The background of the cover is a photograph of a mining tunnel. The tunnel walls are lined with a blue mesh netting. At the far end of the tunnel, a large piece of mining equipment, possibly a haul truck, is silhouetted against a bright light source. The floor of the tunnel is dark and reflective, showing a clear reflection of the vehicle and the light at the end. In the top right corner, there is a logo for GBR (Global Business Reports). A blue diagonal banner in the bottom right corner contains the text 'PRE-RELEASE EDITION' in white, bold, uppercase letters.

GBR

GLOBAL BUSINESS REPORTS

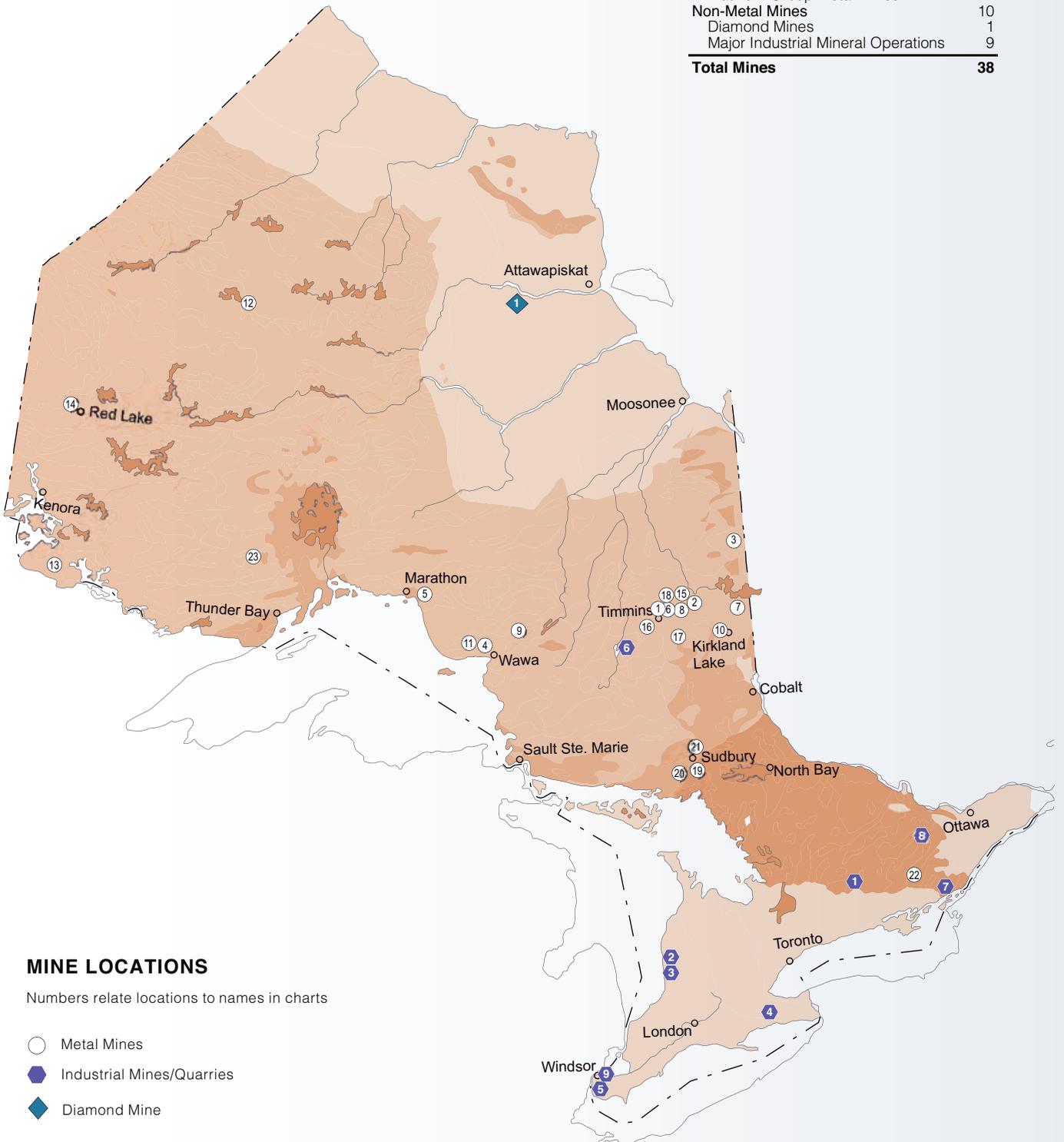
# Ontario Mining 2018

PRE-RELEASE  
EDITION

# MINING OPERATIONS MAP

## Number of Mines in Ontario

<b>Metal Mines</b>	28
Gold Mines	17
Base Metal Mines	9
Iron Mines	1
Platinum Group Metal Mines	1
<b>Non-Metal Mines</b>	10
Diamond Mines	1
Major Industrial Mineral Operations	9
<b>Total Mines</b>	<b>38</b>



## GOLD MINES

	<i>Name</i>	<i>Company</i>
1	Bell Creek Mine	Tahoe Resources Inc.
2	Black Fox Mine	McEwen Mining Inc.
3	Detour Lake Gold Mine	Detour Gold Corp.
4	Eagle River Mine	Wesdome Gold Mines Ltd.
5	Hemlo Mine	Barrick Gold Corp.
6	Hollinger Mine	Goldcorp Inc. – Porcupine Gold Mines
7	Holloway – Holt Mine	Kirkland Lake Gold Ltd.
8	Hoyle Pond Mine	Goldcorp Inc. – Porcupine Gold Mines
9	Island Gold Mine	Alamos Gold Inc.
10	Macassa Mine	Kirkland Lake Gold Ltd.
11	Mishi Gold Mine	Wesdome Gold Mines Ltd.
12	Musselwhite Mine	Goldcorp Inc.
13	Rainy River Mine	New Gold Inc.
14	Red Lake Gold Mines	Goldcorp Inc.
15	Taylor Mine	Kirkland Lake Gold Ltd.
16	Timmins West Mine	Tahoe Resources Inc.
17	Young – Davidson Mine	Alamos Gold Inc.

## BASE METAL MINES

18	Kidd Creek Mine	Glencore PLC
19	Sudbury Operations: Morrison Mine	KGHM International Ltd.
20	Sudbury Operations: Coleman Mine Copper Cliff North Mine Creighton Mine Garson Mine Totten Mine	Vale S.A.
21	Sudbury Operations: Nickel Rim South Mine Fraser Mine	Glencore PLC

## IRON MINES

22	Tomclid Iron Mine	Ferromin Inc.
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## PLATINUM GROUP METAL MINES

23	Lac des Iles Mine	North American Palladium Ltd.
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## DIAMOND MINES

1	Victor Diamond Mine	De Beers Canada Inc.
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## MAJOR INDUSTRIAL MINERAL OPERATIONS

1	Blue Mountain Operations (nepheline syenite)	Unimin Canada Ltd.
2	Goderich Brine Field (salt)	Compass Minerals Canada Corp.
3	Goderich Mine (salt)	Compass Minerals Canada Corp.
4	Hagersville Mine (gypsum)	CGC Inc.
5	Ojibway Mine (salt)	K+S Windsor Salt Ltd.
6	Penhorwood Mine (talc)	Imerys Talc
7	St. Lawrence Mine (wollastonite)	Canadian Wollastonite
8	Tatlock Quarry (calcium carbonate)	OMYA Canada Inc.
9	Windsor Brine Field (salt)	K+S Windsor Salt Ltd.



GLOBAL BUSINESS REPORTS

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## Ontario Mining 2018 Pre-Release

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## Dear Readers,

Global Business Reports is delighted to be back in Ontario, to provide a first-hand account of the current mining landscape in Canada's largest mineral producing province. In this edition of our report, GBR investigates the latest developments across the full value chain, from the service and supply hub in Sudbury, to the financial institutions, junior explorers and mining producers in Toronto that anchor the global mining industry. GBR's research team is stationed in Ontario for three months, conducting face-to-face interviews with the key decision makers throughout the industry to provide a holistic view of Ontario's current business environment.

As the global mining industry continues on its path of recovery after a downturn that spanned half a decade, Ontario, as Canada's largest producer of commodities with C\$9.9 billion of mineral production in 2017, is primed to take advantage as optimism returns. However, the financing has not flooded back to all sectors of the industry, with cannabis, cryptocurrencies and blockchain dominating the attention of the Canadian stock exchanges as junior mining companies struggle to attract investment.

In the face of this new competition, and on the back of a downturn that forced the industry to focus on increasing efficiency and productivity, an innovative ecosystem of institutions, SMEs and OEMs are producing cutting-edge technologies that will fundamentally change the global mining industry in the coming years. Innovation, so often a buzzword without basis in a conservative industry, is finally becoming a priority for mining companies, with technologies being introduced to create safer working environments, and reach deposits that were previously not commercially viable.

