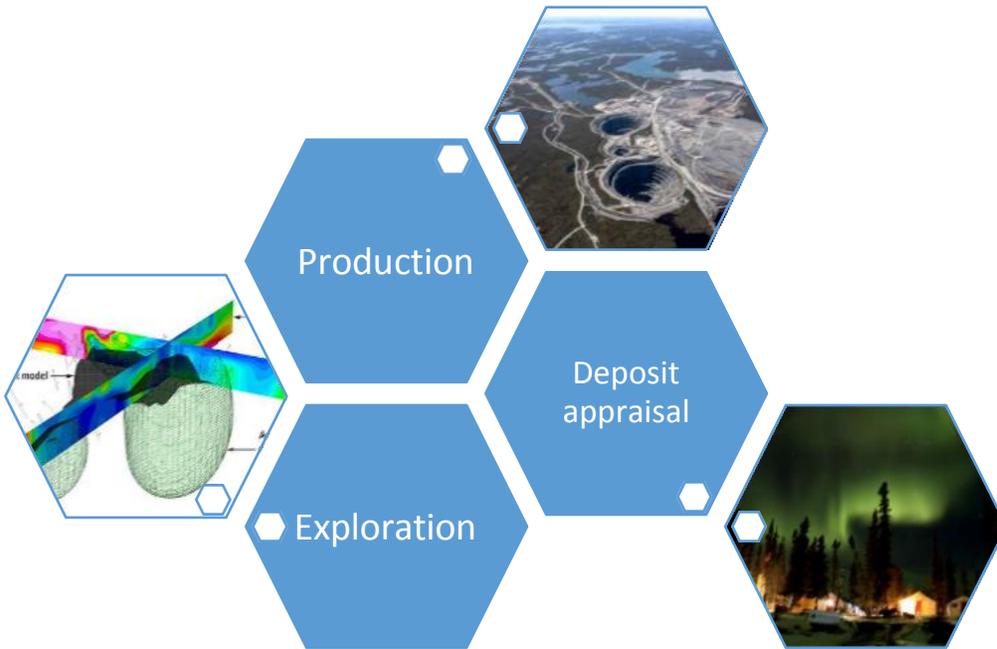


[All graphic titles in square brackets ([]) are translations of authors' free translations and therefore unofficial: translator]



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THE MINING INDUSTRY VALUE CHAIN

**Characterization and mapping of the Northwest Territories
mining sector's value chain**

April 11, 2015

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Cover photos:

Geophysical modelling: <http://www.aurorageosciences.com/services/geophysics/>, consulted April 8, 2015.

Nechalacho rare earth project camp: <https://financialpostcom.files.wordpress.com/2013/11/avalon-fp.jpg?w=620>, consulted April 8, 2015.

Ekati diamond mine: <http://norj.ca/2013/04/dominion-seals-deal-on-ekati-diamond-mine/>, consulted April 8, 2015.

EXECUTIVE SUMMARY

The mining history of the Northwest Territories (NWT) begins in the late 1930s, and the industry rolled along until the early 2000s. Then, with the discovery of diamond-bearing potential, the NWT began to experience a new mining rush that is still continuing. The mining industry represents more than 27% of the NWT GDP and provides jobs to several thousand People of the North. Despite those impressive figures, the NWT currently has only four operating mines. This mining industry value chain study will permit the improved focusing of support and development efforts.

Analysis shows that NWT mineral potential remains very high and promising. As for exploration, the NWT, just like the rest of Canada, has not escaped the world trend: there has been a considerable decrease in exploration spending in recent years but, because diamonds are in a very specific market rather isolated from the usual repercussions of the mining industry, the NWT is much better off than other regions with regard to mining.

The main results of this study highlight opportunities and strengths and threats and weaknesses, which are in the table below:

Opportunities and strengths	Threats and weaknesses
Rich mineral potential	Lack of infrastructure
Devolved federal powers	Unsettled land claims
Simplified legislative framework	Lack of professional and specialized workforce

Intuitively, we knew from the start that numerous business opportunities are accessible in all stages of the mineral development process for several supporting activities. Detailed analysis of the value chain by means of a grid, however, allows us to demonstrate that it is in asset and technology operation/maintenance and research and development activities where the greatest potential lies and where NWT businesses are less present.

We identified five strategic courses of actions:

1. Business partnerships
2. Revived exploration
3. [Promoting] Yellowknife as a hub of Northern development
4. Human resource development
5. Seizing identified opportunities

INTRODUCTION

The mining industry is a significant part of the NWT economy due to the diamond sector, in particular, developed in recent years. In the wake of adopting its NWT investment attraction strategy, the Conseil de développement économique des Territoires du Nord-Ouest (CDÉTNO) [NWT economic development council] then identified the mining sector as having a high economic influence and a strong potential for attracting investment.

Before implementing a development strategy and, above all, the actions it requires, it is important to completely understand the subject and sector in which one wants to be involved. That is why the CDÉTNO began a process that should allow the organization to know and understand the mining industry value chain, including the roles, connections and interactions of the various stakeholders in this activity sector.

Mandate

To help the organization in that process, CDÉTNO representatives gave us a mandate to carry out this NWT mining industry value chain study. To summarize, our mandate was to produce a document about the value chain showing the mining industry stakeholders and the connections they have with other stakeholders in the sector, more specifically, by:

1. Creating an NWT mining industry value chain, that is, establishing the most complete mapping possible of the main stakeholders of the NWT mining industry and the synergy among them;
2. Highlighting industry distribution channels ;
3. Suggesting business opportunities in the activity sector to the CDÉTNO.

Our mandate also meant that we had to [understand] the CDÉTNO investment attraction strategy and governmental mining industry development strategies.

Methodology

Our process involved three components, which overlapped but which were undertaken sequentially. First, we conducted a literature search, which helped us to better understand the specifics of the NWT mining industry. We then filled out that knowledge by collecting data from NWT mining companies. Last, we designed a grid to map and diagram the NWT mining industry value chain.

This report presents that process. It has five sections:

- Mining context: in the first part, we present the mineral development process, an overview of the industry (historical and current), the potential for attracting mining investment and the NWT mineral strategy;
- Mineral resources: this is a presentation of the mineral resources being mined or with the potential to be mined in the near future;
- Economy and employment: we provide an outline of the NWT economic structure and the benefits of the mining industry on the economy and employment;
- Mapping of the value chain: this section presents a summary of our methods and especially the results of our work, which not only includes mapping itself but also analysis of relations and synergies;
- Strategic courses of action and recommendations: last, we describe five strategic courses of action that must be started or continued.

MINING CONTEXT

Development process

Today, the identification of an ore deposit is a scientific, technical and financial challenge. Prospectors have given way to geologists and geophysicists. Detection equipment and satellites have replaced canoes. Working-class miners are gone, and a specialized workforce earning some of the best salaries of the society has taken their place. Engineering has integrated highly developed strategic management processes. Projects are planned and studied for years. Environmental impacts are anticipated, and mining sites are restored. In this context, a mine should be used to boost economic development and encourage the well-being of local and regional communities for years to come well beyond its closure.

The mining industry is probably one of the sectors in which uncertainty is the most prevalent. In fact, the only certainty is that the Earth's crust covers enormous mineral riches. However, that wealth is enclosed in the chemical complexity of rock and distributed unequally over the Earth's surface. Interest in a resource depends on the chance factors of the global economy, technological changes and world consumption trends of goods of all kinds: from steel beams to jewellery to electronic chips. In short, the mineral resource meets humanity's needs.

The mineral development process consists of identifying a geological anomaly in the Earth's crust and then turning it into products that can be used to assemble a complex [group] or consumer goods.

Obviously, a mine must be profitable, and that profitability depends on several factors, including:

- Resource quality (content and quantity);
- Depth of the deposit;
- Workforce productivity and cost;
- Metallurgical process and recovery factor;
- Royalties;
- Market price of the resource.
- Location in relation to infrastructure and markets;
- Availability, quality and cost of transportation and energy infrastructure;
- Nature of the rock;
- Cost of purchasing and maintaining equipment and infrastructure;
- Environmental and social costs;
- Etc.

Mineral development has several successive phases (Table 1), each with an output that reduces uncertainty and generates value, simultaneously facilitating the following financial phase. Therefore, increased certainty is convertible into cash, and so it is the driver of mineral development. Before the start-up of a mine and despite the absence of income, profit is possible for shareholders as their stock value increases.

Thus, during exploration and deposit appraisal, each phase depends directly on the success of the previous phase. The nature of the work is intended to explain and evaluate the coveted mineral resource. Deposit appraisal facilitates the design, planning and [forecasting] of the mining project. Financing is the determining element in designing the mining complex: enormous capital is required before those involved can even hope to expect any income, and the success of the process still remains uncertain. Once the mining complex is built, the pre-production phase (or [breaking-in]) facilitates the validation of the studies conducted during the deposit appraisal phase. This is probably the most critical part in the value chain. Once this phase has passed, commercial production begins, and the mine may generate income that will be used to amortize expenses and reimburse creditors. Therefore, mineral production may be sold, and profits are finally possible. We say "finally" because it is often more than 10 years after the start of exploration, sometimes more. Most mining companies sell a product that is ready for others to process, so the involvement of those companies in the value chain stops there. Of course, part of the profits will be reinvested in exploration to solidify the company's position on the market in the coming years.

Risk

The main characteristic over which a mining company has no control is the location of the resource. Of course, for abundant resources like gravel and sand, it is the proximity of markets and needs that determine operations. For economically viable concentrations of rare resources resulting from geological anomalies, the proximity of markets is much less significant. This explains why the leaders of companies like De Beers and Rio Tinto are interested in the diamonds of the Lac de Gras region. Ideally, a deposit that is difficult to access will have to have "world-class" characteristics¹ to justify the required investment for start-up. Furthermore, because the stock of most mining companies is publicly traded, shareholders' return is often one of the criteria to be considered before investing in the development of a particular project. The planet is a playground for the multinational corporations:

¹ That is, exceptional quality, meaning both size and content

the NWT therefore is in competition with other mining regions. We must also add to this the fact that, for large companies, the decision to invest in a mining project no longer depends on geological potential alone but also on the possibility of the overall reduction of operating costs and increasing mineral reserves to ensure continuity and profitability.

The exploration companies, usually much smaller, are also called "junior companies." They have very limited human and financial resources, rarely more than 10 employees and budgets that [fluctuate every few months], often under \$1 million. Investment in these companies is for seasoned investors or patient ones who can withstand some losses. Despite the high risk, investment remains attractive because the gains can sometimes be enormous. The success of an exploration project, therefore, partially depends on its funding but obviously more so on geological potential and success in each of the preliminary phases. Serious investors, however, are also going to evaluate the quality of the management and technical teams and the risk associated with mineral development in a given region.

To summarize, economic risk management throughout the mineral development process is a critical issue for both exploration and mining operations (Denommé, 2013).

National Instrument 43-101: *Standards of Disclosure for Mineral Projects*

In the 1990s, several incidents and cases of fraud arose regarding reported exploration results, the most well-known of which is the case of Canadian exploration company Bre-X in 1997. The results of exploration done in Indonesia suggested that a world-class deposit had been discovered, but it turned out that the reported results were false, leaving a large number of swindled investors. That led to a general loss of investor confidence in the mining industry and particularly Canadian mineral exploration companies on the Toronto Stock Exchange (TSX) and TSX Venture Exchange (TSXV).

In response to the situation, National Instrument 43-101: *Standards of Disclosure for Mineral Projects*² was developed. Nationally, the Canadian Securities Administrators (CSA) oversee provincial and territorial organizations. In the NWT, it is the Office of the Superintendent of Securities, which reports to the Department of Justice,

² Usually, the abbreviation 43-101, NI 43-101 or simply NI is used.

that is responsible for applying NI 43-101.³

One of the main objectives of the standard is to make sure that mining project declarations are made according to a standard that mining industry leaders and investors recognize. Specifically, it is a representation of the level of confidence in the public statements and technical reports that mining companies publish (Figure 1). The level of confidence reflects the progress of the project and may be correlated with the detailed phases of the value chain.

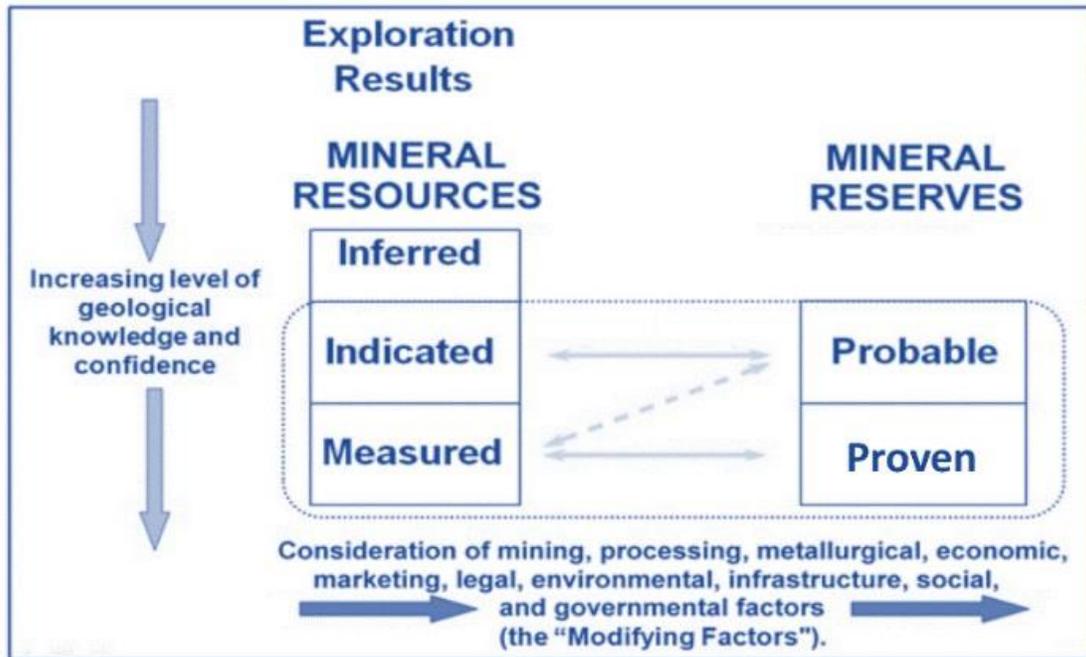


Figure 1: [Relationship between mineral resources and mineral reserves] (Canadian Institute of Mining, Metallurgy and Petroleum (CIM), 2014)

³ In the NWT government's French translation, the term "règlement 43-101," which the CSA use, is replaced with "norme canadienne 43-101."

Summary of the mineral development process

Table 1 summarizes the main characteristics of each phase of the mineral development process. To illustrate the mining industry value chain, we developed a value chain grid in which the different phases are more detailed (see the Value Chain Grid section and Appendix 1: NWT mining industry value chain grid and companies, March 2015).

Table 1: Main characteristics of mineral development phases

Primary activities	Geoscientific compilation	Preliminary exploration	Advanced exploration	Deposit appraisal	Design of mining complex	Mining operations	Site restoration
Abbreviation/s	GC	EX-1 to EX-4	EX-5	DA-1 to DA-4	DMC-1	DMC-2	DMC-3
Description	Geoscientific compilation, research and summaries	Targeted area prospecting and surveys and anomalies	Discovery and delineation of mineral deposit	Definition of deposit, project engineering and economic and feasibility study	Design of mining complex	Production and renewal of reserves	Production and renewal of reserves
Duration	One-10 years or more			Three-eight years	Two-three years	Five-100 yrs.	One year-perpetuity
Input	Suspected mineral potential	Maps, databases and geological anomalies	Indicators	Deposit	Mining project permits and capital	Mining complex	Tailings
Output	Maps, databases, tools and models	Indicators	Deposit	Feasibility study, mining project, permits and capital	Mining complex	Salable mineral production and tailings	Restored site
Involved parties	Governments and junior companies	Predominantly junior companies		Large companies gradually move in	Predominantly large companies and often partnerships		
Main risks	Not discovering deposit, and return on investment not guaranteed			Decision to stop too soon or too late	Financial, social, environmental, health and safety risks and lack of workers	Accumulation of other risks	Environmental risks
Level of confidence (NI 43-101)	Speculative and hypothetical	Inferred or presumed resource		Indicated and measured resources	Probable and proven reserve		NA
Technical documents		Technical report		Studies: preliminary economic, pre-feasibility and feasibility	Engineering of details	All types	Closure plan
Environmental permits	Various	Basic environmental study		Environmental impact and social impact studies	Environmental and social monitoring reports		Closure plan

Sources: Denommé, 2013, and Natural Resources Canada, 2014

Overview of NWT mining industry situation

History⁴

The NWT's enormity and geological diversity make them a place where mineral riches have been present for billions of years. The first inhabitants used those mineral resources. Arrowheads, scrapers and other sharp tools were made from argilite, chert, tuff and quartzite taken mainly along the length of the Mackenzie River Valley. The Inuit and Dene used the local copper to make knives or for trading. As it still is today, Aboriginal art objects were made from soapstone, talc and limestone.

Beginning in the 17th century, part of the current NWT was part of what the British called Rupert's Land. The British, who began the occupation of most of present-day Canada, contributed greatly to development, specifically, the Hudson's Bay Company, which built numerous trading post in strategic locations, although its owners were more interested in buying furs from the Aboriginal peoples than in mineral resources. The boundaries of this land changed depending on political vicissitudes. After 1898, the gold rush in the Klondike region of the Yukon encouraged some prospectors to travel the main watercourses of the Great Slave Lake region. High-content indicators were identified in Yellowknife Bay and Pine Point (today Hay River), but the Klondike madness made those discoveries quickly forgotten.

In the 1920s, the discovery of oil at Norman Wells and the availability of numerous airplane pilots returning from the First World War facilitated prospector access to several isolated parts of the NWT. In 1933, at the Eldorado mine in the Cameron Bay area on the eastern shore of Great Bear Lake, they started digging ore and processing radium, copper and silver (and uranium starting in 1942). It was the first mine in the NWT.

In the early 1930s, prospectors became interested in Yellowknife Bay again. In 1935 during mapping of the region, Dr. Alfred Jolliffe of the Geological Survey of Canada saw gold, and a gold rush ensued. In 1937, the city of Yellowknife was founded, and the Con mine started up in 1938: it was the first gold mine in the NWT. In the following years, numerous mining operations began: Negus (1939), Ptarmigan (1941), Thompson-Lundmark (1941), Giant (1948) and Discovery (1950). The Con and Giant mines ceased their operations in 2003 and 2004, respectively.

⁴The information in this section comes from the NWT Mining Heritage Society, 2015.

Besides gold, numerous minerals were taken from the ground: silver, zinc, lead, nickel, uranium, tungsten and diamonds. The figure below shows the mines that were or still are in operation in the NWT and Nunavut.

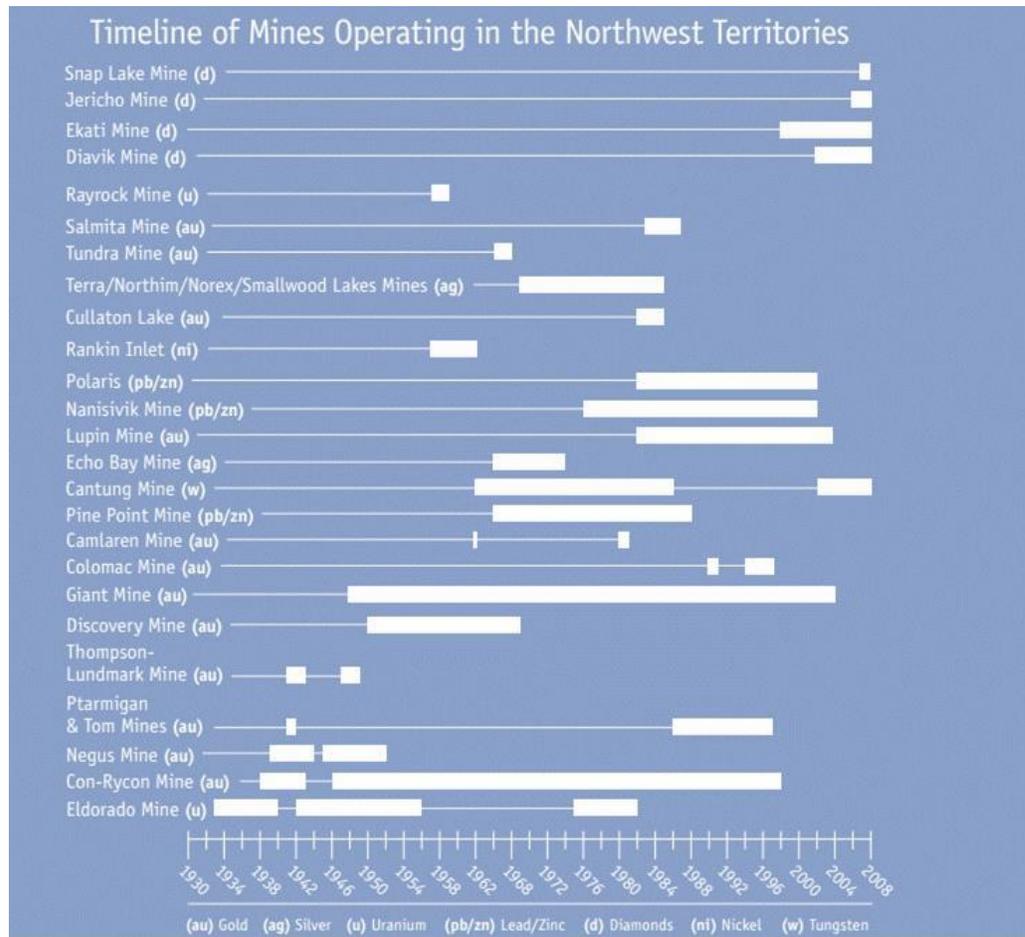


Figure 2: [Mines that were operated or are still operating in the NWT and Nunavut] (NWT & Nunavut Chamber of Mines, 2008)

The diamond rush

In the 1980s, Chuck Fipke relentlessly looked for diamonds by sampling till⁵ in various parts of the NWT. The objective was to identify a kimberlite train that glaciers had left behind. In 1989, his tenacity paid off when he found diamonds in the Lac de Gras area northeast of Yellowknife. Following that discovery, the biggest rush of staking out in Canadian history took place there in 1992. Ekati, the first diamond mine in Canada, opened in 1998, and then

⁵ Layer made up mostly of gravel and sand resulting from the glacial erosion of rock

there was Diavik in 2003 and Snap Lake in 2006. Those mining complexes are still in operation, and others, like Gahcho Kué, will soon follow.

