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SEPTEMBER/OCTOBER 2024 • SEPTEMBRE/OCTOBRE 2024
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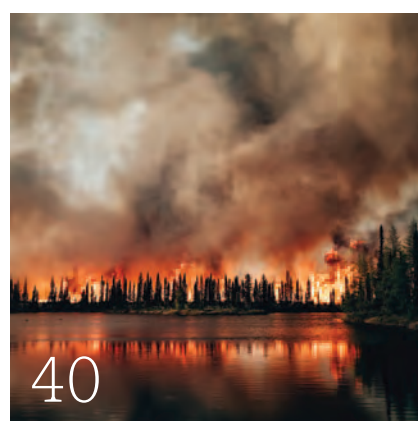
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Innovation, Las Vegas style

It has been eight full years since I spent a little more time than necessary being lectured by the star of a reality TV mining show on the importance of regularly scheduled maintenance and the best choice of industrial lubricants. We sat in a temporary conference room overlooking acres of mining machinery, having the sort of peculiar encounter that can really only be expected at MINExpo International in Las Vegas.

For those who don't know, MINExpo, organized every four years by the U.S.-based National Mining Association, is the pre-eminent exhibition of mining supplies and service in North America. Major equipment manufacturers use the massive venue in Las Vegas to showcase the biggest earthmovers in their fleets and exhibitors compete for attention with gadgets, giveaways and face time with minor celebrities.

In 2016, a key theme was the opportunity of autonomous haulage. Four years later, the pandemic forced the postponement of the event and, with cross border travel still a gamble, *CIM Magazine*, along with many others, opted not to attend when it was ultimately held in the fall of 2021. By this point, battery electric equipment had become the marketing focus on the showroom floor as a growing roster of major miners had signed on to net-zero carbon commitments.

Given the circumstances of the last edition of the show, I expect MINExpo 2024 will be a well-attended spectacle. I encourage you to read our preview of the event, "Global innovation" (p. 48) by regular contributor Alexandra Lopez-Pacheco, which includes the observations of technology and

service providers that have been closely following the arc of innovation in the sector. You can expect a continued focus on technologies such as autonomous operation and battery electric vehicles but from a more holistic, life cycle perspective—and a whole lot of AI.

This year, while I am not able to attend, *CIM Magazine* editors Silvia Pikal and Ailbhe Goodbody will be there to take as much of it in as they can to build out the technology and innovation-focused elements of our editorial calendar for the months ahead.

For those of you going, enjoy the show, and come say "Hi!" at the CIM booth (#1663), and for those who won't be going, we will do our best in the coming issues to highlight the trends and opportunities the *CIM Magazine* team discovers.



Silvia Pikal



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This issue's cover

Solar panel installation at the Diavik mine.

Courtesy of Rio Tinto

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Effective governance for a sustainable future

As I have navigated my career across the globe over the last 40-plus years, I have come to the realization that we as a species cannot self regulate, and therefore it is critical to have in place what I call “checks and balances.” If you were to ask my children, they would roll their eyes and agree that I have discussed this theme, among others, ad nauseum at our everyday dinner table conversations.

In the mining industry, robust governance is essential for sustainable success and long-term viability. Board members must navigate broad strategic goals while addressing day-to-day challenges, guided by key governance themes to foster a thriving, responsible organization.

For CIM, a complex organization that serves members across the vast country of Canada, and which is composed of a National office, Societies and Branches, it is critical that we acknowledge and embrace the principles of good governance before we venture into delivering a strategy.

Diverse leadership teams bring varied perspectives, enhancing decision-making and fostering innovation. Collaboration leverages unique skills and experiences, strengthening strategic planning and operational oversight. A culture of inclusivity and respect enables diverse voices to contribute meaningfully, driving the organization towards its goals.

A rigorous succession plan is essential for maintaining organizational continuity and resilience. Aligning succession planning with position renewal and refreshment ensures that the organization remains dynamic and capable of meeting future challenges. Recognizing the skills matrix required to deliver the organization's strategy is crucial. This approach ensures that the leadership team possesses the necessary competencies and depth of talent to drive the organization forward.

Regular self-assessment and constructive challenges drive improvement. Leadership teams should strive to add value by interpreting complex information, anticipating changes and maintaining core governance principles even amid disruption. This initiative-taking approach ensures that the organization remains agile and responsive to emerging trends and challenges.

CIM (National, Societies and Branches) should identify and then adhere to fundamental governance principles, including accountability, transparency, stakeholder engagement and risk management. These principles must reflect the organization's purpose and be embraced by all. Engaging with both external and internal stakeholders fosters trust and collaboration, which is essential for addressing the complex challenges of the mining sector.

Openness builds confidence. Transparent reporting and early disclosure of issues allow for timely improvements, enhancing organizational maturity and stakeholder trust.

Benchmarking against best practices and maintaining quality and standards are vital. Effective systems provide a line of sight from front line operations to the senior leadership levels. These systems ensure that the organization operates efficiently and safely, adhering to industry standards and regulations.

Effective risk management practices are integral to sustaining the organization's long-term success and resilience.

Any organization, like CIM, must define its purpose and vision clearly, aligning resources and all actions to support these core objectives. This clarity ensures that the organization remains focused on its strategic goals. Without clear strategic direction, even the best-intentioned governance systems can falter.

CIM has worked on a refresh around its bylaws, which form a foundation to our governance framework, and plans to release its new strategic plan this fall, after approval by Council in September 2024.

**Find CIM's
governance
policies
here**



Ian Pearce
CIM President

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D6T LGP	D8T LGP	D9T	D10T	D11T
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938	950	966M/744K	844K/980K/M	988H/K - WA900	992/922G
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20-47 Ton HEX	65-90 Ton HEX	120-200 Ton HEX	EX2600	EX3600	EX5500/PC5500	PC7000	PC8000
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16M	24M - 24
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Upgraded electric truck

Caterpillar will be showcasing its 798 AC electric drive truck, which has a payload of 372 tonnes. It recently underwent some upgrades for improved safety and performance. Key updates include a cab refresh that incorporates drive and hoist controls into a single lever to improve operator control, a redesigned engine access door—which is easier to open and prevents tripping hazards—updated body and chassis lighting to improve visibility for users and a simplified electrical system that now has enhanced troubleshooting capabilities. The truck can also be paired with Cat MineStar Command for Hauling, an autonomous hauling solution, which the company said improves safety by removing operators from the area and has been shown to increase productivity by 30 per cent. The company will also launch its Collision Awareness System (CAS) at MINExpo, which will be demonstrated on the 798 AC and CAT 995 wheel loader. CAS is a site-wide solution that improves safety for operators by warning them ahead of time of any potential collisions or accidents that could occur.



Courtesy of Caterpillar

Reliable and durable vibration control

Haver & Boecker Niagara will be sharing its recently updated full-size Niagara F-class vibrating screen. The company stated that the product is an ideal solution for challenging screen applications that require dependable performance and has been designed with new technology that will help simplify maintenance. The screen is now built using vibration-resistant lockbolts in place of traditional welding deployed in previous editions of the product, which enhances structural integrity during the demanding operation of a vibrating screen and makes maintenance more efficient. The company also secured bar rails to the cross beams with lockbolts, allowing for easy exchange if they become worn. The screen is designed with a double eccentric shaft assembly, which the company said creates a constant stroke to maintain g-force during material surging, providing continuous material stratification to ensure accurate product specification. It added that the dynamically balanced system transmits almost no vibration into the structure or chassis, maintaining the integrity of the structure while also allowing for multiple machine installations.

Courtesy of Haver & Boecker Niagara



Efficient rock extraction

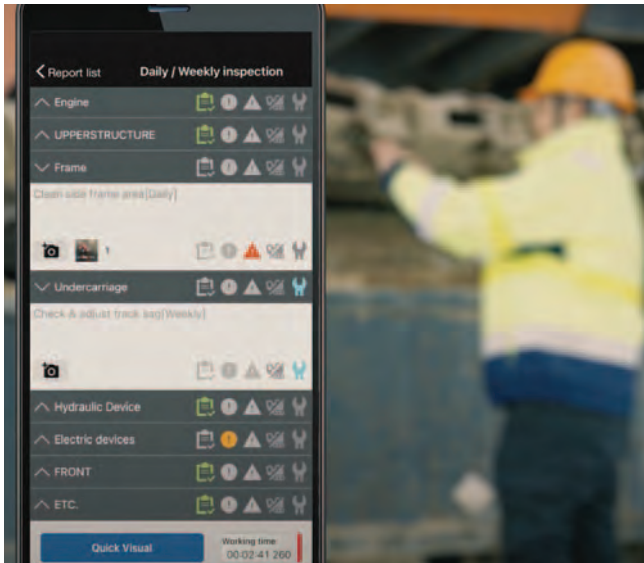
Wirtgen's new cutting drum, which will be making its tradeshow debut at MINExpo, is designed to be used with the company's surface and cross application miners and enables the extraction of high-strength rocks and minerals that are hard to cut, such as limestone and gypsum, that have a uniaxial compressive strength of more than 100 MPa. The cutting drum was launched at a limestone quarry in Louisville, Nebraska, and, when equipped on a surface miner, extracted very hard limestone from a deposit that was previously unutilized. The company said that the use of the new cutting drum extended the working life of the quarry and eliminated the need for drilling and blasting at the site. The product's direct belt drive transfers high usable power to the cutting drum, which is rigged with HT14 toolholders and also includes a redesigned cutting geometry.



Courtesy of Wirtgen

Compiled by Ashley Fish-Robertson

Courtesy of Hitachi



Enhancing machine monitoring

Hitachi is introducing updates made to its ConSite Mine system, which monitors large mining machinery such as hydraulic shovels and rigid dump trucks and uses AI-driven analysis to proactively identify issues before they occur. For example, by predicting cracks in an excavator's boom and arm, the system can help users anticipate where maintenance and inspections are needed to prevent costly repairs. Updates to the system include Pump Health Detection, a function that allows for proactive monitoring of hydraulic pumps, as well as the implementation of ConSite Mine Scan, a powerful new tool that can help operators with performance testing and wear measurement, which assesses how much a machine's component has worn down or degraded over time due to its operational use. ConSite Mine provides two types of detailed reports for users, including a monthly report with updates about a machine's operational status, and an alarm report, which quickly alerts operators to any abnormalities that have been picked up by various sensors.

High-precision drilling

Medatech will be releasing the Borterra RaisePro-48, a new track-mounted in-the-hole (ITH) drill rig that is designed to tackle drilling tasks, which the company stated includes up to 48-inch outside diameter raises and service holes and also tackles highly accurate production drilling using a custom control system and the drill's powerful ITH air hammers. The product features the Eurodrill RH 24X top drive, which is a robust mast with a split centralizer. All of the rig's hydraulic functions can be seamlessly managed through its CAN-BUS controller/computer and programmable modules, providing operators with a reliable control system. Some noteworthy safety features of the rig include motor overload protection, a tramming alarm and safety shutdowns.



Courtesy of Medatech

Courtesy of Flexco



Efficient belt recovery

Flexco will be presenting its new FXC Steel Cord Belt Fastening System. The FXC can act as either a temporary splice until a vulcanized splice is installed or it can pull a belt onto a conveyor system. "A major issue that heavy-duty sites often deal with is reacting to unplanned downtime," said Franklin Moore, Flexco product manager, in a July 10 press release. "The FXC allows users to get their steel cord belts back into operation quickly, drastically reducing the effects of downtime, which helps increase the site's bottom line." The company stated that even though this product is meant to serve as a temporary solution, operators can expect full performance at normal levels until vulcanization is arranged, allowing operations to continue. In addition to the FXC, the company will also be exhibiting its 900 Series Belt Cutter/Skiver for the first time, which will be released soon and includes updated clamp knobs, a drive handle with both manual and powered drill capabilities, and a new design.

Developments

Photo by Lucas G. Pilote

Wildfire season

Compiled by Silvia Pikal

In Eastern Canada, a wildfire that blazed along the borders of both Quebec and Newfoundland and Labrador impacted two different mining operations in July.

Due to an evacuation order, starting on July 12, 2,000 employees

(continued on page 15)

A photo taken of a forest fire in Lac St-Amand, Quebec.

were removed from the Iron Ore Company of Canada's mine in Labrador City and operations were paused at the iron ore mine until July 22.

Champion Iron announced on July 13 that it had temporarily shut down its Bloom Lake iron ore mine in Quebec as a preventive measure due to the same wildfire that was threatening Labrador City, which is located roughly 20 kilometres away from Bloom Lake. Workers began to return on July 15.

In Alberta, a particularly hot and dry July made it difficult for fire crews to battle out-of-control wildfires in the northern part of the province, the looming threat of which led several companies with oil sands operations to evacuate non-essential workers from their sites in July. Those impacted were Cenovus's Sunrise site, Imperial Oil's Kearl oil sands mine and MEG Energy Corp.'s Christina Lake facility, along with Suncor Energy's Firebag site, which also had to reduce production due to the encroaching fires. It did not state by how much.

The *Canadian Press* reported on July 21 that Suncor Energy Inc. filed a disclosure document in 2023 stating that if extreme weather forced a 10-day shutdown of its Base Plant operations, which are located in Fort McMurray and have a production capacity of 350,000 barrels per day, that the company would lose \$56 million of revenue per day.

At the end of July, the Société de protection des forêts contre le feu (SOPFEU) in Quebec sent 40 people, along with fire-fighting equipment, to Alberta as part of a two-week mission to help fight wildfires in the province. In Jasper, the largest wildfire the national park has seen in a century destroyed a third of the structures in the historic town in July.

In central British Columbia, Artemis Gold stated that it had cleared out non-essential workers from its Blackwater mine on July 21 due to an evacuation order across a region that included the mine, which is currently under construction, and Osisko Development took the same measures for its Cariboo gold project. Workers were back at both sites a few days later, neither of which were directly affected by the wildfires.

An August 21 National Wildland Fire Situation Report from Natural Resources Canada reported that approximately 4,848 wildfires had burned in Canada in 2024 to date, with 176 uncontrolled fires still active across the country. **CIM**



Courtesy of Newcrest Mining Limited

A new AME report stated that there are 18 active mines currently operating in B.C., including the Brucejack gold and silver mine owned by Newcrest Mining Limited.

Report urges collaboration on B.C.'s Mineral Tenure Act reform

The Association for Mineral Exploration (AME) released a report on July 24 titled "MTA Modernization: What We Heard and Where We're Going," bringing together insights from AME members, Indigenous communities and other stakeholders about the modernization of B.C.'s Mineral Tenure Act (MTA) and Mineral Tenure Online (MTO) systems and what impact it is having on the industry.

In its report, AME stated that while it agrees that the MTO system should be updated and that there should be a consultation standard in the new system, it is concerned that the mineral exploration and mining industries are being left out of the engagement process by the provincial government. AME called for a more "collaborative approach" to policymaking in the report, adding, "We believe that the government's active engagement with mineral explorers is vital to the successful modernization of the MTA."

Modernizing the MTA

In September 2023, B.C.'s Supreme Court ruled that the province's mineral rights regime, which allows for mineral claims to be registered online without notifying Indigenous groups, violated the

Crown's legal duty to consult Indigenous peoples. Following this ruling, the Supreme Court granted the province a period of 18 months to modernize the MTA and include the duty to consult.

In its recent report, AME compiled feedback, insights and suggestions gained from three months of consulting participants through several sessions across the province, an online survey and one-on-one meetings.

"Members told us throughout our engagements with them that they didn't feel that [the B.C.] government was listening or engaging with them," said Keerit Jutla, president and chief executive officer of the AME, in an interview with *CIM Magazine*. "So, AME and service members chose to go out to several regions of the province to listen and to make sure their voices were heard."

Following an analysis of the collected feedback, AME outlined 10 recommendations on how the B.C. government can approach the modernization of its MTA and MTO systems while simultaneously supporting the province's 2019 Declaration on the Rights of Indigenous Peoples Act and the mineral exploration industry.

Top recommendations

Among the recommendations outlined in the report, Jutla highlighted some key areas for improvement. One is the need for a consultation standard for claim staking, which he considers to be a "big step" given it is not as common to see in the global mineral exploration industry.

“The current MTO does not have a consultation standard and allows people to stake claims from a desktop,” the report stated. “The status quo doesn’t just infringe on Indigenous Nations, but it creates an advantage for organizations that stake large tracts of land to take them off the market and commodify them rather than exploring them. This harms prospectors and creates a pay-to-play system.”

Jutla added that when rebuilding the MTA, the process has to be fair, which means that all parties understand how decisions are made, who makes them and what the standards are for those decisions.

He also underscored the need for increased Indigenous participation in the consultation process, along with actions to further reconciliation. “Reconciliation is something that is essential and that is a key pillar for AME,” said Jutla. “Our members are very committed to it and any type of MTA we want to build has to have a mutual respect-based framework.”

According to the report, 63 per cent of survey respondents said that their organization engages in a “moderate to high degree of effort” to advance Indigenous reconciliation, while 75 per cent of respondents, excluding suppliers, reported maintaining relationships with one or more Indigenous Nations in areas where they operate.

The report said that if the government is committed to reconciliation, it should implement means of accommodating both the Nations and the prospectors.

“Rather than punitive actions that either disincentivize exploration or shift exploration activities to only companies with Indigenous relations departments, government should focus on ways to raise all boats,” the report stated. “This includes increasing capacity of First Nations Land offices and environmental monitors who want to play a role in mineral exploration and mining.”

Jutla added that, in addition to these top recommendations, timely decision making is crucial for the success of an updated MTA. He explained that with mineral exploration, there is often a certain window of time where prospectors can go out and explore, as well as a limited amount of capital to work with.

“If you have a process that doesn’t have clear set timelines, you potentially risk losing a lot of capital by explorers not being able to do the work that [needs to be done],” he explained.

— Ashley Fish-Robertson



Once commercial production is reached at the second phase of the Jansen project in 2029, it is expected to produce around 8.5 million tonnes of potash per year.

First phase of BHP’s Jansen project reaches milestone

BHP announced on July 22 that the first phase of its Jansen potash project has surpassed the halfway point of construction and is 52 per cent complete. The second phase is also under way at the mine, which is located about 140 kilometres east of Saskatoon, Saskatchewan.

First production at the mine is anticipated for 2026, with an estimated output of 4.2 million tonnes of potash per year. Production from the second phase is forecasted to begin in 2029, at which point the mine is expected to produce around 8.5 million tonnes of potash per year.

Karina Gistelinck, BHP’s asset president of potash, told *CIM Magazine* in an interview that critical path activities, such as the underground development of the mine, the shaft buildup and the construction of supporting infrastructure, have all been completed. The focus now will be on completing the mill building and processing plant, port construction, finalizing infrastructure and preparing to hand over the project to operations.

“[At first], we were scheduled to have first production out by 2027, and now with that halfway mark met, we can actually confidently say our first potash will come out in 2026, which means we’re ahead of schedule,” said Gistelinck.

This milestone has not come without its hurdles. Gistelinck said that the company has felt the impacts of Canada’s construction labour shortage. She added that 5,500 jobs have been created at Jansen during construction, and once fully ramped up, the project will have 900 full-time, permanent jobs on site to help run the mine.

Saskatchewan’s strong and persistent winds have been another challenge, she said, adding that a lot of the big lifts being performed at the site were impacted by the consistent winds in the area.

“We’ve been able to respond to that very well,” Gistelinck said. “One of the things that the team has done is adapt the shifts of our crews to be able to hit those windows where the wind is a bit lower, which tend to be in the early morning and just before the evening.”

Of all the hurdles BHP has faced so far during the development of the Jansen project, the sinking of its two shafts was a significant obstacle to overcome considering it can be one of the most risky parts of a greenfield project.

In October 2022, the team at Jansen successfully completed the excavation and lining of two 1,000-metre-deep shafts at the mine. The team devised a novel method for sinking the shafts—which are the largest of their kind in the province—by artificially freezing the ground at the site to a depth of 800 metres. This approach effectively stopped water from entering and maintained ground stability during

4,200,000

Expected potash production in 2026, in tonnes

8,500,000

Expected potash production per year by 2029, in tonnes

5,500

Jobs created at the Jansen potash project during construction

shaft excavation, and it also represented the world's first instance of mechanized shaft sinking.

"In our view, [the method] adds a lot of synergies as you operate because you don't have all of that moisture and the interaction of the soil going into your mines, which, again, also helps us with having a safer environment down there for our colleagues," she said, adding that these advantages will also improve productivity once the mine is in operation.

– Ashley Fish-Robertson



Courtesy of Arizona Lithium

Direct lithium extraction (DLE) eluent from the Prairie project was shipped to Saltworks Technologies in Vancouver to be processed into battery-grade lithium carbonate.

Arizona Lithium produces battery-grade lithium carbonate

Arizona Lithium announced on Aug. 7 that it has successfully produced battery-grade lithium carbonate from its wholly owned Prairie lithium brine project in southeast Saskatchewan, in partnership with Saltworks, a technology company that operates

a lithium refinery that processes brines into battery-grade lithium carbonate and lithium hydroxide.

The lithium carbonate, which is an essential component used in batteries for electric vehicles, was produced from direct lithium extraction (DLE) eluent as part of a pilot project using technology provided by ILiAD Technologies that operated on site from November 2023 to February 2024. The DLE eluent was shipped to the





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Saltworks facility in Vancouver, where it was then converted into battery-grade lithium carbonate.

Arizona Lithium stated that this recent announcement underscores the project's potential to become a key producer of high-quality lithium carbonate in Canada.

DLE technology is used to remove lithium from the brine, with the extracted lithium concentrate converted on-site to upgraded high-purity material. Any left-over brine is disposed of underground into a separate aquifer. According to the company, this process requires less land and fresh water and results in less waste compared to hard rock and evaporation mining of lithium.

The Prairie project is tapping into a substantial, previously unused lithium brine deposit in the Duperow Formation located in the Williston Basin of Saskatchewan. Although this region is better known for its oil production,

considerable lithium concentrations have been identified across the Prairie project site.

Arizona Lithium has already drilled the first commercial well at its Prairie Pad #1, and in July it was conditionally approved for a \$21 million incentive in the form of future royalty credits under Saskatchewan's Oil and Gas Processing Investment Incentive program.

