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GLOBAL BUSINESS REPORTS

Quebec's mining industry

Innovation, knowledge and institutional support fuel a world-class mining jurisdiction.

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Introduction

Institutional and financial support sustain a timeless history

Towns of Labrador City and Wabush. Photo courtesy of Alderon Iron Ore.

Québec's mining history can be traced back as far as the discovery of North America, when Jacques Cartier discovered quartz and pyrite on the slopes of Cap Diamant. Since the discovery of lead in 1686 in the Abitibi-Témiscamingue region, followed by Québec's first gold rush in the 1840s after the discovery of a gold nugget in the Beauce region by Clothilde Gilbert, mining has been fundamental to the development of 'La Belle Province.'

Today, mining remains the foundation of Québec's economy. "The mining sector plays a neuralgic role in Québec's economy and in the dynamism of our regions. Our government relies on the significant contribution of this sector in a more sustainable economy, especially with regard to the challenges of energy transition. Our vision is to have a responsible development of our mineral resources for the durable prosperity of Québec," said Jonatan Julien, Minister of Energy and Natural Resources, Government of Québec.

On the back of strong institutional support, the industry remains in an enviable position on both a national and global level. From mining-related associations, the Québec Mining Association (QMA)and the Québec Mineral Exploration Association (QMEA), to financial organizations stimulating resource development (La Caisse de dépôt et placement du Québec, Ressources Québec, SOQUEM, SIDEX and BMO Capital Markets), Québec has the knowledge, means and geological endowment to prosper as global market conditions improve.

Balancing sustainability and permitting

In 2014 the QMA entered into an agreement with the Mining Association of Canada (MAC) for a four-year mandate to ensure that all mining installations implement the Towards Sustainable Mining (TSM) initiative – a performance system that helps mining companies evaluate and manage their environmental and social responsibilities. Having already achieved 92% of this target by Q3 2018, Josée Méthot, QMA's president and CEO, spoke of the willingness of the Québec mining community to demonstrate its commitment to sustainability: "[mining companies] took the challenge head-on, therefore we did not have to implement tactics to influence them, they simply agreed to the process."

Despite its numerous advantages as a mature and predictable jurisdiction, the challenges of advancing an exploration project to production run deeper than commodity-market dynamics. Lengthy permitting processes at the provincial and federal levels are driving up costs and, in a challenging investment climate, undermining the economic feasibility of a project. Méthot lamented the amount of time it takes for explorers to obtain environmental authorizations, emphasizing the need

Jonatan Julien, Minister of Energy and Natural Resources, Government of Québec.


Josée Méthot, President and CEO, Québec Mining Association (QMA).


Mathieu Savard, president, Québec Mineral Exploration Association (QMEA).


Frank Mariage, former president, QMEA and partner, Fasken.

to streamline the processes: “We need this to be simplified; we need to improve interactions and harmonization between the federal and provincial processes,” she stated.

Mathieu Savard, president of the QMEA, echoed this sentiment, suggesting that the number of administrative steps required for permitting be reduced: “The process is vital, but the delay in obtaining these permits wastes shareholders’ and investors’ money.”

In his interview with Global Business Reports at the 2018 Québec Mines + Energy conference, Savard outlined the QMEA’s core priorities for 2019: to maintain and increase access to territory, define the parameters of current and future regulations, and simplify the social-licensing process.

For Hugo-Pierre Gagnon, partner at Osler, Hoskin & Harcourt, new regulations should be introduced incrementally, and major changes in a short period of time should be avoided. Referencing how previous changes to the mining bill had resulted in a lack of clarity, Gagnon maintained that certain regulations have promoted exploration, reduced expenses, and addressed social issues: “It would be prudent that any new regulations should be introduced with the past in mind,” he reflected.

Frank Mariage, former president of the QMEA and partner at Fasken, was more bullish regarding future market dynamics: “The mining industry has gone through a challenging period, particularly with the rise of the cannabis market limiting the flow of investment capital into the junior space. However, the fundamentals of metals are solid, and companies will need to invest to maintain supply,” he said.

Another Montréal-based law firm specializing in mining services is Lavery, which has seen an increase in Australian and Chinese companies seeking to acquire lithium and cobalt assets in Canada to aid in the production of batteries, according to partner René Branchaud. Suggesting that more leeway could be granted to local authorities such as civil servants and mayors to speed up the permitting process, Branchaud also touched on one of the major advantages afforded to mining companies active in Québec – the tax benefits: “If a company is not financed through flow-through shares (FTS) or does not renounce its exploration work to investors, it has access to large amounts of credits and can recover up to 35% of the cost incurred for exploration work,” he explained.

Can metals and innovation finance the future?

Financial incentives, such as the 30% to 40% tax credit available for exploration activities, make Québec a highly attractive mining destination, but mean little without access to capital. Fortunately, there are plenty eager to invest.

Chad Wells, VP of Altius Minerals, the royalty, streaming and investment company responsible for financing numerous projects across Canada, commented that Québec had the financial clout to back up its commitment to the industry: “In Québec, you not only have a jurisdiction that is willing to support mining at a community level, but there is also enough capital to finance the development.”

Nicolas Brunet, managing director of investment and corporate banking, BMO.

Iya Touré, VP, Ressources Québec.

Michel Champagne, CEO and general manager, SIDEX.

BMO Capital Markets, named by Global Finance as the world's best metals and mining investment bank for the last nine consecutive years, assists mining clients through the development cycle and helps pair those seeking capital (issuers) with the right sources and structures. Nicolas Brunet, managing director of investment and corporate banking at BMO, highlighted the firm's recently established new age metals team that targets issuers working in the lithium, cobalt and graphite space. Commenting on how BMO collaborated with other funds to facilitate the financing for Nemaska Lithium, the largest stand-alone lithium-financing operation to-date, Brunet stated: "It was critical for all financing sources that the financing package be complete, i.e. that the funds raised be sufficient to build the mine and transformation plant. It is highly unlikely that one source alone could have achieved this; cooperation was critical."

As a subsidiary of Investissement Québec, Ressources Québec is the gateway for companies seeking to invest in the mining and hydrocarbon industries. In collaboration with the government, it has access to C$1.5 billion to support mining projects in the region. In recent years, the organization has modified its mandate to add renewable energy as one of its focus areas, and has adapted its approach to form partnerships with major producers such as Agnico Eagle, Glencore, IAMGOLD, and Hecla Mining, in addition to new project development. Iya Touré, VP of Ressources Québec, elaborated on the evolution of the organization's mandate: "The current green movement in the mining industry is having an impact on Ressources Québec's policies and strategy. The Nemaska Lithium project, for example, has huge potential due to the growing interest in the electric vehicle (EV) market," he explained, continuing: "The challenge now is to bring the projects to market. Ressources Québec's credibility relies on these projects and we want to ensure that they are delivered on time. The Québec mining ecosystem also relies on these projects and we believe that their success will attract more investment."

SOQUEM, a subsidiary of Ressources Québec, works with its partners to develop projects at all stages of the exploration cycle. Innovation has been a key driver for SOQUEM in 2018, illustrated by a big data approach that succeeded in identifying six new exploration targets in partnership with Azimut Exploration, four of which led to discoveries. The future, however, needs more than just new technology and metals. While mining has always required long-term thinking on behalf of investors, the pursuit of short-term financial gains often characterized mining operations of the past. Today, the vision for an operation needs to stretch beyond financial gains and even beyond the span of a mine's life. An advocate of the benefits of responsible mining, Michel Gilbert, president of SOQUEM, emphasized the importance of how geology and economics combine with human resources, community engagement, and environmental sustainability. Explaining SOQUEM's forward-looking focus, Gilbert elaborated: "We are working not only on what mineral we should be focused on now, but also which metals and minerals will be important ten years from now; we are, after all, an exploration company."