The growth of the world population and the development of new technologies have led to a demand for mineral resources such as rare earth, cobalt, tungsten and other, more traditional metals. Although already proven to be rich and still promising, the mineral potential of the NWT has not been completely revealed.

Current mines and mining projects

The mining industry is the economic driver of the NWT, and the modern history of the NWT is closely associated with that industry. The mineral wealth of the territories is still greatly underestimated. In this section, a short description of the mining industry is provided: NWT mining projects, the NWT position on the world scale and the mineral strategy of the territorial government.

Main NWT mining projects

The tables below summarize NWT mining projects according to their progress (see also the mining tenure map in Appendix 2. We have included some advanced projects in Nunavut, mostly located in the Yellowknife/Cambridge Bay corridor and, considering their geographic position, there is a natural economic connection with the NWT, especially Yellowknife. We have also included the Agnico Eagle projects a little more to the east because several stakeholders with whom we met mentioned them as an example to follow in terms of mineral development. Furthermore, the Agnico Eagle projects in Nunavut are partially connected with the Val-d'Or airport in the Abitibi-Témiscamingue region of Quebec, a region with which the CDÉTNO would like to reinforce its association.

These mines and projects, even the less advanced ones, all have primary importance to the NWT economy because they generate projects and value. The managers of those mining operations and projects are the originators of the value chain and orchestrate its entirety by raising funds on the stock market or selling their production. Economically, the mines in production are important in the immediate term, as the deposit appraisal projects are in the medium term and the exploration projects in the long term.

Table 2: [NWT mines in production (DMC-2)]

Mine	Company	Commodity	Location	Description	Jobs	Predicted closure
Ekati	Dominion Diamond Corporation (DDC)	Diamonds	Lac de Gras: 310 km NE of Yellowknife	The first and biggest diamond mine in Canada, underground and open-pit	1,400	2020
Diavik	Diavik (2012) Inc. (DDC and Rio Tinto)	Diamonds	Lac de Gras: 300 km NE of Yellowknife	Largest producer of diamonds in Canada, 100% underground since 2012	1,000	2023
Snap Lake	De Beers Canada	Diamonds	220 km NE of Yellowknife	First completely underground diamond mine in Canada	750	2028
CanTung	North American Tungsten	Tungsten and copper	Nahanni area on NWT-Yukon border	Only tungsten mine in North America	-	2017

Source: NWT & Nunavut Chamber of Mines, 2015

Table 3: [NWT advanced appraisal (DA-4) and construction projects (DMC-1)]

Project	Company	Commodity	Location	Description	Anticipated	Predicted closure
Jay (Ekati)	Dominion Diamond Corporation (DDC)	Diamonds	Lac de Gras: 310 km NE of Yellowknife	An extension, not a new mine, to extend the life of the Ekati mining complex by 10	Construction expected to start in 2017	2030
Gahcho Kué	De Beers Canada and Mountain Province	Diamonds	180 km NE of Yellowknife	Most of the construction should be done by the end of 2015. Jobs: 700 in construction and 400 in mine	2016	2028
Nechalacho	Avalon Rare Metals	Rare earth	Near Slave Lake SE of Yellowknife	Underground mine ready for construction, not financing, 200 jobs	-	-
NICO	Fortune Minerals Ltd.	Cobalt, gold, bismuth and copper	50 km NE of Wha Ti	Underground and open-pit mine ready for construction, waiting for financing 150 jobs	-	-
Prairie Creek	Canadian Zinc Corporation	Zinc, lead and silver	120 km W of Fort Simpson	Underground mine ready to construct, waiting for financing 220 jobs	-	-

Source: NWT & Nunavut Chamber of Mines, 2015

Table 4: [NWT appraisal projects]

Project	Company	Commodity	Location	Progress ⁶
Yellowknife Gold	Typhee Corp.	Gold	90 km NE of Yellowknife	DA-3
Pine Point	Tamerlane Venture	Zinc and lead	East of Hay River	DA-3
Courageous Lake	Seabridge Gold (NWT) Inc.	Gold	Slave Lake	DA-2, DA-3
Wrigley	Devonian Metals Inc.	Zinc and lead	Wrigley	DA-1

Source: NWT Centre for Geomatics, 2015, and corporate websites

Table 5: [Advanced exploration projects in the NWT]

Project	Company	Commodity	Location	Progress ⁷
Indin Lake	Nighthawk Gold Corp.	Gold	200 km N of Yellowknife	EX-4, EX-5
Lac de Gras	Peregrine Diamonds Ltd.	Diamonds	Lac de Gras	EX-4, EX-5
Nickel King	Strongbow Exploration Inc.	Nickel, copper and cobalt	45 km NE of Stony Rapids, Saskatchewan	EX-5, DA-1

Source: NWT Centre for Geomatics, 2015, and corporate websites

Table 6: [Preliminary exploration projects in the NWT]

Project	Company	Commodity	Location	Progress ⁸
Lac de Gras	Almaden Minerals	Diamonds	Lac de Gras	EX-4
HOAM Project	Olivut Resources Ltd.	Diamonds	Fort Simpson	EX-4
Thompson-Lundmark Gold Mine	Perlis Enterprise Inc.	Gold	48 km N of Yellowknife	EX-4
Bear property	Silver Bear Mines Inc.	Silver and zinc	110 km NE of Yellowknife	EX-4
Sunrise Lake	Silver Standard Resources Inc.	Silver and gold	130 km NE of Yellowknife	EX-4
Grodon Lake	Boxxer Gold Corp.	Gold		EX-3, EX-4
Monument	New Nadina Explorations Limited	Diamonds	Lac de Gras	EX-3, EX-4
Kennady North	Kennady Diamonds Inc.	Diamonds	200 km NE of Yellowknife	EX-3
Hepburn	Adamera Minerals Corp.	Silver, copper and IOCG ⁹	470 km N of Yellowknife	EX-3
NWT Redemption Diamond Project	Arctic Star Exploration Corp.	Diamonds	Lac de Gras	EX-3
Mazenod	BFR Copper & Gold Inc.	IOCG	Great Bear Lake	EX-3
The Anomaly	Darnley Bay Resources Limited	Base metals	Paulatuk	EX-3

⁶ According to authors' interpretation based on available information

⁷ According to authors' interpretation based on available information

⁸ According to authors' interpretation based on available information

⁹ Iron oxide copper gold, a type of mineralization

Project	Company	Commodity	Location	Progress ⁸
Diamonds	Darnley Bay Resources Limited	Diamonds		EX-3
AB Project	Eagle Plains Resources Ltd.	Zinc, lead and silver	263 km E of Norman Wells	EX-3
Bear-Twit	Eagle Plains Resources Ltd.	Zinc, lead and silver	186 km SE of Norman Wells	EX-3
Bronco	Eagle Plains Resources Ltd.	Zinc, lead, silver and copper	230 km SW of Norman Wells	EX-3
Justice	Eagle Plains Resources Ltd.	Zinc, lead and silver	209 km SW of Norman Wells.	EX-3
Keg	Eagle Plains Resources Ltd.	Zinc, lead and silver	185 km SW of Norman Wells	EX-3
Tom and Sickle	Equitas Resources Corp.	Gold	10 km NE of Yellowknife	EX-3
Mackenzie Mountains	Metallis Resources Inc.	Iron and copper	190 km [?] of Norman Wells	EX-3
Lac de Gras	North Arrow Minerals Inc.	Diamonds	Lac de Gras	EX-3
Redemption	North Arrow Minerals Inc.	Diamonds	Lac de Gras	EX-3
Jax Lake	Pelican Minerals N.W.T. Inc.	Gold	250 km NE of Yellowknife (Courageous Lake)	EX-3
Yellowknife City gold project and Northbelt	TerraX Minerals Inc.	Gold	Yellowknife	EX-3
Article 41 Lands	Transition Metals (HTX Minerals Corporation)	Diamonds	360 km NE of Yellowknife	EX-3
Selwyn Recce Project	Aben Resources Ltd.	Gold, silver and tungsten	Yukon border	EX-2, EX-3
Six NWT projects	Canterra Minerals Corporation	Diamonds	Snap Lake area	EX-2, EX-3
Horton River	Talmora Diamond Inc.	Diamonds	150 km S of Paulatuk	EX-2, EX-3
Redstone	Copper North Mining Corp.	Copper and silver	Nahanni area	EX-2
Margaret Lake	Margaret Lake Diamonds Ltd.	Diamonds	300 km NE of Yellowknife	EX-2
Indian Mountain	Panarc Resources Ltd.	Zinc, lead, silver and copper	East of Great Slave Lake	EX-2
Sunset Yellowknife	Panarc Resources Ltd.	Gold and iodine	115 km ENE of Yellowknife	EX-2
Myrt Lake	Panarc Resources Ltd.	Gold and iodine	East of Yellowknife	EX-2
Purple Onion	Scavo Resource Corp.	Zinc and lead	200 km SW of Norman Wells	EX-2
Eldorado & Contact Lake (12 sub-sections)	Alberta Star Development Corp.	IOCG and uranium	Eastern shore of Great Bear Lake	EX-1, EX-4
Gold, Nickel and VMS (NT)	GGL Resources Corp.	Gold, nickel and VMS ¹⁰	-	-
Diamonds (NT)	GGL Resources Corp.	Diamonds	-	-
Camsell River	DEMCo LTD.	IOCG	SE of Great Bear Lake	-
Kim	Geomark Exploration Ltd. / Pine Cliff Energy LTD.	Gold	200 km S of Yellowknife	-

Source: NWT Centre for Geomatics, 2015, and corporate websites

¹⁰ Volcanogenic massive sulfide (type of mineralization)

Table 7: [Nunavut mines and advanced mining projects located in the Yellowknife area of influence]

Mine/Project	Company	Commodity	Location	Description	Progress
Meadowbank Mine	Agnico Eagle Mines	Gold	330 km W of Hudson's Bay and 70 km N of Baker Lake	Open-pit mine An extension is planned. 763 jobs	DMC-2 In operation since 2010
Medialine Project	Agnico Eagle Mines	Gold	25 km NE of Rankin Inlet near Hudson's Bay	Possibly an open-pit and underground mine 1,000 construction jobs and 700 mine jobs	DA-4 Waiting for permit
Doris North Project/Hop e Bay	TMAC Resources	Gold	130 km S of Cambridge Bay	Finalization of pre-feasibility study in early 2015 and decision during the year: if so, start of production planned for 2020 485 mine jobs	DA-3 Pre-feasibility study
Back River Project	Sabina Gold and Silver Gold	Gold	60 km E of the Hackett River Project	1,600 construction jobs and 900 mine jobs	DA-4 Reception of environmental permits from authorities expected in 2015
Hackett River Project	Glencore	Zinc, silver, copper and lead	Hackett River (S of Bathurst Inlet)	One of the largest undeveloped VMS formations [in the NWT] Open-pit mine	DA-3 Pre-feasibility study started in September 2012
Izok Corridor Project	MMG Resources Inc.	Copper, zinc, gold and silver	High Lake: 190 km ESE of Kugluktuk Izok: 255 km SW of Kugluktuk	MMG re-evaluated the project and said they need infrastructure to proceed. 1,140 construction jobs and 710 mine jobs	DA-?
Lupin & Ulu	Elgin Mining, acquired in September 2014 by Mandalay Resources	Gold and silver	SE of Kugluktuk	Lupin is an old mine that produced 3.7 MOZ. Ulu has 751,000 tonnes of indicated resources.	DA-1

Source: NWT & Nunavut Chamber of Mines, 2015

Presentation of mine operators

This section presents the companies operating mines in the NWT: Dominion Diamond Corporation, Diavik Diamond Mine (2012) Inc. (Rio Tinto), De Beers and North American Tungsten. It is intended to clarify in what context NWT mines operate.

Dominion Diamond Corporation

Dominion Diamond Corporation (DDC) is a Canadian company with its head office in Yellowknife. It was founded in 1994, the year when the Diavik [deposit] was discovered. At first, the company name was Aber Diamond Corporation, but the name was changed in 2007 to Harry Winston Diamond Corporation after the 100% acquisition of Harry Winston Inc., a luxury jewellery company, in 2006. In 2013, after the acquisition of the Ekati Mine, then operated by BHP Billiton, the company took its current name.

DDC holds 80.9% of the Ekati Mine and 40% of the Diavik Mine through its subsidiary, Dominion Diamond Diavik Limited Partnership. The rough diamonds it produces are sold in Canada, Belgium (Anvers) and India (Mumbai). To maximize the value of its rough diamond sales, management deals directly with diamond manufacturers, that is, those who cut and polish diamonds. DDC is the number three producer of rough diamonds in the world, based on value.

To guarantee the integrity of the Canadian diamond industry, DDC has implemented the CanadaMark program. CanadaMark diamonds are mined in Canada, are natural and not treated, monitored from the mine to retail sale and comply with quality standards.

To extend the Ekati Mine's lifespan, the Jay Project is in the permit phase. The Cardinal Project was abandoned due to significant environmental impacts. DDC is also working on the Pigeon and L[y]nx projects. In 2013, the end of construction work on the Misery Project contributed to reducing Northern expenses. All these projects are located in the NWT near the Ekati mining complex in the Lac de Gras area (Dominion Diamond Corporation, 2015).

Diavik Diamond Mine (2012) Inc. and Rio Tinto

Diavik Diamond Mine (2012) Inc. (DDMI) manages operations of the Diavik Mine. DDMI is a wholly-owned subsidiary of Rio Tinto. Rio Tinto owns 60% of the Diavik Mine, and Dominion Diamond Corporation owns 40%. DDMI has its head office in Yellowknife, and Rio Tinto's is in London, England. The latter company operates in more than 20 countries and mines aluminium, iron, copper, coal and several other minerals. Rio Tinto is a major international mining company, with more than 60,000 employees and 140 years of history (Rio Tinto, 2015).

Rio Tinto has complete or partial ownership of three diamond mines and one project being developed:

- Argyle (100%), Australia
- Diavik (60%), Canada
- Murowa (78%), Zimbabwe
- Bunder (in development), India

Most of the diamonds Rio Tinto sells are rough. The sales of those diamonds are centralized in London. Approximately 10 times a year, Rio Tinto management sells its rough diamonds in Anvers, Belgium. To maintain the "national identity" of its diamonds, Rio Tinto's mines are operated independently, which allows for better monitoring of production, mining complexes and polishing. More than two-thirds of Rio Tinto diamonds are cut in India. The Mumbai office takes care of liaison with brokers, diamond manufacturers and exporters.

In 2006, Rio Tinto managers implemented the Select Diamantaire Mark® registered trademark certifying that the diamonds were produced according to the highest health and safety, environmental and social issue standards (Rio Tinto, 2015).

It should be noted that Rio Tinto Exploration operates in more than 20 countries and has 500 employees. Besides generating exploration projects, those in charge of such matters evaluate opportunities for acquisition and partnerships. Their objective is to discover an average of one Tier 1 deposit annually, that is, a deposit contributing disproportionately to the world production of a product based on its size and content (Rio Tinto, 2013).

De Beers Canada Inc.

De Beers Canada Inc., established in 1998, is 100% owned by the De Beers Group of Companies, which was founded in South Africa in 1888. De Beers Canada Inc. operates the Snap Lake diamond mine, the first De Beers Group mine located outside the African continent. In partnership with Mountain Province Diamonds Inc. (49%), De Beers Canada management is developing the Gahcho Kué Project. De Beers also operates the Victor diamond mine in northwest Ontario near Attawapiskat on the west shore of James Bay. The head office of De Beers Canada Inc. is in Toronto.

De Beers workers have been conducting mine exploration in Canada since the early 1960s. In the 1980s, the company incorporated to become De Beers Canada Exploration Inc. They have identified more than 230 kimberlites in Canada, more than half of which contain diamonds. It should be noted that only one kimberlite out of 200 has economic potential and so of becoming the mine. Currently, De Beers exploration is going on at the Victor mine with the Victor Extension Project. Within a 25 km radius of the Victor mine, 16 kimberlites were identified in the late 1980s (De Beers Canada Inc., 2015). Today,

De Beers Canada carries out the whole process from preliminary exploration to rough diamond production. Since 2013, rough De Beers diamonds, including those from Canada, are sold in Gaborone, Botswana.

In the early 2000s, De Beers was greatly involved in implementing the Kimberly process, a certification intended to eliminate from the market rough diamonds coming from conflict zones, the sale of which armed groups use to fund themselves. All of De Beers world production is certified as "conflict-free" and meets the requirements of international law and the Kimberly process (De Beers Group of Companies, 2014). Based on value, De Beers produces approximately one-third of the world's rough diamonds, those diamonds being sold in Gaborone facilities 10 times a year.

De Beers Group of Companies, the parent company, is active throughout the world diamond value chain, from exploration to jewellery sales. It employs more than 20,000 people across the globe (De Beers, 2015). Its head office is in Luxembourg, but the corporate centre is in London. The two sole shareholders of De Beers are Anglo American (85%) and the Government of the Republic of Botswana (15%). The Oppenheimer family, shareholder since 1926, sold its shares to Anglo American in 2012. Ernest Oppenheimer founded Anglo American in 1917 to mine an ore deposit in South Africa. Its head office is in London. The company is active in 15 countries and, besides diamonds, its personnel produce iron, manganese, coal, copper, nickel, niobium, phosphate and platinum (Anglo American, 2015).

North American Tungsten Corporation Ltd.

North American Tungsten Corporation Ltd. (NATCL) operates the CanTung tungsten mine, a project it acquired in 1997, in western NWT a few kilometers from the Yukon. CanTung is one of the largest tungsten mines outside China. The mine's mineral reserves will support operation until 2017. Additional exploration work and the market conditions for tungsten could increase the CanTung Mine's lifespan. The company has no other mines but is currently developing the MacTung Project 160 km north of the CanTung Mine in the Selwyn Mountains in the Yukon near the NWT border. In 2014, the Yukon authorities issued environmental authorizations for the project. The NATCL head office is in Vancouver (North American Tungsten Corporation Ltd., 2015).

NWT mining investment attractiveness

Besides discussing mine operators, we believe that an adequate portrait of a mining region should also cover investor and industry stakeholder perceptions. The *Fraser Institute Annual Survey of Mining Companies: 2014* evaluates and classifies

122 mining jurisdictions in the world according to the interest that geological potential raises and governmental incentives and policies. At the Canadian level, the NWT is number six out of 12 jurisdictions (Figure 3) but, on the world level, the NWT is near the head of the pack, 15th out of 122. Saskatchewan, with the best Canadian performance, is second behind Finland. The NWT is constantly moving up. In 2010, it was 30th out of 79.