"The battery-grade product we produced is in sufficient quantities to go out to all the offtakers and strategic partners we are in conversation with," said Paul Lloyd, Arizona Lithium managing director, in an Aug. 7 press release. "Our team remains focused on bringing Pad #1 at the Prairie project into production in 2025."

Licences have also been obtained to drill two wells at the project's Pad #2. According to the company, constructing this second pad, along with drilling the initial wells, will mitigate risks going forward,

and will allow Arizona Lithium to be able to increase the production of lithium carbonate on a modular basis.

The Prairie project's prefeasibility study was released on Dec. 29, 2023, and forecasted that it would produce 6,000 tonnes of lithium carbonate equivalent for phase one of the project. It predicted a base-case net present value of US\$448 million, based on a long-term price of US\$21,000 per tonne.

On Aug. 8, the Saskatchewan government announced the launch of the Critical Minerals Processing Investment Incentive and the Saskatchewan Critical Minerals Innovation Incentive, two new programs that aim to support the growth of critical minerals development in the province. At a press conference, the government shared that the first kilogram of lithium mined in Saskatchewan had been produced at the Prairie project.

– Ashley Fish-Robertson

Refining drill targets

New funding will accelerate a collaborative geomicrobiology research project

By Ashley Fish-Robertson

On July 23, it was announced that a collaborative research project focused on utilizing geomicrobiology for detecting rare metal deposits received a \$610,000 grant from the Natural Sciences and Engineering Research Council of Canada. The project is being carried out by Pan American Energy Corp. in collaboration with Integral Metals Corp. and the Institute for Microbial Systems and Society (IMSS) at the University of Regina.

In June, Pan American completed its spring 2024 field prospecting and sampling program at its Big Mack lithium project, which is 80 kilometres north of Kenora, Ontario. The program, which was led by geoscientist Jared Suchan, a technical consultant to Pan American, and Andrew Cameron, a biology professor at the University of Regina and co-director of the IMSS, hired eight students from the geosciences and biology programs at the University of Regina to gather field data, document site observations, analyze ground-water chemistry and collect samples of soil, rocks and vegetation at the site.

The data and samples collected during the program will be used by the research team to improve and refine exploratory



Courtesy of Pan American

Pan American's spring 2024 field prospecting and sampling program saw several students collect samples from its Big Mack lithium project in Ontario, which will be used in a geomicrobiology research project.

drill targets at Big Mack. The funding will aid the team with offsetting costs related to conducting research, such as assaying the collected field samples.

Studying bacterial communities

"Geomicrobiology, in the context of our work, involves studying bacterial communities in soil to identify specific species

that can serve as indicators, or pathfinders, of underlying mineralization,” explained Suchan in an email to *CIM Magazine*. “We hypothesize that certain bacteria interact with certain minerals in the soil, creating geochemical anomalies that can be detected and mapped. By combining these microbial studies with traditional geochemical and geophysical methods, we believe that exploration efforts can be improved, by narrowing down drilling targets and improving the efficiency and success rate of discovering economically viable mineral deposits.”

Jason Latkowcer, chief executive officer of Pan American, explained in an interview with *CIM Magazine* that the rate of new critical mineral deposit discoveries is slowing down due to the depletion of easily accessible near-surface deposits, and as a result, it has become increasingly challenging to locate areas of high mineralization.

“When we looked at the potential use of geomicrobiology, what we hoped to have happen is to be able to refine targeting, be more specific with our targeting, and therefore lower our impact in terms of disturbance,” said Latkowcer. “[This

means] creating less drill trails, have less surface disturbance, optimize the drilling spend and reduce wasted meterage.”

“In more remote areas, especially in Canada’s North, it’s very expensive to mobilize equipment,” said Cameron in an interview with *CIM Magazine*. “[When you do have to drill], there is some disturbance that inevitably happens and so [using] geomicrobiology is a very low impact way to complement other preliminary surveys and to really home in on areas that are most likely to produce beneficial drilling results.”

Adding to the toolbox

Suchan explained in an interview with *CIM Magazine* that utilizing geomicrobiology adds to the toolbox of exploration techniques and provides companies with an added layer of data to improve drill targeting. While the use of geomicrobiology has proven to be effective with locating diamonds, he hopes to see it applied to exploration for critical minerals.

In the team’s previous studies, geomicrobiology has shown promise in diamond exploration by identifying bacterial com-

munities associated with kimberlite rocks. Suchan said that he would like to see this approach extended to pegmatite rocks, carbonatite rocks and other rocks that host critical minerals, by identifying specific bacteria that interact with or are influenced by the geochemical environment around these deposits.

By mapping these microbial signatures, exploration targets for critical minerals like lithium in pegmatites and rare earth elements in carbonatites can be refined, leading to more efficient and environmentally friendly exploration efforts. Suchan noted that with pegmatites, there is a challenge in identifying these mineralized deposits because they may not contrast as strongly in their background compared with other minerals.

“You have your pegmatite with your lithium in it, and it’s surrounded by a similar rock type, so a big challenge in this field and in this commodity is that your typical everyday techniques don’t work so well, or they do work, but they’re not as great,” he said. “Developing geomicrobiology as another layer that we can work in, we’re hoping to find that the



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bacteria in the soil are a lot more sensitive to what's going on beneath them than perhaps what we can detect through physical or chemical means.”

Suchan explained that geomicrobiology provides an additional data layer in mineral exploration by detecting bacterial communities that are uniquely sensitive to subsurface geochemical conditions. Although physical and chemical methods are effective at identifying broader anomalies, they may also produce false positives or negatives.

“We believe that soil bacteria can have a more direct relationship with specific minerals below and can produce more localized and precise signals,” he said. “By incorporating geomicrobiology into exploration models, we aim to cross-reference microbial data with geophysical and geochemical data, enhancing drill targeting accuracy and reducing the risk of misinterpreting exploration results.”

Since there is great potential for the use of geomicrobiology in drilling, but still so little that is understood about how to correlate microbes in the soil with the geology around them, work needs to be done to understand the patterns and relationships between the two, and the new funding will allow the team to collect a variety of samples and conduct traditional analysis.

Samples for the project will be collected again in the summer, and then at regular intervals. The funding will also aid the team in gaining better insights into the samples collected, which can lead to building better models of the relationships between microbes and the geology surrounding them.

“From the microbiology side, we never have those big, comprehensive data sets, which means that we’re limited in the types of ecological questions we can ask about what those microbes are and why they are the way they are, and what it is about their environment that makes them that way,” explained Cameron. “So, with this type of partnership, we’re just getting so much great insight into those samples.”

Building a database

The team is currently applying geomicrobiology as a drill targeting tool for rare earth-bearing carbonatites at Integral Metals Corp.’s Burntwood project in Manitoba, as part of this summer’s research program, which is designed to complement the work done on Pan American’s Big

Mack project. Both projects are part of a unified effort to advance geomicrobiology as a drill targeting tool. Cameron noted that once more samples are collected, the team will dive into the collected data and perform advanced analysis to evaluate which bacteria are working the best at providing signatures to help the team locate potential deposits.

“It’s like a snowball effect where it becomes more and more powerful with the more data that we add and with machine learning and artificial intelligence, the capabilities of our analyses are growing more and more powerful,” said Cameron.

Suchan noted that the team is first calibrating bacterial species over known mineralized occurrences in Manitoba to classify effective pathfinder species, which is essential for developing reliable bacterial indicators.

“We will analyze the results together, and then add them to the master geomicrobial database, which will then include

data from the Northwest Territories, Ontario and Manitoba,” he said. “This integrated analysis is an important step in assessing which bacterial indicators are most effective, and ultimately moves us closer to potential commercialization of this technique in the future.”

As the application of geomicrobiology advances, Cameron hopes to see something similar to a live feedback sampling process in the future, which is comparable to the COVID-19 at-home testing kits. In the case of soil samples, this process would allow soil to be rapidly tested, providing users with instant feedback on soil sample programs instead of waiting months to receive the data.

“[Geomicrobiology] is an amazing tool from our perspective, and in terms of near-term data collection, it’ll allow us to get to work a little bit faster with a little bit more optimization and certainly more comprehensive coverage than, arguably, anybody else does in the field,” said Latkowcer. **CIM**

PDAC launches new Indigenous youth program

The Prospectors and Developers Association of Canada (PDAC) launched a new program on July 15 that invites Indigenous youth to participate in the PDAC 2025 Convention, which will take place from March 2 to 5 in Toronto next year.

The Indigenous Youth and Early Career Ambassador Program will provide up to five participants with an all-access pass to the PDAC Convention, along with travel assistance and invitations to select events and other opportunities, to encourage participation of Indigenous youth and early career professionals in the mineral industry. The program was developed in collaboration with PDAC’s Indigenous Affairs Committee, and with guidance from Indigenous PDAC members and partners at Mining Matters, an organization that educates youth about earth sciences and the mineral industry.

Applicants must be Indigenous, between 19 and 30 years old, present an interest in the mineral industry and demonstrate a dedication to the well-being of their community. Preference will be given to PDAC individual and student members in good standing. Those interested in applying can fill out an application for them-



Courtesy of PDAC

In order, left to right: Darrell Beaulieu, Jerry Asp, Renata Smoke, Nathan Skubovius and Sonia Molodecky in discussion during the PDAC 2024 panel titled “Defining a Pathway for Indigenous-led Mineral Exploration.” A new Indigenous youth program will send five individuals to PDAC 2025 to take part in career-building opportunities related to the mineral industry.

selves, or be nominated by a member of their community or a PDAC corporate member. The application consists of a few short questions and can be completed online. Applications will be accepted on an ongoing basis and PDAC will start to review applications and select ambassadors starting on Oct. 1 until the program is full.

“In speaking with past Indigenous attendees, their key takeaways from the convention have included opportunities for dialogue, inspiration, networking, discovery and confidence,” PDAC said in a statement emailed to *CIM Magazine*.

“For youth and early career professionals, [attending] PDAC can mean discovering a new career or education pathway, meeting a mentor or Elder, connecting with peers, learning best practices or new approaches for industry engagement or community participation and development, and contributing unique insights to conversations around Indigenous participation, collaboration and leadership in the mineral sector.”

Candidates from anywhere in Canada are eligible to be selected as an ambassador, and the organization aims to engage with Indigenous communities across the country to share information about this new program and to establish a broad and diverse delegation.

“We hope that by participating in this initiative, ambassadors will gain practical insights into the mineral industry that they can take back to their communities and organizations,” said Raymond Goldie, president of PDAC, in a July 15 press release.

First held in 1932, the annual PDAC Convention sees an average of 25,000 participants from across the globe attend each year. **– Ashley Fish-Robertson**



Courtesy of Teck Resources

Teck's Highland Valley Copper operations in B.C. The Canadian government secured a commitment from Teck Resources to reinvest a significant amount of the proceeds from the sale of its steelmaking coal business to Glencore into its copper growth portfolio.

New market rules

What the tightened guidelines could mean for critical mineral mergers and acquisitions

By Kelsey Rolfe

The federal government's move to limit foreign takeovers of Canadian critical minerals miners is not likely to have a significant impact on the sector and should only

affect the country's largest companies, lawyers and analysts say.

In a July 4 statement that accompanied the approval of Glencore's US\$6.9 billion

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From the wire

Compiled by Ashley Fish-Robertson

After **Deshnee Naidoo** resigned as CEO last year and left **Vale Base Metals** in March, the company searched for a replacement for several months and announced it has appointed **Shaun Usmar** as the new CEO. Prior to this new role, Usmar founded Triple Flag Precious Metals and was senior executive vice-president and CFO of Barrick Gold.

Mark Thompson has taken over from **Pedro Farah** as **Nutrien's** executive vice-president and chief financial officer as part of the company's succession planning. Thompson has been with the company since 2011 and was working as the executive vice-president and chief commercial officer prior to this new role. He has helped the company shape its global strategy and environmental, social and governance initiatives. Farah will stay on in an advisory capacity until the end of this year.

Rio Tinto has appointed **Katie Jackson** as its new chief executive of copper, where she will lead the company's copper business. Jackson, who is currently serving as president of National Grid Ventures, succeeds **Bold Baatar** as of Sept. 1, who will step into the role of COO with Rio Tinto.

Kyle Appleby has been appointed as **Lodestar Battery Metals' CFO**, replacing outgoing CFO **Killian Ruby**. Appleby brings with him experience in financial reporting, fundraising and corporate governance, and has worked as a CFO for both private and public companies in Canada.

Lucas Dow has joined **Sayona Mining Limited**, which owns the North American Lithium (NAL) project, as its new CEO and managing director. Dow has worked as a CEO for other resources organizations and has held executive and non-executive director roles with several companies. **James Brown**, who served as the company's interim CEO, will continue in the role of executive director until Jan. 31, 2025, to aid with the transition. Brown will then take on a non-executive director role. The company also appointed **Sylvain Collard** as president and COO of Sayona's Canada operations. Since he was hired in 2022, Collard has been in charge of Sayona's projects located in the Abitibi-Témiscamingue region of Quebec, including NAL and the Moblan Lithium project.

acquisition of Elk Valley Resources (EVR), Teck Resources' metallurgical coal business, Minister Francois-Philippe Champagne said that moving forward, he would only give the go-ahead to foreign acquisitions of "important Canadian mining companies engaged in significant critical minerals operations...in the most exceptional of circumstances."

The majority of such transactions would no longer meet the net benefit test under the Investment Canada Act, Champagne said, adding that the new higher bar was reflective of the "strategic importance" of Canada's critical minerals sector and the need to take "decisive action" to protect it.

Michael Pickersgill, partner at Torsys LLP and head of the firm's mining and metals practice, said in an interview with *CIM Magazine* that the policy is intended to nurture the energy transition industry.

"Critical minerals are one thing we have—we actually aren't as big as some people think we are in pure critical minerals themselves—but [we have] leading companies in ownership of those assets and new potential assets," he said. "The government wants to maintain that infrastructure and includes having Canadian-headquartered companies—with industry leadership in Canada—because it helps develop and maintain a leading global role."

Increased scrutiny

Canada has significantly stepped up its scrutiny of foreign investments and takeovers of Canadian miners in recent years. In 2022, the government began requiring any attempted investment or acquisition of a domestic miner by a state-owned enterprise to go through a national security review (NSR), leading to a record year for NSRs in 2022-23, which saw 32 investments, a jump from 24 investments in the previous year, according to the Investment Canada Act annual report.

Solaris Resources, a Canadian junior with an exploration-stage copper-gold project in Ecuador, cancelled a \$130 million investment from China's Zijin Mining in May, stating that the deal would take too long to get through its NSR.

In July, Falcon Energy Materials—formerly SRG Mining—re-domiciled its headquarters from Montreal to the United Arab Emirates (UAE). Back in March, the company had called off a \$16.9 million investment deal with a Chinese firm due to a lengthy approval process.

In a July 2 press release, Falcon stated that the move to the UAE will provide it "with expanded strategic options as it advances its partnership discussions."

Mike Kilby, a partner at Stikeman Elliott and head of the firm's competition and foreign investment group, said the policy has echoes of the debate in the early 2000s about the impact of seeing three domestic mining giants, Inco Ltd, Falconbridge Ltd. and Alcan, subsumed by Vale, Xstrata and Rio Tinto respectively. (Stikeman represented Teck Resources in the sale of EVR.)

"The narrative there was, 'is this good policy?' Not that it threatens national security but that...there are benefits to the Canadian mining ecosystem associated with having very large-cap mining companies headquartered in Canada, incorporated in Canada and listed on the Toronto Stock Exchange," he said.

The policy has raised concerns in the sector that foreign investors will become skittish of investing in Canadian companies, even those that are small or medium tier.

"If you create constraints in a capital market, that can't be positive," said Dean McPherson, head of global mining for TMX Group Ltd., which operates the Toronto Stock Exchange and TSX Venture Exchange, in an interview with *CIM Magazine*. "Companies will have to start looking at ways to protect themselves."

Jeff Killeen, director of policy and programs at the Prospectors and Developers Association of Canada, said in an email to *CIM Magazine* that the lack of clarity around the phrase "in the most exceptional of circumstances" creates uncertainty that could negatively impact domestic miners' valuations relative to global peers.

Kilby, however, downplayed the impact of the new guidance. Unlike an NSR, which can apply to transactions of any size and nature, the ICA's net-benefit test only comes into play during foreign buyers' wholesale takeovers of Canadian companies of significant size, usually those worth \$2 billion or more.

He said that the government has blocked transactions on net-benefit grounds only twice, which includes BHP's 2010 attempted hostile takeover of Potash Corp, which was based in Saskatoon, and later merged with Agrium to form Nutrien.

Scotiabank analysts Orest Wowkodaw and Eric Winnill wrote in a July 16 note that they expected "only the largest Canadian-headquartered critical mineral

“There are benefits to the Canadian mining ecosystem associated with having very large-cap mining companies headquartered in Canada, incorporated in Canada and listed on the Toronto Stock Exchange.”

– Mike Kilby, Stikeman Elliott

miners are likely to be fully ring-fenced from foreign buyers” and that the government was unlikely to stand in the way of M&A transactions involving small and mid-tier companies unless there are national security concerns.

“The status of near-term or in-construction development projects could be open for interpretation if they involve large assets that have material impacts to their respective commodity markets;

these are likely to be treated on a case-by-case basis,” they wrote.

Wowkodaw and Winmill stated that they believe Teck and Cameco to be off-limits to foreign buyers, and possibly Nutrien. Large miners with no assets in Canada and relatively small corporate offices, such as First Quantum Minerals and Ivanhoe Mines Ltd., “are likely exempt from the policy,” they wrote.

Buyer commitments

Kilby said he does not see the policy as closing the door on all attempted takeovers of large-cap domestic miners. The pathway to getting a deal approved has historically been about the commitments the buyer makes, which can include committing research and development dollars to Canada, and, in the mining sector, advancing Canadian projects.

The government would also likely be open to acquisition attempts by companies with headquarters in Five Eyes (an intelligence alliance comprising Australia, Canada, New Zealand, the United Kingdom and the United States) or other friendly jurisdictions, Pickersgill said.

He said that the policy statement should be read in conjunction with the government’s approval of the Glencore-Teck deal. While metallurgical coal is not listed among Canada’s critical minerals, the government did include conditions to the sale.

The multinational was required to commit to establishing and maintaining a Canadian head office for EVR in Vancouver, and regional offices in Calgary and Sparwood, B.C., and ensuring the majority of EVR’s directors are Canadians and at least two-thirds of executives and senior management roles are Canadians, all for at least 10 years. In addition, for at least five years, the company must maintain “significant employment levels” at EVR.

Glencore inherited Teck’s obligations under the reclamation bond required by the B.C. government. It also assumed responsibility for paying any environmental obligations under Canadian law that are not covered by the bond, through to 2050. The company would remain responsible for those obligations even if it decides to sell or de-merge EVR in the future, unless



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the industry minister is satisfied that EVR's new owner could take over its environmental liabilities.

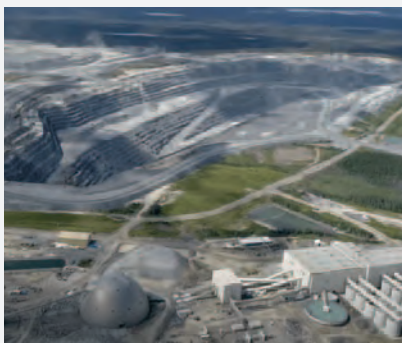
The company also agreed to spend an extra \$350 million on rehabilitation and closure activities over a five-year period, to maintain EVR's commitments to First Nations and to work "in good faith" with First Nations to find any opportunities to increase their benefits from the met coal operations.

"The intention here is they want to support the development of Canadian industry," Pickersgill said. "The focus [in the conditions] was around protecting a Canadian company itself, as would be expected in the net-benefit context. But what's interesting is they also layered in elements around environmental, social and governance (ESG) commitments, around maintaining remediation obligation commitments. They did look at this a bit more holistically in thinking about maintaining a Canadian business and Canadian operating standards."

Longer approval timelines will likely be a feature of any major transactions going forward, Pickersgill said.

"The [Glencore-Teck] deal took eight months to work through," he said. "One can expect just given the political nature of this, even if people want to try to construct exceptional circumstances for transactions, we're talking about [longer time-frames]." **CIM**

Courtesy of Agnico Eagle



#ICYMI

In case you missed it, here's some notable news since the last issue of *CIM Magazine*, which is just a sample of the news you'll find in our weekly recap emailed to our newsletter subscribers.

Agnico Eagle is planning to build two underground mines in Ontario, by expanding its Detour Lake gold mine (pictured) and developing its Upper Beaver gold project. The projects will cost a combined US\$300 million. A two-kilometre exploration ramp will be constructed at Detour Lake, which is northeast of Cochrane, to collect a bulk sample and conduct infill and expansion drilling of its underground mineral

resource. At Upper Beaver, which is north of Larder Lake, both a ramp and exploration shaft will be constructed to create underground drill platforms and collect bulk samples.

Six northern Ontario First Nations are taking the province to court over its Mining Act, claiming it infringes on their treaty and Charter rights. A notice of application was filed at the Ontario Superior Court of Justice on Aug. 9, with the nations arguing that the province's online claim staking process allows anyone to stake a claim without consultation. The nations seek to have several provisions of the Act declared as unconstitutional.

An Ontario court has put Victoria Gold Corp. into receivership at the Yukon government's request following a heap leach failure and significant cyanide spill at the company's Eagle gold mine on June 24. Accounting firm PricewaterhouseCoopers Inc. has been appointed as the receiver. The First Nation of Na-Cho Nyäk Dun has also filed for receivership of the company in Yukon court, citing severe environmental damage on its traditional lands.

Critical minerals milestone for Port of Churchill

The first shipment of critical minerals in over 20 years departed from the Port of Churchill in Manitoba on Aug. 16. The shipment of zinc concentrate was mined from Hudbay Minerals' operations in Snow Lake, located around 200 kilometres east of Flin Flon, and was shipped by the Arctic Gateway Group (AGG), which is a partnership of 41 First Nation and Bayline communities in Manitoba that owns and operates both the port and the Hudson Bay Railway.

The shipment marks a major milestone for the AGG, the federal and provincial governments and other stakeholders in their efforts to restore the Hudson Bay Railway, expand the port and capitalize on the chance to enhance Canada's Arctic trade corridor to international markets. The AGG and Hudbay Minerals came to

an agreement back in 2020 that has allowed the group to ship zinc concentrate through the port to better access international markets.

