused on diversity and inclusion. This can be achieved through the implementation of a key value-added initiative for mining companies: the creation and operation of a corporate volunteering program aimed at developing and executing inclusive practices to promote gender equality, the inclusion of local communities and indigenous peoples, and accessibility for people with disabilities.

This proposal will educate employees and stakeholders about sustainability and promote concrete actions through corporate volunteering to strengthen the mining company's commitment to community development, improve social relations and advance toward achieving the UN's SDGs, establishing the company as a global change agent.

Mónica Campos, María Fe Campos and José Mujica, members SME, are mining engineer and ESH analyst at Bechtel Mining & Metals, Cajamarca, Peru, graduate assistant at South Dakota School of Mines and Technology, Rapid City, SD, and business administration student at Universidad Nacional de Cajamarca, Cajamarca, Peru, respectively, email mcamposc23_2@unc.edu.pe.

Development

Global mining. The mining industry extracts valuable minerals and metals from the Earth, which are essential to produce a wide range of products. For example, iron ore is a key component of steel, which is widely used in construction and manufacturing. Copper is vital for electrical wiring due to its high conductivity. Rare earth elements are crucial for producing high-tech devices such as smartphones, computers and renewable energy technologies like wind turbines and electric vehicles (Escamilla, 2024). Without mining, the availability of these essential materials would be severely limited, stifling technological and industrial progress. As Mashford (2022) states, our daily lives depend on minerals and metals. We need them for almost every component of our modern world, as well as for the world we are building.

Statistical studies by the Austrian Federal Ministry of Finance in its publication *World Mining Data* (2024) detail global mineral production percentages by continent, highlighting that minerals are the backbone of the economy.

Mining is indispensable for the modern world. Magnus Brunner, Austria's Minister of Finance, emphasizes that the industry provides the raw materials necessary for technological innovation, economic growth, infrastructure development and energy production. As we continue to progress and strive for sustainability, the mining industry must also evolve, adopting practices that are more environmentally friendly and considerate of the communities that host mining operations. This is why, in a world where sustainability and inclusion are global imperatives, the mining industry plays a crucial role in economic and social development worldwide (International Institute for Sustainable Development, 2024).

Corporate social responsibility. Interest in sustainability and corporate social responsibility has become an increasingly prominent issue in many countries and industries, with none more so than the mining industry (Jenkins and Yakovleva, 2006). The concept of sustainable development is based on three dimensions: (1) economic development, (2) environmental protection and (3) social inclusion (National Geographic Spain, 2024). Therefore, corporate social responsibility (CSR) is a key aspect in the mining sector, as it involves the commitment to operate in ways that benefit both the environment and local communities, aiming to minimize environmental impact, respect local cultures and traditions,

Figure 2

Sustainable development goals (United Nations, 2024).

and foster economic development in those communities. Now, in addition to considering performance and maximizing profits, miners must also think about their environmental footprint, community acceptance and workforce inclusion (Mashford, 2022).

Mining as an ally to achieve the SDGs. The goal of the 17 SDGs, part of the UN's 2030 agenda, is to achieve equitable economic development, inclusive from a social perspective and sustainable from an environmental standpoint (International Institute for Sustainable Development, 2024). These goals provide a common framework to analyze the most urgent economic, social and environmental

Figure 3

Overall progress across targets based on 2015–2024 global aggregate data (United Nations, 2024).

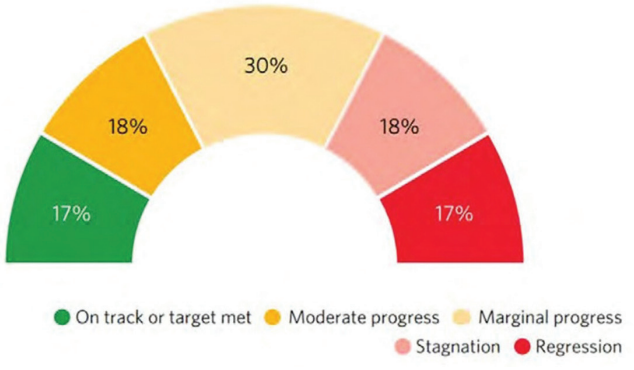
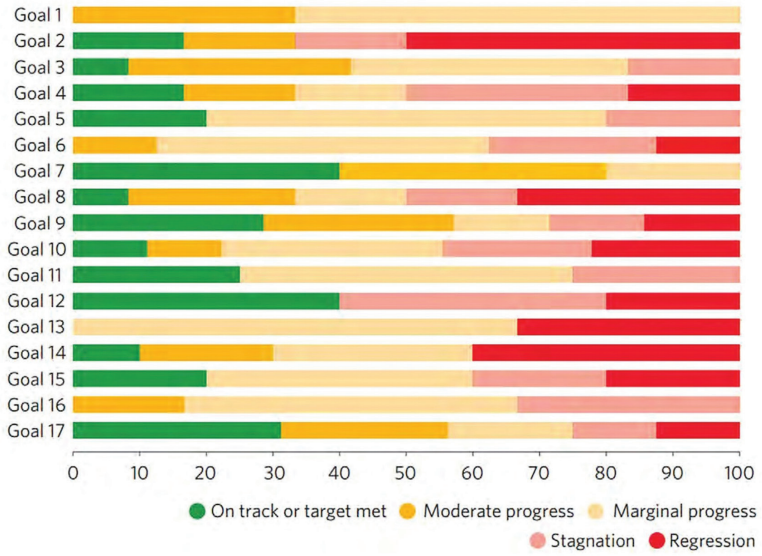


Figure 4

Progress assessment for the 17 goals based on assessed targets, by goal (percentage) (United Nations, 2024).



challenges of the present generation, including the respective roles that all agents of society play in achieving sustainable development (Dlouhá et al., 2022). The mining industry is a key player in achieving the SDGs.

One key reason for the mining sector's role in working toward the SDGs lies in the fact that long-term profitability depends on healthy communities. However, George et al. (2016) suggest that companies alone cannot address the "grand challenges" encompassed by the SDGs, noting that these goals require a collective, collaborative and coordinated effort.

In May 2024, the UN presented "The Sustainable Development Goals Report 2024," which provides a comprehensive overview of the world's progress nine years into the journey to 2030. Using the latest available data, the report highlights both successes and challenges as the international community strives to fully realize the ambitions and principles of the 2030 Agenda for Sustainable Development (United Nations, 2024). This annual SDG report is prepared by the UN Department of Economic and Social Affairs in collaboration with the UN statistical system, consisting of more than 50 international and regional agencies, based on data from more than 200 countries and territories.

The assessment of progress reveals that the world is far from achieving the 2030 agenda, as only 17 percent of the goals are progressing as expected to be achieved by 2030.

This research focuses on SDGs 5, 8, 10 and 16, which are essential for promoting inclusion, diversity and the strengthening of solid institutions. The UN report reveals that, globally, the first three goals (5, 8, and 10) show progress toward the targets set for 2030, with a maximum of 25 percent advancement. The fourth goal (16) shows marginal progress, exceeding 60 percent, but is still far from the level expected by the UN.

Mining plays a key role as a responsible agent in collaborating with the SDGs, contributing to improving performance indicators and the achievement of these objectives. Additionally, it serves as a strategic guide for social investment in the mining sector and the implementation of programs that promote human rights, inclusion and diversity in the local communities hosting mining operations (World Bank, 2024).

This approach includes specific initiatives aimed at strengthening community participation, ensuring that mining activities contribute sustainably to local social and economic development. By aligning with the SDGs, the industry not only fosters positive social impacts but also ensures that its operations are integrated into the broader framework of sustainable development, emphasizing the importance of respecting human rights and the well-being of local populations. In this way, the mining industry will not only generate positive impacts on communities, improving their quality of life and opportunities, but also strengthen its role as an agent of global change.

Value proposition: Corporate volunteering

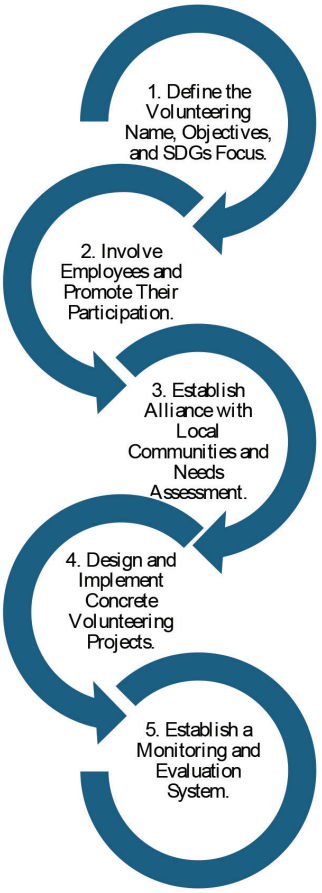
The key value proposition of this project lies in the creation and operation of a corporate volunteering program focused on the SDGs, especially goals 5, 8, 10 and 16. The volunteering program will aim to develop and implement inclusive practices to promote gender equality, the inclusion of local communities and indigenous peoples, and accessibility for people with disabilities. This program will not only raise awareness and educate employees on the importance of sustainability, but it will also enable them to contribute directly to the development of local communities and the achievement of the SDGs.

Therefore, the following steps are proposed for the creation of the volunteering program, which will involve the participation of mining employees as volunteers, the integration of the SDGs, collaboration with communities, and the monitoring of achievements.

Operation. The volunteering program would operate through a system structured by the mining company, where employees have the opportunity to engage in projects designed to contribute to sustainability, improve the quality of life in local communities and promote diversity and inclusion. Volunteers could work directly with communities, participating in

Figure 5

Steps for creating a corporate volunteering program in mining companies.



teaching technical skills, promoting gender equality, facilitating access to job opportunities, or engaging in activities that promote social cohesion and peaceful conflict resolution.

Impacts of creating corporate volunteering in mining companies

- Economic impact: Improved operational efficiency and competitiveness of the mining company through sustainable practices.
- Social impact: Promotion of gender equality, inclusion and empowerment of vulnerable groups. It also impacts social acceptance by demonstrating the company's commitment to the well-being of local communities.
- Environmental impact: Promoting sustainability and environmental awareness in mining operations and within the community.
- Impact on governance and justice: Strengthening civic participation, social justice and local institutions.

Some success stories of mining companies contributing to sustainable development

Figure 6

Project initiatives according to the selected SDGs.

BHP Foundation. The BHP Foundation is a charitable organization funded by BHP that works to address some of the world's most critical sustainable development challenges. Key areas of focus include empowering indigenous peoples as stewards of lands and seas that contain 80 percent of the world's remaining biodiversity; eliminating corruption and poor governance of natural resources, which consign more than 1 billion people to poverty; and harnessing the potential of young people by enabling access to quality education to unlock their potential and improve their life choices (BHP, 2024).

Rio Tinto Indigenous Leadership Development Program. This program supports indigenous employees in accelerating their

transition to higher roles within the company and bridging any development gaps. The program can include access to one of their university partnerships to fast-track tailored learning, helping employees secure qualifications for their next role, or placements in other roles or operations to develop core business and leadership skills (Rio Tinto, 2024).

Newmont-IUCN Biodiversity Net Gain Review Protocol. This protocol aims to help transform Newmont's operations to meet the objectives of achieving "no net loss" in key biodiversity values and generating net gains where possible, thus contributing to sustainable development (Newmont, 2023).

Conclusions

By adopting inclusive mining for sustainable development, and establishing a corporate volunteering program focused on the SDGs, companies will not only meet international sustainability standards but also become a leader in positive transformation within the mining industry. Through these initiatives, a future is envisioned where mining is not only profitable but also a driving force for positive change for present and future generations.

Socially, this volunteering program will generate employment opportunities and professional development for groups that have historically faced difficulties accessing well-paid and stable jobs. Moreover, it will promote gender equity and equal opportunities by encouraging the participation of women in roles traditionally dominated by men. This contributes to poverty reduction and the improvement of the quality of life for these communities.

Corporate volunteering will provide employees with the opportunity to actively engage in projects that not only promote solidarity and teamwork but also strengthen the commitment to more sustainable mining practices. This program will not be managed by a single department; rather, it will be open to everyone, allowing each employee to become an agent of change and contribute their time and effort to the development of the communities where the company operates. It will be a way to create a positive impact both within and outside the company.

Mining, accustomed to operating in complex contexts, has the capacity to strategically contribute to the SDGs. If communities can work with mining companies to identify intersections between the needs of the regions hosting mining operations and the company's own needs, there may be opportunities for mutual benefit. Communities can access the financial resources, influence and technical expertise of the mining sector to advance important sustainable development priorities that are difficult to finance or execute on their own, while mining companies can mitigate operational and social risks. ■

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USGS presents detailed, national-scale geologic map

by Carrie Smith, Associate Editor

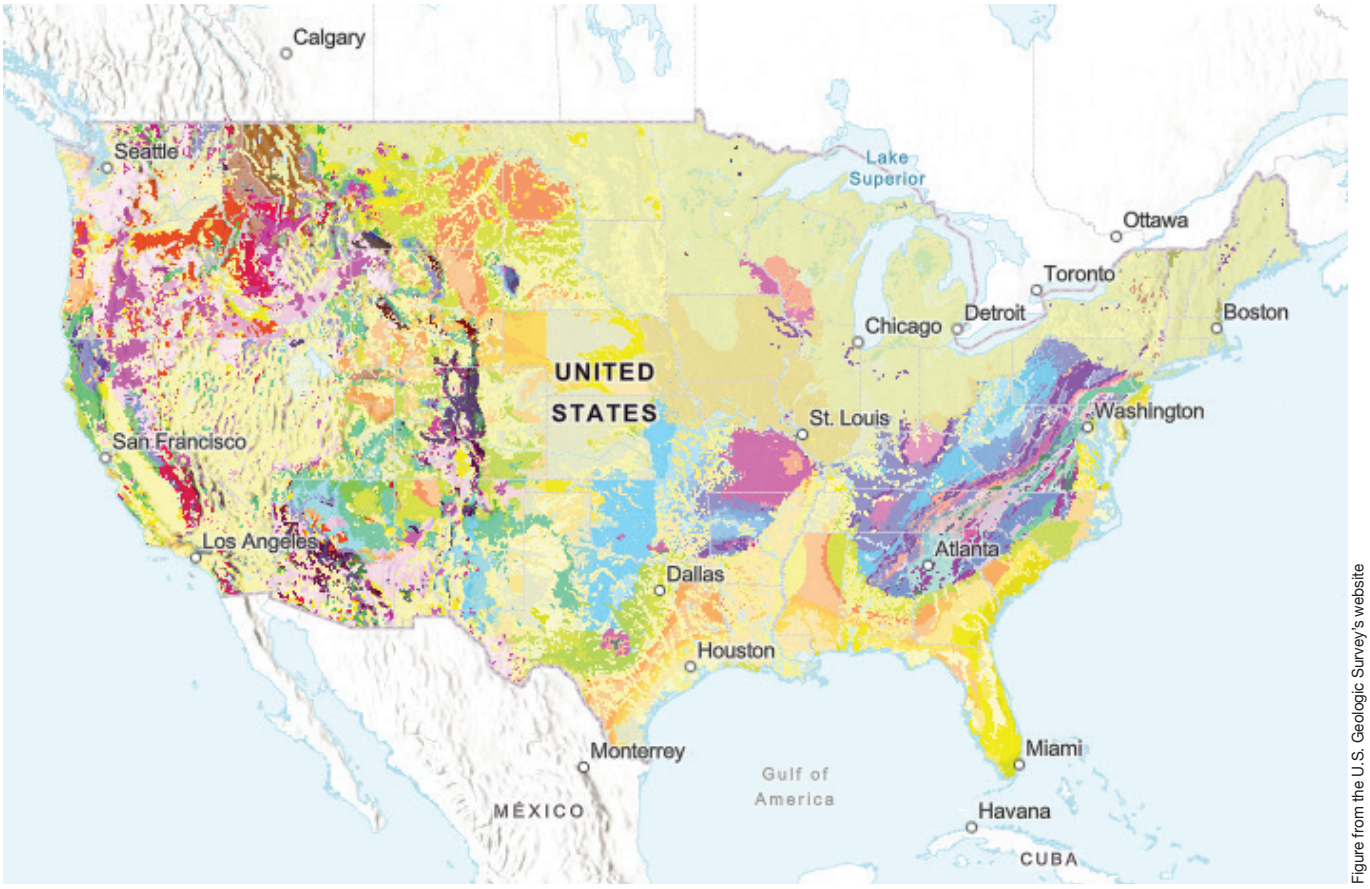


Figure from the U.S. Geologic Survey's website

The Cooperative National Geologic Map is a culmination of more than a century of collaborative mapping between the U.S. Geologic Survey and the nation's state geological surveys.