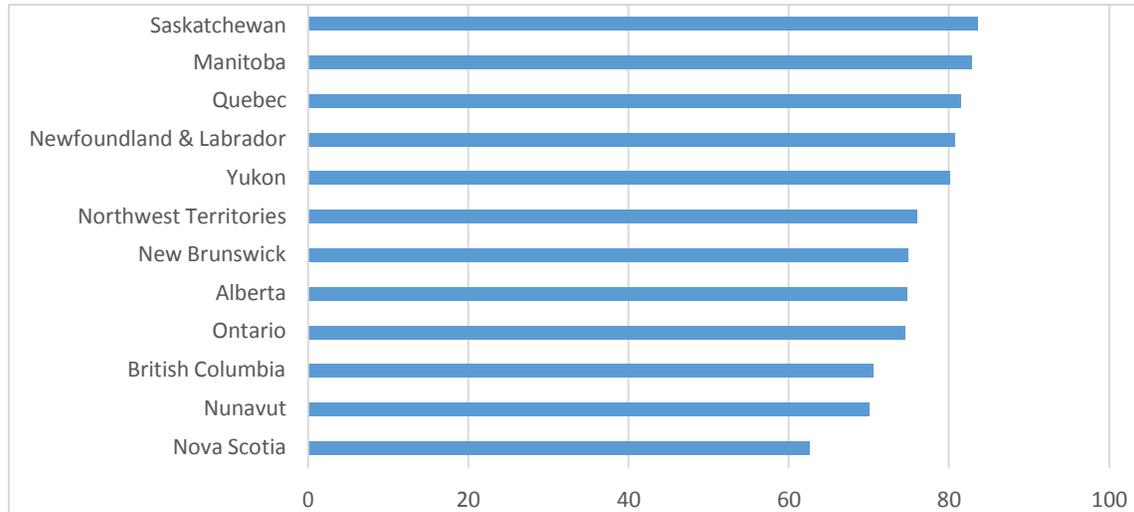


Figure 3: [Classification of Canadian mining jurisdictions based on investment attractiveness index] (Jackson & Green, 2015)

Also, the Fraser Institute survey classifies jurisdictions by their mineral potential and the perception of the world's mining stakeholders. The NWT is classified as fourth out of 122 with regard to mining company executives' perception of mineral potential. At the Canadian level, the NWT is second out of 12. This index only considers geology. The NWT does not do as well with regard to political factors: 38th out of 122 at the world level and 11th out of 12 at the Canadian level. There are several indicators such as regulatory framework, royalties, land claims, protected areas, infrastructure, geoscientific data quality, workforce availability, etc.

NWT mineral strategy

With the devolution of federal powers and mineral resource responsibility (and probably also in response to mining industry stakeholders' poor reception of the NWT), the territorial government has developed a mineral strategy. One of its main objectives, if not the primary one, is to unblock NWT mineral potential to attract investment, especially in exploration. Therefore, the government would like to ensure the sustainable prosperity of the territories. The strategy is based on five pillars that should allow identified needs to be met (Department of Industry, Tourism and Investment, 2013):

1. Creating a Competitive Edge
2. Establishing an Improved NWT Regulatory Environment
3. Enhancing Aboriginal Engagement and Community Capacity Building
4. Promoting Sustainability
5. Enriching Workforce Development and Public Awareness

Legislative framework

Since April 1, 2014, the administration and control of lands and public resources, which used to be under the jurisdiction of Aboriginal Affairs and Northern Development Canada (AANDC), is now the responsibility of the Government of the Northwest Territories. The transfer of powers, also called devolution, includes the administration, control and management of onshore land, waters, minerals and petroleum resources in the NWT.

The main federal act previously governing the mining industry, both exploration and operation, was the *Territorial Lands Act* (R.S.C., 1985, c. T-7). Following the devolution of federal powers, it is now the *Northwest Territories Act*, in particular, the *Mining Regulations*, NWT Reg 015-2014, which define the requirements with which the mining industry must comply (Government of the NWT, Department of Justice, 2014).

Mineral tenure (exploration and operation)

Mining exploration and operation in the NWT are regulated in four steps:

- Prospecting license
- Prospecting permit
- Mining claim
- Mining lease

The first step is to obtain a prospecting licence, which authorizes the holder to prospect for minerals on public lands open to mining exploration. A prospecting licence is also required to obtain other types of mining tenure. It may be granted to an individual or corporation. It must be renewed annually and is never transferable.

The prospecting permit bestows an exclusive right to prospect and register mining claims within a defined area for

a determinate period: three years south of the 68th parallel and five years north of the 68th parallel. Prospecting permits are not renewable: depending on the execution of the required work,¹¹ an area in which the holder is still interested must be converted into one or more mining claims before the expiration of the permit. Unlike the prospecting licence, the prospecting permit may be transferred, but the new holder must also hold a prospecting licence.

The next step, the mining claim, is the last regulatory level of mining exploration. A claim, precisely set out, grants the holder the exclusive right to prospect and appraise the minerals found there. Any holder of a valid prospecting licence may stake out a claim of a maximum area of 1,250 hectares on public lands open to exploration and not already part of another claim or subject to another prospecting permit. As mentioned above, only the holder of a prospecting permit can register a claim in the area his permit covers. As with permits, claims are also transferable to other parties. Keeping a claim valid first requires the annual execution of the work the regulations require and then the presentation of a report on that work, the filing of an evaluation report and the payment of fees.

The last step is to obtain a lease. If it is possible to get some ore from a claim, only a lease then allows full commercial mining operations. As with the prospecting permit and claims, mining leases are subject to regulatory requirements on the nature and value of the work carried out. Staking out is no longer enough, and a survey of the claim must be duly performed and registered before a lease is issued. That lease is valid for 21 years but may be renewed. Furthermore, maintaining a lease requires the annual payment of \$250 per hectare for the first lease and five dollars a hectare for a renewed lease.

Resource co-management

One of the most significant differences distinguishing environmental management in the NWT compared to elsewhere in Canada is the fruit of negotiations with Aboriginal peoples and is based on two fundamental principles (Mackenzie Valley Land and Water Board, 2015):

1. Integration and coordination;
2. Governmental and Aboriginal resource co-management.

¹¹ The *Northwest Territories and Nunavut Mining Regulations* (C.R.C., c. R516) determine that work.

Therefore, sustainable development is a condition for obtaining social acceptability for projects. That acceptability is specifically contingent upon the developer's obligation to negotiate and reach impact and benefit agreements with the concerned Aboriginal peoples. Then, besides the mining tenure for mineral resource exploration and operations, there are also environmental protection requirements: so the concept of water use and land use licensing is integrated.

NWT Aboriginal peoples

According to the Statistics Canada *2011 National Household Survey*, 21,200 people (51.9%) in the NWT reported an Aboriginal identity. The Aboriginal people of the NWT are the Inuvialuit, Dene and Métis. The Dene, who form one nation, include several peoples: Chipewyan, Tlicho (Dogrib), Det'on Cho (Yellowknife), Dehcho (South Slavey), Gwich'in and Sahtu (North Slavey).¹²

¹² <http://www.practicenorth.ca/index.php?page=aboriginal-culture-en>

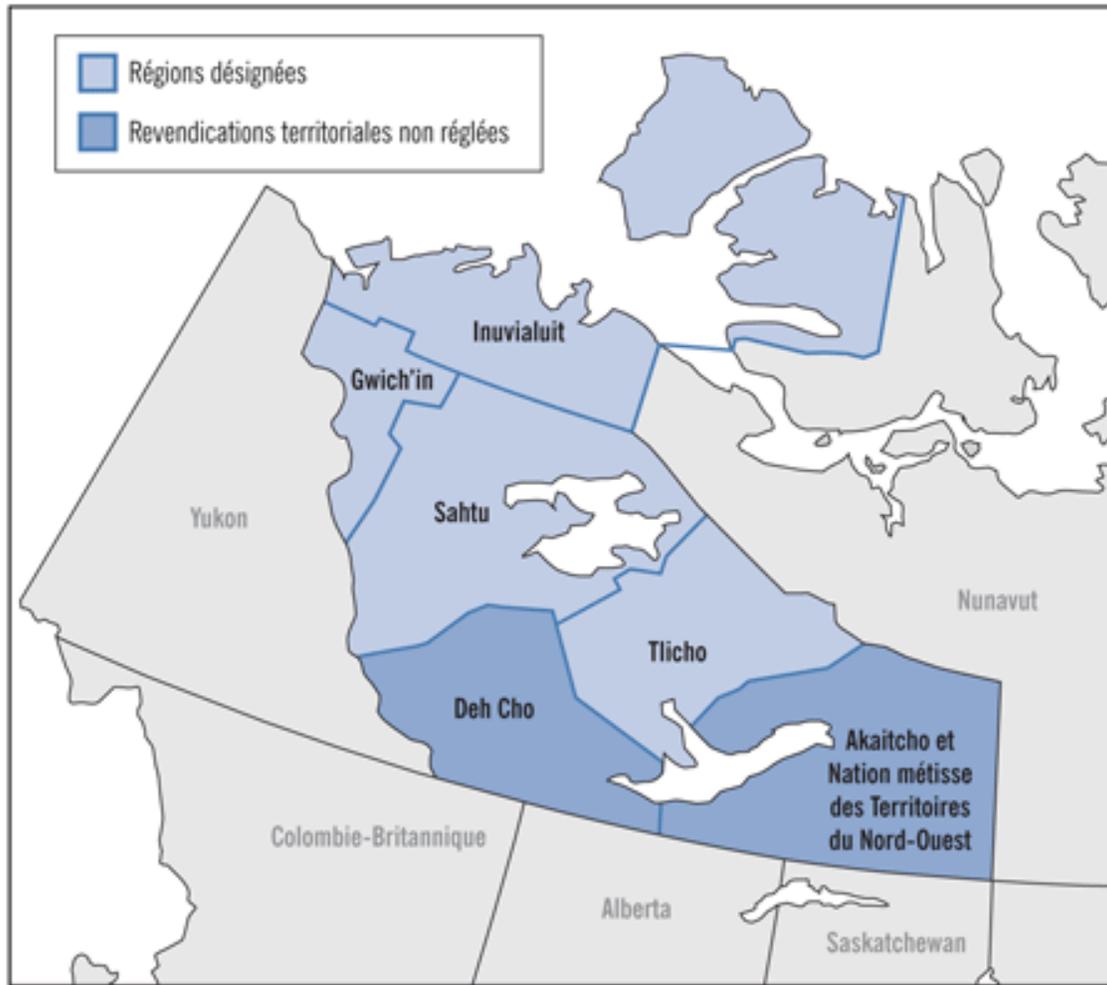


Figure 4: [Map of traditional NWT Aboriginal territories] (Auditor General of Canada, 2010)

Land and water boards

Therefore, the co-management of resources is orchestrated through the direct participation of the Aboriginal peoples in the regulatory process. Permits are currently under the control of land and water boards: the Mackenzie Valley Land and Water Board (MVLWB) and the Gwich'in, Sahtu and Wek'eezhii Land and Water Boards.¹³ Figure 5 below illustrates the areas of influence of the different offices.

¹³There is also the Inuvialuit Regional Corporation, which is responsible for the management of lands and waters in the northern NWT (Inuvialuit region).

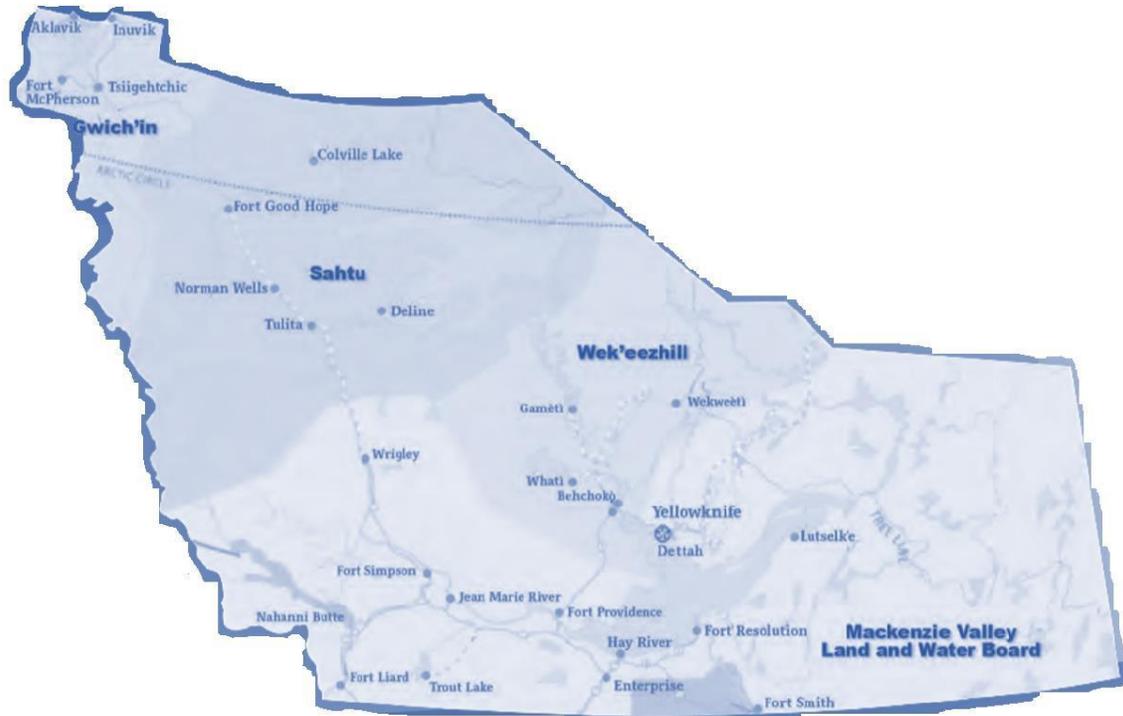


Figure 5: [Land and water board coverage zones] (Mackenzie Valley Land and Water Board, 2015)

As we can easily see, the agency involved in issuing the permit depends on where the project is. In the past, this disparity was a source of complaints from mining company representatives, and still today, they perceive the situation as an obstacle to development. One of the primary purposes of the *Northwest Territories Mineral Development Strategy* (Government of the Northwest Territories, 2013) was just to simplify the regulatory framework to encourage mineral development. Concretely, the creation of a "super board" should facilitate unification and simplification of the process. This new structure will amalgamate the MVLWB and the Gwich'in, Sahtu and Wek'eezhii Land and Water Boards. The new agency will include five members from each of the Aboriginal boards' regions, two members the territorial government will appoint, three the federal government will appoint and a chairperson the federal minister of Aboriginal affairs and Northern development will appoint (NWT & Nunavut Chamber of Mines - *Northern Mining News*, Volume 8, No. 2, 2015). The creation of this super board, however, has been delayed due to injunctions from the Tlicho and the Sahtu Secretariat to protect their respective boards.

Royalties

NWT land claim agreements provide for the sharing of royalties from public land mining operations in the region under the agreement. Those annual royalties are based on profits and vary by region according to the agreements (Government of the NWT, 2013).

Thus, in the Mackenzie Valley, the Gwich'in and Sahtu are entitled to receive the following annually:

- 7.5% of the first \$2 million of income from mineral resources, or \$150,000, and
- 1.5% of additional income from mineral resources.

Also in the Mackenzie Valley, the Tlicho are entitled to receive the following annually:

- 10.49% of the first \$2 million of income from mineral resources, or \$208,580, and
- 2.086% of additional income from mineral resources.

The interim agreement with the Dehcho provides for the sharing of mineral resource income that will be revised once the final agreement is reached. Under the interim agreement, and to support economic development activities, the Dehcho are entitled to receive 50% of the following annually:

- 12.5% of the first \$2 million of income from mineral resources, or \$245,000, and
- 2.45% of additional income from mineral resources.

In regions where there are land claims that have not been settled through the signature of agreements or treaties, mining companies must negotiate with each Aboriginal community with a land claim: we will see below that this situation is one of the primary obstacles to mineral development.

MINERAL RESOURCES (COMMODITIES) SOUGHT AND EXPLOITED IN THE NWT

Although today the NWT is known to be one of the significant sources in the world of diamonds, the history of the territories and especially their mineral potential are much more varied. Gold, base metals and strategic minerals such as rare earth elements are also some of the current and future mineral resources of the NWT. In this section, we address, for each of the commodities sought and mined in the NWT, the main characteristics, different uses of production and world consumption, different processing procedures and associated mines and projects.

Diamonds

Background

Diamonds are formed in the molten rock of the Earth's upper mantle, usually at a depth of between 125 km and 200 km, although some come from as deep as 400 km. At those depths, the temperature can reach 1,300° C, pressure can be 50,000 times that of the atmosphere, and carbon atoms take on a unique crystalline form. Powerful volcanic eruptions push magma up through the Earth's crust to the surface. The speed of the lava pulses, which can reach the speed of sound, maintains the diamonds' crystalline form as it rises. Less speed would transform the carbon into the much more common graphite (De Beers Canada Inc., 2015). The geological formation thus created is called a kimberlite after the city of Kimberly, South Africa. A kimberlite chimney is usually in the form of a carrot, which explains the conical shape of diamond mines. In Canada, diamonds are mined on an industrial scale. NWT kimberlites were formed 55 million years ago.

In several locations, specifically, the African continent, diamonds are extracted from alluvium resulting from kimberlite slag and erosion, often with artisanal methods. Most "conflict diamonds" used to finance rebel groups come from those operations.

Use

Diamonds have two main uses: for jewellery and in industry, 30% and 70% of world production respectively (World Diamond Council, 2008).

Above all, diamonds are recognized for their exceptional value in jewellery. They are associated with luxury. Particularly effective marketing campaigns by De Beers and other companies

in the 1940s led to the diamond ring becoming the symbol of wedding engagement *par excellence*. NWT diamond mines produce very high quality rough diamonds for the jewellery industry, which is much more lucrative than the industrial diamond industry.

The value of rough diamonds is based on the 4Cs (De Beers Canada Inc., 2015):

- Carats¹⁴: because larger diamonds are rarer, they are worth more than several small ones together;
- Clarity: during its formation from other minerals, uncrystallized carbon or even microfractures can occur in the diamond;
- Colour: colourless or white diamonds exist by the tonne, but blue, green, yellow-orange, pink, rouge and black are extremely rare and so worth more;
- Cut: this is the only factor involving human intervention; a well-cut diamond may be worth more than another diamond with superior natural characteristics. Diamond facets are arranged mathematically to maximize brilliance.

The diamond is known as the hardest mineral, that is, with the greatest capacity to resist scratching. Diamonds cannot be scratched except with certain artificial materials developed in recent years. Due to its abrasiveness, it has numerous industrial uses: cutting, grinding, drilling and polishing rock, concrete, precious stones, etc.

Production

World production is calculated by volume and value. In 2013 according to the agency in charge of applying the Kimberley process, world production was 130,482,195 carats worth more than \$14 billion US.

Table 8: World diamond production by country

Volume		Value	
Russian Federation: 29%		Botswana: 26%	
Botswana: 18%		Russian Federation: 22%	
Democratic Republic of the Congo: 12%		Canada: 13%	
Australia: 9%		Namibia: 10%	
Canada: 8%		Angola: 9%	
Others: 24%		Others: 20%	

In 2013, the four Canadian mines (three of which are in the NWT) produced a little more than 10.5 million carats worth \$1.9 billion US.

¹⁴One carat = 200 milligrams.

Consumption

The highest-value diamonds are consumed as luxury jewellery, the main markets for which are in the countries with high per capita income. The emerging countries, with increasing middle-class wealth, are also important markets due to their high economic growth and demographic rates. According to the World Diamond Council, in 2008, the largest retail markets were the US (50%), Japan (15%), Italy (5%), India (3%), China (2%), Persian Gulf States (2%) and other countries (23%).

Diamond processing procedure

According to the World Diamond Council, there are six major links in the diamond value chain from the time diamonds are in the rock until they reach the end consumer.



NWT diamond mining projects and mines

The NWT are recognized worldwide for their diamond-producing potential. Here are the companies with diamond mining tenure in the NWT and their associated diamond mining projects and mines:

Table 9: NWT diamond mining projects and mines

Company	Head office location	Project/mine name	Location	Progress ¹⁵
De Beers Canada Inc.	Toronto, ON	Snap Lake Mine	220 km NE of Yellowknife	DMC-2
Diavik Diamond Mines (2012) Inc.	Yellowknife, NT	Diavik Mine	Lac de Gras	DMC-2
Dominion Diamond Corporation	Yellowknife, NT	Ekati Mine	Lac de Gras	DMC-2
De Beers Canada Inc.	Toronto, ON	Gahcho Kué (51%)	300 km NE of Yellowknife	DMC-1
Mountain Province Diamonds Inc.	Toronto, ON	Gahcho Kué (49%)	300 km NE of Yellowknife	DMC-1
Peregrine Diamonds Ltd.	Vancouver, BC	Lac de Gras	Lac de Gras	EX-4, EX-5
Almaden Minerals	Vancouver, BC	Lac de Gras area diamond project	Lac de Gras	EX-4
Olivut Resources Ltd.	Hinton, AB	HOAM Project	Fort Simpson	Ex-4
New Nadina Explorations Limited	Greenwood, BC	Monument	Lac de Gras	EX-3, EX-4
Kennady Diamonds Inc.	Toronto, ON	Kennady North	200 km NE of Yellowknife	EX-3
Arctic Star Exploration Corp.	Vancouver, BC	NWT Redemption	Lac de Gras	EX-3
Darnley Bay Resources Limited	Toronto, ON	Diamonds		EX-3
North Arrow Minerals Inc.	Vancouver, BC	Lac de Gras	Lac de Gras	EX-3
North Arrow Minerals Inc.	Vancouver, BC	Redemption	Lac de Gras	EX-3
Transition Metals (HTX Minerals Corporation)	Sudbury, ON	Article 41 Lands	360 km NE of Yellowknife	EX-3
Canterra Minerals Corporation	Vancouver, BC	Six NWT projects	Snap Lake	EX-2, EX-3
Talmora Diamond Inc.	Toronto, ON	Horton River	150 km S [of] Paulatuk	EX-2, EX-3
Margaret Lake Diamonds Ltd.	Vancouver, BC	Margaret Lake	300 km NE of Yellowknife	EX-2
GGL Resources Corp.	Vancouver, BC	Diamonds (NT)		

Tungsten

Background

Pure tungsten is a grey metal as high in density as gold but very hard. It is highly resistant to heat (refractory). Its fusion temperature is the highest of all metals. Combining tungsten with carbon produces

¹⁵According to authors' interpretation based on available information

tungsten carbide, which makes its hardness nearly 9 (diamonds are 10) (BRGM, 2012).