As major mining projects come to the end of their mine life, the impending need for significant new discoveries has heightened the senses of the junior mining community, intensifying exploration in areas such as the Red Lake Gold Camp. The global reach of Ontario's mining industry also sees Toronto-based mining companies exploring a variety of foreign jurisdictions in search of the next world-class deposit.

This Pre-release is a snapshot of the research conducted so far for GBR's Ontario series, ahead of our final Ontario Mining 2019 report, to be released in March 2019 at PDAC. We would like to thank all our interviewees that have taken the time to provide their insights into the market. To all our readers, we always welcome your feedback or interest in being interviewed; please feel free to contact us at [elisa@gbreports.com](mailto:elisa@gbreports.com)

A palpable sense of positivity has returned to Ontario, one of the preeminent global mining jurisdictions, and the following pages are an illustration that the tide has turned as we enter the next upswing.

## Enjoy the read!

Elisa L. Iannacone  
Project Director  
Global Business Reports



Elisa L. Iannacone



Ben Cherrington



Sofia Messina

# The Financial Climate for Mining in Ontario

*The Toronto stock exchanges and financial district: the investment engine of global mining*

Toronto is the financial heartbeat of the mining industry, spearheaded by the Toronto Stock Exchange (TSX) and TSX Venture, which accounted for 59% of all global mining financings in 2017. Almost 56 billion mining shares were traded in 2017, with a total value of C\$206 billion, and there was tangible evidence of renewed investor confidence, illustrated by one of the largest mining IPOs in TSX's 165 year-history, as Nexa Resources raised over C\$730 million in Q4.

There are currently four ways companies can list on the Toronto stock exchanges: Capital Pool Company programs (CPCs), IPOs, dual listings and reverse takeovers (RTOs). Since the introduction and success of the CPCs, the Special Purpose Acquisition Companies (SPACs) was introduced – the TSX version of the CPC shell concept.

The CPC program introduces experienced investors to entrepreneurs whose growth and development-stage companies require capital and public company management expertise. Different to a traditional IPO, the CPC program enables seasoned directors and officers to form a Capital Pool Company with no commercial operations and no assets other than cash, list it on TSX Venture Exchange, and raise capital. The CPC then uses these funds to seek out an investment opportunity in a growing business. Dean McPherson, head of business development and global mining at the TMX Group, expanded on the benefits of the CPCs: “The Capital Pool Company program (CPCs) has been a huge success for TSX, with 2,464 created since the start of the program, 87% of which have completed qualifying transactions. Currently, we have 78 CPCs trading on TSXV.”

*“There is still money to be found in the mining sector – a healthy ecosystem relies on junior exploration and entrepreneurship – but the traditional models of raising funding through the institutional and retail markets have really suffered, and juniors need to be creative in the way they source investments.”*

**-Christian Kargl-Simard,  
president, CEO and  
director,  
Adventus Zinc**



Dean pointed to the qualifying transaction made by Brazilian based company Sigma Lithium in May 2018, as a recent example of this alternative way to list.

The return to dual listings was another indicator of the global upswing: “Companies listed on the LSE or the ASX are looking to our Exchanges to access over US\$20 trillion in investor capital,” continued McPherson, who added: “The last time we saw any significant IPO activity was 2012, so there is a general enthusiasm returning to the marketplace.”



# Dean McPherson

Head, Business Development,  
Global Mining,  
TMX Group



## **59% of the global mining financings took place on the Toronto Stock Exchange and TSX Venture Exchange in 2017. What trends can we expect to see within the resources sector in 2018/2019?**

TMX Group's equity markets, Toronto Stock Exchange (TSX) and TSX Venture Exchange (TSXV), are global leaders in the mining sector. In 2017, we saw a return of confidence within the industry, with tangible evidence. Q4 brought us one of the largest mining IPOs in TSX's 165 year history, with over C\$730 million raised by Nexa Resources, a Brazilian company with a dual listing on the NYSE. Two other significant IPOs, Ero Copper and Titan Mining, also took place last year, in addition to the 10 we saw on TSXV.

Another indicator of the global upswing was the return to dual listings, where companies listed on the LSE or the ASX are looking to our Exchanges to access over C\$20 trillion in investor capital. The last time we saw any significant IPO activity was 2012, so there is a general enthusiasm returning to the marketplace.

## **How has your partnership with the Santiago Exchange Venture strengthened relationships with Latin America over the past few years?**

The relationship with SEV certainly continues to strengthen, and second to Canada, LATAM is our strongest market in terms of concentration of companies listed. Although our ties were always strong, the JV showed our commitment to developing capital markets in the region. Companies in Europe and Asia are constantly approaching us to explore the possibility of creating a similar model.

As the social aspect of mining becomes more important, it will be advantageous when communities can start acquiring ownership of mining companies existing within their society. There is intrinsic value in trying to build liquidity within our local market and by leveraging our expertise and our regulatory systems to encourage the development of capital markets in other countries. We are currently looking at ways in which we can expand and market the SEV JV.

## **What role are CPCs currently playing in helping juniors raise capital and what other models can juniors use to go public?**

The Capital Pool Company program (CPCs) has been a huge success for TSX, with 2,464 created since the start of the program, 87% of which have completed qualifying transactions. Currently, we have 78 CPCs trading on TSXV. We encourage the CPC as an alternative way to list and recently saw Sigma Lithium do a qualifying transaction to list via the CPC route. Today, CPCs represent one of four paths companies can use to list on our Exchanges. The alternatives are IPOs, dual listings, and reverse takeovers (RTOs). Since the CPC success, we have introduced Special Purpose Acquisition Companies (SPACs), which are the CPC shell concept, but on TSX. These options give us a unique advantage compared to our competitors.

## **Are mining companies actively looking to other forms of financing for their projects, such as royalty deals? What trends can we see in junior IPOs at the moment?**

We have seen many royalty deals take place in the junior space, but it varies. The closer companies are to production and development, the easier it becomes to attract investors. The general sentiment is that the uptick in mining financing has been slower for the junior sector given that new sectors, such as cannabis and blockchain, have caused a distraction and taken some of the risk capital out of the marketplace. Many juniors are feeling that stress and as a result, are looking at alternate financing more aggressively.

## **Do you have a final message for GBR's global investor readership?**

Canada is one of the world's best jurisdictions for mining with Ontario as a leading province in the sector. There is a very knowledgeable investor pool in Canada, from institutional to the retail level. The risk appetite tends to be stronger than most as Canadian investors are not afraid – we know mining, we understand the risk.

The TSX and TSXV have been complemented by the rise of the Canadian Securities Exchange (CSE), which announced that the first half of 2018 was the strongest six-month period in its history, with significant increases in number of listings, trading volume and value traded compared to the same period in 2017. Juniors such as Argo Gold have benefited from the cost and efficiency of the CSE as an alternative to the main exchanges for earlier-stage explorers that require quick liquidity.

Canada's FTS (Flow-Through Share) program, introduced by the federal government in 1972, is a tax driven structure that allows an individual or corporation to invest in a Canadian exploration company and receive the tax benefit from those expenses being spent on the ground for exploration. Rubicon Minerals utilized the FTS program to raise C\$10M in March 2017, and C\$10M in February 2018, to help fund exploration for their Phoenix gold project at the Red Lake Camp in north-western Ontario.

If the Toronto stock exchanges provide the platform for junior mining companies to raise capital, it is the financial service institutions in the city that orchestrate the transactions. Companies such as IBK Capital, Sprott Asset Management, Franco-Nevada, Dundee Corporation, and Mackie Research Capital, all headquartered in Toronto, provide the backbone of the financial district that anchors both the Canadian economy and the global mining industry.

In September 2018, on the back of Great Bear Resources' high grade gold discovery at the Red Lake Camp, IBK Capital brokered a C\$10 million private placement for the Vancouver-based junior, that included C\$6 million of financing from Rob McEwen and McEwen Mining, who will collectively own 18.8% of Great Bear Resources on a partially diluted basis. Citing the transaction as an example of the market revival, Michael White, president and CEO of IBK Capital, is confident that the tide has turned, reflecting: "The public markets for mining and metals have gone through a period of contraction, but we see that coming to end and heading into a bull market."

### THE RISE AND INFLUENCE OF CANNABIS, CRYPTOCURRENCIES AND BLOCKCHAIN

Despite the renewed sense of optimism surrounding the investment climate for mining, the competition for funding has become fiercer than ever, with the seismic impact of three new industries – cannabis, cryptocurrencies, and blockchain. Since cryptocurrencies peaked in January 2018, digital assets have crashed, losing around US\$600 billion in less than nine months.