In a major milestone for geoscience, the U.S. Geological Survey (USGS) has unveiled the Cooperative National Geologic Map, the most detailed national-scale geologic map of the country to date. The project offers a fresh, layered look at the rocks and sediments that make up the United States. For geologists, engineers and mining professionals, it provides both a technical achievement and a practical tool that will help shape future exploration and land-use decisions across the country.

The new map provides a regional view of geology both on and beneath the Earth's surface. Using different colors to represent rock types and sediments, it allows users to toggle through multiple layers, revealing for the first time the surficial and quaternary deposits that lie above the bedrock.

"This is the first national map to include multiple layers of mapped geology, the first built to be easily updated as new maps are published, and the first to be delivered in a user-friendly online interface," said Joseph Colgan, a USGS research geologist who led the development team.

The Cooperative National Geologic Map is a culmination of more than a century of collaborative mapping between the USGS and the nation's state geological surveys. More than 100 existing maps produced by state geological surveys and the USGS over the past 40 to 50 years were combined and standardized to create the national data set. During its three-year creation, the USGS prepared digital data, built the system to bring the maps together, developed the web interface and underwent a review and approval process. Through this process, decades of fieldwork, analysis and digital cartography were brought together to provide both national and local expertise.

"This map … showcases the importance of state-USGS collaboration to accomplishing the geologic mapping of the nation," said Gale

Blackmer, state geologist of Pennsylvania and chair of the Association of American State Geologists (AASG) Mapping Committee.

The interactive map, accessible through the USGS's National Geologic Map Database, was designed to be user-friendly and accessible to both specialists and nonspecialists. With a few clicks, users can explore rock types, formations and their ages across any part of the country and then dive deeper into linked state or regional maps for finer detail.

An intuitive resource for the public

"The map was created to provide analysis-ready geologic map data nationwide for anyone who needs it," said Colgan. "The USGS and other federal agencies routinely use such data, but they are often difficult to access for nonspecialists."

This gives students, land planners, engineers and members of the public the same access to information once confined to technical experts. By making geologic data truly open and intuitive, the USGS hopes to spark greater public engagement and a broader understanding of how geology shapes our everyday lives.

For the mining and mineral industries, the new map opens wide-ranging possibilities. One of the most significant improvements over previous national efforts is the map's layered approach.

"Previous national maps showed the geology underneath extensive glacial till in the Midwest and Northeast, while the layered approach in the new map honors mapping of both the surficial and bedrock geology in this region," said Sam Johnstone, a USGS research geologist and lead developer for the mapping project.

Now, users can see how surface materials, such as glacial deposits, interact with older rock formations beneath. This is particularly valuable for mining, groundwater modeling and infrastructure planning because it provides a fuller understanding of subsurface conditions. This baseline view is valuable for reconnaissance across wide areas, assessing entire belts or compiling portfolios of target regions.

"This map puts basic information about geology everywhere in the U.S. at your fingertips, at a bird's-eye view appropriate for broad areas or a quick overview of specific locales," Johnstone said.

Due to this, more informed early-stage screening, quicker initial modeling and the ability to triage capital deployment more intelligently is possible. The new map helps reduce "blind walks" across terrain by highlighting areas of geologic promise and flagging zones of structural complexity, deep cover or potential discontinuities. Because the layers include surficial, quaternary and deeper bedrock units, users can also consider cover thickness, regolith stratigraphy and depositional systems that may affect drilling, logistics or geochemical pathways.

For exploration geologists, that accessibility means faster regional assessments and easier identification of areas with potential for mineralization. The ability to layer surface and subsurface data allows users to see structural features or rock types that might host critical minerals such as lithium, nickel or rare earth elements.

"We've provided this both in the web application and in streaming services, for quick access to geology anywhere," said Johnstone. "The application also points the way through the National Geologic Map Database to detailed mapping by state geological surveys and the USGS that is more useful for site-specific applications."

With this function, users can start broad and then drill into state- or project-scale detail without entirely leaving the national framework. This combination of national-scale context and local detail could help companies refine exploration targets and reduce costs associated with preliminary surveying.

The benefits extend beyond resource exploration. According to Christopher Swezey, coordinator of the USGS's National Cooperative Geologic Mapping Program, geologic maps play an essential role in understanding and managing the physical landscape.

"Geologic maps have many uses, such as helping experts look for energy, mineral and water resources," Swezey said. "They can also be used to assess earthquake risks and inform decisions about land use, infrastructure and community planning, and real estate and insurance."

These implications reach multiple sectors, from transportation and construction to environmental protection. Geologic data can help planners avoid landslide-prone slopes, identify aquifers and even estimate the potential impact of natural disasters. A recent cost-benefit study cited by USGS found that the value of geologic maps can be up to 10 times greater than the cost of producing them.

Faster mapping initiative

Now, with the creation of this new mapping procedure combining automation and data standardization, future national-scale mapping efforts will be accelerated.

"Although earlier national maps provided a consistent, 'seamless' representation of the

nation's geology, they required years of manual interpretation that were not feasible to replicate whenever new discoveries were made," said Johnstone. "Our process-driven approach retains discrepancies between source maps but enables rapid refreshes as new information is available."

Because of this process, the new map is remarkably efficient and stays relevant for its users. While past national maps took decades to complete, this one was built in just three years thanks to a semiautomated digital workflow that merges state and federal data. This speed is not just a matter of convenience, it ensures that new discoveries, corrections or updates can be integrated quickly.

"Now that this process is in place, the map can be rebuilt very quickly as state geologic surveys and the USGS contribute new geologic maps," said Johnstone. "New statewide geologic maps have already been published since this data set went to review, and more actively in production."

The USGS has already begun preparing an update that will include Alaska, Hawaii and U.S. territories to represent the full scope of U.S. geology. Though making significant progress, they do not have an exact timeline yet for when it will be released.

Once those additions are complete, the Cooperative National Geologic Map will serve as a comprehensive, evolving archive of the nation's geological framework. Its digital infrastructure means new state maps or discoveries can be seamlessly integrated, keeping the national data set current for years to come.

"We hope people see this map and appreciate how much mapping has been done by states and the USGS to understand the geology of the United States, as well as seeing the mismatches between those maps and realizing how much work remains to be done," said Colgan. "We hope they explore the different layers to appreciate how different geology is across the country." ■

What students are seeking

in a degree program and in their future careers, and what that means for attracting new talent

by Jodi Banta

In an effort to reverse the trend of declining enrollments to mining engineering programs that began in 2015, the University of Arizona has implemented a number of interventions over the past five years, including ramping up its pre-college mining education and outreach, and undertaking several enrollment research projects.

This article is the second of two installments to discuss the results of our latest study. The first part can be found in the September 2025 issue of *Mining Engineering* magazine.

Figure 1

Most popular STEM majors.

Top five majors	%	Top five engineering majors	%
Biology	24	Aerospace	12
Medicine or health science	21	Mining	11
Computer science	19	Architectural	10
Aerospace engineering	12	Biomedical	9
Mining engineering	11	Computer	9

To better understand mining's competitive position, the School of Mining Engineering and Mineral Resources conducted a comprehensive study to determine:

1. How prospective college students, parents and educators perceive the industry, related careers and the mining engineering degree.
2. Factors affecting students' choices of degrees and career plans.
3. The roles parents and educators play and how they influence students.

Study parameters

The nationwide survey, conducted online in December 2024, builds on previous University of Arizona studies and investigations at other universities. Respondents, predominately from the western states, included 566 students primarily between the ages of 13 and 21 aiming to pursue a four-year STEM (science, technology, engineering and mathematics) degree; 361 parents of the same; and 474 teachers and counselors. Most students were planning to enroll in degree programs in fall 2025. A second phase of the research includes focus groups with high school and community college students considering four-year STEM degrees, previous University of Arizona first-year engineering students who have (1) never considered mining engineering, (2) considered but did not choose mining engineering and (3) chose mining engineering. Focus groups were completed in April and September 2025.

This installment focuses on what students are seeking in their degrees and careers, and how mining stacks up against other degrees and industries.

Value and security are driving decisions

Students are looking for a good deal, and a sure thing. Whether choosing a major or career, value and security are key factors for making it into a student's consideration set. According to many recent studies — and even reflected in Nike's new tagline "Why do it?" — this younger generation is risk averse when it comes to the possibility of mistakes and failure.

In our study, this is evident in students' prioritization of factors affecting degree and career choice. Feeling secure about their decision to invest in higher education and in choice of degree is important to them, as the perceived cost of mistakes is very high.

Choosing a major

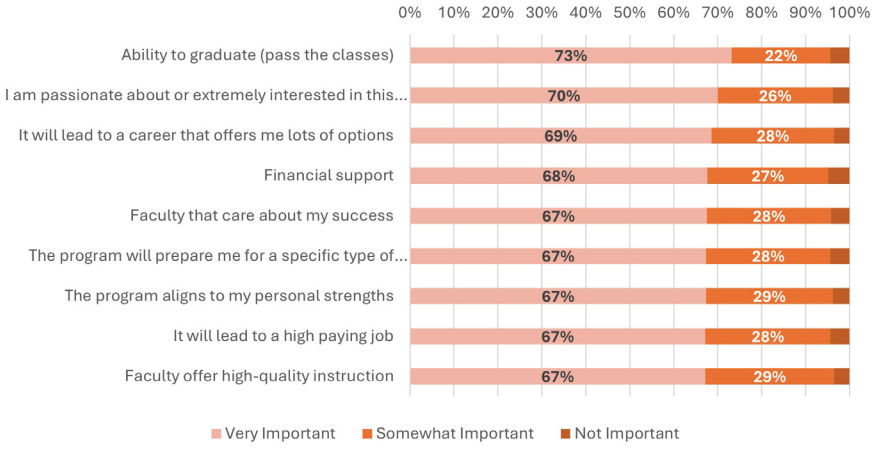
They start young. The nationwide push for college and career-readiness programs starting in kindergarten has led to an increase in students thinking about college majors at younger ages. Nearly 30 percent of students were thinking about possible majors before they got to high school, with 10 percent already thinking about it in elementary school. Eighty-six percent felt at least knowledgeable about their degree options.

Our survey found that 11 percent of students reported considering mining engineering as a major. That may not sound very high, but it was the fifth most popular major choice. There is simply a lot of choice out there.

Jodi Banta, member SME, is program manager at the School of Mining Engineering & Mineral Resources, The University of Arizona, Tucson, AZ, email: jhbanta@arizona.edu.

Figure 2

Top five factors in choice of major or degree program (including five tied for fifth place).



Top five factors for choice of major

Ability to graduate. Concerns over the cost of higher education and the student debt crisis, as well as widespread mental health challenges with GenZ have caused prospective students to carefully consider outcomes, and their ability to achieve them. They hesitate to invest the time or money in pursuing a degree without a clear and promising path to graduation, and with good reason: in a recent study, the Gallup-Lumina Foundation (2025) found that 25 percent of students currently enrolled in four-year degree programs have considered "stopping-out" (withdrawing temporarily). Top reasons cited include emotional stress (49 percent), mental health (41 percent), cost of the program (24 percent), did not feel like they belonged (24 percent), and coursework too difficult (20 percent). Of students that actually stopped-out, cost of program was the top reason (32 percent).

In our study, 21 percent of students identified mining engineering as the best major for "ability to graduate."

Interest in the subject. This has been a primary driver of choice of major since we started measuring in the fall of 2020. According to a study of middle and high school students conducted by Curtin University Western Australia School of Mines (2023), this is a strategy students use to reduce the chance of choosing the wrong career path — students feel they are more likely to enjoy their career if it is related to their interests.

An ongoing study of freshmen engineering students by the University of Arizona (2021) established a strong correlation between knowledge of a subject and interest in it — students tend not to be interested in subjects they know nothing about. And while public awareness of mining and minerals appears to be increasing, knowing that mining is important and that it is the process by which society obtains the mineral resources it requires is not the same as knowing what a mining engineer does, or even what happens at a mine. These remain largely a mystery to the public, and this lack of knowledge affects interest.

In our study, only 10 percent of students identified mining engineering as the best major for "interest in the subject." In contrast to students' lack of interest, 56 percent of educators think mining engineering is more interesting than other majors. Often cited in our interactions with educators — particularly science teachers — is the wide range of science applied in mining.

It will lead to a career with a lot of options. Related to the above, students may fear that after investing so much time and money in a degree, they may not like their job or they might get bored after a while. They do not want to feel stuck. Locking themselves into a lifelong career choice at this age is risky. A degree that is relevant for a variety of roles is a safer bet. In our study, 14 percent of students identified mining engineering as the best major for "it will lead to a career with a lot of options."

Financial support. Return on investment (ROI) is critical right now. Students are comparing the cost and advantages of institutions and majors, and choosing based on value for money. They are aggressively seeking and evaluating scholarships and financial aid. This is some of the most sought-after content with respect to degrees and impact on career success (such as placement, salary). In our study, 25 percent of students identified mining engineering as the best major for "financial support."

Five factors tied for fifth place. All of them align with the ability to graduate, career success, or both. Details can be found in Fig. 2.

