

**O  
R  
E**

# **URANIUM:**

## **Turning the lights on**

**THE 100,000 km<sup>2</sup> HAYSTACK**  
URANIUM EXPLORATION CONTINUES IN  
THE ATHABASCA BASIN.

**POWERING UP**  
PREDICTED URANIUM DEMAND IS  
DRIVING TODAY'S INVESTMENT.

**GEOPHYSICS**  
WHAT'S UNDER THERE?



**SPRING/SUMMER 2013**

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Drum area at McClean Lake mill.  
Photo Courtesy: AREVA

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#### COVER PHOTO

Providing clean energy for growing global markets - that is what developing Saskatchewan's uranium deposits are about. This issue of ORE predicts a bright future.

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## MINING: GREAT FOR SASKATCHEWAN BUSINESSES!

### A MESSAGE FROM SMA EXECUTIVE DIRECTOR – PAM SCHWANN

As Rider Nation gets ready for the 2013 season, this issue of ORE will provide you the “playbook” of uranium in Saskatchewan, including a lineup of the veteran and rookie players and an introduction to the Taylor Field of uranium country – the Athabasca Basin of northern Saskatchewan – home to the world’s highest grade uranium deposits.

This past year was a difficult one for many of

the players in the uranium game, particularly the junior exploration companies, as investors stayed out of the equity markets. As a result, a number of junior uranium companies are no longer “on the roster” as they merged or were acquired (M & A) last year. To those entrepreneurial individuals and companies who were part of the M & A landscape, we salute your contributions to enriching the understanding of the Athabasca Basin playing field. As we move through 2013, we look forward to new uranium production from the Cigar Lake mine, the world’s second richest uranium deposit after the McArthur River mine.

This issue of ORE will explain why the Athabasca Basin is the world’s best home

turf for uranium producers and exploration companies; identify the benefits of drafting more women onto the mining team; and provide a national perspective on Canada’s mining league.

Additional articles in this edition of ORE explore safety and environment issues. When it comes to safety, everyone must be vigilant and prepared – the underground fire at PotashCorp Rocanville in September 2012 reminds us of that, and takes readers behind the scenes as to what was happening during that event.

Operating mines in an environmentally sustainable way is also incumbent on the industry. As you will read, our member companies

are supporting research to identify the population status and trend of boreal caribou and what habitat is critical for their activities.

The Technology and Innovation article explores how geophysics uses the physical properties of rocks to discover mineral deposits and related features; our Tagging Along feature gives you insight into a day in the life of a Safety/Training Coordinator at Boundary Dam and Bienfait coal mines near Estevan; the eARTH article describes a recent addition to Moose Jaw - the “City of Murals”; and our Beyond the Bio features Michael Hogan, President PCS Potash, PotashCorp who “sails the seas” in the prairies. Welcome on board.



## A MESSAGE FROM SMA PAST PRESIDENT – DAVID NEUBURGER

make up a large portion of the northern Saskatchewan economy. Long before the term “corporate social responsibility” was used, our province’s uranium companies were leading the nation in creating employment opportunities for northerners, cultivating northern businesses, and partnering with educational institutions and government in the development of education and training programs. The success of these efforts is evident. The uranium sector is one of the largest employers of aboriginal people in Canada – almost 1,600 in 2011 or 42% of the workforce. In addition, more than \$460 million of goods and services were

procured from northern businesses in 2011 alone.

We have a great opportunity to learn from the successes of the uranium industry and to leverage these lessons to enhance aboriginal participation throughout our provincial economy.

Over the past two years, I’ve had the honour of serving Saskatchewan’s mining industry as president of the SMA. I’d like to take this opportunity to introduce Steve Fortney as the new president of the association. Steve has a long history working within the potash sector and has for many years volunteered with the SMA, both within the

potash section and on the executive committee.

It has been a sincere pleasure to share some of my thoughts and observations in these columns.

Mining ... great for Saskatchewan!

The Saskatchewan uranium mining sector, similar to other sectors of our industry, is currently experiencing strong investment in new projects and expansion or extension of existing operations.

With all operations located in the Athabasca Basin, uranium mining activities



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# URANIUM IN SASKATCHEWAN: A SUMMARY

Provided by Sask Geological Survey, Ministry of the Economy

## Glossary of terms

### Precambrian

The time in Earth's history older than 540 million years ago.

### Crystalline

Rocks formed by interlocking mineral crystal. There is very little space between adjacent crystals in this type of rock.

### Igneous

Rocks crystallized from magma that originated from deep below the Earth's surface.

### Sandstone

A rock formed when grains of sand are cemented together after they are buried in the Earth's crust. As sand grains are generally

rounded, there is commonly space between the individual grains of sand in sandstone.

### Unconformity

The contact between older rocks and younger sedimentary rocks above them. The contact is presumed to represent a time period during which no sedimentary rocks were being deposited.

### Vein

Minerals deposited into spaces in older rocks by fluids.

### Faults

Planar breaks in the Earth's crust. Movement of the rocks on either side of the breaks causes earthquakes.

## DIGGING DEEPER:

### Mineral Resource map

<http://www.economy.gov.sk.ca/mineralresourcemap>

### Exploration and Development Highlights

<http://www.economy.gov.sk.ca/sedh>

### Athabasca Basin Map

<http://www.economy.gov.sk.ca/GM2010-1>

### U working group site

<http://www.economy.gov.sk.ca/AthabascaUgroup>

Drum area at Key Lake mill. Photo Courtesy: Cameco

### What is Uranium?

Uranium (U) is the heaviest naturally occurring element (atomic weight 238.03) in the Earth's crust, typically concentrated at about three parts per million (0.0003% U). The Athabasca Basin of northern Saskatchewan contains the highest grade uranium deposits in the world; the grade at the McArthur River deposit, before mining, was about 20 per cent U. Uraninite (uranium dioxide,  $UO_2$ ) is the most common ore mineral at Saskatchewan's current uranium operations.

### What is uranium used for?

In the 21st century the primary use of uranium is generation of clean electricity as the process emits no greenhouse gases. In 2011, nuclear power was

responsible for 13.5 per cent of the electricity generated globally. Many countries rely heavily on nuclear power. For example, in 2011 nuclear power provided over 77 per cent of France's electricity and 15.3 per cent of Canada's.

### How did uranium deposits form?

Uranium hosted in *veins* and *igneous* rocks were first introduced to the *crystalline* Precambrian Shield of northern Saskatchewan between 1.95 and 1.80 billion years ago. Some of these deposits were mined at the Beaverlodge camp near Uranium City between 1953 and 1982. Subsequently, the earlier formed uranium was recycled during the deposition of sandy sediments on top of the *crystalline* rocks of

the *Precambrian* Shield between 1.75 and 1.50 billion years ago. The resulting *sandstones* were preserved in a depression in the *crystalline* rocks that is now called the Athabasca Basin. The contact between these sediments and the older, underlying *crystalline* basement rocks is referred to as an *unconformity*. The *sandstones* were saturated with fluids that scavenged and transported uranium from them and/or from the *crystalline* basement rocks beneath the *unconformity*. These uranium-bearing fluids traveled through the *sandstones* to graphite-bearing *faults* rooted in the *crystalline* basement rocks. A local chemical change caused the precipitation of uranium from the fluids, primarily as the mineral

uraninite, starting at about 1.6 billion years ago. Precipitation was typically focussed near the *unconformity* contact of the *crystalline* basement rocks and the overlying *sandstones*. The uranium deposits mined in the Athabasca Basin since 1975 are termed '*unconformity*-related deposits' and are the richest in the world.