Cannabis, however, has gone from strength to strength, exemplified by the US\$3.8 billion investment made by Fortune 500 alcoholic beverage company Constellation Brands in Canadian cannabis company Canopy Growth in August 2018. Canopy Growth, founded in 2014, already boasts a market cap comparable to Barrick, highlighting the scale of the impact the cannabis industry has made.

Pat Dubreuil, president of Ontario-based junior Manitou Gold, which announced a C\$1.4 million equity financing in August 2018 following its 25% acquisition of the Goudreau-Lochalsh deformation zone (GLDZ belt) in 2017, believes it is a matter of time before investors come back to the commodity market. However, he is under no

illusions as to where the attentions of the market are currently focused: "During a recent TSX course I attended, around 80% of the 250 people attending were from new cannabis companies to be listed on the stock exchange."

Dean McPherson echoed this sentiment: "The uptick in mining financing has been slower for the junior sector given that new sectors, such as cannabis and blockchain, have caused a distraction and taken some of the risk capital out of the marketplace."

Executive vice president of IBK Capital, Adam Schatzker, sees the capital created by cannabis, cryptocurrencies and blockchain companies as an opportunity rather than a distraction, recognizing: "Mining is notoriously cyclical, and can actually benefit from the great wealth being created from these new industries... Years ago the dot-com boom took investment away from the mining sector, which was later reinvested into juniors when equity metal market conditions improved."

Denis Frawley, founding partner of Toronto law firm Ormston List Frawley LLP, likened the cannabis boom to a magnet, pulling in capital, focus and talent. He suggested that rather than trying to compete with the momentum of this new industry, junior mining companies should present themselves as attractive options for the investment of the vast amount of new wealth being created, explaining: "Investors will want to diversify their holdings, and many of them here in Toronto have deep knowledge and expertise in the mining industry, so will be open to interesting opportunities."

The image shows a graphic for IBK Capital Corp. At the top, the IBK Capital Corp. logo is displayed in white text on a blue background with a world map. Below this is a white rectangular box containing the Great Bear Resources logo (a bear paw print) and the text "GREAT BEAR RESOURCES" and "TSX.V: GBR". The central focus is the amount "\$10,000,000" in large, bold, black font, with "Units of Common Shares and Warrants" written below it. Further down, it states "The Undersigned Acted as Agent to Great Bear Resources Ltd." and "IBK Capital Corp." followed by the date "September 2018". Below the white box, a blue banner contains the text: "IBK Capital is proud to be financial advisor to Great Bear Resources and its high-grade gold discovery in the world class Red Lake gold camp". At the bottom of the graphic, another blue banner provides the address: "130 King Street West, Suite 640, Toronto, Ontario Canada M5X 1E4 +1 416 360 4505 www.ibkcapital.com".

In the midst of the changing environment for funding, juniors are having to become innovative in their approach. Christian Kargl-Simard, the former investment banker turned president, CEO and director of Adventus Zinc, a public junior mining company backed by two major royalty companies and two private equity groups, managed to raise capital through a hybrid financial model. When asked about the current investment climate for juniors, he underlined the necessity to think outside the box: “There is still money to be found in the mining sector – a healthy ecosystem relies on junior exploration and entrepreneurship – but the traditional models of raising funding through the institutional and retail markets have really suffered, and juniors need to be creative in the way they source investments”.

#### RECRUITMENT IN THE UPSWING: THE SCRAMBLE FOR TALENT AND PUSH FOR DIVERSITY

Even during the downturn, from the end

of the ‘super cycle’ in 2012 until early 2017, there were over 1,000 unfilled jobs in Canadian mining operations, as the sector struggled to attract quality talent regardless of the commodity cycle, according to Chris Stafford, president of executive search company C.J. Stafford & Associates. Chris has been recruiting for the mining industry since 1981, and warned that the mining sector recovery, in the wake of retiring baby boomers, will pose a new set of challenges: “Mining Industry Human Resources Council (MiHR) predicts that over the next 10 years, 88,000 new workers will be needed to make up for 50,000 retirement exits, alongside other shortages.”

Chris went on to note that the MiHR prediction was merely the baseline estimate, and considering current industry trends and forecasts, in an expansionary economic scenario, that figure could rise to 130,000: “The shortage is real and will continue to plague the industry unless it broadens its scope for hiring,” he said, suggesting that mining companies should

embrace diversity, and spend more time with schools garnering the interest of students early in their education, as Cominco had previously practiced to great effect.

The Canadian Institute of Mining (CIM) was one of the first industry associations to have a Diversity and Inclusion Advisory Committee, and intends to lead by example to support the push for diversity. CIM president elect, Roy Slack, is part of a leadership team that includes Janice Zinck, Angela Hamlyn, and Samantha Espley, a GM at Vale. Roy emphasized the importance of CIM’s Mining 4 Society (M4S) initiative, put in place to enhance awareness of mining and increase mineral literacy. Rather than focusing on just recruitment, the M4S initiative aims to nurture a better public understanding of the sector: “Mining is essential for the quality of life we have today and our industry has made advances in terms of safety, environmental stewardship and working with Indigenous peoples”.

NORCAT, the non-profit organization based in Sudbury, won the De Beers Canada Indigenous Partnership Award in 2018. Don Duval, CEO at NORCAT, noted that many mines in Ontario are located in areas with a high population of Indigenous peoples, and the growing skilled labor shortage can act as a catalyst for meaningful career opportunities: “NORCAT has made a strong, very deliberate effort to partner with various First Nations to identify opportunities to deliver training and development programs to prepare them for jobs in companies that are operating in their communities”.

Neil Novak, president and CEO of BWR Exploration, and former VP Corporate and Aboriginal Affairs for Noront Resources, when quizzed on the status of the planned all-season access road into the Ring of Fire, underlined the importance of involving the indigenous peoples through all stages of a project. Concluding that development can be beneficial for all parties, he added: “It provides more cost-effective access to this exciting area for all exploration and development companies, while providing better service to the affected communities as needed for their sustainable growth.”

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# Production and Exploration in Ontario

*Mining players across the province try to extend mine-life through brownfield expansions*

As the largest producer in Canada of gold, platinum group metals, and nickel, and the second largest producer of copper, Ontario led all Canadian jurisdictions in mineral production in 2017. Political stability, mining tradition, infrastructure, proximity to the financial markets and the relative ease to find skilled labor, all contribute to a favorable mining environment that ensures continuous production, regardless of the commodity cycle.

Nevertheless, high labor costs, social sensitivities and bureaucratic hurdles from a federal and provincial level, make it challenging to move projects forward and transition from exploration to production. Stephen Roman, chairman, president and CEO of Harte Gold, lamented the ever-increasing permitting requirements: “The new Ontario Mining Act of 2013 was a major blow to exploration and development due to punitive new rules. For instance, to permit our bulk sample took three years.”

**GOLD PRICE EVOLUTION**

Source: APMEX



*“Gold is going higher. Gold shares are very attractively priced relative to the broad equity market. It’s time to buy gold and gold shares.”*

**-Rob McEwen,  
chief owner and chairman,  
McEwen Mining**

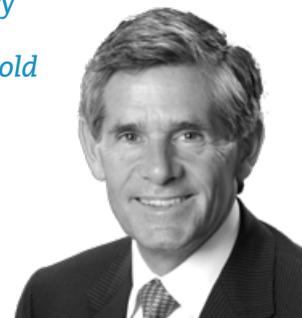


IMAGE: Courtesy of Cementation

A dearth of new greenfield deposits in Canada, combined with the impact of the downcycle and mineral prices that have still yet to fully recover, has forced mining companies to focus on the development of brownfield projects.

Glencore’s Kidd operation in Timmins, the deepest base metal mine in the world with a maximum depth of almost 10,000 feet, celebrated its 50th year of production in 2016, and recently extended its life-of-mine (LOM) expectancy to early 2022. Glencore also announced it will move ahead with the C\$700-million Onaping Depth project in Sudbury, and expects to reach full production at the deposit, located 2,500 metres beneath the Craig mine in Onaping, by 2025.

In March 2018, Vale announced it will spend C\$760 million over the next four years to expand its historic Copper Cliff operation in Sudbury. With six mines, a mill, a smelter, a refinery and nearly 4,000 employees, Copper Cliff is one of the largest integrated mining complexes in the world. Vale says it is doubling its exploration budget in the Greater Sudbury Area to C\$42 million.