Another institutional fund looking to work with innovative, smaller companies is SIDEX, a limited partnership that finances exploration companies and aims to encourage mineral diversification. In 2017, SIDEX financed new entrepreneurs Kintavar and Harfang Resources. Michel Champagne, CEO and general manager of SIDEX, outlined its strategy: "Creating new concepts and techniques within the mining industry can change the playing field and pave the road for more and better discoveries to be made," he said. "SIDEX has a focus on innovation with the hope to find the next transformational technology or technique for the global mining industry."

Metals and Materials of the Future

Lithium and vanadium projects attracting substantial investment

Shawinigan site. Photo courtesy of Nemaska Lithium.

Québec's mining industry was built upon gold from the Abitibi Greenstone Belt, iron ore from the Labrador Trough, and nickel from the Ungava Belt. These resources remain the bedrock of today's industry, but the metals that underpin emerging technologies are now gathering the most attention.

In Québec, it is metals for use in renewable energy and battery technologies – lithium, vanadium, and others – that are attracting significant investment. Nemaska Lithium has managed to raise C$1.1 billion, including Japan's SoftBank Group's first-ever resource investment, to advance construction at its Whabouchi mine and Shawnigan electrochemical plant to unearth long-term sources of lithium to power electric taxi fleets across Asia. In parallel to this, BlackRock Metals, owners of a vanadium and titanium-bearing magnetite (VTM) and ilmenite deposit, raised US$890 million to construct the mine and concentrator at its property in Chibougamau. Such vast sums of investment have been supported in part by institutional funds. For instance, Ressources Québec added renewable energy to its mandate and BMO Capital Markets created a new metals team. The global market gives sustenance to these projects, with ferro vanadium prices reaching a 13-year high of US$123 per kg in Europe in December 2018.

In January 2018 a report by Morgan Stanley speculated there would be an oversupply of lithium from low-cost brine producers SQM and Albemarle in Chile that would cause the lithium price to crash in the first half of the year. These forecasts have not, however, come to bear, and the fundamentals for battery metals such as lithium and cobalt appear solid, underpinned by a growing demand from vehicle manufacturers looking to electrify their fleets."Volkswagen (VW) has committed to make 30% of their sales electric by 2025, and this alone would require five mines like Whabouchi," stated Guy Bourassa, president and CEO of Nemaska Lithium. "In 2016, less than 12,000 mt were needed for car batteries, but this figure will rise to 550,000 mt by 2025."

In addition to the overall growing demand for lithium, Québec is a favorable lithium jurisdiction due to its conducive geology. "In Canada, lithium is mainly found in hard rock, which is easier to access than brine as the extraction and purification processes differ," said Yves Rougerie, President and CEO of explorer Vision Lithium in which Nemaska Lithium is the largest shareholder. The company's flagship resource is located within the 1,100-hectares Sirmac property that sits halfway between Chibougamau and Nemaska.

Critical Elements completed a feasibility study on its Rose lithium-tantalum project in September 2017, followed by an environmental impact study in December 2017. The feasibility study indicates a 17-year mine life, and the company is hoping to reach commercial production by 2021, according to CEO Jean-Sébastien Lavallée. It has completed two pilot plants, one to produce lithium carbonate and another lithium hydroxide: "It offers high conversion rates of spodumene to lithium carbonate or hydroxide," said Lavallée, continuing: "The new battery generation is leading towards lithium hydroxide."

The expanding lithium market also opens doors for potential downstream processing. As Nemaska and North American Lithium plan to


Guy Bourassa, president and CEO, Nemaska Lithium.


Yves Rougerie, President and CEO, Vision Lithium.


Jean-Sébastien Lavallée, CEO, Critical Elements.

build a phase-two plant to process tailings from their mines, Jonathan Gagné, general manager of Sayona Lithium, sees the possibility of aiming for such a scenario for Sayona. "Authier on its own demonstrate a good potential, which could be strengthen if we make a discovery at our recently acquired Tansim lithium asset." He added: "Quebec demonstrates a real potential to become a top player in the lithium industry. We have good lithium deposits, a great mining expertise, cheap power, access to ports and rails and a good support from our Government."

Sayona is focusing on its Authier Lithium project located in the municipality of La Motte, 45 km northwest of Val d'Or. The hard-rock spodumene lithium deposit is now entering in permitting phase.

As the use of lithium keeps snowballing, service providers are seeing opportunity for greening the cycle. Engineering and consulting firm Seneca is in the process of deploying the first automotive lithium-battery recycling hydro-power pilot plant. Lithion Recycling Project Consortium, of which Seneca is part of, received a C$3.8 million funding in 2018 from Sustainable Development Technology Canada. Lithion Recycling is aiming for a worldwide commercialization of its technology, which will begin with the construction of a 200-mt/y capacity pilot plant in Québec in 2019. VP and co-founder Raymond Simoneau commented: "Currently, 90% of our projects are driven by the sustainability factor – mostly by either recycling of improving yields. The entire Québec region is focussed on sustainability and the province's low cost and renewable energy resources offer great opportunity."

Another essential metal used in EV batteries is graphite and the demand – primarily from the Chinese market – continued to increase throughout 2018. Montréal-based graphite mining and processing company Mason Graphite received government authorization for its Lac Guéret project in June 2018, and construction is scheduled to be completed by early 2020. "At this stage, we will produce concentrates which will be used directly by customers and users in consumer electronics, friction brake pads, steel industry and flame retardant, to name a few," said President and CEO Benoît Gascon. "We also developed the processes for the second transformation to produce products mainly used in the battery industry. The second transformation is not part of the current feasibility study; a detailed study will be conducted early 2019 to advance the industrial design of this second production facility and refine the economics of the project."

Nickel remains an important component in lithium-ion batteries as the battery's energy density corresponds with the nickel content. While some companies scramble for solutions to reduce the nickel content as it detracts from the safety of each individual cell, the future market will more likely demand higher nickel grades than to eliminate the component. High-grade nickel will bring higher production costs, but as the metal is primarily used for production of stainless steel – one of the world's most important metal markets – nickel will likely remain a wise investment in the foreseeable future. Orford Mining's West Raglan is an advanced stage Ni-Cu-PGE exploration project in the Cape Smith Belt, Nunavik. The belt hosts high grade polymetallic nickel deposits, including two operating mines: Nunavik Nickel and Glencore's Raglan operation. In 2016, a major gold discovery was made in the same belt which resulted in Orford shifting focus from nickel mining to gold mining. "The gold mining project, known as Qiqavik is a 40 km long trend with potential of more than one deposit," said president and CEO David Christie. "To the best of our knowledge it is the first gold discovery of significance in the Cape Smith Belt, with high grade showings across the entire property length which is about the size of the island of Montréal."


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Vanadium: the key to sustainable energy

Prospects for vanadium, the strategic metal used primarily as a strengthening alloy to steel and titanium, boomed in 2018. Vanadium has four oxidation states and can conduct electricity without generating heat. It represents approximately 80% of vanadium redox flow batteries (VRFB), of which the electrolyte within the flow battery is 100% reusable and lasts forever. Adriaan Bakker, president and CEO of VanadiumCorp, elaborated on the benefits of VRFBs: “VRFBs are a mature technology capable of storing an unlimited amount of energy. The batteries also have the unique ability to charge and discharge power at different rates, as vanadium is both the analyte and catholyte of the battery.”


