2022 FALL & WINTER

THE OFFICIAL PUBLICATION OF THE SASKATCHEWAN MINING ASSOCIATION

ORE MAGAZINE

SMA Saskatchewan Mining Association

Publication Mail Agreement No. 42154021

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ORE MAGAZINE

The Official Publication of The Saskatchewan Mining Association

ORE is produced solely by the Saskatchewan Mining Association.

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Cover
This issue of Ore Magazine focuses on Saskatchewan's critical minerals essential to supplying the global supply chain with low carbon energy, fertilizer and clean technology.

SMA Saskatchewan Mining Association

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Growing Saskatchewan as a Global Critical Minerals Hub

> **Critical minerals are the building blocks of a global economy that is quickly adopting digital and clean energy technology, while providing food and clean energy security.**
>
> **– PAM SCHWANN**

I've got some questions for you. Are you reading this with coffee in hand, either in print or on your smart phone? If so, then you have already benefited from the production of critical minerals. The buzz around the term critical minerals is starting to become mainstream, but what does it really mean?

This issue of ORE probes why Saskatchewan is front and centre in having a reputation as a secure, reliable and ethical global trading partner for well-established and growing production of critical minerals including potash and uranium, but also emerging commodities and their supply chains, like copper, lithium and rare earth elements.

Critical minerals are the building blocks of a global economy that is quickly adopting digital and clean energy technology, while providing food and clean energy security. Canada has identified 31 critical minerals – 23 of which are produced or have the potential of being produced in Saskatchewan. Our Cover Story expands on how Saskatchewan is growing its Critical Minerals Hub.

The global population has just surpassed 8 Billion people, and by 2050, Earth, will be home to more than 10 Billion people. Compounded by political global unrest related to Russia's illegal invasion of Ukraine, how will the planet's carrying capacity respond to the increased food and energy production needed to provide people with food and clean energy security? The geopolitical significance of Saskatchewan's potash and uranium production has never been so stark - and global politicians and citizens alike are quickly focusing in on Saskatchewan as a preferred trading partner for these critical minerals and other emerging opportunities, something our Feature Story explores.

Innovative technologies, including adoption of automation, and new mining techniques, are key to improving safety and ore recovery as well as reducing environmental impact. Our Technology article identifies some of the activities underway. Innovation is also about developing the people talent, a thread running throughout a number of articles. The story spotlighting Taryn Roske, bridges a number of innovative practices – as the first female Jet-Boring System Operator at Cigar Lake, she is laying the pathway for other women in non-traditional, high-tech roles. With over $368 M in goods and services purchased from Indigenous-owned businesses in 2021, find out about some of the longstanding and growing partnerships between mining companies and Indigenous owned suppliers. Innovative thinking is also a hallmark of our Beyond the Bio feature on David Cates, President and CEO of Denison Mines, a new generation of mining leaders using established technology, but in a new environment, to develop new mines.

While Saskatchewan mining operations are helping provide global food and clean energy security, they are also significantly contributing to economic security in Saskatchewan. When Saskatchewan mining companies are healthy, so is main street Saskatchewan, through increased employment, supply chain opportunities and community contributions. Improved commodity prices and increased production has also delivered commensurate increased royalties and taxes to the Saskatchewan government coffers in 2022, lifting the provinces finances from a deficit into projected $1.4 B surplus position, elevated by at least an additional $1.13 B in potash revenues, as well as higher than budgeted uranium and gold revenues.

The global focus on the sustainable production of critical minerals and their supply chains offers Saskatchewan a growing opportunity to expand its mineral production. With sustained robust support for mining from 92% of residents surveyed in 2022* across Saskatchewan, the world will increasingly look to Saskatchewan to provide materials to fuel the global economy while delivering benefits to Saskatchewan. With great opportunity, comes great responsibility. We are ready to deliver.

** 1,000 surveys conducted by Fast Consulting with a 95% level of certainty that overall results are within plus or minus 3% of what they would be if the entire adult population of Saskatchewan were polled.*

Creating a future full of possibility, joy, and discovery

Through the Youth+Us program, we celebrate diversity, encourage life skills, and provide young people with access to more moments that inspire confidence, creativity, and character.

K+S Potash Canada proudly supports Big Brothers Big Sisters and other organizations that help future leaders, innovators, and trailblazers build a brighter tomorrow.

"It would have been nice to have a role model like this. It would have been a positive influence in my life, but now, I get to be that positive influence in Denika's life."

- Jade, BBBS Mentor

Over $1.5 million invested annually supporting 60+ organizations across Saskatchewan and Port Moody, British Columbia where employees live and work.

K+S Potash Canada

K+S youth+us

Read more about Jade & Denika
www.ks-potashcanada.com

SASKATCHEWAN: A GROWING CRITICAL MINERALS HUB

> "Saskatchewan is already a global leader in uranium and potash production, and we're an emerging producer of helium, lithium, copper, zinc and now rare earths. The world needs what Saskatchewan has to offer."
>
> **- JIM REITER,**
> MINISTER OF ENERGY AND RESOURCES
> GOVERNMENT OF SASKATCHEWAN

Major projects presented at the Rare Earth Summit in Saskatoon this past September highlighted Saskatchewan's emerging leadership in rare earth elements (REE) production, research, and education. The Saskatchewan Research Council (SRC) introduced its $55 million vertically integrated Rare Earth Processing Facility in north Saskatoon. A first-of-its-kind in North America, the facility will include processing, separation, and metal stages. Already a global leader in uranium and potash production, Saskatchewan is emerging as a producer of helium, lithium, copper, zinc, and now rare earths. The world needs what Saskatchewan has to offer.

The SRC Rare Earth Processing Facility is establishing a REE technology hub in Saskatchewan, creating an industry model for future commercial REE initiatives and supply chain development. Prior to its official unveiling in September, the facility announced a major step forward in August, when the first REE metal ingots ever produced in Canada were processed during a successful test run of the facility's metals smelting unit. The unit was made possible by an additional $20 million in funding from the provincial government and expands the facility's participation in the REE value chain, as the metal ingots are used in the manufacture of magnets which in turn are used in electric vehicles, wind turbines and various electronics.

"With its world-leading REE expertise, SRC is already working with industrial partners to develop company-specific REE concentration facilities in Saskatchewan, which is the precursor process to full REE processing. This facility will allow for an environmentally sustainable, reliable, and strategic supply of REEs to be produced outside of China," says Mike Crabtree, SRC President and CEO.

The second major announcement of the summit came from Vital Metals Limited, Canada's first rare earths producer. Vital Metals unveiled phase one of its multi-million-dollar rare earth extraction facility, also located in the city's north industrial area adjacent to SRC. The unveiling was attended by key stakeholders including representatives from all four levels of government as well as Indigenous and Métis leaders and international guests representing the company's rare earth supply chain. The facility has already begun processing beneficiated ore from its Nechalacho rare earth mine. Located in the Northwest Territories, Nechalacho is Canada's first, and so far, only operational rare earth mine.

In Saskatoon, the ore will be processed to a high purity, mixed rare earth carbonate. This product is then exported to Norway

and the United States for separation into individual magnetic rare earth metals. From there, it travels to Europe, where it will be used in the manufacture of electric vehicle motors.

Vital Metals hopes to double the plant's capacity by 2025. Speaking at the summit, David Connelly, Vice President of Strategy and Corporate Affairs for Cheetah Resources, a subsidiary of Vital Metals said, "The world is watching us. We are Canada's first rare earths miner and producer. Our teams at the Nechalacho rare earth project in the Northwest Territories and here at Vital Metals' Rare Earth Extraction Facility in Saskatoon are the cornerstones of an independent mine-to-motor supply chain."

Pam Schwann, president of the Saskatchewan Mining Association (SMA), sees the SRC Rare Earth Processing Facility and Vital Metals Rare Earth Extraction Facility positioning Saskatchewan as a North American leader in critical minerals processing. "Without those processing facilities, Canada misses out on a key component of the value chain," Schwann says. "I see this as an area that can be carved out for Saskatchewan really developing that global centre of expertise, where countries ship their rare earth element concentrates to Saskatchewan to be processed."

WHY CRITICAL MINERALS ARE … CRITICAL

Critical minerals are essential to our modern, digitized economy. They are used in the production of everything from electric vehicle motors to agricultural crops and from wind turbines to smartphones. Agriculture, energy, communication, transportation, health care—every sector of our economy depends on a reliable supply of critical minerals. Surging global demand combined with supply chain disruptions caused by the pandemic prompted the creation of Canada's Critical Minerals List.

The Critical Minerals List was developed by the federal government in collaboration with provincial and territorial governments and other stakeholders, including the SMA. The list identifies 31 minerals, each considered essential to Canada's economic security and our transition to a low-carbon economy as well as necessary for Canada to become a sustainable source of critical minerals for our partners.

In addition to REEs, Saskatchewan has a major role to play in the supply and processing of other critical minerals, notably potash, uranium, helium, lithium, and copper.