Use

Most metals are used in their metallic form. Like metallic copper, tungsten is used in various compounds. There are numerous applications for tungsten due to its hardness, heat resistance and durability. The main uses of tungsten, in its cemented tungsten carbide form, are for tools such as saws, drills, lathe tools and punches and for protective coatings, making tungsten alloys and superalloys, [metallic tungsten and various chemical compounds of tungsten] [*sic*] (BRGM, 2012).

Production

As it is for many other mineral resources, China is also the largest producer of tungsten (82%). In 2015, the Chinese government abolished its exportation quotas but reinforced control over tungsten mining, production and distribution (Shedd, 2015). With three percent of world production, Canada is the number three world producer and the only one in North America. It should be noted that secondary tungsten (recycled) accounts for 25-30% of the world supply (BRGM, 2012). Here is tungsten production in producing countries according to the US Geological Survey (USGS):

Table 10: [Annual tungsten production by country in metric tonnes]

Country	Australia	Austria	Bolivia	Canada	China	Congo (Kinshasa)	Portugal	Russia	Rwanda	Vietnam	Others	Total
2014 production (mt)	600	850	1,300	2,200	68,000	800	700	3,600	700	2,000	1,700	82,450
%	1	1	2	3	82	1	1	4	1	2	2	100

Source: Shedd, 2015

The only tungsten mining operation in North America is the CanTung Mine in the western NWT. Although the North American Tungsten plan is to close it in 2017, company managers are currently developing the MacTung Project in the eastern Yukon.

Consumption

World consumption of primary tungsten in 2010 broke down as follows: China (53.3%), US (13.1%), Europe (12.4%), Japan (10.4%) and others (8.7%) (BRGM, 2012). Total world consumption was 70,750 tonnes. We see that consumption was in the highly industrialized countries where cutting-edge technology has an important place.

Tungsten processing procedure



Source: BRGM, 2012

NWT tungsten mine

The table below is on the company with tungsten mining tenure in the NWT and the related mine.

Table 11: NWT tungsten mine

Company	Head office location	Project/mine name	Location	Progress
North American Tungsten Corporation Ltd.	Vancouver, BC	CanTung	Nahanni	DMC-2

Gold

Background

Gold (symbol: Au, atomic number: 79) is certainly one of the most well-known of the precious metals and, above all, one the most sought after in human history. Because it is resistant to oxidation and most acids, it retains its characteristic colour and does not tarnish. Furthermore, gold is also very malleable and an excellent conductor of electricity, third best after silver and copper (Agence Française du Négoce de l'Or et des Métaux Précieux, 2013).

Use

Due to its universally recognized preciousness, national governments and large world banks use most of the gold on earth for hoarding. Today, the US, Germany and the IMF are the three largest holders of gold in the world (World Gold Council, 2015). While governments and banks use gold as a guarantee of wealth, individuals also use it. In fact, if we exclude gold reserves for monetary purposes, the main use of gold is for jewellery. Furthermore, its physical and chemical properties make it useful in various industrial processes, specifically, electronics, in which its conductivity and resistance to oxidation are particularly desirable.

Production

Once again, China is the main producing country of this metal as well. Australia, Russia and the US are also important in this regard, and Canada is in the running at number five in the world with six percent of the production (USGS, 2015).

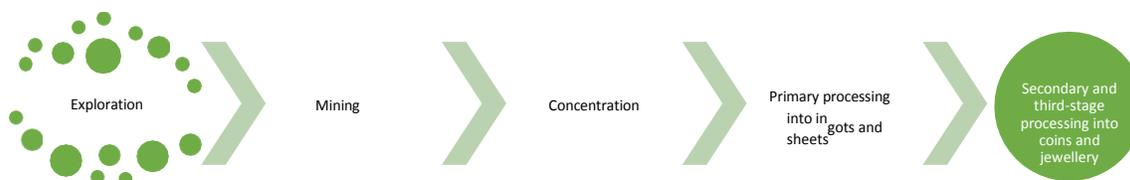
Table 12: Annual gold production by country in metric tonnes (2014)

China	Australia	Russia	US	Canada	Peru	South Africa	Uzbekistan	Mexico	Ghana	Brazil	Indonesia	Papua New Guinea	Chile	Others	Total
450	270	245	211	160	150	150	102	92	90	70	65	60	50	695	2,860
16%	9%	9%	7%	6%	5%	5%	4%	3%	3%	2%	2%	2%	2%	24%	100%

Consumption

India and China are by far the countries with the greatest consumption of gold in the world, 223 tonnes and 197 tonnes respectively, the two countries alone accounting for nearly half the current gold demand (GFMS, Thomson Reuters; World Gold Council, 2015).

Gold processing procedure



Source: Board of Trade of Metropolitan Montreal, Minalliance and KPMG-SECOR, 2013

NWT gold mining projects and mines

The table below is on the companies with gold mining tenure in the NWT and related projects and mines.

Table 13: NWT gold mining projects and mines

Company	Head office location	Project/mine name	Location	Progress ¹⁶
Fortune Minerals Limited	London, ON	NICO	160 km NW of Yellowknife	DA-4, DMC-1
Tyhee Gold Corp.	Vancouver, BC	Yellowknife gold project	50-90 km N of Yellowknife	DA-3
Seabridge Gold (NWT) Inc.	Toronto, ON	Courageous Lake	240 km NE of Yellowknife	DA-2, DA-3
Nighthawk Gold Corp.	Toronto, ON	Indin Lake	220 km NW of Yellowknife	EX-4, EX-5
Silver Standard Resources Inc.	Vancouver, BC	Sunrise Lake	130 km NE of Yellowknife	EX-4
Perlis Enterprise Inc.	Etobicoke, ON	Thompson-Lundmark Gold Mine	48 km NE of Yellowknife	EX-4
Boxxer Gold Corp.	Calgary, AB	Gordon Lake	100 km NE of Yellowknife	EX-3, EX-4
GGL Resources Corp.	Vancouver, BC	Gold, nickel and VMS	250 km N of Yellowknife	EX-3
Equitas Resources Corp.	Vancouver, BC	Tom and Sickle	10 km NE of Yellowknife	EX-3
Geomark Exploration Ltd.	Calgary, AB	Kim	200 km N of Yellowknife	EX-3
Pelican Minerals N.W.T. Inc.	Saskatoon, SK	Jax Lake	250 km NE of Yellowknife	EX-3
TerraX Minerals Inc.	Vancouver, BC	Yellowknife City gold project and Northbelt	15 km N of Yellowknife	EX-3
Aben Resources Ltd.	Vancouver, BC	Selwyn Recce Project	190 km [SE NW] [sic]	EX-2, EX-3
Panarc Resources	Whitehorse, YT	Sunset Yellowknife & Myrt Lake	Yellowknife area	EX-2

Rare earth

Background

There are 17 rare earth elements (REEs), 15 of which are lanthanides. The other two are scandium and yttrium. The REEs are divided into two categories according to their atomic weights: light REEs and heavy REEs.¹⁷ The rarity of lanthanides is relative because some REEs are more abundant in the Earth's crust than some base metals. This is especially true for LREEs. Usually, the HREEs are less abundant.

These metals have numerous applications and are found in our daily lives, usually in electronics. Some people are talking about rare earth elements as the petroleum of the 21st century because a great deal of them are used in new technologies and renewable energy

¹⁶ According to authors' interpretation based on available information

¹⁷ LREEs and HREEs

(electronics, electric cars, wind power, etc.). Although mined industrially since the middle of the 20th century, it was not, however, until the 1990s that the Chinese authorities gradually took control of up to more than 95% of the rare earth market.

In 2009, a dispute over the maritime borders between Japan and China started a rare earth rush. The diplomatic incident led China to decrease its rare earth exportation quotas, thereby highlighting the dependence of consumer economies on the Chinese monopoly. In 2014, the World Trade Organization upheld a decision in favour of the European Union, the US and Japan in which China is mentioned as violating trade regulations by imposing exportation quotas (Gambogi, 2015).

Use

REEs such as neodymium and dysprosium are key elements in permanent magnets used in wind and electric motors. Terbium and europium (to name just two more) are found in products we use every day (smart phones, computers, LCD screens, cars, LED and compact fluorescent bulbs, etc.).

Production

According to the USGS (Gambogi, 2015), the Chinese share of the world rare earth oxide production in 2014 was nearly 85%, 95,000 tonnes (Table 14) of total world production that year, which was 111,500 tonnes.

Since the above-mentioned friction between the leaders of China and Japan, several REE exploration projects have begun across the world outside China: currently, 52 projects in 16 different countries. Fifteen of them are in Canada, one of those being in the NWT (Technology Metals Research, 2015), the Avalon Rare Metals Inc. Nechalacho HREE project. To date, it is the most advanced project in Canada, the company having obtained authorization from two governmental levels to construct the mining complex.

Table 14: [2014 world production of rare earth oxides in metric tonnes]

Country	2014	%
Australia	2,500	2
China	95,000	85
US	7,000	6
India	3,000	3
Malaysia	200	0.2
Russia	2,500	2
Thailand	1,100	1
Vietnam	200	0.2

Source: USGS, 2015

Consumption

Because REEs have diverse industrial applications and are used in high technology, the countries with the highest usage are those with the cutting-edge manufacturers. In 2010, the main consuming countries of REEs were China (60%), Japan and Southeast Asia (20%), the US (12%) and other countries including Europe [sic] (8%). Estimated world consumption was 125,000 tonnes that year (Polinares, 2012). By 2020, the demand for REEs should have increased by five percent per year. Despite that, prices have dropped due to surplus inventory, which does not encourage the financing of mining projects (Gambogi, 2015).

REE processing procedure



Source: Avalon Rare Metals Inc., 2013

REE mining project in the NWT

The table below is on the company with REE mining tenure in the NWT and the associated mining project.

Table 15: REE mining project in the NWT

Company	Head office location	Project name	Location	Progress ¹⁸
Avalon Rare Metals Inc.	Toronto, ON	Nechalacho (formally Thor Lake)	Slave Lake	DA-4

Base metals

Background

Although base metals are discussed as a homogeneous group of minerals, that is not the case: their name refers to their use as opposed to that of precious metals. Base metals are usually used for industrial purposes. Traditionally in the mining industry, four base metals are important: copper, lead, nickel and zinc, to which we can add iron, although iron is usually studied independently of the others (World Bank Group in collaboration with the United Nations

¹⁸ According to authors' interpretation based on available information

Environment Programme and the United Nations Development Organization, 1999). Today, the definition of base metals has been expanded to include not only their chemical properties but especially to associate them directly with their industrial uses (Investopedia, 2015). Furthermore, some writers are now including tin, cobalt and aluminum in the base metal, or common metal, family. For the purposes of this report, we are using the term "base metals" in the broad sense involving their great quantity in nature, their mostly industrial use and their lower value than that of the precious metals. In the NWT, there are copper, cobalt, iron, nickel, lead and zinc (all base metals) mining projects.

Use

Copper

Copper, because it is an excellent conductor, is used primarily for the manufacture of electrical transmission products. Therefore, worldwide, more than two-thirds of copper production is destined for the manufacturing of wires and cables (Natural Resources Canada, 2014). A lot of copper is also used in the construction industry. In fact, [several pipe parts] [*sic*] are made of copper, and copper is also used in the production of brass (International Copper Study Group, 2015).

Iron

Iron is the main element used in the production of steel and so is crucial for a wide range of consumer products, especially in the construction and transportation industries.

Table 16: [World iron usage sectors (2013)]

Market segment	Percentage
Building construction	52.2%
Construction of machines and mechanical devices	14.2%
Manufacturing of metal objects	12.4%
Automobiles	11.6%
Other transportation	4.6%
Electrical equipment	2.9%
Household appliances	2.0%

Source: World Steel Association via

<http://www.societechimiquedefrance.fr/extras/donnees/metaux/fe/texfe.htm>

Cobalt

The ferromagnetic properties of cobalt and its Curie point, which is the highest of the elements, make it a popular industrial component. It is mainly used for manufacturing certain rechargeable batteries and superalloys. It is also used for manufacturing permanent magnets and magnetic media (Audion A.S., 2014).

Nickel

The anti-corrosion properties of nickel make it an ideal ingredient in stainless steel production. In fact, in 2012, nearly two-thirds of the nickel produced in the world was destined for that purpose. Stainless steel is obviously the top material for manufacturing consumer containers and products that are secure and hygienic, but it is also used for household items, various devices and medical equipment and in the food industry. Stainless steel is also used in the construction and transportation industries (Natural Resources Canada, 2014).

Lead

Like copper, lead is a metal that has been used since antiquity. Nowadays, however, lead is used, above all, for manufacturing lead-acid batteries, essential components of all cars. Approximately seventy-five percent of world lead demand is related to manufacturing the batteries used in the automobile industry, industrial products and consumer products: for example, a simple car battery can contain around 10 kg of lead (Natural Resources Canada, 2014).

Zinc

Galvanizing steel is another way to protect it from corrosion: nearly 60% of the world's zinc is used for that purpose. Due to its relatively low fusion point and high fluidity, zinc is also very important in the production of die-cast parts: approximately 16% of zinc is used for that purpose. Furthermore, zinc is also used in the production of brass (Natural Resources Canada, 2014).

Production

Because base metals are relatively abundant compared to precious metals, it is not enough to find an ore deposit to ensure mining profitability. Although somewhat true of any project, the size of the deposit and its proximity to buyers even more strongly influence base metal mining profitability and production. A key factor in the production of base metals is the large volume of ore to be transported: therefore, the availability of transportation and energy infrastructure determines

development in this kind of mining. Canada has long been an important producer of base metals: fourth for nickel, eighth for zinc and ninth for copper. Although far behind the Congo, Canada is the number three producer of cobalt. It is also the number 14 producer of lead (USGS, 2015).

Table 17: [Main base metal producing countries by metal in metric tonnes (2014)]

Copper		Cobalt		Nickel		Zinc		Lead	
Chile	5,800,000	Congo	56,000	Philippines	440,000	China	5,000,000	China	2,950,000
China	1,620,000	China	7,200	Russia	260,000	Australia	1,500,000	Australia	720,000
Peru	1,400,000	Canada	7,000	Indonesia	240,000	Peru	1,300,000	US	355,000
US	1,370,000	Australia	6,500	Canada	233,000	US	820,000	Peru	270,000
Congo	1,100,000	Russia	6,300	Australia	220,000	India	700,000	Mexico	220,000

Source: USGS, 2015

Consumption

As explained above, because base metals are used in manufacturing various construction materials and to support several important industries, it is normal that the inhabitants of almost all countries consume base metals in one form or another. An undeniable trend, however, when analyzing this segment of the industry is found in the BRICS countries (Brazil, Russia, India, China and South Africa). Although the five countries are very different, they all have economic growth and industrial and urban development in common: consequently, they have an extremely important impact on the base metal market. China alone accounts for about 40% of the world's base metal production (Hancock, 2015).

Base metal processing procedure



Source: Board of Trade of Metropolitan Montreal, Minalliance, KPMG-SECOR, 2013

NWT base metal mining projects

Here are the companies with base metal mining tenure in the NWT and associated mining projects.

Table 18: Base metal mining projects in the NWT

Company	Head office location	Project name	Location	Progress ¹⁹
Fortune Minerals Limited	London, ON	NICO (Au-Co-Bi-Cu)	160 km NW of Yellowknife	DA-4, DMC-1
Canadian Zinc Corporation	Vancouver, BC	Prairie Creek (Zn-Pb-Ag)	Fort Simpson/Nahanni National Park	DA-4, DMC-1
Tamerlane Venture Inc.	Blaine, WA, USA	Pine Point (Zn-Pb)	Hay River	DA-3
Devonian Metals Inc.	New Westminster, BC	Wrigley (Zn-Pb)	Wrigley	DA-1
Strongbow Exploration Inc.	Vancouver, BC	Nickel King (Ni-Cu-Co)	145 km NE of Saskatoon	EX-5, DA-1
Silver Bear Mines Inc.	Sherwood Park, AB	Bear property (Ag-Zn)	110 km NE of Yellowknife	EX-4
Adamera Minerals Corp.	Vancouver, BC	Hepburn (Ag-Cu, IOCG)	470 km N of Yellowknife	EX-3
Metallis Resources Inc.	Vancouver, BC	Mackenzie Mountain (Fe-Cu)	190 km NW of Norman Wells	EX-3
DEMCo LTD.	Yellowknife, NT	Camsell River (IOCG)	SE of Great Bear Lake	EX-3
BFR Copper & Gold Inc.	Saskatoon, SK	Mazenod (IOCG)	Great Bear Lake	EX-3
Darnley Bay Resources Limited	Toronto, ON	The Anomaly	Paulatuk	EX-3
Eagle Plains Resources Ltd.	Cranbrook, BC	AB project, Bear-Twit, Justice, Keg, Bronco (Zn-Pb-Ag-Cu)	Several sites 180-260 km around Norman Wells	EX-3
Copper North Mining Corp.	Vancouver, BC	Redstone (Cu-Ag)	Nahanni mining district	EX-2
Panarc Resources Ltd.	Whitehorse, YT	Indian Mountain (Cu-Zn-Ag-Pb)	E of Great Slave Lake	EX-2
Scavo Resource Corp.	Coquitlam, BC	Purple Onion (Zn-Pb)	200 km SW of Norman Wells	EX-2
Alberta Star Development Corp.	Vancouver, BC	Eldorado & Contact Lake (IOCG)	Great Bear Lake	EX-1, EX-4
GGL Resources Corp.	Vancouver, BC	Gold, nickel (Au-Ni) and VMS	250 km N of Yellowknife	

¹⁹According to authors' interpretation of available information

ECONOMY AND EMPLOYMENT

The 2014 CDÉTNO NWT investment attraction strategy presents a general description of the NWT economy. In this section, we will concentrate on the fundamental importance of the mining industry for the NWT economy.

Economic structure

In 2013, the GDP of the NWT in chained (2007) dollars was more than \$3.5 billion (Figure 6). Figure 7 shows that the mining and petroleum and gas extraction sector was \$978 million, or 27% of the total GDP, 15.7% of which was solely the diamond mining sub-sector. That was equivalent to the public administration sector, which was the second most important one.