Adriaan Bakker, president and CEO, VanadiumCorp.

VanadiumCorp has had a transformational year. After evaluating production models worldwide, it came to the conclusion that the techniques used in the vanadium industry for 50 years and in the steel industry for 100 years were now obsolete. From this backdrop, VanadiumCorp decided to determine a new process technology, which led them to a partnership with Montréal-based Electrochem Technologies & Materials, that had tested bulk samples from VanadiumCorp’s Lac Doré project.

In August 2018, the jointly owned, patented VanadiumCorpElectrochem Processing Technology (VEPT) was announced, which allows users to process any material that contains vanadium and to recover vanadium, iron and titanium from magnetites of any shape or size.

VanadiumCorp can now focus on VEPT rather than production and transition from a mining company to a technology one. This will also allow the company to become the discriminating customer of feedstock from around the world, according to Bakker. VanadiumCorp’s goal is to lease out vanadium electrolytes (VE) that will provide people with free access to battery technology, significantly reducing the cost of energy storage. Discussing the potential of VanadiumCorp’s new technology, he concluded: “With VEPT we have a disruptive technology that vastly supersedes any technology before it. We are confident VEPT will revolutionize the cost and sustainable nature of energy storage as well as vanadium, titanium and iron production worldwide.”

Exploiting the niches: rare-earth elements and silicon

Québec is the second-largest niobium producer globally after Brazil, and with global demand appreciating at roughly 10% per annum, companies such as Commerce Resources and Saville Resources believe they are well positioned. Chris Grove, president of Commerce Resources, has observed a fundamental shift in the rare-earth elements (REE) market since 2016, as the global drive to find substitutes for REEs used for magnets in electric motors proved unsuccessful, and more recently in October 2018, as China announced that imported REE feedstock has now surpassed domestic production. “The Chinese government has been very active in shutting down illegal producers of commodities and projects that pollute heavily inside China. This may provide opportunities for companies such as Commerce Resources,” reflected Grove.

Commerce Resources’ sister company, Saville Resources, has a 75% earn-in agreement on the Niobium Claim Group property, and will be responsible for drilling the niobium-rich areas. Meanwhile, Commerce Resources continues to focus on developing its Ashram REE project. The Niobium Claim Group property is located within the central Labrador Trough, approximately 130 km south of Kuujjuaq, Québec, and covers several prospective niobium-tantalum targets. Mike Hodge, president and CEO of Saville Resources, expanded on the eye-catching exploration results at the property: “Saville Resources currently has the highest grades of ground samples globally. For instance, our grades are at 16%, while others are at 0.6%,” he said.

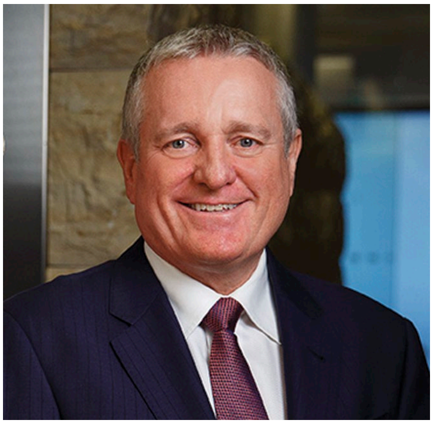
GéoMéga Resources focuses on a lanthanide called neodymium, but has shifted attention from exploration to refining in recent years. Kiril Mugerman, president and CEO of GéoMéga, detailed the reasoning behind this shift in focus: “The biggest bottleneck in the mining industry is not actual mining or scarcity of resources, but rather lack of refining capacity,” he explained. GéoMéga has made significant progress in its refining processes, from running tests at 0.003 grams of rare earth per liter in 2014, to over 100 grams per liter in 2018.

When it comes to niche markets, Canadian Metals, as the only junior company in the silicon space, believes it can take advantage of the growing demand for silicon from the solar panel market, which is growing at 30% per year. Silicon does not exist in its pure state and must be extracted from quartz, one of the most abundant minerals of the earth’s crust. René Boisvert, president of Canadian Metals, wants to educate the market on the benefits of a material that is not well known: “Without silicon, many of the technologies that we use today would not exist and, to date, no other material has been found that can replace silicon in its application,” he explained.

Gold Exploration in Québec

Time to reinvest and replenish

Phil Baker, CEO, Hecla Mining.



George Burns, president and CEO, Eldorado Gold.

In 2014, Osisko sold its Canadian Malartic mine to Yamana Gold and Agnico Eagle for C$4.3 billion after escaping a hostile takeover attempt by Goldcorp. It has since become the 10th-largest producing gold mine in the world. Despite missing out on Canadian Malartic, Goldcorp reached commercial production at its US$1.8-billion Éléonore mine in 2015. Since then, gold shipments from Québec have risen steadily, from just under 1.8 million oz in 2016 to over 2.08 million oz in 2018.

Yet a lack of new projects coming into production in the years since, combined with a number of gold mines across Canada nearing the end of their mine life, has heightened the need for new, large-scale discoveries. What is on the horizon?

Eldorado Gold and Osisko Mining advance progress at Québec's next gold mines

Québec's next gold mine belongs to Vancouver-based, multi-asset, mid-tier Eldorado Gold, whose Lamaque mine in Val-d'Or was expected to reach commercial production in Q1 2019. As a minority shareholder and business partner of Integra Gold since 2015, Eldorado noticed the potential of the Lamaque project first-hand from an early stage, and finalized a friendly acquisition in July 2017. Adding a Canadian asset to a global portfolio that includes mines in Turkey and Greece, and development-stage projects in Romania and Brazil, George Burns, president and CEO of Eldorado Gold, spoke of the potential he sees at Lamaque: "The initial life of mine is estimated at seven years, with an average annual gold production of 117,000 oz. We believe that is only the beginning and the potential of this district is enormous," he stated.

Eldorado's pre-feasibility 43-101 report released in March 2018 highlighted a current reserve of just under 900,000 oz, with 1.3 million oz of inferred resource potential to convert additional resources into reserves. Burns went on to detail the robust economics of the project, with an after-tax NPV-5% of US$205 million, an after-tax IRR of 34%, and a payback period of 3.7 years. "We see it as the beginning of a long and valuable future for the surrounding community, the province and ourselves. Lamaque will be a source of employment and opportunity for years to come," concluded Burns.

No other company has performed as much exploration in Québec in recent years as Osisko Mining. Since its restructuring in 2015, Osisko has managed to drill over 800,000 meters in a little over three years. Its flagship asset, the Windfall Lake property located in the Abitibi Greenstone Belt, James Bay, is a large, intrusive-related gold deposit with a 3.1 million-oz reserve defined from the Windfall deposit and its contiguous Lynx discovery. The newly discovered Triple 8 zone, located at a depth of 2 km, at Windfall, and a secondary deposit of 510,000 oz at Osborne Bell, will be factored into a feasibility study due for completion by the end of 2019, according to Osisko's CEO John Burzynski.

Osisko expects to complete drilling in Q2/Q3 2019, and will apply for permitting with the feasibility study in hand by the end of the year. After permitting, construction at the site will take another 12 months, which will lead to commercial production by late 2021/early 2022. Elaborating on his vision for the Windfall project, Burzynski said: "Osisko Mining intends to create the next intermediate Canadian mining company, and we believe that Windfall has the potential to be Osisko's cornerstone asset. As we drill out and advance exploration, the project will grow to world-class scale."


John Burzynski, CEO, Osisko Mining.