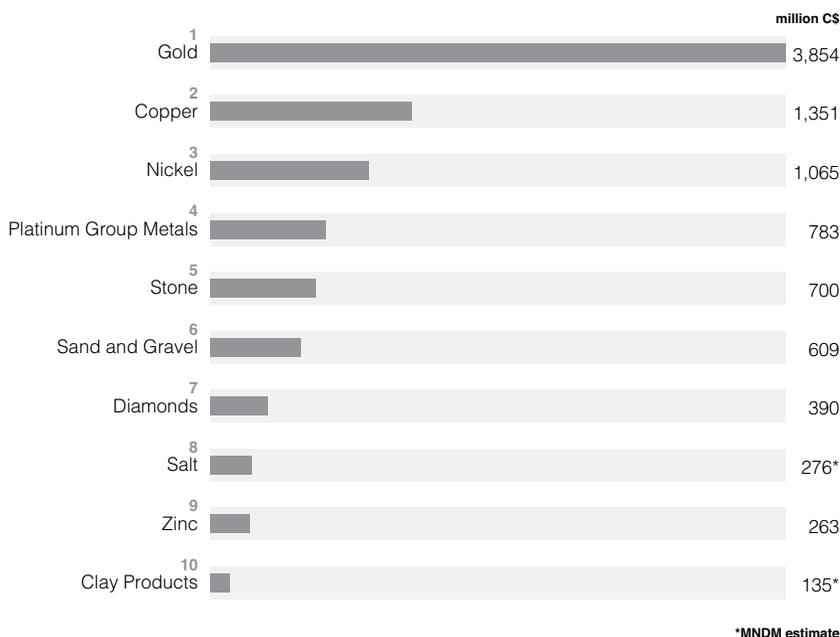
De Beers, the world’s leading diamond company, 85%-owned by Anglo American, announced it will not extend the life of Ontario’s first diamond mine, the Victor mine located in the James Bay Lowlands of northern Ontario. Mining and processing activities are due to be completed in Q1 2019, before moving into the formal closure phase. De Beers will have contributed C\$6.7 billion cumulative GDP impact for Ontario during the life of the Victor mine.

Barrick’s Hemlo project, located 350km west of Thunder Bay, has been in operation continuously for more than 30 years, producing more than 21 million oz of gold. Production is due to raise from 196,000 oz in 2017 to 200,000-220,000 oz in 2018. However, the open pit section of the mine is due to operate until 2021, with the focus then shifting completely to the underground operation.

Over the past century the Timmins area has produced more gold than any mining camp in Canada. The Black Fox project,

### ONTARIO’S TOP 10 MINERALS IN 2017

Source: Natural Resources Canada & MNDM



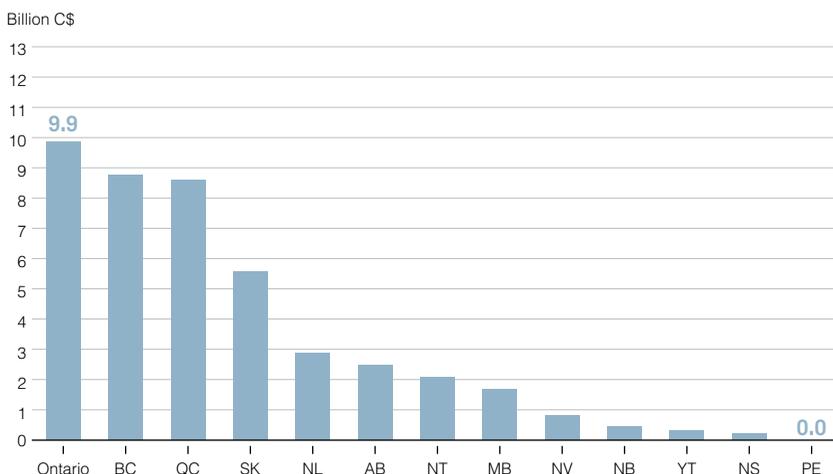
that has produced a total of 972,000 oz of gold since commercial production began in 1989, was acquired by McEwen Mining in October 2017. Rob McEwen, chairman and CEO of McEwen Mining, expanded on the potential of the project, which sits on what is known as the ‘Golden Highway’: “Our 2018 Exploration budget at Black Fox is C\$15 million. To date, the drill results have been most encouraging. Not only

have we identified numerous new zones of mineralization on the property, we are also seeing a continuation of the mineralization to depth in the mine. Our exploration program has increased our resource ounces and the grade.”

The Black Fox mine has a production guidance of 48,000 oz gold equivalent (AuEq) for 2018, with an indicated resource of 1,349,000 oz AuEq. While gold has not

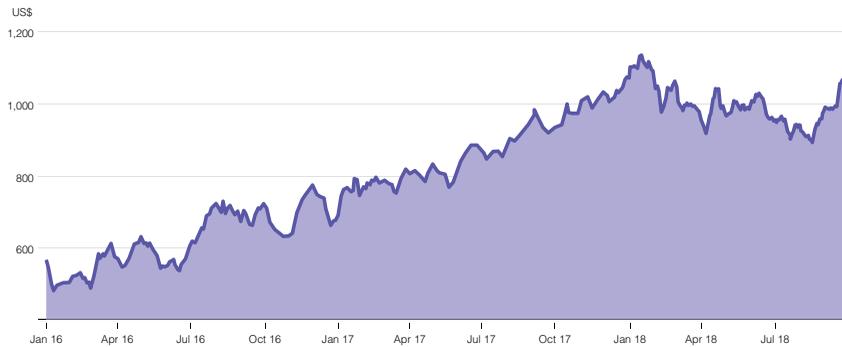
### VALUE OF CANADA’S MINERAL PRODUCTION IN 2017

Source: Natural Resources Canada & MNDM



**PALLADIUM PRICE EVOLUTION**

Source: APIMEX



performed as strongly as many analysts predicted at the start of 2018, Rob McEwen is bullish about its fundamentals: “Gold is going higher. Gold shares are very attractively priced relative to the broad equity market. It’s time to buy gold and gold shares,” he said.

Palladium is a precious metal with industrial qualities, with 80% of its consumption coming from auto sales. With demand being driven up by the move from diesel to petrol and hybrid vehicles, and producers in South Africa scaling down operations and announcing cutbacks due to the decreasing price of platinum, of which palladium is often a by-product, the price of palladium has doubled from its low of US\$473/oz in January 2016, to around US\$980/oz in September 2018.

North American Palladium (NAP) advertises itself as the only pure play palladium producer, after Stillwater Mining was bought out by Sibayne Gold. Re-capitalized in 2015 when Brookfield Asset Management (BAM) acquired 92% of the business, NAP is now focusing on its single producing asset, the Lac des Iles mine north of Thunder Bay, Ontario. The site is currently processing over 6,000 mt/d, with the intention to double capacity to 12,000 mt/d in 2019, and NAP has managed to reduce its underground mining costs to less than C\$40 per tonne delivered to surface. Jim Gallagher, president and CEO of NAP, revealed that the move to a variation of sub-level cave mining called sublevel shrinkage mining (‘SLS’), has been a catalyst for NAPs change in fortunes: “Due

to this change in method, we are now able to go back to the upper part of the mine which was historically mined out, but now provides an economically viable resource.”

**EXPLORATION: THE HUNT FOR THE NEXT WORLD CLASS DEPOSIT**

As impending mine closures for the major players approach, the eyes of the

junior community are widening with an acute sense that new greenfield projects of substantial proportions and quality will have to be found, or acquired, in the near future. In a tier one jurisdiction with little threat of political instability halting production, the prospect of a high-grade discovery in Ontario is tantalizing for all involved in the industry.

One of the juniors making the transition from explorer to producer is Harte Gold, whose Sugar Zone property in White River Ontario is located between a number of producing gold mines, including the Barrick’s Hemlo operation. Harte Gold has signed a deal with Barrick to mill a 70,000-mt bulk sample and permit and build Ontario’s newest gold mine and milling facilities. Stephen Roman, chairman, president and CEO of Harte Gold, is in confident mood: “When I took over, we had a market cap of C\$1 million. Now we have a C\$250 million market capitalization with strong growth potential.”

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Stephen expects the project to revitalize the White River region, employing hundreds of people.

The Red Lake Gold Camp, northern Ontario, is home to Goldcorp's Red Lake mine, one of the largest gold camps in Canada and the world. It is also the location of a hive of exploration activity, as a variety of juniors jostle for a share of the spoils in a district that has produced over 29 million oz of gold since 1949.

Vancouver-based junior Great Bear Resources (GBR) caused a stir in the Canadian mining community in August 2018, when results of their high grade gold discovery in the famous Red Lake Camp in Ontario included 16.35 meters of 26.91 g/mt gold and 7 meters of 44.47 g/mt gold. Since the announcement of the drill results at the Dixie project hinge zone, GBR's share price rose from C\$0.50 to C\$1.80 in less than a month.