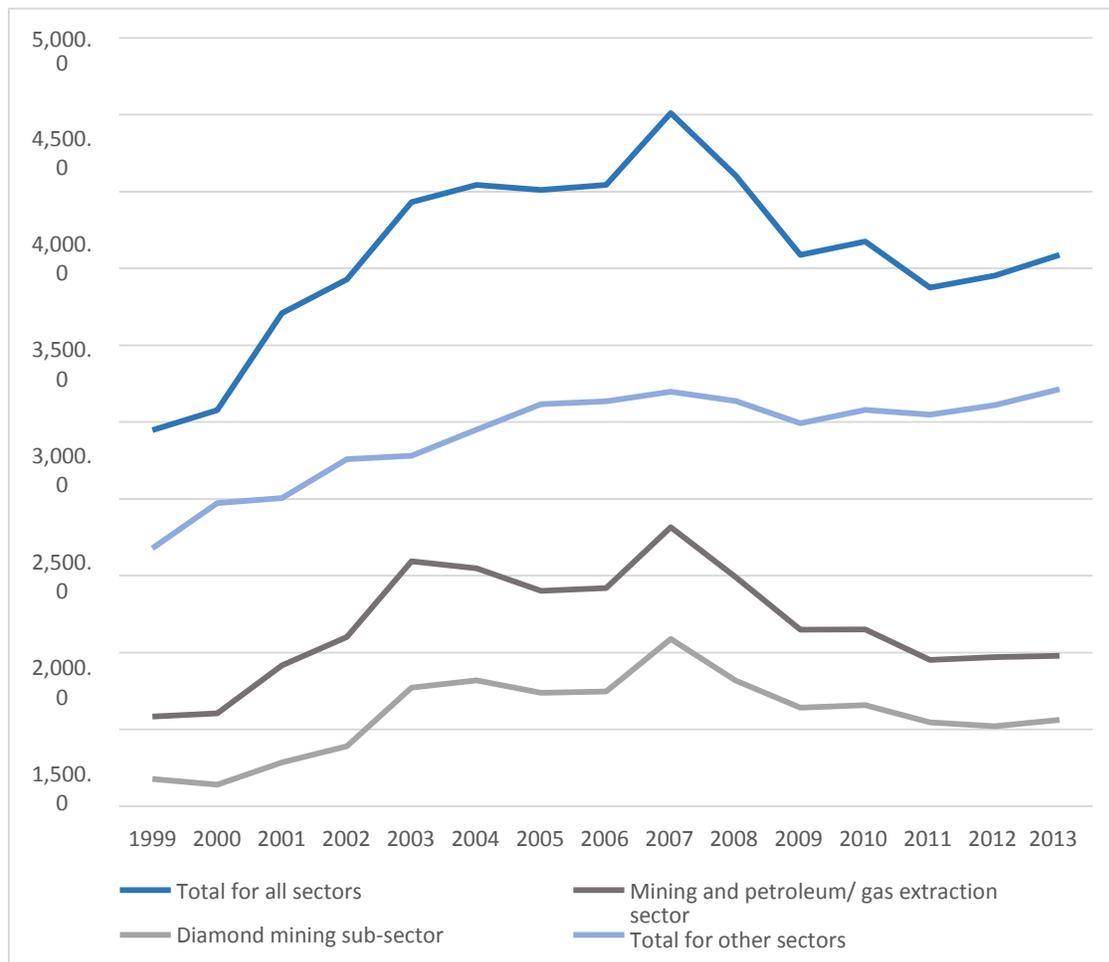


Figure 6: [Evolution of GDP of the NWT, 1999-2013, in millions of chained (2007) dollars (NWT Bureau of Statistics, 2015)]

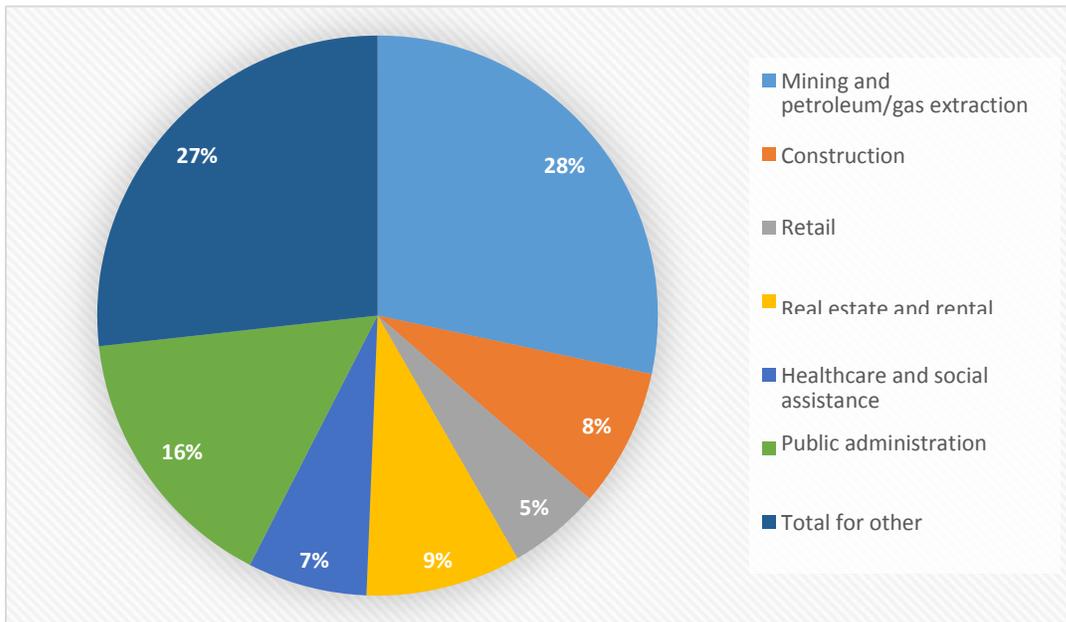


Figure 7: [Main economic activity sectors of the NWT in 2013 (that produce more than five percent of the GDP)] (NWT Bureau of Statistics, 2015)

Considering these figures, it is clear that the NWT economy is directly related to the mining sector and, more specifically, diamond mining. Despite the constant increase, except between 2009 and 2011, of all the other sectors combined, the evolving NWT GDP remains correlated with the mining sector and, more specifically, diamond mining. In 2007, the GDP rose to more than \$4.5 billion, that summit attained before the October 2008 financial crisis, which led to a major world recession, especially in the industrialized countries. The 2008 financial crisis especially affected the developed countries, especially the United States, where it began, and then Europe [*sic*] and Japan (Robin, 2014). We point out that those three parts of the world accounted for at least 70% of 2008 retail diamond sales (World Diamond Council, 2008). In 2015, the global economy has barely started to recover from that crisis, but the upturn is still difficult for some regions, such as Japan and Europe. It must also be mentioned that the Diavik and Snap Lake mines started their commercial production in January 2003 and June 2008 respectively. Commercial production at Ekati began in October 1998.

Employment

Analysis of workforce and employment data allows us to better understand certain aspects of the mining industries value chained. Despite decreased world demand for mining products and the slowdown of exploration, the NWT mining industry is still an important employer. Figure 8 below illustrates that, in Canada, the Yukon, Alberta and the NWT have the highest employment rates.

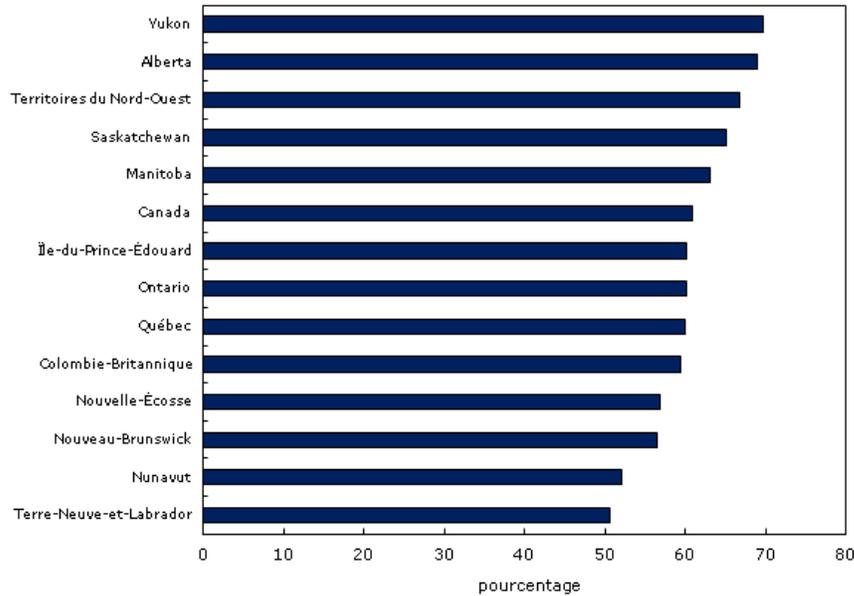


Figure 8: Employment rate of the population aged 15 and over (percentage), May 2011 (Statistics Canada, *National Household Survey*, 2011) [English figure at <http://www12.statcan.gc.ca/nhs-enm/2011/as-sa/99-012-x/2011002/c-g/c-g01-eng.cfm>: translator]

Still according to the 2011 *National Household Survey*, the geographic distribution of the NWT population allows us to observe another demographic reality. Nearly half (46%) of the 41,462 NWT residents in the 2011 census live in Yellowknife, and only five other agglomerations have more than 1,000 residents (Hay River, Inuvik, Fort Smith, Behchoko and Fort Simpson). The rest of the NWT population, mostly Aboriginal, is distributed in 28 communities with fewer than 1,000 residents.

When we analyze the NWT employment rate based on certain criteria (for example: gender, origin and place of residence), we see high disparities in the population. Table 19 below illustrates that non-Aboriginal people living in an urban environment have most of the jobs. As for the employment rate, there is no significant difference related to the gender of workers, but it is important to note that these data concern all activity sectors and not solely the mining industry, in which men are overrepresented.

Economic activity and development opportunities have a lot to do with the educational level of the population and workers: it is understood that the employment rate increases with the educational level. In Canada in 2011, Nunavut, the NWT and the Yukon had the highest employment rate for people with a university education: 93%, 90.3% and 86.4% respectively. Furthermore, a sign of prosperity and a favourable job market is that, in the NWT, those with a high school diploma as their highest level of educational attainment

had the best employment rate, 80.4% (Statistics Canada, 2011).

Table 19: [NWT employment rate according to various criteria, February 2015]

	Workers ²⁰	Rate (%)
NWT total	21,800	67.7
Men	10,800	66.7
Women	11,100	68.9
Aboriginals	7,900	52.7
Non-Aboriginals	14,000	81.4
Yellowknife	12,500	80.6
Other cities	9,400	56.3

Source: Northwest Territories Bureau of Statistics, 2015

In 2009 and 2014, De Beers, Diavik and Dominion Diamond partnered with the Government of the NWT and its Bureau of Statistics to conduct surveys on mining sector workers. Analysis of those surveys revealed [the results of] mining company managers' efforts to encourage local hiring, but we see that a significant proportion of mine employees have no diploma. Figure 9 below illustrates the higher level of education attained based on place of residence for mining employees alone. We can quickly see that nearly a quarter of employees residing in the NWT have no diploma and that more than 35% of the employees from outside the NWT have a vocational diploma or skill certificate.

²⁰Totals may not correspond due to the rounding-off of data.

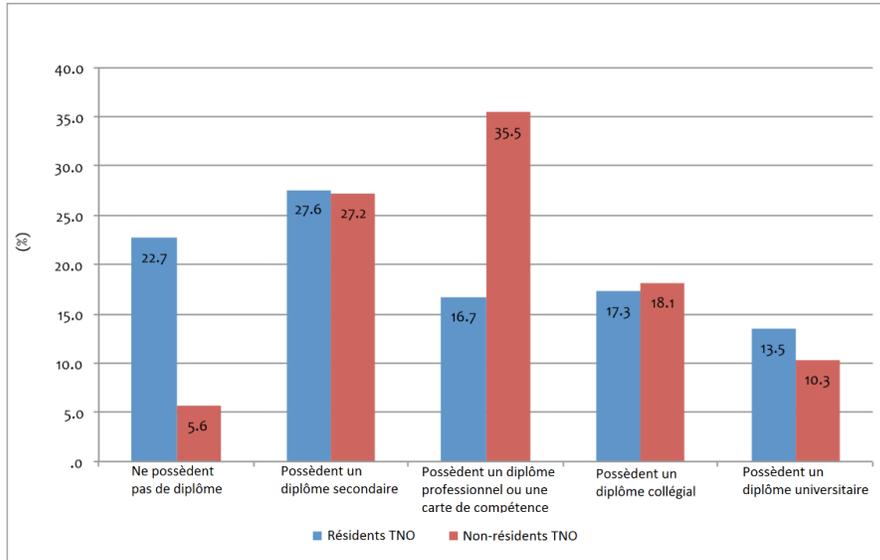


Figure 9: [Highest level of schooling according to community type] (2014) (Northwest Territories Bureau of Statistics, 2014)

Economic benefits of mines in production

In this section, we will discuss the economic benefits of the four NWT mines in production: Ekati, Diavik, Snap Lake and CanTung. Most of the information comes from the companies' own sustainable development reports. It should be noted that there was no information available about the CanTung Mine on the company's website.

Ekati Diamond Mine benefits

In 2013, the Ekati Diamond Mine had 1,336 employees, including 533 hired by various contractors. In 2015, there were 1,500 employees. Figure 10 below illustrates the origins of those employees in 2013.

TABLE 1A: EMPLOYMENT BY PRIORITY GROUP (PERSON YEARS)						
	Northern Aboriginal	Northern	Total Northern	Other	Grand Total	Indigenous Aboriginal
Dominion Diamond	272	183	455	348	803	305
Contractor	105	111	216	317	533	127
Total	377	294	671	665	1336	432

TABLE 1B: EMPLOYMENT BY PRIORITY GROUP (PER CENT)						
	Northern Aboriginal	Northern	Total Northern	Other	Grand Total	Indigenous Aboriginal
Dominion Diamond	60%	40%	57%	43%	100%	67%
Contractor	49%	51%	41%	59%	100%	59%
Total	56%	44%	50%	50%	100%	64%

• Indigenous Aboriginal percentage of Subtotal Northern

Figure 10: [Ekati Mine employee origins, 2013] (Dominion Diamond Corporation, 2014)

Because it is a business based in Canada's North, one of DDC management's goals is to construct a strong Northern economy through local investment and by supporting other Northern companies. In 2013, DDC had expenditures of more than \$245 million in the North, \$88 million of which went to Aboriginal companies. Most of company expenditures made in the North can be put in three categories (Dominion Diamond Corporation, 2014):

- Drilling and blasting: \$34.7 million went to Kete Whii/Procon, Polar Explosives/Dyno Nobel and McCaw North Drilling and Blasting Ltd.
- Transportation and cargo: \$49.7 million went to Tli Cho Landran Transport Ltd., Braden Burry Expediting, Tli Cho Logistics Ltd., Northcan Freighters, First Air and Great Slave Helicopters.
- Capital equipment (rock handling equipment): \$70 million went to Sandvik, Finning and Atlas Copco.

It should be noted that the 2013 price jump in diesel fuel increased expenditures from the South. Figure 11 below details DDC Northern spending in 2013.

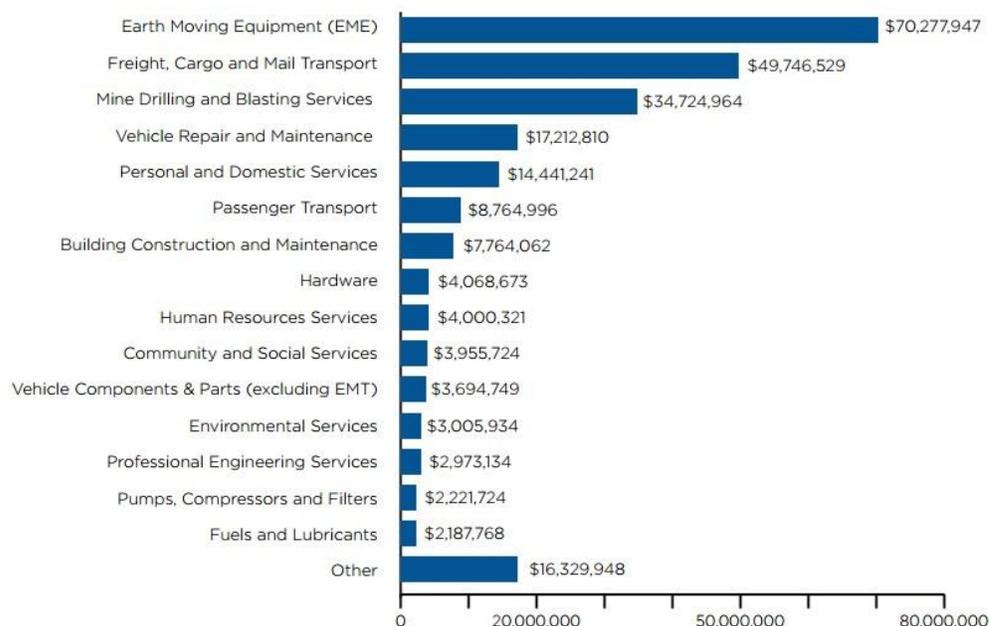


Figure 11: [Dominion Diamond Corporation Northern spending in 2013] (Dominion Diamond Corporation, 2014)

Diavik Diamond Mine benefits

In 2014, the Diavik Diamond Mine employed 1,010 people, 476 of whom were residents of the North. Figure 12 below details the origins of employees in 2013.

Employment history by residency (individuals)

	2011	2012	2013	Mid 2014
Northern Aboriginal**	313 (28%)	206 (19%)	202 (20%)	205 (20%)
Other northern	329 (29%)	302 (28%)	283 (28%)	271 (27%)
Total northern	642 (56%)	508 (47%)	485 (49%)	476 (47%)
Southern	495 (44%)	563 (53%)	512 (51%)	534 (53%)
Total	1,137	1,071	997	1010

Figure 12: [Origins of Diavik Diamond Mine employees in 2013] (Diavik Diamond Mine Inc., 2014)

In 1999, Diavik management reached a socio-economic monitoring agreement stating that the company was committed to providing training, jobs and business opportunities in the NWT and West Kitikmeot area of Nunavut. In 2013, 72% of company spending, \$261.5 million, went to Northern companies. The most was in workforce, transportation, construction and petroleum product sub-contracting. Since 2000, Diavik has spent more than \$5.5 billion, \$4.3 billion of which has been in the North. Figure 13 below indicates how those main expenditures were made in 2013.

2013 spending by category and priority group (\$ millions)					
Category	Northern Aboriginal	Other northern	Subtotal northern	Subtotal other	Overall total
Outsourced labour	57.8	4.5	62.4	11.0	73.4
Freight, cargo, transport	16.5	30.8	47.3	0.3	47.6
Construction	9.7	14.6	24.3	25.5	49.8
Human resources services	0.1	0.9	0.9	5.3	6.2
Consumables	5.5	24.8	30.3	34.2	64.6
Accommodations services	9.4	0.5	9.9	-	10.0
Drilling, blasting	4.2	-	4.2	0.2	4.3
Professional services	-	2.6	2.6	7.7	10.3
Telecommunications	-	1.3	1.3	3.2	4.5
Passenger transport	6.7	3.7	10.4	-	10.4
Environmental services	0.7	4.0	4.7	0.9	5.6
Fuels, lubricants	-	47.2	47.2	-	47.2
Other	4.9	11.2	16.1	12.2	28.3
Total spend	115.5	146.0	261.5	100.7	362.2

Figure 13: [See title in graphic: translator] (Diavik Diamond Mines (2012) Inc., 2014)

De Beers Canada benefits

De Beers does not reveal its data by mine but according to categories covering all of its operations or by geographical sector. However, it is mentioned in its GRI compliance table that 62% of 2013 spending at the Snap Lake Mine [was with] NWT businesses, 39% of that amount going to Aboriginal businesses (De Beers Group of Companies, 2014, p. 74). De Beers promotes local supply or from historically disadvantaged groups. In 2013, according to its criteria, approximately \$1.1 billion was paid to businesses held by local interests or historically disadvantaged groups in South Africa and Canada. Through its operations, De Beers managers want to encourage the long-term enrichment of host countries and communities. In their 2013 sustainable development report, it is mentioned that De Beers:

continues to honour our commitment to the Government of the North West Territories (GNWT) to offer 10 percent of economically viable production from Snap Lake to Sightholders that are NWT approved diamond manufacturers. Uptake of these goods has been limited as there is currently only one diamond manufacturer, Crossworks, operating in the North West Territories. The GNWT continue to explore ways to develop a more sustainable secondary industry in Yellowknife (De Beers Group of Companies, 2014, p. 24).

It is also mentioned that processing rough diamonds is a challenge in countries where costs are higher than in China or India. To encourage the implementation of a diamond processing industry, diamond producers must commit to supplying a certain quantity and quality of rough diamonds, but all

stakeholders must also make that commitment in the long term, including governmental representatives. "In general, Sightholders with strong downstream/integrated businesses are faring better than those who supply at the wholesale level" (De Beers Group of Companies, 2014, p. 24).

CanTung Mine benefits

No information on socio-economic benefits was available. Due to its geographic position and road network, the CanTung Mine is economically connected with the Yukon. Currently, the company is in the appraisal phase of the MacTung Project in the Yukon. The CanTung Mine is at the end of its lifespan, and restoration costs are estimated at \$13.1 million (North American Tungsten Corporation Ltd, 2014). Therefore, there could be business opportunities in that regard as Denommé (2013) mentions [translation]:

Mine [operators] with mines at the end of their lifespan, even mines still in operation, seem to turn more readily to sub-contracting than those who plan to continue mining for several more years. We will recall that some tasks, such as mine maintenance, underground construction, deep-hole drilling and cabling, are activities requiring significant investment to maintain qualified personnel and for the technology to execute those tasks. However, the time it takes to recoup new investments for those purposes becomes longer than the life expectancy of the mine itself (p. 103).

MAPPING OF THE NWT MINING INDUSTRY VALUE CHAIN

In this section, we summarize our methods but especially our work, including not only the mapping itself, but also analysis of the relationships and synergies among the various NWT mining industry stakeholders.