POTASH

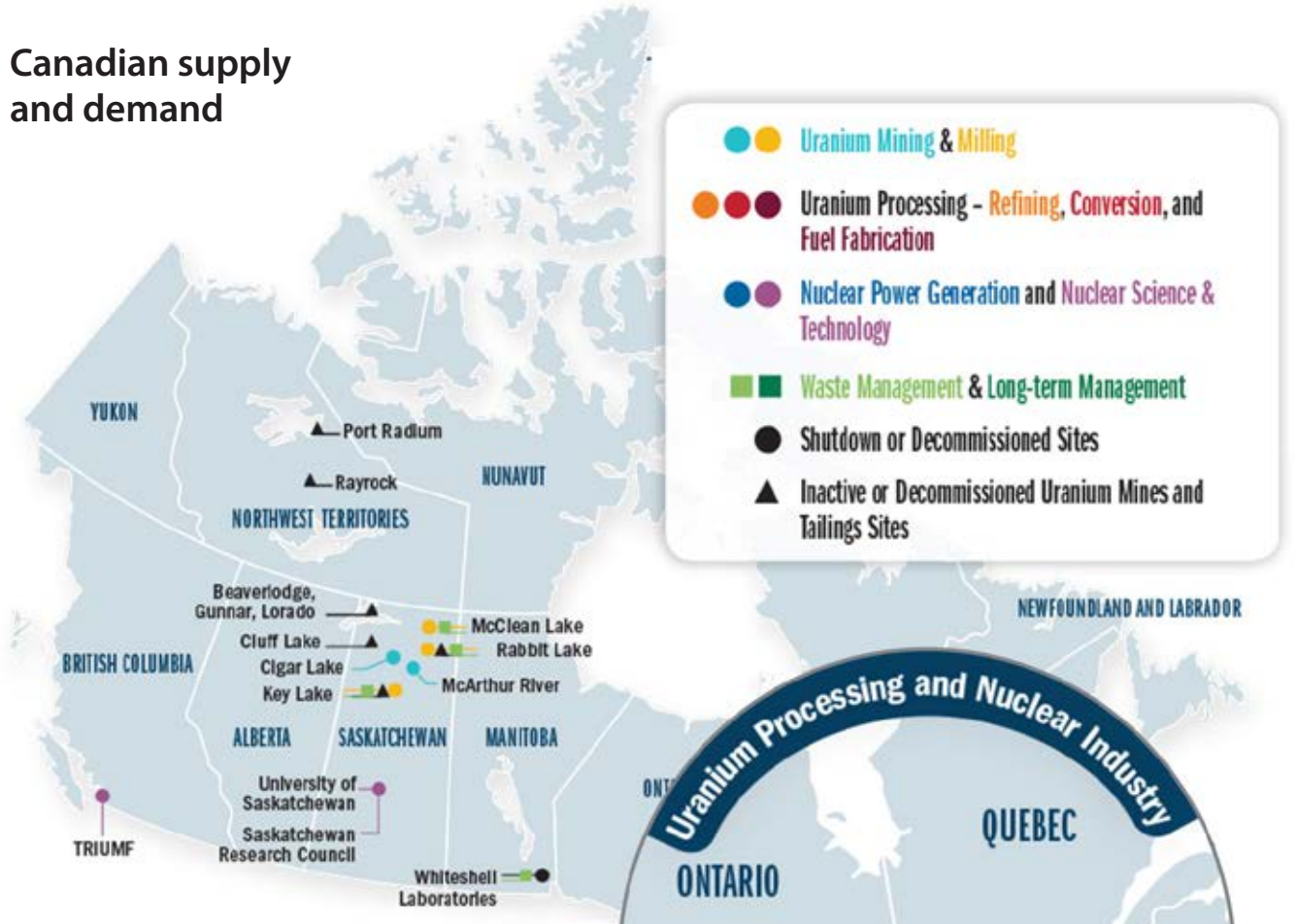
Some might be surprised to see potash included on Canada's list of critical minerals, but it is there for good reason—global food security. Whether due to climate change or geopolitical issues, food security is a growing concern. This has led to growing demand for potash, and Saskatchewan's potash sector is responding by ramping up production.

"Global interest in Saskatchewan is at an all-time high as countries look to us as an ethical and reliable producer for their resource needs. We are proud of our world-class potash sector for stepping up to meet growing global demand for decades to come," says Minister Jim Reiter.

In response to a sharp increase in global demand for potash resulting from Russia's invasion of Ukraine, Nutrien, The Mosaic Company and K+S Potash Canada have all announced planned potash production increases at their Saskatchewan facilities. BHP, which announced in 2021 that it was completing the Jansen potash mine—at $12 billion, the single largest economic investment in Saskatchewan's history - is also accelerating its first potash production from 2027 to 2026.

K+S Potash Canada announced a long-term plan to increase potash production at its Bethune mine, growing continuously over the next several decades to effectively double the current production output. Mosaic announced plans to increase potash production capability by a further 1.5 million tonnes by the second half of 2023 at their Esterhazy K3 and Colonsay operations. And Nutrien is ramping up its annual production capacity to 18 million tonnes by 2025, which will

Canadian supply and demand



Source: https://www.nrcan.gc.ca/our-natural-resources/minerals-mining/minerals-metals-facts/uranium-and-nuclear-power-facts/20070

lead to approximately 350 new jobs in the province.

"One of the objectives identified in Saskatchewan's Growth Plan is to increase the annual value of potash sales to $9 billion," says Minister Reiter. "With the strong performance of the sector, I am pleased to say that Saskatchewan's potash companies have reached this goal this year."

URANIUM

Saskatchewan is home to the world's highest grade uranium mines. In 2019, Saskatchewan-produced uranium was used around the world to generate approximately 306 billion kilowatt hours of clean electricity, the equivalent of powering approximately 28 million homes for an entire year. The Pan-Canadian nuclear energy industry includes uranium mining and milling in Saskatchewan, refining, conversion, and fuel fabrication in Ontario; nuclear power stations operating in Ontario and New Brunswick, and a strong nuclear science and technology presence across Canada, including the production of isotopes for medical and industrial applications. Canada also has a globally respected and experienced nuclear regulator in the CNSC.

With world demand for non-emitting power on the rise, Natural Resources Canada engaged interested provinces, territories, power utilities and stakeholders on the creation of a roadmap for the possible development and deployment of Small Modular Reactors (SMR) in Canada. Ontario, Saskatchewan, New Brunswick and Alberta have since partnered on the advancement of SMR's to provide a source of clean electricity, and in some cases generate heat, which would help meet the goal of Net-Zero GHG emissions by 2050, by displacing power generated from fossil fuels. According to SaskPower, although a decision on whether to build a SMR in Saskatchewan won't be made until 2029, planning is happening now. As the utility seeks to reduce emissions and fill the gap left by the legislated retirement of conventional coal-fired power plants by 2030, there is now a potential to add SMRs into the energy supply mix.

Nuclear fuel bundle.

COVER

Core sample from Cameco McArthur River mine

The increased interest in clean energy is encouraging news for Cameco Corporation and ORANO Canada, the province's two largest uranium producers. Earlier this year in response to growing demand, improving commodity prices and increased interest in nuclear power around the world as part of the solution to combat climate change and to meet energy security needs, Cameco and Orano announced the gradual return to production of their McArthur River mine and Key Lake mill after a four-year hiatus

In October, Cameco announced a strategic partnership with Brookfield Renewable Partners, a leader in the clean-energy space, to acquire Westinghouse Electric Company, one of the world's largest nuclear services businesses. Brookfield Renewable, with its institutional partners, will own a 51% interest in Westinghouse and Cameco will own 49%.

"We're witnessing some of the best market fundamentals we've ever seen in the nuclear energy sector," Tim Gitzel, President and CEO of Cameco says. "As one of the few forms of electricity generation capable of safely, reliably and affordably producing emissions-free, baseload power, nuclear energy is becoming increasingly important in a world that prioritizes electrification, decarbonization and energy security."

Gitzel says the partnership will create a platform for growth across the nuclear value chain. "Coupled with our more than 30-year proven track record of providing secure and reliable fuel supplies to a global customer base, this transaction fits perfectly within Cameco's strategy and is expected to increase our ability to meet the growing needs of existing and new customers at a time when origin and security of supply is of significant concern. At the same time, we expect the recurring demand for Westinghouse's operating plant services and nuclear fuel will generate a strong revenue stream and add stable cash flow to complement Cameco's existing uranium and fuel services business."

LITHIUM

In southern Saskatchewan, Prairie Lithium is establishing itself as a

A Key Driver of Saskatchewan's Economy

Representing 12% of Saskatchewan's gross domestic product (total value of goods and services produced), the mining sector generated $8.6 billion in sales in 2021, the second-highest level on record. Last year alone Saskatchewan mining companies purchased more than $2.2 billion of their total goods and services from Saskatchewan suppliers, including over $368 million from Indigenous-owned businesses. And these mining operations made over $20.2 million in social and community contributions. The Saskatchewan mining industry provides over 26,000 direct jobs, paying more than $1.1 billion to employees in 2021. For every direct job there are at least two indirect jobs in the mining supply and services sectors. The mining industry is a key economic driver across the province.

12%
of SK GDP

The SK mining sector represents **12%** of the province's Gross Domestic Product (total value of goods and services produced).

Payroll
>$1.1 BILLION

From exploration through operations and export, SK companies **support jobs** in every part of the province.

SK mining operations paid more than **$1.1 billion** to employees in 2021.

"Mining companies operating in Saskatchewan are global leaders in safe, sustainable and socially responsible production," says Pam Schwann, president of the Saskatchewan Mining Association.

"Local and global communities benefit when more minerals are produced from Saskatchewan mines."

Procurement
> $2.2 BILLION

In 2021 SK mining companies purchased **$2.2 billion** of their total goods and services from Saskatchewan suppliers.

leader in lithium brine development. That is important because, right now, North America imports the large majority of its lithium from producers in South America, Australia, and China.

The company is using a proprietary extraction process to access untapped lithium resources trapped in the oil-rich Williston Basin," says Zach Maurer, Prairie Lithium President and CEO. "Our technology directly extracts the lithium from the brine and puts the brine back underground in hours."

Early results from the company's September 2021 drilling program at its Discovery #1 lithium well in Southeast Saskatchewan indicated some of the highest known lithium brine concentrations in Canada. "I always believed that the best was yet to come in terms of finding higher lithium concentrations in Saskatchewan," Maurer says. "To find the highest repeated lithium brine concentrations in Canada to date, on the first well drilled for lithium brine in the country, is the result of a targeted exploration program with an A-class team of industry experts."

Core sample from Foran Mining.

COPPER

In northern Saskatchewan, Foran Mining is developing the world's first carbon neutral copper development project.

The McIlvenna Bay mine, which is aiming to be the first new copper mine in the province in decades, is being designed to take advantage of the latest technological advances to reduce its emissions and make it safer and more efficient.

As part of its commitment to carbon neutrality, the company has secured a fleet of battery electric underground equipment such as drills, trucks, and loaders that will be used for the mine's development and production activities. "Utilizing battery electric equipment with semi and fully autonomous capabilities can help us achieve our carbon neutral targets and provide a safe working environment, which is part of our Net Positive Business strategy as we look to deliver critical metals essential for global decarbonization in a responsible and social-empowering way," comments Dave Bernier, Chief Operating Officer of Foran Mining.

A GLOBAL ENERGY AND FOOD SECURITY LEADER

The pandemic and recent geopolitical events, such as Russia's invasion of Ukraine, have demonstrated the world's interdependence to an extent that surpassed accepted notions. The lack of supply chain resiliency, weakened energy security, increased need for reliable food production, and disastrous weather events are hot topics. Amidst the global turmoil, Saskatchewan has emerged as a strong, reliable, and sustainable supplier of choice for the products the world needs.

Saskatchewan's uranium and potash producers have entered a new growth commodity cycle. For the uranium market, "this cycle is marked by low inventory, depleted mine reserves and minimal production below consumption," says Jerry Grandey, former CEO of Cameco Corporation and former board member of Nutrien. "For the first time in a long time, nuclear is increasingly looked at to meet the increasing demand in electricity while combatting climate change, and as a secure source of energy for individual jurisdictions through long-term agreements."