Toronto-based investment banking firm, IBK Capital, orchestrated a C\$10 million private placement for GBR on August 24th 2018, which included a C\$4.8 million investment from Rob McEwen. Michael White, president and CEO of IBK Capital, is bullish about the potential of the discovery: "A high-grade deposit of this size,



**ONTARIO'S NEWEST HIGH GRADE GOLD MINE**

- Commercial production target: Q4 2018
- Located in a historically prolific gold mining region
- District scale potential: 83,000 hectare land package

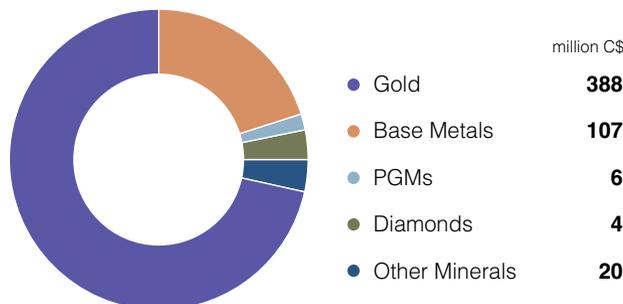
[www.hartegold.com](http://www.hartegold.com) TSX: HRT | FRANKFURT: H40





### EXPLORATION SPENDING IN ONTARIO BY MINERAL IN 2017

Source: Natural Resources Canada & MNDM



concentrated in a near vertical shoot or hinge, is straight-forward to mine, and such a discovery could easily trade through C\$1 billion dollars in value," he proclaimed.

Another junior with lofty aspirations – to become Canada's next iconic gold company – is Pure Gold Mining (PGM). Like GBR, PGM has also acquired land at the Red Lake Camp, assembling 100% ownership of over 47 square kilometers of contiguous patented mining claims. Its Madsen mine asset has produced 2.5 million oz of gold, making it the second largest historic gold producer in Red Lake. Darin Labrenz, CEO of PGM, reflected on the quality of the Madsen asset: "There is a global scarcity of quality projects. Pure Gold Mining has one of them, sitting in a strong, stable mining jurisdiction, that has witnessed over 100 years of mining activity." Madsen contains a current indicated resource of 1.74 million ounces gold (6.24 million tonnes grading 8.7 g/mt Au, at a 4g/mt

*"Based on the results announced in August 2018, in addition to what we know about the Red Lake camp, it [Great Bear Resource's discovery] could become a multi-million-ounce deposit. A high-grade deposit of this size, concentrated in a near-surface, vertical shoot or hinge, is straight-forward to mine, and such a discovery could trade through C\$1 billion dollars in value"*

**-Michael White,  
president and CEO,  
IBK Capital**





IMAGE: Courtesy of McEwen Mining

cut-off), and an inferred resource of 296,000 ounces gold (1.16 million tonnes grading 7.9 g/mt Au, at 4 g/mt cut-off). The PEA from September 2017 gave a production estimate of 911,000 oz of gold during a mine life of 14 years, an after-tax net present value (at a 5% discount rate) of C\$258 million, and an internal rate of return of 47% with a 2.8 year payback of initial capital.

The third junior vying for success at the Red Lake Camp is Rubicon Minerals. A former producer, Rubicon successfully came through a CCAA bankruptcy protection process in late 2016, raising C\$45 million while in bankruptcy protection. Utilizing the Flow-Through Share (FTS) program, Rubicon managed to raise C\$10 million more in March 2017, and another C\$10M in February 2018. George Ogilvie, president and CEO of Rubicon, detailed the infrastructure at the Phoenix gold project, and the tax advantages Rubicon's context offers its shareholders: "Rubicon has mine infrastructure which is fully built, permitted, with a working mill, tailings pond, a 200-man camp on-site, and with the benefit of C\$687 million worth of tax-loss pools. If the Phoenix gold project went to commercial production, we would defer paying taxes on any profits, and the tax-loss pools could also be advantageous if we were to look at M&A activity at a later stage."

George pointed to the personal investment he made of C\$650,000 into Rubicon Minerals as tangible evidence of his belief in the project.

Continuing the theme of juniors focusing exploration on gold-rich, past producing areas, Manitou Gold are also following the

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adage that ‘the best place to find a new mine is in the shadow of an old mine’. Their acquisition of 25% of the Goudreau-Lochalsh deformation zone (GLDZ belt) came in two separate transactions: the purchase of four mining patents in 2017, consisting of over 160 acres of unexplored land – adjacent to the past producing Edwards and Cline mines, followed by the purchase of Argo Gold’s RockStar property, totalling in excess of 7,000 acres, in April 2018.

The Western 10 kilometers of the belt, representing around 50% of the GLDZ belt, is completely owned by Alamos Gold – who acquired the Island gold mine in November 2017 through their takeover of Richmond Mines for just under US\$1 billion. Pat Dubreuil, president of Manitou Gold, sees Alamos Gold’s success as an indication of the potential for world-class deposits in the GLDZ belt: “Alamos Gold’s exploration activity is quickly proving up 2 million ounces of defined reserves in the area. They have been consistently producing 100,000 oz of gold per year and have become one of the lowest cost producers in Ontario.”

#### CANADIAN EXPLORATION BEYOND ONTARIO

Toronto is renowned for the global reach of its mining industry,

but is also home to a number of junior companies with domestic operations in other Canadian provinces. Some of the provinces outside of Ontario, while serving up logistical challenges, offer the benefit of under-explored land that often comes at a cheaper premium.

In late 2016, Black Widow Resources rebranded to BWR Exploration, shifting its attention away from Ring of Fire targets in Ontario and towards the Little Stull Lake gold project in Manitoba, which was acquired from Puma Exploration. Neil Novak, president and CEO of BWR Exploration, expanded on the reasoning behind the change of direction: “We targeted projects that have historical resources on them and that needed further exploration to bring them along the exploration cycle from historical resource to a maiden compliant resource.”

In 1990, Westmin Resources completed an internal resource estimate on the project, estimating 250,000 oz of gold within 750,000 tonnes of material with a grade of 10.6 g/mt in the West Zone. The rest of the 6.2 kilometer strike length hosted four other mineralized gold zones with less dense drilling. Neil intends to prove this area of NE Manitoba, adjacent to the Ontario border, is an emerging gold camp of high potential: “The aim is to work over a few years with definition and delineation drilling to approach the 1 million-ounce range,” he said.

Anaconda Mining is not a typical junior mining company, producing an average of 15,000 to 16,000 oz of gold per year, which translates to an average of C\$20 million to C\$25 million in revenue. The Point Rouse project in Newfoundland, Anaconda’s flagship asset, has been under development and in operation for ten years, with mill capacity to process 13,000 to 14,000 tonnes of ore per day (mt/d). Dustin Angelo, president and CEO of Anaconda Mining, divulged on the next steps for the advanced-stage junior: “We are in the transition to move to our Stog’er Tight mine, and recently found another discovery, Argyle, located approximately four and a half miles from our mill.”

One of the benefits of mining in Nunavut, the northernmost Canadian territory, is the amount of land potentially available to explorers. Aston Bay is the 100% owner of the one-million-acre Aston Bay property on Somerset Island, Nunavut, situated high in the Canadian Arctic. Aston Bay is exploring areas that have similar geology to the Central African Copper Belt and Teck’s successful past-producing Polaris Zn-Pb mine. Thomas Ullrich, president and CEO of Aston Bay, believes there are very few places in the world that contain geologic conditions that allow for these types of deposit: “The mineralogy, zonation, grade and structural setting for both Storm Copper and Seal Zinc are similar to sediment-hosted copper deposits such as Kamoakakula as found in the Congo, as well as zinc deposits such as Polaris, located just 200km to the north.”

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IMAGE: Courtesy of Torex Gold

# Global Reach

## *Ontario mining's international presence*

Canada is home to 75% of the world's mining companies, many of which will never have an operation in the country. The TSX and TSXV, financial cornerstones of the mining industry, support a network of junior and mid-tier mining companies plying their trade in over 100 jurisdictions worldwide. Attracted by underexplored regions with high-grade mineralization and lower wage costs, Toronto is home to a plethora of companies attempting to reap the benefits, and navigate the challenges, that mining in foreign jurisdictions presents.

Dundee Precious Metals (DPM), with current operations in Namibia and Bulgaria, and exploration in Armenia, Bulgaria and Serbia, epitomizes the global reach of mining companies based in Toronto. Rick Howes, president and CEO of DPM, adheres to a philosophy that respects cultural nuances when operating in foreign jurisdictions: "Whenever you operate abroad, it is important to remember you are a guest in that country. We must be respectful of culture and traditions, without imposing foreign ways of doing business."

Praising the transparency of the Namibian government and the support it has given its mining industry by creating a regulatory

framework that works for the sector, Rick suggested that modern mining practices can sometimes be applied with more ease in less developed jurisdictions: "The countries DPM operates in are sometimes more open to adopting Industry 4.0 mechanisms than some of the more established Western countries. Governments are open to new technologies and want to increase social responsibility," he affirmed.