Meetings with NWT mining industry stakeholders

To complement our research in various documentary sources, we managed to obtain comments from several mining industry stakeholders. On February 9-15, 2015, we met with the representatives of 16 organizations. We also collected comments from two suppliers via an electronic questionnaire (see Appendix 3). Last, we had a teleconference with two mining company representatives, one from a junior company and one from a mine in production.

Topics discussed and interview summaries

Besides the questionnaire we used as a basis for discussion, we adjusted our data collection to improve the fluidity of discussion during the interviews. After providing an overview of the CDÉTNO and/or mandate for this study at the beginning of the interview, we raised the subjects below, among others:

- Description of the organization and main activities
- Key suppliers
- Opportunities
- NWT mining industry strengths and weaknesses
- General perception of the mining industry
- Main clients
- Reasons that could restrict investment
- What is needed to support mineral development

We always concluded the interviews by asking the following question [translation]: "If you could have one wish granted to your organization or the mining industry in general, what would it be?" That question, apparently insignificant, was an excellent means of properly understanding and summarizing the basis for our interviewees' thoughts. The summary of our discussions is presented below by respondent group:

Governments and associations

Table 20: Governments and associations

Governments and associations	Representatives	Dates
Municipality of Yellowknife	Nalini Naidoo	February 10, 2015
Department of Industry, Tourism and Investment (ITI), Government of NWT	Deborah Archibald	February 11, 2015
Canadian Northern Economic Development Agency (CanNor)	Matthew Spence	February 12, 2015
Chamber of Mines	Tom Hoefler	February 12, 2015
Denendeh Investments ²¹	Darrell Beaulieu	February 9, 2015

For the representatives of the various governmental levels and of the associations, the mining industry is doing relatively well despite a very significant decrease in exploration investments and a global economy that is currently unfavourable for mineral development. The recent devolution of federal powers, the adoption and implementation of the mining strategy and simplification of the legislative framework were identified as the main positive points in NWT mineral development. The lack of infrastructure, especially roads, was identified as crucial and, even if work is done, they said there is not enough capital. They also mentioned the major problem of filling specialized, technical and scientific positions with NWT residents.

Opportunities and strengths	Threats and weaknesses
Legislative framework devolution and simplification	Lack of infrastructure and of professional and specialized workforce

Mining companies (exploration and operation)

Table 21: Mining companies (exploration and operation)

Companies	Representatives	Dates
Avalon	Don Bubar	February 11, 2015, by telephone
Demco	Darrell Beaulieu	February 9, 2015
Panarc	Gary Vivian	February 9, 2015
Dominion Diamond	Chantal Lavoie	March 9, 2015, by telephone

Mining exploration company representatives had a little gloomier perspective on the state of the NWT industry. Besides the global economic context for them, the restrictive legislative framework and the issue of unsettled land claims are

²¹ Although Denendeh Investments managers act as promoters in some situations (joint ventures), in reality, the company is the operational arm of Denendeh Development Corp. Therefore, we decided to classify this organization under associations due to his likeness to an economic development organization.

two main reasons for decreased exploration investment. At one point, an interviewee mentioned to us that the perceived message in recent months was [English in the original]: "Sorry, we're closed." That being said, all of them were well aware of the cyclical nature of the industry and, despite the rough patch to endure, they still were considering the future in a positive way. Among the strengths of the NWT, high undeveloped mineral potential came up as a key element. The lack of infrastructure and trouble recruiting and retaining specialized, technical and scientific personnel were reported as significant weaknesses.

With regard to diamond mining, it is important to understand that the diamond is in a class of its own when compared to other mineral substances. Although the diamond industry is not completely immune from economic repercussions, the diamond's uniqueness makes diamond mining companies much more solid than others. In the NWT, the population thinks well of diamond mines generally speaking, and impact and benefit agreements contribute to maintaining good relations. As for operations, there is a lot of reliance on sub-contracting: doing business with local or regional companies ensures some stability and respects hiring and economic benefit commitments. As for operations like exploration, the lack of specialized workforce both internally and via sub-contractors often poses a major challenge. Specific requirements vary somewhat among companies, but this need is fairly generalized. The representatives told us that it was especially true during planned maintenance shutdowns, specifically in the electrical, instrumentation and technical fields. To meet those needs, some companies' managers have been very open to participation and collaboration in networking activities or recruitment events. With regard to benefits and strengths, subsoil wealth is surely at the top of the list: even though some projects are ending, the diamond mines still have several years, even several decades, of life yet.

Opportunities and strengths	Threats and weaknesses
Mineral potential	Regulatory restrictions, lack of infrastructure and of professional and specialized workforce

Professional service providers

Table 22: Professional service providers

Providers	Representatives	Dates
Golder Associates	Damian Panayi	February 9, 2015
McLellan Ross LLP	Alain Chiasson	February 9, 2015
Île Royale	David Connelly	February 10, 2015
Aurora Geoscience	Gary Vivian	February 9, 2015

Advanced Medical Solutions	Mike Ross	February 11, 2015
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As for the professional service provider respondents, their perception of the state of the industry was divided depending on whether their activities are concentrated in exploration or distributed over all phases of the development process. For example, geoscientists working mostly in the early part of the process or attorneys helping prospectors and junior companies to obtain or transfer claims are not affected by fewer exploration investments the same way as environmental specialists are. Therefore, although all stakeholders have noticed a significant decrease of exploration, it does not have the same impact on all of them. To compensate for that decreased turnover, some respondents mentioned that diversifying activities could help maintain a good business volume.

In this category, there are very few key suppliers from the NWT except those from transportation companies (airplane and helicopter). The environmental and geoscience respondents told us that it was irritating that their analytical labs in Yellowknife had closed due to decreased business volume. Although they all agreed on the mineral wealth of the territory and its great potential, as for opportunities, each had his own idea based on his particular expertise. As for [threats and] weaknesses, however, there was nearly a consensus on unsettled land claims, lack of infrastructure and problems recruiting and retaining specialized personnel. They also said they wished the market would re-establish itself and that the land claims would be settled. Furthermore, they said they would like to see an improved overall perception of the mining industry so that all levels of the population were aware of the importance of the mining industry for the economy and society.

Opportunities and strengths	Threats and weaknesses
Potential mineral wealth	Unsettled land claims, lack of infrastructure and of professional and specialized workforce

Equipment, product and transportation suppliers

Table 23: Equipment, product and transportation suppliers

Companies	Representatives	Dates
Danmax	Danny Cimon	February 10, 2015
Paul Bros. Nextreme	Eddie Paul & Dennis Clark	February 11, 2015
AA Technical Services	Al & Bertha Harman	February 12, 2015

Atlas Copco	Michel Boivin	February 13, 2015
Matonabee Petroleum	Mike Dove	February 9, 2015 (e-mail)
Summit Air	Matthew McElligott	February 13, 2015
Inkit Ltd.	Dawna Marriott	February 4, 2015 (e-mail)

For the equipment, product and [transportation] supplier respondents, the perception of the mining industry was still very good. They were aware that exploration had decreased, but business volume is mostly in the later phases. Without exception, these respondents were getting through the rough patch much easier, although they were all looking forward to an upturn arriving. They have few key suppliers in the NWT: in most cases, they themselves are distributors and must turn to major suppliers in the rest of Canada or abroad. In fact, some of them told us that Yellowknife is a kind of crossroads or hub for all of Canada's North: consequently, they were taking advantage of their geographic situation and basing their business strategies on that fact.

Most of our respondents were already doing good business with the established mining companies, but they also mentioned that it could be difficult for someone from a small-or medium-sized business to approach the big companies: networking and mentoring activities are needs some of them expressed. One of the respondents also spontaneously indicated that he would be willing to collaborate on organizing such activities. As for opportunities, several respondents identified partnerships as a way to grow. For all the respondents, the strength of the NWT mining industry, above all, lies in its mineral potential. As mentioned above, they also talked about the strategic position of Yellowknife, but also local expertise and knowledge of the territories: the ability to deliver and properly respond to requests. Once again, the main weakness the respondents identified was lack of infrastructure, and they also mentioned the necessity of raising public awareness of the role the NWT mining industry plays. They would like to see increased infrastructure and an environment that is favourable to entrepreneurs/stimulates entrepreneurship.

Opportunities and strengths	Threats and weaknesses
Potential mineral wealth	Lack of infrastructure
Yellowknife's strategic location	
Local expertise and knowledge of the territories	
Need for partnerships	

Mining industry value chain grid

To map the NWT mining industry value chain, we designed a grid in which the various phases of mineral development are positioned in relation to the necessary activities to turn mineral potential into income and profits and meet the needs of the global economy.

Theoretical model

Mineral development phases were determined using documents generally recognized in the industry. We used the 2014 Natural Resources Canada *Generalized Model of Mineral Resource Development*, according to which mineral development begins with the identification of mineral potential and ends with mine closure/site restoration. We determined the other phases (sale of production, processing and diversification/consolidation) using Vorster's model (2001), which facilitates the connection and application of Michael Porter's value chain model to the mineral development process, that is, from exploration to sale of production.

In his model, which applies to a company, not an industry, Michael Porter maintains that, to maintain a profit margin, a company's personnel conduct primary activities and supporting activities. The primary activities are inbound logistics, operations (or production), outbound logistics, marketing and sales and service. Supporting activities are business infrastructure (administrative activities), human resource management, technology and supply. The table below shows the relationships among the primary activities of the Porter model, Vorster's model and the model we propose of the primary mineral development phases.²²

²²We are aware that, at the theoretical level, the connections among certain activities (primary and supporting) as Porter and Vorster defined may be lacking, but our mandate has to do with identifying potential business and investment and not establishing a theoretical model.

Table 24: Primary activities: Connections between Porter and Vorster's models and application in a value chain grid

Michael Porter's value chain	A. Vorster's value chain-based mining architecture ²³	Authors' value chain grid
Inbound logistics	Locate	Geoscientific compilation
		Preliminary exploration
		Advanced exploration
	Valuate	Ore appraisal
Operation	Establish	Design of mining complex
	Mine	Mining operations
	Transport	
	Beneficiate	
Divest ²⁴	Site restoration	
Outbound logistics	Market	Sale of gross production
Marketing and sales		
Service	Divest	No connection
	No connection	Processing Diversification/consolidation ²⁵

With regard to supporting activities applied to the mining industry, Vorster proposes the following nomenclature: mineral resource management, financial management, procurement/logistics, asset/maintenance management, research and development, human resource management, risk management and information systems. The table below shows the relationships among the primary activities of the Porter model, Vorster's model and the model we propose of the supporting mineral development phases.

Table 25: Supporting activities: Connections between Porter and Vorster's models and application in a value chain grid

Michael Porter's value chain	A. Vorster's value chain-based mining architecture ²⁶	Authors' value chain grid
No connection	Mineral resource management	Mineral resource management
Business infrastructure (administrative activities)	Financial management	Administration and finance
Supply	Procurement/logistics	Supply/logistics
Technology	Asset/maintenance management	Asset and technology operation and maintenance
No connection	Research and development	Research and development
Human resource management	Human resource management	Human resource management
No connection	Risk management	Risk management
No connection	Information systems	Integrate as specific activity under

²³ <https://www.realirm.com/speakers/adriaan-vorster> and <http://www.saimm.co.za/Journal/v101n02p061.pdf>

²⁴ As opposed to Vorster, we have included the termination of activities (divestment) of a mine under operation because planning and operating a mine is done in anticipation of its closure. Although mine closure and tailing management are considered expenses, we believe that an unrestored mine results in a loss of value and additional expenses for the company. Furthermore, planning and carrying out the closure plan means potential business, which is why it is included in our value chain mapping.

²⁵ (To ensure the continuity of NWT mining activity): we also believe that diversifying and consolidating by reinvesting in exploration, for example, is a better way of representing the value chain. In that regard, our model is not linear but circular.

²⁶ Cf. footnote 23

	administration and finance
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Methodology

Table 27 below summarizes the primary and supporting activities we used to map the NWT mining industry value chain. For each supporting activity, we have identified the specific activities included so we can better characterize value chain activities. Furthermore, to facilitate the interpretation of the grid, we have identified activities in which there is little or no potential business for a given mineral development phase. Inversely, we have identified where activity is the most intense. This aspect is only represented in the complete grid (see Appendix 1).

Because we had almost no response (two respondents) to the questionnaire e-mailed in early February 2015, we then consulted the website of each member company of the NWT & Nunavut Chamber of Mines. That helped us to position them in the grid based on the services they offered as indicated on their websites. We are aware that those members do not represent all the companies working in the NWT mining industry, but we believe the sample is valid based on the fact that, above all, belonging to the Chamber of Mines is voluntary, [which indicates an interest for the mining industry]. Because there are companies almost everywhere in Canada, we could calculate the proportion from the NWT.

A company can be found under several specific activities and mineral development phases; the obtained values thus reflect the coverage of a specific activity according to the development phases of a mining project. For example, one of the engineering consulting firms we analyzed is mentioned 153 times in the grid. We interpreted and analyzed 142 companies, most from the NWT. Each company is mentioned an average of 33 times in the grid.

To refine the analysis, we indicated from where companies come for each specific activity, that is, whether they have an NWT address or one outside the NWT. However, it was impossible for us to determine the size of a company operating in the NWT except for those with representatives we met. Therefore, if a specific activity seems well-covered, the origin of the companies can tell us if there is potential business or investment to explore regarding the local implementation of a company providing that type of service. The coverage of the NWT mining industry value chain for a specific activity by Chamber of Mines member companies was determined according to three categories explained in the table below:

Table 26: Determination of activity coverage

Coverage	1. Activities for which coverage seems sufficient, and most companies are based in the NWT	2. Activities for which coverage seems sufficient, but most companies are based outside the NWT	3. Activities not conducted by NWT-based companies or conducted by only a few companies
Category	Companies with an NWT address are in the majority or equal in number	Companies with an address outside the NWT are in the majority	Complete absence of a company with an NWT address or fewer than two companies covering an activity regardless of company address
Potential business or investment	Less interesting potential, but some activities may still present potential	Potential to explore and there could be local opportunities	More interesting potential to explore

We must add that, following our analysis and February 2015 meetings, the potential business for three of the value chain phases (sale of production, processing and diversification/consolidation) is, in our opinion, very weak. The producing companies directly carry out the sale of production and diversification/consolidation. As for diamond processing, numerous governmental and producing company efforts have been deployed in recent years to carry out the primary processing of diamonds (sizing and polishing) locally, but the NWT has trouble competing with processors in India, China and other countries where labour costs are much lower.

For those reasons, we did not use those three value chain phases in the analysis, which also explains why there is no specific activity for those phases. However, we must point out that this does not mean there is no potential in those three phases: investors and entrepreneurs with daring, determination and innovation and support from the main industry stakeholders could change that fact.

Analytical limitations

The results of the grid come from our interpretation of the available information we found on corporate websites and not directly from the executives of the concerned companies except for those with whom we met. The values we obtained allow us to create a general portrait with relative accuracy. Additional analysis is relevant and even necessary to better identify the activities in which there is potential business and investment. Nonetheless, the results we obtained help in the identification of activity sectors and to orient the actions of the CDÉTNO.

In addition, [translation]: "a complete analysis [of the value chain] does not end with constructing the nomenclature of the value chain but determines the costs and margins for each company activity and compares them with those of competing companies" (Denommé, 2013). In this regard, our value chain analysis is incomplete because we focused on NWT mining industry activities and companies rather than on the expenditures and profits of the companies themselves and the precise interactions among those companies.

Analysis of the NWT mining industry value chain grid

This section presents a general analysis of the value chain grid and a more detailed analysis based on our interpretation of companies (their services) and where they are from.

General analysis

Table 27: Simplified mining industry value chain grid (the darker the colour, the better the coverage)

Primary activities	Geoscientific compilation	Preliminary exploration	Advanced exploration	Ore appraisal	Design of mining complex	Mining operations	Site restoration	Sale of gross production	Processing	Diversification/consolidation	Coverage of provided services ²⁷	
											NWT	Other
Supporting activities												
Mineral resource management								Not evaluated			43%	57%
Administration and finance								Not evaluated			61%	39%
Supply/logistics								Not evaluated			72%	28%
Asset and technology operation and maintenance								Not evaluated			51%	49%
Research and development								Not evaluated			0%	100%
Human resource management								Not evaluated			72%	28%
Risk management								Not evaluated			64%	36%

Table 27 provides an overall view of the NWT mining industry value chain. It indicates where the coverage of a supporting activity seems adequate (darker in colour on grid) for a primary activity (mineral development phase). For more details, see the complete grid, in which coverage for each specific activity is indicated (see Appendix 1).

Generally speaking, the services companies provide seem to adequately cover the activities of the advanced exploration phase, more specifically, designing the mining complex and mining operations. This is not surprising because

²⁷ Based on company head office location

activities are more intense during these phases. Available budgets are also much larger. Furthermore, in the next few years, the mining complex design phase will present the best business opportunities for non-NWT companies. Although the current coverage for some supporting activities seems to be adequate, mine construction generates a need for labour and goods and services that local companies could have trouble meeting.

The less intense coverage for geoscientific compilation and preliminary exploration does not necessarily mean that coverage is inadequate and that the scope of activities and available budgets is much smaller for those phases.

Here are our main findings from Table 27 for supporting activities:

- **Mineral resource management:** this activity seems to have adequate coverage, but non-NWT companies conduct 57% of it. If an exploration boom occurs, there could be exciting potential to be explored.
- **Administration and finance:** this activity seems to be adequately covered, and most of the companies covering it are from the NWT.
- **Supply/logistics:** this activity seems to be adequately covered, and most of the companies covering it are from the NWT.
- **Asset and technology operation and maintenance:** considering the importance of this activity, especially for operating a mining complex, we believe there is potential to be explored in this activity. Furthermore, only 51% of the companies covering it are from the NWT.
- **Research and development:** this activity does not seem to have adequate coverage, and no NWT company covers it. Obviously, several NWT companies do research and development without necessarily publicizing it, and research centre and governmental activities were not considered in this analysis. Nonetheless, there is potential to be explored for this activity and for all the mineral development phases. More research and development for the entire value chain would be highly desirable to facilitate access to mineral potential and promote NWT prosperity.
- **Human resource management:** coverage of this activity by NWT companies seems to be adequate, but considering the lack of a workforce in the NWT, we believe there is potential to be explored.
- **Risk management:** this activity seems to be adequately covered, and most of the companies covering it are from the NWT.

Services from NWT companies cover a little more than 60% of the necessary activities for value chain functioning (Figure 14).

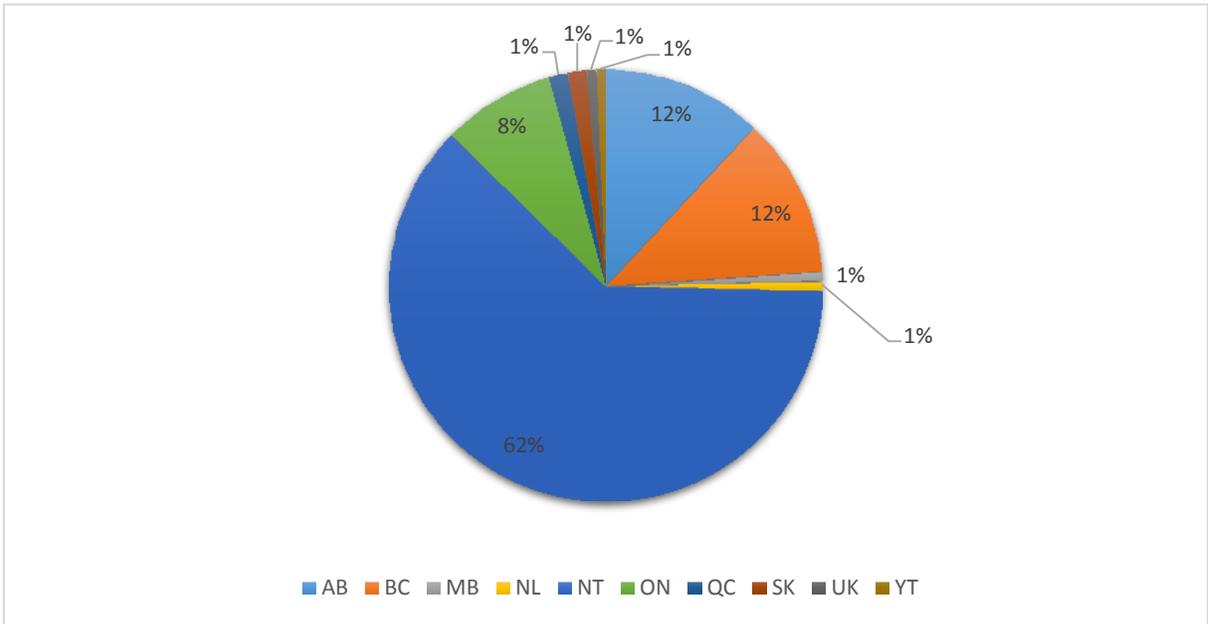


Figure 14: Head office locations of value chain companies

Analysis of specific activities

Mineral resource management

Table 28: Activity coverage level (number of companies) for mineral resource management

1. Activities for which coverage seems sufficient, and most companies are based in the NWT	Activities with potential to be explored							
	2. Activities for which coverage seems sufficient, but most companies are based outside the NWT		3. Activities not conducted by NWT-based companies or conducted by only a few companies					
	NWT	Other		NWT	Other		NWT	Other
Calculation of mineral resources and reserves	5	5	Mechanized exploration activities	1	2	Underground drilling	0	3
Blasting	3	1	Non-mechanized exploration activities	1	2	Mineralogical and metallurgical lab analysis	0	4
Economic and engineering studies	5	3	Mineral resource sampling	4	8			
Mining engineering	5	4	Surface drilling	1	5			
Metallurgy	3	2	Geology, geophysics and other geoscientific activities	4	5			
Technical and scientific services	7	6	Open-pit mining	2	3			
			Underground mining	2	3			

Table 28 shows that mineral resource activities seem to be generally well-covered in the NWT. Here are the main findings from the table:

- Activities requiring professionals such as geologists, engineers, etc. seem to be well-covered locally and, when that is not the case, outside companies are filling the gap. Most of our respondents mentioned there was a lack of professionals in the companies, which limits their development.
- The more working-class activities such as those that drillers, miners, operators, etc., conduct are also well-covered, but several of those workers come from outside the NWT except for those doing blasting. It must be pointed out that, locally, Aboriginal companies (Tl'icho, Det'on Cho], etc.) are covering most of those activities besides numerous others in the value chain.
- Our interpretation is that, at the local level, there are no companies doing underground drilling or lab analysis. Those activities will have to be analyzed more closely to determine the real potential for business and investment.