"The collaborative work done between all levels of government and the leadership of the AGG has paved the way for this historic day," said Dan Vandal, federal minister of northern affairs, in an Aug 16 press release from the AGG. "With a revitalized Hudson Bay Railway and Port of Churchill, jobs will be created, mining and forestry opportunities will open, and Bayline communities will have the opportunity to position themselves as a true gateway to the Arctic and the world."

The Port of Churchill is the country's only Arctic seaport that is serviced by rail, running from the town of The Pas to Churchill. During the last two months, over 100 rail cars containing zinc concentrate from Hudbay's Snow Lake operations were brought to the port, with the concentrate being temporarily stored at a newly developed storage facility, the

first new building at the port in over 20 years. AGG completed construction of the facility in May of this year and said that it will be important in the export of critical minerals through the Churchill port.

In addition to reviving the port, some of the tasks being carried out by AGG on the railway for the 2024 construction season include replacing 125,000 rail ties, rehabilitating several crossings and improving various bridges.

On Feb. 23, Vandal and Wab Kinew, the premier of Manitoba, unveiled a joint investment from the federal and provincial governments of up to \$60 million for the AGG to help support the completion of the Hudson Bay Railway, initiate the redevelopment of the port, and provide further benefits to the communities and economic sectors dependent on the AGG's activities.

According to the Aug. 16 press release, when work on the port and railway is finished by 2028, the Canadian economy is expected to benefit from over \$1 billion

The Eagle mine heap leach failure has also impacted Western Copper and Gold's plans to submit the environmental and socio-economic effects statement for its Casino copper-gold project, which is located in west central Yukon. The company has informed the Yukon Environmental and Socio-Economic Assessment Board (YESAB) that it will delay the submission to July 2025 instead of the latter half of this year until more is learned about the impacts of the incident at the Eagle mine.

Calibre Mining has received federal environmental assessment approval to add a third open pit to its wholly owned Valentine gold mine, located in Newfoundland and Labrador. The approval allows the company to move forward with its three-pit mine plan, which was outlined in its 2022 feasibility study. First gold at the Valentine mine is planned for the second quarter of next year.

Kinross Gold plans to begin the construction of an exploration decline in mid-2025 at its Great Bear gold project, which is located in Red Lake, Ontario. According to its second quarter 2024 results, preparation for the decline will begin in the second half of 2024 once

permitting, engineering and procurement are complete. The company aims to start production at Great Bear in 2029.

Following Sayona Mining's operational review earlier this year of its North American Lithium operation in Abitibi, Quebec, which led to cost-cutting measures and layoffs, the mine still has a bit of a hill to climb. While more spodumene concentrate was produced in the second quarter than the previous one thanks to improved mill utilization and recoveries, the company shipped less of the product in the second quarter due to weather delays. While operating unit costs for one tonne of spodumene concentrate are \$995, the average realized selling price is currently \$604.

On Aug. 2, Iamgold reported that it had operated at an average of 60 per cent of its nameplate capacity for 30 days to achieve commercial production at its Côté Gold operation in Ontario. Nameplate throughput for the Côté plant is 36,000 tonnes per day. The company's goal is to have the operation ramped up to 90 per cent by the end of the year.

Generation Mining has secured approval from the federal government to construct specific water management structures at its Marathon palladium-copper project in northwestern Ontario. A few other provincial and federal approvals and permits are expected to be secured in the near future, which are needed for Generation to proceed with construction.

Australian uranium producer Paladin Energy has listed its shares on the Toronto Stock Exchange (TSX). The last time a large foreign mining company joined the TSX was in 2022. Paladin struck a deal in June to acquire Fission Uranium Corp. and its uranium properties in Saskatchewan.

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Courtesy of Arctic Gateway Group



Zinc concentrate from Hudbay Minerals' Snow Lake mine was stored at the port for two months before it officially shipped on Aug. 16.

annually in economic activity. This development would also support more than 5,500 jobs each year and reduce the cost

of resupply shipments to Arctic communities, thereby enhancing food security.

– Ashley Fish-Robertson

Gold Fields to buy Osisko Mining

South Africa's Gold Fields announced on Aug. 12 that it has an agreement to acquire Canada's Osisko Mining in an all-cash deal worth \$2.16 billion. Once the sale is approved, Gold Fields would gain full control of the Windfall gold project, located in Quebec, which it currently has a 50 per cent stake in, as well as the entire exploration area associated with the project.

The company expects the deal to be finalized in the fourth quarter of this year. The offer was approved by the Osisko board and still needs a minimum of two-thirds of Osisko shareholders to vote in favour. The acquisition is the largest takeover of a Canadian junior mining company not yet in production in recent years.

The Windfall project is located in the Eeyou-Itseeche James Bay territory of Quebec, and on the traditional territory of the Cree First Nation of Waswanipi. The project



An underground shot from Osisko Mining's Windfall gold project in Quebec, which Gold Fields will wholly own once its deal to acquire Osisko Mining is approved.

property comprises 286 independent claims, totalling a combined area of 12,523 hectares. Environmental permitting for Windfall's full-scale construction is advancing, and final authorization is anticipated for 2025.

10

Windfall's expected mine life, in years

306,000

Estimated average gold production per year over 10 years, in ounces

374,000

Estimated peak gold production in the second year, in ounces

Gold Fields is aiming to have the mine begin production by the end of 2026 or early 2027 and, according to Osisko Mining's 2022 feasibility study, the project is expected to yield an average of 306,000 ounces of gold per year over 10 years at an average all-in sustaining cost of US\$758 per ounce. Peak production at Windfall would see an output of 374,000 ounces of gold produced in the second year, with an after-tax net present value of \$1.2 billion and 34 per cent after-tax unlevered internal rate of return, based on a gold price of US\$1,600 per ounce.

According to Gold Fields, the acquisition is part of its growth strategy as it seeks to replace output from its outdated assets located in Peru and Ghana. The Windfall project will aid the company in broadening its presence in the Americas, where it currently owns the Salares Norte gold-silver greenfield project in the Atacama region of Chile, and the Cerro Corona copper-gold mine in northern Peru.

This is not the first time that Gold Fields has sought to add a Canadian mining company to its portfolio. In 2022, it tried to purchase Yamana Gold, but it was outbid by a joint offer from Agnico Eagle Mines and Pan American Silver Corp. The chief executive officer of Gold Fields at the time, Chris Griffith, stepped down as a result.

While the federal government announced it will tighten M&A restrictions to limit foreign takeovers of big Canadian mining companies to protect the country's critical minerals sector (see p. 21), the deal is not anticipated to raise major national security concerns since gold is not a critical mineral.

"We are pleased to be handing over the reins to Gold Fields, a partner whose expertise and vision align with the solid foundations we have established over the past years," said John Burzynski, CEO of Osisko Mining, in an Aug. 12 press release. "Throughout our collaboration, Gold Fields has demonstrated a commitment not only to advancing a promising project in a key

sector of Quebec's economy, but also to establishing strong and enduring relationships within the local community."

– Ashley Fish-Robertson

Harry Nijjar will be taking over the role of CFO for **Pacific Ridge Exploration** from **Salvador Miranda**, who has retired. As managing director of Malaspina Consultants Inc., Nijjar offered CFO and strategic financial advisory services to clients across a variety of industries.

Patriot Battery Metals announced that chief operating officer **Blair Way** has retired from his role. The company also shared that **Alex Eastwood** will be joining the company in the newly created role of executive vice-president – commercial, where he will aid in the company's current industry engagement as Patriot prepares for the future of the Shaakichiuwaanaan project (previously called the Corvette project) in the James Bay region of Quebec. Eastwood has a background as a lawyer with over 28 years of experience in mining and corporate transactions and is one of the founding senior executives at Pilbara Minerals.

Keshav Kochhar, **Li-Metal Corp.**'s COO, has taken over the position of CEO on an interim basis as **Srini Godavarthy** has resigned from the role, as well as from his position on the company's board of directors. Kochhar previously held the roles of co-founder and CEO of Lacero Solutions, a clean-technology firm.

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Seeing beyond



Strategies for complying with Bill C-59

By Robert Simpson

A significant development in the business landscape was the introduction of Bill C-59, Canada's new competition law amendments. Passed on June 20, 2024, and coming into effect June 2025, it sets stringent standards for environmental claims made by Canadian businesses. This legislation targets greenwashing by mandating that companies provide substantial evidence to support their environmental claims.

For decades, the Competition Act, enforced by the Commissioner of Competition, has governed misleading advertising in Canada. Historically, only the Commissioner could bring cases to the Competition Tribunal, including those related to greenwashing. This centralization limited the number of greenwashing cases due to the Competition Bureau's numerous priorities.

The new provisions, however, empower non-governmental organizations (NGOs) and private parties to seek remedies directly from the Competition Tribunal. This shift is significant. It decentralizes enforcement, allowing entities focused solely on environmental laws to take action. Consequently, mining companies must be vigilant about their environmental claims to avoid becoming targets of these newly empowered watchdogs.

The bill's wording says businesses must not make claims to the public about what they are doing to protect the environment or mitigate the effects of climate change unless those claims are based on "adequate and proper substantiation in accordance with internationally recognized methodology." Any assertion of sustainability, green mining, carbon neutrality, eco-friendliness or reclamation must be backed by solid and verifiable evidence.

The new legislation creates a reverse onus on businesses, meaning they must prove their environmental claims are *not* misleading rather than the NGO proving they are. While it seems unlikely that complainants will target statements taken down before June 2025, businesses should be cautious about all publicly available claims in reports, presentations and social media.

Key strategies for mining companies to comply

With the introduction of Bill C-59, it is more important than ever for mining companies to communicate sustainability efforts transparently and truthfully. Here is how you can avoid claims of greenwashing and build trust with your audience.

1. Ensure claims are substantiated.

- Any environmental claims should be supported by credible, third-party verified data. For example, if you claim your company has reduced carbon emissions in its operations, provide detailed reports and certifications from recognized environmental standards organizations.
- Adhere to internationally recognized standards and methodologies. This includes ISO certifications, GHG Protocol for carbon accounting and other industry-specific standards.

2. Be specific and transparent.

- Avoid vague wording and terms like "eco-friendly," "carbon neutral" or "green," which are often seen as ambiguous. Be specific about the actions your company is taking, such as, "Our operations reduced water usage by 30 per cent through

recycling processes." Then point to the evidence and the standard that was used to measure the reductions.

- Provide comprehensive information about your environmental initiatives, such as case studies, data sheets and detailed explanations of your sustainability practices. Ensure that all information is backed up by globally accepted methodologies.

3. Regularly audit and update claims.

- Regularly review and update your environmental claims across all of your historic and current communications to ensure they remain accurate and up to date. Environmental technologies and standards evolve, and so should your claims.
- Engage third-party auditors to verify your claims. Independent verification adds credibility and helps identify any potential areas of greenwashing.

4. Communicate holistically.

- Consider the full life-cycle impact of the company, from raw material extraction to end-of-life disposal. Highlighting improvements in one area while ignoring significant impacts in another can be misleading.
- Report both the positive and negative impacts of your operations. Transparency about challenges and areas for improvement can build trust with your stakeholders.

5. Educate your team.

- Implement training programs for your communication and sustainability teams to ensure they understand the importance of accurate environmental claims and the risks associated with greenwashing.
- Develop and enforce clear internal guidelines for making environmental claims. Ensure all team members are aware of the legal requirements and best practices.

6. Engage with stakeholders.

- Regularly engage with stakeholders, including customers, regulators and environmental groups. Their feedback can provide valuable insights into how your claims are perceived and help identify areas for improvement.
- Foster open and honest communication with stakeholders about your environmental initiatives and performance.

Consequences of non-compliance

Failure to comply with these requirements can result in severe penalties. For misleading representations, penalties can reach up to \$10 million for first-time offences and \$15 million for subsequent ones. The financial and reputational risks underscore the importance of adherence to these new regulations.

In the era of heightened environmental awareness and stringent regulations, avoiding greenwashing is essential for mining industry communicators. By ensuring all environmental claims are substantiated, specific and transparent, you can build credibility and trust with your stakeholders and enhance your company's reputation. **CIM**

Robert Simpson is the president and CEO of PRA Communications, which is dedicated to helping mining companies and suppliers by showcasing their innovations, workforce opportunities and positive impacts.

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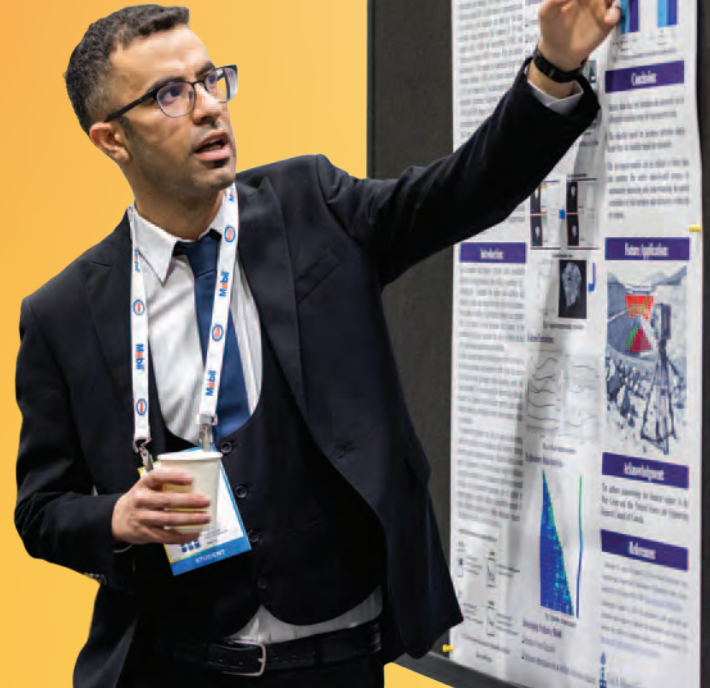
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A student's guide to mining conferences

By Ksenia Bilaniuk, with Omar Wani and John Forster



For students and young professionals, attending conferences is an excellent way to grow your professional network. You can increase your knowledge by attending talks, engage in meaningful discussions with industry veterans or make an intellectual contribution by delivering a presentation. This guide can help you navigate the many aspects of attending mining industry conferences.

Preparation

Attending a conference can be quite demanding, so preparation is key. The social aspect can be overwhelming as you meet new people constantly, and the early mornings and late nights can lead to overall exhaustion. Start by setting a general goal to guide your activities and expectations. In the professional sphere, meetings with clients or attending specific sessions may fill your schedule. However, having a broader goal of networking and exploring industry options can help you build a manageable itinerary.

The conference program includes the opening ceremony and keynote sessions, technical presentations, panel discussions, mealtimes and trade show hours (if applicable). At larger conferences such as CIM CONNECT, technical presentations run in multiple parallel streams, so reviewing the program's presentation topics or abstracts before the conference is essential. You can start to build your itinerary by selecting your favourite topics or speakers, providing you with clear destinations and a structure for each day. Be sure to carry a bottle of water to both

the technical sessions and the social events and take breaks when needed, as the days can be long.

Dress code

Though business casual is typically the standard at conferences, overdressing is preferable to underdressing. Your attire can reflect your overall goal for the event: dressing to blend in allows for independent exploration, while a more elegant style can project confidence and attract attention. Corporate attendees often wear business dress, such as suit and tie, whereas those from operations or exploration may dress in business casual. Starting with office-appropriate attire gives you the flexibility to add personal touches that people may remember you by. You can choose your daily attire based on your comfort and the crowd you wish to engage with.

Winning networking strategies

Social events at conferences provide attendees the opportunity to make new connections and maintain existing ones. Walking through the trade show can help you meet people and develop lasting contacts.

Networking events can be stressful, especially for newcomers or introverts. Start by making a few connections who can introduce you to others. Always carry business cards and a pen for notes. At your first few conferences, try to collect as many business cards as possible. Sometimes, people may take a picture of your conference badge to reconnect later. Take note that people

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Mineral Economics and Mine Management-Informed Mine Asset Valuation for Sustainable Returns Under Risk and Cyclicity

INSTRUCTOR Mustafa Kumral, McGill University, Canada • **PLACE** Montreal, QC • **DATE** October 9-11, 2024

Select Canadian mining conferences

- **Prospectors and Developers Association of Canada (PDAC)** Held in Toronto, Ontario, over four days in March, PDAC is the world's premier mineral exploration and mining convention. It features a core shack, investors exchange, prospectors' tent, and trade show, attracting delegates from over 135 countries.
- **CIMCONNECT** The national CIM convention, held in May, alternates between Vancouver, B.C., and Montreal, Quebec. It includes short courses, a three-day technical program and panel discussions that cover the entire mining value chain, as well as a trade show. CIM CONNECT also has a full student program.
- **Canadian Mineral Processors Conference (CMP)** A niche technical conference focused on mineral processing operations, CMP is held in January in Ottawa, Ontario, and is excellent for networking, with many attendees returning annually. The Canadian Mineral Processors Society of CIM offers travel packages for undergraduate students.
- **Conference of Metallurgists (COM):** A larger technical conference focused on extractive metallurgy and materials, COM includes numerous symposia attended by academics, government employees and industry executives. Organized by the Metallurgy and Materials Society of CIM (MetSoc), the host city changes yearly, and MetSoc offers travel assistance to students. Next year's will be in Montreal in July.

presenting a business card is often a way to politely end a conversation. If this happens to you, accept the card with thanks and move on.

Though it is common to feel nervous and want to stick together with your classmates, it is crucial to separate from your friends and meet new people. There will be plenty of time to debrief with your fellow students.

When you introduce yourself to someone, give a brief description of your school or work affiliation and interests,

which works well as a conversation starter. As you talk to more people, your introduction will become more refined and will boost your confidence. These conversations may naturally lead to discussions about shared interests or even potential internship opportunities.

After the conference, set aside time to follow up with your new connections by adding them on LinkedIn or by sending thank you emails.

Presentations

Delivering a presentation at a conference can be challenging, but with the right preparation, you can excel. Ensure a good night's sleep the evening before so you are rested and alert. Whether you are presenting in a student poster competition or giving a technical presentation, remember to smile, pause when needed and be direct when responding to questions.

If you are presenting slides in a technical presentation, use graphs and images to illustrate the script of your presentation. Do not read aloud your presentation text from the slides. Employ a laser pointer to guide your audience through the slides. Use your university's template for a professional appearance. Include slide numbers and consider adding a progress bar. Be sure to time your presentation by rehearsing alone, with colleagues and in front of your supervisor. Summarize your key findings on the concluding slide. During the question and answer period, answer honestly and follow up if needed. Networking is crucial, so bring business cards with your details to hand out afterwards.

Attending conferences is key as you embark on your journey as a young professional. The networking you do as a student serves as a foundation for future prospects as you progress throughout your career. **CIM**



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Ksenia Bilaniuk, BSc mineral engineering, University of Toronto, has worked in mineral processing, metals recycling and refining. She is now pursuing a master's degree studying grinding media materials and wear at Queen's University.

John Forster, BSc and MSc mining engineering, Queen's University, and PhD materials science and engineering, University of Toronto, works at EY in the Business Tax Incentives Group, specializing in Scientific Research and Experimental Development claims.

Omar Wani, PhD chemical engineering, University of Toronto, is a senior scientist in Vale's hydrometallurgy group at the Technology and Innovation Centre in Mississauga.



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mining and mental health

Away from home

The impact of fly-in, fly-out operations on mining workers and how to best support them

By Mackenzie Patterson



Courtesy of Francisco Valenzuela

Francisco Valenzuela, a safety advisor at Imperial Oil, launched the online platform fifo4real.ca, which includes educational content and resources aimed at building a mental-wellness culture for FIFO workers.

Francisco Valenzuela, a safety advisor at Imperial Oil with more than 25 years experience, has enjoyed the perks and suffered the trials of the fly-in-fly-out (FIFO) lifestyle.

As lucrative as it has been, he has seen the physical and emotional toll it can take on others and on himself. These common experiences inspired him to lend support to his fellow FIFO workers, whose unique routines and their impacts are getting more attention.

Valenzuela recounted how when he thought he had finally “made it” in the big oil industry, a coworker, who was a veteran of the industry, stated in a straightforward way, without a trace of spitefulness in his voice, that he was not there yet until he had “a divorce or two” under his belt.

“That will stick in my mind forever,” Valenzuela said in an interview with *CIM Magazine*.

Although he dismissed it as a joke at the time, he said the statement rings true for him today, now that he has been through two divorces.

Spending lengthy stretches of time away from family members has one of the biggest impacts on mining workers’ mental health and personal lives, but to attribute it as the only cause of familial issues would be an oversimplification. The time spent apart from family puts a strain on FIFO workers’ interpersonal relationships, but according to Valenzuela, it can also be the time they spend back home—and the transition between the two vastly different lifestyles—that causes emotional wear and tear over time.

Valenzuela explained that in his own experience, while he may have been physically “there” with his family during his two weeks off, there was a palpable emotional disconnect that eventually began to weaken the bonds with his partner and children.

“It’s tough because even before you leave home, you have to start preparing yourself, so you disconnect a little bit ahead of time,” he said. “So, you lose maybe a day and a half, two days together, because you’ve already started to disconnect from your partner. That way, it doesn’t hurt so much when you leave.”

Valenzuela added that another challenge of flip-flopping between working and living on site and returning home to

family life is the vast difference in communication styles between the two environments.

“When you’re at work, you’re in a high-performing environment with less emotions used in decision making, and your patience is different,” he said. “And the other aspect of it is, [when] you leave work, you’re in that high-energy, assertive mode, and then you come home, and all of a sudden, now you have to soften those edges a little bit. And it’s hard.”

For the family that is left behind, it can also be difficult adjusting to having their partner around constantly—or not at all. While the worker is away, many family members eventually adapt to life without them, which means it can become almost disruptive for the two weeks they are back home, because they may not know all the ins and outs of the family’s daily routine, or how certain chores are done around the house.

And then there is the issue of money, which is already one of the leading causes of divorce for couples. Valenzuela was the primary financial provider for his family, which he said ultimately led him to question his own place within the family unit: “You start to have all these little disconnects and resentments building up, and you start to feel like the dairy cow just being milked. Or some of us try to buy our way back into the good books, which then creates financial stress. A lot of people say, I’d quit, but I need the money, so we call it the golden handcuffs.”