Although uranium production and nuclear energy had their start in military applications, previous cycles helped establish their reliability for commercial markets. Uranium had the promise of being a cheap energy source; it was viewed as a scarce commodity and its price drove government energy policy. To evolve from its military past, producers and national and international regulatory bodies established country of origin tracking requirements and trade policies. Producers and customers ensured security of supply through the establishment of long-term agreements. Today's cycle builds on this foundation and adds new elements, such as rapid innovation in mining techniques and nuclear power plant technologies, and sustainability through ESG (environment, social and governance) compliance considerations for producers and utilities.

Grandey explains that the emergence of small modular reactor (SMR) technology (100-300 megawatts), with about 50 designs under development around the world,

> **"With the world's largest fertilizer producer here, Saskatchewan is in a good position to produce the crop nutrients global farmers need, and to grow the food we need locally and nationally."**
>
> **– LARRY LONG, SENIOR VICE PRESIDENT OPERATIONS, POTASH AT NUTRIEN**

MC headframe – Cameco McArthur River Mine

FEATURE

Scissors Creek – Nutrien Rocanville

is one of the solutions to bring reliable energy to markets that may not have been able to afford large scale nuclear power plants over 1,000 megawatts nor have the population base to justify one. "SMR technologies are being evaluated and selected in many jurisdictions including in Canada. However it still takes time to permit the technology, license it and built the plant; a 10-year period would not be unusual. Also, although the capital costs are inferior to that of conventional nuclear power plants, they are still quite high. But we have to remember that the high capital costs are offset by the extremely low operating costs compared to other sources of energy. So the good news is that within the next decade the SMRs currently going through licensing and those already under construction will be deployed. SMRs will be the way for small markets," adds Grandey.

Similarly, potash production and distribution has entered a new bullish cycle. After four years of low commodity prices, the sanctions imposed on Belarus, the ongoing war in Ukraine and the depletion of stockpiles, the commodity price is once again on the upswing. Food prices are going up at the same time as fertilizer prices. Larry Long, Senior Vice President Operations, Potash at Nutrien, says that "We anticipate that when the war in Ukraine stops, the sanctions are lifted and trade relations re-established, that it will take time to rebuild confidence in some parts of the world."

"With the world's largest fertilizer producer here, Saskatchewan is in a good position to produce the crop nutrients global farmers need, and to grow the food we need locally and nationally. The difficulty lies in global transportation. We need reliable rail and marine shipping services. Transportation is the limiting factor to production and to worldwide distribution. The key for Saskatchewan producers, who are landlocked is the ability to get their product to either coast to deliver to our customers in a timely fashion," adds Long.

Alanna Koch, former Saskatchewan Deputy Minister of Agriculture and Chairperson of the board of directors of the Saskatoon based Global Institute for Food Security (GIFS), confirms that there has been significant improvement in global food security in the past 20 years. "We have seen innovations in crop productivity thanks to the better use of inputs such as fertilizer. And the advancements in crop genetics, with varieties resistant to droughts or extreme heat for example, have also contributed to the progress in food security."

Yet, Koch points out that for the first time in decades they are seeing a slide backwards under the current geopolitical situation. "The impact of the war in Ukraine, short-sighted government policies, the COVID-19 pandemic and the ensuing rise in crop input prices and food prices mean that it is a challenge to feed the hungry and maintain healthy diets around the world. The solutions rest in fertilizer and crop innovation and access to technology to enhance the use inputs, predict yields and to distribute these advancements to those that need them," says Koch.

Whether on the clean energy or food security front, the current geopolitical situation amplifies Saskatchewan's resourceful position as a secure, reliable and sustainable trading partner to fuel and feed the world.

A map of the locations of central Saskatchewan's critical materials. Image courtesy of Saskatchewan Geological Survey.

CRITICAL MINERALS

Many places in the world, including Canada, are trying to reduce the emissions of greenhouse gases to minimize the impacts of a changing and warming climate. This will involve significant development of new green-energy operations and storage facilities, increased use of electric vehicles, and an even greater dependence on a strong digital infrastructure. However, this will require an increased supply of important elements and metals that must be mined and then processed for use. These are called critical materials, as they are important in many green-energy and high-technology applications, but they are often found only in specific parts of the world and their supply may be disrupted. Canada has recently identified 31 materials that are deemed important to our economy and lifestyle.

For example, a number of elements are needed to produce the infrastructure to support a low-carbon future through electricity generation and electric vehicles. Electric vehicles require lithium and cobalt for batteries, copper for wiring, and an array of rare earth elements for the electronics. The latter are also used in permanent magnets for wind turbines. Solar panels contain elements such as indium and gallium.

Consider your smartphone: the display panel, circuitry and battery require various elements such as silica, indium, copper, silver, tungsten, lithium, carbon and many others, that come from minerals. Helium, which is found as a gas, is used in its liquid form to cool superconducting magnets in MRIs, and in high-capacity hard drives in massive data centers (e.g., Netflix and Bitcoin). The great variety of rocks in Saskatchewan, ranging from the igneous and metamorphic rocks of the Canadian Shield in the north, to the sedimentary rocks in the south, means that the province may be able to supply some of these critical materials. For example, rare earth elements are found in the mineral monazite, in a location north of Lake Athabasca, and cobalt has been found associated with some of the large uranium deposits. In the south, lithium could be produced from some of the groundwater found deep in the sedimentary rocks, and helium gas is being extracted from other reservoirs in these rocks.

Monazite crystals (reddish brown) in a deformed Precambrian host rock; photo from Appia Energy Corp. website.

Selected Critical Materials in Saskatchewan

- Lithium
- Cobalt
- Rare Earth Elements
- Helium
- Copper
- Major Cities

ORE DEPOSITS

NEW ROBOTICS KIT HEADLINES SMA'S POST-PANDEMIC EDUCATION OUTREACH

2022 GeoVenture Teacher's Program at Mosaic Colonsay's mine.

The SMA's Education Outreach program has been offering free curriculum-correlated learning resources to Saskatchewan educators for many years. During the pandemic, these resources—from lesson plans to posters to mineral maps—proved especially valuable as learning switched to online delivery. But when pandemic restrictions were lifted earlier this year, it caused a ripple of excitement because it opened the door to in-person activities. First up was the return of GeoVenture Teacher's Program.

The GeoVenture "Rock'n the Classroom" Program returned in August 2022 after a two-year absence. Travelling over 1,300 km in six days, 16 educators were taken on a whirlwind tour of mines and related sites throughout the province, where they learned first hand about operations and ways to link Saskatchewan's mineral resource industry to the provincial education curriculum. In a jam-packed week, participants also piloted robotics kits, and Indigenized Lesson Plans. "Phenomenal experience! Hands-on, relevant, once in a lifetime experience! I loved it!" said one of the participants in the feedback survey, while another said "All of our tour guides and presenters gave meaningful, insightful explanations."

As the new school term got underway in September, SMA's Potash Kits were distributed to over 200 schools across the province. The Kits are a free resource for educators across the province and correspond with SMA's curriculum-correlated Potash Lesson Plans.

To support educators using these kits and related lesson plans, SMA Education Consultant Hilary Roemer developed a series of YouTube videos that are posted on the SMA website.

Another project Roemer has been closely involved in is developing a new Robotics Kit in partnership with Sask Code, industry partners and another educator, Dave Dalton, who has led a very active and successful robotics club at his school in Ile a la Crosse.

"Our goal was to create a robotic kit focused on the mining industry for Grades 7 and up," Roemer says. "We wanted something that would tie in with mine safety and environmental stewardship as well as careers in mining. Early on, I suggested a 'fly away birdie' challenge."

'Fly away birdie' refers to devices, both high and low tech, used to safely scare birds away from potentially harmful sites, such as wind farms and airports, as well as from agricultural crops. According to Roemer, the focus of the SMA Robotic Kit is to challenge students to create a device that will scare birds away from tailings ponds around mine and mill sites.

When Roemer first suggested the idea, she was surprised by the immediate uptake. "Everybody jumped on board—SMA, Sask Code, sponsors. Sponsors have been actively participating in meetings since the start. They've shared their experience and knowledge, have helped us test it out and provided feedback," she says.

"It's been a big collaborative effort," Roemer says. "Robotic kits are a natural fit for the mining industry, which already uses robotic devices to transport materials, mine ore, explore tight spaces, monitor areas and more. This kit is a hands-on way to help students learn how robotics work, how they're used in the mining sector and what kind of careers are associated with that."

Phase one of the Robotics Kit roll out is happening this fall, with the first workshop planned for December.

K+S Potash Canada Bethune Mine

We would like to acknowledge the following awards and recipients:

Feifan Yang - Recipient of the SMA Environmental Systems Engineering Scholarship at the University of Regina for 2022.

Tessa Petrus - Recipient of the SMA Environmental Scholarship at the University of Saskatchewan College of Engineering for 2021–2022

Bamisho Afolabi - Recipient of the SMA Mining Engineering Technology Scholarship at Saskatchewan Polytechnic for 2021 – 2022

SUPERHERO SPONSORS:

Fission 3.0 GRAHAM Mosaic Nutrien K+S youth+us

VISIONARY SPONSORS:

BHP Cameco SSR MINING SEABEE

Nutrien Allan – Overall Underground Winner

EMERGENCY RESPONSE MINE RESCUE SKILLS COMPETITION RETURNS IN FULL FORCE

After a two-year hiatus due to the COVID-19 pandemic, this year saw the return of the Saskatchewan Mining Association Emergency Response Mine Rescue Skills Competition in late spring. In its 52nd year, the competition featured nine underground and six surface emergency response teams from 15 mine sites across Saskatchewan who challenged themselves in simulated emergency response scenarios. The full scope of the competition was possible thanks to our sponsors Applied Industrial Technologies and Thyssen Mining as well as the long-standing support of many companies who donated equipment and resources for the event.

In addition to the usual fire fighting, first aid, proficiency skills, practical skills, and simulated surface and underground mine problems, the teams also competed in the new rope rescue event. "The dedicated rope rescue event took place outside utilizing the grandstand at Saskatoon's Prairieland Park. The event required teams to repel down the side of a building, prepare a patient for transport and lift the patient to the top. Once on the top, they needed to re-rig and lower the patient safely to the ground. The team from K+S Potash Canada was the winner of this first-time event and the runner-up was Mosaic's Belle Plaine's team," says Chris Stansfield, Competition Chair and Safety Supervisor at Orano Canada's McClean Lake Operation in northern Saskatchewan.