Golden opportunities: the juniors hunting for the next major deposit

Since winning discovery of the year at the 2016 Xplor conference for its flagship Cheechoo gold asset, located in James Bay a mere 7 km from Goldcorp's Éléonore mine, Sirios Resources has continued conducting intense exploration, reaching 50,000 meters of drilling on the property. By the middle of 2019, Sirios will produce its first resource estimate, and capacity at the camp is being increased from 20 to 50 people, with improvements to road access allowing machinery to be transported to the site directly any-time of the year. Dominique Doucet, founder and CEO of Sirios, believes Cheechoo has the potential to host at least 3 million oz of gold, and is bullish on its chances of becoming a significant mine in the future: "I consider the probability of a mine being developed from the project to be greater than 75%, which is remarkably high considering that the probability of a grassroots project moving into production is far below 1%."

Another junior with ties to Goldcorp in James Bay is Eastmain Resources, which operates three different projects in northern Québec. Eastmain's flagship asset is the Eau Claire project on the Clearwater property, for which a preliminary economic assessment (PEA) was issued in May 2018. Eastmain's second asset, the Éléonore South project, is held in a joint venture agreement with Goldcorp and Azimut. Describing the six targets that the company is currently working on, Claude Lemasson, Eastmain's president and CEO, said: "We are trenching, stripping and drilling. The vision is to continue work on these targets, leading to further discoveries, and advance the project itself through pre-development."

One of the larger market cap juniors operating in Québec is Probe Metals, formed as a result of the sale of Probe Mines Limited to Goldcorp in March 2015 for over C$500 million. In 2016, Probe Metals acquired all of the outstanding common shares of Adventure Gold to create a well-funded Québec and Ontario-focused gold explorer and developer. The aim of the acquisition was to attain financing to rapidly advance the Val-d'Or East project, which Probe Metals has realized, with a shareholder base consisting of players such as Goldcorp, La Caisse de dépôt et placement du Québec, and SIDEX, among others. Marco Gagnon, executive VP of Probe Metals, detailed the mineralization found at Val-d'Or East: "We have already identified numerous gold zones, which are characterised by sulphide-bearing, quartz-tourmaline veins typically associated with mineralized diorite dykes."

Adding to the list of Val d'Or success stories is Golden Valley Mines that has applied a unique and demonstrably successful funding strategy for its projects. "Our business model is quite different as we do not spend our own money on exploration, with the joint venture partner having the obligation and responsibility to provide all of the funding," stated CEO and president Glenn J. Mullan.

Golden Valley Mines has about 100 projects and focuses on gold, precious metals, energy minerals and base metals. The company has projects across Canada and abroad but mostly focuses on Ontario and Québec with project experience from the Nunavik region to Labrador, James Bay and the Abitibi region.

Brownfields: capitalizing on old merits

The prospects of the next major discovery will always be seductive enough to guarantee a level of greenfield exploration, but resource companies and investors alike have become more cautious with their dollars and many favor brownfield projects as a low-risk option. With the mining sector still recovering from the latest dip in the cycle, and with cannabis as well as cryptocurrency diluting the investor wellspring, brownfield exploration will be critical in maintaining Québec as a leading mining investment destination.

Explorer Cartier Resource's signature business model is to acquire projects that has demonstrated their mineralized endowment at a time when drilling was conducted within a zero to 250-meter range. Once having acquired these projects, the company upgrade the database into a digital platform to better understand the characteristics of the mineralization in order to design an appropriate and modern exploration program. Cartier's straight-forward business model has been successful and attracted much attention from investors. "In December 2016, Agnico Eagle took a 19.9% interest in our shares for an investment of C$4.5 million," said president and CEO Philippe Cloutier. "Subsequently, JP Morgan UK took a 9.9% interest in Cartier Resources. This gave us significant publicity which attracted various other investment interests, and by the end of 2017, the company had C$16 million." Concurrently, the company launched an aggressive diamond drilling program on its Chimo deposit and Cartier is to bring a maiden resource calculation to market in the near future.

As market conditions have not favored the junior community since the end of the super cycle, a collaborative approach that brings together financial resources and expertise is becoming more commonplace. One such case is Québec Precious Metals Corporation (QPM), which was formed in April 2018 as Canada Strategic Metals acquired Sphinx's three gold projects through an asset purchase, and then teamed up with Matamec Explorations and the Sphinx management team to create the new gold exploration company. Goldcorp invested C$4 million, and an initial exploration program commenced at the Sakami gold project in Q3 2018. Normand Champigny, CEO of QPM, outlined the reasoning behind this business model: "The industry requires consolidation as there are currently too many junior companies with too little funding in the market. It is better to offer very high-quality projects that will attract investment and encourage development," he said.

The modernization of African gold mining

Many of the exploration companies based in Canada do not have assets in North America, but use the country as a base, taking advantage of Canadian mining expertise and proximity to money markets. Canadian Overseas Resources (COR) was created in May 2018 to promote the different activities of its partner companies operating in Cameroon, Gabon, Congo Brazzaville, Central Africa Republic, and the Democratic Republic of Congo (DRC). Through these African companies, COR holds dozens of artisanal mining sites and 11 research permits covering an area of 4,500 square km. COR's aim is to leverage Canadian mining knowledge to accelerate the research and prospecting that will help push its African activities into industrial gold mining by 2025. COR will launch the first stage of its drilling campaigns in Cameroon and DRC in 2019.

Fabrice Ngondi Demtare, president of COR, is looking to draw on Canadian expertise, technology and investment to advance central-African projects that have previously replied on artisanal mining practices: "The land is gold-rich and has huge potential, but to realize it, operations must be modernized," he explained. "Sustainable development in the communities in which COR's partner companies operate is the ultimate goal."

Toronto-based Teranga Gold operates in three countries in West Africa - Senegal, Burkina Faso and Côte d'Ivoire. The company's vision is to create a multi-asset, mid-tier gold producer capable of producing 500,000 oz/y of gold. Its flagship in Senegal, the Sabodala mine, has been in production since 2009 and, in 2017, Teranga published an optimized mine plan which calls for over 1 million oz of production and C$230,000 of free cash flow over five years, beginning in 2018. CEO Richard Young emphasized the importance of social programs to be successful in the region, and the company has been operating a CSR model based on the requirements of each local community. "At Sabodala they wanted agricultural food security, youth training, and stable economic opportunities," Young said. "Beyond that we have invested in clean water and the health and well-being of the community. Sabodala was one of the poorest regions in the country before the mine was built and famine was rife, but now it is one of the healthiest regions."

Iron Ore & Base Metals

Premium-quality iron ore in high demand

The Labrador Trough, an extensive belt of mineralization running through the provinces of Québec and Newfoundland & Labrador, has been producing iron ore since the 1930s. Roughly 500 km south, the port of Sept-Îles – Canada's largest iron ore export port – ships product for steel production around the world, of which China accounted for 49.2% in 2017.

Although the price of regular-grade iron ore has slumped since 2015, higher-grade iron ore concentrate of 65% Fe and above, with a lower content of alumina, is attracting a price premium as China looks to reduce its carbon emissions. Tayfun Eldem, president and CEO of Alderon Iron Ore, explained: "China continues to drive the iron ore market, but in recent years, its influence has shifted towards product quality, rather than being solely volume-based, due to the country's strict policies to curb air pollution."

Kiril Mugerman, CEO, Kintavar.