Major stressors

Many of the mental and social challenges Valenzuela mentioned have been reflected in research. Sara Dorow is a sociology professor at the University of Alberta in Edmonton, and the director of the school’s International Institute for Qualitative Methodology. Along with Valerie O’Leary, a trained crisis and trauma responder, Dorow led the research for a study titled “Mobile Work and Mental Health: A Preliminary Study of Fly-in Fly-out Workers in the Alberta Oil Sands,” which was published in October 2021.

One of the study’s key findings was that distance and time spent away from home is the number one most stressful element of FIFO work, with 87 per cent of study participants reporting that it was the cause of some or a lot of their stress.

“The difficulty of establishing and maintaining relationships with family, feelings of loneliness, and the inability to be at home for family events or emergencies are significant stressors among FIFO workers,” the study noted.

Living in camps was another major stressor for study participants, with 77 per cent citing it as the cause of some or a lot of their stress—this is due to a variety of factors like limited healthy food options, poor sleep or even a feeling of “entrapment” on site. In addition, 39 per cent of respondents said that transitioning between their work and home lives was difficult, which echoed many of Valenzuela’s experiences.

For Dorow, one of the most surprising findings of the study was that 57 per cent of workers who had access to healthcare services while on rotation were unlikely to use them, while 80 per cent reported “working when sick,” and a third reported not taking time off if they had been injured.

“I had not anticipated how many would say [they] will not use health services on site, or even in town, because of the fear that they’ll be seen as weak. The fear that [for contract workers] it’ll be like, oh, you’ve got health issues, so we’re not sure if you’ll be called back. There are all of these barriers to actually accessing health services while you’re at work,” Dorow said in an interview with *CIM Magazine*.

A mixed bag of emotions

Glenn Nolan is the vice president of Indigenous enterprises at Wyloo, which is currently developing its Eagle’s Nest project in Ontario’s Ring of Fire region. Part of the Missanabie Cree First Nation, Nolan’s community has been involved in the mining industry for more than 80 years. He is a regular commentator on mental health issues and organized the panel on Indigenous workforce development and mental health resiliency at the 2024 Prospectors and Developers Association of Canada (PDAC) convention.

In an interview with *CIM Magazine*, he said that the experience of FIFO work brings with it a “mixed bag” of emotions, and that no two experiences will be exactly alike. For Indigenous workers in particular, the experience can be intertwined with generational trauma, adding an additional layer to a situation that is often emotionally charged to begin with.

“I think the commonality with many Indigenous people—in fact, I would say, almost all of us—is that our families have been traumatized for generations, and we are all survivors... My father’s parents both went to residential schools, and they were traumatized by that experience. They downloaded a lot of that trauma onto my aunts and uncles and my father. In turn, he downloaded a lot of that trauma onto me and my siblings,” he said.

Nolan said that mining companies need to find ways to support their Indigenous workforce by recognizing the historical context that influences their work experience and addressing individual needs with this background knowledge in mind.

To support workers’ mental health needs, Wyloo offers an employee assistance program to all employees globally, in addition to in-house chaplain services, which provide non-denominational, non-religious spiritual care for life challenges, such as coping with loss and grief. It has also implemented a regular town hall to discuss mental health and “Mental Health Mondays,” a weekly meeting for staff at its Esker site, during which the company shows an educational video and creates a welcoming space for discussion.

While Nolan acknowledged the reality that there is no ideal solution to address mental health issues among FIFO workers,

he said companies need to be aware of their experiences and be prepared to support them.

“We don’t have all the answers, but being aware of that is the biggest step forward,” he said. “I’m not a counsellor, I just know that probably the biggest thing that we can do as a company is to have a support system in place.”

Christine Korzenko, director of people and culture at Wyloo and a registered nurse by trade, said in an interview with *CIM Magazine* that employees have access to counselling through Wyloo’s benefits package, but that the company also aims to maintain a culture of transparency and an open-door policy with its workers.

She added that not everyone will be negatively affected by FIFO work: “Some individuals really like the lifestyle. I find that the individuals that are single prefer it, because then when they’re on their two weeks off, they can go and travel and do whatever it is that they want to do.”

Finding community

After his second divorce in the summer of 2022, Valenzuela could no longer see a way out. Buried in despair, he found himself tying one end of his climbing rope to a bridge near his rental home, and the other to himself.

“Then I realized if I make that decision, that’s a permanent decision during a temporary circumstance,” he said.

Since that experience, Valenzuela has been focused on improving his mental health. He found support by connecting online with other men who had lived through similar experiences.

Valenzuela also launched fifo4real.ca, a community and online platform featuring content, resources, members’ groups and support groups specifically geared towards the unique challenges of FIFO work.

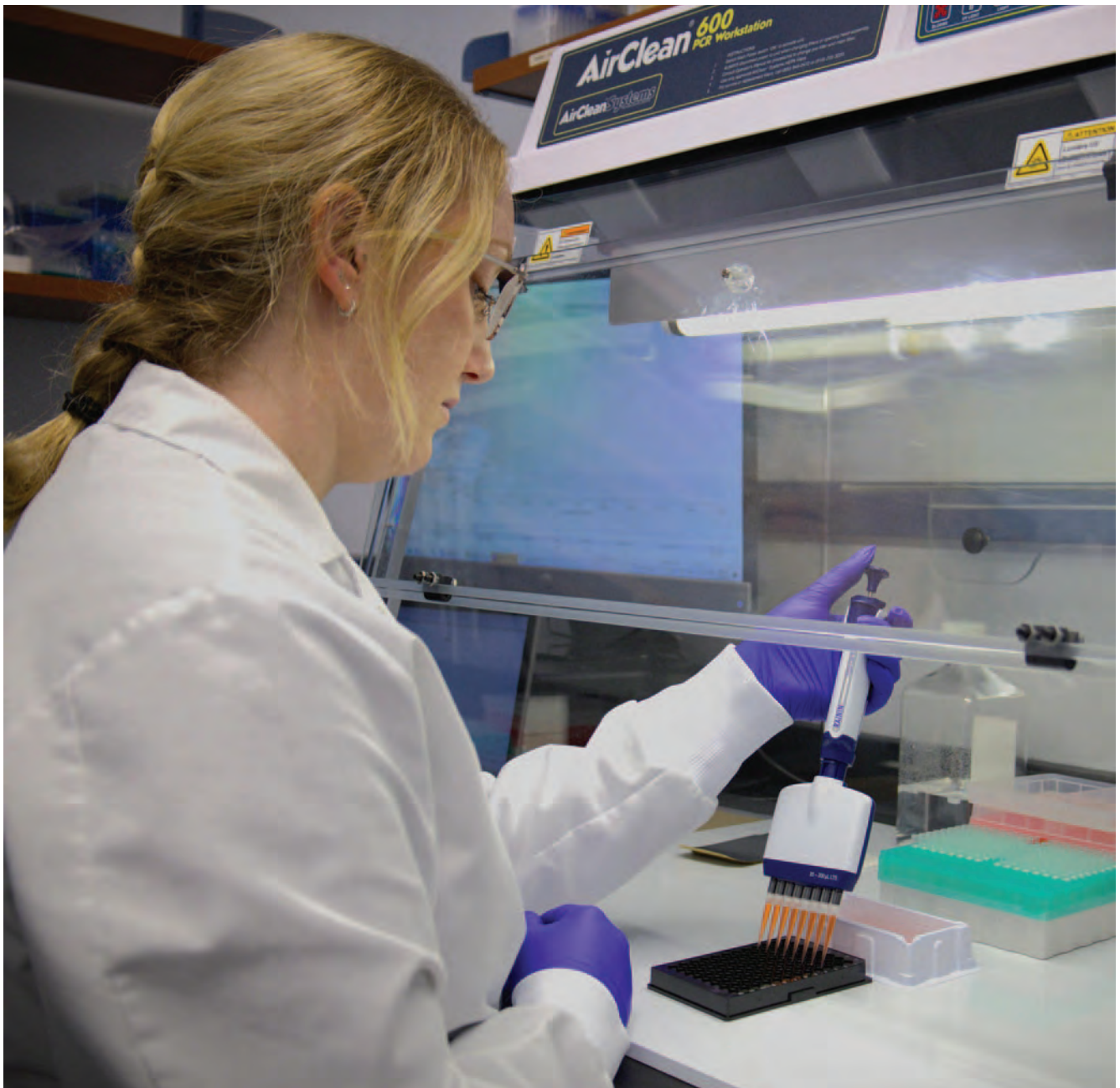
“If I hadn’t shared my story, my vulnerability, my pain, nobody else would have shared with me. Now, we’re on this journey together—we are a community. We are a big FIFO family across the world,” he said.

In its executive summary, the University of Alberta study noted that industries that are reliant on FIFO workers should “act immediately and on many fronts to better understand, prevent and provide resources and support for mental health challenges faced by mobile workers and their families.”

For Valenzuela, this starts with creating an open dialogue. He believes that reducing the stigma surrounding mental health issues through community, conversation and connection is something that everyone can work on, not just industry leaders. Dorow and O’Leary echoed this statement, noting that their research was just the first step towards improving the situation for mobile workers and their families.

“In some ways, this research is a way to more systematically confirm what we know is happening,” Dorow said. “But we need to have a more systematic understanding of the problems to make an impact and have the issues be heard. We need to make sure this is on the radar as an important issue to kickstart the conversation and the understanding.” 

Mining and Mental Health will run throughout 2024 and showcase the people, programs and initiatives that are prioritizing the mental health of mining workers. Each article will examine how to improve worker mental health, which is key to a safe and productive workplace. If you have a story tip, email editor@cim.org.



Analyzing environmental DNA from the area around a mine site can be faster and more accurate than traditional biodiversity surveys.

The power of DNA

Surveys that collect environmental DNA are allowing mining companies to monitor biodiversity over large areas more quickly and cost effectively

By Lynn Greiner

To manage the impact mines have on the environment throughout their life cycle, mining companies need to understand their impact on nature. To do this, they need to understand what lives and grows in the area around a mine site, and how it will be affected before, during and after a mine is in operation.

This is a global concern. In January, ICMM released a nature position statement in which it pledged to contribute to a nature positive future in five areas: direct operations, the value chain,

landscapes surrounding operations, systems transformation and governance and transparency. The statement described specific actions that ICMM's members should take in each area.

Canadian government guidelines lay out the rules under which the mining industry must act in the country, requiring baseline studies, risk assessments, management and monitoring, as well as detailed plans for restoring the site once the mine is shut down. The list of considerations is extensive, but one thing the rules do not do is tell miners how to do the work.

Biodiversity is often the difficult part of environmental analysis, noted Mehrdad Hajibabaei, associate professor in the department of integrative biology at the University of Guelph, and founder and chief scientific officer of Newfoundland-based environmental genomics company eDNAtec.

“When you want to get chemical or physical data, you have sensors [and] automated systems, but when it comes to biodiversity, it often turns into a black box,” he pointed out. “That’s the nightmare for an environmental manager, to be able to generate timely and comprehensive biodiversity data, and because of that, regulatory regimes have also not been as comprehensive when it comes to biodiversity.”

Within mining operations, there are several areas where biodiversity data becomes critical, Hajibabaei said. During the initial baseline assessment, mining companies need to understand how their operations will affect general biodiversity: the number of species present, and whether any are endangered or under pressure, and thus need to be protected. Those operations do not just include the actual mine; aspects such as building roads to the site, running powerlines or other activities that alter the state of the environment must also be taken into consideration.

Then, when the mine is being decommissioned, restoration activities need to ensure that the site is returned to its initial natural state. “Rather than [just] putting grass on it so it looks green, we want to actually ensure that it has the diversity of organisms that it used to have there,” said Hajibabaei.

Increased scale

While manual assessments, in which field workers perform an in-person audit of the environment to record the flora and fauna, are useful, they are inefficient—labour-intensive, time-consuming, expensive and require expert ecologists to be in the field for extended periods of time.

“What’s more, the low availability of taxonomic experts to perform this work—as demand outstrips supply—limits the collection of data at the speed and scale that is necessary within the mining industry,” explained Rachel Mador-House, head of scientific affairs for North America at nature intelligence technology company NatureMetrics, which has worked with mining companies such as Anglo American, Teck Resources, Rio Tinto and Glencore.

But thanks to a relatively new approach, an environmental assessment can be performed more quickly and accurately by analyzing environmental DNA (eDNA).

“DNA surveys allow us to detect species without seeing or hearing them, but through the collection of trace amounts of DNA, or ‘eDNA,’ that organisms leave throughout the environment,” explained Joshua Newton, a PhD candidate at the Trace and Environmental DNA Laboratory (TrEnD) at Australia’s Curtin University. “We’re now able to harness this DNA by collecting a non-invasive sample from water, flowers or swabbing of plant material, removing the DNA from the sample, amplifying and analyzing this DNA, and then mapping it back to a reference database, which will give us a list of species whose DNA is present in that sample.”

The DNA can come from any number of sources: the organisms themselves, shed cells, reproductive material such as seeds or spores from larger organisms, or even scat. DNA may also be retrieved from places like insect traps, samples netted in streams or the water itself. Newton is also working on new ways of retrieving samples, such as gathering the DNA of pollinators



Courtesy of eDNAtec

An eDNAtec ecologist collecting a sediment sample from a river for eDNA analysis.

from flowers, and is looking into the ability of spiderwebs to capture the DNA of vertebrates.

In comparison to conventional observation methods, Mador-House said, eDNA sampling is highly scalable, can track multiple species at once, and can be used to monitor large areas and more diverse environments, which can provide more expansive and accurate datasets. “Crucially, it is much easier to deploy in the field, requiring less specialist support on the ground, which means it is quicker and cheaper to deploy,” she explained. “It is designed to be easily repeatable, and because the data is standardized, it provides an incredibly accurate picture of how an ecosystem is changing over time, to allow companies to make more informed and impactful decisions for nature.”

Adam Cross, principal biodiversity at Australian mining company Mineral Resources (MinRes), which has previously partnered with Curtin University on eDNA research, noted that eDNA surveys “often require less taxonomic expertise than traditional flora and fauna surveys to provide something akin to a genetic fingerprint for which species from different groups of organisms are present in an area.”

He added that eDNA surveys likely represent a powerful supplement to traditional biodiversity monitoring techniques. “They may be a cheaper and more rapid way of capturing a holistic picture of the biodiversity in an area and can more reliably detect organisms that might be difficult to identify or hard to distinguish from other similar organisms visually—for example, different subspecies or plants that are only easily distinguished from each other when in flower,” he explained. “These surveys can also help detect organisms not commonly considered in traditional surveys, such as fungi, mosses and microbiota [microorganisms].”

The eDNA surveys can also discover small, hard-to-detect species, according to Matt Brekke, senior wildlife biologist at Stantec. “Since some species are endangered, it’s very important to be accurate when conducting presence/absence surveys,” he noted.

Those surveys do not always need to be conducted in isolation. There are ways to efficiently collect samples at a low cost during other monitoring activities, said Joe Huddart, biodiversity solutions engineer and mining sector expert at Nature-Metrics. “Water is often the gateway for eDNA monitoring at a mine site. Routine testing of water to screen for pollution and contamination provides a perfect opportunity to collect eDNA samples,” he said. “By collecting eDNA alongside physicochemical data, mines can add a layer of comprehensive biodiversity data at very little additional logistical effort.”

In addition, said Huddart, soil sampling can be useful for identifying soil contamination and tracking revegetation success. “The soil microbiome ultimately dictates what plants grow above the ground, so by characterizing soil communities, it is possible to identify which species are vital for healthy functioning soils and how these respond to restoration and reclamation activities,” he explained.

Limitations

However, eDNA surveying will not entirely replace traditional environmental surveys. It has two limitations: it can detect only the presence (or absence) of an organism, not necessarily its quantity, and it can only identify species whose DNA is already in a reference database.

“When it comes to quantification, we cannot count individual organisms because we’re not capturing them. But we can provide other measures to address this shortcoming,” Hajibabaei said. “We can use prevalence data to provide quantitative measures; for example, if we get 10 samples, and find DNA of a certain species in five of them, that shows that in that region, you have relatively 50 per cent of prevalence of that species. Whereas [at] another site, it may be 80 per cent. So we can provide some quantitative measures, but we cannot count the number of fish or the number of birds.”

He pointed out that there are not DNA reference libraries for every species. “In order to be able to put a name on a DNA sample

that we get from the environment, we need to compare it against the reference DNA,” he said. “In certain taxonomic groups—at least in some contexts, like the large mammals—we do have references for them. But if you go, for example, to a marine setting, or to a remote site, we still see the DNA and say, ‘there is an amphibian here, there is a fish here,’ but we cannot necessarily put names to all the species.”

That is why organizations performing eDNA testing are calling for the development of more comprehensive DNA reference libraries.

The International eDNA Standardization Task Force (iESTF) was founded by Hajibabaei in 2023 to address such challenges. Its global membership is working to develop international eDNA standards and encourage their adoption, as well as helping to set quality requirements for standardized procedures while “allowing room for growth and optimization in this rapidly advancing field,” according to its website. The iESTF is also involved with ISO working groups on the effective development of standards for applications, engages with multiple stakeholders and acts as a “point of contact for information, resources and educational material.”

Given its current limitations, Mador-House thinks that eDNA testing will not replace traditional biodiversity surveys in the near future, but it is a valuable complement to them. “There will always be a need for conventional species monitoring, using transects and highly skilled individuals in the field,” she said. “However, the number of these ecologists and taxonomists is not sufficient to meet demand and a bottleneck has emerged; eDNA can help relieve this, while complementing and supporting field teams.”

Huddart offered one further benefit of eDNA testing, “The simplification of nature’s complexities into easily comprehensible metrics means that site-level data can be translated up to the boardroom and everyone in between, transparently reporting on the impact and progress being made towards organizational commitments to nature.” 



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A wildfire in the Côte-Nord region of Quebec on June 5, 2024.

Improved climate resilience

As extreme weather events become more frequent, weather forecasting technology can help mining companies mitigate climate-related risks

By Trish Saywell

Wildfires, lightning strikes, tropical storms, droughts, flooding and other extreme weather events are accelerating in frequency and intensity due to climate change.

Last year marked the warmest year on record since global temperature records began. In Canada, which is warming twice as fast as the global average due to its significant landmass in the north, and which has more than a quarter of the world's boreal forests, unprecedented wildfires ripped across parts of the country in 2023, devouring 16.5 million hectares and forcing some mining companies to suspend operations. While year-to-date statistics show that the 2024 wildfire season in Canada is less severe than last year's, it is too early to tell what the total

impact will be; multiple mining operations across the country have already been impacted by wildfires (see p. 14).

"The wildfires are the first Canadian wake-up call," said Toronto-based Theo Yameogo, EY Americas and Canada mining and metals leader. "Climate change is real, but mining companies are at different maturity levels depending on their experience or exposure to it."

Larger companies with global operations are more in tune with the variety and extent of climate risks across continents, he said. And as costs rise to tackle climate-related risks, smaller companies may find taking preventive measures to be capital intensive. "Even with a small problem, a lot of money is required," noted Yameogo. "Some will have to

reduce profitability, and the cost becomes a discussion with shareholders and investors.”

An EY survey of 150 mining executives last year ranked climate change as the fourth-biggest threat to the mining industry after environmental, social and governance (ESG) issues, capital and licence to operate. In the same survey the previous year, climate change ranked as the third-biggest threat to mining.

“Companies need to make sure they are baking risk into their business decisions,” said Eric Jones, Texas-based global manager of business risk consulting for mutual insurance company FM, formerly known as FM Global.

“Where are they vulnerable? If there is a risk of wildfires, how will that impact them? If they’re relying on a supplier for a key piece of equipment and it’s located in a 100-year flood zone, how willing are they to accept that risk? You need to understand the physical threats. If you’re building a production facility, make sure it’s away from flooding and wildfire risk,” he advised.

Risk reduction

One mitigation approach mining companies can incorporate into their business plans is the use of technology that can detect and forecast extreme weather.

For wildfire risk management, Vancouver-based SenseNet offers technology that integrates satellite imagery, advanced gas sensors, smoke detection cameras, artificial intelligence (AI) algorithms and real-time data analysis to provide early alerts for wildfires.

The company collects environmental data in real time from sensors that detect temperature, humidity, air quality, volatile organic compounds, carbon dioxide and monoxide, methane, nitrogen oxides and particulate matter.

The sensors last up to eight years and can detect fires in the smouldering stage, even in dense forests. They continuously collect data and upload it to the cloud, where it is processed by specialized AI algorithms. If there are irregularities or spikes in the air composition, these can be detected.

When the sensors pick up anomalies, cameras then zoom in for a better view. By capturing real-time images from wildfire zones, SenseNet’s algorithm can then detect fire behaviour, danger levels and air quality. The company also tracks fire weather index and other datasets to understand weather patterns and predict potential fire outbreaks by lightning strikes.

That is important because the warming climate is creating drier and windier summers and more frequent lightning strikes; according to the Canadian Climate Institute, 93 per cent of the land burned in Canada in 2023 was due to wildfires started by lightning strikes. What is more, fire season is starting earlier and lasting longer. Some fires—called “zombie fires”—are now even burning through the winter months, kept alive by a combination of peat moss and dense snow.

“The first challenge is getting the messaging out,” said Alex Pourian, SenseNet’s director of strategic partnerships. “But we’ve seen some significant growth. Mining is a newish vertical for us and we’ve seen a fair bit of traction in the last six months.”

U.S.-based AEM is another company that aggregates, analyzes and alerts on data from advanced technologies including lightning detection, surface observations, AI smoke detection and hydrological data for worker safety and environmental regulatory reporting. AEM also offers round-the-clock custom weather forecasting through its team of meteorologists. Through an automated alerting engine, AEM utilizes multiple

data sources and allows users to customize location-based threshold alerts and deliver notifications via SMS, email, in-app alerts and through siren/strobe hardware.

AEM owns its own lightning and weather station networks, which mining companies use to understand surface conditions as well as where, when and how severe the lightning is. Timely alerts manage when workers need to take shelter and when they can return to work. The deployed remote weather stations collect data for simplified regulatory reporting and are also used to alert on conditions such as high winds and heat stress.

“We work with one of the largest domestic mining companies in the U.S. and we have put equipment out at most of their mines and processing sites,” said Stuart Hershon, a mining solutions specialist at AEM. “Mining companies don’t want to be in the weather business. They do not want to devote resources to maintain weather equipment and data. They would prefer a managed approach.”