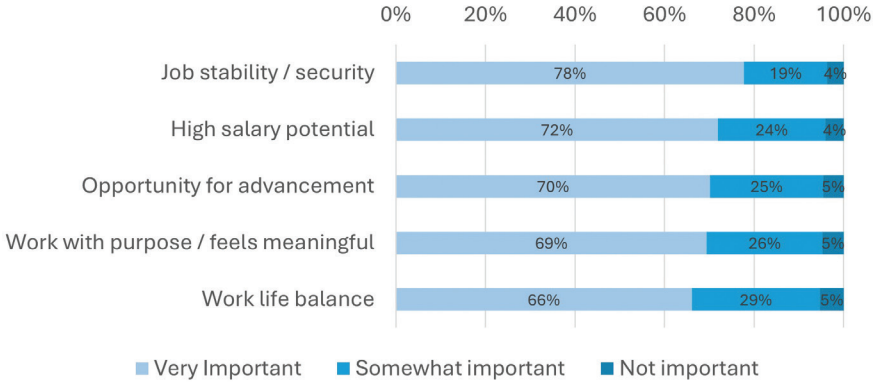
What would make students change their minds to mining engineering?

When asked to choose the single most important factor for convincing them to change their minds to mining engineering, three factors stood out.

Interest in the subject (20 percent). Considering how critical interest is, and how

Figure 3

Top five factors for choice of career.



low mining ranks on interest when compared to other degrees in this survey as well as year after year in the University of Arizona's freshmen engineering survey, this needs a lot of attention. Students have very little knowledge of what mining involves. If they knew, many of them would realize it aligns with their interests.

It will lead to a high-paying job (20 percent). While noted as important, mining is already relatively well associated with high-paying jobs, and many students remark that all engineering jobs are typically well paid. It is a hygiene factor. So, it always needs to be mentioned, but the actual salaries available may not make it significantly more competitive than other degrees.

Financial support (11 percent). Fifty-five percent of students said they would consider switching to mining engineering if they could get a scholarship that they otherwise would not receive. Considering the significance of ROI in decision-making, and the abundance of scholarships available for mining studies, this has significant potential. Scholarships should be highlighted at every opportunity.

Sources of information

When it comes to finding information on degree programs, top sources of information are no surprise.

College websites (59 percent). Students rely heavily on college websites for information on degree programs, requirements, courses, benefits (outcomes), costs, financial aid and other student support. They also look for information on "what it's like" to be a student in that program. While students are thinking about their future careers, when choosing a major some of the questions that are on their minds are more immediate — What will their college experience be like? What kind of support does the program offer to help them succeed? The vast majority of students will visit college websites as part of their research and selection process.

Teachers (43 percent). Teachers are among the most consulted and most trusted resources about degrees and education pathways. Teachers know what their students' interests and strengths are (and are not), and students value this insight. Unfortunately, by their own admission teachers are not always well informed of degree options, requirements and application processes.

Guidance counselors (38 percent). Guidance counselors are still consulted by students when it comes to what is next for them. These are the designated experts. But, also by their own admission, guidance counselors are not always well informed of degree and career options.

Parents (31 percent). Parents can be a useful source of information, especially in the case where a student is interested in the same career and/or degree as their parent, and/or the same school.

YouTube (29 percent). Students often consult YouTube to see what it is like to do something, including particular jobs. In focus groups, "day in the life of" videos were cited as very popular, as well as useful. Students did say the videos need to be entertaining and were open to both short and long formats.

Choosing a career

When it comes to GenZ, "purpose and pay" have been cited as drivers for the past several years. Pay has been rising above purpose for some time now, and recent findings confirm that the balance has tipped. "Pay" does not necessarily mean students are motivated by material success — rather, they may simply be more concerned about their ability to earn a living wage. GenZ witnessed the financial uncertainty introduced by the COVID-19 pandemic, and then rapid and significant inflation quickly placed things once taken for granted out of reach. In such circumstances, a career that offers financial security and a base level of comfort is a must, with a job that offers purpose still important. In bad financial times, the latter is a luxury.

But how much are they thinking about their career versus college experience at the point in

time when they are choosing a major? According to Gallup-Lumina Foundation's "The State of Higher Education 2025" report, "expected future job opportunities" is the primary motivator for deciding to go to college in the first place. Our own research found that 58 percent of students know what career they want to pursue before they apply for college. So, their awareness of, and impression of careers matters early on and can impact their choice of major.

Top five factors for career choice

Job stability/security. Seventy-eight percent of students identified job security as very important — a full five points higher than the next selection. Whenever "security" is the leading factor in decision-making, it points to decisions being driven by necessity rather than desire. Fear and insecurity are present, and as a result, decisions are driven by needs nearer to the base of Maslow's Hierarchy of Needs (Fig. 4). Ten percent of students identified mining as the best industry for job security. Students confirmed that when a field is perceived to be growing or there is high demand, this equates to perceived job security.

High salary potential. High salary does double duty, providing both security as well as the potential for luxury and better quality of life. Mining engineering specifically is generally associated with good salaries. Ten percent of students identified mining as the best industry for high salary potential.

Opportunity for advancement. Mining's weakest performance was on opportunities for advancement, with only 6 percent of students selecting mining as the best industry for this. A global study by BDO in 2022 had a similar finding, with career advancement perceived as poor and among the industry's worst-performing attributes.

Work with purpose/feels meaningful. Purpose still matters, but it has been relatively deprioritized. A career that offers all of the above plus purpose is likely to be more competitive.

Work-life balance. Again, this is still important, but deprioritized. This used to feature very prominently in career research, but right now for our study population it is more of a perk than a requirement. As with purpose, any opportunity to demonstrate good work-life balance can help with competitiveness.

Figure 4

Maslow's Hierarchy of Needs (Image source: SimplyPsychology.org).

Ideal work environment

When asked about ideal work environment, a few things stand out. On a positive note, students want to travel a lot and work in person. However, they prefer to work indoors and would like the ability to live where they want — they value choice. They also want to work in an environment that embraces new perspectives. If students perceive mining as an industry that prizes tradition or is reluctant to change, that may be problematic. Being viewed as modern or innovative is about more than technology — it is about culture as well.

On the issue of work location, 41 percent

Figure 5

Industry comparison on key attributes.

When asked, which industry offers the best opportunity for "X", Mining is chosen 10% of the time for 2 of 3 top attributes. Students do not see Mining as a good choice for "Opportunities for Advancement."

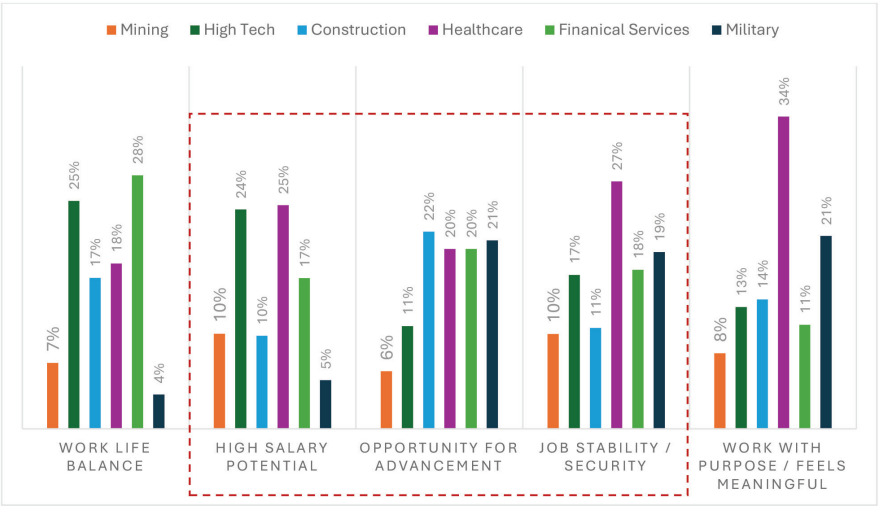


Figure 6

Ideal work environment.

Which do you prefer when you think about how to spend your day-to-day at work?			
Working inside	67%	33%	Working outside
High physical activity	49%	51%	Low physical activity
Desk/computer job	55%	45%	Tools/machinery job
Work with lots of people	66%	34%	Work alone
Urban environment	59%	41%	Rural or suburban environment
I want to travel a lot	67%	33%	I don't want to travel a lot
A job that requires me to live in a specific location	29%	71%	A job where I can live and/or work where I want
In person	72%	28%	Remote
Generally do the same tasks each day	44%	56%	Do different tasks each day
Follow instructions or procedures	44%	56%	Solve new problems or challenges
A job that embraces new perspectives	75%	25%	A job that values tradition

indicated preferring a rural or suburban environment — not everyone wants to live in a big city. But just how rural or remote is unclear. Certainly, questions about location exist. In a recent question-and-answer session about mining engineering with hundreds of University of Arizona engineering freshmen, work location was a top hot topic. Considerations included working indoors versus outdoors; do they have to go into the mine versus do they get to go into the mine; even, do they have to live at the mine site; what states have jobs; what countries have jobs; are there opportunities for remote (virtual) work, and so on.

It is important to be ready with answers to as many of these questions as possible, as uncertainty on its own can contribute to the elimination of mining from a student's consideration set. Careers and degrees that offer greater certainty are a safer choice. The fact that mining and mining engineering are not well understood on so many fronts is a distinct disadvantage.

Key takeaways

1. Students are thinking about future degrees and careers very early on. Their initial ideas will be shaped by parents, teachers and the subjects they find interesting in school. Introducing students to mining topics before they get to college is critical to filling the mining talent pipeline.
2. Building interest in mining is essential. Interest instigates exploration into degree and career options, it also mitigates fear of both not being able to pass classes (graduate) and not liking their future career — making mining a safer choice.
3. When considering a major, students are looking for value for money and solid fundamentals — a high probability of graduating with the lowest possible investment and dependable outcomes (like job placement). They want a degree they are confident will position them for career success without getting mired in debt or restricting options.
4. When it comes to choosing a career, financial drivers come first. Students are worried about financial security. Security is more than just keeping a job — students are witnessing a time of high inflation, where financial security can also be compromised by stagnant pay. So high salary potential and opportunity for advancement can be as much about keeping up as getting ahead.
5. Opportunity for advancement is an important factor in career choice, and the mining industry rates poorly on this attribute compared to other industries. Improving communication and transparency around career progression and potential is important. Equally important is GenZ's lived experience working in this sector, as they are sure to share it.
6. It is important to demystify mining to derisk it as a choice. A generation described by many experts as "anxious" will seek to minimize uncertainty. Uncertainty on its own can contribute to the elimination of mining from a student's consideration set. Careers and degrees that offer greater certainty are a safer choice. ■

(A copy of the survey questionnaire/report is available from the author.)

Acknowledgments

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An observation on similarities

and differences between Canadian and US mining industries and academia

by Vladislav Kecojevic

Both Canada and the United States are endowed with significant reserves of mineral resources. Mining industries in these two countries have a strong safety and health culture; skilled, dedicated and well-paid workforce; applications of state-of-the art technologies and high productivity, strict environmental requirements and social responsibility. Both countries are global leaders in safe, economic, productive, environmentally responsible and sustainable mining practices. Mining schools/departments in Canada and the United States provide a strong and comprehensive education and training, hands-on learning experience, with support for internships and co-op opportunities to prepare graduates for careers not only nationally but also in the global mining industry.

While there are many similarities in their industries and mining schools, there are also some differences. This article examines the contribution of mining to the economy, the political climate, the regulatory framework, the investment climate, environmental regulations, the language, the perception of mining, news and press coverage, and the academic landscape in both countries. Opinions, observations and perspectives shared in this article are of the author, and do not necessarily reflect the views, policies or positions of any organization, employer or affiliated group.

Contribution to economy

The direct contribution of Canada's minerals and metals sector to total gross domestic product (GDP) was 4 percent in 2023, while the broader mining, quarrying, and oil and natural-gas extraction sector contributed 7.8 percent of Canada's GDP (Natural Resources of Canada, 2025). Mining in the United States contributed to 1.3 percent of total GDP (U.S. Bureau of Labor Statistics, 2025). The total GDP in Canada was US$2.17 trillion in 2023 (World Bank, 2025), while the total GDP in the United States was $27.72 trillion in the same year (World Bank, 2025).

In Canada, there is a heavy focus on the mining of metals, nonmetals and oil sands. Coal is insignificant in Canada, with only 19 active coal mines, mostly in western Canada (*Canadian Mining Journal*, 2025), while there were 560 coal mines across the entire United States in 2023 (U.S. Energy Information Administration, 2025). Metal mining in the United States is mostly conducted in western United States with Arizona, Nevada, Utah and Alaska as leading metal producers. There is a notable difference in the scale of aggregate mining (stone, sand and gravel) between the United States and Canada. While Canadian quarries tend to be small to medium-sized, many in the United States are massive, rivaling the scale of large metal mines. The Thornton Quarry in Thornton, IL, is a prime example. This immense operation is one of the world's largest aggregate quarries, measuring 2.4 km (1.5 mile) long, 0.80 km (0.5 mile) wide, and reaching a depth of 140 m (500 ft). The United States had almost 10,000 aggregates operations in 2013 (U.S. Geological Survey, 2025), while Canada had 6,500 aggregates mines (Natural Resources Canada, 2025).

Political climate

Political leadership, no matter liberal or conservative, has been very supportive to mining in Canada, while with the Democratic administration in Washington, DC, the mining industry has faced many challenges (particularly coal mining). It is encouraging to see stronger support for mining industry with a new administration in Washington, DC.

The political climate could be relative to the economic influence: that is, the importance of the industry to the state in the United States, or province and territory in Canada. One may argue that even within Ontario, mining is very important to Northern Ontario but less so to the metropolitan centres of Southern Ontario, where the industry has less impact. An overview of the mineral production by each state in the United States is given by the U.S. Geological Survey while Canadian mineral production, by province and territory, is summarized by the Natural Resources of Canada. It should be noted that the Canadian version does not include oil sands production in Alberta. To some degree, these sources show that mining is an

Vladislav Kecojevic, member SME, is professor and head, Noranda-Falconbridge Chair in Mine-Mechanical Engineering, Robert M. Buchan Department of Mining, Queen's University, Kingston, Ontario, Canada, email: v.kecojevic@queensu.ca.

important economic contributor to all provinces and territories in Canada, while this is not the case for all states within the United States. Therefore, the perception and importance may be less uniform in the United States. This may make it a more polarizing issue potentially within the United States, where it is important to some but not all states, whereas in Canada, mining as an economic interest is important to all provinces and territories.

Regulatory framework

The regulatory framework somewhat differs in these two countries, where in Canada, provincial governments primarily regulate mining, with a supportive environment for the mining industry, while in the United States there is a more complex regulatory environment with both state and federal laws. It should be noted, though, that the Canadian federal government regulates environmental impact assessments primarily under the Fisheries Act and the Impact Assessment Act, as well as all mining activities on federal and offshore lands. Key federal regulations also emphasize environmental protection, notably through the Metal and Diamond Mining Effluent Regulations. Additional oversight extends to the handling of explosives and dangerous goods, as well as international trade controls for certain strategic minerals, such as uranium. The Canadian Impact Assessment Act and provincial regulations, and Indigenous communities, are included in the assessment of the environmental impacts of mining projects (The Mining Association of Canada, 2025). The environmental regulations in the United States are covered by few federal laws: the National Environmental Policy Act (NEPA), the Clean Water Act and the Clean Air Act (U.S. Environmental Protection Agency, 2025).