Alderon's advanced-stage, premium-quality Kami iron ore project is fully permitted to commence construction. The project will contribute approximately C$7.6 billion to workers and businesses across Canada during its lifecycle, according to Eldem. With support of the Quebec government, Champion Iron has acquired Cliff's Natural Resources' Bloom Lake iron mine with associated infrastructure under the Companies' Creditors Arrangement Act. "Projects that mine bulk commodities are first and foremost infrastructure projects, and having access to good rail and port infrastructure is critical," stated Eldem.

While the general market may not yet be fully aware of the different markets for the varying grades of iron ore, the mining investment community has taken note, exemplified by Altius Minerals becoming a shareholder in Champion Iron and investing C$10 million in a convertible debenture to help restart the Bloom Lake mine. Chad Wells, Altius Minerals' VP, explained the investment: "Champion Iron is going to play a significant role in the bifurcation story of iron ore, as they are producing a significantly high grade with low impurities," he said.

Tata Steel Minerals Canada (TSMC) is the Montréal-based mining arm of the Tata Steel Group, one of the world's largest steel producers with over 77,000 employees globally. TSMC is developing iron ore deposits in Québec and Newfoundland & Labrador, and started with a small, direct shipping ore (DSO) operation from a section of its deposit that could be extracted directly from the ground, crushed, and screened. The sinter fines and pellet fines are then shipped to customers. PK Ghose, TSMC's CEO and MD, commented on how their product has been widely accepted across both Europe and China: "Over the last three years, we have extracted 6 to 7 million mt, with the majority shipped to China and later Tata Steel's European steel making facilities."

In 2017, TSMC signed a memorandum of understanding with Société du Plan Nord and Québec Iron Ore for the development and enhancement of the infrastructure facilities at Pointe-Noire in Sept-Îles via the limited partnership Société Ferroviaire et Portuaire de Pointe-Noire (SFPPN). The collaboration will facilitate the development of the Pointe Noire infrastructure to match the anticipated ore delivery needs of its partners. One of TSMC's partners is New Millenium Iron (NML), which completed a pre-feasibility study in 2016 for its Taconite project, NuTac. Dean Journeaux, director of NML, provided details of the grade at Taconite: "Its concentrate grade is 67% Fe, with very low alumina and other deleterious elements, which commands a premium in the market," he said.

Juniors restructure to focus on base metal exploration

After selling its gold assets in northern Québec to the newly formed Québec Precious Metals Corporation (QPM), Sphinx Resources chose to focus on zinc in southwestern Québec. Its Calumet-Sud discovery in the Pontiac regional county municipality, in collaboration with SOQUEM, has extensive zinc mineralization on the surface of the ground and rock, according to director Normand Champigny.

Normand also divulged Sphinx' relationship with Osisko to explore for zinc in the Grenville geological province, characterized by the presence of zinc-rich dolomitic marble. Champigny compared the geology

Tayfun Eldem, president and CEO , Alderon Iron Ore.

Innovative Solutions

No longer an afterthought, but a necessity

in the region to that of Australia, where half the world's zinc has been produced, and explained its benefits: "One advantage of this rock is that it is basic, meaning that there is no acid mine-drainage. Additionally, it is soft and can be used to sell non-zinc material as a fertilizer."

Another base metal-focused company working in the Grenville geological province is Kintavar, established in March 2017 as part of a transaction between GéoMéga Resources and a private company, and financed to the tune of C$10 million. Kintavar's Mitchi property is a stratiform copper-type deposit (SSC), with mineralization from-surface, which means it can be mined as an open pit and is thus more cost-effective. Kiril Mugerman, Kintavar's CEO, revealed that results from trenching activities in 2017 did not fit into a traditional skarn model, and shared similar characteristics to sedimentary deposits from the DRC. Despite a decrease in the copper price in 2018 due in part to the tariff war between the US and China, Mugerman sees strong fundamentals for copper moving forward: "It is now a good time for investors to look at the copper market. The macro picture suggests that the price will increase significantly, as major copper discoveries are rare, but demand is increasing," he advised.

Galway Metals is one of two spin-off companies from the sale of Galway Resources for US$340 million in December 2012. In addition to its gold-focused Clarence property, its Estrades property in the northern Abitibi region of western Québec has five metals – gold, silver, zinc, copper and lead. The overall metal content at Estrades has risen by 32%, with reserves increasing by 47%, according to Louis Morin, CEO of Galway Metals, who elaborated on the features of the resource: "Crossing the Estrades property are two under-explored rhyolite units in which volcanogenic massive sulfide ore deposits are found, usually in clusters," he said.

Volatile commodity prices and a seven-year downturn forced the mining industry to think outside the box to maintain competitive cost structures, optimize processes and enhance security. Traditional methods become obsolete when they no longer guarantee profit, and the necessity to embrace change has fostered a robust, innovative ecosystem of small and medium-sized enterprises, multinationals and research organizations creating and developing technologies that are already transforming global mining operations. Québec is at the forefront of this charge, from its world-renowned artificial intelligence (AI)-research hub in Montréal to a mature service sector in Val-d'Or that constantly adapts to the evolving market. Capital development fund Fonds de Solidarité (FTQ) identified labor as one of the big risks facing the mining sector in 2018. "Labor and retention is a risk this year and will be a big challenge in the future. We need to make sure that our mines are at the top of the technology. We also need more collaboration between businesses, share experiences and network," reflected FTQ's VP Dany Pelletier.

Spearheading the development of mining innovation in Québec is COREM, the largest organization in Canada solely devoted to mineral processing R&D, with six fields of expertise – comminution, physical separation, flotation, extractive metallurgy/ hydrometallurgy, pelletizing/thermal processes and mineralogy. Based in Québec City, COREM's facilities include 10,000 square m of offices, labs and pilot plants. A C$16-million project to build a new hydrometallurgy platform, install new equipment and modernize COREM's buildings is due to be completed by the summer of 2019.

When asked about the challenges that the industry must address, COREM's president and CEO Francis Fournier highlighted energy consumption, water use, tailings and environmental issues, and suggested that a value chain-approach is required to maximize the benefits of innovation: "The work done in extraction has an impact on mineral processing as well as on tailings and environment. We cannot continue to develop innovation with a silo approach," he responded.

This sentiment was echoed by Gianni Bartolacci, director at COREM: "The innovation ecosystem in Canada is fragmented and needs to work together and collaborate in order to fast-track the deployment of the innovation that will bring more value to the industry."


Francis Fournier, CEO, COREM.

The tools and software defining the march towards the digital mine

In 2008, Montréal-based Newtrax Technologies decided to focus 100% of its attention on the digitalization of underground metal mines, with the vision of becoming the global leader in wireless Internet of Things (IoT) and the preferred source of big data for AI, according to Alexandre Cervinka, Newtrax' president and CEO. To produce this big data, Newtrax designs, builds and globally deploys purpose-built devices to monitor machines, people and the underground environment in which they operate. In the last three years, Newtrax has undergone dramatic growth from 34 employees in 2016 to 128 today. Newtrax' solutions help companies reduce overhead costs and enhance safety. One example is Agnico Eagle's Goldex mine, which reported significant cost reductions on its tire expenditure and fuel consumption by implementing the Newtrax MET (Mobile Equipment Telemetry) system. Another major to have worked with Newtrax is Goldcorp at its Éléonore mine. After being recognized as the safest mine in Canada in 2016, Goldcorp mandated that its 660 workers wear fully integrated Newtrax-Enabled Personal Safety Devices.

Elaborating on Newtrax' partnership with the Institute for Data Valorisation (IVADO), whose scientific director Yoshua Bengio is one of the three founders of deep learning, Cervinka explained: "There are three important pillars to deliver value with AI – application knowledge, quality of data, and application of algorithms. In collaboration with IVADO, we have established machine learning pilot projects to test the quality of our datasets to understand if there are any gaps in the way we capture, consolidate and contextualize data."