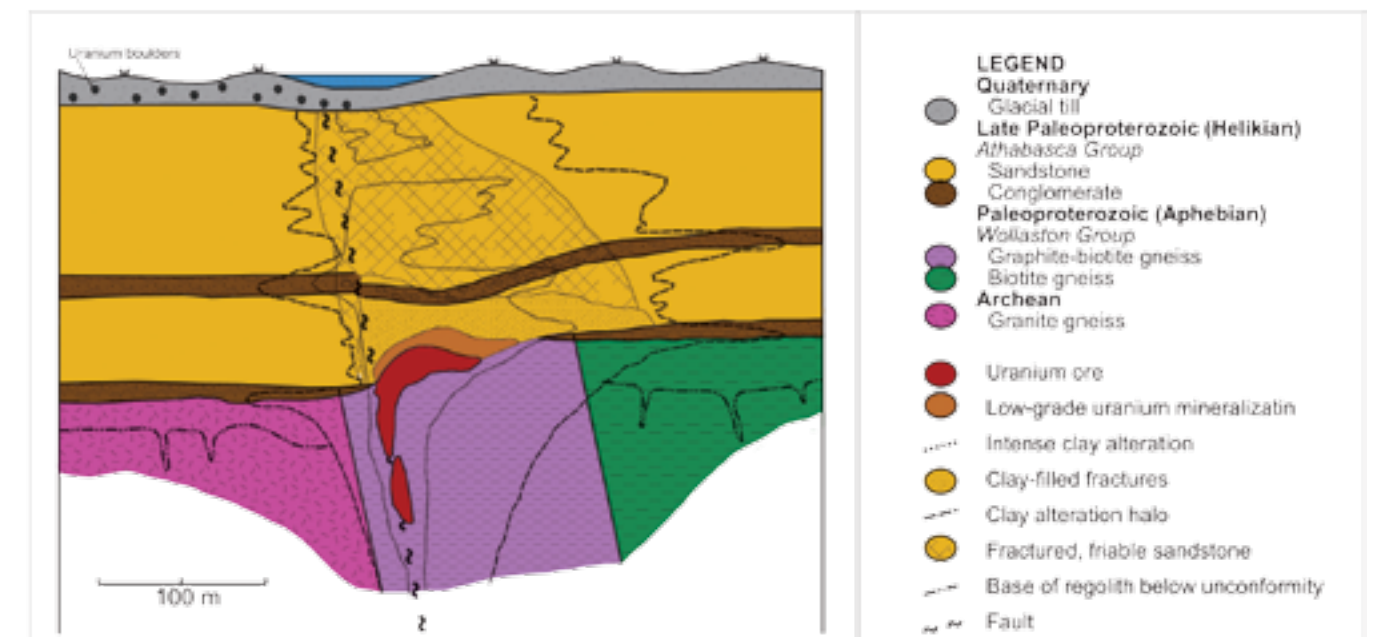
### How much uranium is there in Saskatchewan?

Canada contains about 9 per cent of the world's known recoverable uranium resources, the vast majority of which are in Saskatchewan's Athabasca Basin. Saskatchewan, which has been a continuous producer since 1953, and contributed about 17 per cent of the world's uranium in 2011, is second only to Kazakhstan.

The McArthur River mine is the world's most prolific uranium operation, producing 14 per cent of global supply. It is anticipated that the

Cigar Lake mine, set to be in production in 2013, will be the world's second largest producer by 2017, helping to ensure that Saskatchewan

remains a world leader in uranium production for the foreseeable future. ■





# THE 100,000 KM<sup>2</sup> HAYSTACK

It's not easy finding uranium, but that's not stopping mining and exploration companies in Saskatchewan's Athabasca Basin.

Starting at the Alberta border, the Athabasca basin stretches for some 100,000 km<sup>2</sup> across northern Saskatchewan. The Basin contains the world's richest known deposits of uranium ore. But how much more is up there, the "needles lying within the Precambrian haystack", ready to fuel our world with carbon-free energy for hundreds of years to come? That question is being answered, kilometre by kilometre, by the world's leading mining and exploration companies, along with junior exploration firms eager to be a player.

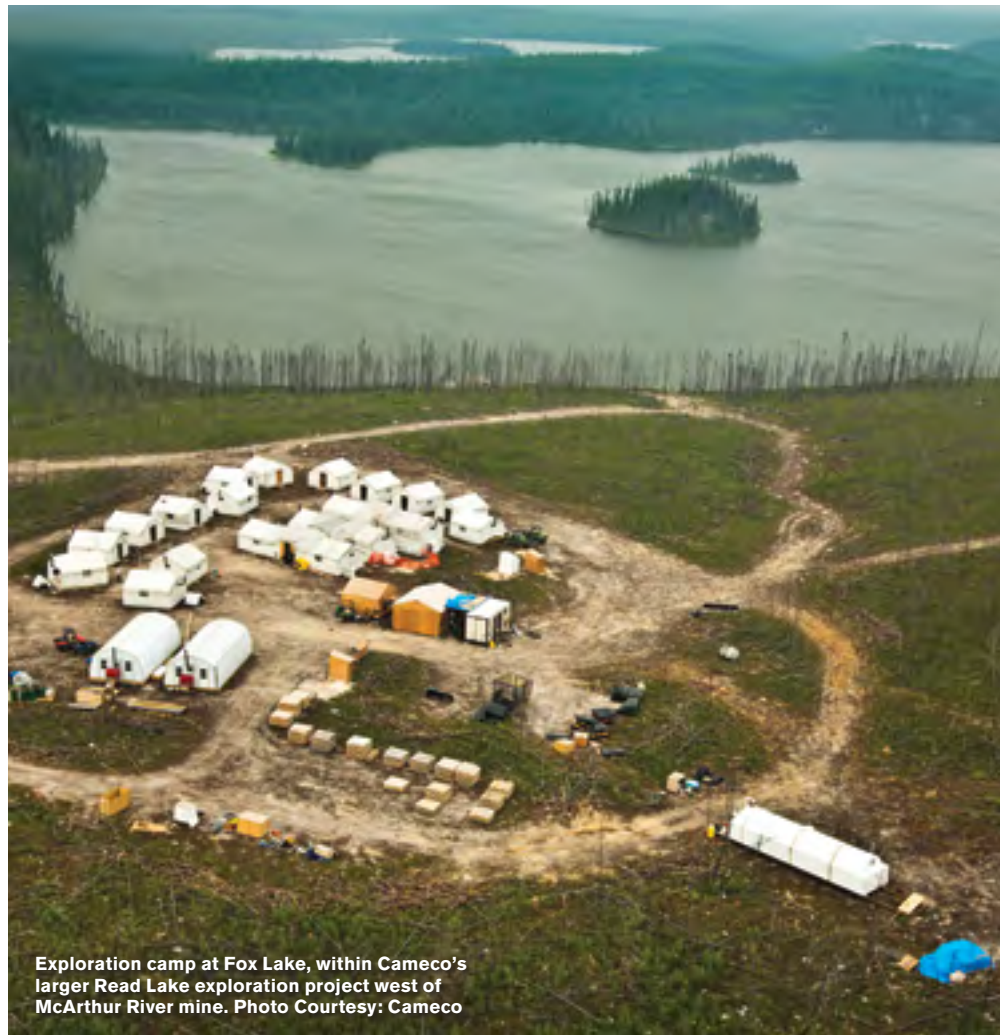
In the words of John Robbins, senior project geologist with AREVA Resources Canada, exploration is "the thrill of the chase, the sense of discovery, the future of the company." The stakes are high, and unlike oil exploration where you know where the oil reservoirs are, with uranium exploration the common term is, "You're drilling blind." Even with all the scientific advancements (see Geophysics story, p. 25), a lot of it is still luck," says Robbins' colleague, Erwin Koning, AREVA's district geologist for west Athabasca. AREVA's newest deposit was discovered

less than 100 metres from a known deposit. In western Athabasca, AREVA is focusing principally on the Shea Creek property as the majority owner and operator. The property is attractive for a number of reasons, including its fortunate position near to AREVA's now decommissioned Cluff Lake property, with a highway leading right to it. "It is a massive mineralizing system," according to Graham Thody, president and CEO of UEX Corporation, 49 per cent owners. "It has enormous potential to rival the biggest deposits in the Basin in size."