In Canada, the regulation of mining safety is primarily a provincial responsibility. Each province and territory has its own set of laws, regulations and enforcement bodies that oversee the health and safety of workers in the mining industry. This decentralized approach allows for regulations to be tailored to the specific geological, environmental and operational characteristics of each region's mining sector. Conversely, in the United States, mining safety is regulated at the federal level by the U.S. Mine Safety and Health Administration (MSHA). MSHA, an agency of the U.S. Department of Labor, establishes and enforces mandatory safety and health standards for mines across the country. Its jurisdiction extends to all mining operations, regardless of the state, ensuring a uniform and consistent application of safety protocols nationwide. This federal oversight aims to provide a baseline level of protection for all miners, irrespective of their location.

Investment climate

The investment climate in the Canadian mining industry has been attractive for both domestic and international mining companies. The country maintains political stability and transparent regulatory environment, and well-established and positive mining culture (Invest in Canada, 2025). Many of the international public mining companies are listed on the Toronto Stock Exchange (TSX) and TSX Venture Exchange (TSX-V), and they attract significant investment. TSX and TSX-V are home to 43 percent of the world's public mining companies, making Canada a leading destination for international mining finance (Invest in Canada, 2025). The New York Stock Exchange (NYSE) and the Nasdaq Stock Market host significant mining companies in the United States. While the U.S. mining industry presents attractive investment opportunities, with a strong domestic market, the regulatory environment can be more challenging, with longer permitting processes (Mining and Minerals Today, 2025).

Canada has far more junior mining and exploration companies than the United States, and these are quite active worldwide. The ability to raise money is significant, ensuring Canadian banks and investment companies are very aware of mining. Canada holds the largest prospectors and exploration conference in the world, the Prospectors & Developers Association of Canada (PDAC) in Toronto, while the United States holds the largest mining exhibition show, MINExpo International in Las Vegas, NV.

Fly-in fly-out (FIFO) mines

One of the notable differences in mining industries in these two countries is that fly-in fly-out (FIFO) mines are very rare in the United States, while they are more common in Canada, particularly in the northern part of the country. The FIFO work schedule — which often consists of various rotations, for example, two weeks on and two weeks off — used to be a major hurdle for mining engineers and geologists who wanted to pursue graduate or professional degrees. However, the rise of online education has changed this. Hybrid education, also known as blended learning, combines traditional in-person instruction with digital components. This approach offers the flexibility of online resources while still including valuable face-to-face interaction, often through real-time online

sessions. Mining programs can easily adapt this blended model to accommodate the FIFO schedule. This allows working professionals to advance their education by participating in graduate or professional courses without the need for constant on-campus attendance.

According to a Canadian mining executive who spent a significant amount of time working in FIFO mines, FIFO work has resulted in a higher-quality workforce in that there are frontline miners as well as geologists, engineers and maintenance technicians across the country that have mining experience and can move between FIFO jobs without the burden of moving their lives/families. Being able to start a mine, for example, in Nunavut is not as difficult a process as it would be if one had to hire and train locally before ramping up production. Management can quickly get candidates with northern mining experience to serve as a base workforce supplemented by local hires, who then become a trained resource for other mines. For example, the Diavik diamond mine is shutting down and many northern, Inuit Indigenous people, trained employees, are available for hire as part of the larger Canadian mining FIFO workforce.

Perception of mining

The perception of mining may be different in Canada and the United States, and public acceptance of mining appears to be more favorable in the former. It could be an isolated case, and an anecdotal story, but the author can recall walking in Johnston Canyon in Alberta, Canada last year with his engraved Mining Engineering backpack, which was greeted by "how cool" and positive conversation with the people. At the same time, the same backpack triggered some nasty words two years ago in Martha's Vineyard in Massachusetts in the United States, and comments suggesting, "You should be ashamed for promoting mining." The author has also been delighted that any conversation about mining with the public in Canada has been insightful and with an understanding of the importance of mining to a modern society. While the author was chasing potential students and parents in the hallways at his previous academic institutions in the United States to at least attend the presentations on mining during the career fairs and open houses, the author has been very encouraged that students and parents are eager to learn about mining in his current institution, Queen's University, in Canada. It is also rewarding that Queen's mining alumni encourage their children to consider mining engineering as a career path.

It also should be noted that the majority of Canada's population is along the border with the United States. This leaves a vast land space and resources in the northern parts of Quebec, Ontario, Manitoba, Saskatchewan, Alberta, British Columbia and the three territories of Yukon, Northwest Territories and Nunavut. Given the low population density in these regions, mining is not perceived as a negative as it is typically far from population centers and is a major income source for the population centers it is near, as well as a driver for better infrastructure.

However, both countries face a certain level of challenges with some environmental groups who have actively been lobbying against mining projects with legal and permitting delays. Some examples of the mining projects include Pebble in Alaska, Rosemont in Arizona, aggregate mining expansion on Maury Island in Washington, Thacker Pass in Nevada, and many mountain-top coal mining operations in Appalachia, all in the United States. Some environmental and citizen groups have actively lobbied against Canadian projects abroad in Guatemala, Romania, Ecuador, Panama, Tanzania, Mongolia and Papua New Guinea, and gave the support to the community-driven resistance movements. Canadian mining industry has been working with Indigenous communities to advance mining projects, although in Northern Ontario, the Grassy Narrows First Nation has opposed prospecting on Indigenous-protected land, and the Long Point First Nation has opposed lithium projects in Quebec.

Media and news outlets coverage

The press and news outlets are mostly very favorable to mining in Canada while the coverage in United States has persistently been negative over the years, with the exception of some recent and sporadic positive articles on critical minerals and importance for the national security and economy. It appears that mining in Canada is branded as part of the solution and the future, and not seen as an archaic and outdated industry with pick and shovels or like something in the gold-rush era.

However, it is encouraging that the press and news outlets in both countries are picking up on the link between economy, politics and mining and role of critical minerals and rare earth elements, and China's dominance in this area and the need for other countries to pick up the pace; in addition, the interest in Greenland and the Canadian arctic from a strategic point of view, with the main interest being in the untapped mineral potential within this underdeveloped area.

Language

While the official language in United States is English, Canada has English and French as official languages. English is predominant in Canada, but in the province of Quebec, all mines and universities with mining schools (except McGill) use the French language. Not having knowledge of French could be a significant barrier for an employment in mines in Quebec.

Academic landscape

There are nine mining engineering schools in Canada, and 14 in the United States. The former's programs are accredited by the Canadian Engineering Accreditation Board (CEAB), while the latter are accredited by the Accreditation Board for Engineering and Technology (ABET).

While both have a similar requirement for maintaining the accreditation, one notable difference is that CEAB requires faculty members to be licensed as professional engineers in Canada in order to teach courses related to engineering design and engineering science, while the same requirement is not mandatory for faculty in U.S. mining schools. One may argue in favor of either; however, it appears that U.S. mining schools are able to attract world-class talent as faculty, while Canada may restrict itself to the same talent by imposing the requirement for the professional licensure.

There are four endowed mining engineering schools/departments in Canada: Robert M. Buchan Department of Mining at Queen's University, Norman B. Keevil Institute of Mining Engineering at the University of British Columbia, The Goodman School of Mines at Laurentian University, and Lassonde Institute of Mining at the University of Toronto. Each of these schools/departments is supported by significant gifts from the donors. While many mining schools/departments in the United States have received financial support for endowed professorships and chair positions, like in Canada, there is no single endowed mining engineering school/department.

The overall enrollment in Canadian mining schools appears to be higher than in mining schools in the United States. The enrollment in the latter, in 2023, ranged from lowest 12 to highest 97 undergraduate students, or 12 to 77 excluding first-year students. Some schools in the United States allow direct entry to mining engineering at first year. At the same time, Queen's University in Canada, alone, had 120 undergraduate students in 2023, and the enrollment reached a total of 171 undergraduate students, and 42 full-time MASC and Ph.D. students in 2025.

Mining schools/departments in Canada, such as those at Queen's University and University of British Columbia, have a significant number of tenure-track and tenured faculty and staff within the department. For example, the Robert M. Buchan Department of Mining at Queen's University has 12 full-time tenure-track and tenured members and nine staff members. At the same time, the average number of full-time tenure-track and tenured faculty at U.S. mining schools/departments is about six, with two staff members. The number of staff positions in mining schools in the United States is inadequate, resulting in the use of overhead or private funds to fulfill these positions. The majority of faculty and staff members at Canadian universities are members of the unions, while this is not the case at U.S. universities.

The faculty workload is similar in mining schools in both countries: commonly, 40 percent teaching, 40 percent research and 20 percent service. While requirements for the promotion and tenure of faculty members at highly research-intensive R1 universities in the United States require significant research accomplishments (research dollars, quality and number of refereed journal publications, number of graduate students) and could be at a higher level than at Canadian mining schools, there is significant weight placed on quality of education and teaching in Canadian mining schools.

While summer internship opportunities are available to students in both countries, some Canadian universities have the requirement of a long industry internship as part of the degree program (12 to 18 months), usually after the junior year.

It appears that access to government (federal and provincial) and industry funding for mining research is more stable and persistent in Canada, while it is mostly sporadic in the United States through the National Institute for Occupational Safety and Health (NIOSH) Mining Program for health and safety research and capacity building (which was abolished in 2025) and Department of Energy for critical minerals research. Research funding from Natural Sciences and Engineering Research Council of Canada (NSERC) provides many opportunities and competitive grants, from NSERC Discovery that most mining faculty obtain, to other large grants like the NSERC Alliance that fund research programs jointly with industry. Other similar funding program that uses a cost-sharing model include Mitacs Accelerate, where funding is split between Mitacs (federally and provincially funded) and industry partners. In addition, the Canada Research Chairs are competitive grants and fund faculty positions

with C$200,000 per year for seven years, renewable for a second seven-year term.

Some of the strategies for recruiting high school students are similar and include visitation days by high school students and parents, career fairs, discipline nights, limited visits to high schools, use of web pages and social sites (Facebook, Instagram, X, LinkedIn and YouTube), and distribution of brochures and videos on importance of mining. Mining faculty, for example, at Queen's University, teach some general engineering courses to almost 1,000 first-year students, providing an excellent opportunity to present mining engineering to undecided first-year students.

The United States has its premier mining professional society, the Society for Mining, Metallurgy & Exploration (SME), while Canada is home to the Canadian Institute of Mining, Metallurgy and Petroleum (CIM). Both associations are similar in their missions, with significant support for students' scholarships, professional development, technical presentations and network opportunities at their annual meetings. Students participate in a variety of mining-related competitions in the United States: SME/NSSGA Student Design Competition, SME Metallic Student Design Competition, Intercollegiate Mine Emergency Rescue Development Competition, SME Eastern Collegiate Mine Rescue Organization Coal National Competition, Senior Student Design Award Competition, Carlson Software Senior Design Competition, International Intercollegiate Mining Games and various SME student poster contests. The competitions in Canada include Canadian Mining Games, Goodman Gold Challenge, THE Mining Investment Event, Mined Open Innovation Challenge and CIM Student Poster Competition.

There is an established professional culture in the United States where all mining engineering schools, their faculty and students, attend the annual MINEXCHANGE SME Annual Conference & Expo, while Canadian mining schools are not fully represented at CIM annual meetings. The SME has also been very generous in supporting tenure-track faculty through the competitive SME Career Development and Ph.D. Fellowship grants, which is not the case with CIM and mining faculty in Canada.

High school curricula in Canada provide some coverage of mining and minerals. Students can learn through elective courses or extracurricular programs and resources from mining organizations, which provide hands-on activities, industry connections and career information. For instance, in some provinces, like Ontario, students can choose a specialist high skills major in mining, which offers sector-specific courses and cooperative education credits, providing in-depth knowledge and skills. School also may offer contextualized learning activities (CLAs) within other subjects to meet specific curriculum expectations through activities related to the mining sector. Industry and nonprofit initiatives, like Mining Matters, provide teachers with resources and develop programs to educate students at all levels about the importance of rocks, minerals, mining and Canada's geology through hands-on STEM activities and career engagement. The Mining Industry Human Resources Council (MiHR) develops curriculum resources to promote careers in the mining sector, aiming to attract the next generation of workers by highlighting the need for skills in the industry.

Conclusion and recommendations

Canada and the United States both contribute significantly to the global mining industry, though Canada's sector enjoys broader public support. Canada's mining education system benefits from stronger funding, higher enrollment and endowed schools, while the United States excels in aggregate mining and professional society engagement through SME.

It is recommended that Canada continue strengthening Indigenous engagement, maintain consistent government-industry-academic funding partnerships and encourage fuller representation of mining schools at CIM. The United States should consider investing in high-school-level science and mineral curricula, expand industrial and federal research support, improve student recruitment strategies and develop public champions to reshape the societal perception of mining.

By learning from each other's strengths, both countries can ensure mining remains safe, sustainable and central to modern society. ■

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Acknowledgment

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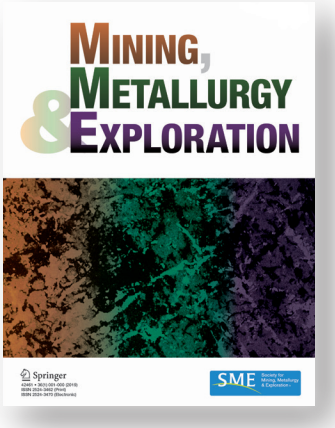
Extended abstracts from the SME journal Mining, Metallurgy & Exploration



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Invited Extended Abstracts

A comprehensive review of whole-body vibration exposure assessment among heavy earthmoving equipment operators in the mining industry

Rahul Upadhyay[1,*], Ashish Kumar[2] and Ashis Bhattacherjee[2]
[1]Department of Mining Engineering, Indian Institute of Technology (BHU), Varanasi, India
[2]Department of Mining Engineering, Indian Institute of Technology, Kharagpur, India
*Corresponding author email: upadhyay.rahul143@gmail.com

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Keywords: Heavy machinery, Mining industry, Occupational exposure, Whole-body vibration

Whole-body vibration (WBV) is a major occupational hazard for heavy earthmoving machinery operators in mining, and it is associated with serious long-term health risks. This systematic review analyzed 34 peer-reviewed studies, sourced using PRISMA guidelines, to evaluate WBV assessment methods and sources of variability. The results revealed that differences in equipment type, operational conditions, tasks, measurement methods and applied standards — along with inconsistent sample sizes — contribute to large variations in reported WBV levels. The review emphasizes the need for standardized assessment protocols, consistent data collection and ergonomic improvements, such as vibration-attenuating seats and better cabin design. Addressing these factors can improve worker safety, reduce health risks and support regulatory compliance. Further research is required to develop effective strategies for mitigating WBV-related hazards.