Commenting on the importance of data gathering, Christian D'Amours, owner and president of software manufacturer Geotic, underlined how a well-organized and updated database is a necessity for making the right business decision and also minimizing the turnaround time for delivering a resource estimate. The company has developed tools for core logging and database maintenance that also includes 3D modeling. D'Amours explained: "Geological description is mostly based on subjective appreciation of any observed characteristic. For example, 'fine grained', 'highly silicified' and more. Having access to the core photo when linking two drill holes in 3D space allows for a more accurate modelling." Currently, Geotic is developing software that will enable a hand-held tablet to record samples on site from surface or underground.

The case for tailored solutions is echoed by Michael Gribbons, VP of mine ventilation and automation company Maestro Digital Mine. "Many mine supply companies will purchase commercial-grade equipment and wrap it in a hard box. This frustrates the mining industry as commercial equipment is available relatively cheaply, but product design or software changes to these products are not possible."

Maestro Digital Mine has developed a new system, Plexus PowerNet, that delivers a high speed, low-latency digital communication network that provides PoE+ power to Wireless Access Points (WAPs), cameras and any other IP based device. "With factors such a blast concussion and damage due to mobile equipment movement, fiber optic cabling is at a major disadvantage. We designed a last-mile communication leg to extend the network from the level entry network switch to the face."

Smart exploration

In mature mining jurisdiction like Québec, it is by now well understood that big data is more than one of many ways of optimizing operations; rather, it is a necessity in boosting efficiency, logistics, collaboration, intelligence as well as safety and security. However, junior explorers – facing stiff competition and low availability of funds – are often hesitant to spend their dollars on IT and much of the development towards smart solutions is pioneered by major players.

Azimut exploration generates targets based on the advanced processing of large geoscientific databases. Over the past 15 years, Azimut has signed more than 30 exploration deals with players like Rio Tinto, Goldcorp, IAMGOLD and Hecla Mining – amounting to C$100 million in work commitments. In addition, SOQUEM and Azimut combined their strengths in 2016 through a strategic alliance covering the James Bay region for gold exploration. For the first step, Azimut generated predictive mineral potential maps over the region and identified high-quality underexplored targets. Follow-up field work quickly validated those targets with the discovery of significant mineralized zones on the Munischiwan, Pikwa, Pontois and Galinée properties. "In contrast to AI, Azimut's method (AZtechMine) is a purely data-driven approach," said president and CEO Jean-Marc Lulin. "We describe it as a white box expert system. We consistently develop, test and operate it by incorporating scientific and operational knowledge. More importantly, it is not just about predictions; it has been clearly backed up with significant mineral discoveries. This dual approach – advanced data processing and solid operational capabilities – constitutes our distinctive exploration edge."


Claude Sarrazin, president and CEO, SIRCO.

Weighing in on the dominating demand from major players, Alain Carrier, co-founder of mining consultant company InnovExplo, stated: "The difficulty which junior companies are currently experiencing is definitely reflected in our client base. Today, one third of our client base are established producers such as IAMGOLD, Goldcorp, and Glencore. The junior companies that we are currently offering services to are companies that are already at advanced exploration stages or pre-feasibility stages, and they still have some financing."

The exploration sector is also moving away from the pick-and-shovel approach by adopting more efficient ways of gathering data. French drone manufacturer Drone Volt is developing designs specifically aimed at mining operations. "We have realized that the drone industry can offer more to the mining industry than what we are offering now," said CEO Martin Laporte. "Expertise and technologies within the two industries can be merged to develop systems which can provide optimized results in specific applications. Over the last few years, Drone Volt has been developing solutions like Thederd drone vertical take-off and landing drone call (VTOL) and autonomous charging systems for induction charging. The idea is that the drone can land on a docking station and charge itself without any human involvement."

Québec is home to numerous other French technology companies looking for a North American base – a natural fit due to language, proximity to Europe, and culture. CORALIS, specialists in production planning and monitoring software for the mining industry, has been operating in France for 30 years, and has responded to increasing demand from the North American market by recently opening a Montréal office. Guy Donatini, co-founder and president, is counting on CORALIS' newly developed cloud software to boost business development: "This technology offers our customers better access to our software and their data, and an even more efficient technical customer service…with its monthly payments, the miner's cash flow is improved."

Security: the evolving threats that must be addressed

As software continues to evolve and operations become increasingly reliant on technology, the issue of cybersecurity has become more vital, particularly for heavy industries that have high-risk data that affects global markets and thousands of people. However, the

Patrick Vena, damage insurance broker and VP, BFL Canada.

mining industry is still far behind when it comes to cybersecurity, according to Claude Sarrazin, president and CEO of SIRCO, the Montréal-based private investigation firm offering undercover services, computer forensics, and cybersecurity. In a staggering 96% of cases, SIRCO is able to break into its clients' systems when performing penetration testing, which illustrates the pertinent need to tighten security.

Patrick Vena, damage insurance broker and VP at BFL Canada weighs in on the issue: "The use of technology has progressively increased across all stages of mining operations, which has presented the sector with a wide range of new exposures."

Vena identifies the following primary concerns: loss of data or loss of access to data (financial, mining rights, etc.); disruption to supply chain; loss of communications; and loss of access to control systems and critical monitoring systems.

Security threats have been present long before the digital era, and SIRCO has conducted 21 training sessions related to narcotics over the last three months for companies in the mining sector alone, as more frequent testing for cannabis has seen positive results for other drugs such as methamphetamine and cocaine. In SIRCO's 27 years of experience, it has identified that around 10% of employees are problematic – deliberately breaking or vandalizing equipment, stealing company resources or benefitting from corruption. "This 10% represents most of a company's legal fees and insurance costs and can have a huge effect on profit margin and even the culture within an organization," said Sarrazin. "Security issues, whether internal or external, do not go away. You need to address them, and although they are not always high on the list of companies' priorities, it is vital that you stay on top of these risks before they turn into major issues," he concluded.

Environmental regulations drive growth for green technologies

The global drive away from higher carbon fossil fuels towards green-energy solutions transcends industries, and in a mining context has seen companies increasingly concerned about the environmental and economic costs of diesel fuel use, especially with government-imposed carbon-reduction legislation on the horizon.

Distributed Gas Solutions Canada (DGSC) is hoping to change this, and offers turnkey liquefied natural gas (LNG) and compressed natural gas (CNG) supply solutions for industrial and transportation end-users in Canada who are not served by pipeline infrastructure. DGSC was established in 2017 in a partnership created by three company partners: Hydromega Services, the Montréal-based renewable energy power producer; Galileo Advanced Solutions, the U.S.-based commodity supply chain arm of manufacturer Galileo Technologies; and Québec City-based Groupe Desgagnés, a marine transportation service company.

In November 2018, diesel fuel rack pricing was approximately C$21.50/GJ in Montréal, whereas natural gas was approximately C$5.50/GJ. In addition to the considerable cost benefits, Andrew Wilkins, DGSC's VP of business development, expanded on the environmental benefits that LNG offers: "CO2 reductions of up to 25%-35% and nitrous oxides (NOX) reductions of over 70% can be achieved. There is a virtual elimination of particulate matter (PM) and sulfur oxides (SOX), which are air pollutants that cause smog and human health problems."