Families, friends and communities can be assured that their loved ones are well supported when it comes to mine rescue, as demonstrated by the high caliber of the competition. Whether they are tasked to rescue a worker that has become trapped by a piece of equipment, to enter an unsafe area with bad ground conditions or smoke filled, to face the situation of a worker crushed by materials dropping from above, to extinguish fires, or to respond to an incident involving the detonation of explosives, the teams are required to demonstrate proper techniques, use of resources and equipments, teamwork and leadership skills. Stansfield remarks, "It comes down to the dedication, training and preparedness of all mine rescue personnel."

For the eight year the Family Safety Zone also made its return at the competition. The popular area provides fun, interactive activities aimed at teaching families and children attending the competition about mining and safety at work and at home. This year the Family Safety Zone included activities such as the virtual reality fire suppression simulation, exploration geophysics and potash solution mining activity.

Next year, after five years as the competition's Chair, Stansfield will pass the torch to Kevin Kingdom from Nutrien's Rocanville mine. "Our organizing committee starts the planning process in September for the following spring competition, so we're already at it for 2023, but next year I won't be chairing it. I've had a good run, it's time for someone else to take it on," says Stansfield.

Similar to the organizing committee, the teams are already practicing for next year, although they really kick it in high gear in May. Their emergency response training is ongoing on a monthly basis throughout the year. They have to keep their skills current and be ready 24/7. For first time team captain, Jessica Klarholm of Westmoreland's Estevan Mine, the opportunity to gain new skills as a rescuer and to help her

coworkers if they ever need assistance is what prompted her to join the mine rescue team in the first place. "The added bonus is that those skills transfer to my personal life, being a horsewoman they sure come in handy," says Klarholm.

"Taking on the role of Captain was a way to challenge myself further and to grow my skillsets in a new direction. In this role the learning curve prompted me to really evaluate the way I delivered directions and to view situations in their entirety. It's one thing to be working within the team and another to be directing and overseeing all the moving parts. My leadership style is different than what the team experienced before. By nature I am a quiet person, so I've had to adjust and so has the team," explains Klarholm.

At Westmoreland's Estevan mine, the team captain is voted in every three years by the team members and typically remains in place until other names are put forward and selected. Klarholm concludes, "I will remain Captain as long as that is where I best serve my team."

Since the 2022 SMA competition, The Mosaic Company's Esterhazy mine rescue team who won the First Aid Underground event and was the runner-up for the Overall Underground event, competed at the International Rescue Competition in Beckley, West Virginia. The competition hosted 22 teams from Australia, Canada, Columbia, India, Poland, United States, Zambia, Finland and India. The Esterhazy team placed second overall. And that's not all, Justine Fuchs, also from the Esterhazy mine rescue team competed in Beckley as a member of the Diamonds in the Rough mine rescue team, comprised of women from various mines across Canada. Their team finished 6th overall.

52nd Annual Saskatchewan Emergency Response/Mine Rescue Skills Competition

OVERALL
Surface Winner - Mosaic Belle Plaine
Runner Up – Nutrien Patience Lake

Underground Winner – Nutrien Allan
Runner Up – Mosaic Esterhazy K3

FIRST AID
Surface Winner - Mosaic Belle Plaine
Runner Up – Nutrien Patience Lake

Underground Winner - Mosaic Esterhazy K3
Runner Up – Mosaic Colonsay

FIRE FIGHTING
Surface Winner – Nutrien Patience Lake
Runner Up – Mosaic Belle Plaine

Underground Winner – Mosaic Colonsay
Runner Up – Nutrien Cory

PROFICIENCY
Surface Winner - Orano McClean Lake
Runner Up – Mosaic Belle Plaine

Underground Winner – Nutrien Lanigan
Runner Up – Nutrien Cory

PRACTICAL SKILLS
Surface Winner – Mosaic Belle Plaine
Runner Up – Nutrien Patience Lake

Underground Winner – Nutrien Allan
Runner Up – Nutrien Cory

SURFACE ROPE RESCUE SKILLS
Winner – K+S Potash Canada
Runner Up – Mosaic Belle Plaine

SURFACE FIELD PROBLEM
Surface Winner - Nutrien Patience Lake
Runner Up – Westmoreland
Poplar River

UNDERGROUND MINE PROBLEM
Underground Winner – NutrienAllan
Runner Up – Nutrien Lanigan

Mosaic Esterhazy K3 competing in the Emergency Response Mine Rescue Competition

PARTNERSHIPS THAT GROW TOMORROW'S WORKFORCE

Orano – Teaching new recruits.

Saskatchewan's mining industry has a long history of partnership with educational institutions and communities to ensure that young people, particularly Indigenous people – the fastest growing segment of the province's population – have the knowledge and opportunity to gain the experience required to work in the mining sector.

In response to the mining industry's increasing workforce needs several training and educational institutions have created programs such as the Saskatchewan Indian Institute of Technologies' Mining Industry Pre-Employment Program, the Mining Engineering Technology Program at Saskatchewan Polytechnic, and the Mineral Exploration Techniques Program at Northlands College in La Ronge. Discussions with mining companies and direct participation by industry representatives are informing their curriculum and providing opportunities for field-training, practicums, summer employment and apprenticeships.

In addition to programs offered at post-secondary education institutions, many of the mining companies are creating operations-specific training opportunities and partnering with local communities and organizations for their delivery. One such collaboration is Orano Canada's Mill Operator training program. Orano has partnered with Northern Career Quest, a joint federal, provincial and local northern initiative, to offer several training programs. Since the start of the Mill Operator Training Program in 2012, over 100 residents of northern Saskatchewan have had the opportunity to learn new skills and experience life at the McClean Lake uranium operation in northern Saskatchewan. More than 85% of the trainees received opportunities to work at the McClean Lake operation, in the mill and in various positions around the site, while others are applying the skills they learned to other locations or industries. This year Orano welcomed a new cohort of

> **"We currently have 8 trainees on site, who are all from the Athabasca Basin, progressing through the program. They will finish at the end of the year, and with successful completion will be offered positions at site."**
>
> **– GLENN LAFLEUR, NORTHERN AFFAIRS MANAGER, ORANO**

trainees. "We currently have 8 trainees on site, who are all from the Athabasca Basin, progressing through the program. They will finish at the end of the year, and with successful completion will be offered positions at site," says Glenn Lafleur, Orano's Northern Affairs Manager.

Like many others, the mining industry is continuously changing - adapting to new technologies is a necessity. Mosaic Potash's Digital Transformation Training Program responds to its need for a technology savvy workforce and provides an opportunity for Indigenous students to broaden their knowledge about the crop nutrient market, potash mining, processing and distribution, site safety, communication and automation.

The Digital Transformation Training Program was born from the International Minerals Innovation Institute's 2021 call for projects to increase Indigenous representation within the mining and minerals industry. Morris Interactive, a Saskatoon-based business services provider, joined forces with Cowessess First Nation to develop an innovative digital training program for adult Indigenous people. The duo contacted Mosaic to join the partnership and help develop the curriculum. The partnership resulted in the launch of a 10-week program in January 2022, which included a two-week practicum at Mosaic's Esterhazy mine site. "Mosaic is proud of the partnership we have with the Morris Interactive group and the Cowessess First Nation. We strive to have a diverse workforce that represents the communities near which we operate. The students saw first hand how we use technology in the workplace," says Braden Domres, Human Resources Manager at Mosaic Potash Esterhazy.

"We have a mature workforce at our Esterhazy location and we project that over the next five to eight years, we will need to replace close to 200 retired workers. Programs such as this one help enrich the lives of people who reside nearby and will also help us secure the workforce needed for our operations," adds Domres.

The first cohort of the Digital Transformation Training Program concluded successfully in March 2022 and since then Mosaic has hired several students while others have found work with local mining contractors. In August, Mosaic announced a $1 million investment to further expand the program over the next five years. And in September the partnership kicked-off a second iteration of the program. Domres explains that "for this second cohort we partnered with the Gabriel Dumont Institute (GDI). The program takes place in Saskatoon and students will complete their two-week work practicum at our Colonsay operation. We are also preparing the third cohort, once again with the Cowessess First Nation in the spring of 2023."

With training programs such as these, Saskatchewan's mining sector and community partners are actively developing the workforce of tomorrow.

Morris Interactive cheque presentation.

BUILDING INDIGENOUS CAPACITY

Most Saskatchewan mines are in remote or rural areas, often near Indigenous communities. In northern Saskatchewan, since 1978, surface leases between the Province and the uranium mining companies have included considerations for worker and environmental safety and protection as well as provision of employment and economic opportunities for people living in northern Saskatchewan, over eighty percent of whom are Indigenous people. These considerations have led the companies to implement northern hiring and contracting preference policies. Central and southern mining companies later adopted policies to also ensure diversity and inclusion within their operations and procurement strategies. The Truth and Reconciliation Call to Action #92 further highlighted the need for socio-economic reconciliation and the promotion and participation of Indigenous people in business. Today, while much work remains to be done, there are several existing and emerging success stories.

Xtended Hydraulics

BY THE NUMBERS

Since 1991-2020, northern mining operations related to uranium and gold mining and milling have paid $8.4 billion to northern employees and northern goods and services suppliers.

$8.4 BILLION

SUCCESS STORIES

Athabasca Basin Development
Complete or partial ownership in 14 businesses

14
Businesses

Des Nedhe Group
In 2020, 362 employees, $51.5M in revenue with complete or partial ownership in 17 businesses

$51.5
Revenue

Kitsaki Management Limited Partnership complete or partial ownership in 14 businesses, distributed over $20M to Lac La Ronge Indian Band communities since 2009.

$20
Distributed

File Hills Qu'Appelle (FHQ) Developments
Partial ownership in 7 businesses. FHQ Developments is owned by 11 member First Nation Communities and File Hills Qu'Appelle Tribal Council.

7
Businesses

Cameco Corporation, with uranium mining operations 700km north of Saskatoon, has set out to help build local capacity by implementing a northern hiring and contracting policy. "In some cases, our contracting with Indigenous organizations allows us to temporarily assign an employee within the organization to share best practices to meet our requirements. We also partner with northern educational institutions to deliver training and education programs required to work at our mine sites. We make a point of hiring local people and providing them with training and advancement opportunities within the company," says Darryl Burnouf, Manager Northern Business Development at Cameco.