Hershon, who has worked at AEM for nearly 20 years, noted that it was only a few years ago that the mining sector began to understand the availability of comprehensive weather solutions for safety and environmental applications.

“A lot of mining operations cobble together their weather picture from a variety of sources, including free public apps and/or sensors that are old and uncalibrated,” he said. “A technology solution that not only provides everything in one, real-time system, but ensures data quality, is an easy decision.”

Challenges do arise when working in remote locations, where communications are not always as simple as a hardwired or cellular connection. At one site, the company was unable to connect to any of the local cellular networks, but AEM was able to provide satellite communications for near real-time data collection.

“They are seeing much less data loss, and even C-suite folks can log in to the software and get a clear picture of conditions at any site, globally,” Hershon said. “It is monsoon season in Arizona right now and they’re able to see lightning activity, precipitation data, heat stress and flash flooding information all in one common operating platform, which can also send notifications.”

AEM works directly or in strategic partnerships with clients in Canada, North and South America, Australia, Africa and Southeast Asia. “We are seeing far more inquiries, both domestically and internationally, on new and reconstituted mine sites capitalizing on the increased demand from EV [electric vehicle] and solar battery proliferation,” he added.

“More attention is being paid to climate change, and I believe that mining companies have a responsibility to focus on getting the best available data for safety and mitigation, especially as it pertains to water resources and wildfires.”

Finland’s Vaisala, a global leader in measurement instruments and intelligence for climate action, has a variety of tools including light detection and ranging (LiDAR) scanners for dust blooms, air quality sensors that can measure particulate matter down to 0.3 microns, and cloud-connected weather stations with multi-weather sensors. It also has water height sensors that can measure the level of a tailings dam using radar technology, and precipitation sensors that can detect freezing rain and freezing fog.

“The technology exists to mitigate extreme weather events, and the technology exists to save lives,” said Frank DeFina, Vaisala’s New York-based business development manager.

The Canadian National Lightning Detection Network, which is owned by Environment and Climate Change Canada, uses Vaisala

technology. “We can detect cloud-to-ground flashes with a location accuracy better than 100 metres,” DeFina said. “At many of these open pits there’s nothing much around them and your vehicle is the tallest thing at the site, [so] knowing where the lightning is, how much time you have to shut down, is pretty paramount.”

DeFina confirmed that attention to climate change is growing in the mining sector. “There have been mining conferences where I talked about climate change and there were only a handful of people attending,” he said. “But I think now a lot of the big CEOs are starting to understand the impacts of extreme weather events more and more. We’ve always had business from mines, but the dollar value of what’s happening as a result of climate change-related weather impacts is growing, and they know they have to be stewards of the environment.”

Financial impact

In Canada, insured damage for severe weather events and natural catastrophes in 2023 reached \$3.1 billion, according to the Insurance Bureau of Canada. Insured damage from two wildfires

in the Okanagan and Shuswap areas of British Columbia alone during August and September 2023 totalled \$720 million.

While mining companies can talk about climate risk and qualitative impacts, they typically respond best when they know the financial cost of inaction, according to Jones of FM.

“You need to know what can go wrong—whether it’s wildfire, climate risk or a train derailment—whatever can shut you down, and you need to understand the financial ramifications that can result,” he said.

It is not just the cost of the actual disruption that should be of concern, Jones added. Disruptive events can have “long tails of financial impact,” including opportunity costs, lost customers and diminished market share.

“All those things dilute cash flow going out in the future,” he said. “When your cash flow is diluted and investors and the community see there’s more risk associated with your operation, or you’re not managing your risks properly, your cost of capital can increase, which can decrease the enterprise value of your business.” **CIM**



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Noise control

Soft dB's Pierre-Claude Ostiguy discusses how mining projects can help maintain noise and vibration compliance while keeping operations running smoothly

By Mehanaz Yakub

Pierre-Claude Ostiguy is the director of the acoustics and vibration monitoring division at Soft dB, the largest private engineering firm in Canada that specializes in acoustics and vibration. With a doctorate in vibration, his expertise encompasses turning complex technical insights around acoustics and vibrations into practical solutions. Over the past five years, he has led his team in the development of tools, products and services designed to address the increasing need for effective noise and vibration monitoring at mining projects.

CIM Magazine spoke with Ostiguy to learn more about the importance of noise and vibration monitoring, the challenges it presents and the solutions that mines can adopt to ensure that their noise and vibrations are under control.

CIM: Why is noise and vibration monitoring and management crucial for mining projects?

Ostiguy: There are two main reasons. The first involves regulatory compliance. In Canada, mining operations are mandated to comply with federal, provincial and local noise regulations and standards. With certain noise or vibratory guidelines set in place, the noise contribution of a mine must not be in exceedance of these specific levels during daytime or nighttime

hours. As such, if a blast were to occur, it is critical that emissions do not surpass certain vibration or overpressure values.

There are studies that can be conducted in the design phase to ensure that a mine will operate within regulatory compliance once production is under way, but it is important to understand that there are many variables that can have an effect on noise climate—whether it's wind direction or thermal inversion. If there is a constant noise source, the noise level heard at a distance may actually change from day to day, even though the sound generated by the source remains unchanged. Having monitoring stations strategically in place allows for the ability to verify that operations are maintaining regulatory compliance, while also being able to address any variations in noise levels, should it become necessary.

The second reason is that community engagement becomes increasingly more important over the course of the entire mining process, starting from the exploration phase to the completion, or decommissioning, of the mine. Utilizing noise and vibration monitoring is an effective strategy, particularly with regard to community relations and social acceptance.

With the addition of new activities to the existing environment, such as exploration drilling, open-pit mining or the use of ventilation fans for underground mines, these changes can

cause a dramatic effect on the acoustic climate of the area. Therefore, when neighbouring communities are impacted by such change, this can often result in social acceptance challenges, especially when noise and vibration is not properly taken into account.

While there are some methods that can be used to reduce noise at source, effective noise and vibration monitoring has the advantage of being able to quickly address any complaints being raised by neighbouring communities. Continuous audio recording gives you the ability to verify the precise noise levels at the time of the complaint, assess whether the levels were in compliance and identify the exact source of the noise causing the disturbance.

An important aspect of community engagement is also understanding that it's not necessarily the loudest noise over a certain period that generates complaints—it could be a specific sound. For example, a fan that is continuously running might blend into the background over time, but a back-up alarm on a truck at 2 a.m. is more likely to lead to complaints. Despite being louder and shorter in duration, if we were to look at the average noise level over an hour, the noise contribution of the back-up alarm is marginal.

By having an effective real-time monitoring solution with continuous audio recordings, you can literally go back in time, listen to the noise and then assist the mine in identifying the noise needing mitigation. Finding resolution efficiently and effectively is particularly helpful if the mine is aiming to improve community acceptance for its operations.

CIM: What are some challenges when it comes to managing noise and vibration at mine sites?

Ostiguy: The main challenge has been finding a way to isolate and provide only relevant information to the mine, while still being able to measure everything in the process. This becomes particularly important in cases where there has been a complaint or compliance assessment is needed, so that the mine has access to all the necessary information required.

Noise and/or vibration monitors run 24/7, which means that the volume of data being collected is quite high. The goal of any type of monitoring system is to have the ability to avoid false positives. An example of a false positive would be if a bird chirps next to the microphones and causes an exceedance of noise thresholds, thus causing an alert. Given that this noise is not associated with the mine's operations, finding a way to prevent the mine from being notified is a success that Soft dB has been able to achieve.

Soft dB has developed a patented artificial intelligence (AI) filtering tool, specifically designed for the mining sector, that has the ability to remove/filter any unrelated noises from the mining activities, such as cars, airplanes, trains, birds, frogs—anything unrelated to the mine. Therefore, only relevant noise specific to mining operations, and approaching the threshold of exceedance, will send a notification.

It's the same concept with vibration monitoring. To prevent sending false positives for vibration, we've also developed a patented system for seismic and blast monitoring called the Master Trigger, where all the vibration monitoring stations can communicate with each other. If there is an increase in vibration at one point, the server connected to the stations will ask all the other stations if the particular vibration was measured. If the answer is yes, a report is generated and sent to the mine, but if

the answer is no, the mine will not be notified, as it is deemed to be irrelevant.

CIM: What should be considered when implementing a noise and vibration monitoring system?

Ostiguy: There are a few aspects for mines to consider. It is important to have a solid background in noise and vibration, or to be supported by a company with strong expertise specifically in mining noise and vibration. Understanding mining operations, knowing precisely what is needed and what options are available, allows for the best outcomes when implementing and operating an effective monitoring system.

Monitoring solutions need to be capable of providing all the information necessary for a comprehensive understanding of the noise and vibration climate at all times. Monitoring isn't just about measuring a certain level, at a particular time—noise and vibration is far more complex. Having information on the amplitude and frequency of noise and continuous audio files is optimal.

Additionally, having a monitoring system that can reduce the overall time spent in the field, thereby increasing its efficiency. Monitoring solutions also need to be able to send data online in real time. If the system allows for this, then the mine can also receive notifications in real time, and is thus able to adjust accordingly.

There are also more advanced features, like automated calibration verification of microphones or vibration sensors, as well. These systems can perform daily self-checks, so that the mine won't need to send someone into the field every week to verify the sensors—it's all done automatically. Essentially, if something goes wrong, the client gets notified.

CIM: Do you have any successful case studies you can share with us?

Ostiguy: Soft dB is currently monitoring the noise and vibration at several mines across North America.

We have been providing monitoring services at Agnico Eagle's Canadian Malartic mine in Quebec for more than 10 years. It is one of the largest open-pit mines in Canada and its operations are located in close proximity to a community. Soft dB developed a system that informs the mine only when it is at risk of noise exceedance, while taking into consideration weather conditions, topography and the location of the trucks in real time. It calculates the mine's actual noise contribution in the community, which allows the company to be proactive at ensuring compliance. By utilizing the various tools that Soft dB has developed, the mine has been in total regulatory compliance for noise since 2018.

Soft dB was recognized for its excellence in environmental noise monitoring for the Canadian Malartic mine, in addition to being awarded a 2020 Québec Consulting Engineering Award (Grands Prix du génie-conseil québécois) acknowledging Soft dB for its mining activity monitoring program.

As part of its monitoring division, Soft dB actively participates in a variety of community initiatives. This includes meetings and presentations to provide its knowledge and expertise in noise and vibration, regarding the process of monitoring, how it works and how it can help [communities] to gain a better understanding of environmental noise, thus improving community acceptance.

Soft dB also provides noise and vibration monitoring services to Eldorado Gold Québec and its mining operations located in

Val-d'Or in northern Quebec. At the beginning of May, our specialists were invited to take part in a community meeting to offer an informational session about monitoring. This opportunity allowed our team to present our monitoring solutions, showcase our monitoring equipment being used for the mine, provide further explanation of what we are measuring (and how), as well as address any questions or concerns raised by the community members. Offering such opportunities to connect with communities, and provide transparency to noise and vibration solutions, has been shown to greatly increase social acceptance, thus contributing to the overall success of the mine.

CIM: What trends do you see in the future of noise and vibration monitoring for the mining sector?

Ostiguy: I believe that the future of noise and vibration monitoring in mining is having fully automated systems where there is no longer a need for someone to manage them or analyze the data and reports. The systems will provide all the relevant information effectively and independently on their own.

Getting to that point will require a lot of innovation, and this is precisely the direction where Soft dB is aiming to go—developing the next generation of noise and vibration monitors and web-based monitoring platforms. **CIM**



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MINExpo 2024 is expected to host over 1,900 exhibitors across 65,000 square metres of exhibition space.

Global innovation

Advances in technologies such as electrification, data analytics and improved monitoring are some of the trends that will be featured at MINExpo 2024

By Alexandra Lopez-Pacheco

MINExpo International is set to return in full force this Sept. 24 to 26 with its first post-COVID-19 pandemic showcase of mining equipment, products, services and technologies. Hosted by the U.S.-based National Mining Association (NMA) every four years in Las Vegas, Nevada, the event is the world's largest gathering of the mining industry. It includes the unveiling of original equipment manufacturers' (OEMs) latest technologies, as well as mining leaders and professionals

from around the globe networking, exchanging ideas and meeting potential new partners.

The 2020 edition of MINExpo was postponed by a year due to the COVID-19 pandemic, and the rescheduled event in September 2021 attracted approximately 22,000 participants and 1,400 exhibitors—numbers that were significantly lower than usual because the world was still grappling with the pandemic and travel restrictions.



In sharp contrast, this year's MINExpo is expected to host over 44,000 attendees from 126 countries, and more than 1,900 exhibitors across 65,000 square metres of exhibition space. As with previous events, MINExpo 2024 mirrors major industry trends of adapting to past challenges and highlighting the innovations that will chart the direction of mining in the coming years. That direction is one in which the mining industry is no longer merely adopting new technologies, but in which mining is re-designing itself and its operations to leverage what are now mature technologies and position itself as a sustainable player in the green energy transition.

Shifting focus to ESG

The three years since the last MINExpo have been marked by a major global shift in public and investor awareness of climate change. The year 2021 was plagued with a notable increase in the number of extreme weather events. In October 2021, just weeks after that year's MINExpo, members of ICMM committed

to a goal of net-zero Scope 1 and 2 greenhouse gas (GHG) emissions by 2050 or sooner.

That awareness and sense of urgency has clearly led to global recognition of mining as a key player in the energy transition as it will supply the critical minerals needed for global electrification. In turn, that has increased pressure on mining companies to move towards more sustainable mining practices, including choosing suppliers that can help them reduce their Scope 1, Scope 2 and Scope 3 emissions and increase electrification and automation at their operations, according to Marla Tremblay, executive director of MineConnect, Ontario's mining supply and services association. This organization will have a booth at MINExpo's Canada Pavilion, run by the Mining Suppliers Trade Association (MSTA) Canada, and MineConnect will also be hosting a 500-person Northern Ontario reception at the event.

"We're seeing more and more companies, even at the supplier level, working with firms that are experts in assessing their carbon footprint," she said. "Because if an operation has the paperwork, that can really help it with its carbon offsets."

Mining companies are increasingly refocusing on environmental, social and governance (ESG) priorities, with a particular emphasis on the "social" aspect, as they recognize the growing importance of building stronger, more equitable relationships with local and Indigenous communities, she added.

"There's no doubt there's been a huge focus on ESG in the last few years for the industry as a whole and for us as a contractor," said Paul Healy, president of mining contracting and engineering company Redpath Americas, which is headquartered in North Bay, Ontario, and will have some 35 representatives from its operations in Australia, South Africa and Germany at its MINExpo booth. "It's a pretty hot topic for pretty much all the mining companies. Investors want companies that are socially and environmentally responsible and have proper governance—and it's the right thing to do."

Randi Ray, who sits on the MineConnect board and is the founder and CEO at Miikana, a First Nations-owned and operated consulting firm that specializes in helping companies in various industries build sustainable, mutually beneficial relationships with Indigenous communities, has noted significant interest in recent years from both Canadian and international mining companies.

While in the past many mining companies saw the "social" aspect as a risk mitigation strategy, more and more are recognizing it "as an opportunity to be working in partnership with Indigenous peoples, enhancing their supply chain and labour force while benefitting from thousands of years of knowledge of the land," said Ray.

Ray will be attending MINExpo with MineConnect and actively networking at the event.

Mature technologies

In terms of technological innovation, MINExpo 2024 will showcase how yesterday's advancements in electrification, robotics—from autonomous vehicles to drones and tunnel-boring machines—as well as the Internet of Things (IoT), wireless technology and data analytics have permeated nearly every facet of mining.

These technologies have matured and are now reaching new levels of sophistication, including achieving the once elusive "holy grail" of big data analysis through tools such as machine learning and artificial intelligence (AI). Due to a combination of



Mining utility vehicle manufacturer Kovatera will be launching its third generation of battery electric vehicles at MINExpo 2024.

younger tech-savvy generations entering the industry over recent decades, and the growing adoption of these technologies, the once conservative mining industry is now increasingly driving change.

“From an OEM perspective, if you’re building something and trying to push it out to market, and they’re resisting, that’s one thing,” said Don King, sales and marketing manager for Sudbury, Ontario-based Kovatera, which designs and manufactures battery electric vehicles (BEVs) for underground mining. “But when the market is actively pulling for these innovations, it accelerates acceptance significantly. And that’s what we are seeing now. Most mature mining markets know BEVs are inevitable.”

Kovatera will be launching the third generation of BEVs for its KT Series line of heavy-duty underground trucks and its KM Series of utility vehicles at MINExpo. The company’s new BEVs feature regenerative braking, which King pointed to as an example of the new levels of sophistication being achieved in what is now a mature technology. Conventional BEVs recharge the battery with regenerative energy when going down ramps, he noted, meaning that when the charge hits 100 per cent, the vehicle disconnects from the generator.

“When that happens, then the vehicle freewheels,” said King. “In a mining application, you certainly don’t want vehicles freewheeling down the ramp. You can put your foot on the service brake, but then you would be riding the brakes all the way down.”

Existing solutions tend to address this challenge with methods that either slow down the vehicle or dissipate—and waste—the regenerative energy. Kovatera’s regenerative braking includes a braking resistor on the vehicle that can handle 100 per cent of the regenerative energy created going down ramp for a smooth, controlled drive down the ramp. “We think it’s a very safe and practical method,” said King.

Kovatera is not the only company unveiling new BEV technology. Others include Caterpillar, which announced that since MINExpo 2021, the company’s teams have made enormous progress with the development of its electric technology, including its new Cat R1700 XE load-haul-dump (LHD) underground truck that features battery-electric propulsion with zero exhaust emissions that can handle bigger payloads, faster loading and lower emissions than older models.

Robotics, including autonomous and semi-autonomous mining equipment, will also have a prominent presence at MINExpo 2024. Caterpillar, for example, will have its new 372 tonne Cat 798 AC mining truck on display, which is configured for autonomous haulage (see p. 12).

This trend reflects not only the industry’s shift towards improved efficiency but also a focus on safety. “There’s a lot of interest in the industry in anything that’s getting people away from the face. The safety piece is a priority,” said Tremblay.

Redesigning the mine

The maturing of technologies such as electrification and automation—which require electricity and wireless network connections—have led to a transformation in the infrastructure being put into mines, according to Healy.

“I think that’s the biggest change we’re seeing,” he said. “Historically in mines, one of the challenges was that people went underground and they were isolated; except for a few visits by their supervisors, [they] were pretty much left to their own devices. Now, the ability to communicate and to actually see the headings remotely, [has] really made a big difference in our ability to plan work, to understand what’s happening, to make decisions based on real-time information and then to use the data to forecast and optimize things.”

Adding electrical, Wi-Fi and LTE infrastructure has become the norm for new mining projects and that is opening up new possibilities into how mines are designed. “Depending on the actual cross-sectional area of the drift where you need to run your electric fleet, you can potentially look at a smaller profile of a drift to support the work you’re doing,” said Healy.

As electrification and automation becomes the norm, King noted that mine design will likely adapt to optimize the technology, for example by including ramps that are designed to better leverage regenerative energy.

Evolving connectivity

Established companies that provide real-time monitoring technologies for the mining industry for everything from micro-seismic activity to asset management and material analysis are now incorporating advanced tools such as AI to leverage years’ worth of data to increase their precision and capabilities.

Kingston, Ontario-based ESG Solutions, which specializes in subsurface microseismic monitoring technology and services, is a prime example of this. “The speed at which we can operate computers today, and machine learning, have made it possible for us to look through all of this data and make sense of trends and patterns,” said Alexander Mataseje, key account manager and global sales operations lead for mining and geotechnical services at ESG Solutions.

While deploying Wi-Fi and LTE networks underground represents the future, it also presents challenges for 24/7 monitoring

that requires real-time data. Time synchronization in wireless networks is typically dependent on GPS, which is not accessible underground. However, ESG Solutions is working to change that.

At MINExpo, the company will showcase a solution developed in partnership with communications technology company Rajant Corporation at NORCAT's Underground Centre in Sudbury. By integrating precision time protocol (PTP) from ESG Solutions' system with Rajant's network, the two companies stated they have achieved microsecond precision in transmitting data across two wireless hops (the number of network devices through which data passes from source to destination) and are now working to extend this capability to three.

Sudbury-based Symbioticware, which developed the 4-Sight.ai asset performance management platform for mining fleets, is another example of an established company incorporating leading-edge advancements to its offerings. It is also one that illustrates the rapidity of change in the industry over the last three years. In 2021, the company showcased its hardware solution at MINExpo, but this year, the company is unveiling its dramatic transformation—and rebranding as Symxai.

“We are trying to disrupt the status quo with vertically integrated IoT software, AI and a connectivity platform,” said Ash Agarwal, the company's CEO. “We offer all solutions in one and our AI is not a general-purpose AI—it is specifically built for mining.”

The company's AI has been trained on the years of data and insights it has collected through its systems in actual mine settings—taking predictive maintenance to the next level. “For example, we know what happens immediately before a failure,” said Agarwal. “We don't want to predict a failure event—we want to predict what happens right before the failure event by looking at data, and that's something that AI can do.”

Symbioticware has also partnered with SpaceX's subsidiary Swarm and integrated satellite connectivity into its system. “Mining companies that do not have internet or Wi-Fi can still use our solution at a significantly lower cost than installing the [communications] infrastructure,” said Agarwal.

Another company that has been leveraging AI to increase the sophistication of its offering in recent years is North Bay-based WipWare, which offers real-time analysis of materials—for



Courtesy of WipWare

WipWare's WipFrag image analysis software can be used on a cellphone or tablet.

example, on a conveyor or in a truck—using photoanalysis systems for underground and surface mining. By training its intelligent cameras on its extensive libraries of rock photos, the company is now able to achieve excellent precision and accuracy.

Changing workforce

The changing workforce in mining is another major trend that will be reflected at MINExpo 2024. Technology has significantly shifted the types of skills needed in the mining industry, with a growing demand for expertise in digital systems, automation, data analysis and wireless communication, alongside traditional mining skills—and to improve safety with these tools by removing or reducing the need for humans from high-risk areas. WipFrag, WipWare's flagship offering, for example, is used to optimize blasting using cameras, keeping humans out of harm's way and letting them focus on creative problem solving.