More specific for the mining sector, the use of cyanide is increasingly being banned in progressive mining jurisdictions, and companies consequently face challenges in obtaining permits. Dundee Sustainable Technologies (DST) has developed two green processes for the treatment of materials in the mining industry: a cyanide-free gold extraction process and arsenic stabilization through a vitrification process. The company has already field tested the technology with the delivery of an arsenic plant to a customer operating in Africa, as well as the finalization of a second demonstration campaign on its gold extraction technology using chlorine. President and CEO Brian Howlett commented that DTS had experienced a recent upswing in demand from tier-one producers, not only as a prospective solution for the future but actual implementation. "DST is currently working on numerous quality projects that aim at implementing our process on a commercial basis."

Services

Engineering and consulting

Fednav Polar Class vessel in the Canadian Arctic. Photo courtesy of Fednav.

While the innovations dragging the mining industry into the twenty-first century come from companies of all sizes, the movers and shakers in the engineering and consulting space in Québec have a decidedly international footprint.

As service companies in the mining industry go, few have a global reach that compares with SGS, with 14,000 of its 95,000 employees dedicated to the minerals sector, 2,400 offices and laboratories around the world and operations in 14 locations across Canada. SGS' newest sample preparation facility opened in Val-d'Or in July 2018 and is being used as a base for its geological consulting services, an area that SGS intends to expand in 2019, according to Daniel Leroux, global business manager from SGS' Blainville office in Québec.

SGS plans to launch a new service within its geochem business line by March 2019, which will include on-site quick-testing capabilities, providing rapid information feedback to geologists so that they can make quicker decisions. Lawrence Ng, SGS' VP of minerals, highlighted the mini flotation pilot plant capabilities that SGS is adding to its existing pilot plant-testing expertise: "Mini flotation pilot plants deliver the same quality of engineering data as a large-scale pilot plant but only require a fraction of the sample volume typically required, saving substantial program costs," he stated.

A theme of consolidation became apparent in the engineering, procurement and construction management (EPCM) space during the downturn, as companies looked to expand their service offerings through M&A activity. One such case was DRA Global's acquisition of Montréal-based engineering firm MetChem in 2016, boosting DRA's lithium and graphite capabilities and adding a mineral resource and geology group to its portfolio. Daniel Gagnon, senior VP of mining, geology and Met-Chem operations at DRA Global, had been with Met-Chem for 19 years before the acquisition. He commented of the efficiency of the transition, due in part to a shared, hands-on philosophy and focus on innovation.

DRA Met-Chem is working with Nouveau Monde Graphite on its Saint Michel-des-Saints project – the first-ever all-electric, open-pit mine. Gagnon recounted Met-Chem's early-stage involvement as part of Nouveau Monde's task force committee: "We discovered that all the required technology and machinery existed and had been utilized in various other projects, but had not yet been brought together for one operation." The Saint-Michel-des-Saints graphite project, an important milestone for the global mining industry, is due to enter into production in 2021.

Stantec, the Canadian engineering and environmental services company with 22,000 employees globally, has grown its Québec operations through two acquisitions in recent years, the first being the acquisition of Des-

Daniel Leroux, global business manager, SGS.

Marie-Andrée Morin, VP minerals and metals, Ausenco.

sau's engineering assets in 2014, followed by Saguenay-based Cegertec in 2018. Kirk Morrison, Stantec's executive VP, touched on the benefits of having expertise and experience in a wide range of sectors: "Stantec is well placed to take advantage of the cross-pollination that is starting to happen between the power and mining industries," he stated.

The Montréal arm of Australian multinational EPCM company Ausenco is moving to a new office in 2019 to accommodate growth in the region. Ausenco's project delivery team in Montréal provides conceptual studies for clients such as Atlantic Gold at its Moose River Consolidated Gold project, an open-pit gold mine located 110 km northeast of Halifax, Nova Scotia. Marie-Andrée Morin, VP minerals and metals at Ausenco Canada, detailed the scope of the EPC contract that included the delivery of a 2-million mt/y carbon-in-leach gold-processing plant and associated infrastructure: "Working under a very tight schedule, we delivered the first gold pour on schedule in October 2017, 16 months after mobilization," she said.

Another engineering firm with Australian roots is Primero, which opened its North American headquarters in Montréal in 2017. Having developed a strong relationship with Galaxy Resources by working on its Mt Cattlin lithium mine in Western Australia, Primero was invited to work on Galaxy's James Bay project in northern Québec and decided it was an opportune moment to establish a North American base. Jacques Parent, general manager of Primero Americas, has witnessed the company grow from two employees to 22 in little over a year and hopes to triple those figures by the end of 2019. When asked to define Primero's business model, Parent responded: "We work from the standpoint of a partnership and prefer a client and engineer-constructor relationship, rather than a purely financial contracting endeavor."

Mining and engineering group Cementation, which also has a presence in Australia as well as the Americas and Africa, has worked with players like Falconbridge, Xstrata and Glencore and puts emphasis on the need for engineering to be more integrated into construction. "Getting involved in pre-feasibility, feasibility and peer review of the owner's plans is important to get an unbiased view of the budgets and schedule and a review by an experienced, reputable company," said Roy Slack, director at Cementation Americas.

In 2018, after having worked on the project for 20 years through different designs, Cementation America was awarded the design and construction of the new internal underground shaft for the Onaping Depth project at Craig mine, which is part of Glencore's Sudbury integrated nickel operations.

Commenting on the importance of a synergic relationship between company and cli-

Roy Slack, director at Cementation Americas.

ent, Michael Gignac, VP at Montréal-based consultancy firm G Mining Services, points to the importance of ensuring all information is shared and that resources are used efficiently at an early stage of the project. "G Mining provides resources to cover certain aspects of a project, and the client provides various complementary resources to reach mutually beneficial objectives," Gignac said. "Our approach replaces the common EPCM contract, which is a complicated legal agreement between project owner and contractors involving higher costs, duplication of resources in various departments and additional contracts."

Equipment providers

As investors become increasingly surgical with their placements and technological innovation has transformed into an integral part of the sector, pressure on mining companies is steadily rising – and thereby companies along the value chain. Cost efficiency and productivity are decisive success factors, and service providers are expected to provide increasingly tailored solutions. Upon its founding in 2016, HydroTech Mining, which specializes in the sale, design and production of pumping and dewatering systems, started by selling their own brand of dewatering pumps but soon noticed that clients wanted turnkey solutions. "We will go on-site as to see the operation, after which we will give the client a recommendation," said part-owner and president Cheyne Poirier. "We design, build and commission systems, and we also offer after sales services to our clients. Today, custom design systems contribute approximately 50% to our business."

Similarly, Major Drilling – one of the world's largest drilling services companies primarily serving the mining industry – shifted its focus around the year 2000 from geographical expansion to specialized drilling. "Looking at our customer base, we realized that numerous of our projects consisted of difficult drilling activities," said president and CEO Denis Larocque. "We saw that there was a niche market for specialized drilling services and then shifted our focus to this niche. We focused the company on higher end services that were difficult, deep and remote, which requires significant expertise."

Advancements in the service space is also an important factor in risk reduction. As pointed out by Dino Lombardi, VP at Val d'Or-based G4 Drilling Canada, the push for innovation and modernization is often towards safety and environment. "In the past, people were physically handling the diamond drill rods, but with innovation and automation, G4 Drilling has now incorporated mechanized robotic arms to handle the rods," Lombardi said. G4 Drilling recently added a R&D division which enables the company to do most of the development on our diamond drill rigs in-house. G4 has also expanded into drill and blasting services for open-pit mines with the purchase of a company called CCL Drill and Blast.