So far, AREVA's exploration team has investigated 3 km out of a possible 32 km trend, using an innovative technique called directional drilling. This process sinks one pilot hole, then directs the drill underground from that pilot hole in multiple directions resembling the spokes on a wheel. Thus, while the surface footprint has 12 drill holes, underneath at depths from 500 to 600 metres, you will find about 100 drill holes. "This is the only place in the world where you would see that kind of operation," notes

Drill rig at Shea Creek in Western Athabasca Basin. Photo Courtesy: AREVA.





Exploration camp at Fox Lake, within Cameco's larger Read Lake exploration project west of McArthur River mine. Photo Courtesy: Cameco

Craig Cutts, AREVA's director, exploration projects. "There's no major infrastructure, no big clear-cuts, and its much more environmentally friendly." On average there are 30 people on site, including about 20 subcontractors.

Eventually, Shea Creek may be an underground mine, but not for some time. "We've got major projects going on in several areas," says Cutts. In the Athabasca Basin, AREVA has an interest in several projects with known reserves including the Cigar Lake deposit (currently under development, see p. 11) and the Midwest and McClean Underground projects.

UEX has a very strong relationship with AREVA. "They have excellent personnel," says Thody. UEX itself, through its 49% ownership in Shea Creek and its 100% ownership in Hidden Bay, is involved in the largest and sixth-largest undeveloped resources in the Basin, representing over 80 million pounds of  $U_3O_8$  (uranium oxide). "Very few junior companies have developed N.I. 43-101 resources in the Basin."

AREVA's other focus with more immediate potential is McClean Lake Underground. Known as "The McClean deposits," they were the first to be identified back in the late '70s, but more attractive deposits were mined first. Today, the McClean deposits are now within a brownfield site (roughly 1.5 km from the existing open pit) which has all of the infrastructure in place, making it much more feasible for development. AREVA has all the regulatory approvals in place, but has not set a target date for mining to begin. "We need to see the market improve," says Jim Corman, vice-president of projects and operations at AREVA. "We want to process Cigar Lake's ore

first. Perhaps in another year or two, we may start mining the McClean deposits."

Besides working to get Cigar Lake into production and expanding its other mining and milling facilities (see p.11) in Saskatchewan, Cameco Corporation is sharpening its exploration focus in the province. While shrinking its global exploration budget in 2013 by 5 to 10 per cent, the company is actually spending more money in the Athabasca Basin this year than it did in 2012. Cameco's focus is on brownfield exploration near its existing McArthur River and Rabbit Lake mines with the goal to find additional high-grade, low-cost deposits where ore can be hauled to existing mills for processing, according to Darryl Clark, Cameco's vice-president exploration.

That scenario is a good description of Cameco's Millennium project, discovered in 2000, according to Bob Steane, Cameco's chief operating officer. Steane describes Millennium, located just 21 kilometres off the Key Lake-McArthur River haul road, as a project that is "in the bullpen . . . still progressing, but at a pace matched to market opportunities."

For other mining companies, including some of the world's biggest, the Basin is clearly the place to be if you are serious about adding or increasing uranium in your portfolio. Denison Mines is most excited about its Phoenix Deposit on its Wheeler River property. Exploration at Wheeler River has been going on for 30 years, so why wasn't the Phoenix Deposit discovered until 2008? "Often, people don't understand the challenges of exploration in the Athabasca Basin," explains Steve Blower, Denison's vice-president of

exploration. "We're talking about small deposits in a vast area. Phoenix A is just 380 metres long by 40 metres wide by six metres deep – and it's under 400 metres of barren sandstone." For the past two years, Denison has been doing "definition drilling" to determine the exact size, but it's worth the investment. Of the 26 properties that Denison owns in the eastern Athabasca region, about half of this year's \$14.6 million will be targeted for Phoenix. "There are very few super high-grade deposits like this in the world," says Blower. A recent mineral resource update estimates that Phoenix contains 60 million pounds of uranium.

Where there's good mineral prospects, you are sure to find Rio Tinto. The mining giant has several properties in the Basin, but the only deposit is Roughrider, purchased from Hathor Exploration in late 2011. "This year, we will have five rigs defining the deposit, as well as others in the vicinity, says Jay Fredericks, director of external relations, energy. "As a small exploration company, Hathor focused on where they found uranium. Rio Tinto has the resources to see what other deposits may be close by. It's called an 'order of magnitude study'." They will also be putting in a temporary trail of 7 km to connect the site to Hwy 907, and received regulatory approval to proceed at the beginning of this year. About 5 km of the trail already exists. Extending it will greatly reduce expenses by reducing if not eliminating the need for helicopters, and that will also make exploration safer. When the trail is no longer needed in the future, it will be reclaimed to resemble its natural state.

Roughrider is, "a great potential asset to Rio Tinto's energy portfolio," notes

Fredericks, adding that, "there are, however, still hurdles to overcome." Four of the major ones are the federal government's non-ownership policy, which needs to change before Rio Tinto can mine Roughrider; further studies to determine if indeed there are enough resources to mine; ascertaining if other factors, such as ground conditions, make mining feasible; and economic uncertainty which might move Roughrider's development further down Rio Tinto's global list of priorities. Rio Tinto is not alone in addressing the regulatory issue in particular. "We are very pleased with the support we have received from the provincial government and the Saskatchewan Mining Association," says Fredericks. "Saskatchewan is a great place to do business."

Ben Ainsworth, president of Alpha Minerals Inc., agrees with Frederick's assessment. Last November, Alpha announced a discovery at Patterson Lake which Ainsworth says, "is the most significant discovery of new mineralization in the southwest Athabasca Basin since Cluff Lake and Shea Creek." Ainsworth added that, "The departments of the provincial government that regulate and support our work have been a key reason for our continued enthusiasm for this project."

Why all this activity and massive spending on uranium exploration? To help answer that question, turn to the next feature story on uranium, "Powering Up", on p. 11. The world needs more energy, and less carbon emissions. Up in northern Saskatchewan the answers are there, as they have been for millions of years. Now, we just have to find them. ■

## What happens to our uranium ore?

The produce from Saskatchewan's mines and mills is a powdery yellow substance called "yellowcake". It's chemical name is uranium oxide ( $U_3O_8$ ). It has to undergo further processing at plants outside of Saskatchewan to finally become part of nuclear fuel rods used in the production of electricity at nuclear power plants in Ontario and throughout the world.

As the Canadian Nuclear Safety Commission points out on its website, "Canada's nuclear non-proliferation policy establishes the conditions under which Canada may engage in nuclear cooperation with selected partner countries.... Canadian nuclear materials and equipment will only go to facilities that are subject to IAEA (International Atomic Energy Agency) safeguards." In other words, Saskatchewan's uranium has only one purpose: peaceful, civil nuclear applications.



Geologist Amber Doney at the Moffat Lake drill rig near the McClean Lake operation. Photo Courtesy: AREVA





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Scoop tram in operation underground at the Cigar Lake project. Photo courtesy: Cameco

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# POWERING UP

Saskatchewan's uranium producers are investing now to meet future demand.