Mining in Mongolia accounts for over 10% of its GDP, half of its industrial production, and 40% of export earnings. The Oyu Tolgoi mining project, a JV between Turquoise Hill Resources (a majority-owned subsidiary of Rio Tinto) and the Mongolian Government, is the largest financial undertaking in Mongolia's history. A Foreign Investment Promotion and Protection Agreement (FIPA) was signed between Canada and Mongolia in September 2016, and in 2017, Mongolian private company Steppe Gold, with head offices in Toronto and Ulaanbaatar, was the first company to sign an MOU with the government for their Gold-2 program.

Founded in 2016, Steppe Gold acquired the ATO project from Centerra Gold, with the intention to grow the company through other acquisitions. In July 2018, Steppe Gold went public and



# Growth and innovation

Dundee Precious Metals operates an innovative gold mine in Bulgaria as well as a specialty smelter in Namibia. We are also nearing the opening of a second high grade gold mine in Bulgaria, the first to be built in 40 years. This, along with continued progress on our Timok gold project in Serbia, creates an exciting growth profile for our company.



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*“Whenever you operate abroad, it is important to remember you are a guest in that country. We must be respectful of culture and traditions, without imposing foreign ways of doing business.”*

**-Rick Howes,  
president and CEO,  
Dundee Precious Metals**



raised C\$25 million with an IPO on the main board of the TSX. Aneel Waraich, director and executive president of Steppe Gold, expanded on their immediate priorities: “The aim is to have the mine fully built and start production by Q1 2019. The ATO Project will provide an estimated 37,000 oz AuEq/year, at US\$333/oz cash costs from oxides.” When asked about Steppe Gold’s longer-term ambitions, Aneel declared: “To become Mongolia’s largest mid-tier gold and mineral producer.”

In Latin America, Canadian miners are the most influential foreign group within the region’s mining sector. Supported by bilateral trade agreements, institutions such as chambers of commerce, and a shared deep-rooted mining tradition, many of the mining producers and junior explorers active in Latin America are headquartered in Canada’s two major mining hubs – Toronto and Vancouver.

McEwen Mining has operations in two Latin American jurisdictions: open-pit gold and silver production and exploration at the El Gallo Complex in Mexico’s Sinaloa State; and the underground San José mine, held in partnership with Hochschild Mining, located

*“The Oyu Tolgoi Underground Project is the most recent example of Jacobs’ continual involvement in developing and delivering the world’s largest and most complex underground mines, from South America to Australia, Africa and now, central Asia.”*

**-Jeremy Okolisan,  
vice president business  
development,  
Jacobs**





IMAGE: Courtesy of Steppe Gold

20km north of Goldcorp's Cerro Negro project in Santa Cruz, Argentina. McEwen Mining is also the 100% owner of the Los Azules advanced-stage porphyry copper exploration project in San Juan, Argentina, one of the world's largest undeveloped high-grade open pit copper projects, with a 10.2 billion lb indicated copper resource. Rob McEwen, president and CEO of McEwen Mining, expanded on his plans for Los Azules: "Currently, access to Los Azules due to high mountain passes & multiple river crossings is restricted to 5 months of

the year. We're working on developing a route that will give us year-round access. This will transform the economics of the deposit. This route will be largely below the snow line and provide a low altitude power corridor to the project."

Also active in Mexico is Torex Gold Resources (TGR), which came into production in 2016 with an U\$800 million investment. TGR is the 100% owner of the Morelos gold property, an area of 29,000 hectares in the Guerrero Gold Belt, located 180 km southwest of Mexico

City. In April 2018, TGR overcame an illegal blockade at their El Limón Guajes (ELG) mining complex that had lasted six months. Crediting the resistance of the local community who rallied against the blockaders, Fred Stanford, president and CEO of TGR, elaborated on one of the biggest challenges faced by Mexican miners: "Blockades such as this shut down Mexican mines for up to ten years. However, we were up and running again in 10 weeks, and still continued partial operations despite the blockade."

# MONGOLIA'S NEXT GOLD AND SILVER PRODUCER

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TGR are developing their own innovative solutions to drive down costs and increase efficiency at their ELG operation. These include a 1.3km long conveyor belt which generates its own energy, the Calix Filtration Plant – the biggest filtration plant in the world which uses dry stack calix, and Muckahi mining technology, which Fred Stanford has been developing for years, and Torex Gold will be testing in Q1 2019. The Muckahi monorail conveyor system utilizes a slusher and transports the ore body continuously, requiring a drift half the size of the large trucks currently in use. Fred believes the Muckahi technology is a game-changing innovation that can dramatically improve productivity: “The aim is to reduce the time necessary for the mining and transportation of the ore body to one third of the current time,” he stated.

For many years Ecuador remained relatively underexplored, particularly in comparison to its Andean neighbour, Peru.

However, the Ecuadorian government has started to support its burgeoning mining sector, with gradual improvements to the fiscal policy to attract direct investment, culminating in the complete removal of the windfall tax in August 2018. The government has also decreased royalties on mining projects and granted automatic approval of up to 40 exploration drill pads for any new mineral concessions issued. Glenn Mullan, president of PDAC, noted how Ecuador has garnered the attention of the global mining community: “At PDAC 2018, a day was dedicated to presentations on Ecuadorian geological case studies, showcasing the potential of the region to significant foreign investors.”

Christian Kargl-Simard, president, director and CEO of Adventus Zinc Corporation (AZC), was given a global mandate to find the next world-class base metal deposit, with a particular focus on zinc. Backed by two major royalty companies and two private equity groups, AZC spent one year looking extensively at over



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*“The aim [of Muckahi technology] is to reduce the time necessary for the mining and transportation of the ore body to one third of the current time.”*



**-Fred Stanford,  
president and CEO,  
Torex Gold Resources**

220 zinc related opportunities globally, which was whittled down to a shortlist of six opportunities. Of these six projects, AZC executed on its Ecuadorian target, the high-grade copper-gold-zinc Curipamba project, in partnership with Salazar Resources, providing AZC with first-mover advantage in Ecuador for making new discoveries. “We strongly believe that the best bang-for-your-buck in exploration right now is in Ecuador,” declared Christian, before expanding on the reasoning behind investing in the Curipamba project: “The Curipamba project fits all of our M&A objectives. We were looking for an existing 10 million tonne resource that was already economic and with the potential to at least double in size. In addition, the transaction structure supports a rate of return (ROR) much greater than 15% with long-term prices, including the cost to acquire the asset,” he said. Further north, Colombia is also attracting significant attention. Newmont Mining, the world’s second largest gold producer, acquired 19.9% of Vancouver-based gold junior Orosur Mining in September 2018, with the view to increase its shareholding to 75% in Orosur’s Anzá project. However, the mining industry in Colombia has not received widespread governmental support, with the ban of mining activities in the so-called páramos ecosystems being a particular blow. On top of this, some regions have suffered from artisanal mining and violence, and the mining community was rocked on August 26th 2018, when police confirmed that five workers were murdered in a gold mine in the town of Tumeremo, in the southern state of Bolívar. Antioquia Gold, a Toronto-based junior whose Guaico mine sits 55km northeast of Medellin, has not experienced any safety

issues at their operations, citing the favorable location of its flagship Cisneros project: “Infrastructure, access and safety are superb, especially because we have several players in the area, such as Anglo Gold Ashanti, B2Gold, Red Eagle, Colombian Mines, Arturus Ventures and CuOro,” said Gonzalo de Losada, president and CEO of Antioquia Gold.

In the same vein as Torex Gold, Antioquia Gold is introducing innovative technology to improve productivity. Gonzalo elaborated on the ‘ore sorting’ process, which works with a sensor-based machine that identifies which rocks have mineralized material: “High-speed air machines selectively blow on the pieces with a higher gold content, separating them from the rest. This process is completed through color and density sensors that can detect sulfites, which are associated with gold and are denser than the rest of the material.” Gonzalo expects the ore sorting technology to be fully implemented in Q1 2019.

A promotional graphic for Torex Gold Resources Inc. featuring the Muckahi Mining System. The graphic has a dark background with a central circular image showing a mining site with a large yellow excavator. Text elements include the Torex Gold logo at the top, the headline "A high-quality, long-life gold asset Led by a proven team that embraces technical innovation", the Muckahi Mining System logo at the bottom, and contact information for the Exchange Tower in Toronto. The website www.torexgold.com is also listed.

# Mining Innovation

## *Disrupting the Industry*

On September 12th 2018, Barrick Gold Corporation announced it will eliminate the executive role of Chief Innovation Officer as part of a broad decentralization push. Whilst adding that they will continue to work on innovation, this news is in line with the trend of major mining companies opting to rely on the service industry for the development and provision of new technology.

