MINING NORTH WORKS!

The North turns rocks to riches with mining and exploration

NORTHWEST TERRITORIES & NUNAVUT CHAMBER OF MINES

EXPLORE FOR MORE!

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Mining North Works!

Visit the website to learn more about all things mining!
MININGNORTHWORKS.COM

Photo: NWT Mine Training Society

Mining North Works!

Exploration starts here!

This booklet, with a focus on the mineral resources in Canada's Northwest Territories and Nunavut, provides details on the many ways mining north works!

The pages that follow include information about past, present, and potential future mines, and give details to demystify the mineral resources cycle – a process that goes from exploration through production to mine closure.

Read on to discover more about benefits industry creates. Learn little known but interesting facts about exploration and mining and about northern minerals produced for the world's modern needs.

Images and infographics help tell the story of the rich, diverse, and exciting industry that helped build the North. Mineral resources have the potential to power people to greater wealth for stronger self-reliance and social and economic success.

Mining North Works! for Canada's Northwest Territories and Nunavut

The vast Canadian north ... a remote land, a challenging environment, a harsh climate. But rich in mineral resources and home to a people with a rich history which includes exploration and mining.

Successfully and skillfully transforming rocks to riches is a northern tradition.

Centuries ago, Inuit fashioned copper into tools including ulus, knives, icepicks, gaff hooks, and harpoon heads. Metals were vital for the items for day to day living and for trading for much needed supplies.

The Yellowknives Dene are descendants of the Tetsǫ́t'ıné Indigenous people who lived around Great Slave Lake and were known to have used copper to make tools. Early exploration and fur trade records referred to this group of Dene as copper, yellow-knife, red-knife, or couteaux jaunes. The City of Yellowknife, and a nearby river, would be named after the Yellowknives Dene.

Many European explorers would come north looking for wealth while others explored for the Northwest Passage, the sea route to the Pacific through the Arctic.

Indigenous peoples, early European explorers, fur traders, and more recently national defence, and sovereignty, have all played a role in the development of the North.

Woven throughout is the story of metals and minerals.

And for the past several decades, the minerals industry has been a major force in developing the modern North.

Photo: Agnico Eagle

Training is a key driver to create opportunities, especially for employment. NWT Mine Training Society trainees, pictured left, prepare for employment opportunities. Gabriel Ulayok, who completed heavy equipment training works at Meadowbank, one of Nunavut's gold mines.

Prospectors, mineral exploration companies, and mining businesses have converted rocks to riches which have then been used improve the quality of life and to build a path to a better future for northerners and Canadians.

With its diverse First Nations, Inuit, and Métis peoples, the North has emerged a national leader in Indigenous reconciliation. Indigenous peoples are today very much a part of the industry – participating in every step of every development, including the benefits.

Gifted with a diverse geology rich in mineral resources, and home to a resilient people, including adventurous explorers and hearty miners, the Northwest Territories and Nunavut have built a strong tradition of using mineral resources wisely.

Minerals are the North's economic advantage

For decades gold powered the economy of Yellowknife and even more remote mines were built in the High Arctic in Nunavut. Today, diamond mines drive the NWT's economy and gold and iron are expanding in Nunavut.