After the tsunami disaster in Japan and that country's announcement last September to phase out its nuclear power plants, there was a growing misconception that countries around the

world were following suit. Quite the opposite. There are 64 reactors under construction in China, the United Arab Emirates, India and the United States. "We haven't seen this much new construction since the heyday period of the late '70s and '80s," notes Bob Steane, chief operating officer of Cameco Corporation. His company is investing now to meet the anticipated

cumulative demand of some 2.2 billion pounds of uranium oxide (the raw material called "yellowcake" produced by its mines) in the coming decade; so, too, is AREVA, the other uranium producer in our province.

For both of these global leaders in the uranium industry, optimism for the long term is balanced by today's comparatively





## The Northern Commitment

According to the *Northern Socio-Economic Benefits Summary* published in 2011, close to half (47 per cent) of all workers at Saskatchewan's northern mines are from the north, with 42 per cent being of Aboriginal descent. This represented a total of \$80 million in wages paid annually to northern employees. In addition, more than \$481 million was spent on purchases/contracts with northern vendors and joint ventures. In total, over a 20 year period, \$4.3 billion had

been invested in northern wages, goods and services. This does not include the many scholarships awarded to northern students each year, or other corporate sponsorships in the region.

These benefits arise from commitments which mining companies must make in order to operate in northern Saskatchewan:

- Employment and Job Forecasting
- Employee Education and Training

- Employee Services (uranium mining commitment)
- Education Promotion ("Stay in School Program" – uranium mining commitment)
- Business Participation and Opportunity Forecasting
- Compensation to Other Impacted Traditional Lease Holders
- Community Vitality (uranium mining commitment)

- Public Involvement (uranium mining commitment)

*Note that four commitments apply to all companies, with an additional four applying to uranium mining companies.*

Performance on these commitments must be routinely reported to the provincial government, to monitor progress and measure results.

low market prices and a reduced forecast for demand in the medium term. Their resulting business strategy is to invest in expanding existing locations – called "brownfield sites" – which takes advantage of existing mines, mills and infrastructure until the market can support "greenfield" development.

Cameco sees greatest value over the short term by expanding production at its McArthur River mine, and refurbishing and expanding the Key Lake mill. Known measured and indicated reserves at McArthur increased by 19 per cent to 378.9 million pounds in 2012, and the company has completed a feasibility study that will see production increase from 18.7 to 22.0 million pounds  $U_3O_8$  annually by 2018, pending regulatory approval. McArthur River has produced more than 230 million pounds of  $U_3O_8$  from 2000 to 2012, and has sufficient reserves to sustain production until at least 2034. Cameco's Key Lake mill has set the standard in uranium milling operations

for more than 30 years. Steane is confident about its future. "I see no reason why it can't be operating for another 30 years." Throughout Cameco's operations, including its Rabbit Lake

had to overcome serious flooding problems and is now on schedule to open later this year. "By Q4, the first drum of processed Cigar Lake ore should be coming out of the McClean Lake mill and

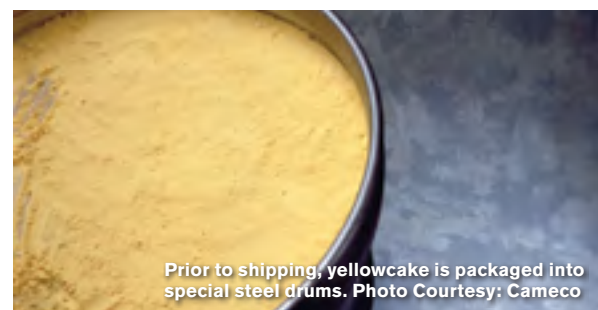
of the richest uranium ore in the world. Cigar is the key to Cameco's revised goal of 36 million pounds of total annual supply by 2018.

Cigar Lake is of keen interest to AREVA Resources Canada, who owns 37 per cent. (Cameco, as the operator, owns 50 per cent.) The ore from Cigar will be transported the 70 kms to AREVA's McClean Lake mill, which has been on standby mode for more than a year because of previous delays in the mine's development. Although the McClean Lake mill is fully capable of handling the supply from Cigar Lake when it comes rolling in this fall, AREVA has already started on a major expansion, with scheduled completion in 2016.

"This will increase the McClean mill's capacity from 12 million pounds per annum of uranium concentrate to 18 to 24 million pounds when it is finished," says Jim Corman, vice-president of operations and projects at AREVA Resources. "The final total investment will be around \$200 million." He hastens to add that AREVA is very



AREVA's McClean Lake mill in northern Saskatchewan is undergoing a major expansion. Photo Courtesy: AREVA



Prior to shipping, yellowcake is packaged into special steel drums. Photo Courtesy: Cameco

mine, improvements are in progress to ensure long-term production growth.

Cameco's top priority, though, is Cigar Lake, which

on its way to market," says Steane. To get to that point, Cameco will have invested over a billion dollars in what will be the newest mine in the province, containing some

pleased with the current technology and systems in place at McClean. "What we're trying to do is replicate circuits to increase capacity."

Increased production, however, is not the only benefit of these mine investments. The experience and commitment to best practices has multiple payoffs for all stakeholders. Bob Steane emphasizes the advancements in safety practices at Saskatchewan's mines, and the knowledge that our province's companies now have when it comes to northern mine development.

Jim Corman says another major benefit is how northern-owned businesses with a strong aboriginal representation have leveraged their relationships with AREVA and Cameco to create highly skilled companies that are now competing for contracts outside the Athabasca Basin. "We have come to know each other very well," Corman says of relationships with these contractors and subcontractors. "We trust in their ability to get the work done." ■



Cigar Lake head frame and load out area. Photo Courtesy: Cameco



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# THE REWARDS OF PRACTICING SAFETY FIRST

When a fire broke out underground at PotashCorp's Rocanville mine last September, all of the 29 miners returned to the surface unharmed within 24 hours. Ensuring that happy result, however, didn't happen overnight.

Hundreds of heavy machines; miles of infrastructure; thousands of workers; the fact is that in Saskatchewan's mines, not unlike any industrial environment, you are dealing with potential risks. It's how you deal with it that can make a huge difference, as the Rocanville incident proved so well. Through rigorous safety training programs, strict policies, and a constant drive to learn from experience and share that knowledge, today's mines exemplify an outstanding safety-first culture.

Last September 25, 2012, three large cable spools – each about 6 feet in diameter by 5 feet high and weighing 2500 kg – were being transported on skid plates to a location underground at the Rocanville mine. Transportation of materials on skid plates had been commonly used, because of the typically low 8-foot

ceilings at Rocanville which made it difficult to use wheeled flatbeds. This time, though, the transportation distance was too great, and the prolonged friction started a fire. The alarm was sounded – and the training kicked into action.

"Within thirty minutes, all the mine personnel who were working throughout the mine were in a refuge station and accounted for," says Mark Fracchia, Vice President, Safety, Health and Environment at PotashCorp. The refuge stations are very large – roughly 200 feet by 50 feet – with furniture, food, cabinets, water, first aid equipment and a phone. Cell phones don't work underground, but each of the miners was patched through on the refuge station phone to talk to their friends and family, who had already been notified when the incident



began. According to several accounts, the biggest complaint from the miners about the incident was the boredom while waiting for the all-clear. The fire had started just before 2 in the morning; the last of the miners were brought to the surface – after ensuring all was safe – at 8:30 that evening.

When the fire began, Calvin Petracek, the emergency response coordinator for the

mine, had been immediately called to the scene. Petracek arrived shortly after 2:00 a.m. "Everything went just the way we had trained for. We spend a lot of time training, so when the real thing happened, everybody knew exactly what to do."