Administration and finance

Table 29: Activity coverage level (number of companies) for administration and finance²⁸

1. Activities for which coverage seems sufficient, and most companies are based in the NWT	Activities with potential to be explored							
	2. Activities for which coverage seems sufficient, but most companies are based outside the NWT		3. Activities not conducted by NWT-based companies or conducted by only a few companies					
	NWT	Other	NWT	Other	NWT	Other	NWT	Other
Sustainable development and corporate social responsibility	3	2	Legal affairs	2	3	General administration	2	0
Energy efficiency	2	1	Accounting and auditing	1	2	Bookkeeping	0	1
Financing	3	2	General engineering	3	4			
Greenhouse gas management	4	3	Process optimization, quality management and certification	2	3			
Strategic planning and project management	16	10						
Information system/data management	11	5						
Advertising, promotion and public [affairs]	8	1						

Table 29 shows that administrative and financial activities seem to be generally well-covered in the NWT. Here are the main findings from the table:

- Local coverage seems to be adequate, especially strategic planning and project management, information system/data management and advertising, promotion and public affairs activities.
- As for finance, except for Denendeh Investments, the concerned companies work on the legalities of transactions or equipment purchase instead. There is no actual investment fund. We believe there is a lack of lenders, especially in exploration, an essential link for the continuity of the mining industry value chain.
- The low number of companies performing general administration and bookkeeping does not necessarily indicate an interesting potential because companies usually carry out those activities in-house.

²⁸ Traditionally, some of these activities are not considered administration, but because they affect all facets of a company and so the value chain, we decided it was the most appropriate category. Those activities are sustainable development and corporate social responsibility, energy efficiency, greenhouse gas management, auditing and accounting, general engineering and process optimization, quality management and certification.

Supply/logistics

Table 30: Activity coverage level (number of companies) for supply/logistics

1. Activities for which coverage seems sufficient, and most companies are based in the NWT	Activities with potential to be explored						
	2. Activities for which coverage seems sufficient, but most companies are based outside the NWT		3. Activities not conducted by NWT-based companies or conducted by only a few companies				
	NWT	Other	NWT	Other	NWT	Other	
Camp construction	8	3			Technical and scientific equipment supplier	0	3
Transportation infrastructure construction	8	4			Hardware and software supplier (including design)	0	0
Mining infrastructure construction	6	4			Inventory and warehouse management	0	1
Electricity production and distribution	2	2			Installed mining equipment supplier	1	0
Non-mining infrastructure construction	12	6			Electricity-producing equipment supplier	1	0
Operational product supplier	4	0			Transportation of ore	1	0
Mobile mining equipment supplier (including drilling equipment)	3	0			Water transportation	1	0
Non-mining equipment supplier	12	6					
Provider of miscellaneous supplies	2	0					
Network and telecommunications supplier	5	0					
Camp management	4	1					
Food, restaurant and hotel services	8	0					
Petroleum products	3	0					
Air transportation	9	6					
Transportation of people	10	5					
Land transportation	4	1					
Logistical support	5	0					

Table 30 shows that supply/logistics activities seem to be well-covered in the NWT. Here are the main findings from the table:

- The NWT seems to be very well-covered in infrastructure construction, equipment supply, transportation and logistics and especially camp construction; transportation infrastructure construction; non-mining infrastructure construction; non-mining equipment supply; food, restaurant and hotel services; air transportation and the transportation of people.
- The obligation to buy local to which mining operators must submit, 70% in the case of the Ekati complex, are reflected in the table.
- As for more specialized equipment (scientific and computer), there seems to be an interesting opportunity to explore, especially in hardware and software design, no Chamber of Mines member company covering that activity. Obviously, in 2015, information technology is at the heart of

operations (all phases), so mining operators must meet that need.

- Installed mining equipment supply (industrial pumps, ventilation, conveyors, etc.) and ore transportation are important activities in the mining industry value chain, so there seems to be interesting potential there to explore. Because one local Aboriginal company covers ore transportation, the very low number of companies (one) does not reflect the scope of that activity.

Asset and technology operation and maintenance

Table 31: Activity coverage level (number of companies) for asset and technology operation and maintenance

1. Activities for which coverage seems sufficient, and most companies are based in the NWT	Activities with potential to be explored							
	2. Activities for which coverage seems sufficient, but most companies are based outside the NWT				3. Activities not conducted by NWT-based companies or conducted by only a few companies			
	NWT	Other		NWT	Other		NWT	Other
Electricity production, electrical power plant operation and maintenance (fossil and nuclear fuel)	2	2	Electricity production, electrical power plant operation and maintenance (renewable energy)	1	4	Technical and scientific equipment operation and maintenance	0	0
Non-mining equipment operation and maintenance	4	1	Mobile mining equipment operation and maintenance (including drilling equipment)	1	2	Installed mining equipment operation and maintenance	1	1
Transportation infrastructure operation and maintenance	3	2	Mining infrastructure operation and maintenance	1	2	Software operation and maintenance	0	0
Network and telecommunication operation and maintenance	4	2	Non-mining infrastructure operation and maintenance	2	3	Hardware operation and maintenance	0	0
						General maintenance (housekeeping and porter services)	1	0

Table 31 shows that there seem to be some gaps in asset and technology operation and maintenance activities. Here are the main findings from the table:

- Non-mining equipment operation and maintenance, transportation infrastructure operation and maintenance and network and telecommunication operation and maintenance activities seem to be adequately covered.
- Mobile mining equipment operation and maintenance, mining infrastructure operation and maintenance and especially installed mining equipment operation and maintenance activities seem to be underserved by NWT and outside companies alike. Therefore, we believe there is very interesting potential for installed equipment maintenance to be explored, especially during planned shutdowns in mining complexes.
- As for supply/logistics, companies inside and outside the NWT providing technical and scientific equipment operation and maintenance and software and hardware

operation and maintenance are completely absent. There also appears to be very interesting potential to be explored in those activities. As mentioned above, in 2015, information technology is at the heart of operations (all phases), so mining operators must meet that need.

Research and development

Table 32: Activity coverage level (number of companies) for research and development

1. Activities for which coverage seems sufficient, and most companies are based in the NWT			Activities with potential to be explored						
			2. Activities for which coverage seems sufficient, but most companies are based outside the NWT			3. Activities not conducted by NWT-based companies or conducted by only a few companies			
NWT		Other	NWT		Other			NWT	Other
						Research and development	0	2	
						Innovation	0	1	

Table 32 indicates an obvious absence of research and development activities. Here are the main findings from the table:

- Companies providing research and development and innovation activities seem to be absent from the NWT. It must be noted that the one company covering innovation activities is 51% Inuit-owned, Nuna Logistics, which has a regional office in Yellowknife. However, its head office is outside the NWT, and its innovation subsidiary is in British Columbia.
- Considering the importance of research and development and innovation to the vitality of the value chain and the economy in general, it is surprising to see so few companies are involved in this field. We must mention that companies often participate in or implement in-house research and development programs or even an innovation process, so it is highly probable that those activities are better covered than our analysis shows. But that means that very few companies publicize their research and development activities, which is a concern because it is usually done with pride. Therefore, there is a high potential to be explored.

Human resource management

Table 33: Activity coverage level (number of companies) for human resource management

1. Activities for which coverage seems sufficient, and most companies are based in the NWT			Activities with potential to be explored						
			2. Activities for which coverage seems sufficient, but most companies are based outside the NWT			3. Activities not conducted by NWT-based companies or conducted by only a few companies			
NWT		Other	NWT		Other			NWT	Other
Skill development	3	1				Coaching and motivation	1	0	
Training	6	3				Hiring	1	0	
Personnel recruitment	2	1							

Table 33 shows human resource management activities seem to be generally well-covered in the NWT. Here are the main findings from the table:

- Most of the companies covering those activities are located in the NWT.

- Although skill development, training and personnel recruitment activities are in a category in which NWT coverage seems adequate (based on the categorization parameters), we believe there is interesting potential to be explored. The NWT is experiencing a shortage of professionals and qualified workforce: human resource management activities could certainly play an important or even crucial role in the mining industry value chain and NWT development.
- Coaching and motivation and hiring activities present an interesting potential to be explored.

Risk management

Table 34: Activity coverage level (number of companies) for risk management

1. Activities for which coverage seems sufficient, and most companies are based in the NWT	Activities with potential to be explored							
			2. Activities for which coverage seems sufficient, but most companies are based outside the NWT			3. Activities not conducted by NWT-based companies or conducted by only a few companies		
	NWT	Other		NWT	Other		NWT	Other
Community communications and relations	6	2	First responders and medical care	2	3	Environmental analysis lab	0	4
Environmental permit applications and management	9	6	Environmental services (emergencies, clean-up, waste management, etc.)	2	3	Business intelligence	0	0
Environmental and social impact studies	11	6				Crisis management	1	0
Mine closure and restoration, including exploration sites	14	6						
Environmental management and monitoring	6	3						
Agreement negotiation	4	4						
Tailing and contaminant management	6	2						
Economic, environmental and social risk management	4	0						
Health and safety (prevention)	6	3						
Life and property safety	3	0						

Table 34 shows that risk management activities seem to be [generally well-covered] in the NWT. Here are the main findings from the table:

- The NWT seems to be [very well-covered] with regard to risk management, especially environmental risks. That is especially true for environmental permit applications and management, environmental and social impact studies and mine closure and restoration (including exploration sites). There are many uncertainties in the mining industry, so it is not surprising that mining and exploration managers strive to reduce them by managing risk throughout the value chain and doing business with companies specializing in that area.

- Not mentioned much during our interviews and so not appearing in our analysis, restoration of the old Giant Mine near Yellowknife presents an interesting business potential to be explored. A recent CDÉTNO commercial mission confirmed that potential when an entrepreneur concluded a contract while another one is in talks (April 2015) on the Giant Mine Remediation Project,²⁹ which will encourage companies with innovative solutions that will reduce long-term costs.
- First responder/medical care and environmental service activities seem to be well-covered, but most companies providing those services come from outside the NWT, so there is potential to be explored.
- The data indicate that there is no environmental analysis lab. It would be interesting to explore that potential especially because there are no mineralogical and metallurgical analysis labs either (see p. 60). We believe there is potential to be explored regarding those activities. We should add that, during our interviews, some respondents mentioned that an analysis lab in Yellowknife has closed its doors a few months ago.
- Business intelligence and crisis management activities appear to us to indicate interesting potential to be explored. The first facilitates the prevention and anticipation of risks, while the second helps to improve responses to crises.

²⁹ This is one of the worst abandoned Canadian mining sites. Restoration costs are estimated to be between \$450 million and more than \$900 million (Fion & Leffler, 2014). AANDC and the Government of the NWT are jointly managing the remediation project (Government of Canada's Contaminants and Remediation Directorate (CARD), 2014). Besides treating the water there and restoring the site, arsenic trioxide waste will be frozen and contained in sealed vaults. Once the restoration has been completed, the site will be monitored and maintained permanently or even to perpetuity (therefore long-term business potential).

STRATEGIC COURSES OF ACTION AND RECOMMENDATIONS

We are well aware that CDÉTNO members and partners were not waiting for the conclusions of this report to begin strategic actions to encourage NWT economic development. However, we are permitting ourselves to identify, in the light of our analysis, some strategic courses of action in which we believe that efforts should be concentrated.

Strategic course of action 1: Business partnerships

One of our first findings is that regional economic incentives have some impact. Impact and benefit agreements and local hiring and purchasing policies also contribute directly to stimulating the NWT economy. Mining operators must respect those commitments and therefore need Aboriginal and non-Aboriginal companies from the NWT. Consequently, the creation of business partnerships, obviously, is one strategic course of action to take to meet current needs.

For example, an NWT company could partner with a large company from elsewhere in Canada to increase the former's capacities. Also, partnerships with Aboriginal companies are certainly one way that deserves careful study. Besides giving a direct competitive advantage by making the company eligible according to impact and benefit agreement criteria, such partnerships increase the chances of success and maximize continuity. Business partnerships:

- Support and develop local expertise,
- Increase the capacities of local companies,
- Provide access to new markets,
- Allow for reliance on knowledge of the NWT,
- Provide access to a large labour pool,
- Meet mining companies' needs,
- Etc.

The importance of partnerships is already known, and the CDÉTNO has made them a priority in its investment attraction strategy. However, we would like to recommend some actions:

- Continuing to organize commercial missions helping companies to network and possibly firm up partnerships. Furthermore, we believe that local activities bring entrepreneurs from Yellowknife and the region together and have an excellent stimulating and multiplying effect while continuing to publicize the CDÉTNO as a development organization. A mini business show

based on the CIM's mining week concept is an excellent model for that type of activity. But even a simple lunch-and-learn session or networking Happy Hour with a mining theme could quickly several bring companies together.

- Collaborative arrangements between the CDÉTNO and its various partners such as the Municipality of Yellowknife and the Chamber of Mines are an excellent step in the right direction. According to the available resources, in our opinion, it would be beneficial to start concerted actions with those partners. The formation of a kind of partner task force in which the mining industry holds the central role would be an excellent means of implementing innovative solutions. This task force would not only help to conduct a kind of business intelligence and coordination of efforts but would contribute as well to solidifying relations between the CDÉTNO and its partners.
- Besides formal impact and benefit agreements, it would be appropriate to explore the possibility of implementing agreements in principle between the mining companies and the Francophone community specifically or the Municipality of Yellowknife more generally. The example of the cities of Chapais and Chibougamau, the representatives of which signed a partnership statement with Stornoway Diamonds, is particularly instructive.³⁰ The Comité de maximisation des retombées économiques de l'Abitibi-Témiscamingue (ComaxAT) [Abitibi-Témiscamingue economic benefit maximization committee] has also been innovative in this regard with its *Guide des bonnes pratiques en matière de retombées économiques des projets majeurs en Abitibi-Témiscamingue* [Abitibi-Témiscamingue major project economic benefit good practices guide].³¹

Strategic course of action 2: Revived exploration

Exploration is the foundation of the mining industry value chain. The issue is simple: without exploration, there is no operation, production, sales, income and so no economic benefits coming from the mineral resource. A very sharp and ongoing drop in exploration has consequences 15, 20 or 30 years later. One does not have to wait for a mine to close to carry out exploration. It is an activity that must be ongoing and for a variety of commodities. Recent history proves this. What would have happened to the NWT economy if there had been no diamond exploration in the 1980s and 1990s considering the fact that the Giant and Con mines closed in the early 2000s?

In mineral exploration, investment choices are made based on several criteria, the three main ones being:

³⁰ http://fr.stornowaydiamonds.com/investor_relations/news_releases/ashton_archives/index.php?&content_id=677

³¹ http://www.comaxat.com/images/uploads/files/comaxat_-_guide_des_bonnes_pratiques.pdf

1. the world economic context governing the commodity market,
2. mineral potential (geology and geoscientific knowledge) and
3. a jurisdiction's policies and the perception of those policies.

As for the first one, NWT mining industry stakeholders have almost no means to be involved at the world commodity market level. However, it is still possible and even desirable to act proactively to mitigate the lull in business by encouraging investment with some financial incentives or supporting an exploration fund.

As for the second criteria, NWT geological potential still remains to be revealed. That was a consensus we heard in our meetings with respondents. According to the *Fraser Institute Annual Survey of Mining Companies: 2014*, in purely geological terms, NWT potential is among the best in the world. However, with regard to perceptions of NWT policies, they are rather negative. Despite those perceptions, founded or not, the NWT is nonetheless a politically stable jurisdiction in which the environmental assessment process was recently improved and where most Aboriginal land claims have been settled. Therefore, to re-establish the facts on both geology and rather negative perceptions, there is some promotional work to be done.

Regarding the problem of reviving exploration, as a Francophone organization dedicated to individual economic development, the CDÉTNO can intervene in two ways:

- The Quebec mining investment model covers the entire mining industry value chain. The CDÉTNO could identify the elements from that model that could apply to the financial reality and political culture of the NWT and then make recommendations in that regard to the territorial government. As an example, the Société de développement économique de la Baie-James (SDBJ) mining investment fund or the Diversification of Exploration Investment Partnership (SIDEX), both especially for exploration, could be interesting cases to analyze.
- To support the efforts of the Government of the NWT in implementing its mineral strategy, specifically, with regard to exploration investment, the CDÉTNO in collaboration with NWT mining stakeholders could promote NWT mineral potential to Francophone exploration companies, specifically, those from Quebec, which have recognized expertise in Northern exploration.

Strategic course of action 3: [Promoting] Yellowknife as a hub of Northern development

The NWT, and Yellowknife, in particular, occupy a prime position for Northern Canadian development, not only because of the current diamond mines, but also when considering the projects in development in the NWT and Nunavut. In fact, geological formations do not end or begin at borders, and several mining projects are in the advanced exploration and appraisal stage in Nunavut close to the NWT.

In territories where a lack of infrastructure is identified as one of the main restrictions on

development, Yellowknife has the advantage of being extremely well-situated: the municipality is accessible by road and has modern airport infrastructure. Even more, companies working in air and road transportation and logistics are numerous, well-established and, according to our observations and the statements of our interviewees, they are performing admirably well.

Of course, the CDÉTNO would be unpopular, as an NWT-based Francophone economic development organization, if members tried to extend the organization's area of influence into Nunavut. However, one of the largest mining projects in Nunavut in recent years is certainly the Meadowbank mine near Baker Lake. It is the property of Agnico Eagle and is located a little more than 300 km from the western shore of Hudson's Bay. Despite the distance and the fact that several activities are conducted directly at the mining site, Agnico Eagle management has decided to establish a nerve centre in Val d'Or, Quebec, to take advantage of the infrastructure and expertise of that traditional mining region.

Along those same lines, we recommend:

- Continuing networking with companies working in the Quebec mining industry and in the rest of the Canadian French-language industry. The CDÉTNO has an interest, in our opinion, to very attentively study the background of the development of the Meadowbrook project and its benefits to the city of Val d'Or and the Abitibi-Témiscamingue region. A quick comparison will make the similarities immediately apparent: there is a very obvious opportunity for Yellowknife to be positioned as a hub of Northern mineral development.
- Putting this notion of Yellowknife as a hub into action far surpasses the CDÉTNO mandate and mission, but as an important intermediary in attracting investment [in companies from Francophone markets from NWT governmental and economic stakeholders], the CDÉTNO could certainly play a definite role as a generator of ideas and opportunities in this regard.

Strategic course of action 4: Human resource development

During our interviews, several respondents emphasized that qualified human resources are in short supply: university graduates, technicians and specialized workers are not lining up to work in the NWT mining industry. Analysis of statistical data illustrates this fact and is no surprise, neither to the authors of this report nor to the CDÉTNO, which is already working its hardest to remedy the situation. Skill development and, above all, a transition from a wage worker culture to a work culture based on know-how and expertise will require some patience. Figure 9 on page 43 is especially revealing: despite the fact that industry representatives are complaining that there is a lack of qualified employees, many people without diplomas manage, despite everything, to find work. Although that observation might, immediately, at least, make us believe that everything is fine, that is not the case: training and qualified employees are the ones who contribute most consistently to the

economy. Commodities are replaceable, but expertise is indispensable because it generates the most value.