John Desjarlais, a professional engineer, says that he has benefited from Cameco's efforts to build Indigenous capacity. "I had the opportunity to move up through the company and meaningfully participate in discussions and decisions that had a direct impact on the operations, on innovations and even on the reduction of the cost per pound."

Now, Desjarlais a General Manger of an industrial construction First Nations partnership focused on engaging the First Nations community in Saskatchewan's growing economy, particularly in the mining sector. In his leadership capacity he promotes Indigenous capacity building through the development of his organization's workforce. "We must create an environment of inclusivity. By virtue of creating jobs and hiring Indigenous people to participate at work sites and in the leadership of organizations, we build capacity within the community," he says.

"Capacity development must be deliberate, intentional, and unconditional; it's having a people first attitude. It must be a partnership between industry, non-Indigenous people, and Indigenous businesses and communities. We can't do it alone. And when our people learn and grow from working at different job sites and move around to different contractors or go work for the mining companies, that's a positive. It's the reflection of a positive partnership. We also have to think about Indigenous sole proprietors. We have to make sure that there are measures to allow them to participate in the procurement process."

Similarly, Xtended Hydraulics and Machine, a 100% Indigenous business located in Emerald Park, Saskatchewan and privately owned by the Tebb family, has committed to give back to the community through employment and apprenticeship opportunities. "We have a loyal and engaged workforce in the shop. With over 50% of our people being Indigenous, there's no question that the environment is respectful of Indigenous people and culture, that's one of the reasons people stay," says Robert Tebb, General Manager at Xtended.

> **"With over 50% of our people being Indigenous, there's no question that the environment is respectful of Indigenous people and culture, that's one of the reasons people stay."**
>
> – ROBERT TEBB, GENERAL MANAGER AT XTENDED

Tebb explains, "We know that in Indigenous culture, people are very close to their family and communities, which means that they aren't often open to relocating for a job. That's why we're exploring opportunities to open shops in other regions and communities of the province such as up North."


Xtended Hydraulics

For both Desjarlais and Tebb the intent of Indigenous Procurement policies has to be about building community. They recognize that building community capacity means building community financial wealth, but the aspects of social well-being and socio-economic well-being of the people are the most important. "Indigenous procurement isn't about politics or risk management. It's about the social value of procurement. When Indigenous people win, the communities win, and we all win," concludes Desjarlais.

THE PATH TO NET ZERO

Just like you, Saskatchewan's mining companies are looking to reduce their Greenhouse gas (GHG) emissions to achieve Net Zero. Their journey to net zero requires collaboration with organizations upstream and downstream of the mining process and the pursuit of innovative processes and technologies to meet their climate-related commitments.

SaskPower Boundary Dam carbon capture and storage.

One of the largest sources of greenhouse gas emissions in the mining sector is the consumption of energy. It is also one of the largest costs of production. Consequently, the reduction in energy consumption, the adoption of low-carbon electricity sources and the implementation of carbon capture and sequestration top the list of many mining companies' sustainability improvement measures.

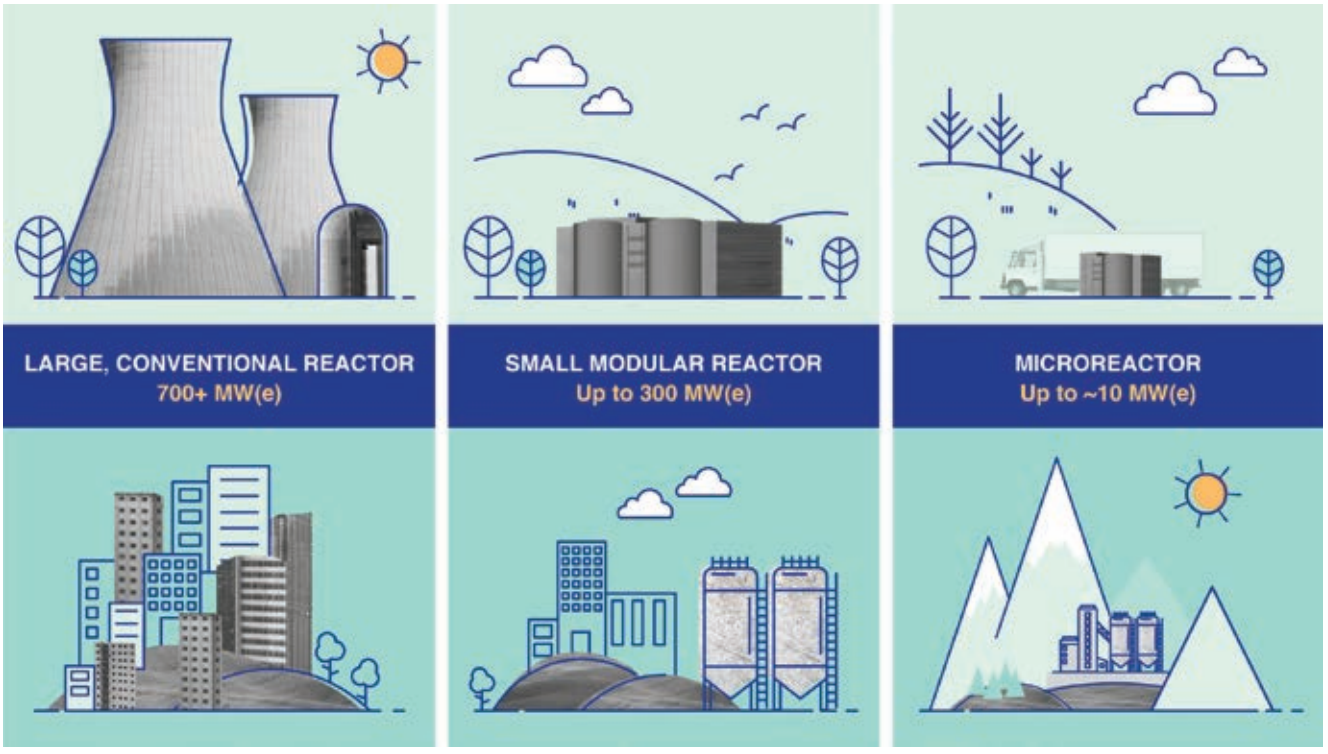
In Saskatchewan, mining operations rely on SaskPower, the provincial crown corporation electricity provider, to meet their electrical needs and to collaborate with to reduce their greenhouse gas emissions from power consumption. SaskPower has developed a plan to transition to Net-Zero through the elimination of conventional coal-burning plants (meaning without carbon capture), and the diversification of energy sources with a focus on renewable and low-carbon technologies. SaskPower is also increasing opportunities for customer self-generation and cogeneration options, upgrading its grid technology to reduce overall power consumption, while expanding low-carbon transmission and infrastructure such as with electric vehicles charging stations, and rounding their plan with the purchase of offsets. These measures require substantial capital investments. For 2022-2023 alone, budgeted capital investments for power distribution amount to $296M, plus $341M for power generation, and another $229M for transmission.

Under SaskPower's aggressive transition plan, by 2030, up to 50% of the province's electricity will come from renewable sources, mostly hydro (which currently produces 20% of the electricity), wind, solar, as well as biomass, utility-scale battery, and others such as geothermal. The company is also evaluating the use of nuclear energy through small modular reactors (SMRs). The SMR project planning phase is a seven-year process to address the feasibility, technology evaluation, site selection, impact assessment, construction licensing and regulatory review and approval. A decision whether to build SMRs would likely not occur until 2030 and construction would take an additional four years bringing the start of operation to 2035. Indigenous, stakeholders and public engagement is already underway and is an ongoing element of the planning and construction process and during operation. The use of SMRs in Saskatchewan would mean the diversification of the province's nuclear industry from uranium mining, (as uranium is used to fuel nuclear power plants) to also using this energy source to power the local grid.

SaskPower is a trailblazer in carbon capture and storage (CCS) with the experience acquired at its boundary Dam facility. Several mining companies are investigating the application of CCS at their operations while some, such as Nutrien, already have experience using this technology. The International CCS Knowledge Centre provides unbiased, expert technical advice to help organisations reduce carbon dioxide (CO2) emissions. The International CCS Knowledge Centre simply explains the CCS process as the capture of CO2, its injection deep underground for its recycling using enhanced oil recovery (EOR) and its permanent storage in depleted oil or gas formations. Like the process for SMRs, the Centre indicates that a CCS project investment process takes approximately 6 years from the early interest stages to feasibility, operation, and optimization. CCS is emerging as a public good that requires government support and involvement to encourage investment. The Canadian federal refundable tax credit for eligible carbon capture and utilization storage (CCUS) equipment or for using EOR are helpful.

Saskatchewan mining companies have all committed to pursuing carbon neutrality as demonstrated by their net-zero transition plans, their proactive approach in managing climate-related risk, transparent reporting, and participation in various climate-focused industry groups. These companies are implementing measures to achieve substantial GHG emissions intensity reduction by 2030 through innovation. Potash companies were early adopters of battery-electric mining vehicles that were manufactured locally in Saskatoon by Ens Toyota and Prairie Machine. Moving forward, they are planning to deploy self-generated wind and/or solar energy and launch cogeneration projects whereby, for example, an efficient gas turbine generates electricity and the waste heat from the exhaust is recovered to make valuable steam. They are all making substantial financial commitments and operational technological changes to optimize electricity consumption.

WHAT ARE SMALL MODULAR REACTORS (SMRS)?



Small modular reactors (SMRs) have a power capacity of up to 300 MW(e) per unit. Many SMRs, which can be factory-assembled and transported to a location for installation, are envisioned for markets such as industrial applications or remote areas with limited grid capacity. (Image: A. Vargas/IAEA)

What's Net Zero?