That level of safety efficiency also protects the lives of trained first responders, who are on





In front of one of the PotashCorp Rocanville's refuge stations.  
Photo Courtesy: PotashCorp

every shift, and the mine rescue teams – including one crew that had come from Mosaic Potash at Esterhazy to help out. Because everyone had followed the right procedures, no mine rescue team member was put into a dangerous situation.

The safety procedures didn't end with the rescue of the miners. "You learn from every experience," says Fracchia. "We closely analyzed the incident to see what improvements could be made." As a result, the procedure for the use of skid plates was amended and

more areas were upgraded with additional water supply to fight fires.

The information is also shared with other companies through reports to the provincial Mine Safety Unit, and through the Saskatchewan Mining Association, particularly its safety committee (see Tagging Along, p. 35). "There's great cooperation in the mining industry when it comes to sharing best practices and first-hand knowledge," notes Fracchia. ■

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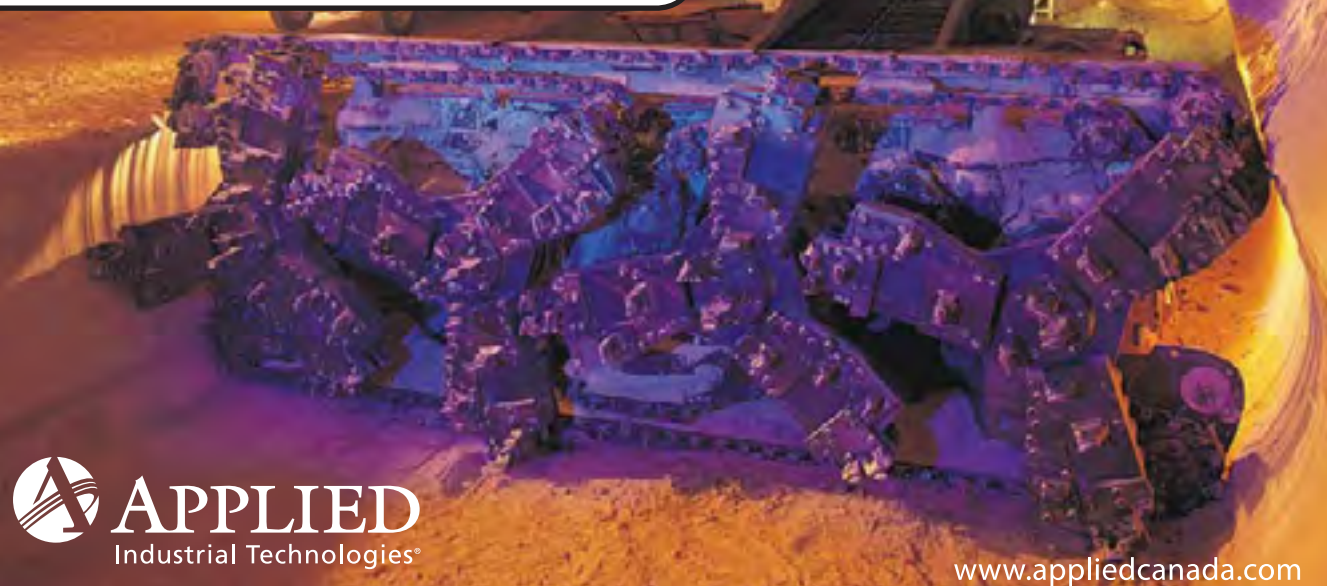
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# COUNTING WOODLAND CARIBOU

A comprehensive study planned for next year will address how caribou and northern development can both flourish in our province.

Unless you follow only sports, it would have been difficult in the past year to avoid the increasingly polarized debate in Canada over whether the country's natural resources are being developed at the expense of the environment.

One sure way of even further elevating the emotional element in this debate is to suggest an iconic Canadian animal found on the back of the Canadian quarter is at risk of disappearing from a loss of habitat. The woodland caribou, a cousin of the barren ground caribou, was identified as being "threatened" in 2002, which triggered the development by Environment Canada of a National Recovery Strategy, as required by the Species at Risk Act.

While the automatic assumption from many people is that habitat loss is the result of human activity, the issue of woodland caribou

habitat in the far north of Saskatchewan is unique compared to most areas of Canada.

Environment Canada categorized the various herds that exist across Canada and rated their chances of being self-sustaining or disappearing. Using Environment Canada's recovery model, which was based on areas of high human activity in Quebec, the woodland caribou population in any given region could survive only if 65 per cent of the animal's natural habitat were categorized as "undisturbed."

With 57 per cent of the Saskatchewan boreal shield area categorized by Environment Canada as disturbed habitat, the region appears to be a long way from meeting the criteria outlined in the national recovery strategy. In fact, less than 3 per cent of the disturbance in northern

Saskatchewan is related to human activity, including development of roads, power line corridors, mines and the footprint of northern communities.

So if not human activity, how does the far north of Saskatchewan get assessed as being 57 per cent disturbed habitat? The answer is that the vast majority of the disturbance is from natural forest fires that have occurred within the past 40 years.

Because Environment Canada included natural disturbances like fire in their model, development in northern Saskatchewan, including investment and jobs from potential new mines, may be in jeopardy.

"This is tragically ironic, as northern Saskatchewan is one of the least developed areas in all of Canada. The high level of habitat

disturbance has nothing to do with human activity and everything to do with Saskatchewan's natural forest fire history," explained Saskatchewan Mining Association executive director Pam Schwann. "That woodland caribou currently exist in northern Saskatchewan is evidence that they can exist in a landscape that has been significantly modified by fire over a very long time."

This was a point that Schwann would stress repeatedly at meetings with both federal and provincial government officials and the Saskatchewan public throughout 2011 and most of 2012 as Environment Canada worked to produce a final national recovery strategy for woodland caribou as required under Canada's Species At Risk Act (SARA).

"It was clear that if we didn't identify the shortcomings of





Fire burned areas are considered “disturbed” for 40 years in the Environment Canada model.

the draft recovery strategy to the federal government, then future development of any kind in northern Saskatchewan would have been at risk under the Environment Canada recovery strategy,” said Schwann. “This would have included new mines, but also any new roads. Even power lines would be disallowed, threatening the possibility of new hydro developments some First Nations communities are considering.”

Saskatchewan’s unique situation was acknowledged in the *Final Recovery Strategy for Woodland Caribou* that was released in October 2012. It identified the boreal shield region in Saskatchewan as an “outlier” to their model, and more information on the population status and trends of the woodland caribou in

northern Saskatchewan was required.

In response, the province has begun the urgent task of acquiring and compiling this information.

The provincial research program will begin in early 2014. Mining companies, the Saskatchewan Mining Association and SaskPower are among the partners that have committed to funding and working with the province and Environment Canada on this five-year study. It is being led by Dr. Philip McLoughlin, an expert in population ecology and associate professor in the Department of Biology at the University of Saskatchewan.

McLoughlin is excited about the scope of next year’s study which will, for the first time, attempt to establish the population trend for

woodland caribou in the boreal shield as well as learn more about natural predators (wolves and black bears) and gain more information about how caribou habitat and populations respond to high fire, but low man-made, disturbance.

“This research is being started with no assumptions for better or worse on how the caribou population is faring,” McLoughlin explained. “It is a scientific project that we hope will also be supported by other methods including aboriginal or traditional knowledge.” The research will involve ground studies, animal capture and radio collaring of caribou over a 40,000 km<sup>2</sup> area of the boreal shield region.

Questions remain as to whether the caribou recovery strategy could still impact future economic development in Saskatchewan’s north.

That’s because Environment Canada’s national recovery strategy categorizes areas burned by forest fire as disturbed habitat for 40 years, Schwann explains. If that goes unchanged, she says it will be difficult for Saskatchewan’s far north to ever see sufficient recovery to a level of 65 per cent undisturbed habitat.