This trend has been growing over the last decade with “mining companies creating positions or whole teams whose job it was to seek out these tools on the market and put them into the hands of their miners, so that blasters and other staff can do a better job,” said Andrew Palangio, senior technical specialist for WipWare. “But with the pandemic, that trend has taken off crazy fast.”

This trend comes with a twist that mirrors the evolution of the global digitalization revolution. As the technology advances, it becomes increasingly accessible to those who are not experts in IT or programming, making it easier for everyone to use these technologies without needing specialized knowledge. WipFrag, for example, can be used on the ground using a cellphone or tablet.

“[Someone could] take a photo with their cellphone and they might identify a problem that has been haunting the line or the operation for years, or maybe even decades,” said Palangio. “And they could do this on their first week on the job.”

The future

This is only a sampling of the innovations that will be at MINExpo 2024, but overall they point to the biggest trend in the industry. After a decades-long journey of innovation, the mining industry has now reached a pivotal moment: it has already entered a new era of transformation.

With almost 2,000 exhibitors from around the world, and tens of thousands of participants, this year's MINExpo could be remembered as the landmark event that marked a turning point where the enormous potential these innovations and technology have shown become day-to-day operational reality. It not only points to the future direction of the industry, but it also showcases how far it has come. **ENR**



Courtesy of Symbioticware

Symbioticware's 4-Sight.ai platform is designed to generate real-time insights into equipment productivity, efficiency and safety.



Rio Tinto's Diavik diamond mine is located on a 20-square-kilometre island in Lac de Gras, Northwest Territories.

The transition to closure

The Diavik diamond mine in the Northwest Territories is approaching closure in early 2026, but Rio Tinto aims to leave a positive legacy

By Ailbhe Goodbody

Rio Tinto's Diavik diamond mine in the Northwest Territories is set to close in approximately 18 months after almost a quarter of a century of operations. Over 144 million carats of rough diamonds have been recovered at Diavik through a combination of open-pit and underground mining since it entered commercial production in 2003, and the mine is a major contributor to the economy of the Northwest Territories, accounting for more than 10 per cent of the territory's gross domestic product.

The current mine plan anticipates that operations will cease in the first quarter of 2026, followed by a transition to closure activities from 2026 to 2029. However, the mine was designed with closure in mind from the outset, and Rio Tinto hopes to leave a lasting beneficial impact in the region after its closure activities end in 2029, while limiting its carbon footprint at the same time.

Background

Significant diamond deposits were discovered in the Northwest Territories in the early 1990s. The diamondiferous kimberlite deposits were formed approximately 54 million to 58 million years ago when magma—which included diamonds as xenocrysts—ascended from the mantle and intruded the older

Archean rocks of the Slave Craton in the northwestern Canadian Shield, erupting as a volcano. Volcanic material then flowed back into the open crater created by the eruption, creating the ore bodies.

The Diavik diamond mine, which is wholly owned and operated by Rio Tinto via its Yellowknife-based subsidiary Diavik Diamond Mines (2012) Inc., is located on a 20-square-kilometre island known as East Island in Lac de Gras, approximately 300 kilometres northeast of Yellowknife and 200 kilometres south of the Arctic Circle.

The construction of the Diavik mine was approved in 2000, and the mine consists of four high-grade diamond-bearing kimberlite pipes—A154S, A154N, A418 and A21. Accessing these kimberlite pipes, which are located at the bottom of the lake, required the construction of water retention dykes, as well as the dewatering of parts of the lake.

Commercial production began in January 2003 from the A154S and A154N open pits, and the A418 open pit started producing in May 2008.

A managed transition to underground mining was implemented as the first three open pits approached completion—the A154N, A154S and A418 pits were depleted by July 2008, late 2010 and September 2012, respectively. However, underground

production from A154N began in February 2010 and from A154S in August 2010, followed by underground production from A418 in September 2012.

The fourth open pit, at the A21 kimberlite pipe, opened in August 2018 and was mined until mid-2023. However, in early 2023, Rio Tinto approved a \$40 million investment in the first of two phases of underground mining at A21, which extended Diavik's mine life from 2025 until the first quarter of 2026. The second phase of the project has since been approved.

"There will be a planned increase in carats produced once the A21 underground mine comes into full production," said Matt Breen, chief operating officer of the Diavik diamond mine at Rio Tinto.

Phase 1 of the A21 underground mine is anticipated to deliver an additional 1.4 million carats of rough diamonds, while Phase 2 is expected to deliver an additional 0.8 million carats. As of Dec. 31, 2023, the Diavik mine's remaining proven and probable reserves totalled 3.1 million tonnes grading 2.2 carats of rough diamonds per tonne, based on a nominal one-millimetre lower cut-off size and a final re-crushing size of six millimetres.

An economic powerhouse

The Diavik mine operates under a socio-economic monitoring agreement (SEMA) with the Government of the Northwest Territories, which commits to ensuring that local communities benefit from the mine by formalizing employment and training opportunities, business development and capacity-building initiatives. It also has individual participation agreements with the Thchq Government, Yellowknives Dene First Nation, North Slave Métis Alliance, Kitikmeot Inuit Association and Łutsel'k'e Dené First Nation, which were formalized before Diavik began operations.

The mine currently employs over 1,300 people; of these, 36 per cent are from northern communities and 18 per cent are northern Indigenous.

"As of the end of 2023, Diavik [has] spent \$10.4 billion since construction began in 2000, of which \$7.5 billion has been with northern businesses," said Breen. "This represents 72 per cent of our total business spend, reflecting our strong partnerships."

Of this figure, \$3.7 billion has been spent specifically with northern Indigenous businesses and their joint ventures, which Breen noted has provided jobs and revenue for northern communities. As an example of this, he pointed to the extension of Diavik's agreement for Bouwa Whee Catering's services through to the end of mine life.

"Bouwa Whee is a subsidiary of Det'on Cho Corporation, which is owned by Yellowknives Dene First Nation, and provides catering, housekeeping and janitorial services to the camp," he said. "The agreement extension was signed in December 2023 and ensures we can retain employment in the North and strengthen our partnership with Indigenous organizations."

In addition, the recent construction of a solar power plant at Diavik was contracted to Whitehorse-based Solvest Inc. and the Thchq Investment Corporation, which is Indigenous-owned, with support from the Diavik team. "Approximately 30 per cent of the construction workforce came from the Thchq Investment Corporation," he added.

Powered by renewable energy

Rio Tinto announced the project to build a solar power plant at the Diavik mine in August 2023. The project had been

granted funding of \$3.3 million from the Government of the Northwest Territories' Large Emitters Greenhouse Gas Reducing Investment Grant program; according to Rio Tinto, the Diavik solar plant was the first project to be funded by this program, under which the territorial government sets aside 12 per cent of the carbon tax paid by the operation (in this case, the Diavik mine) and makes it available for projects that will contribute to reducing greenhouse gas emissions in the Northwest Territories.

The Diavik solar project also received \$600,000 from the federal government's Clean Electricity Investment Tax Credit.

Construction of the solar plant began in February 2024, and the remoteness of the mine site meant that the team had to overcome some logistical and engineering challenges. The region's climate is sub-Arctic tundra, with daytime temperatures above freezing for approximately five months per year; Diavik has road access for only a couple of months each year, although it also has its own airstrip.

"Because of the Diavik mine's remote location and lack of a permanent all-season road, the panels and racking were transported to site on the 2024 winter road from Yellowknife, which only operates for approximately eight weeks per year during the winter months," said Breen.

To minimize the need for new materials, the project reused spare electrical equipment. "A heated structure was temporarily set up at the construction area to provide a comfortable space for staging and pre-assembly of components," he explained. "The very cold ambient temperatures at Diavik actually enhance the efficiency of the panels, increasing their maximum potential output by about 15 per cent at minus 25 degrees Celsius compared to plus 25 degrees Celsius."

Rio Tinto revealed on July 2 this year that construction of the Diavik solar plant had been completed. According to Breen, this 3.5-megawatt-capacity plant stands as the largest off-grid solar facility in Canada's three territories.

"The 6,620 solar panels are organized in 23 rows and span a swath of land that is equivalent to seven city blocks," he said. "The solar power plant will support all infrastructure needed for closure activities, including the water treatment plant, camp accommodations, workshop, offices, airport and storage buildings."

The new solar plant will generate approximately 4.2 million kilowatt hours of electricity annually, which will significantly reduce Diavik's on-site diesel consumption by approximately one million litres per year and cut emissions by 2,900 tonnes of CO₂ equivalent, which the company stated is comparable to removing the emissions of 630 cars from the roads.

"This reduction aligns with Rio Tinto's decarbonization strategy, which targets a 50 per cent reduction in Scope 1 and Scope 2 greenhouse gas emissions by 2030 and aims for net-zero emissions across our operations by 2050," said Breen. "The bifacial solar panels will also capture additional energy from light reflected off the snow, enhancing power generation by an estimated 10 to 15 per cent, which is particularly beneficial given Diavik's seven months of snow cover each year."

He noted that the construction of the solar plant also demonstrates that renewable power generation is viable in the sub-Arctic.

A wind power plant was installed at Diavik in 2012, and Breen pointed to it as another example of Rio Tinto's commitment to minimizing environmental impact. The wind plant consists of



The construction of the new solar power plant at Diavik was contracted to Whitehorse-based Solvest Inc. and the Indigenous-owned Tłı̨chǫ Investment Corporation.



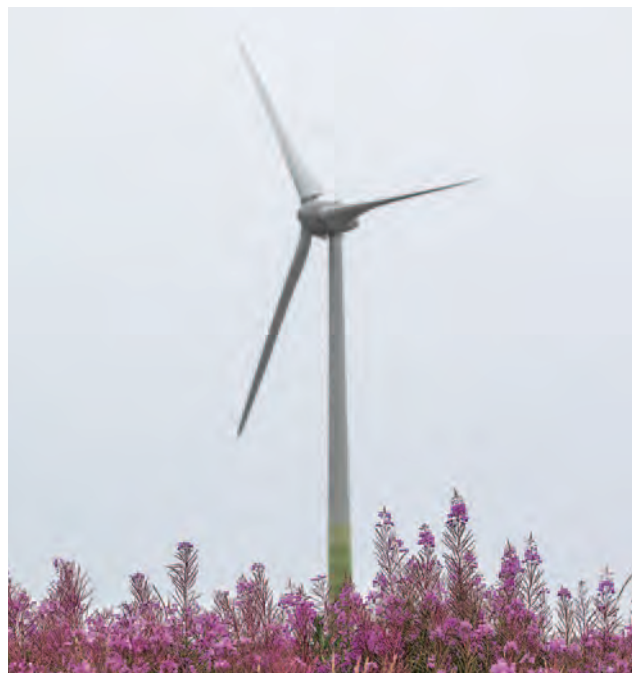
Diavik's new solar power plant is the largest off-grid solar facility in Canada's three territories.

four 64-metre tall, 2.3 megawatt turbines that have a combined 9.2 megawatts of capacity, which according to Rio Tinto is the largest wind power installation in Canada's North.

"[The wind power plant] has generated 198 million kilowatt hours of renewable energy since 2012, saving 135,500 tonnes of CO₂ equivalent emissions and 47.5 million litres of diesel fuel," said Breen. "Together, these projects underscore Diavik's leadership in cold climate renewable technology and our dedication to reducing our carbon footprint."

Throughout the remaining years of commercial production, Rio Tinto estimates that approximately 15 per cent of Diavik's electricity will come from renewable generation.

During the mine's closure phase from 2026 to 2029, 32 per cent of its power generation will come from the wind and solar



The wind power plant at Diavik has generated 198 million kilowatt hours of renewable energy since it was installed in 2012.

farms, with over 50 per cent generated during periods of high renewable energy production (periods when the wind and solar farms are operating at their maximum or near-maximum capacity due to favourable weather conditions, such as strong sunlight for solar energy or strong winds for wind energy.) "Additionally, the solar power plant alone will supply about 25 per cent of the site's electricity during closure activities," noted Breen.

Responsible closure

The integrated closure strategy for the Diavik mine was developed with input from local communities. According to Breen, Diavik's objectives for successful mine closure include ensuring safe and responsible asset closure, achieving positive environmental, social and governance (ESG) outcomes and

implementing innovative solutions to minimize long-term liabilities, while also delivering shared benefits for local Indigenous communities, employees and investors.

As closure costs are embedded throughout the Diavik mine, Breen told *CIM Magazine* that it is not possible to provide a single cost figure for its closure; however, he noted that closure considerations and opportunities to find efficiencies are continuously addressed in the mine's planning and budgeting.

Diavik's closure strategy involves reclaiming the land and water to create a post-closure site that is safe, stable and neutral. The post-closure landform will be reshaped to match the surrounding environment where possible and to provide safe passage for wildlife such as caribou.

"From the outset, Diavik has planned for closure by designing site buildings for removal, reclaiming embankments and allowing lake water to flow back into the open pit," he said.

Any hazardous substances and equipment will be cleared from the mine workings, and once water quality has been confirmed to meet closure and cultural use criteria, the pits will then be reconnected to Lac de Gras to be reflooded.

Progressive reclamation at Diavik began several years ago. For example, the reclamation of a waste rock storage area called the North Country Rock Pile (NCRP) began in 2017 and was completed in 2023. The mine has also started final reclamation of its processed kimberlite containment facility (PKCF) by depositing processed kimberlite into the former A418 underground mine, which ceased production in December 2022.

"A closure rock cover is being placed over the PKCF to ensure a safe and stable surface for future use and to prevent the release of processed kimberlite into the environment," explained Breen. "This work demonstrates Rio Tinto's commitment to modern best practices in mine closure, including the Global Industry Standard on Tailings Management (GISTM) and the Mining Association of Canada's Towards Sustainable Mining (TSM) standards, with the majority of closure cover works associated with the waste rock storage area now complete."

Diavik's closure strategy also has significant emphasis on reducing negative socio-economic impacts from the closure of the mine and providing a positive legacy for the region.

For example, Rio Tinto is collaborating with the Government of the Northwest Territories and its community partners to explore how Diavik's renewable energy infrastructure could best benefit the region after closure, as by then the solar panels will still have 25 years of operational life left.

Breen thinks that Diavik's approach of planning for closure since before mining operations began demonstrates a key lesson for the mining industry—to integrate closure planning into every stage of mining operations.

"By prioritizing environmental responsibility and innovation, Diavik has effectively managed remote and challenging conditions," he concluded. "These efforts ensure that the positive impacts of mining extend well beyond the life of the mine, providing long-term environmental and economic benefits to the local communities." **CIM**

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A MacLean EV TM3 transmixer at MacLean Engineering's underground research and training facility in Sudbury.

Big machines, big batteries

Key OEMs gave their insights on the latest developments in battery electric vehicles at a recent forum and also discussed some of the obstacles to their wider implementation in underground mines

By Ailbhe Goodbody

Secure supply chains, safety and the need for boots on the ground when introducing new technology animated a special panel discussion at the third edition of the BEV In-Depth: Mines to Mobility conference in Sudbury in late May.

The panelists—Alex Willows, business line manager, load and haul at Sandvik Mining and Rock Solutions; Shawn Samuels, business line manager at Epiroc Electrification Solutions Canada; and Alex Lenz, product manager, electrification at MacLean Engineering—shared insights from their expertise in the implementation of battery electric vehicles (BEVs) in underground mines, including the importance of buy-in from all levels at a mine site and how they see electrification advancing.

The panel began by discussing the challenges that BEV providers have to account for in an underground mining environment, such as battery performance and longevity, which are different to those faced by BEV manufacturers that serve the automotive sector.

“Underground mining is a pretty dark and rugged place for loaders and trucks,” said Willows. “You’ve really got to create a rugged battery system that is as waterproof as you can, as there’s water in all kinds of places in underground mining.”

Samuels pointed to the importance of increased safety for batteries used in underground vehicles. “The safety systems we have underground for our batteries are far [safer] than in automotive, because a fire underground is really not good if you’re in an enclosed area,” he said. “The vibration is also a lot more

underground than it is on roads. Those two are the key areas when you design a battery [for use] underground.”

Connectivity and communication systems for effective monitoring of the battery, either on site or remotely, is important for underground BEVs, added Lenz. “Not only [for] talking to the operators and the maintenance people to see what’s happening visually, but being able to see what’s happening inside [the vehicle] that is not visible to the technician,” he said.

Key advances

The discussion turned to some of the developments in BEVs that have helped with efficiency and performance in the companies’ respective vehicle classes.

“For Sandvik, we’ve had a big advancement with one of our cell suppliers in the last year or so; they’ve been developing a new higher-density cell,” said Willows. “Just last year, we saw about a 36 per cent increase in capacity in the exact same cell volume.”

Samuels stated that battery cells have improved a lot in the last decade, including becoming more power dense, which allows for a longer battery life. “Probably the fastest-growing [area of BEV advancement] right now is charging, and the different methodologies and the speed of charging has really grown,” he said. “All that combined, I think, has really led to the vehicles being a lot more usable underground, [and] a lot more feasible for a lot of projects.”

According to Samuels, locking down a long-term supply of batteries has been important to Epiroc in the past, although the demand has eased a little recently. “[Suppliers] are getting more sustainable now, but it was always tough for us to find good sustainable suppliers,” he said. Since 2018, Epiroc has had a partnership with Swedish supplier Northvolt to supply the lithium-ion battery packs for its BEVs.

Willows pointed to Sandvik’s 2019 acquisition of Artisan Vehicle Systems, a U.S.-based supplier of underground BEV solutions that was developing batteries and electric drive lines, as a milestone.

“Our company is a little bit unique in the sense that for some of our equipment, we build the batteries all in house. We do

have other equipment that we purchase off-the-shelf batteries for; there are pros and cons with both sides, as you can imagine. We’ve got a good number of machines coming out in the field, but we’re just starting to ramp up,” he noted, adding that the most impactful gains offered by BEVs will come with this expanded implementation.

Having a battery supplier that produces the cells itself is a “big win” for MacLean Engineering, according to Lenz, as he said, “we’re not reliant on multiple third parties to be able to get the end product,” and it also allows MacLean to be certain that the supplier sources the raw materials in a safe and sustainable way.

He also highlighted the company’s investments in Canada, including the 2018 purchase of an underground research and training facility in Sudbury, now known as Ducky Mine. “We bought the test mine so we can validate and test our vehicles there before sending them out to the field,” he said. “Because [there are] so many new technologies being worked on and developed, we need to make sure that they’re safe and fully tuned before we send them out.”

Underground implementation

Buy-in from all levels is the most important consideration when implementing BEVs at an underground mine, Lenz emphasized. “You’ve got [to get] buy-in from corporate [and] from the people actually driving and servicing the vehicles,” he said.

He added that it can be tougher to get this buy-in when there are only one or two BEVs on site, because it only goes to the shop every few months. “There are so many other things that the mechanics and electricians have to work on, [so] they don’t always necessarily remember how to work on that particular vehicle or how to fix that issue,” he said. “When you do bring in an expert to troubleshoot, make sure that they’re paired up with an appropriate person from the mine site [for] that added benefit of peer-to-peer training, because that is the best way of training.”

Samuels agreed that buy-in from all levels is important. “Part of the way we do that is [by doing] a lot of education and training at all levels,” he said. “We try to work with customers very early,



Courtesy of Epiroc

Epiroc’s second generation of battery electric vehicles, launched in 2018, includes loaders, trucks, drills and rock reinforcement rigs.



Courtesy of Sandvik

Sandvik's BEV customers include New Gold's New Afton mine in British Columbia.

well before they get the machines, and do a lot of education, and that's critical to any success we've had."

Epiroc also works with the mines on planning the charging infrastructure and how the BEVs will run in the mine. "We [can] supply everything from cables to chargers to substations—all the infrastructure needed—[and] then we can do design work on that and everything to go along with the machine," said Samuels.

Sandvik's biggest successes with implementing BEVs have been with larger fleets, noted Willows. "We seem to run 10 machines better than we can run one machine," he said. "[Perhaps] because you've got more of the buy-in from the mining company, from the top all the way down to the bottom."

The panelists acknowledged that there can sometimes be resistance to BEVs from equipment operators, especially when change management processes are not implemented properly. "I think it's the fear of the unknown, and rumours of the [battery] cells catching fire," said Lenz. "They're not sure, so they don't want to try it. So one hazard is resistance to change."

However, Willows said that he has seen both positives and negatives in operator perceptions of BEVs. "As soon as you get an operator driving a less loud, less vibrating machine, they love it," he commented. "Typically, they tend to have more power on [electric] loaders and trucks, so once they get in the seat, they enjoy it."

An area where he has seen challenges is when the first problem with the electric vehicle comes up. "You get the first fault code, and [if] no one can fix it within a few minutes or an hour, it's lost a lot of credibility," he said. "So, having on-site support for the first little while has been critical as well."

Future developments

The discussion concluded with predictions of some of the key advancements, either in battery technology or related technologies, that the panelists think will benefit the wider adoption of electric vehicles underground.

Willows pointed to advancements in trolley-assist technology as an area that will become increasingly important, especially as it would allow mines to be less reliant on batteries for their electric vehicles.

"Trolley has been around for decades and decades," he said, adding that there are already underground trolley truck lines operating in Ontario and that there could be potential to implement trolley-assist on other equipment.

Samuels agreed. "Everybody asks about trolley pretty well every time we tender anything," he added.

He also highlighted automation as a key trend, as well as the potential for developing autonomous charging solutions for fleets.

According to Willows, at Sandvik, "we see lithium-ion batteries as the key battery source for at least the next five or 10 years," even as many people ask about the potential for solid-state batteries in the future. "Sandvik is not a battery technology driver," he said. "We want to go with something that's proven."

Along with new battery technologies and new charging technologies that would reduce the number of times vehicles need to be charged, Lenz added that more power-dense batteries need to be developed that are able to limit charging needs while still keeping the battery size manageable.

However, he added that new battery technologies are not going to be immediately put into underground environments. "It's definitely going to be tried [first] on surface, in either the automotive [industry] or maybe surface mining," he explained. "We're not going to be putting brand new types of [battery] chemistries underground because of the risk of fire. We've been first for a lot of things; but we may have to be in that race for second, and let other people work it out first."