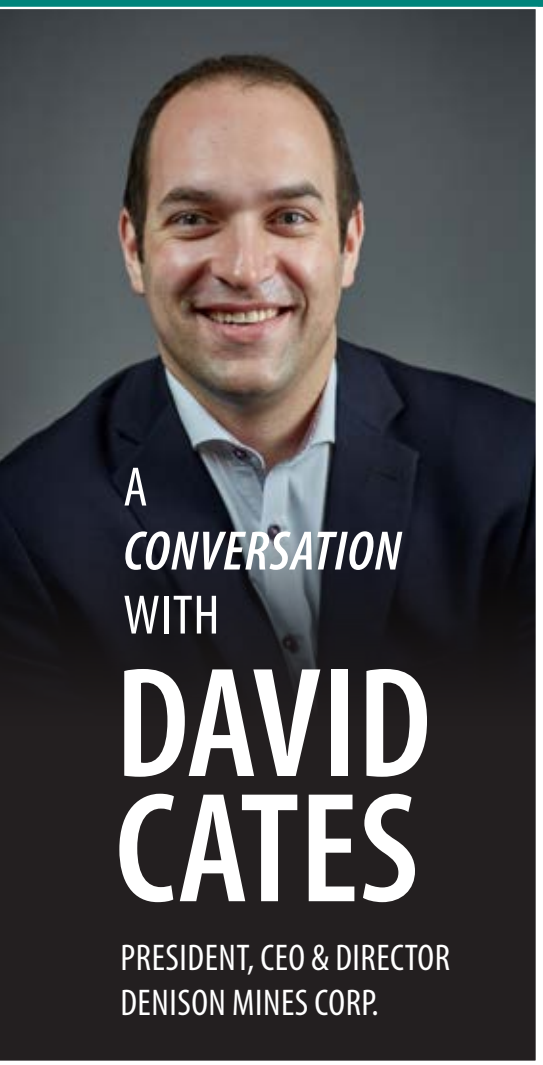
Achieving net-zero emissions means that the economy either emits no greenhouse gas emissions or offsets its emissions, for example, through actions such as tree planting or employing technologies that can capture carbon before it is released into the air.

Canada is among over 120 countries committed to achieving net-zero emissions by 2050, including all other G7 nations (United Kingdom, United States, Germany, Italy, France, and Japan).

Canada's Net-Zero Challenge is a voluntary initiative that encourages businesses to develop and implement credible and effective plans to transition their facilities and operations to net-zero emissions by 2050.

Saskatchewan's mining companies are also taking a life-cycle approach to their net-zero transition by collaborating with suppliers, transporters, and end-users to help minimize their GHG emissions. For example, potash companies have joined a joint industry study for the use of ammonia as an alternative marine fuel and the development of green ammonia (made of hydrogen obtained from electrolysis of water using renewable electricity) plants. While with the understanding of the crucial role that nuclear power can play in the energy transition, uranium mining companies are supporting the planning process for the future deployment of SMRs. This fall Cameco Corporation announced that it had formed a strategic partnership with Brookfield Renewable Partners, experts in clean energy, to acquire Westinghouse Electric Company, one of the world's largest nuclear services businesses. And in 2021 Cameco signed several memorandums of understanding with various companies, such as X-energy, GE Hitachi Nuclear Energy, and others to explore areas of cooperation to advance the commercialization and deployment of several types of SMRs like the X-energy Xe-100 or the GE Hitachi BWRX-300. Saskatchewan's mining industry's commitment to achieving net-zero is apparent in their operations and in their promotion of sustainable practices upstream and downstream of their activities.

In each edition of ORE, we go beyond the official bios to give our readers insight into the leaders of Saskatchewan's mining and exploration companies.



A *CONVERSATION* WITH DAVID CATES

PRESIDENT, CEO & DIRECTOR
DENISON MINES CORP.

Denison Mines Corp. is a uranium exploration and development company with interests focused in the Athabasca Basin region of northern Saskatchewan, Canada, including its flagship Wheeler River Uranium Project (holding an effective 95% interest), which is the largest undeveloped uranium project in the eastern portion of the Athabasca Basin. Denison also holds various interests in uranium exploration properties and projects in the northern Saskatchewan, such as in the McClean Lake joint venture (22.5% interest) which includes several uranium deposits and the McClean Lake mill which processes uranium ore from the Cigar Lake mine.

Denison's President and CEO, David Cates, has been in his role for seven years. His appointment at the helm of the corporation followed his service as the company's Vice President, Finance & Tax and CFO. Prior to joining Denison, Cates held various positions at Kinross Gold and at PwC LLP.

We caught up with Cates during one of his latest regular visits in Saskatoon and he agreed to answer a few questions.

Ore Magazine: As someone who grew up in the Waterloo region in southwestern Ontario, what do you find unique about Saskatchewan and why do you see Denison being successful here?

David Cates: Beyond Saskatchewan's natural endowment of exceptional uranium resources, I've come to appreciate the value of the province's people and business environment. The people that we have developed and recruited in Saskatoon are the heart of our business – they have a passion for the environment and take enormous pride in our Company's plans to supply uranium to the world, which supports nuclear energy and global efforts to reduce carbon emissions.

Ore Magazine: What have you learned in your previous roles that prepared you to lead Denison and pursue the development of the Wheeler River project in Saskatchewan?

Cates: I learned a great deal from my time working directly with Denison's former Board Chair Lukas Lundin and Denison's current Board Chair Ron Hochstein. Both Lukas and Ron placed great trust in me when I was appointed CEO of Denison in 2015. Lukas had a unique way of focusing on results and made you believe that there was nothing you couldn't achieve if put your mind to it. Ron is still a mentor to me, and reminds me of the importance of calm, steady, and thoughtful leadership.

Ore Magazine: When you're not working, what gets you going in the morning?

Cates: This is a tough question because I'm often working! Outside of work, I find great enjoyment in the simple things in life – like being outdoors, gardening, cooking something up on the BBQ – and spending time with my family.

Ore Magazine: What else do you do to take a break from work?

Cates: My personal interests include the Toronto Blue Jays and auto racing. I've been watching racing and baseball in person since I was child. My family would go to the Toronto Indy Car race every year and when I came out of university and started work in Toronto, I went to many (many) Blue Jays games after work. Now, I enjoy taking care of my own cars (oil changes, switching to snow tires, polishing) and catching the occasional Jays game when it works with my schedule.

Ore Magazine: In Saskatchewan, we know you as the Toronto-based CEO, who spends a great deal of time with his Wheeler River and exploration teams in Saskatoon, but on the personal side you're quite private. You mentioned earlier that you enjoy spending time with family, would you tell us a bit about your family and if they have an impact on how you approach your job?

Cates: I have a wonderful family. My wife, Jennifer, is an elementary school vice-principal and is unbelievably supportive of my demanding career. We have two young daughters. They love running around outside, playing t-ball, and spending time with their grandparents. Our girls inspire me to help ensure gender equity becomes a norm in the workplace, and that we appreciate the importance of protecting the environment and taking steps towards reconciliation with Indigenous people. When I watch the news, sometimes it feels like it will be difficult to leave the world better off for our kids, so I focus on how I can make a difference and try to lead by example.

Ore Magazine: How does your commitment to making a difference translate into your leadership style?

Cates: I'm responsible for strategic leadership and oversight of all aspects the business, but to do that efficiently and effectively, you must rely on the

David and Sophie

BEYOND THE BIO

people that work for the Company. So, generally, I see my role as CEO as that of a facilitator, helping the leaders within our company make decisions, remove barriers to innovation, creativity, and/or success, and create alignment between different groups. I believe that a healthy and productive work environment involves creating a culture where people are motivated from within and genuinely care about the Company's success.

Ore Magazine: That's an interesting perspective on leadership. How would you say your experience in previous roles has impacted who you are today and the way you lead the company?

Cheque presentation at 2022 Elder's Gathering.

Cates: My first real work experience was in professional services at PwC LLP where I qualified as a CPA. That's where I gained an appreciation for the power of coaching. Professional services firms are constantly developing junior staff and grooming future leaders. I try to lead in a way that organically creates a continuous coaching environment, where we focus on finding the right opportunities for our people, supporting them to achieve their full potential, and creating space for people to ask questions and challenge the norm. Coaching is not about directing the "players," so much as it is about showing teams how to be open to hearing alternative perspectives and working together to develop our people and deliver the best outcomes for the Company.

Ore Magazine: Thank you for giving us a glimpse of David Cates in and out of the corner office. Is there anything else you'd like to add to conclude?

Cates: With the world waking up to the critical role that nuclear energy must play in the global battle against climate change, it is an incredibly exciting time to be leading a uranium development company in Saskatchewan. Denison has a long history in Canadian uranium mining, and we are charting a new path with our efforts to be the first to bring the In-Situ Recovery mining method to the high-grade uranium deposits in Saskatchewan. Our teams are committed to delivering success for our shareholders and the province, and their enthusiasm is frankly infectious. We have an excellent team and I'm fortunate to have their trust to lead the way forward.

TARYN ROSKE:

FIRST NORTHERN WOMAN JET BORE SYSTEM OPERATOR

A member of the Lac La Ronge Indian Band, who grew up in La Ronge and still calls the northern town home, Taryn Roske has always known that she would be working in a non-traditional role; her education and career paths prove it. "I took the Geological Technician course at Northlands College in town as soon as I graduated high school. A few months after I finished the course, I started as a Radiation Technician at Cameco Corporation's Rabbit Lake mine," says Taryn.

Since her early days at the northern Saskatchewan uranium mine, Taryn hasn't stopped learning and trying new things. She is quick to mention, "I've been a radiation technician, a mine technician, and environment technician and now I'm a Jet Bore System (JBS) Operator. I like learning something new every day."

Working at Cameco's Cigar Lake mine for the past four years, Taryn describes her current work as a JBS Operator as fairly repetitious and a straight forward process. "We set up the drill under the planned cavity location. Once the rig is in place, we drill up a pilot hole and ream it out to enlarge the cavity. When the reaming is complete, we install casing up the hole and grout it into place to prevent the hole from caving in. Finally once the grout has set, we run the jet rods up into the cavity and begin jetting the ground to extract the uranium ore by turning it into a slurry. Once we've completed a cavity, the surveyors come to make sure all is in order, and then we can backfill it with concrete and move on to the next one."

Although Taryn has the ability to explain the process fairly simply, it takes time and demands precision. And the work fits well with her desire to continuously learn. "There are always new challenges, new ground conditions, various issues to solve with the drill. I retain all the information so I can use it in the future when similar issues arise," she says.

"I am proud of being the first and only female JBS Operator. I not only represent women, but also Indigenous women in non-traditional roles. It took me being persistent and proving that I really wanted to do this job before I was hired as a fulltime operator. I hope that younger generations can see my journey and that it inspires them to pursue their dreams. Working at the mine site can be intimidating and it might be hard to leave loved ones for work two weeks at a time, but the extended time off makes it worth it. Being at site feels a bit like home. There are lots of really great people and we can make lifelong connections. It's worth at least giving it a try and seeing if that lifestyle is for you."

"I am proud of being the first and only female JBS Operator. I not only represent women, but also Indigenous women in non-traditional roles.

MINING: DRIVE BY INNOVATION

Technology and innovation aren't necessarily the first words that come to mind when talking about mining, yet they should be. Today's mining is quite different than its early days; innovation and technology advances are driving continuous improvements in safety, productivity and access to orebodies previously assessed as uneconomical.