Introduction

Whole-body vibration refers to mechanical oscillations (0.5 to 80 Hz) transmitted to the human body, commonly affecting operators of heavy earthmoving machinery (HEMM) in the mining industry. Prolonged exposure is linked to musculoskeletal disorders, particularly lower back pain, as well as circulatory, neurological, gastrointestinal and urological issues. WBV risk factors include machine characteristics (type, age, speed, seat suspension), operational conditions (haul road quality, climate), ergonomics (seat design, posture) and individual traits (age, body mass index, experience). Resonance frequencies in the human body are low, making certain tissues vulnerable to specific vibration ranges. Major WBV sources in mining are dumpers, shovels, loaders and dozers, with vibration transmitted

through seats or feet. ISO guidelines measure WBV using frequency-weighted root-mean-square (RMS) acceleration and vibration dose value (VDV). However, inconsistencies in measurement methodologies, limited factor consideration and varied study designs contribute to heterogeneous findings and hinder comprehensive WBV management strategies. This systematic review aims to evaluate WBV exposure across mining equipment, identify influencing factors and compare measurement approaches. It highlights gaps in long-term monitoring, operator-specific interventions, and consistent application of standards. Understanding these factors can guide technical and procedural interventions to reduce WBV exposure, improve health outcomes and enhance occupational safety in the mining sector.

Methods

This systematic review considered all online published research articles and conference proceedings on WBV up to May 2024. Searches were conducted across Scopus, Web of Science, ProQuest, ScienceDirect and Google Scholar using Boolean keyword combinations such as "whole-body vibration" with "assessment method," "mining," "occupational vibration," "mining equipment," "influencing factors," "mitigative strategies" and "opencast." The search yielded 1,285 records; after removing duplicates, 226 unique records remained. Title and abstract screening reduced these to 101, from which three could not be retrieved and three were excluded based on criteria, leaving 98 for full review. Following consensus-based evaluation, 34 records were selected. Inclusion criteria specified English-language, peer-reviewed journal or conference papers published between 2014 and 2024, focusing on engineering aspects of WBV exposure in real mining conditions. Reviews, theses, dissertations and core medical science studies were excluded. The PRISMA guidelines were followed to minimize bias. Bibliometric sorting was also performed by year, country, journal and institution (Fig. 1). Screening was initially performed by one researcher, verified by another, and data analysis was conducted by two researchers with final validation by a third.

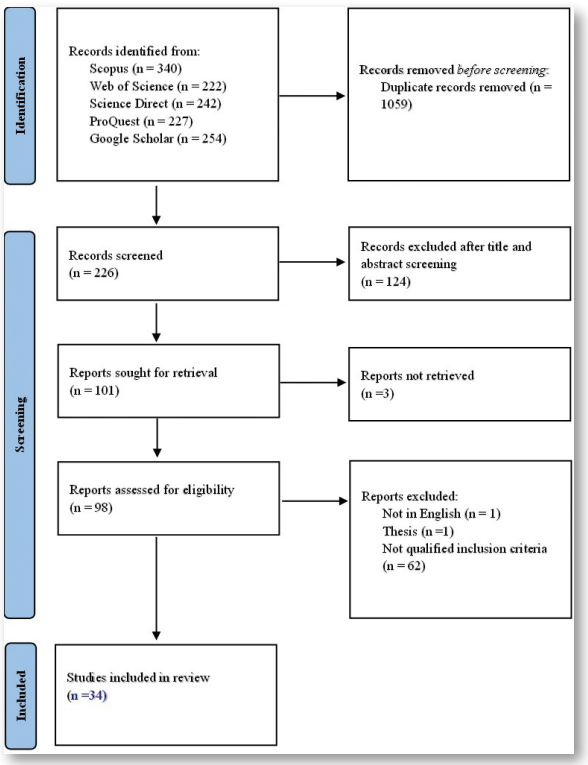

Fig. 1 PRISMA flowchart.

Results and discussion

This review addresses that gap by categorizing studies into four groups for in-depth analysis. Most research focused on factors influencing vibration magnitude, grouped into design considerations and behavioral modifications. Key design factors include haul road condition, vehicle size, speed, load, vehicle age, seat suspension and seat design. Poor road maintenance, higher speeds and inadequate suspension significantly increase WBV. Properly maintained haul roads, moderate speeds (20 to 30 km/h on rough terrain) and advanced active suspension seats reduce exposure. Vehicle load effects are complex: moderate loads can reduce WBV, but overloading stresses suspension systems. Older, poorly maintained machines generally increase WBV, though some studies found higher levels in newer vehicles due to assembly and operational factors.

Behavioral and ergonomic factors include task type, mine type, operator age, weight, posture and exposure duration. Tasks involving rough terrain, high speeds and long driving cycles elevate WBV. Older operators are more susceptible to WBV-related musculoskeletal disorders. Operator body mass and posture influence vibration transmission patterns, highlighting the need for adjustable ergonomic seats. Prolonged measurement durations yield more accurate exposure assessments. Rock characteristics, such as hardness and fracture patterns, influence vibration frequencies and amplitudes, with harder rocks generally producing higher WBV. Mine type and working conditions, including exposure hours and machinery type, are major determinants of WBV risk.

Preventive measures suggested for mitigating WBV exposure include a combination of engineering controls, behavioral strategies and maintenance practices. Engineering interventions focus on better haul road design and maintenance, the use of active suspension systems, ergonomic seat designs and ensuring proper load distribution. On the behavioral side, strategies such as regulating driving speed, maintaining optimal posture, implementing task rotation and reducing driving hours can significantly reduce risks.

Conclusion

Overall, WBV exposure among operators is shaped by the combined influence of machine, task, environment and human factors. Load, equipment type and age, speed, posture and road conditions all play significant roles, with smaller or older trucks, higher speeds, rough surfaces and poorly adjusted seats generally increasing exposure. While patterns such as axis shifts with speed and differences across tasks are evident, gaps remain in understanding posture effects, seat design impacts and manufacturer-related variations. Given these complexities, effective mitigation requires integrated solutions that combine ergonomic cabin and seat design, regular road maintenance, optimized speed/load management and operator training. Addressing WBV is therefore not about isolated fixes but about adopting coordinated en-

gineering, operational and behavioral strategies to achieve lasting control. ■

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A list of all references is available in the full paper.

Collection in Honor of Dr. Jan D. Miller

Innovative gravity separation for sustainable utilization of mineral resources

Patrick Zhang[1,*], Aaron Medley[1], Wending Xiao[2], Dapeng Zhang[2] and David Yang[3]

[1]Florida Industrial and Phosphate Research Institute, Florida Polytechnic University, Bartow, FL, USA

[2]Wuhan Gewuzhizhi Mining Co. Ltd, Wuhan, China

[3]Mineral Technologies International, Salt Lake City, UT, USA

*Corresponding author email: jzhang@floridapoly.edu

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Keywords: Gravity separation, Phosphogypsum, Phosphate, Silica, Dolomite

Recent technological advancements have enabled the commercialization of a novel gravity separation device, the packed column jig (PCJ). The PCJ offers several distinctive advantages: an exceptionally long (virtually unlimited) separation zone, compact footprint, minimal water consumption, chemical-free operation (making it environmentally friendly), high throughput, and the ability to process a wide range of particle sizes, including very fine particles. Significant breakthroughs have been achieved to enhance the PCJ's robustness for industrial use. A major advancement is the effective resolution of a potential plugging issue through a combination of four strategies: (1) adoption of new packing materials, (2) innovative packing design, (3) variable feed-point configurations and (4) a novel discharge system. Another critical improvement is the development and integration of a fully automated computer control system, which also contributes to preventing plugging.

Introduction

This paper presents three case studies demonstrating the application of the PCJ in significantly improving resource utilization efficiency and reducing the environmental footprint of phosphate mining, particularly in processing tailings and byproducts from the industry.

Key results

Upgrading of phosphogypsum. The global phosphate industry produces more than 150 Mt of phosphogypsum each year. Phosphate producers are under increasing pressure to identify practical and sustainable uses for this byproduct. One promising solution is the utilization of phosphogypsum in construction materials, which could significantly reduce its accumulation. Figure 1 presents a process flowsheet for phosphogypsum purification, which combines gravity separation using PCJ with flotation.

Pilot-scale testing of this integrated process has successfully produced upgraded phosphogypsum suitable for various construction applications. The treatment reduced soluble phosphorus content from 0.89 percent to 0.04 percent and increased whiteness from 39 to 87.

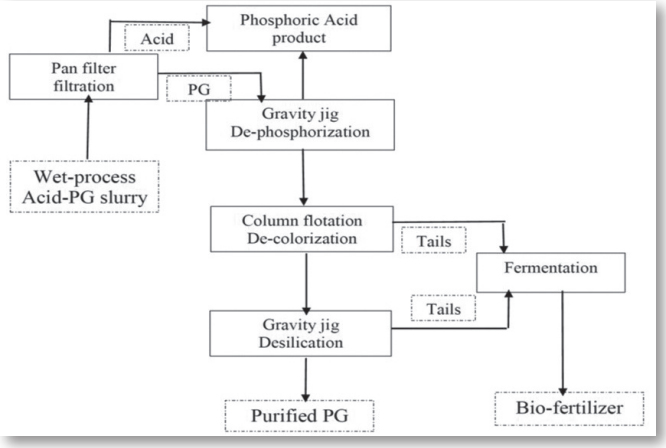

Fig. 1 A phosphogypsum processing strategy for total consumption with gravity separation using PCJ.

Fig. 2 PCJ pilot plant installed in Florida.

Removing dolomite from Florida high-dolomite phosphate pebbles. Encouraged by promising laboratory results, the Florida Industrial and Phosphate Research Institute undertook a major pilot PCJ testing program using a pilot plant with a capacity of 1 t/h (Fig. 2). Based on initial laboratory testing results, the feed preparation scheme for the PCJ pilot testing was selected as follows: (1) Screen the test sample at 5 mm, with the –5 mm portion screened into 5 by 2.36 mm (8 mesh), 2.36 by 1.4 mm (14 mesh) and –1.4 mm fractions simultaneously. (2) Crush the +5 mm portion of the test sample and screen into 5 by 2.36 mm (8 mesh), 2.36 by 1.4 mm (14 mesh) and –1.4 mm fractions simultaneously. Table 1 summarizes the continuous, long-hour pilot testing results.

Table 1 — Summary of best pilot runs.

Feed size (mm)	Feed MgO content (percent)	Concentrate MgO content (percent)	Concentrate P_2O_5 content (percent)	P_2O_5 recovery (percent)
–2.36+1.4	3.33 to 3.42	0.91 to 1.16	26 to 27	77.7 to 82.5
–5+2.36	1.96 to 2.09	1.74 to 1.81	26.4 to 26.8	82.7 to 82.8

Conclusion

The results for the –2.36 +1.4 mm size fraction are highly encouraging; however, the concentrate grade — particularly the MgO content — from the –5+2.36 mm fraction was not acceptable. Based on a comprehensive analysis of laboratory and pilot-scale testing, as well as the size distribution of high-dolomite pebbles and their crushed fractions, an optimized processing scheme has been developed, as shown in Fig. 3. In this proposed approach, only two size fractions are subjected to jigging using the PCJ. The –70 mesh fraction from the crushed pebbles is excluded from further processing due to its high MgO content (7.7 percent) and relatively minor phosphate loss (14.37 percent P_2O_5), making recovery economically unjustifiable. ■

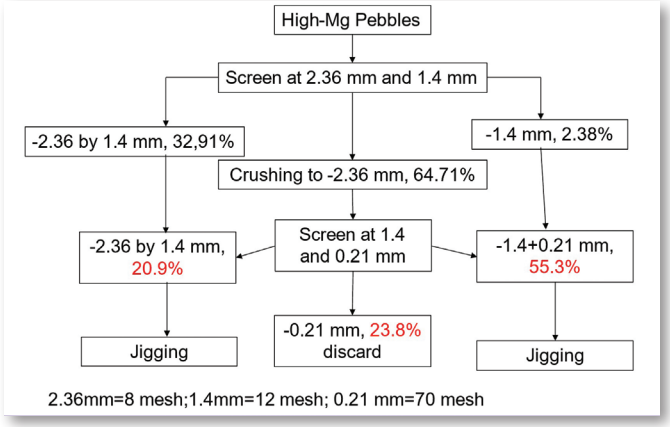

Fig. 3 Proposed scheme for further pilot testing.

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Collection on Intelligent Mining

An algorithm for the efficient placement of air quality sensors in underground mines

Kate Brown Requist[1,*] and Moe Momayez[2]
[1]Department of Civil and Architectural Engineering, Tennessee State University, Nashville, TN, USA
[2]School of Mining Engineering and Mineral Resources, University of Arizona, Tucson, AZ, USA
*Corresponding author email: krequist@tnstate.edu

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Keywords: Atmospheric monitoring systems, Graph theory, Combinatorics, Air quality, Underground mining

Air quality sensor installation best practices are typically poorly defined in underground mines. Current approaches rely on the perspectives and experiences of ventilation engineers and health and safety professionals, but this reliance leads to disagreement when installing air quality monitors for ventilation and health and safety monitoring. While a nonrandom sampling approach is useful for initial investigation and area monitoring of airborne contamination, this alone is not ideal. By optimizing monitor installation location with a constrained number of air quality sensors, monitors can be used to their fullest extent and provide coverage of the largest area possible.

Background

The installation of underground air quality monitors has been relatively static. Atmospheric monitoring systems (AMSs) employed in underground coal mining operations have gone through minimal regulatory changes since August 2004, with minor changes to sensor spacing requirements going into effect at the end of 2009. For more than 15 years, there has been no change in US 30 CFR 75.351(e)(1) or 75.351(f), which establishes maximum AMS sensor separation along beltways in coal mines. AMSs are purpose-built, with the intention of monitoring carbon monoxide generation as a precursor to or indicator of spontaneous combustion of coal. Despite the lack of progress with AMSs, these systems remain the blueprint for large-scale, real-time air quality monitoring practices in underground mines, regardless of the purpose of installation or commodity type.

While AMSs are well-established features in underground coal mines in the United States, there exist no further regulations prescribing real-time air quality monitoring outside of beltways. There exist no agreed-upon industry best practices for the installation of air quality monitors, despite an obvious desire to expand monitoring capacity, especially in the face of an uncertain regulatory environment for particulate matter hazards. By developing an algorithm that prioritizes an even spacing of air quality sensors that respects ventilation behavior (such as airflow direction, turbulence and diffusion effects), it is possible to paint a clearer picture of airborne contamination dynamics with existing real-time area monitoring technologies.

Methods

We present an algorithm for the efficient placement of air quality sensors (EPAQS). It is a polynomial time algorithm that relies on a computational geometry approach to approximate a solution to the capacity-constrained centroidal Voronoi diagram (CCCVD) problem, a subclass of the NP-complete optimal set partition problem. Overall, Voronoi diagrams can be thought of as an extension of the nearest neighbor method, dividing an area into cells based on a proximity to a certain "seed" (sensor) location (Fig. 1). This division of the area and corresponding cells constitute a Voronoi tessellation. The goal of the CCCVD problem is to determine a set of sensor locations such that each sensor sits at the centroid of its corresponding cell in the Voronoi tessellation.