“Tracking a number of these animals will help determine woodland caribou populations, identify areas of their critical habitat and better describe how the caribou are adapting to habitat that has been disturbed by fire,” Schwann concluded. “This study will better inform everyone how activities can be carried out so they mitigate risk to caribou populations and their habitat while allowing development opportunities.” ■

# A BUMPY ROAD TO A BRIGHT FUTURE

Brendan Marshall

Director, Economic Affairs, Mining Association of Canada

It was an active year for the mining industry. China’s current weaker demand for mined products as well as other global market forces sent price fluctuations through several mined commodities. The continued credit crunch adversely affected exploration prospects. Resource nationalism continued to rear its head as miners’ number one risk worldwide. These events shaped the past year in mining, and have affected forecasts for 2013. Although the industry’s outlook remains favourable over the long-term, there is no shortage of challenges to face over the coming year.

China, an enormous consumer of minerals and metals, and driver of growth in the mining sector, made headlines in March by cutting its annual growth target from 8 per cent, its goal in place since 2005, to 7.5 per cent. In October, the IMF followed suit, also reducing its growth projections for China. To put these figures in perspective: 7.5 per cent growth is still robust, and China still accounts for upward of 40 per cent of global base metal demand, compared to 5 per cent in the 1980s. If the past is the best indication of the future, then China, as a demand driver for minerals

and metals, is unlikely to run out of gas overnight.

Despite these moderately-reduced growth projections, the prices of certain key products remained buoyant, even if volatile at times. For example, iron ore prices slumped 42 per cent from a high in April to a three-year low of \$87 m/t, only to rebound to \$110 m/t in September as Chinese investors anticipated domestic stimulus measures to increase the demand for steel. Potash, though buoyant, has also descended from price peaks in recent years. Meanwhile, some speculate gold will

reach \$2000/oz in the short term while copper retains strength, both supporting multi-metallic operations across Canada.

Even with historically buoyant prices, factors beyond supply and demand played larger roles for some mined products in certain jurisdictions. The price of nickel, for example, has tripled over the last decade to \$17.7 k/t. However, when production input cost increases are factored in – such as oil and coal up 349 and 296 per cent respectively – the facts change. In Canada, when additional labour

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costs (up 26 per cent), consumer price index (up 25 per cent) and dollar value (up 56 per cent) changes over the decade are also factored in, the reality becomes clearer: high prices do not necessarily equal high profits.

In Canada, the significantly reduced availability of capital is a challenge for prospectors. Although it is also true for some majors, today's environment has been particularly demanding for junior companies. The current risk-averse sentiment among investors, linked to uncertainty about global economic strength, is likely to endure until U.S. and European economic fluctuations stabilize. This prospect is difficult for many Canadian companies, and one that may carry on for some time yet. Ambiguity over the length of global economic

uncertainty, the adverse impact this uncertainty has on the ability to raise funds, and the crucial exploration role that junior companies play, present significant challenges to the industry, especially considering the marked decline in proven and probable Canadian base metal reserves.

**"Canada has the opportunity to capitalize on a growing mining sector, even if there are some bumps on the way."**

Finally, resource nationalism remained the number one risk to miners according to Ernst & Young. Perhaps the most glaring example is Australia's July 1 Senate approval of a 30 per cent tax on iron ore

and coal mining profits – proof that no jurisdiction is immune to this phenomenon. Examples such as this are spurring mining companies to exercise heightened precautions when investing in future projects. But Canada's aggressive trade expansion has helped increase both flexibility and investment security in resource-rich

countries. Examples from 2012 include bi-lateral agreements with China, Tanzania and other strategic partners, and the Trans Pacific Partnership, whose importance and scope are

poised to surpass NAFTA. Despite concerns, particularly over Chinese growth rates, the Canadian mining sector's future is bright. Proactive measures, such as preserving Canada's attractive and stable domestic regulatory and investment environment, while enhancing international growth opportunities through bi- and multi-lateral trade expansion, provides industry working in Canada with a degree of certainty and flexibility in a volatile time. Growth, even if at a more moderately-reduced pace, is likely to remain strong over the long-term. As a country rich in mineral resources and mining talent, Canada has the opportunity to capitalize on a growing mining sector, even if there are some bumps on the way. ■

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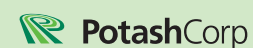
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Four small inset images showing various mining operations: a worker in a tunnel, a large rock drill, a conveyor belt system, and a worker operating equipment.



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# LOOKING INTO THE EARTH

The science of geophysics  
gives exploration teams an  
extra set of eyes.

In mining, exploration asks one principal question: "What's under there?" The answer determines not only where to mine, but also how to mine – the risks and the rewards. The answer, in large measure, comes from geophysics.

“Geophysics is used to map the earth’s subsurface through the application of remote sensing survey

techniques," explains Garnet Wood, manager, geophysics at Cameco Corporation, which has collected and trialled virtually every type of geophysical data. "Changes in geology at depth, or of the same geological feature at depth, result in variations in the physical properties of the rocks. Exploration geophysics is about mapping these changes from the air, on the earth's surface, or

from within boreholes. The properties of the rocks that we can measure include density, porosity, magnetic susceptibility, conductivity, sonic velocities, sulfide content and radioactivity." The geophysicist is responsible not only for collecting this data, but also interpreting it.

Wood goes on to explain that the major advancements in

geophysics have been in the collection of “huge volumes of high quality data, and our capability of processing that data for quicker and more accurate interpretation.”

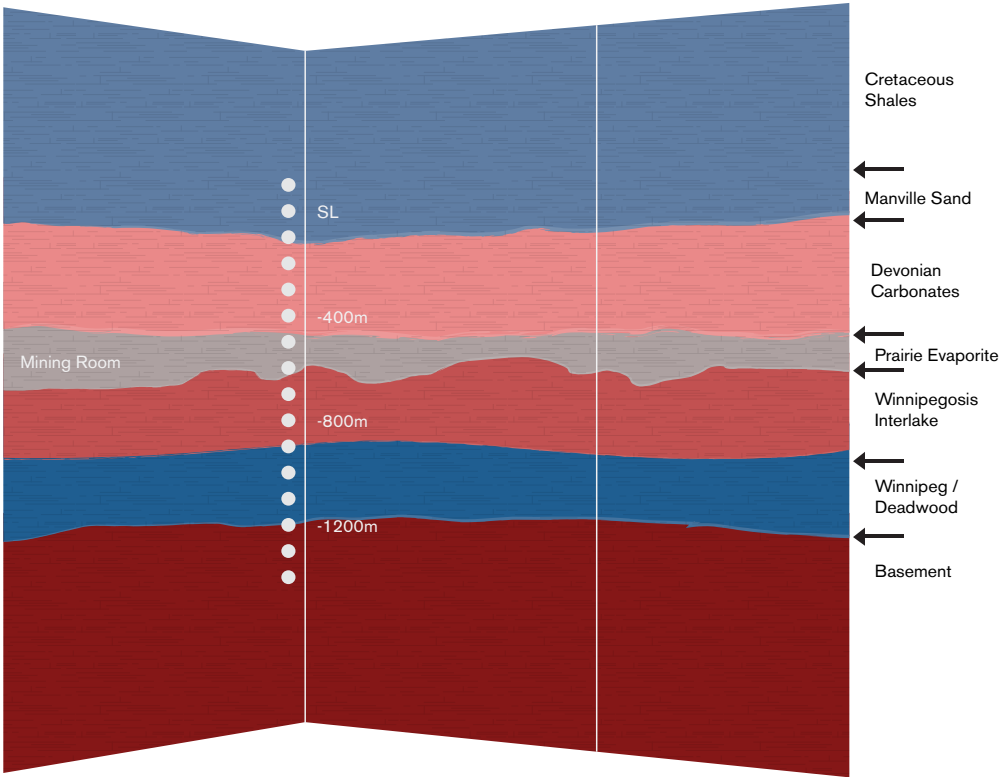
One way of collecting this data is the airborne survey. Ben Goldak, owner and president of Goldak Airborne Surveys, says this type of survey is used to get "the bigger picture."