The Surface Access Borehole Resource Extraction (SABRE) technology is a prime example of Orano Canada and its joint venture partner Denison Mines Corp.'s long-term research and development efforts. The successful five-year mining test program using SABRE at the Orano operated McClean Lake Operation in northern Saskatchewan has demonstrated that this one-of-a-kind non-entry, surface-based mining method may be a game changer for economic access to certain high-grade orebodies in the Athabasca Basin that are too deep for open pit mining and too small for conventional underground mining.

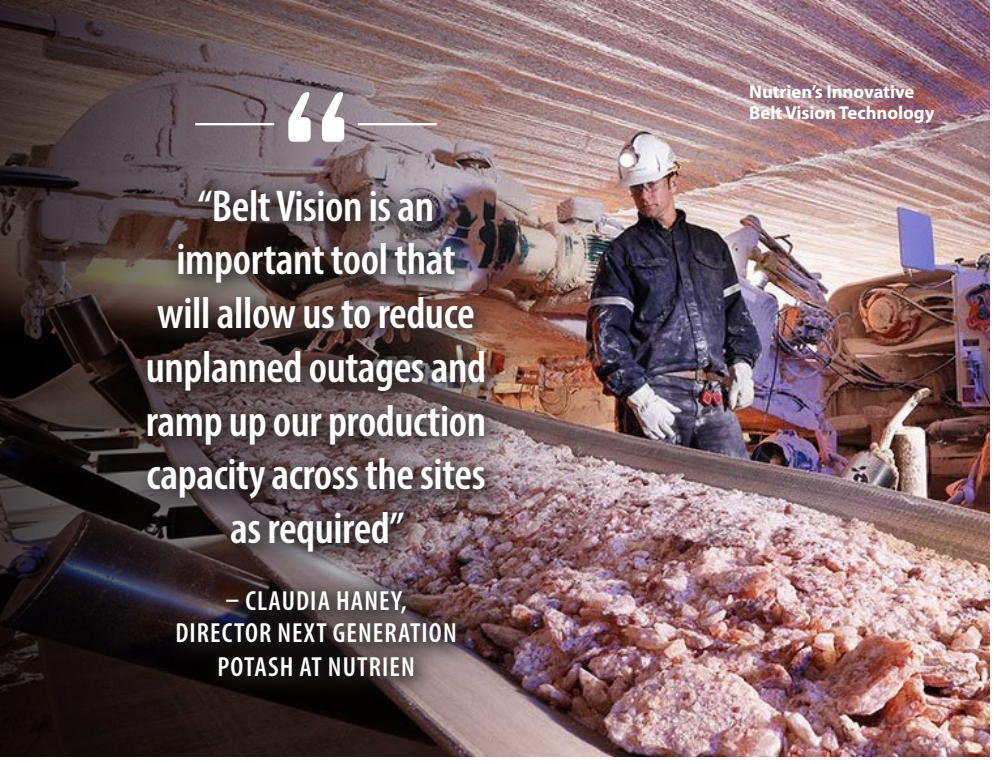
The SABRE mining method, which can be selective and scalable, uses a high-pressure water jet placed at the bottom of a drill hole to excavate a mining cavity, and air lifts the cuttings from the excavation process to the surface. "The SABRE operational team of drillers, mechanics and engineers have shown how agile this method can truly be. They demonstrated the Orano values of innovative thinking, cohesion and team spirit, revising plans to incorporate the learnings from each new drill hole," said Jim Corman, Orano Canada President and CEO.

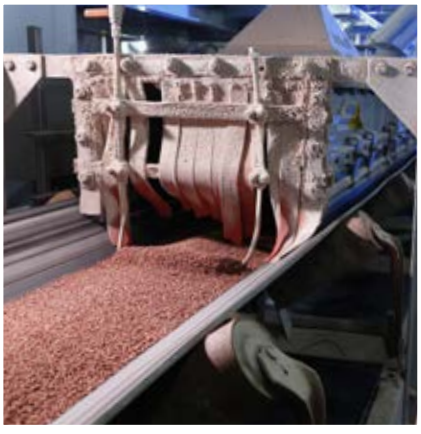
Orano Canada's McClean Lake Uranium Mill

This environmentally friendly mining method is less intrusive and offers a potentially smaller surface footprint than traditional open pit and underground mines. Its reduced water usage and power consumption also contribute to potential reductions in greenhouse gas emissions and improved sustainability, while its non-entry process minimizes radiological exposure for mine workers.

The mining industry is also making tremendous efforts and investments targeted at improving existing processes.

SABRE Drill at the McClean Lake Operation





Nutrien's Innovative Belt Vision Technology

Such is the case at Nutrien's Saskatchewan potash mines. The company recently implemented its Belt Vision technology.

Nutrien Belt Vision is the result of the collaboration started in 2019 between the company's potash production sites and its Next Generation Potash and IT teams. It addresses an issue that has plagued the industry. The mainline conveyor belts moving the ore from the borers to the hoists that bring it to surface are a significant bottleneck. The belts' mechanical splices – a series of clips that look like a zipper – that connect two pieces of belt material – are causing a significant loss of production if they rupture and cause a belt to fail.

Using a combination of existing equipment and customized artificial intelligence (AI) technology, a multi-disciplinary team created a system that monitors and analyzes the belts splices and identifies potential issues before they occur. "Thanks to this new system, we're able to significantly improve the belt maintenance process, while increasing the quality and quantity of our belt inspections considerably," said Claudia Haney, Director Next Generation Potash at Nutrien.

Beyond its success with maintenance and reliability improvements, the new Belt Vision technology also brings safety and productivity improvements. "Belt Vision is an important tool that will allow us to reduce unplanned outages and ramp up our production capacity across the sites as required," added Haney.

Belt Vision is one of the many projects the Nutrien operations network is working on as it focuses on improving safety, efficiency and reliability across the company's network of sites by leveraging digital solutions and automation. While the Belt Vision was initiated and first deployed at Nutrien's Saskatchewan operations, they are now planning to roll out similar technology at some of their Nitrogen and Phosphate facilities.

Whether mining uranium or potash, the use of best practices, the adoption of digital and AI technologies, and the continuous modernization of methods and processes is a constant for Saskatchewan miners.

Successful Feasibility Field Test of Low-Cost Uranium Mining Method

The focus on safety, efficiency and reliability is a trend across commodities. This fall Denison Mines Corp. announced a successful feasibility field test of its in-situ recovery (ISR) uranium mining method at its Wheeler River Project in northern Saskatchewan. ISR is an established mining method around the world, but it is new to northern Saskatchewan. Denison has adapted the technology to the Athabasca Basin ground conditions. With ISR, a mining solution is injected into the orebody using an injection well from surface. The uranium is dissolved "in situ," meaning in place, as the mining solution travels through the orebody. The solution carrying dissolved uranium is pumped to surface using a recovery well. The dissolved uranium is then extracted from the solution in a processing plant on surface. Finally the mining solution is returned to the injection wells for further production in a closed loop system. With this mining method, there is no open pits or major earthworks, no traditional underground workings, no tailings production, no large waste rock piles. It is a globally proven, environmentally protective, cost-effective uranium mining method that provides a safe and above-ground environment.

"The successful recovery of uranium bearing solution from Denison's high-grade Phoenix deposit is a historic moment for uranium mining in Canada. With this result, Denison has truly showcased its industry leadership in bringing the low-cost ISR mining method to the high-grade uranium deposits of the Athabasca Basin," commented David Cates, Denison's President & CEO.

PROBING THE DEPTHS

Pegmatite dyke cutting a layered metamorphic rock near Colin Lake Photographer: Svieda Ma Other Credits: Saskatchewan Geoscience Calendar 2021, Saskatchewan Geological Society

A Glimpse into the Subsurface:

Drillcore (each piece about 5 by 20 cm) extracted from 175 m below the surface during exploration for copper-zinc deposits reveals the presence of a sedimentary rock known as conglomerate.

Digging Deeper:

This conglomerate, comprising a variety of pebble- to cobble-sized rocks–or clasts–in a sandy matrix was likely deposited by a high-energy river around 500 million years ago. Many of the larger clasts exhibit an outer rim of reddish concentric rings, a feature informally known as onion skin weathering. Both the rings and the red colour (iron oxidation) resulted from prolonged exposure of the constituent rocks to atmospheric conditions at the time of deposition.

Fun Fact:

Archaeologists working in China and Pompeii have determined that onions have been part of the human diet for at least the last 7000 years.

Did You Know?

Earth's atmosphere currently contains 21% oxygen, though this was not always the case. Geological evidence indicates that a significant rise in atmospheric oxygen concentrations took place about 2.4 to 2.0 billion years ago during a period known as the Great Oxygenation Event. This drastic change led to a large extinction event that ultimately enabled the proliferation of multicellular life.

SMA EDUCATION OUTREACH PROGRAM

BUILDING BLOCKS

http://saskmining.ca/

WHO ARE WE?

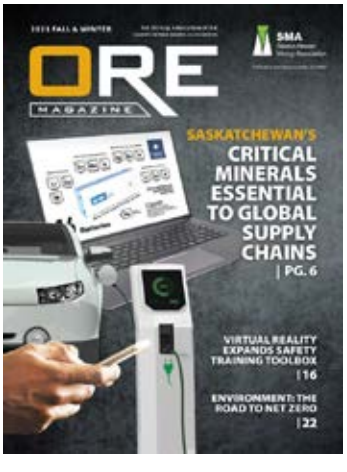
Through our **Education Outreach program**, we strive to build awareness of Saskatchewan's mineral resources through **free** resources that are **connected to the curriculum.**

Connecting with communities through workshops, career fairs & events

Educational Resources

Free Materials, Lessons & Videos!