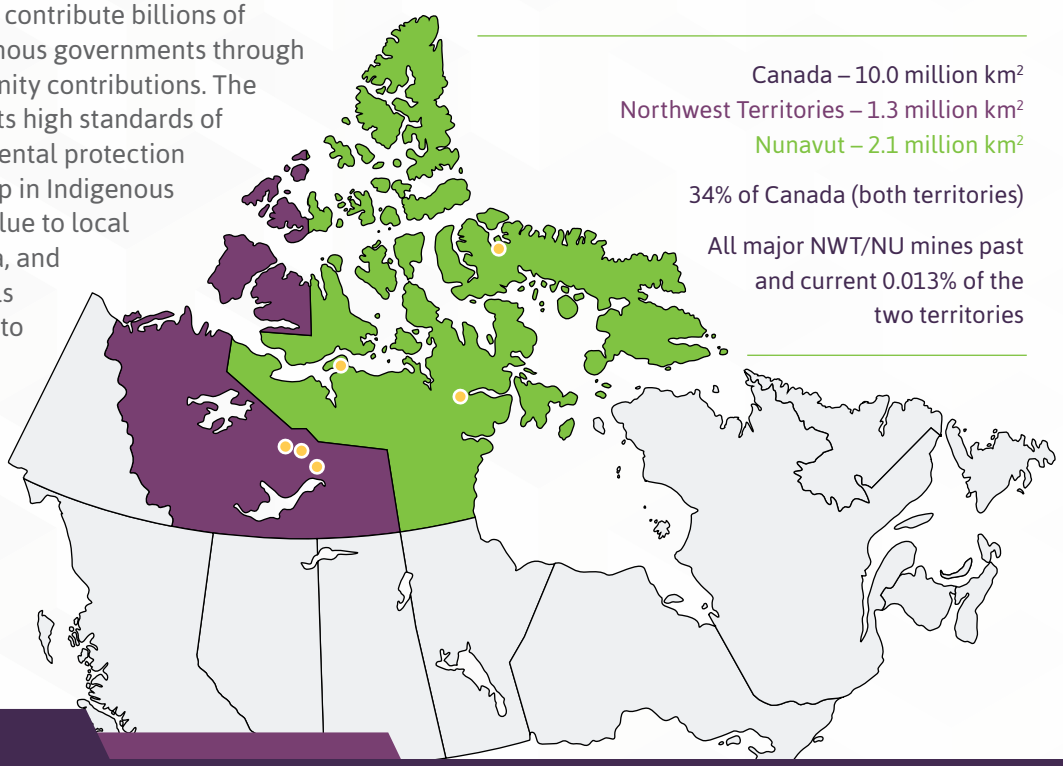
The North still holds much of Canada's future wealth but finding and developing new mineral resources remains extremely challenging. The North's remoteness, lack of infrastructure such as roads and power grids, land closed to development, unsettled land claims, regulatory uncertainty, are all contributing to a high cost environment. Mining is complex and expensive!

Only one mineral project in a thousand becomes a mine. The North's high operating costs means a mineral find must be even richer. Deposits of ore, rock which is economic to mine, are becoming more remote. But the rewards are enormous.

Mining companies create thousands of jobs, and spend billions of dollars with businesses, many of which are Indigenous. Companies also contribute billions of dollars to public and Indigenous governments through taxes, royalties, and community contributions. The North's resource industry sets high standards of worker safety and environmental protection and demonstrates leadership in Indigenous reconciliation. Mines add value to local communities, and to Canada, and produce minerals and metals for materials everyone uses to innovate, create, and thrive. Cell phones and computers, cars and snow machines, bicycles and buildings, would not be possible without metals and minerals.