That picture can be on a scale of hundreds of square kilometres, such as those Goldak has done in the Athabasca Basin. He specializes in radiometric mapping, which measures radiation emitted by uranium deposits, and magnetic mapping, which measures the variations that indicate mineral deposits. Other companies specialize in electromagnetic airborne surveys which require planes big enough to carry the large equipment needed to generate a signal to the ground which is bounced back and measured. The results of an airborne survey often result in a ground survey which concentrates on a particular, much smaller area.

For ground geophysical surveys on a much larger scale, you would head to the potash-rich southern and central areas of the province, where carefully controlled, strategically placed small amounts of explosives are detonated to send energy into the ground, and to record the echoes that ensue. This is the domain of seismic geophysics, which was pioneered in the oil and gas industry and is now also used extensively by the mineral industry. Craig Funk, PotashCorp's chief geophysicist, says their main purpose for seismic surveys is to identify anomalies – changes or peculiarities – and mine around them. “We don’t mine into any ground until we’ve done seismics,” says Funk.

A typical seismic survey costs millions of dollars over a year, but it’s well worth it. The 3D images produced by the echoes identify anomalies such as “collapse zones” and other problematic areas that could endanger workers, lower the grade or destroy the mine. “Seismic geophysics



A typical seismic image, showing the cross-section of a potash mine. The numerals show the depth in metres below sea-level (“SL”). A mining room is labeled. Image courtesy: PotashCorp

is extremely efficient at finding those anomalies,” says Funk. “We’ve honed the technique to the point where we can make subtle production decisions.” Funk and his team are fortunate because they don’t have to contend with shallow coal layers, such as those found in Alberta, which, “soak up the seismic waves like a sponge.” The result is some of the best seismic

images you’ll find anywhere in the world. “It’s all about the frequency you can get into the earth and the frequency you get back,” explains Funk. “The higher the frequency you get back, the better the image resolution you have.” PotashCorp is also working on ground-penetrating radar, used within the mine to guide mining operations and detect threats to people,

infrastructure and the milling process. It’s not hard to see why the geophysicist is an important member of any mining and exploration team. Considering the millions and into the billions of dollars that today’s companies invest, the pictures of the earth painted by the geophysicist are worth many times their weight in gold...and uranium...and potash...and more. ■

### Say hello to the muon

Just when some physicists thought we’d discovered it all, along comes a new particle –called the “muon” – raining down on us from our solar system. Hundreds of muons go through your head every minute, according to John Butterworth

of The Guardian newspaper, but don’t worry – they’re harmless. In fact, they’re proving to be very advantageous to human understanding. On its website, Advanced Applied Physics Solutions announced that they and their collaborator, Breakwater Resources,

have demonstrated that muon tomography can successfully identify orebodies underground. This has led to project co-funding of \$1.8 million from Western Diversification. Muons are very likely to be the newest advancement in creating 3D images of dense mineral deposits.



Mural at Mosaic Place by Grant McLaughlin. Photo courtesy: Mosaic

## eARTh The Mural at Mosaic Place

To most people in their community, Mosaic Place is known as “the home of the Moose Jaw Warriors” but thanks to the work of local artist Grant McLaughlin, as commissioned by The Mosaic Company, there’s a new, impressive mural to add to the city’s collection. Painted on a smooth solid wall approximately 16 feet by 44 feet, the mural depicts a colorful canola crop in the foreground, with a Mosaic

mine in the background. It represents the connection between agriculture and potash mining, according to Grant. “The idea was chosen from a photo, but my style makes it look more ‘painterly’ than photographic.” Grant has become one of the most prolific large mural painters in the province, and his work is prominent throughout Moose Jaw, a city that has made a tradition of

large public mural displays. “My personal work often involves themes of the prairies, people and nature, and when I can use my artistic vision to combine two passions, sculpture and painting, in an art piece, it’s a rewarding process.” Mural painting is also a challenging process. Although weather wasn’t an issue for the Mosaic Place indoor mural, timing

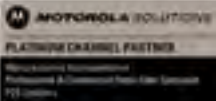
was. Construction and management decisions about the mural meant he couldn’t get started until late summer. “I did the painting over ten days, as it had be ready for the building’s opening in early September 2012.” Growing up on a farm, Grant appreciates the mural’s theme. There is also another connection: “While I was an art student many years ago, I spent a summer working at their mine.” ■

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Photo courtesy: Mosaic

# INCLUSION AND DIVERSITY IN MINING - TAKING ACTION NOW IS CRITICAL



Melanie Sturk

Director of Attraction, Retention and Transition, MiHR

As the Director of Attraction, Retention and Transition at the Mining Industry Human Resources Council and a member of the Women in Mining Canada's Board of Directors, I've had the opportunity to be part of many interesting, forward-thinking discussions and initiatives related to diversity in Canada's mining industry and the barriers that keep our sector from being inclusive.

The business case for workforce diversification is persuasive; our most recent research forecasts that the mining industry will require over 140,000 workers by 2022. Yet despite the labour shortage, women are underrepresented in all of the industry's employment opportunities, from entrance positions to leadership/senior management roles. In fact, women's employment in the mining industry (approx.

15 per cent for the past 14 years) is much lower than other sectors.

What's behind this? Sure, we can blame this on poor public perceptions, a lack of young people, or schedules that pose extreme challenges for families. But the truth is our sector does have the means to invest in change.

A 'Critical Conversations' session, that resulted in the

report *The Pathway Forward*, was held recently at Carleton University. The meeting brought together senior industry representatives to discuss challenges facing the mining industry in recruiting and retaining women, and explored strategies to address these issues. In these conversations strong commitment and support from the top was seen as essential. Suggestions included incentivizing senior

executives to appoint and promote women, and to also ensure that women are well represented on companies' executive boards and in senior executive positions.

There was also a clear recognition that multi-dimensional strategies are needed to increase women's participation. Strategies included transforming workplace culture by encouraging collaboration between men and women, creating HR policies that improve work-family balance, and promoting a positive image of the industry through careers awareness campaigns. In recognition of the size of this task, some participants suggested leadership training and mentorship programs could be helpful.

Measuring progress was also seen as important, eventually enabling industry-wide progress to be tracked. Somewhat linked to the concept of incentivizing management in promoting diversity was the idea that performance measurement scores for managers should reflect their impact on increasing diversity.

The key takeaway from all of this is that industry needs to act now. Since June 2011, I have been working with eight companies, all members of The Take Action for Diversity Network, in developing, implementing and measuring diversity and inclusion plans to literally 'change the faces of mining' at companies and sites. Leading change isn't easy, but in just a year some companies have made great strides by not only stating that inclusion is part of their corporate strategy, but also, more importantly, by taking action. A report on this work will be made available in April 2013 on [www.mihr.ca](http://www.mihr.ca) ■

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# BEYOND THE BIO

MICHAEL HOGAN  
PRESIDENT PCS POTASH

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



Being the newly-appointed president of PCS Potash can make for some long days. At 5 a.m., Mike Hogan is already in the gym, and by 6 a.m. he's usually in his office, preparing for the many aspects of running PotashCorp's mines in Saskatchewan and New Brunswick. He started his new role as of January 1, after 23 years with PotashCorp, where he has steadily advanced since beginning his career as a senior mine engineer at the Allan mine in 1989.

of the main reasons why he has been happy to stay in mining, and with PotashCorp. "It's given me the ability to grow. PCS is not too big, but it is not too small, so there

are opportunities to advance based on merit and work ethic." To Mike, though, moving up the corporate ladder does not mean moving farther away

from his days in the mine. "You have to make time to stay connected," he says. "I was at the Corey mine yesterday. You have to create the opportunities to get out of your office and into the mines and mills. That's when you can talk to people face to face – and more importantly, you get the opportunity to listen. Those are my best days."