Samuels agreed. "We have to make sure it's safe, [and] we have to have multiple redundancy safety systems," he said. "Any technology has got to be really proven. It's coming, but it's going to come slow. That development takes a while, [and] it takes a lot of money and time to execute." **CIM**



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Deliver better project results

The fourth edition of CIM's Capital Projects Symposium will focus on the key elements for successful project development and execution

By Michele Beacom

The theme of this year's edition of the Capital Projects Symposium (CPS) is improving the global track record of capital project delivery and execution in the mining industry.

Taking place in Toronto at the Marriott Downtown from Nov. 3 to 5, the event will open Sunday with training workshops on topics such as: project and corporate financial modelling; operating cost estimation; and technical reporting requirements. "This year's training workshops will address critical aspects of capital projects, equipping professionals with cutting-edge knowledge and practical skills to navigate the complexities of today's ever-evolving industry," said Ian Pearce, CIM president and one of the conference organizing committee members. Registration for the conference is not required to attend the workshops. A certificate of participation with professional development hours will be granted following the completion of each course.

Following the workshops are two days of sessions, which are designed to offer an in-depth exploration of key areas: project development, execution, financing and invaluable lessons learned from past experiences. "While the structure remains consistent with previous years' symposia to ensure a coherent learning journey, the content is refreshingly new, delivered by distinguished experts and thought leaders who bring fresh perspectives and insights," said Pearce.

Four sessions will be held over two days of the symposium:

- **Rocks to riches.** From initial exploration to study development, this session will focus on the entire journey of transforming geological data into viable mining projects. Topics include data gathering, geological modelling, and risk assessment of tonnages and grades in situ.
- **Putting your neck on the line.** This session will cover the crucial stages of a mining project, from making the final investment decision to project delivery. It will include discussions on applying modifying factors to mine design, equipment sizing and production planning. Emphasis will be on the importance of stochastic mine plan-

ning to create multiple scenario sensitivities for enhanced value and risk analyses.

- **Whose money to use?** A comprehensive review of various financing mechanisms for mining projects. Topics include the evaluation of different funding sources and strategies to secure investment. Discussions will highlight current rules for disclosing mineral resources and reserves, as well as incentive programs for critical and strategic mineral production.
- **The good, the bad and the ugly.** This session will focus on real-world experiences and lessons learned from past mining projects. Attendees will hear about both successful and challenging projects, providing valuable insights into best practices and common pit-

falls. Key takeaways will include strategies for mitigating risks and optimizing project outcomes.

"This symposium provides an opportunity to update people on what's happening from permitting all the way through to closure, including expectations of communities and Indigenous engagement," said Samantha Espley, organizing committee member.

Pearce added that CPS "is not just an event—it's an invaluable opportunity for professionals to deepen their knowledge, share experiences and forge lasting connections within the industry. It is a must-attend for those looking to stay ahead of industry trends, enhance their project management skills and be part of a thriving community of forward-thinking professionals." **CIM**



The Capital Projects Symposium 2024, the only conference of its kind focused entirely on mining projects, will take place in Toronto from Nov. 3 to 5.

Unsplash



**CIM Health & Safety
Conference**

The safety imperative

New CIM conference aims to address current challenges and promote continuous improvement in health and safety practices in mining

By Michele Beacom

CIM's inaugural Health & Safety Conference will take place in Toronto from Oct. 6 to 8.

CIM's newest society, the Health & Safety Society, is taking its strong and very popular CIM CONNECT conference stream to the next level with its own dedicated event. Unlike most health and safety conferences, organizers say that this one will focus entirely on advancing safety practices within the mining industry.

The event, which will take place at the Marriott Downtown in Toronto from Oct. 6 to 8, will kick off with a professional development workshop on Sunday afternoon led by Nancy Wilk, certified industrial hygienist. "Assessing occupational exposures to diesel particulate matter in mining" will cover recent changes to regulations on diesel exhaust emissions in underground mines, including new performance standards and occupational exposure limits. It will also discuss risk assessments, compliance challenges and transitioning to more environmentally friendly fuels. Registration for the conference is not required to attend the workshop. A certificate of participation with professional development hours will be granted following the completion of the course.

Day one of the conference will focus on current and leading best practices in health and safety, starting with culture. Mark Cutifani, conference honorary chair and chairman of Vale Base Metals, will set the stage with his Monday morning keynote, "Leadership in safety: A moral obligation or a business imperative?" According to Samantha Espley,

conference co-chair, "Mark is going to talk about how each element of ESG [environment, social and governance] is aligned to health and safety. A lot of people think it's just climate change, but he is going to make the case for why it's also about the health and safety of workers."

The Monday morning presentations will focus on the people, added Espley, "the different programs and approaches that mining companies are taking to put topics like psychological safety, mental health and addiction on the table and start talking about them."

Monday's afternoon sessions will centre on serious injury and fatality prevention, with several presentations.

Day two will look at health and safety challenges in the future, starting in the morning with culture. Tuesday's keynote speaker Ann Masse, independent director at Iamgold, will talk about why people are at the heart of a safer and healthier future in mining.

The afternoon's sessions will pivot to tools and technology. "Presenters will be talking about how you can leverage new tools, AI and systems and use those types of technologies to further enhance health and safety performance," said Espley.

The conference will serve as a pivotal platform for industry professionals, experts and stakeholders to come together, share insights and explore innovative solutions that enhance health and safety standards in mining operations across Canada.

"Join us as we discuss mining health and safety, with a focus on best practices and future opportunities for achieving zero harm," said Cutifani. **CIM**

Upcoming events

CIM Chapais-Chibougamau Soirée

September 24
Chibougamau, QC

Challenges and Opportunities of Metal Additive Manufacturing

October 1
Edmonton, AB

October 3
Vancouver, BC



**MRMR 2024
Conference**
Mineral Resources & Mineral Reserves

October 16-18
Vancouver, BC

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Par Lynn Greiner

L'innovation, façon Las Vegas

Huit années se sont écoulées depuis que j'ai passé un peu plus de temps que nécessaire à me faire expliquer par la star d'une émission de télé-réalité minière sur l'importance d'une maintenance régulière et le meilleur choix de lubrifiants industriels. Nous étions assis dans une salle de conférence temporaire surplombant des hectares de machines minières, le genre de rencontre singulière que l'on ne peut attendre que de MINExpo International à Las Vegas.

Pour ceux qui l'ignorent, MINExpo, organisée tous les quatre ans par la National Mining Association, basée aux États-Unis, est la principale exposition de matériels et de services miniers en Amérique du Nord. Les principaux fabricants d'équipements utilisent l'immense site de Las Vegas pour présenter les plus gros engins de terrassement de leur flotte et les exposants se concurrencent pour attirer l'attention avec des gadgets, des prix promotionnels et des rencontres avec des célébrités mineures.

En 2016, un thème clé était l'opportunité du transport autonome. Quatre ans plus tard, la pandémie a forcé le report de l'événement et, les voyages transfrontaliers étant toujours un pari, *CIM Magazine*, comme beaucoup d'autres, a choisi de ne pas participer à l'événement qui s'est finalement tenu à l'automne 2021. À ce moment-là, les équipements électriques à batterie étaient devenus la priorité marketing dans les salles d'exposition, car un nombre croissant de grandes entreprises minières avaient pris des engagements en matière d'émissions nettes de carbone.

Compte tenu des circonstances de la dernière édition du salon, je m'attends à ce que MINExpo 2024 soit un spectacle très fréquenté. Je vous encourage à lire notre avant-première de l'événement, « *Global innovation* » (p. 48, uniquement en anglais) par notre collaboratrice régulière Alexandra Lopez-Pacheco, qui inclut les observations des fournisseurs de technologies et de services qui ont suivi de près l'arc de l'innovation dans le secteur. Vous pouvez vous attendre à ce que l'accent continue d'être mis sur des technologies telles que la conduite autonome et les véhicules électriques à batterie, mais dans une perspective plus holistique et axée sur le cycle de vie — et à ce qu'il y ait beaucoup d'intelligence artificielle.

Cette année, je ne pourrai pas y assister, mais les rédactrices du *CIM Magazine*, Silvia Pikal et Ailbhe Goodbody, seront présentes pour en tirer le meilleur parti possible afin d'élaborer les éléments de notre calendrier éditorial axés sur la technologie et l'innovation pour les mois à venir.

Pour ceux qui s'y rendent, profitez du salon, et pour ceux qui n'y vont pas, nous ferons de notre mieux dans nos prochains numéros pour mettre en lumière les tendances et les opportunités que l'équipe de *CIM Magazine* découvre.



Silvia Pikal



Ailbhe Goodbody

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Au cours de ma carrière qui m'a conduit à travers le monde durant plus de 40 ans, j'ai fini par réaliser que, en tant qu'espèce, nous ne sommes pas en mesure de nous auto-réguler, et que, par conséquent, il est essentiel que nous ayons en place ce que j'appelle un système de « freins et de contrepoids ». Si vous posiez la question à mes enfants, vous les verriez rouler leurs yeux et reconnaître que j'ai parlé, entre autres, de ce sujet *ad nauseam* pendant nos conversations quotidiennes au souper.

Dans l'industrie minière, il est essentiel de pouvoir compter sur une solide gouvernance pour obtenir des succès durables et être viable à long-terme. Les membres du conseil d'administration doivent naviguer à travers des objectifs stratégiques très larges tout en s'occupant des défis du quotidien, guidés par des thèmes de gouvernance clés afin de favoriser l'épanouissement de l'organisation, et faire en sorte que cette organisation assume ses responsabilités.

Pour l'ICM, un organisme complexe, qui est au service de membres répartis partout dans ce vaste pays qu'est le Canada, et qui est composé d'un bureau national, de sociétés et de sections, il est primordial que nous reconnaissions et que nous faisons nôtres les principes d'une bonne gouvernance avant de nous aventurer à mettre sur pied une stratégie.

Des équipes de direction diverses apportent des perspectives variées, améliorant ainsi la prise de décision et favorisant l'innovation. La collaboration permet de tirer parti de compétences et d'expériences uniques, ce qui renforce la planification stratégique et la surveillance opérationnelle. Une culture d'inclusivité et de respect permet à des voix diverses de contribuer de manière significative, permettant ainsi à l'organisation d'atteindre ses objectifs.

Un plan de relèvement rigoureux est essentiel pour maintenir la continuité organisationnelle et la résilience. Aligner le plan de relèvement sur le renouvellement et le rafraîchissement des positions

fait en sorte que l'organisation demeure dynamique et capable de faire face aux défis futurs. Il est crucial de reconnaître la matrice des compétences requises pour mettre sur pied la stratégie de l'organisation. Cette approche fait en sorte que l'équipe de direction possède les compétences et les talents nécessaires pour faire progresser l'organisation.

Des auto-évaluations régulières et des défis constructifs sont les moteurs de l'amélioration. Les équipes de direction devraient s'efforcer d'ajouter de la valeur en interprétant des informations complexes, en anticipant les changements, et en maintenant les principes de gouvernance fondamentaux même lors de perturbations. Cette approche de prise d'initiative permet à l'organisation de demeurer agile et réactive face aux tendances et aux défis en émergence.

L'ICM (le bureau national, les sociétés et les sections) devrait identifier, puis adhérer à des principes de gouvernance fondamentaux, incluant l'obligation de rendre compte, la transparence, la participation des parties prenantes, et la gestion des risques. Ces principes doivent refléter la raison d'être de l'organisation, et tout le monde doit y adhérer. S'engager avec les parties prenantes, tant internes et qu'externes, favorise la confiance et la collaboration, ce qui est essentiel pour relever les défis complexes du secteur minier.

L'ouverture génère la confiance. Produire des rapports transparents et divulguer très tôt les problèmes, cela permet de procéder à des améliorations dans les temps, ainsi que de développer la maturité organisationnelle et la confiance des parties prenantes.

Il est vital de déterminer les meilleures pratiques, de maintenir la qualité, et de respecter les normes. Des systèmes efficaces permettent d'avoir de la visibilité sur les opérations de première ligne et jusqu'au niveau de la haute direction. Ces systèmes font en sorte que l'organisation fonctionne de manière efficace et sécuritaire, tout en répondant aux normes et aux règlements de l'industrie.

Des pratiques de gestion du risque efficaces sont primordiales pour soutenir le succès à long terme de l'organisation et sa résilience.

Toute organisation, comme l'ICM, doit définir clairement sa raison d'être et sa vision, et aligner les ressources sur toutes les actions afin de se donner les moyens d'atteindre ces objectifs fondamentaux. Cette clarté fait en sorte que l'organisation demeure centrée sur ses objectifs stratégiques. Sans une direction stratégique claire, même les systèmes de gouvernance élaborés avec la meilleure des intentions peuvent vaciller.

L'ICM consacre beaucoup d'efforts à rafraîchir ses règlements qui constituent les fondations de notre cadre de gouvernance, et elle prévoit faire connaître son nouveau plan stratégique cet automne, après approbation par le Conseil d'administration, en septembre 2024.

Vous trouverez les politiques de gouvernance de l'ICM ici



Ian Pearce
Président de l'ICM

L'actualité

Nouvelles règles en matière de fusions et acquisitions

Par Kelsey Rolfe

I est peu probable que la décision prise par le gouvernement fédéral de limiter les prises de contrôle étrangères de compagnies minières canadiennes exploitant des minéraux critiques ait un impact significatif sur le secteur, et elle ne devrait affecter que les plus grandes entreprises du pays, d'après ce que disent les avocats et les analystes.

Dans une déclaration faite le 4 juillet, et qui a accompagné l'approbation de l'acquisition par Glencore, pour 6,9 millions de dollars US, de Elk Valley Resources (EVR), qui constitue la branche du charbon sidérurgique de Teck Resources, le ministre François-Philippe Champagne a affirmé qu'à partir de maintenant, il n'autoriserait l'acquisition, par des étrangers, de « compagnies minières canadiennes importantes engagées dans l'exploitation de minéraux critiques ... que dans les circonstances les plus exceptionnelles. »

La majorité des transactions de ce type ne répondrait plus au critère de l'avantage net en vertu de la Loi sur Investissement Canada, a déclaré M. Champagne, ajoutant que le fait d'avoir mis la barre plus haut reflétait « l'importance stratégique » du secteur des minéraux critiques au Canada, et la nécessité de poser une action « décisive » pour le protéger.

Michael Pickersgill, partenaire chez Torsys LLP et responsable des pratiques de l'entreprise en matière d'exploitation minière et de métaux, a dit dans une entrevue accordée au *CIM Magazine* que le but de cette politique était d'appuyer l'industrie de la transition énergétique.

« Des minéraux critiques, nous en avons. Mais en fait, pas autant que certaines personnes pourraient le penser en termes de minéraux critiques purs en tant que tels, mais nous avons des entreprises de premier ordre qui possèdent ces actifs et de nouveaux actifs potentiels, »



Avec l'aimable autorisation de Teck Resources

Site Highland Valley Copper de Teck, en Colombie-Britannique. Le gouvernement canadien a obtenu l'engagement de Teck Resources à réinvestir un montant important des produits de la vente de ses activités de charbon sidérurgique à Glencore, dans son portefeuille de croissance pour le cuivre.

a-t-il dit. « Le gouvernement veut entretenir cette infrastructure, et cela inclut d'avoir des compagnies ayant leur siège social au Canada, des compagnies leaders au Canada, parce que cela aide à développer et à conserver un rôle de leader au niveau mondial. »

Le Canada a considérablement renforcé sa vigilance par rapport aux investissements étrangers et aux prises de contrôle de minières canadiennes dans les récentes années. En 2022, le gouvernement a commencé à exiger que toute tentative d'investissement ou d'acquisition d'une compagnie minière canadienne par une entreprise d'État passe par un examen relatif à la sécurité nationale, ce qui a mené à un nombre records d'examen de ce type en 2022-23. Durant cette période, on a dénombré 32 investissements, une forte augmentation par rapport aux 24 investissements effectués l'année précédente, d'après le rapport annuel de la Loi sur Investissement Canada.

Solaris Resources, une petite entreprise canadienne avec un projet cuivre-or encore au stade de l'exploration, a annulé un investissement de 130 millions de dollars de la compagnie chinoise Zijin Mining en mai, déclarant que l'accord prendrait

trop temps à suivre le processus de l'examen relatif à la sécurité nationale.

En juillet, Falcon Energy Materials, autrefois SRG Mining, a redomicilié son siège social de Montréal aux Émirats Arabes Unis (EAU). Quelques mois plus tôt, en mars, l'entreprise avait annulé une opération d'investissement de 16,9 millions de dollars avec une société chinoise en raison d'un processus d'approbation trop long.

Dans un communiqué de presse diffusé le 2 juillet, la société Falcon déclarait que la redomiciliation aux EAU allait lui offrir « des options stratégiques élargies pour faire avancer ses discussions relatives aux partenariats. »

Mike Kilby, un partenaire chez Stikeman Elliott et responsable du groupe concurrence et investissements étrangers, a déclaré que cette politique fait écho au débat né au début des années 2000 au sujet de l'impact de l'absorption de trois géants de l'industrie minière du Canada, Inco Ltd, Falconbridge Ltd. et Alcan, respectivement par Vale, Xstrata et Rio Tinto. (Stikeman a représenté Teck Resources pour la vente d'EVR.)

« L'idée était de se demander si c'était « une bonne politique ». Pas que cela

menace la sécurité nationale, mais plutôt... si cela présentait des avantages pour l'écosystème minier canadien avec le fait d'avoir des sociétés minières à très forte capitalisation ayant leur siège social au Canada, constituées au Canada, et inscrites à la Bourse de Toronto, » a-t-il déclaré.

La politique a soulevé des inquiétudes dans le secteur à l'effet que les investisseurs étrangers allaient devenir méfiants pour ce qui est d'investir dans des entreprises canadiennes, même dans les petites et moyennes entreprises.

« Si vous créez des contraintes dans un marché financier, cela ne peut pas être positif, » a dit Dean McPherson, responsable du secteur minier mondial pour *TMX Group Ltd*, qui gère la Bourse de Toronto et la Bourse de croissance TSX, dans une entrevue accordée au *CIM Magazine*. « Les entreprises devront commencer à chercher des façons de se protéger. »

Jeff Killeen, directeur des politiques et des programmes pour la *Prospectors and Developers Association of Canada* (PDAC, l'association canadienne des prospecteurs et entrepreneurs), a écrit dans un courriel adressé au *CIM Magazine* que le manque de clarté entourant l'expression « dans les circonstances les plus exceptionnelles créait de l'incertitude » qui pourrait avoir un impact négatif sur la valeur des entreprises minières du pays par rapport à leurs homologues du reste du monde.

Toutefois, M. Kilby, a minimisé l'impact des nouvelles directives. Contrairement à un examen relatif à la sécurité nationale, qui peut s'appliquer à des transactions de toute taille et de toute nature, le critère de l'avantage net de la Loi sur Investissement Canada n'entre en jeu que durant des prises de contrôle, par des acheteurs étrangers, d'entreprises canadiennes de taille importante, généralement celles d'une valeur de 2 milliards de dollars ou plus.

Il a ajouté que le gouvernement n'a bloqué qu'à deux reprises des transactions pour des raisons d'avantage net, incluant la tentative de prise de contrôle hostile, par BHP, de Potash Corp, en 2010, une société dont le siège se trouvait à Saskatoon, et qui a plus tard fusionné avec Agrium pour former Nutrien.

Les analystes de la Banque Scotia, Orest Wowkodaw et Eric Winnill, ont écrit dans une note du 16 juillet qu'ils s'attendaient à ce que « seulement les plus grandes sociétés minières engagées dans l'exploitation de minéraux critiques ayant leur siège

social au Canada soient susceptibles d'être pleinement protégées des acheteurs étrangers », et qu'il était peu probable que le gouvernement barre la route à des transactions de fusions et acquisitions impliquant des petites et moyennes entreprises, à moins qu'il n'y ait des inquiétudes en matière de sécurité nationale.

« Le statut de projets de développement à court terme ou en cours de construction pourrait être sujet à interprétation si ces projets impliquaient d'importants actifs ayant des impacts matériels sur leurs bourses de marchandises respectives ; il est probable que des projets de ce type soient traités au cas par cas, » ont-ils écrit.

M. Wowkodaw et M. Winnill ont déclaré croire que Teck et Cameco sont interdites d'accès aux acheteurs étrangers, et possiblement Nutrien. Il est probable que de grandes compagnies minières sans actifs au Canada et ayant un siège social relativement petit, comme First Quantum Minerals et Ivanhoe Mines Ltd, soient exemptées de la politique, » ont-ils écrit.

M. Kilby a dit qu'il ne considérerait pas que cette politique signifiait de fermer la porte à toute tentative de prise de contrôle de sociétés minières canadiennes à forte capitalisation. La voie à suivre pour qu'une transaction soit approuvée a toujours historiquement été une question d'engagements pris par l'acheteur, ce qui peut inclure l'engagement de fonds dans la recherche et le développement au Canada, et, dans le secteur minier, pour faire avancer des projets canadiens.

Il est aussi probable que le gouvernement serait ouvert à des tentatives d'acquisition par des entreprises ayant leur siège social dans le Groupe des cinq (une alliance de renseignement comprenant l'Australie, le Canada, la Nouvelle-Zélande, le Royaume-Uni, et les États-Unis) ou dans d'autres juridictions amies, a déclaré M. Pickersgill.

Selon lui, la déclaration de politique devrait être lue en conjonction avec l'approbation par le gouvernement de l'accord Glencore-Teck. Si le charbon métallurgique ne figure pas sur la liste des minéraux critiques du Canada, le gouvernement a tout de même inclus des conditions pour la vente.

Il a été exigé de la multinationale qu'elle s'engage à établir et à conserver un siège social canadien pour EVR à Vancouver, et des bureaux régionaux à Calgary et

à Sparwood, en Colombie-Britannique, et qu'elle s'assure que la majorité des membres du conseil d'administration d'EVR soient canadiens, et qu'au moins deux tiers des dirigeants et des cadres supérieurs soient des Canadiens, tout cela pour au moins 10 ans. De plus, pendant au moins cinq ans, l'entreprise doit conserver « des niveaux d'emploi importants » chez EVR.

Glencore a hérité des obligations de Teck en vertu de l'obligation de réhabilitation requise par le gouvernement de la Colombie-Britannique. La société a également assumé la responsabilité de payer toutes les obligations environnementales en vertu du droit canadien qui ne sont pas couvertes par l'obligation jusqu'en 2050. L'entreprise resterait responsable de ces obligations même si elle décidait de vendre ou de défusionner EVR dans le futur, à moins que le ministre de l'Industrie ne soit satisfait du fait que le nouveau propriétaire d'EVR pourrait reprendre ses passifs environnementaux.