Several of the companies prospering in the NWT are doing so due to their unique expertise and their ability to innovate and adjust. Furthermore, nearly all our respondents mentioned an [actual or desired supplier] who distinguished itself with its skill, expertise and efficiency. In this regard, we believe that the CDÉTNO should continue its communication efforts to publicize the NWT as attractive for investors but also as welcoming for professionals and graduates of all kinds. Our recommendations for this strategic course of action are as follows:

- Exploring the possibility of forming connections between NWT companies and certain teaching institutions in Quebec and the rest of French-speaking Canada for ongoing training and recruitment: for example, by facilitating internships in the NWT for students in engineering, geology and other relevant fields.
- Because mine workers are usually used to greater mobility than those working in other economic sectors, the investment attraction strategy could easily be extended to include a worker attraction strategy (Ruée vers le Nord [the rush North]³² and Valorisation Abitibi-Témiscamingue models.)³³
- Publicizing and promoting employment sectors in which knowledge and innovation ability are appreciated and, by extension, publicizing companies that recognize and value those qualities.

Strategic course of action 5: Seizing identified opportunities

Based on the findings of the analysis of the mining industry value chain grid, some activities seem to present very interesting business opportunities, [and several specific activities merit exploration depending on requests]. Besides human resource recommendations, we have identified three other recommendations intended to orient the CDÉTNO in its mission:

- **Planned shutdowns:** asset and technology operations and support supporting activities (electrical, instrumentation, etc.) seem to indicate some gaps, and more specifically,

³² <http://www.larueeverslenord.com/>

³³ <http://valorisation-abitibi-temiscamingue.com/>

during planned shutdowns in mines in production. The CDÉTNO could identify the specific needs of mining operators in production and call upon and support regional Francophone mining companies suitable or ready to meet the demand. It would be highly desirable if the CDÉTNO tried, above all, to establish strategic partnerships between outside Francophone companies and local companies.

- **Research and development:** several Francophone universities and research centres have developed expertise in Northern and mineral development. The CDÉTNO could identify the research and development needs of the companies making up the mining industry value chain and act as the intermediary between those companies and one or more Francophone researchers.
- **[Human resource management]:** some of our respondents said they would like to have the presence of a university in the NWT. The CDÉTNO could establish connections between NWT governmental authorities and a university, such as the Université du Québec en Abitibi-Témiscamingue (UQAT), in a mining region and with expertise in an Aboriginal context covering a large area. It would be interesting to evaluate if this model could be adapted to the NWT context.
- **Design of the mining complex:** designing mining complexes is the mineral development phase representing the best business opportunities for companies not established in the NWT. In this regard, the opportunities are excellent for several specific activities of the value chain. Currently, there are several projects in the NWT in the more or less advanced appraisal phases (Table 3 and Table 4)[,and] the CDÉTNO could begin communicating with the concerned mining companies to present the organization's mission. At the right time, the CDÉTNO could identify the [planned needs] of the mining companies and then appeal to and support regional Francophone mining companies suitable or ready to meet the demand. It would be highly desirable if the CDÉTNO tried, above all, to establish strategic partnerships between outside Francophone companies and local companies.

CONCLUSION

Despite a clear global decline in the mining industry due to the economic context, we have observed that several NWT mining companies are still doing well currently. Of course, it is certain there is still a lot of room for improvement: new business opportunities are present, and growth is desirable to maximize NWT economic benefits. With its extremely rich and diverse mineral potential, the NWT subsoil will mean a promising future for the mining industry. The diamond market and the relative abundance of diamonds in the NWT are also positive elements that have contributed to lessening the repercussions of decreased world demand for mineral resources. On the other hand, it is obvious that the significant decrease in exploration does not bode well. That situation, however, is not unique to the NWT and, although a concern, it is not insurmountable.

The NWT are in a historical phase of their development: the fact that federal powers have devolved is a propitious starting point in many regards. We believe that the mining industry will be vitally important as an engine of economic growth and that the CDÉTNO can contribute significantly to NWT economic development by maximizing the organization's connections with the Francophone stakeholders of that industry.

BIBLIOGRAPHY

- Board of Trade of Metropolitan Montreal, Minalliance and KPMG-SECOR. 2013. Metal Processing and Greater Montréal: A Sustainable and Promising Alliance. Montreal.
- Agence Française du Négoce de l'Or et des Métaux Précieux. (2013, février 9). *Propriétés de l'or*. [the properties of gold] Récupéré sur Agence Française du Négoce de l'Or et des Métaux Précieux: <http://www.agence-francaise-du-negoce-de-l-or-et-des-metaux-precieux.fr/Les-informations-Or-et-metaux-precieux/proprietes-de-l-or.html>.
- Anglo American corporate website. Consulted March 2, 2015: <http://www.angloamerican.com/>.
- Audion A.S., H. C. (2014). *Panorama mondial 2013 du marché du cobalt: Rapport public*. BRGM [public report on 2013 overview of world cobalt market].
- Avalon Rare Metals Inc. June 2013. Rare Earths 101: The basics, economics, supply chain and applications. Consulted March 9, 2015: http://avalonraremetals.com/_resources/pdf/REE101.pdf.
- BRGM. (2012, juillet). *Panorama 2011 du marché du tungstène - Rapport public* [public report on 2011 overview of world tungsten market]. Consulted March 10, 2015: <http://infoterre.brgm.fr/rapports/RP-61341-FR.pdf>.
- Northwest Territories Bureau of Statistics. 2015. Gross Domestic Product - Table 1: NWT GDP by Industry, 2007 to 2013. Consulted March 11, 2015: <http://www.statsnwt.ca/economy/gdp/>.
- De Beers corporate website. Consulted March 2, 2015: <http://www.debeersgroup.com/en/index.html>.
- De Beers Canada Inc. corporate website. Consulted March 2, 2015: <https://www.canada.debeersgroup.com/>.
- De Beers Group of Companies. 2014. LIVING UP TO DIAMONDS - REPORT TO SOCIETY 2013 - HOW ARE WE PERFORMING? Consulted March 2, 2015.
- Denommé, F.-M. (2013). *Les déterminants de la sous-traitance dans l'industrie minière -Mémoire présenté en vue de l'obtention du grade de maîtrise ès gestion* [Master of management thesis on mining industry sub-contracting determinants]. Montréal: HEC Montréal.
- Department of Industry, Tourism and Investment. 2013. Northwest Territories Mineral Development Strategy (PDF document). Yellowknife: Government of the Northwest Territories.
- Diavik Diamond Mine Inc. July 31, 2014. 2014 socio-economic monitoring agreement report. Consulted February 28, 2015: http://www.riotinto.com/documents/Diavik_2014%20mid_year_socio_economic

_ monitoring_agreement_report%20July%202014.pdf.

Diavik Diamond Mines (2012) Inc. April 2014. Diavik Diamond Mine 2013 sustainable development report. Consulted February 27, 2015: http://www.riotinto.com/documents/Diavik_2013_Sustainable_Development_Report.pdf.

Dominion Diamond Corporation. 2014. Dominion Diamond's 2013 Socio-Economic Agreement Report. Consulted February 26, 2015: <http://ddcorp.ca/docs/default-source/default-document-library/dd-2013-sea-report-03nov14.pdf>.

Dominion Diamond Corporation corporate website. Consulted February 26, 2015: <http://www.ddcorp.ca/home>.

Fion, F., & Leffler, B. November 2014. TIMELINE: Yellowknife's Giant Mine. Consulted April 2, 2015: <http://globalnews.ca/>: <http://globalnews.ca/news/1682932/timeline-yellowknifes-giant-mine/>.

Gambogi, J. January 2015. Rare Earths. Consulted March 9, 2015: <http://minerals.usgs.gov/>: http://minerals.usgs.gov/minerals/pubs/commodity/rare_earths/mcs-2015-raree.pdf.

GFMS, Thomson Reuters; World Gold Council. March 2015. Supply and Demand of Gold by Region. Retrieved from World Gold Council: [http://www.gold.org/supply-and-demand/demand/regional-analysis?areas\[0\]=all&periods\[0\]=Q4%2714&categories\[0\]=Jewellery&categories\[1\]=Total%20bar%20%26%20coin%20invest.&filter=1#gold-data-filter-form](http://www.gold.org/supply-and-demand/demand/regional-analysis?areas[0]=all&periods[0]=Q4%2714&categories[0]=Jewellery&categories[1]=Total%20bar%20%26%20coin%20invest.&filter=1#gold-data-filter-form).

Government of the Northwest Territories. June 30, 2011. National Instrument 43-101: Standards of Disclosure for Mineral Projects. Consulted March 4, 2015: <http://www.justice.gov.nt.ca/SecuritiesRegistry/documents/43-101-NI-2011-06-30-French.pdf>.

Government of the Northwest Territories. November 2013. Mineral Development Strategy. Retrieved from <http://www.iti.gov.nt.ca/publications/northwest-territories-mineral-development-strategy>.

Government of the Northwest Territories. [January 10, 2013]. Resource Revenue Sharing Provisions in Existing Land Claim and Self-Government Agreements. Retrieved from Devolution of Lands and Resources in the Northwest Territories: <http://devolution.gov.nt.ca/resource-management/resource-revenue/existing-resource-revenue-sharing-agreements>.

Government of the Northwest Territories. 2015. Office of the Superintendent of Securities. Consulted March 4, 2015.

Government of the Northwest Territories Department of Justice. [January 4, 2014]. Department of Justice, *Mining Regulations*. Retrieved from

- http://www.justice.gov.nt.ca/PDF/REGS/NORTHWEST_TERRITORIES_LAN_DS%5CMining.pdf.
- Government of Canada Contaminants and Remediation Directorate. August 25, 2014. Giant Mine Remediation Project. Consulted April 2, 2015: <https://www.aadnc-aandc.gc.ca/fra/1100100027364/1100100027365> [French].
- Hancock, T. January 22, 2015. Global Base Metals Outlook - Moody's. Retrieved from Mining Weekly: <http://www.miningweekly.com/article/global-base-metals-outlook-turns-negative-moodys-2015-01-22>.
- Canadian Institute of Mining, Metallurgy and Petroleum. 2014. CIM DEFINITION STANDARDS - For Mineral Resources and Mineral Reserves (electronic document).
- Canadian Institute of Mining, Metallurgy and Petroleum. 2015. Official Standards & Guidelines. Consulted March 4, 2015: <http://web.cim.org/standards/menuPage.cfm?menu=177>.
- International Copper Study Group. 2015. The World Copper Factbook 2014. Retrieved from www.icsg.org: <http://www.icsg.org/index.php/component/jdownloads/finish/170/1997>.
- Investopedia. February 2015. Base Metals. Retrieved from <http://www.investopedia.com/terms/b/base-metals.asp>.
- Jackson, T., & Green, K. February 2015. Fraser Institute Annual Survey of Mining Companies: 2014. Consulted March 20, 2015: <http://www.fraserinstitute.org/uploadedFiles/fraser-ca/Content/research-news/research/publications/survey-of-mining-companies-2014.pdf>.
- Mackenzie Valley Land and Water Board. 2015. Co-Management/Mackenzie Valley Land and Water Board. Retrieved from <http://mvlwb.com/content/co-management>.
- North American Tungsten Corporation Ltd. 2014. Technical report on the CanTung Mine, Northwest Territories, Canada - Report for NI 43-101. Consulted March 3, 2015: <http://www.natungsten.com/i/pdf/Tech-Report-CanTung-Mine-Northwest.pdf>.
- North American Tungsten Corporation Ltd. corporate website. Consulted March 3, 2015: <http://www.natungsten.com/s/Home.asp>.
- Northwest Territories Bureau of Statistics. 2014. NWT Survey of Mining Employees - Overall Report.
- Northwest Territories Bureau of Statistics. March 13, 2015. NWT Labour Force Activity. Retrieved from <http://www.statsnwt.ca/labour-income/labour-force-activity/Monthly/February2015NewStatsLF.pdf>.
- NWT Centre for Geomatics. January 2015. NWT Mineral Tenure (four shape files). Consulted January 2015: <http://www.geomatics.gov.nt.ca/default.aspx>.

- NWT & Nunavut Chamber of Mines - Northern Mining News, Volume 8, No. 2, February 2015. Yellowknife, NT, Canada.
- NWT & Nunavut Chamber of Mines. February 18, 2008. Mining makes a difference. Consulted [?], 2015: [http://www.miningnorth.com/_rsc/site-content/library/publications/Mining_Makes_Difference\(ChamberMines2008\).pdf](http://www.miningnorth.com/_rsc/site-content/library/publications/Mining_Makes_Difference(ChamberMines2008).pdf).
- NWT & Nunavut Chamber of Mines. January 2015. Mines & Promising Northwest Territories and Nunavut Mine Projects. Northern Mining News, 8(1), 23-26.
- NWT Mining Heritage Society. 2015. Mining History. Consulted February 18, 2015: <http://www.nwtminingheritage.com/mining-history>.
- Polinares. March 2012. Fact Sheet: Rare Earths Oxides (REO) - POLINARES working paper n. 37. Consulted March 9, 2015: http://www.polinares.eu/docs/d2-1/polinares_wp2_annex2_factsheet3_v1_10.pdf.
- Natural Resources Canada. 2014. [Articles on mineral products, 2012]. Retrieved from <http://www.rncan.gc.ca/mines-materiaux/marches/articles-produits-mineraux/2012/13839> [French].
- Natural Resources Canada. 2014. Generalized Model of Mineral Resource Development. Consulted March 17, 2015: <http://www.rncan.gc.ca/mines-materiaux/statistiques/8855> [French].
- Rio Tinto. February 2013. Exploration - Creating value through discovery - Capability brochure. Consulted February 27, 2015: http://www.riotinto.com/documents/RT_Exploration_brochure.pdf.
- Rio Tinto. February 2015. Diamonds: Beauty with integrity - Capability brochure. Consulted February 2015: http://www.riotinto.com/documents/20150224_Diamonds_capability_brochure_Eng.pdf.
- Rio Tinto corporate website. Consulted February 27, 2015: <http://www.riotinto.com/default.aspx>.
- Robin, J.-P. (2014, octobre 10). *Six ans après la chute de Lehman Brothers, vers une nouvelle crise mondiale ?* [a new global crisis six years after the Lehman Brothers collapse?] Consulté le mars 12, 2015, sur <http://www.lefigaro.fr/>: <http://www.lefigaro.fr/voix/economie/2014/10/10/31007-20141010ARTFIG00204-six-ans-apres-la-chute-de-lehman-brothers-vers-une-nouvelle-crise-mondiale.php>.
- Shedd, K. January 2015. TUNGSTEN - U.S. Geological Survey, Mineral Commodity Summaries. Consulted March 10, 2015: <http://minerals.usgs.gov/minerals/pubs/commodity/tungsten/mcs-2015-tungs.pdf>.

- Statistics Canada. 2011. National Household Survey. Retrieved from <http://www4.rhdcc.gc.ca/servlet/WBPub?&lang=fra¤taction=downloaddata&iid=36&suffix=.xls> [French].
- Technology Metals Research. 2015. TMR Advanced Rare-Earth Projects Index. Consulted March 9, 2015: <http://www.techmetalsresearch.com/>:
<http://www.techmetalsresearch.com/metrics-indices/tmr-advanced-rare-earth-projects-index/>.
- USGS. February 2014. Mineral Commodity Summaries.
- USGS. 2015. Mineral Commodities Summary.
- Auditor General of Canada. 2010. 2010 Spring Report. Retrieved from http://www.oag-bvg.gc.ca/internet/images/content/parl_oag_201004_04_f_01.gif [French].
- Vorster, A. March/April 2001. Planning for value in the mining value chain. The Journal of the South African Institute of Mining and Metallurgy, pages 61-68.
- World Bank Group in collaboration with the United Nations Environment Programme and the United Nations Development Organization. April 1999. Pollution Prevention and Abatement Handbook, 1998: Toward Cleaner Production. Washington, D.C.: WORLD BANK GROUP.
- World Diamond Council. 2008. The diamond industry fact sheet. Consulted March 5, 2015: [https://www.worlddiamondcouncil.org/download/resources/documents/Fact%20Sheet%20\(The%20Diamond%20Industry\).pdf](https://www.worlddiamondcouncil.org/download/resources/documents/Fact%20Sheet%20(The%20Diamond%20Industry).pdf).
- World Gold Council. March 1, 2015. World Official Gold Holdings.

APPENDICES

[All appendix links go to French-only documents: translator]

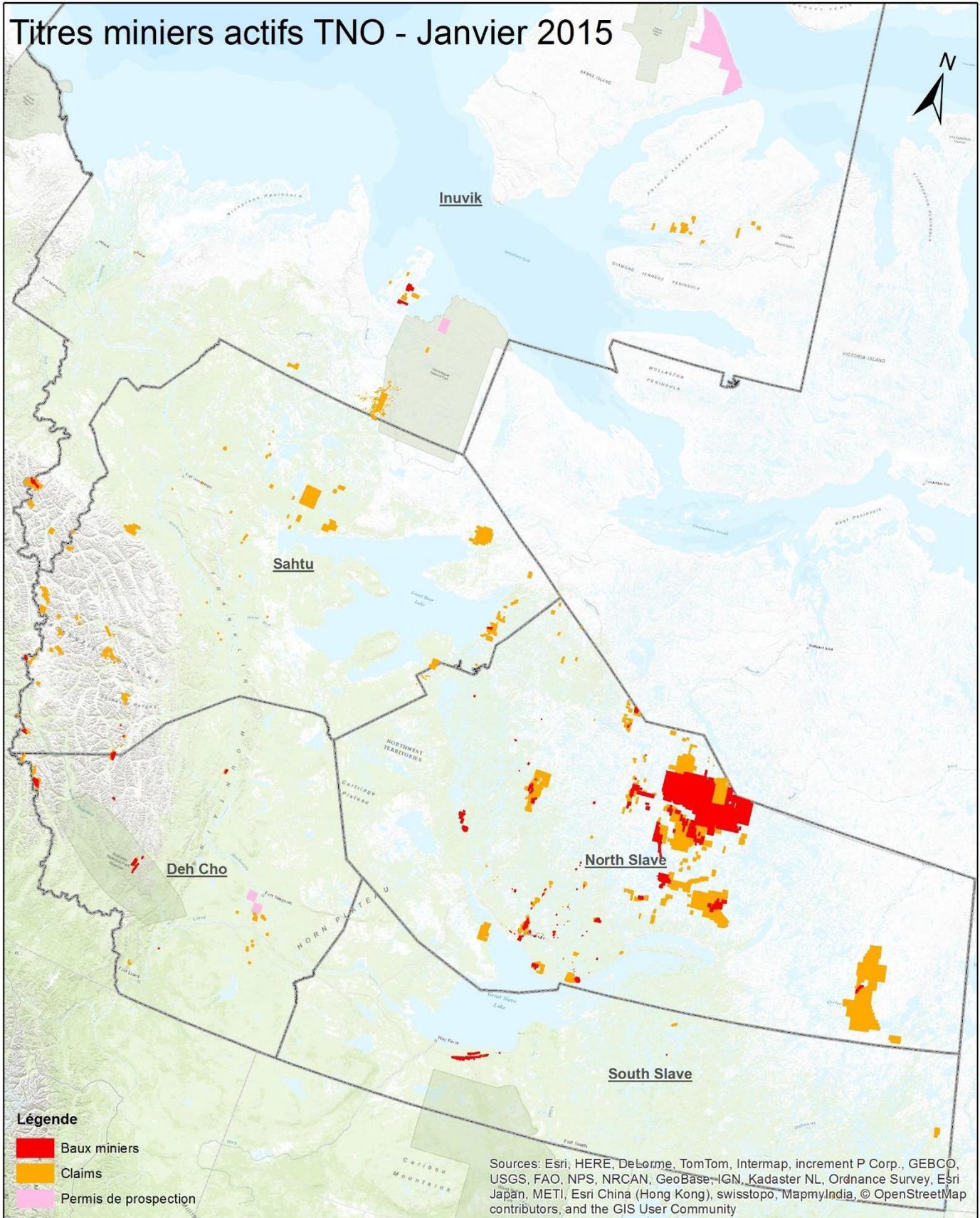
Appendix 1: NWT mining industry value chain grid and companies, March 2015

- See Excel file entitled Appendix 1: Mining industry value chain grid and companies, March 2015
- To print on 11 x 17 paper in landscape mode, insert the following PDF files:
 - Appendix 1a: Complete NWT value chain grid, 1 of 3
 - Appendix 1b: Complete NWT value chain grid, 2 of 3
 - Appendix 1c: Complete NWT value chain grid, 3 of 3

Appendix 2: NWT mining tenure, January 2015

- See JPEG file, Appendix 2: Active NWT mining tenure, January 2015

Titres miniers actifs TNO - Janvier 2015



Sources: Esri, NWT - Centre for Geomatics, 2015
Échelle approximative - 1:6 500 000



Frédéric Gauthier
8 avril 2015

Appendix 3: Mining industry value chain questionnaire, final version

- See or insert Word file called Appendix 3: Mining industry value chain questionnaire, final version