EPAQS uses a graph realization of the mine, which is distinct from typical graph theory network modeling approaches used in mine ventilation. Instead of realizing airways as edges within the graph, discrete locations within the mine are realized as vertices of the graph, with edges representing the statistical "cost" from one location to the next under airflow constraints. This allows EPAQS to consider airflow effects when placing sensors. Previously developed algorithms for the CCCVD problem rely on a known density or weight function for the calculation of centroids, but this is not an option in underground ventilation where airflow conditions are nonlinear and nonuniform across the mine. Otherwise stated, contaminant transport effects cannot be described as a function over the original existing mine geometry. This ultimately requires the graph realization to facilitate determination of relevant centroids, allowing EPAQS to suggest sensor installation locations.

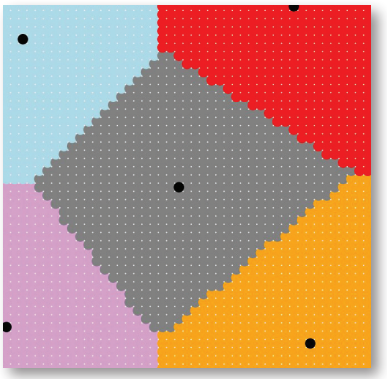

Fig. 1 Example of Voronoi tessellation.

Results and discussion

The EPAQS algorithm iteratively compares potential installation locations by considering the amount of overlap between any two installation locations when requiring each sensor covers the same amount of area in the mine, thereby fulfilling the capacity constraint. It is important to note that the centroid of the Voronoi cell, or the sensor's region of influence is not necessarily at the geometric center of the cell because of airflow effects. This allows for a region of influence around the sensor that accurately reflects the statistical relevance of a sensor's ability to reflect conditions upwind or downwind of the sensor. As such, these Voronoi cells display larger areas of influence downwind of the sensor than upwind of the sensor.

Compared to a naive approach involving random selection of installation locations, EPAQS presents a significant improvement in even sensor spacing. In the case of sensor placement in a portion of an underground room-and-pillar

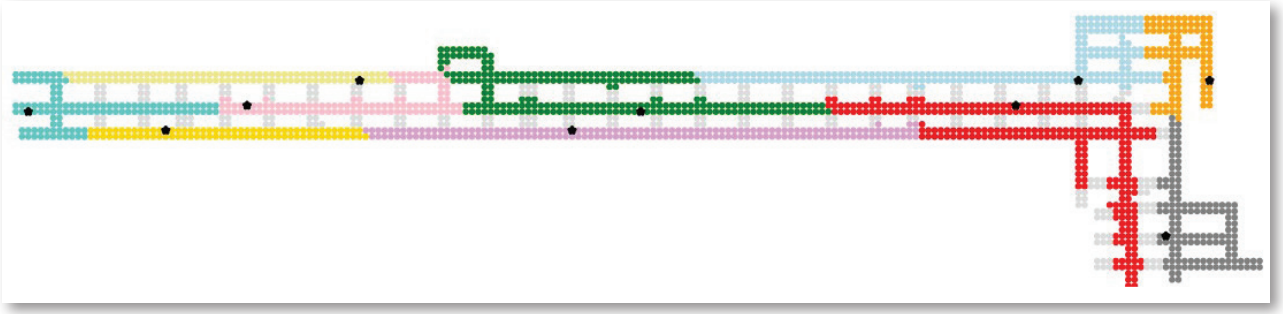

Fig. 2 Optimized sensor installation regime using EPAQS algorithm to guide the installation of 10 air quality monitors.

coal mine, EPAQS starts with a naive distribution of sensors, and iteratively selects the most promising installation locations by rejecting locations that lead to large overlaps with other sensors.

In the case of 10 sensors, EPAQS can provide an installation regime that has a mean overlap of three percent of the fixed Voronoi cell capacity (Fig. 2). When compared to random installation, there is a significant improvement in the spacing of air quality sensors, with EPAQS providing a far lower overlap between Voronoi cells.

Conclusion

The EPAQS algorithm aims to provide a new option to support the installation of air quality monitors in underground mines, especially with the lack of industry-accepted best practices. With a lack of federal regulation to guide installation regimes in nonregulatory areas as is prescribed for underground coal AMSs in US 30 CFR 75.351(e)(1) and 75.351(f), EPAQS gives mining operations a new method to ensure monitoring programs provide a comprehensive picture of real-time air quality conditions. By removing outright reliance on experience, EPAQS uses a physics-informed approach to consider airflow effects while suggesting installation locations. As an approximation algorithm, EPAQS approximates a solution to the CCCVD problem in polynomial time, representing a steep improvement when compared to existing genetic algorithm methods.

As the first algorithm developed for air quality sensor installation that prioritizes the spatial distribution of sensors explicitly for the purpose of reliable air quality monitoring data that covers the largest part of the mine as possible, EPAQS is a strong basis for future sensor placement methods to support real-time air quality monitoring. The EPAQS algorithm is available as a Windows program at no cost to the user upon reasonable request. ■

References

A list of all references is available in the full paper.

A survey of current planning, design and geotechnical practices for orepasses

Kristin Guerin-Davey and Andrea Brickey*
Mining Engineering and Management, South Dakota School of Mines and Technology, Rapid City, SD, USA
*Corresponding author email: Andrea.Brickey@sdsmt.edu

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Keywords: Underground mining, Orepass design, Finger raises, Orepass hang-ups, Survey

Determining the location, design and construction method for orepasses in underground mining operations can be challenging. Existing studies and literature contribute useful content but stop short of offering standardized methodologies for design and placement decisions. Past surveys have documented operational procedures at select operations, with the most recent published survey being from 2013. This paper presents the results of a survey conducted in 2024 of numerous underground operations in Canada and the United States. The survey obtained information regarding orepass design, construction and planning. Responses are compared to industry best practices and case studies found in the available literature. Topics covered in this article include construction methods, orepass dimensions, guarding, mechanical support, causes of hang-ups, corporate policies on placement, and geotechnical factors, among others. The survey responses provide valuable insights into the current state of orepass practices and the benefits of orepass placement for effective and efficient strategic and operational mine planning.

Background

Orepasses are vertical or near-vertical excavations that use gravity to transfer ore from production levels to lower haulage levels for transport to the surface in underground mining. They feature tipping points, often with grizzlies and dust control, and terminal ends equipped with chutes, hoppers, or drawpoints, as shown in Fig. 1. Additional design elements, such as knuckles or finger raises, influence material flow but can also contribute to wall degradation, as shown in Fig. 2. Common hazards include blockages ("hang-ups"), uncontrolled flow, and structural failures from impact damage or adverse geotechnical conditions. Clearing methods, such as secondary blasting or high-pressure water, carry operational and safety risks.

Although orepasses are critical to underground mining productivity, research on their design, construction and maintenance is limited compared to other mine infrastructure. Existing literature consists largely of site-specific case studies and small-scale surveys, with broader industry surveys highlighting gaps in strategic planning and inconsistent application of best practices. Past studies have explored design methodologies, excavation methods, support systems and geotechnical considerations as well as hazard mitigation for wall degradation, hang-ups and gate loading. Recent advances include optimization models for orepass location and cost efficiency. Bridging the gap between theoretical best practice and operational reality remains essential for improving safety, reliability and orepass longevity.

Survey methodology

To collect current information on orepass use and planning in Canada and the United States, we created a 26-ques-

tion SurveyMonkey survey sent to 65 targeted operations chosen by commodity type (gold, silver, platinum-group metals and base metals) and location. Potential respondents were identified through online searches, the Mine Safety and Health Administration (MSHA) database, and professional contacts via LinkedIn, email and referrals. The survey, open from July 11 to Sept. 29, 2024, received 37 responses, representing a range of mine sizes and methods, including surface mines transitioning underground. Of the 37 respondents, 26 use orepasses, while 11 did not. Some questions allowed multiple selections or follow-ups, leading to varying response totals.

Survey results

Survey results showed that conventional drill-and-blast drop-raising remains the dominant orepass excavation method, followed by raiseboring and Alimak raises, with many operations using multiple methods. The 44 percent use of Alimak raises differs from Hadjigeorgiou et al. (2005), who reported 63 percent usage in Quebec and 39 percent in Ontario, indicating regional and temporal shifts. Consistent with MacLeod (1954), excavation method choice is influenced by rock conditions and layout, with raiseboring favored for longer sections. Recent work by Edelbro et al. (2019) and Rojas et al. (2024) on pregrouting for poor rock masses aligns with respondents' practices to improve orepass longevity.

Orepass cross-sections and dimensions reported match known method constraints: for example, raiseboring producing circular profiles. Lengths typically exceed 125 ft, similar to Hadjigeorgiou et al.'s (2005) Canadian average. Steeper inclinations (80 to 90°) were more common than the 70° average reported by Lessard and Hadjigeorgiou (2006).

Half of respondents keep orepasses full or partially full, echoing Iverson et al. (2003) and Esmaieli (2010), to reduce dynamic loading and wall wear. Most use grizzlies, consistent with Hadjigeorgiou and Mercier-Langevin (2008) findings on reduced impact loads, and with Manzoor et al. (2023) on productivity gains from screening out oversize material. Wall degradation, reported by more than half of operations, aligns with earlier observations linking seismicity, poor maintenance and empty operation to accelerated wear.

Three-quarters of operations employ engineered support — shotcrete and resin-grouted cable bolts — reflecting recommendations by Sjöberg et al. (2003) and Maree (2011). Geotechnical placement factors match Hart (2006) and Gardner and Fernandes (2006), who emphasized avoiding structures prone to gravitational failure.

Finger raise use, angles and associated wall damage are consistent with Esmaieli and Hadjigeorgiou's (2009) impact force findings. Hang-up causes and mitigation strategies support Hambley et al.'s (1983) particle size ratios and Szwedzicki (2007) on clearing methods.

Only one operation included orepass placement in long-term planning, confirming Hadjigeorgiou and Stacey's (2013) observation of an industry-wide lack of strategic orepass design, despite available tools like the orepass longevity calculator and chart (Hadjigeorgiou and Mercier-Langevin, 2008; Sredniawa et al., 2022).

Conclusion

The 2024 survey and literature review indicate that integrating orepass planning into long-term mine design, rather than relying on ad hoc operational decisions, offers significant benefits. Currently, many operations depend on "rule of thumb" practices, with limited formal guidelines, particularly for components such as finger raises, where fewer than 10 relevant technical references exist. Of the 65 targeted operations, 37 responded, and 26 reported active use of orepasses across a range of commodities and mine sizes. These are most commonly exca-

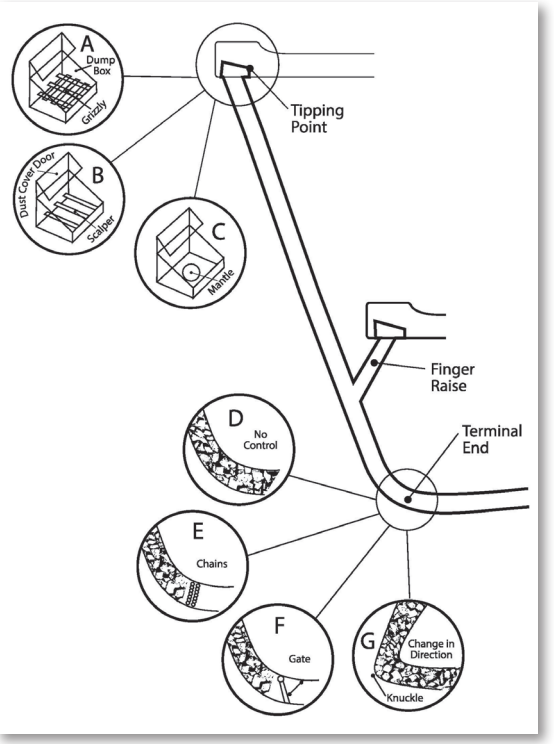

Fig. 1 Schematic of an orepass showing various material movement control methods and orepass components. Adapted from Lessard and Hadjigeorgiou (2006).

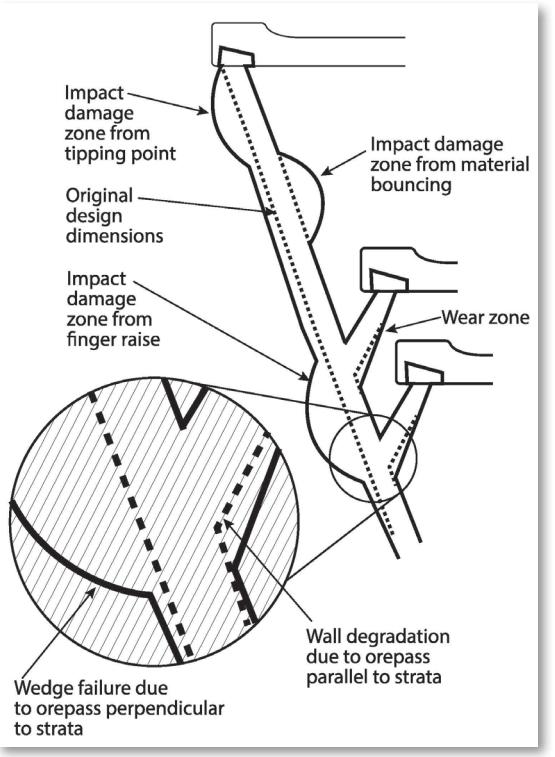

Fig. 2 Typical damage seen in an orepass. Adapted from Hadjigeorgiou et al. (2005).

vated via drill and blast, typically with square cross-sections of about 10 × 10 ft (3 × 3 m), inclines of 80 to 90° from horizontal, and lengths exceeding 125 ft. Orepass infrastructure often includes a grizzly at the tipping point and finger raises, but nothing at the terminal end.

Despite common use of shotcrete and cable bolts, more than half of respondents reported significant wall degradation, frequent hang-ups and/or premature orepass failure. Industry practice typically includes the use of orepasses for two to 10 years, one to three orepasses operated concurrently, and passes kept full or partially full. No standardized industry methodology exists for orepass planning, and even companies with multiple underground operations rarely have formal policies, raising the risk of knowledge loss as experienced staff retire. Only one operation reported incorporating orepass placement into long-term planning.

Documenting and sharing best practices and developing a geotechnical risk calculator adapted from existing longevity tools, could help engineers optimize placement, extend orepass life, reduce production disruptions and safeguard institutional expertise. ■

Acknowledgments

We would like to thank the National Institute for Occupational Safety and Health (NIOSH) for partially funding this research under contract 75D30119C06090 and contract 75D30124C20308.

References

A list of all references is available in the full paper.