Junior mining companies, faced with stiff competition for funding from the cannabis industry, and with commodity prices dipping in recent months, have also had to look for innovative new methods to drive down costs and increase productivity. The epicenter of this wave of innovation can be found in the small mining town of Sudbury, Northern Ontario. World-renowned as the service and supply hub of Ontario mining, Sudbury is also home to a plethora of small and medium enterprises (SMEs) and organizations spearheading a technological revolution that is changing the way we mine.

A trip to the NORCAT Underground Centre at the Fecunis mine in Onaping, Ontario, allows visitors a snapshot of the future,

*“The most valuable asset that we have is time and the mining industry squanders a great deal of it. It is essential that we adopt a systems approach to innovation if we are to make the transition from batch processes to continuous processes.”*

**-Doug Morrison,  
CEO of CEMI,  
Centre for  
Excellence in  
Mining Innovation and  
UDMN, Ultra-Deep  
Mining Network**



IMAGE: Courtesy of Pure Gold Mining

nurturing a robust innovation ecosystem that supports approximately 60 mining technology projects per year. “NORCAT is the only non-profit regional innovation center in the world that has an operating mine designed to enable start-ups, SMEs, and international companies to develop, test, and showcase new and innovative technologies in an operating mine environment,” commented Don Duval, CEO of NORCAT.

The unique facility anchors one of the world’s leading advanced manufacturing and mining technology clusters and represents a “one-stop shop” ecosystem for the future technologies and innovations that are poised to transform the global mining industry.

The NORCAT Underground Centre also plays host to the next generation of miners, from Cambrian College’s Mining Engineering Technology (MNTY) program. INCO (now Vale) and Falconbridge (now Glencore) were founding partners of Cambrian College 50 years ago, and the institution continues to work closely with mining industry partners, particularly through its applied research division, Cambrian Innovates. Shawn Poland, vice president of Cambrian College, explained how SMEs can benefit from Cambrian’s R&D resources: “The companies working with us will still hold their IP, and look to us for real-world, real-time solutions for the challenges they are facing.”

One of the mining tech companies to have tested its products at the NORCAT Underground Centre is Maestro Digital Mine, who provide a complete automation network backbone and rugged IoT devices for underground mines. “Recognizing the industry’s growing demand for data, and the challenges that many of our customers encountered with connecting ventilation solutions to their networks, we identified a

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IMAGE: Courtesy of Maestro

gap in the market,” said Michael Gribbons, co-founder of Maestro. Creators of the Plexus PowerNet, the world’s first powered coaxial Gigabit network, Maestro Digital Mine have installed products in over 100 mines globally. Acknowledging that it has taken time to educate the mining community, Gribbons has noticed an acceleration in the uptake of digital connectivity solutions in the last twelve months: “Five or six years ago, companies did not put gas sensors in the mines, whereas today it is commonplace,” he stated, continuing: “This momentum will continue to gain traction with the growing need for mining companies to reduce costs and become more productive”.

Centric Mining Systems provides enterprise solutions software to mining companies worldwide, with offices in Sudbury and Perth, Australia. Recognizing that automated systems and technologies need to work in unison, Centric’s technology unifies data streams into a single view and uses analytics and predictive analytics to interpret data. Utilizing WipWare fragmentation data, integrated with power consumption and recovery data from the mill, Centric has created an AI system that generates workable scenarios of information. Chris Novak, CEO of Centric, explained: “We discovered that we could tune the drill and blast processes to optimize power usage in the mill and recovery, all based on fragmentation. By taking those 4 verticals: drill and blast, fragmentation, milling and

*“The Digital Mine is not a technological accomplishment, it is a culture. It is the integration of people, process, and technology which creates an environment where data-driven knowledge empowers decision makers and creates opportunities to improve the business.”*

**-Chris Novak,  
CEO,  
Centric Mining Systems**



grinding, and recovery at the processing plant, we could generate entirely new answers.”

When asked to define the digital mine, Novak suggested that advances in technology alone will not be enough to significantly disrupt the industry, and a holistic change in culture and approach

is necessary if mining companies are to reap the benefits of innovation: "The Digital Mine is not a technological accomplishment, it is a culture. It is the integration of people, process, and technology which creates an environment where data-driven knowledge empowers decision makers and creates opportunities to improve the business," he said.

Vic Pakalnis, president & CEO of MIRARCO (Mining Innovation Rehabilitation and Applied Research Corporation), the largest non-profit applied research firm in North America, expressed the mood of renewed optimism: "The last five years in the industry were the worst I have ever witnessed in my 40-year career, but the times are finally turning. The sector is adopting sophisticated new technologies from alternate verticals to increase safety, productivity, and sustainability."

MIRARCO and Laurentian University recently signed a C\$1 million Memorandum of Understanding (MOU) with nuclear energy giant Bruce Power for the development of small modular reactors (SMRs). Vik Pakalnis said that this initiative could provide a transformational solution to current power challenges, considering the cost of running diesel generators is C\$0.32/kilowatt-hour, which can go up to C\$0.78/kilowatt-hour in Arctic operations due to fuel supply unreliability. "SMRs will be able to produce energy lower than C\$0.15/kilowatt-hour with zero greenhouse emissions," stated Pakalnis.

Another company investing in innovation to drive down costs is global consulting firm SRK, which recently merged with the Sudbury-based mine simulation company, Labrecque Technologies. Gary Poxleitner, SRK's principal mining engineer, explained how this partnership can help customers visualize mining operations and plan accordingly: "Once a mine has been designed, Labrecque Technologies' software simulates processes that help clients accurately predict mine production

and work out how best to equip their operations to maximize profitability."

The solution currently driving business growth for NSS Canada (formerly Northern Survey Supply) is MOSS – Miner Operated Survey Systems, a hardware/software solution created by Bernie Smith at Glencore, and then developed in partnership with Leica, Precision Mining Systems and Autodesk. MOSS allows for millimeter accuracy, whereas traditional mine survey methods give an accuracy of around 1 to 3 feet. Bruno Lalonde, general manager of NSS Canada, expanded on the benefits of this technology: "MOSS reduces the overbreak percentage from 30% typically, to under 10%," he said, continuing: "A 1% overbreak can cost up to US\$500,000 in material handling, so MOSS offers its users vast savings both in time spent and economically, as well as a quick return on investment."

Tom Palangio, president of WipWare, the North Bay-based producer of photo-analysis systems and software, believes that competitive necessity drives innovation in Canadian mining: "An ounce of gold is worth the same throughout the world, but if operating costs abroad are cheaper, domestic companies need to find a way to leverage to survive" he stated.

WipWare has created non-disruptive methods of measuring granular sizes in real time to help mining operations optimize processes. Tom explained how 'machine vision' allows companies to allocate resources to tasks that require human talent: "WipWare looks at repetitive, boring, sampling jobs within the industry, where people can be freed to do more important jobs if a machine can monitor results for them."

Noticing the high rate of failures of pipes and fittings transporting slurries and different abrasive materials in the mines, David Dillon, founder of Dura 21, began creating machinery and coatings to dramatically extend their service cycle.

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*"The last five years in the industry were the worst I have ever witnessed in my 40-year career, but the times are finally turning. The sector is adopting sophisticated new technologies from alternate verticals to increase safety, productivity, and sustainability."*



**-Vic Pakalnis,  
president & CEO,  
MIRARCO**

Dura 21's technology, developed at NORCAT and supplied to clients such as Vale at their Copper Cliff mine, claims to outperform comparable products by as much as 20 times. Citing one particular case, David gave an example of Dura 21's cost-saving potential:

"The installation of one Dura 21 product prolonged the lifecycle, and it was estimated that the facility had saved C\$130,000".

Doug Morrison, CEO of CEMI, Centre for Excellence in Mining Innovation and UDMN, Ultra-Deep Mining Network, believes that, for the industry to fulfill its potential, it must first change its approach: "The most valuable asset that we have is time and the mining industry squanders a great deal of it," he stated. "It is essential that we adopt a systems approach to innovation if we are to make the transition from batch processes to continuous processes".

Suggesting that an adoption of the Kaizen philosophy utilized by automotive companies such as Toyota would increase efficiency and productivity, Doug continued: "The current ore transport platform of LHDs means 80% of the diesel we burn goes to move the equipment, only 20% to move the ore. Our job is to move ore, not run equipment."

#### **OEMS MAKING THE TRANSITION FROM DIESEL POWER TO BATTERY ELECTRIC VEHICLES**

In a similar vein to the automotive industry, mining equipment is rapidly making the transition from diesel-powered machinery to battery electric vehicles (BEVs). Increasing global emissions



IMAGE: Courtesy of Jacobs

standards, the heightened awareness of the threat Nano diesel particulate matter (nDPM) poses to mine worker's health, in addition to the economic and safety benefits electrical equipment provides, are all factors contributing to an industry-wide push to electrify mining.