In addition to the Saskatchewan mining industry, Mike's career

has taken him to the Arab Potash Company in Jordan, which is 28 per cent owned by PotashCorp, and to PotashCorp's operations in New Brunswick. The three years in Jordan were a "wonderful experience" for his children. "Many times I would come home after work and our home would be like the United Nations, with teenagers from around the world." The Hogans' time in New Brunswick resulted in, among other things, a passion for sailing that Mike and his wife pursue during their vacations. They have a summer home in New Brunswick, and love taking their 36-foot catamaran along the St. John River. They also have sailed with friends in the Mediterranean and Caribbean.

Mike's love of sailing and his enthusiasm for his new role as president of PCS Potash bring to mind the old saying, "Ships in a harbor are safest; but then, that's not what ships are meant for." Whether it is taking on new responsibilities in his career or sailing in new waters, to Mike, "Challenges are opportunities – opportunities to grow as an individual, and opportunities to grow the company." ■



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## TAGGING ALONG

ANITA KJERSEM  
SAFETY/TRAINING COORDINATOR  
SHERRITT COAL, BOUNDARY DAM/BIENFAIT MINE

"When I started, I had no previous knowledge of the mining industry, far less what position within it could match my skill set. I did, however, have a strong administrative background. I had worked "downtown," in sales, but look at me now – blue jeans and a hard hat!"

As safety/training coordinator, Anita Kjersem is on the highway heading to work at 6:45 in the morning. It's a 15-minute drive from her home in Estevan to her office at Boundary Dam, with the Bienfait mine just 10 minutes farther on. "I'm normally greeted by my general manager, the training supervisor, and safety advisor who start their day even earlier," says Anita. "It's an ideal time to talk with workers and

supervisors at the 7 a.m. shift change."

After checking for any accident reports, she then usually focuses on follow-up regarding any incident reports. She also monitors the results for regulatory and corporate reports. A big believer in the maxim, "If it's important, write it down," Anita uses an access database system to ensure that corrections are made and procedures followed.

In addition to reports, Anita coordinates safety training programs including orientation sessions for new workers and contractors, updating communications throughout the workplace, and rewarding safety accomplishments with incentives such as the annual safety awards banquet.

Anita has taken advantage of training opportunities offered through Sherritt, as well as other courses. Every week day evening for one year, she

made the four-hour round trip to Regina to attend a Dale Carnegie course. However, she'll tell you one of the most important qualifications for her job isn't having a course diploma – it's being well-organized, and understanding the impact of your actions and decisions on others.

She may not have known much about mining when she started, but she knows it now. "Mining has been very good to my family. My husband is a dragline

operator. Through my and my husband's employment in the mining industry, our children have benefited by summer employment, university scholarships and employment at other mine sites. It's not unusual to talk mining around the dinner table."

Her esteem for the industry is also demonstrated by her role as chair of the SMA's safety committee. She is proud of the SMA's contribution to mine safety, pointing out that close to 700 mine supervisors have already attended the Association's introductory Industrial Supervisor safety

course, with Level Two launching this year.

"Working in the safety/training field for over 20 years has opened my mind to the realities of the workplace," she concludes. "A visible characteristic in our safety culture is the willingness of workers to bring up any health and safety concern. I'd like to think this is a natural consequence of talking 'with' people about safety – not 'to' them. It is always our challenge to raise the profile of safety across the site, daily." ■

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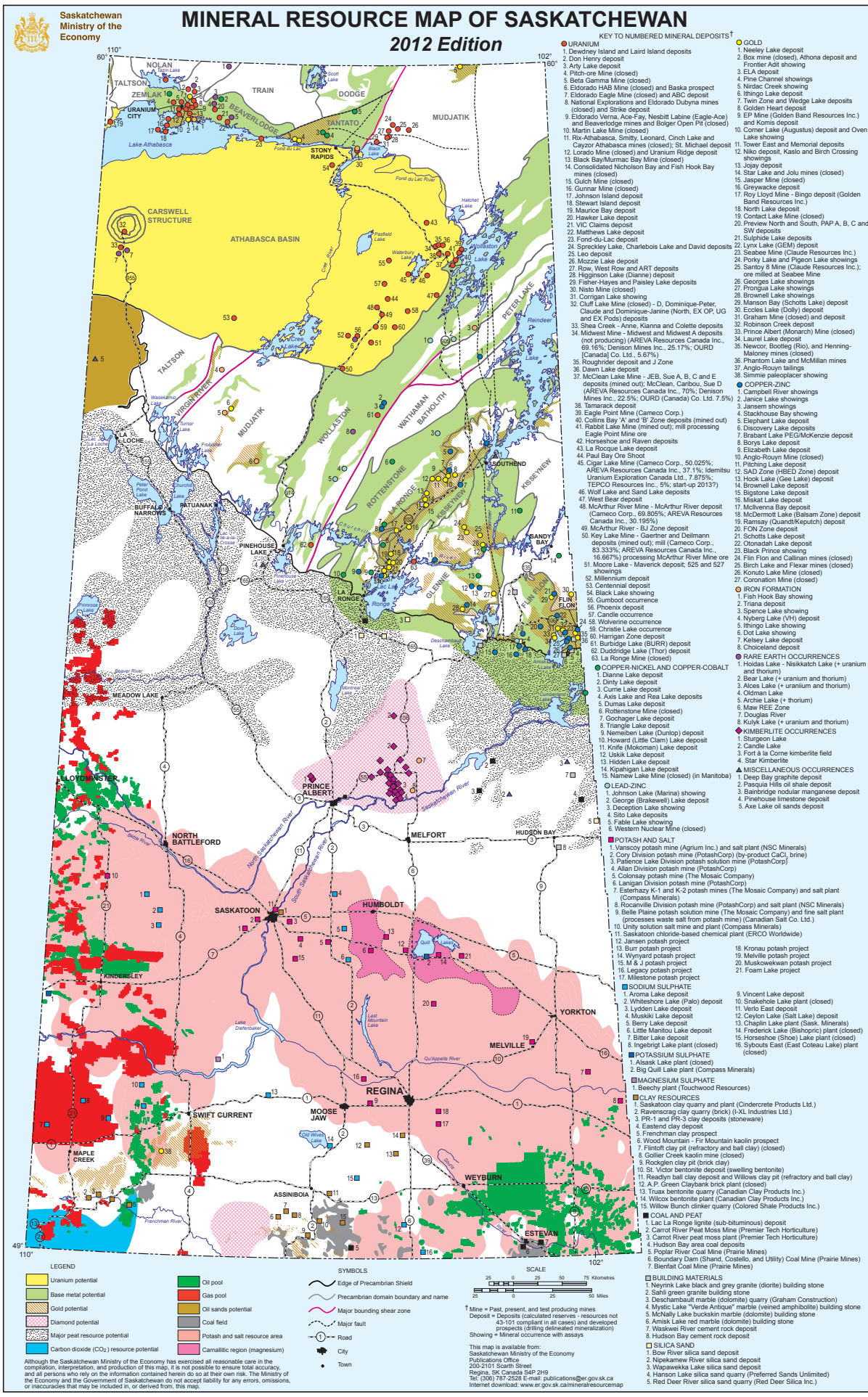
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