Selected Abstract

A machine learning approach to lithology classification in mining using measurement while drilling and exploration data

Gbétoglo Charles Komadja[1,2,4,*], Erik Westman[1], Aditya Rana[3] and Anye Vitalis[2]

[1]Department of Mining & Minerals Engineering, Virginia Tech, Blacksburg, VA, USA
[2]Department of Materials Science and Engineering, African University of Science and Technology, Galadima, Abuja, Nigeria
[3]Rock Excavation Engineering Research Group, CSIR-Central Institute of Mining and Fuel Research, Dhanbad, India
[4]Department of Earth Sciences, University of Abomey-Calavi, Abomey-Calavi, Benin
*Corresponding author email: gkomadja@aust.edu.ng

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Keywords: Lithology classification, Machine learning, Spatial data, MWD parameters, Geological modeling

Accurate lithology classification is essential as variations in rock formations can significantly impact the cost and efficiency of mineral exploration and mining. Initial exploration maps provide insights into subsurface formations, though typically collected at widely spaced intervals. This study examines the use of early exploration data and measurement while drilling (MWD) data for lithology prediction through machine learning.

The research specifically evaluates the benefit of incorporating spatial coordinates with MWD parameters to enhance classification accuracy, using support vector machine (SVM), random forest (RF) and extra gradient boosting (XGBoost) classifiers with 10-fold cross-validation. The models were trained on 235,501 data points of six MWD parameters from 308 drill holes. The effects of raw (imbalanced) versus synthetic minority oversampling technique combined with edited nearest neighbor (SMOTEENN) (balanced) data were analyzed, along with a comparison between random and spatial data splits. The results indicate that SMOTEENN-balanced data paired with a spatial split strategy consistently improved model stability, with the XGBoost model achieving the highest performance with a precision of 95.60 percent and an F1 score of 94.41 percent on unseen data. Additionally, the study revealed that integrating spatial coordinates of drilling locations consistently enhanced lithology classification, with a notable F1 score improvement of 27.97 percent using XGBoost. The findings highlight the value of combining spatial coordinates and MWD data for improved lithology classification and offer potential support for geological modeling and sustainable mining practices. ■

Navigating regulatory shifts;

What miners need to know

by Joseph R. Peré, INTERA Inc. and Leslie M. Watson, Public Service Company of New Mexico, Government and Public Affairs Committee

The environmental regulatory landscape continues to evolve in ways that directly affect mining professionals. Recent events, including key discussions at the State Bar of Texas Environmental Superconference in August and federal actions, shed light on important trends that miners may want to monitor.

Compliance still matters

Despite the push toward deregulation, regulators made clear that enforcement remains a priority at both federal and state levels. Compliance expectations are not easing; mining firms should continue adhering to existing permits and environmental obligations.

EPA's deregulatory push

The U.S. Environmental Protection Agency (EPA) is pursuing one of the most ambitious deregulatory agendas in U.S. history. Agency officials emphasize that these actions are being carried out within legal bounds, with a focus on plain-language interpretations and administrative streamlining. While this approach may create opportunities for faster permitting, unresolved scientific debates are expected to fuel litigation and extend timelines for finalizing some rollbacks.

Photo from Shutterstock

Factors such as data centers are driving energy demand.

NEPA reform and project development

The White House Council on Environmental Quality (CEQ) has prioritized streamlining the National Environmental Policy Act (NEPA). The goal is to make NEPA a more effective review tool that supports, rather than hinders, project development. Recent updates narrowed the scope of NEPA reviews to more immediate, project-level impacts rather than distant or indirect effects. This aligns with legislative proposals such as the SPEED Act, which seek to shorten permitting timelines and reduce litigation risks. For mining companies, NEPA reform presents an opportunity for more predictable and efficient pathways to advance new projects.

Energy demand as a market driver

Energy demand is climbing rapidly, driven by artificial intelligence, data centers and population growth. National

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SME News Contents

SME Midyear Meeting –

A howling success for WAAIME

by Barbara A. Filas, Chair, WAAIME Executive Committee

The SME Midyear Meeting, held Sept. 12–14 in Denver, CO, brought together SME's top leadership team. It kicked off with a welcoming reception at SME headquarters in Englewood, the hub of operations that supports SME's inner workings, including SME's WAAIME Division.

WAAIME's highlight was Saturday morning, when we hosted our first-ever outreach meeting. We invited all SME leaders in attendance to join us for a continental breakfast while we:

1. Reintroduced our WAAIME Executive Committee members.
2. Provided a brief update on our recent strategic planning efforts.
3. Shared new initiatives like Careers That Rock!, the Rebecca Beuwpe-Siwale

(Continued on page 47)

MPD plenary session, luncheon,

Scotch Nightcap and student posters await you at MINEXCHANGE

by Aaron Noble, Associate Chair, MPD Executive Committee

The Mineral & Metallurgical Processing Division (MPD) of SME will host its annual MPD Plenary Session in the afternoon of Feb. 23 during the MINEXCHANGE 2026 SME Annual Conference & Expo (Feb. 22-25, Salt Lake City, UT). This session features lectures by the recipients of the prestigious Antoine M. Gaudin, Robert H. Richards and Milton E. Wadsworth awards.

The award recipients present technical topics while sharing their expertise and experiences in mineral processing and extractive metallurgy. Their lectures often include personal stories and career insights that make the sessions engaging and memorable. The 2026 MPD Plenary Session promises to be just as exciting and inspiring as in previous years. It is a must-attend event for MPD members and colleagues from other divisions. This year's presentations will feature:

- Jan Cilliers, the Antoine M. Gaudin Award recipient, for contributions in development and application of methods for tracking, characterizing and modeling particle motion and separation in classifiers and froth flotation processing equipment.
- Robert E. Mclvor, the Robert H. Richards Award recipient, for his long service and numerous contributions to the science and practice of comminution and mineral processing.
- Ronel Kappes, the Milton E. Wadsworth Award recipient, for her commitment to the development and transfer of flotation technology from theory to effective commercial practice for precious metals recovery worldwide.

MPD Luncheon

Additional MPD awards will be presented and acknowledged at the MPD Luncheon on Feb. 25, including:

- The Mill Gentleman of Distinction Award will be presented to Tarun Bhambhani.
- Sunil Kumar Tripathy will receive the Arthur F. Taggart Award for the paper "Development of Cold-Bonded Coke Briquettes for Ferrochrome Production in Submerged Arc Furnace."
- The MPD Outstanding Young Engineer Award will be presented to Fangyu Liu, whose award citation states: "For his enthusiasm, initiative, and can-do attitude, backed by a strong sense of responsibility in following through to successfully completing all the projects he takes on."
- James E. Gebhardt will be recognized for the Frank F. Aplan Award, which will be presented to him at the SME Awards Reception that evening, for significant contributions to fundamental and operational coal-minerals flotation chemistry and optimization/control for coal-mineral processing/hydrometallurgical operations.

Paula Sierra brought her A-game and won over the poster judges.

This year's invited speaker is 2017 SME President John Mansanti. Mansanti has more than 45 years of experience in the mining industry and has held several leadership positions. His talk will be inspiring and insightful.

MPD Unit Committee Meeting, Scotch Nightcap and Student Poster Contest

Other MPD events scheduled for MINEXCHANGE 2026 include:

- The MPD Unit Committee Meeting on Feb. 22, which is open to all MPD members who wish to get involved in the following year's MINEXCHANGE 2027 SME Annual Conference & Expo.
- The famous Scotch Nightcap scholarship fundraising event on Tuesday night, featuring MPD Past Chair David Meadows and the Bass Metals band. Commemorative whiskey glasses and T-shirts will be available for sale again this year.
- The MPD Student Poster Contest on Wednesday morning, preceding the MPD Luncheon.

Join in the fun

Your participation in these events helps the MPD raise scholarship funds and encourages and supports the future engineers and scientists within the mineral processing and extractive metallurgy field. Come join us for any or all of these events during MINEXCHANGE 2026 in beautiful Salt Lake City, UT. Get involved in your division and become more engaged with your colleagues and peers. ■

Richard Gertsch Memorial Silent Auction 2025 raised record funds

by Matt Blattman, vice president – technical services, Hecla Mining

The Mining & Exploration (M&E) Division is thrilled to announce another resounding success from the 2025 Richard E. Gertsch Memorial Silent Auction held at MINEXCHANGE 2025 in Denver, CO. Through the generous support of our members and industry partners, we raised an impressive $4,810 for student scholarships — more than doubling last year's total.

This remarkable achievement demonstrates the division's and the mining community's commitment to supporting the next generation of mining professionals. Every dollar raised — 100 percent of the proceeds — goes directly to deserving students pursuing careers in mining and exploration fields. These scholarships are critical in helping students manage the significant financial burden of their education while attracting top talent to our industry.

A decade of impact

Since 2016, the M&E Division's commitment to student support has yielded extraordinary results:

- $48,200 raised from the silent auctions with another $42,400 in direct contributions from our members.
- More than $129,000 awarded to deserving students from the M&E Division scholarship fund.

These numbers represent real impact: students who can focus on their studies rather than financial stress; emerging professionals who will lead our industry forward; and a stronger mining community built on investing in our future. These totals do not include the more than $80,000 donated to the SME Foundation from the M&E General Fund in support of the SME Ph.D. Fellowship Grant program.

Introducing Silent Auction Sponsorship for 2026

Building on this year's momentum, we are excited to announce a new opportunity for MINEXCHANGE 2026: the Silent Auction Sponsorship.

Organizations and individuals can now become official sponsors of the Richard E. Gertsch Memorial Silent Auction, receiving prominent recognition while amplifying their impact on student scholarships. Here is how it works:

- Sponsors will commit to matching all funds raised by the auction up to a maximum level, starting at $500 (though all amounts will be appreciated).
- Sponsors will receive full recognition as a Silent Auction Sponsor throughout the event.
- Sponsors will receive acknowledgment in *Mining Engineering* magazine and all auction materials.
- Sponsors will have the satisfaction of potentially doubling the auction's impact for our deserving students.

This sponsorship opportunity allows companies to demonstrate leadership in supporting mining education while receiving the recognition and prestige that comes with being a primary supporter of this important initiative.

Call for 2026 auction items

The momentum from 2025's success inspires us to aim even higher for 2026. With the addition of matching sponsors, your donated items could have twice the impact. Popular items that helped us achieve this year's success included:

- Scale models of mining equipment.
- Rare mineral specimens.
- Historical mining memorabilia.
- Mine tours and site visits.
- Commemorative coins and rounds.
- Professional sporting event tickets.
- Adventure and travel packages.

All donations are tax-deductible and will be recognized in *Mining Engineering* magazine.

Looking ahead to MINEXCHANGE 2026

MINEXCHANGE 2026 will return to the Salt Palace Convention Center, Feb. 22-25. The M&E Division will continue its tradition of combining scholarship fundraising with our annual luncheon, award ceremony and Jackling lecture, creating an engaging event that brings our community together for a worthy cause. With the new sponsorship opportunity, we anticipate our most successful auction yet.

Thank you to our supporters

The M&E Division extends heartfelt gratitude to everyone who contributed to making the 2025 auction our most successful in recent years. Your generosity directly impacts students' lives and helps ensure a strong future for our industry.

For information about Silent Auction Sponsorship opportunities or to arrange early donation of auction items for 2026, please contact Matt Blattman at mblattman@hecla.com. Together, we are building the future of mining, one student at a time. ■

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20th North American Mine Ventilation

Symposium included keynotes, technical papers and workshops

by John Bowling, 2026 Chair, C&E/M&E Underground Ventilation Unit Committee

The 20th North American Mine Ventilation Symposium (NAMVS) was hosted by Penn State in Canonsburg, PA June 21-26, 2025. The symposium is hosted biannually with support from the Coal & Energy (C&E)/Mining & Exploration (M&E) Underground Ventilation Committee (UVC).

This year's symposium brought together 137 attendees from mines, vendors and research institutions, including 16 exhibiting companies. The 2.5-day symposium featured keynote speeches from George Luxbacher, Craig Stewart, Jozef Stachulak, Alexander Bugarski, Kingsley Hortin and Brian Prosser, and 51 peer-reviewed technical papers on many aspects of mine ventilation. The symposium was preceded by two days of four-hour technical workshops offered on topics including mine air heating and cooling, fan selection and performance, ventilation surveys and model calibration, and dust control methods. A smaller group of attendees toured Komatsu's Franklin facility following the technical program.

The 20th North American Mine Ventilation Symposium (NAMVS) was hosted by Penn State in Canonsburg, PA June 21-26, 2025.

The UVC presented the Mine Ventilation scholarship to Aamir Iqbal of Missouri S&T.

Meeting discussions

At the 2025 NAMVS, the UVC met to discuss the period lapse between the next NAMVS and the 2028 International Mine Ventilation Congress (IMVC). The proposal to postpone the 2027 NAMVS received broad acceptance and support due to the proximity of its abstract submission deadline to the conclusion of the 2026 IMVC in Bali, Indonesia. The UVC also discussed the SME timeline for awarding the Hartman Award, as well as the appointment process, nomination criteria and duties related to the appointment of the IMVC committee U.S. representative. The UVC decided to host the International Mine Ventilation Congress coincident with MINEXCHANGE 2028 SME Annual Conference & Expo in Phoenix, AZ.

Howard L. Hartman Award

The UVC presented the 2025 Coal & Energy Howard L. Hartman Award to Cheryl Allen for her distinguished contributions in practice and research in the field of underground ventilation engineering.

Cheryl Allen received the Howard L. Hartman Award.

Allen is a professional mining engineer and technical manager with more than 40 years of experience in hard-rock mining in various mining engineering positions in Canada and the United States. She recently held roles of manager ventilation design and tech support for Vale NA Operations, then moved to Vale Base Metals as interim practice leader, mining guiding the work of the strategic mine planning group and is currently technical leader, vent and infrastructure in the CTO Center of Excellence.

Allen has served on government committees and research organizations tackling ventilation's most pressing challenges from diesel particulates and heat stress to carbon emissions, green technologies and battery-electric vehicles. She is currently president of the Mining Diesel Emissions Council, co-chair for CSA M424 series standards and participates on Ontario's mining legislative review committee.

She has authored or coauthored more than 45 technical papers, led workshops, delivered keynotes and participated on expert panels – sharing knowledge freely and helping to shape the future of mining ventilation. ■

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Equipping next generation of miners on how to identify and reduce risks

by Matthew Main, Communications Chair, H&S Division Executive Committee

Since 2020, the mining industry has seen a shift in the workforce delivering the needed products to an ever-consuming world, with many people transitioning from nonindustrial backgrounds to the industrial world of mineral production. This shift, unfortunately, has led to increased injury and fatality rates at many operations. I often hear comments like "people just aren't recognizing risk" and "anyone should have known not to do that." With this understanding that much of our workforce does not have previous heavy-industry experience, I want to share some insights into how we might help employees recognize and treat risk more proactively to reduce injuries and fatalities.

Every 1/18th of a second, our brains absorb approximately 1,850 bits of information from our senses (that is about 32,000 bits of information every second). Our conscious brains, which absorb and respond to information, can only respond to 7±2 bits of that information. The brain will prioritize these 32,000 bits of information for response by the hierarchy of what is dangerous, important, pleasurable and interesting (DIPI), in that order. (Sentis Pty Ltd, 2009) Without going into more of how the brain works, the most important thing for us as mining professionals is to have our workforce recognize and respond to the signals that will help keep them safe.