In the move away from diesel-powered machinery, Sudbury-based equipment manufacturer, Marcotte Mining, and global technology powerhouse, Siemens, have teamed up to integrate electric drive technology into Marcotte's RAM40 carriers. Alicia Woods, GM of Marcotte, divulged: "We partnered with Siemens with over 900 electrical-drive trucks operating in open pit mines globally to develop our first battery electric vehicle (BEV)."

The first generation of Marcotte's BEV was trialed and tested in September 2018, and is due to hit the market in Q4 2018.

In February 2018, Sudbury-based RDH Mining Equipment was acquired by SMT Scharf AG from Hamm, Germany, subsequently creating RDH-Scharf. Gustavo Portalier, CEO and MD of RDH-Scharf, accredits the Canadian-German alliance for enlarging the company's global footprint and potential to take on more projects, as well as increasing its product line. RDH-Scharf is extending its regional targets by introducing battery technology with CODELCO in Chile, and Gustavo insists that the adoption of BEVs must be a wholesale change: "There is no point in having one battery-operated machine when there are another ten working with diesel in the same project. This is a change that must happen from the start", he reflected.

Normet, the global OEM from Finland, restructured the company on July 1st 2018, separating into four distinct, regional sales areas – APAC, EMEA, North America and Latin America. Normet announced that its net sales were up 24% in the first half of 2018 compared to the same period of 2017, partially due to the upturn in the mining

market, an increased presence in the tunnelling market, and a more streamlined, focused international structure, according to Randy Ouimet, director of Normet Canada. On the innovation front, Normet intends to electrify its trademark wet shotcrete equipment: "Normet is developing products that will enable us to spray headings more robotically. Right now our machine sprays somewhat robotically, but this will be brought to a total robotic perspective." stated Ouimet.

Normet will be launching their first BEV in Canada in early 2019.

Another OEM to undergo significant structural changes recently is global giant Epiroc, which listed on the Stockholm Stock Exchange as a separate entity to Atlas Copco on June 18th 2018. Epiroc collaborates with customers in more than 150 countries, had revenues of US\$3.7 billion in 2017, and employs more than 13,000 professionals globally. Epiroc has already achieved over 50,000 hours of automation and interoperability – the ability of different information technology systems and software applications to communicate, exchange data, and use the information that has been exchanged – in Canada to date. Jason Smith, general manager of Epiroc Canada, hopes to see the introduction of Epiroc's second generation of BEVs in Canada in 2019. Regarding their development timeline, Jason commented: "The first prototypes of the generation 2.0 BEVs are expected to be coming off our production lines in Q4 2018, with trials beginning in Europe together with our development mining partner".

Boart Longyear has been providing drilling services, drilling equipment and performance tooling for mining and drilling companies for 128 years. When asked about Boart Longyear's innovative products, president and CEO Jeff Olsen pointed to the MDR700 underground coring mobile drill rig, which utilizes Boart Longyear's underground exploration LM700 feed

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frame technology, and the MDR500 mobile underground diamond drill rig: "It leverages an LMI (linear matrix inequality) power and control interface, and comes equipped with 500 meters of on-board rod storage (NQ rods), making it a self-sufficient mobile drill rig," explained Jeff.

When it comes to mining at depth, South African company New Concept Mining (NCM) is leveraging its experience to provide a range of solutions that include pre-stressing units, rockbolts, areal coverage, monitoring and warning devices. "Canada's mining industry is now moving into deeper mining environments, whereas South Africa has experience in deeper mining since the 1970s," elaborated Heinrich Greeff, NCM's managing director for Canada. NCM currently supplies support to the world's three deepest mines, all in South Africa – Mponeng, TauTona, and Sebuka. "This enables us to bring very mature and developed knowledge of down support products for dynamic environments into the Canadian market," affirmed Heinrich.

As remote, tele-operated technology helps remove workers from the dangers of underground mining, how much distance could feasibly be placed between the operator and the mine site? This question was posed to Gabriel Janakaraj, VP of special projects at Hard-Line: "We currently have a tele-op system set up between Australia and Canada, though we could essentially operate from the moon to Canada and vice versa".

Hard-Line's technology allows clients to control their operations remotely through an Operator Control System that can be placed anywhere in the world.

Another company that deals in teleoperations is Penguin ASI. Greg Baiden, co-founder and CTO of Penguin, has a track record in the industry for mining innovation projects having completed studies for NASA and the Canadian Space Agency (CSA) for mining on the moon. While noting that changing the conservative culture of the mining industry is a lengthy process, Dr. Baiden believes that when the technology is mature enough, the transition to fully tele-operated mines will not take long: "When one major company makes the investment to run in total tele-operation, they will make such a vast profit, other companies will have no choice but to follow," he said.

#### **FORTIFYING THE FOUNDATIONS: THE SERVICES THAT SUPPORT THE INDUSTRY**

The innovation coming out of Ontario is not only increasing productivity and driving down costs, but also creating safer working conditions in historically hazardous environments. Cementation, recipients of the gold award in the Mining and Natural Resources category as one of Canada's Safest Employers for 2017, has developed a culture that permeates through the organization, assured Roy Slack, president of Cementation Canada. Slack recognizes that innovation is more than just a cost saving measure: "When you talk about innovation, it is not necessarily automation, but different processes that take people away from the face or away from the greatest risk. Separating people from the hazards is the next

*"When you talk about innovation, it is not necessarily automation, but different processes that take people away from the face or away from the greatest risk. Separating people from the hazards is the next step from a safety standpoint, through remote operation and the development of processes."*

**-Roy Slack,  
president,  
Cementation Canada**



step from a safety standpoint, through remote operation and the development of processes".

Engineering giant Jacobs acquired CH2M Hill for US\$3.27 billion in December 2017, and has seen double-digit pro forma revenue and profit growth since the merger came into effect. In September 2017, it was announced that Sirius Potash will continue to move forward with their Wilton project, and Jacobs was awarded the material handling facility (MHF) construction contract, with construction due to start by Spring 2019. Jacobs also won an EPCM contract for the development of the Oyu Tolgoi underground project in Mongolia, one of the largest mining projects worldwide.

On the innovation front, Jacobs Connected Enterprise (JCE) offers services to several major clients in the US including the NSA, NASA and the Department of National Defense. Jeremy Okolisan, vice president business development and leader of Jacobs' MM&T (Mining Minerals & Technology) division, intends to leverage JCE's experience in other sectors to provide innovative solutions to the mining industry: "Jacobs' is applying digital intelligence lessons learned from its work in the aerospace, advanced facilities and nuclear defense industries and adapting them for other sectors, including mining," he said.

DMC Mining Services, in operation since 1980 as a mining contractor, pledges to 'build mines of the future'. In February 2018, DMC was awarded a contract to develop a 1,600 meter shaft and two smaller ones for UK-based Sirius. The driverless shaft sinking unit will be one of only six globally, the first being the SBR (Shaft Boring Roadheader) at the Jansen potash project in Saskatchewan. Graham Buttenshaw, president of DMC Mining, elaborated on the technology: "Instead of having people down the hole drilling, blasting and repairing walls, it grinds its way down... "There will be fiber optic cables going down in Sirius, with all of the work completed at surface. We are pulling men out of harm's way."

Since winning a five-year contract with Vale in 2015, Sudbury-based NATT Safety Services has focused on providing the full safety package

as a turnkey operation – supplying rescue teams, developing rescue plans, performing hazard assessments and providing training. Mark Arnold, general manager of NATT Safety Service, divulged on the philosophy driving business growth: “We take care of our client’s health and safety, so they can focus on their core business”, he declared.

Building on the foundations of the Vale contract, NATT is going to Flin Flon in Manitoba for Hudbay Minerals to provide health and safety training, and will travel to Brazil to perform a health, safety and logistics assessment for nine mines in Jacobina, south of Salvador.

The mining industry contributes to over 30% of all business for Golder Associates, which provides consulting, design, and construction services in earth, environment, and related areas of energy. As mining companies become more aware of water management issues across the entire mine site, and energy reduction becomes an increasing priority, David Brown, principal of Golder’s mine environment division, commented on Golder’s intention to expand its presence in Ontario and across Canada: “We are starting to see upticks in the market and thus we are also in the process of attaining more staff to meet the industry demands,” he said, continuing: “We would like to expand our integrated mine water management and treatment, and climate change and carbon emission reduction services.”

Steve Matusch, CEO of IONIC Engineering, emphasized the need for the mining industry to shed its conservative nature and embrace innovation at an early stage: “If we want to continue to have a competitive mining industry, especially in areas where the ore bodies are getting deeper, there is going to have to be a shift from passively awaiting technology to actively pursuing it.”

The wheels are in motion as the industry moves towards a more efficient, modern mining culture that breeds greater safety and productivity. As the march towards digitalized and autonomous mining gathers pace, Ontario has positioned itself at the forefront of mining innovation. •



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