Continuing the theme of specialization, Québec-focused Manulift has singled in on the telehandler market and doubled its business both in revenue and size over the last five years. The company now has approximately 250 employees based in four locations; Montréal, Québec, Toronto and Calgary. "When providing equipment to the mining industry, we have to adapt the equipment as to comply to their rules, regulations and demands," said marketing and communications director Michel Robert. "We have an engineering team and all adaptations and tailor-made features are done in-house."

Due to the need for increasingly specialized services, coupled with the overall volatility of the sector, outsourcing has also risen steadily over the last decades. Making use of external expertise means more flexibility for mining companies that have to adapt to seasonality and fluctuating commodity prices. Mining contractor and equipment manufacturer CMAC-Thyssen Mining Group has grown to 800 employees and offers turnkey solutions. CMAC's services include blasting and drilling, underground infrastructure installations, excavation, shaft sinking and underground construction. "We also manufacture three types of drills and have five different models," added human resources director Guy Tremblay. "We started as a long-hole company, but over the last year, we have seen an increased demand for lateral development, and this is where most of our current revenues are coming from."

Logistics: all-season access to remote locations

Projects that mine commodities are first and foremost infrastructure projects, and in extreme climates, the logistical components of a mining operation are of fundamental importance. A lack of all-season road access has been a significant barrier to the development of multi-billion dollar deposits, such as the Ring of Fire in Ontario. In Québec and the surrounding provinces, specialized air and sea travel services have become a vital part of the value chain.

Montréal-based global shipping company Fednav celebrates its 75th anniversary in 2019, and operates a fleet of between 100 and 115 ships. Tom Paterson, Fednav's senior VP, ship owning, arctic and projects, outlined that any mining project that requires shipping needs in-depth planning from an early stage: "New ports close to the mine sites must be designed in harmony with the mining companies' needs, in order to ensure maximum output and cost efficiency," he explained.

Fednav ships approximately 2 million mt/y of base metal concentrates from various mines in remote locations across Canada and Alaska, such as Teck's Red Dog, Vale's Voisey's Bay, Glencore's Raglan and Canadian Royalties' Nunavik nickel mine. Fednav also supplies these mines with all of their consumable materials, including fuel.

For many communities and mining operations in northern Québec, air travel is the only means of transportation, due to a lack of infrastructure and extreme weather conditions that can reach -55 degrees Celsius.

One of the airlines providing vital air services to remote communities is Air Inuit, collectively owned by the Inuit of Nunavik through the Makivik Corporation, which has been in operation for 40 years. Air Inuit services an area the size of France, working with mining clients that include Glencore, Canadian Royalties, Tata Steel and the Canadian Government. Considering the extremity of the environment Air Inuit operates in, safety is paramount, and ensuring it has become the bedrock of the company. Pita Aatami, Air Inuit's president and CEO, assured that his airline consistently looks to improve safety, and its record speaks for itself: "In 40 years of service at Air Inuit, we are proud to have never suffered any major accidents," he stated.

Chrono Aviation began operations six years ago, and has worked with clients such as Nemaska Lithium, Osisko Mining, Stornoway Diamonds, Goldcorp and Rio Tinto. In 2019 it plans to add two more aircraft to a fleet that includes seven Pilatus PC-12s, two Beechwood

1900Ds, one Super King air 350 exec, one Dash 8, one Falcon 50 EX, and two 737-200s. Vincent Gagnon, president of Chrono Aviation, believes the airline competition in Québec is positive: "Our philosophy is that competition is healthy and it means that customers will get the best deals."

As the need for remote service providers increase, Sirius Wilderness Medicine has developed an expertise in medical services in hard-to-reach areas. Founded as a wilderness first-aid educational company in 1990, Sirius has expanded its model to include medical support services, training, and consulting for companies in developing emergency response plans, health and safety programs, as well as health promotion programs. "Sirius provides extra paramedic training to enable our responders to implement a different kind of care to what they are used to in an urban setting," said project director Yannick Sisla. "When they are at remote sites, they are typically regarded as the main medical resources and support."

As new mining regions are opening up in remote areas with sparse infrastructure, companies are increasingly in need of logistical solutions with short turnaround time and flexibility. Sprung Structures has designed and patented a fabric membrane technology that delivers rapid construction capabilities, total design flexibility, exceptional durability and longevity and lower overall project costs. "Large mine sites that we work with, such as Rio Tinto, value the product as they can install our structures in remote areas and never have to worry about them again. Conventional structures require routine maintenance," said Tom Lloyd, regional business development manager.

Sprung Structures operates in 120 countries with its Canada offices located in Toronto and Calgary. The structures are suited for Canadian climates as the product is insulated as part of the manufacturing process. "The standard sprung will operate, from energy efficiency standpoint, at 50% of the cost of standard/conventional."

Conclusion

With gold constituting the bedrock of Québec's mineral wealth, the region is set to benefit greatly from rising gold prices in the coming decade. Yet, with cannabis and cryptocurrency diluting the investor wellspring, junior exploration companies struggle to attract the funds needed to generate new, large-scale discoveries. While key gold mining areas such as the Cadillac Break and the Abitibi Greenstone Belt are far from being depleted, and companies such as Osisko and Eldorado Gold bring new mines into production, Quebec's mining sector has understood it needs to look beyond reliance on traditional gold mining to remain competitive. The government has already demonstrated its support of the mining industry, most notably with the economic development strategy, Plan du Nord, but also financial initiatives such as the 30% to 40% tax credit available for exploration activities. Québec also has the cheapest electricity in North America which is a substantial benefit as mines move towards diesel independence. In an industry previously known for its conservatism, electrification, automation and digitalization are increasingly being embraced and contribute to higher efficiency as well as mine safety. Maybe most important for Québec, the industry 4.0 revolution could potentially solve the region's labor shortage while also shortening Québec's lengthy permitting processes by bettering predictive capabilities. However, this shift is still in a nascent stage and miners struggle to meaningfully connect digitalization to the unique circumstances and challenges of the industry. As new technology and software companies enter the market, there is — in the words of Drone Volt's CEO Martin Laporte — a need for companies to "play with open cards so we can understand their requirements and build the right tools to offer the best solutions for their operations."

The metals that underpin emerging technologies are also garnering the most investor attention and Quebec is in a good position to ride the wave of future metals. The demand for electric vehicles is anticipated to exceed that of gas-powered cars already by 2030, and so far, China has been the quickest in securing a place on the future metals podium, controlling nearly half of global lithium production and 60% of electric battery production. China is also the primary global consumer of lithium. Eager to reduce oil imports and counter the country's chronic air pollution, China represents nearly 40% of passenger EVs sold in the last decade. But Québécois firms are side-stepping Chinese autocracy to build their own future metals market, with Nemaska and North American Lithium leading the way. This opens the door for downstream processing possibilities and, as mentioned by Sayona Mining's general manager Jonathan Gagné, a group of lithium companies is already detailing the plans to build a battery plant in Quebec. Such initiatives would greatly benefit a region where electricity is cheap and lithium is drawn from hard rock which has strategic market advantages over lithium brine deposits. However, new market entries coupled with the race for supplies also entail risks. While the drastic uptake in production has been driven by skyrocketing lithium prices, an oversupply could just as easily entail a price plummet if companies and governments make faulty prediction for future supply and demand. Lastly, Quebec-based mining companies are bound to profit from the opening up of Canada's northernmost regions. Fueled by the construction and operation of new mines, economic growth in Nunavut is forecasted to grow with an average of 4.6% in the upcoming five years and Yukon's economy will also experience a boom, with two new mines set to open within the next five years.