Career Profile Cards & Poster Series

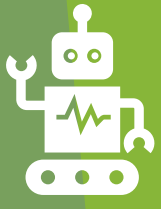


ORE Magazine

Mining Inquiry Project Storytelling as a Way of Knowing

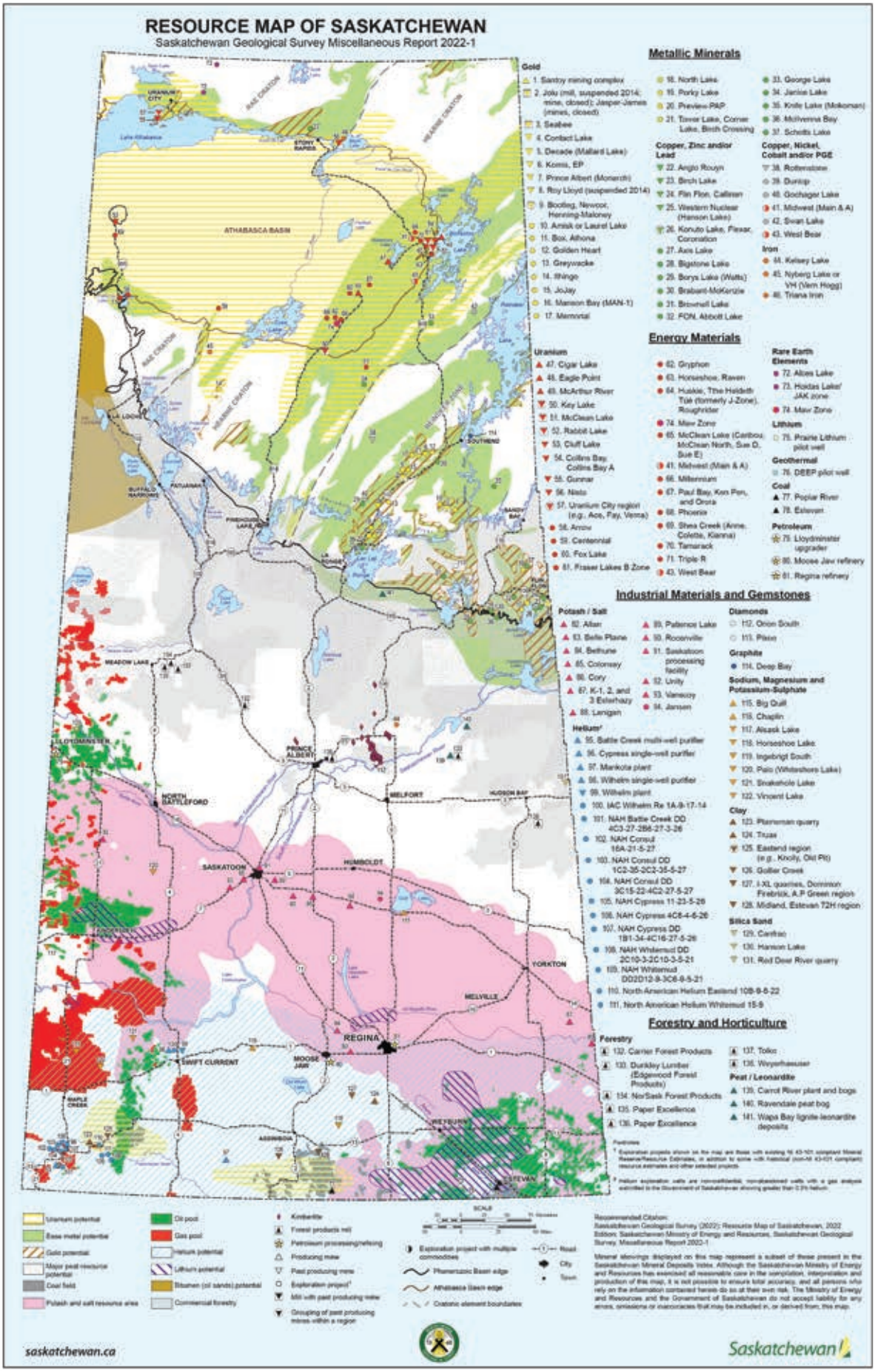
Coming Soon!

New **Poster Series**
Robotics Mining Kit
Translation into more languages
Minerals And Products **(MAP)** event in November
Another issue of **ORE** Magazine



Teachers Pay Teachers

BUILDING BLOCKS


RESOURCE MAP OF SASKATCHEWAN
Saskatchewan Geological Survey Miscellaneous Report 2022-1
Metallic Minerals
Gold
1. Sandoy mining complex
2. Joki (mill, suspended 2014; mine, closed); Jasper-James (mines, closed)
3. Seabee
4. Contact Lake
5. Decade (Mallard Lake)
6. Koms, EP
7. Prince Albert (Monarch)
8. Roy Lloyd (suspended 2014)
9. Bootleg, Nevoor, Henning-Maloney
10. Amisk or Laurel Lake
11. Box, Athona
12. Golden Heart
13. Greywacke
14. Ihlinge
15. JoJay
16. Manson Bay (MAN-1)
17. Memorial
18. North Lake
19. Porky Lake
20. Preview-PAP
21. Tonor Lake, Corner Lake, Birch Crossing
Copper, Zinc and/or Lead
22. Anglo Rouyn
23. Birch Lake
24. Flin Flon, Callinan
25. Western Nuclear (Hanson Lake)
26. Konuto Lake, Flexar, Coronation
27. Axis Lake
28. Bigstone Lake
29. Borys Lake (Watts)
30. Brabant-McKenzie
31. Brownell Lake
32. FDN, Abbott Lake
33. George Lake
34. Janice Lake
35. Knife Lake (Mokomani)
36. McIlvenna Bay
37. Schotts Lake
Copper, Nickel, Cobalt and/or PGE
38. Rottenstone
39. Dunlop
40. Gochager Lake
41. Midwest (Main & A)
42. Swan Lake
43. West Bear
Iron
44. Kelsey Lake
45. Nyberg Lake or VH (Vern Hogg)
46. Triana Iron
Energy Materials
Uranium
47. Cigar Lake
48. Eagle Point
49. McArthur River
50. Key Lake
51. McClean Lake
52. Rabbit Lake
53. Cluff Lake
54. Collins Bay, Collins Bay A
55. Gunnar
56. Nisto
57. Uranium City region (e.g., Ace, Fay, Verna)
58. Arrow
59. Centennial
60. Fox Lake
61. Fraser Lakes B Zone
62. Gryphon
63. Horseshoe, Raven
64. Huskie, Tthe Heldeth Túé (formerly J-Zone), Roughrider
74. Marr Zone
65. McClean Lake (Caribou, McClean North, Sue D, Sue E)
41. Midwest (Main & A)
66. Millennium
67. Paul Bay, Ken Pen, and Orora
68. Phoenix
69. Shea Creek (Anne, Colette, Kianna)
70. Tamarack
71. Triple-R
43. West Bear
Rare Earth Elements
72. Alces Lake
73. Hoidas Lake/ JAK zone
74. Marr Zone
Lithium
75. Prairie Lithium pilot well
Geothermal
76. DEEP pilot well
Coal
77. Poplar River
78. Estevan
Petroleum
79. Lloydminster upgrader
80. Moose Jaw refinery
81. Regina refinery
Industrial Materials and Gemstones
Potash / Salt
82. Allan
83. Belle Plaine
84. Bethune
85. Colonsay
86. Cory
87. K-1, 2, and 3 Esterhazy
88. Lanigan
89. Patience Lake
90. Rocanville
91. Saskatoon processing facility
92. Unity
93. Vanscoy
94. Jansen
Helium[1]
95. Battle Creek multi-well purifier
96. Cypress single-well purifier
97. Mankota plant
98. Wilhelm single-well purifier
99. Wilhelm plant
100. IAC Wilhelm Re 1A-9-17-14
101. NAH Battle Creek DD 4C3-27-2B6-27-3-26
102. NAH Consul 16A-21-5-27
103. NAH Consul DD 1C2-35-2C2-35-5-27
104. NAH Consul DD 3C15-22-4C2-27-5-27
105. NAH Cypress 11-23-5-26
106. NAH Cypress 4C8-4-6-26
107. NAH Cypress DD 1B1-34-4C16-27-5-26
108. NAH Whitemud DD 2C10-3-2C10-3-5-21
109. NAH Whitemud DD02D12-9-3C8-9-5-21
110. North American Helium Eastend 10B-9-8-22
111. North American Helium Whitemud 15-9
Diamonds
112. Onion South
113. Pikoo
Graphite
114. Deep Bay
Sodium, Magnesium and Potassium-Sulphate
115. Big Quill
116. Chaplin
117. Atsask Lake
118. Horseshoe Lake
119. Ingebrigt South
120. Polo (Whiteshore Lake)
121. Snakehole Lake
122. Vincent Lake
Clay
123. Plasterman quarry
124. Truax
125. Eastend region (e.g., Kholly, Old Pit)
126. Golber Creek
127. I-XL quarries, Dominion Firebrick, A.P Green region
128. Midland, Estevan T2H region
Silica Sand
129. Cantrac
130. Hanson Lake
131. Red Deer River quarry
Forestry and Horticulture
Forestry
132. Carrier Forest Products
133. Dunkley Lumber (Edgewood Forest Products)
134. NorSask Forest Products
135. Paper Excellence
136. Paper Excellence
137. Tolko
138. Weyerhaeuser
Peat / Leonardite
139. Carrot River plant and bogs
140. Ravendale peat bog
141. Wapa Bay lignite-leonardite deposits
Footnotes
[1] Exploration projects shown on the map are those with existing NI 43-101 compliant Mineral Reserve/Resource Estimates, in addition to some with historical (non-NI 43-101 compliant) resource estimates and other selected projects.
[2] Helium exploration wells are non-confidential, non-abandoned wells with a gas analysis submitted to the Government of Saskatchewan showing greater than 0.3% helium.
Uranium potential
Base metal potential
Gold potential
Major peat resource potential
Coal field
Potash and salt resource area
Oil pool
Gas pool
Helium potential
Lithium potential
Bitumen (oil sands) potential
Commercial forestry
Kimberlite
Forest products mill
Petroleum processing/refining
Producing mine
Past producing mine
Exploration project[1]
Mill with past producing mine
Grouping of past producing mines within a region
SCALE
Exploration project with multiple commodities
Phanerozoic Basin edge
Athabasca Basin edge
Cratonic element boundaries
Road
City
Town
Recommended Citation:
Saskatchewan Geological Survey (2022): Resource Map of Saskatchewan, 2022 Edition; Saskatchewan Ministry of Energy and Resources, Saskatchewan Geological Survey, Miscellaneous Report 2022-1
Mineral showings displayed on this map represent a subset of those present in the Saskatchewan Mineral Deposits Index. Although the Saskatchewan Ministry of Energy and Resources has exercised all reasonable care in the compilation, interpretation and production of this map, it is not possible to ensure total accuracy, and all persons who rely on the information contained herein do so at their own risk. The Ministry of Energy and Resources and the Government of Saskatchewan do not accept liability for any errors, omissions or inaccuracies that may be included in, or derived from, this map.
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