Without having background into the consequences of exposure to the high energies involved in mining, it is difficult for someone to understand the dangers that these hazards pose. Telling newer employees that high-energy hazards could cause serious injuries or fatalities may not be enough. I wonder how effective it would be to bring back some of those safety meeting presentations we had 30 years ago where we showed photos of what the consequences of these high energies can do to a person. I know those are not popular for many reasons, but I think as leaders we can respectfully show those images and tell our personal stories that will engage that emotional response to pay attention to those danger signals.

Identifying things that can hurt us as the enemy

When we look at the importance of information that a miner may perceive, this is where we as mining leaders have the most potential for impact. We all know that what is important to the boss is something to which we should pay attention. So, what is important to the boss? It is what the boss always asks about and has a passion to follow up. As a leader in the mining industry, what is important to you and how do you show that? I am confident that if you continually follow up on the fatal risks in your business, miners will know that it is important, and they will pay attention to it.

There is a lot of conversation that "safety" includes workplace exams (WPEs), preshift equipment inspections and job risk assessments (such as JRA, JSA) — what you do before you really get to work. All this just seems like paperwork and something to get through. What if we, as leaders, do something to make these tasks pleasurable? I have heard hazards and risks referred to as alligators, gorillas, boogers and gremlins. I love this concept because that identifies what can hurt us as the enemy. I totally support those programs that incentivize things that identify things that can hurt us. As a mining leader, how do you support and recognize identifying and eliminating these hazards? I know this is not easy, because it means at times we must sacrifice production.

Understanding what you do and why you do it — why it is important

Understanding the bigger picture of what we achieve by our efforts is interesting because it impacts us personally. Knowing that hazards can prevent us from providing for or achieving what is most important to us will make the information, particularly safety information, interesting to miners. It is important that we help link miners' labor to the value and benefit they provide to the lives of others. When miners know how important their efforts are to the lives of others, especially those who are most important to them, information that will help them work safer and more successful will become interesting. I encourage all of us to share more information with our workforce that will help them understand that being a miner is much more than just a job. Miners provide materials that enhance the quality of life of everyone.

To close this share, I hope that I have inspired our mining leaders to think about how we equip the next generation of miners to identify hazards, evaluate the risk and apply treatment to reduce risk to as low as reasonably practicable (ALARP). It all begins with identifying hazards.

How we communicate information to our new miners that will make it DIPI has never been more essential. We have a newer workforce and at the same time we have emerging safety challenges with things like artificial intelligence and automation. Mining has a history of overcoming monumental challenges, and I believe that the mining community will rise to the challenge once again. ■

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WAAIME Wire

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Memorial Scholarship, and the mentoring and industry partnership programs of our Lima Section.
- Explored synergies between WAAIME's new vision and goals and the initiatives of other SME divisions and committees.

We had a fantastic turnout, including nine past, current and future SME Presidents. The Government and Public Affairs Committee (GPAC), whose meeting overlapped with ours, even paused for 20 minutes to hear what WAAIME had to say. Thank you, GPAC — and thanks to everyone who attended — for your support.

Immediately following the outreach meeting, we held our finance meeting. Tom Austin and Ryan Smith of RBC Wealth Management provided our executive committee with an overview of the securities market and the economic outlook. As of Aug. 31, 2025, the WAAIME portfolio was valued at approximately $9.5 million, with an estimated cash flow for operations exceeding $250,000 and a year-to-date return on investments of more than 8 percent. Michelle Hegarty, SME Chief Financial Officer, updated us on WAAIME's financials through July 31, 2025. Factoring in our forecast for the remainder of the fiscal year, we are projecting revenue over expenditures of about $22,000 — a solid recovery given the market's performance earlier this year.

Our midyear executive committee meeting took place Sunday morning. One of my priorities over the past few years has been to increase transparency in WAAIME activities. Last year, we developed the WAAIME Operations Handbook, which was approved in February. Building on that, we have now established five guidance documents to help future WAAIME leaders and committee members carry out routine tasks and programs. These documents, along with the operations handbook, are available online at https://www.waaime.org/AboutUs.

We are also excited to announce the creation of our second award. Since 2014, the Founder's Award has recognized members who have made significant contributions to a local WAAIME section or committee, or to the goals and vision outlined in our incorporation and vision. To better honor our outstanding international volunteers, the WAAIME Executive Committee unanimously voted to establish the International Founder's Award. This new award will recognize WAAIME members from Chile, Mexico and Peru separately from our U.S. recipients. Our U.S. awardees will continue to be honored at the MINEXCHANGE SME Annual Conference & Expo, while international recipients will be recognized at appropriate extractive industry-related events in their respective countries. We anticipate presenting the first International Founder's Award in 2027.

The outreach meeting drew strong attendance from volunteer leaders interested in exploring new WAAIME initiatives.

Barb Filas, WAAIME Chair, delivers key division updates during the SME Midyear Meeting in September 2025.

It was wonderful to see SME volunteer leadership rally behind WAAIME's vision to "invest in students of all ages to help solve the workforce challenges of the extractive industries." If you have not already, consider adding WAAIME as your secondary SME Division by updating your SME profile at https://www.smenet.org. You can support WAAIME in addition to your membership in your chosen technical division (https://www.smenet.org/divisions). If you need assistance, feel free to email us at waaime@smenet.org.

Encourage your nontechnical partners and friends to join our mission — free of charge and without needing to formally join SME — by clicking "Join Us" at https://www.waaime.org and completing the form. Stay informed and connected by following us on LinkedIn at https://www.linkedin.com/company/waaime, https://www.linkedin.com/company/waaimeperu, https://www.linkedin.com/company/waaime-chile and, coming soon, WAAIME Mexico.

It was a busy and productive weekend at the SME Midyear Meeting, and the enthusiasm for WAAIME was palpable. We look forward to working with you — let us know how you would like to get involved. ■

WAAIME Wire **serves as a forum for the presentation and discussion of facts, ideas and opinions pertaining to the interests and technology of the WAAIME Division. Accordingly, all material published herein is signed and reflects the individual view of the authors. It is not an official position of SME or the division. Comments by readers will be referred to that division for response. The division chair in 2025 is Barbara Filas.**

Letter from the SMEF President

At this year's MINEXCHANGE 2025 SME Annual Conference & Expo, the SME Foundation (SMEF) hosted an update meeting for Corporate Roundtable Partners. During the session, details were provided on our latest accomplishments and plans were outlined for the near future. In addition to updates, we held a tabletop discussion, inviting attendees to share insights on how SME and SMEF can better serve the mining community.

Gathering recommendations for domestic mining support

One of the key discussion questions focused on how SME could better capitalize on the current support for domestic mining. Participants offered a wide range of recommendations, including ideas related to legislation, education, advocacy, enhancing industry collaboration and bolstering research and innovation. While SME does not engage in direct lobbying, it collaborates closely with other industry groups that advocate for mining by providing technical expertise and subject-matter experts. SME is also working to raise its profile on Capitol Hill, positioning itself as a key source of technical and operational knowledge.

Strengthening engagement and industry support

Additional questions sought suggestions for SME and SMEF to strengthen engagement and improve overall industry support. Attendees contributed numerous valuable ideas, especially in the areas of education, awareness, student involvement and positive public perception. The Foundation's principal annual program, the Minerals Education Coalition, remains dedicated to educating the public on the importance of minerals and mining in contemporary society.

Collaboration and outreach initiatives

SME supports the National Outreach Collaboration (NOC), which hosts quarterly discussion-based meetings with mining organizations nationwide. These meetings facilitate the sharing of best practices and innovative ideas. Another significant area of SME's support includes local sections and student chapters, which serve as important sources of public engagement and knowledge exchange.

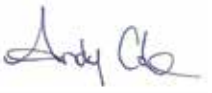
Appreciation and next steps

The Foundation is grateful for the interaction and input from all participants in the discussion. The suggestions collected are invaluable for ensuring that the Foundation's efforts are focused appropriately and aligned with the objectives of our partners. This feedback will be shared with the SME Board of Directors as we begin the process of updating the strategic plan.

Looking ahead

We look forward to meeting with Corporate Roundtable Leadership during MINEXCHANGE 2026 in Salt Lake City, UT. This upcoming event will provide another opportunity to connect, share ideas and strengthen partnerships to help advance the mining industry.

Best wishes,



Andy Cole
SME Foundation President ■

Andy Cole

2nd annual WV golf tournament a great success

by Megan Martin, SME Foundation Manager

For the second year, mining companies from coal country gathered to raise money for the SME Foundation at The Greenbrier Resort in White Sulphur Springs, WV.

Thanks to the generous sponsors and numerous golf teams, the SME Foundation raised more than $18,000 for the Ph.D. Fellowship and Career Development Grant Program. Guests enjoyed an evening reception on Thursday night; then, on the following morning, 100 golfers competed on the beautiful Meadows Course. The big winner of the day was the team from SKF.

Thank you to the Golf Planning Committee members Joe McQuerrey, Michael Myers, Tom Rauch and Eric Shereda. This event would not have been possible without their commitment and dedication.

We look forward to holding this event again next year. ■

John Anthony Organiscak, 1958-2025

John Anthony Organiscak, 67, of Eighty-Four, PA passed away Sept. 18, 2025, at UMPC Shadyside Hospital, Pittsburgh after battling leukemia over the past year. He was born in Washington, PA on Aug. 3, 1958.

Organiscak came from a family history of coal miners. When he was three years old, his father, Joseph, died as the result of a coal mining accident. This influenced his dedication and passion to improve the health and safety of miners.

After graduating from Bentworth High School, Organiscak received a B.S. degree in mining engineering from Pennsylvania State University and an MBA from Duquesne University. He began his career in research in 1981 as a mining engineer with the U.S. Bureau of Mines. In 1996, he was transferred with his coworkers to the National Institute for Occupational Safety and Health (NIOSH).

Organiscak became nationally and internationally respected for his research and expertise in dust control for both underground and surface mining industries. He conducted research for underground mining that optimized the performance of water sprays, evaluated the effectiveness of wetting agents, assessed the performance of wet and dry scrubbers, and identified cutting-bit designs that minimized respirable dust generation.

He developed a mathematical model that has been used by the International Organization for Standardization (ISO), consultants and mining companies to improve air quality in enclosed operator cabs used in surface mining, construction and agricultural industries.

John Organiscak

Organiscak authored 60 technical manuscripts that were published in *Mining Engineering,* peer-reviewed journals, government publications, and the proceedings of mining conferences. He coauthored an additional 60 manuscripts with coworkers and/or industry partners. He also completed 64 technical presentations at mining conferences and industry workshops.

Organiscak was a respected senior researcher and became an influential mentor to many young engineers and scientists. His research findings identified operating practices and control technologies that have been implemented by mine operators to lower respirable dust levels in their mining operations. He retired in 2018 after 37 years of service at the Pittsburgh Research Laboratory.

Outside of work, Organiscak was an avid marksman, hunter, all-around outdoorsman and golfer. After retirement, he enjoyed traveling with his wife, Joan. ■

Green News

(Continued from page 42)

projections suggest electricity consumption could increase by 25–35 percent over the next decade, placing a premium on reliable, resilient power infrastructure. For the mining industry, this surge in demand highlights the critical role of domestic mineral suppliers in supporting the energy transition, positioning them as essential partners in meeting the country's growing electricity and technology needs.

For miners, these developments present both risks and opportunities. Deregulation and NEPA reform may streamline permitting, increased energy demand could drive new project opportunities. However, compliance remains essential and litigation risks associated with unresolved scientific disputes are likely to persist. Companies that stay ahead of these shifts will be best positioned to capitalize on a changing regulatory landscape. ■

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Media Review

SME

Renewed support for mining stretches beyond Washington

William Gleason
Editor

On page 6 of this issue, SME President Bill Hancock hands over his pen for the President's Page to Debra Struhsacker, a mining and public lands consultant, to help explain the recent mining developments that have come out of Washington, DC this year. It's a tall order to pack all of that information into one column, yet Struhsacker skillfully carries readers through a sea of executive orders (EO) that relate to domestic mining.

For an industry that normally operates away from public view it has been remarkable to see how much attention the mining industry has attracted in recent months. The journey begins with the EO 14154 — Unleashing American Energy and EO 14156 — Declaring a National Energy Emergency. Struhsacker notes these orders "form the foundation for the energy, mining and permitting policies in subsequent executive orders."

Additional EOs have aims that include to eliminate all agency actions that burden domestic mining and mineral processing and to reassess the mineral potential of withdrawn public lands; define energy to include critical minerals and underscore the need for reliable and affordable energy and create the National Energy Dominance Council in the Executive Office of the President to advance President Trump's energy and minerals agenda. They also aim to reinstate coal as an important fuel source for U.S. power plants and to accelerate the development of nuclear power.

And it doesn't stop there. Congress is considering a number of bills that could benefit the mining industry, including H.R. 4776, that would propose significant improvements to the National Environmental Policy Act (NEPA) along with many other actions.

Supporting these efforts is an unprecedented amount of investment in the mining sector by the federal government including the government's willingness to invest directly in the sector. In October, the U.S. Department of Energy announed it has taken a five percent stake in Lithium Americas and an additional five percent stake in the Thacker Pass lithium mine. This follows the public-private partnership agreement with MP Materials that was announced in July. That agreement makes the federal government the largest shareholder of the company.

Since then, *Reuters* reported that at least a dozen mining or mining-related companies with interests in lithium, copper and rare earths have inked deals with major Washington lobbying firms. *Reuters* found that there has been a sharp uptick in influence campaigns aimed at securing federal investment, permitting support and long-term procurement guarantees.

The Biden administration also provided significant support for critical minerals development and processing as part of a broader industrial policy agenda. However, it relied largely on loans to the industry from the Department of Energy and Department of Defense and tax credits from the Inflation Reduction Act.

Outside of Washington, there is an increasing amount of interest in domestic critical mineral development as well.

On Oct. 13 JP Morgan announced plans to hire bankers and invest up to $10 billion in U.S. companies critical to national security and economic resilience as part of a broader $1.5 trillion pledge. The 10-year initiative aims to facilitate, finance and invest in industries central to the growth of the U.S. economy, including defense, energy and manufacturing; presumably, this will include mining and mineral processing companies.

JP Morgan chief executive officer Jamie Dimon said the investments were not driven by the Trump administration but would be 100 percent commercial.

"This is a JPMorgan initiative," Dimon told journalists on a call in which he was asked about the investment.

"It has become painfully clear that the United States has allowed itself to become too reliant on unreliable sources of critical minerals, products and manufacturing — all of which are essential for our national security," Dimon said in an earlier statement.

JPMorgan said its new "security and resiliency initiative" would facilitate financing and investment across four strategic sectors: supply chain and manufacturing; defense and aerospace; energy independence and frontier technologies such as artificial intelligence and quantum computing.

The interest in critical mineral development has been building for a few years, but what we are witnessing now seems to be something more, something that Struhsacker calls a "once-in-a-career opportunity." ■

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