L'entreprise a aussi accepté de consacrer 350 millions de dollars de plus à des activités de réhabilitation et de fermeture, sur une période de cinq ans, afin de maintenir les engagements d'EVR envers les Premières Nations, et pour travailler « en toute bonne foi » avec les Premières Nations afin de trouver des occasions d'augmenter leurs bénéfices provenant des activités de charbon métallurgique.

« L'intention ici, c'est qu'ils veulent soutenir le développement de l'industrie canadienne, » a dit M. Pickersgill. « Le but [des conditions] était de protéger une compagnie canadienne elle-même, comme on s'y attendrait dans le contexte de l'avantage net. Mais ce qui est intéressant, c'est qu'ils ont aussi intégré des éléments concernant les engagements ESG, s'agissant de maintenir des engagements en matière d'obligation de réhabilitation. Ils ont envisagé cela d'une manière un peu plus holistique lorsqu'ils ont réfléchi au maintien d'une entreprise canadienne et de normes d'exploitation canadiennes. »

Il est probable que des délais d'approbation plus longs vont dorénavant devenir une caractéristique de toute transaction majeure, selon M. Pickersgill.

« L'accord [Glencore-Teck] a pris huit mois à se concrétiser, » a-t-il dit. Étant donné la nature politique de la chose, même si les gens veulent essayer d'élaborer des circonstances exceptionnelles pour les transactions, on peut s'attendre à des délais plus longs. » **ICM**



La puissance de l'ADN

Des études portant sur la collecte d'ADN environnemental permettent aux sociétés minières de contrôler la biodiversité sur de grandes superficies plus rapidement et à moindre coût

Par Lynn Greiner

L'analyse de l'ADNe dans les environs d'un site minier peut être plus rapide et plus précis que les études traditionnelles sur la biodiversité.

Pour gérer les répercussions des mines sur l'environnement pendant tout leur cycle de vie, les sociétés minières doivent comprendre l'impact de leurs activités sur la nature. Pour ce faire, elles doivent comprendre ce qui vit et ce qui pousse dans la zone entourant un site minier, et les répercussions sur cette zone avant, pendant et après l'exploitation d'une mine.

C'est une préoccupation d'ordre mondial. En janvier, l'*International Council on Mining & Metals* (ICMM, le conseil international des mines et métaux) a publié un état de la situation de la nature, dans lequel il s'engage à contribuer à un avenir positif en faveur de la préservation de la nature dans cinq domaines, à savoir : l'exploitation directe, la chaîne de valeur, les paysages entourant les exploitations, la transformation des systèmes ainsi que la gouvernance et la transparence. L'énoncé décrivait les actions spécifiques que les membres de l'ICMM peuvent prendre dans chaque domaine.

Les directives du gouvernement canadien établissent les règles régissant les actions de l'industrie minière dans le pays. Elles exigent des études de référence, évaluations des risques, la gestion et la surveillance, ainsi que des plans détaillés de l'assainissement du site après la fermeture de la mine. Si la liste des considérations est longue, l'une des choses qu'omettent ces règles est d'indiquer aux sociétés minières comment procéder.

La biodiversité constitue souvent la partie complexe d'une analyse environnementale, faisait remarquer Mehrdad Hajibabaei, professeur agrégé du département de biologie intégrative à l'université de Guelph, fondateur et conseiller scientifique en

chef de la société de génomique environnementale eDNatec basée à Terre-Neuve-et-Labrador.

« Pour la recherche de données chimiques ou physiques, il existe des capteurs [et] des systèmes automatisés. Mais lorsqu'il est question de biodiversité, les informations sont difficiles à déchiffrer, à mesurer et à comprendre », faisait-il remarquer. « Le cauchemar pour les responsables de la gestion environnementale, c'est d'être en mesure de générer des données exhaustives sur la biodiversité au bon moment. C'est la raison pour laquelle les régimes réglementaires ne sont pas aussi exhaustifs lorsqu'il est question de biodiversité. »

Dans les activités minières, il existe plusieurs domaines où les données sur la biodiversité deviennent essentielles, expliquait M. Hajibabaei. Pendant la première évaluation de référence, les sociétés minières doivent comprendre l'impact de leurs activités sur la biodiversité générale, à savoir le nombre d'espèces présentes, et si certaines sont menacées d'extinction ou soumises à de fortes pressions, et doivent donc être protégées. Ces activités ne concernent pas uniquement la mine en elle-même. Elles doivent aussi tenir compte d'aspects tels que la construction de routes vers le site, l'exploitation de lignes électriques ou d'autres activités qui modifient l'état de l'environnement.

Ensuite, lorsque la mine est déclassée, les activités de remise en état doivent garantir que le site retrouve son état naturel initial. « Plutôt que de [se contenter] de s'asseoir sur l'herbe pour voir si elle est bien verte, nous voulons nous assurer de la diversité des organismes qui la peuplaient auparavant », indiquait M. Hajibabaei.

Changement d'échelle

Dans les évaluations manuelles, des travailleurs de terrain effectuent une vérification en personne de l'environnement afin de consigner la faune et la flore. Ces évaluations sont, certes, utiles, mais elles sont inefficaces. De fait, elles exigent une grande main-d'œuvre, sont chronophages, onéreuses et requièrent la présence d'experts en écologie sur de longues périodes.

« Par ailleurs, la faible disponibilité d'experts en taxonomie pouvant effectuer ces travaux (étant donné que la demande dépasse l'offre) limite la collecte de données à la vitesse et à l'échelle nécessaires au sein de l'industrie minière », expliquait Rachel Mador-House, qui a travaillé pour des sociétés minières telles qu'Anglo American, Teck Resources, Rio Tinto et Glencore et qui est désormais responsable des affaires scientifiques pour l'Amérique du Nord à NatureMetrics, une société spécialisée dans la technologie de l'intelligence de la nature.

Grâce à une approche relativement nouvelle, une évaluation environnementale peut être menée plus rapidement et plus précisément en analysant l'ADN environnemental (ADNe).

« Les études de l'ADN nous permettent de détecter des espèces sans les voir ni les entendre, mais en recueillant des quantités infimes d'ADN, ou "ADNe", que les organismes laissent dans l'environnement », expliquait Joshua Newton, doctorant au *Trace and Environmental DNA Laboratory* (TrEnD, le laboratoire de l'ADN environnemental et des traces d'ADN) à l'université Curtin en Australie. « Nous sommes désormais en mesure d'exploiter cet ADN en collectant un échantillon non invasif dans l'eau, sur des plantes ou en tamponnant une matière végétale. On retire ensuite l'ADN de l'échantillon, on amplifie et on analyse cet ADN, puis on le cartographie de nouveau dans une base de données de référence, qui nous donnera une liste d'espèces dont l'ADN est présent dans cet échantillon. »

L'ADN peut provenir de diverses sources, notamment les organismes eux-mêmes, des cellules dispersées, du matériel de reproduction tels que des graines ou des spores d'organismes plus gros, ou même des matières fécales. On peut aussi récupérer l'ADN dans des endroits tels que des pièges à insectes, des échantillons trouvés dans des cours d'eau ou dans l'eau directement. M. Newton travaille aussi sur de nouvelles méthodes pour récupérer des échantillons, tels que la collecte d'ADN des pollinisateurs dans des fleurs, et il cherche à déterminer la capacité des toiles d'araignées à capturer l'ADN des vertébrés.

Par rapport aux méthodes d'observation traditionnelles, indiquait M^{me} Mador-House, l'échantillonnage d'ADNe est une pratique hautement évolutive. Elle permet de suivre plusieurs espèces simultanément, et peut servir à contrôler de vastes zones et des environnements variés qui offriront des ensembles de données plus larges et plus précis. « Essentiellement, elle est bien plus simple à utiliser sur le terrain, exige moins de soutien de spécialistes sur place. Elle est donc plus rapide et moins coûteuse à utiliser », expliquait-elle. « Elle est conçue pour être facilement reproductible. En outre, parce que les données sont normalisées, cette méthode offre une image extrêmement précise de l'évolution d'un écosystème au fil du temps, ce qui permet aux sociétés de prendre des décisions plus éclairées et qui auront plus d'impact pour la nature. »

Adam Cross, spécialiste principal en biodiversité à la société minière australienne Mineral Resources (MinRes), qui a déjà collaboré avec l'université Curtin sur la recherche dans le

domaine de l'ADNe, indiquait que les études de l'ADNe « requièrent souvent moins d'expertise en matière de taxonomie que les études traditionnelles de la faune et la flore pour fournir quelque chose de comparable à une empreinte génétique indiquant quelles espèces de différents groupes d'organismes sont présentes dans une région ».

Il ajoutait que les études de l'ADNe sont susceptibles de représenter un complément puissant aux techniques traditionnelles de surveillance de la biodiversité. « Elles peuvent constituer une méthode moins onéreuse et plus rapide de capturer une image holistique de la biodiversité dans une région. Elles permettent aussi de détecter de manière plus fiable des organismes qui pourraient être difficiles à identifier ou à distinguer d'autres organismes similaires, par exemple des sous-espèces ou des plantes que l'on ne peut différencier l'une de l'autre que lorsqu'elles sont en fleur », expliquait-il. « Les études de l'ADNe permettent aussi de détecter des organismes qui ne sont généralement pas pris en compte dans les études traditionnelles, telles que les champignons, les mousses et les microbiotes [micro-organismes]. »

Comme l'indique Matt Brekke, premier biologiste à Stantec, les études de l'ADNe permettent aussi de découvrir de petites espèces difficiles à détecter. « Étant donné que certaines espèces sont en danger, il est très important d'être précis dans les études d'absence/de présence », faisait-il remarquer.

Il n'est pas toujours nécessaire de mener ces études individuellement. Il existe des manières de recueillir des échantillons en toute efficacité et à bas coût pendant d'autres activités de surveillance, expliquait Joe Huddart, ingénieur en solutions sur la biodiversité et expert du secteur minier à NatureMetrics. « L'eau constitue souvent la porte d'entrée pour la surveillance de l'ADNe dans un site minier. Les essais routiniers sur l'eau pour détecter une pollution ou une contamination sont l'occasion idéale de recueillir des échantillons d'ADNe », indiquait-il. « En recueillant l'ADNe ainsi que des données physico-chimiques, les mines peuvent ajouter une couche de données exhaustives sur la biodiversité avec un effort logistique supplémentaire très limité ».

En outre, indiquait M. Huddart, le prélèvement d'échantillons du sol est utile pour identifier une contamination du sol et suivre la réussite de la revégétation. « Au final, c'est le microbiome du sol qui dicte quelles plantes poussent au-dessus du sol. Ainsi, en caractérisant les organismes du sol, il est possible d'identifier quelles espèces sont présentes ou absentes », expliquait-il.

Les limites

Toutefois, l'étude de l'ADNe ne remplacera pas entièrement les études environnementales traditionnelles. Elle présente deux limites. D'une part, elle ne permet de détecter que la présence (ou l'absence) d'un organisme, et pas nécessairement sa quantité. D'autre part, elle ne peut identifier que les espèces dont l'ADN existe déjà dans une base de données de référence.

« Lorsqu'il est question de quantification, nous ne pouvons pas compter sur des organismes individuels car nous ne les capturons pas. Mais nous pouvons fournir d'autres mesures pour y remédier », indiquait M. Hajibabaei. « Nous pouvons utiliser des données de prévalence pour obtenir des mesures quantitatives. Par exemple, si l'on recueille 10 échantillons et que l'on trouve l'ADN d'une certaine espèce dans cinq d'entre

eux, ceci montre que dans cette région, la prévalence de cette espèce est de 50 % relativement. [Dans] un autre site, cette prévalence pourrait atteindre 80 %. Ainsi, on peut donner des mesures quantitatives, mais on ne peut pas recenser les poissons ou les oiseaux. »

Il faisait remarquer qu'il n'existe pas de bibliothèques de référence sur l'ADN pour chaque espèce. « Pour pouvoir mettre un nom sur un échantillon d'ADN que nous recueillons dans l'environnement, nous devons le comparer à l'ADN de référence », indiquait-il. « Dans certains groupes taxonomiques, du moins dans certains contextes, tels que les grands mammifères, nous avons des références. Mais dans un contexte marin ou dans un site isolé par exemple, on observe un amphibien ou un poisson et on les compare à l'ADN, sans pouvoir nécessairement mettre un nom sur toutes les espèces. »

C'est la raison pour laquelle les organisations qui mènent des tests ADNe appellent au développement de bibliothèques de référence sur l'ADN plus exhaustives.

L'*International eDNA Standardization Task Force* (iESTF, le groupe de travail international sur la normalisation de l'ADNe) a été créé par M. Hajibabaei en 2023 pour faire face à ce genre de difficultés. Ses adhérents à l'échelle mondiale s'efforcent de développer des normes internationales sur l'ADNe et encouragent leur adoption. Ils aident aussi à établir des exigences de qualité pour les procédures normalisées tout en « laissant une certaine latitude pour la croissance et

l'optimisation dans ce domaine qui évolue rapidement », peut-on lire sur le site Internet. L'iESTF collabore également avec des groupes de travail ISO pour le développement concret de normes relatives aux applications, engage le dialogue avec plusieurs parties prenantes et tient lieu « d'entité à contacter pour obtenir des renseignements, des ressources et du matériel éducatif ».

Compte tenu des limites actuelles, M^{me} Mador-House expliquait que, s'il n'est pas prévu que les tests ADNe remplacent les études traditionnelles sur la biodiversité dans un proche avenir, ils restent toutefois un complément précieux. « Nous aurons toujours besoin d'une surveillance traditionnelle des espèces à l'aide de transects et d'individus hautement qualifiés sur le terrain », indiquait-elle. « Toutefois, le nombre de spécialistes en écologie et en taxonomie n'est pas suffisant pour répondre à la demande, et nous nous trouvons face à un goulet d'étranglement. L'ADNe peut contribuer à pallier ce problème, tout en complétant et en soutenant les équipes de terrain. »

M. Huddart indiquait un autre avantage du test ADNe. « La simplification des complexités de la nature en des mesures chiffrées compréhensibles signifie que l'on peut transposer les données d'un site dans une salle de réunion et les présenter aux personnes intermédiaires, en indiquant de manière transparente l'impact et les progrès réalisés en faveur des engagements organisationnels envers la nature. » **ICM**

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THE RUSH FOR NORTHWEST QUEBEC

The origin stories of our industry are contained within the digital archives of the *CIM Bulletin*, the predecessor to *CIM Magazine*. In this issue, we examine how the discovery of the Horne deposit in Quebec led to the Rouyn-Noranda mining rush

By Ailbhe Goodbody

The discovery of a deposit containing copper, gold and other minerals in Rouyn-Noranda, in northwestern Quebec, started a mining rush that spurred the economic development of what was then a remote area of the province.

The initial mineral discovery that led to the development of the Horne mine was made by Edmund Horne—the mine's namesake. Following prospecting trips to the area in 1911, 1914 and 1917, he staked his first claim in the area during the summer of 1920.

"Horne managed to raise \$225 from 10 individuals and the Tremoy Lake Prospecting Syndicate was formed," wrote Harold L. Gibson, David J. Kerr and Sergio Cattalani (*Explor. Mining Geol.*, Vol. 9, No. 2, 2000). "With this 'grub-stake,' Horne ventured again to Lake Osisko and staked 70 acres, not realizing at that time that his first claim would ultimately contain about 95 per cent of all the ore exploited from the Horne mine."

Noranda Mines Limited was incorporated in May 1922 to exploit the Horne deposit; Oliver Hall recorded that "Noranda" is an abbreviation of "Northern Canada" (*CIM Bulletin*, 1937).

News of Horne's success drew large numbers of prospectors into the area in the early 1920s. "During the twelve months beginning with July 1924, as many as 5,143 mining claims were recorded," wrote A.O. Dufresne (*CIM Bulletin*, 1926).

Gibson et al (2000) noted: "It is important to remember that prospecting in northern Quebec during these early years was incredibly difficult with no existing access except canoe routes, and in most respects, was more challenging and costly than exploration in the remote areas of today."

In May 1924, the Montreal-based Laurentide Air Service began regular hydroplane flights from Angliers, Quebec, and Haileybury, Ontario, to the Rouyn mining camps. "The commencement of this service to the Quebec gold-fields is notable, as it is the first time that a regular commercial aeroplane service for a mining district



An aerial view of the Horne mine and smelter, showing part of the town of Noranda (*CIM Bulletin*, 1936).

has been initiated anywhere in the world," pointed out G.C. MacKenzie (*CIM Bulletin*, 1924).

A few years later, C.P. Browning (*CIM Bulletin*, 1927) added, "The transportation facilities have been greatly bettered by the construction of a branch line from O'Brien, on the main transcontinental line of the Canadian National Railway, into the Rouyn area."

A.O. Dufresne (*CIM Bulletin*, 1928) noted that two towns had been created in the area of the mining camps. "Alongside the pioneer town of Rouyn is the company town of Noranda. Both were incorporated by Acts of the Provincial legislature in 1926," he wrote. "The town of Rouyn, on the west shore of a pretty lake, has grown in less than three years out of the virgin forest. In July 1926, it boasted 250 to 300 buildings of all sorts and had a population of 1,500; in December 1927, the number of buildings was fully 700 and the population 4,500, and growth still continues apace. The townsite of Noranda, immediately to the north of the town of Rouyn, is rapidly rising along the lines of the most modern town-planning principles."

Rouyn and Noranda went on to merge in 1986, becoming the city of Rouyn-Noranda.

The Horne mine

Meanwhile, the development of the Horne deposit continued. Noranda Mines made a production decision in 1925 based on reserves of 611,500 tons grading 0.27 g/t Au and 5.66 per cent Cu, according to Gibson et al (2000).

"Work on the Horne property has been pushed with great rapidity," wrote H.C. Cooke (*CIM Bulletin*, 1926). "The No. 1 shaft was sunk to 328 feet and stations cut at the 206 and 306-foot levels. More than 4000 feet of lateral work was done. The No. 2 shaft is sunk to a depth of 158 feet, and more than 800 feet of lateral work done at the first or 140-foot level."

Noranda Mines began constructing a smelter in June 1926, and commercial production at the Horne mine began in late 1927. "The first copper ingot was cast on December 17th, 1927," wrote Dufresne (1928). "The product shipped is copper in slabs, 99 percent pure, carrying some four ounces of gold and twelve ounces of silver per ton."

However, it was not immediately clear how valuable the Horne deposit would turn out to be. "Construction of a smelter was an economic gamble, given the relatively limited ore reserves at this stage; however, it paid off handsomely in the years to come when the Horne deposit proved to be much larger than initially projected," wrote Gibson et al (2000).

The sinking of a third shaft at the Horne mine began in 1926, which led to an important discovery in 1928. "The No. 3 shaft entered a swelling of the H ore-body and was found to be in sulfide with high copper and gold values," wrote Hall (1937).

The bulk of the mine's subsequent production came from two massive pyrrhotite-pyrite-chalcopyrite pods, designated the "Upper H" and "Lower H" ore bodies, that were located within the upper 950 metres of the mine workings and fell entirely within Edmund Horne's original mineral claim from 1920. "Together, the H ore bodies yielded over 90 per cent of the Horne mine production," wrote Gibson et al (2000).

Custom smelter

The Horne mine remained in continuous production until July 1976. "Since the closure of the mine in 1976, [the Horne smelter] has been operating as a custom smelter," wrote C.H. Teh and L. Lamothe (*CIM Bulletin*, 1985). "The concentrates treated at the smelter come from various mines with mixed sulfide ores, many of them containing significant amounts of lead and zinc."

The Horne smelter underwent several technological changes since its original construction in 1927. In March 1973, it pioneered a prototype continuous process furnace. "The Noranda Process is a continuous operation in which the smelting and converting steps of the traditional reverberatory furnace and converter can be combined in a single, cylindrical, refractory-lined reactor," wrote J.B.W. Bailey and A.G. Storey (*CIM Bulletin*, 1980).

"The Noranda continuous smelting process has been in operation for six years and in that time it has smelted a million and a half tons of concentrate. It is currently smelting 1,200 to 1,250 tons per day of concentrate on an instantaneous basis and it is handling approximately 40 per cent of the Horne smelter throughput. Since early in 1975, a high-grade matte averaging 73 per cent copper has been produced, which is then sent to the converter aisle for final treatment."

A later phase of production at the Horne mine, called REMnant NORanda (REM NOR), began in February 1985 to provide auriferous flux to the smelter from the mine's upper levels. "REM NOR operations ceased in early August 1989, after producing approximately 604,000 tonnes averaging 5.8 g/t Au, including 118,000 tonnes of massive sulfide ore grading 7.2 g/t Au," wrote David J. Kerr and Robert Mason (*CIM Bulletin*, 1990).

They noted that in total, from 1927 to 1989, the Horne mine "produced 53.7 Mt of ore grading 6.1 g/t Au and 2.2 per cent Cu."

The Noranda Converter (CvN) was developed in 1997 to replace the four conventional Pierce-Smith converters that had previously been used at the smelter. "Developing and implementing the CvN were major steps forward in maintaining Horne smelter's competitive position in the custom smelter market, while improving operational flexibility and environmental performance," stated Glencore, which now operates the smelter.

Significance

"The Horne deposit—by any criterion including size, grade, or economic and social significance—is a world class ore deposit," wrote Gibson et al (2000). They noted that the Horne mine and smelter provided the economic impetus and infrastructure that "opened up northwestern Quebec for both settlement and exploration in the early part of the 20th century and contributed, in a broader sense, to the economic growth of Quebec and Canada."

In June 2005, Noranda Mines merged with Falconbridge, another Canadian company, and continued under the name Falconbridge until it was taken over by Switzerland-based Xstrata in 2006. Xstrata was in turn acquired by another Swiss miner, Glencore, in 2013.

Glencore is still running the Horne smelter in Rouyn-Noranda, and in December 2017 the company celebrated the 90th anniversary of its first casting. According to Glencore, over those 90 years, the smelter produced 12,404,390 tonnes of copper, 40,614,617 ounces of gold and 847,040,998 ounces of silver. 

Throughout 2024, we will be looking back through the CIM archives for contemporary coverage of the discovery and development of major mineral deposits in Canada.

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