Photo: Aurora Geosciences

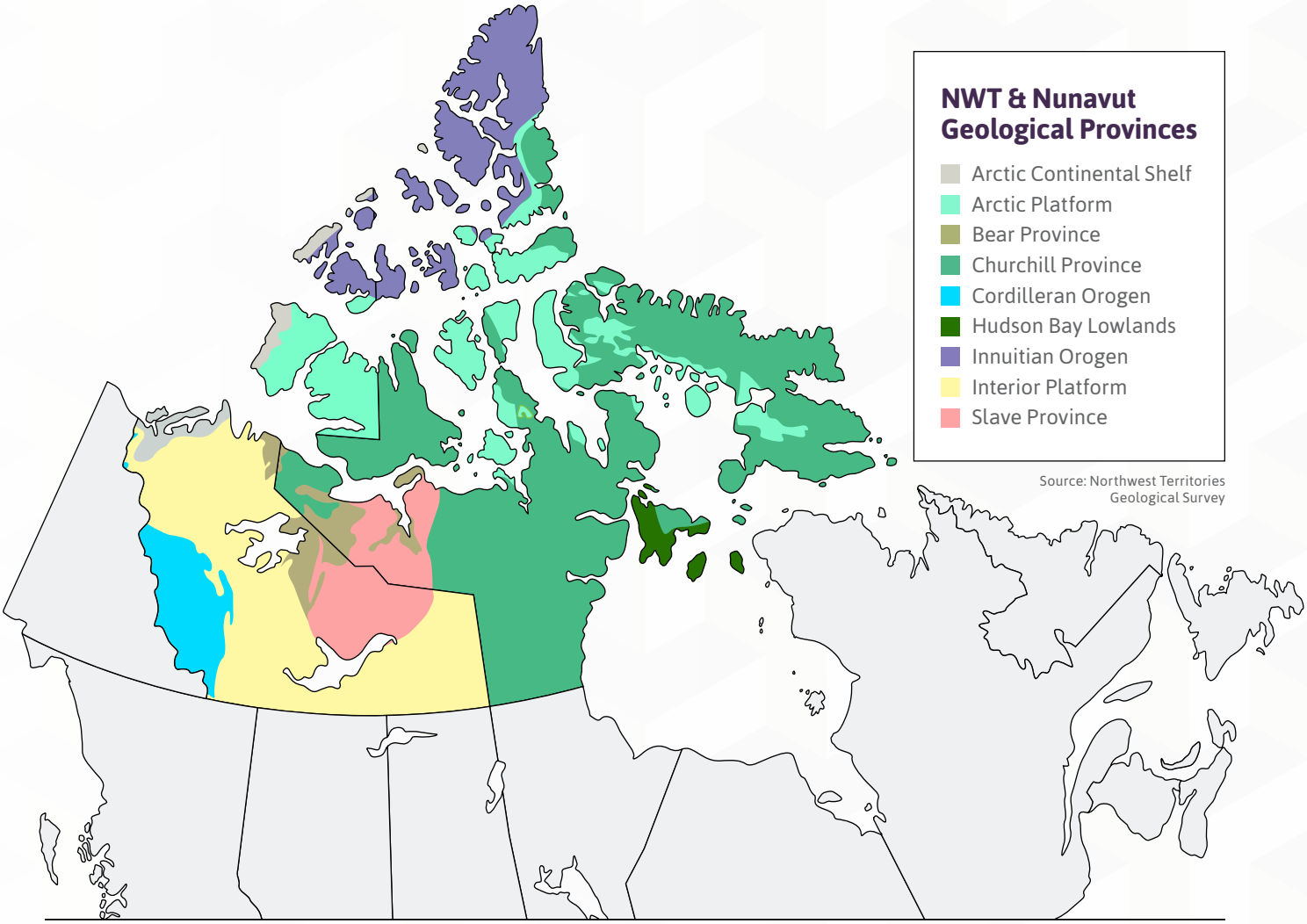
At Mountain Province's Kennady North site, geologist Dave Cox, with Yellowknife-based Aurora Geosciences, inspects Faraday kimberlite – rock known to host rough diamonds – core sample. The Kennady North kimberlites, located northeast of the Gahcho Kué diamond mine, have a resource estimated at 18 million carats. Aurora Geosciences, formerly known as Covello, Bryan & Associates, staked and conducted early exploration work that led to the discovery of Diavik and Snap Lake diamond mines.



Canada – 10.0 million km^2
Northwest Territories – 1.3 million km^2
Nunavut – 2.1 million km^2

34% of Canada (both territories)

All major NWT/NU mines past and current 0.013% of the two territories



Northern rocks – a diverse and vast geology

Geology is the science of the Earth. Geoscientists and geologists are the 'detectives' searching to learn more about how the Earth was formed and what it is made of.

Geoscientists have divided the NWT and Nunavut into nine geological regions, known as 'provinces', with each presenting a different age or history, and its own kind of attractive and diverse mineral potential.

Because of the North's huge size, and its challenging geography and climate, much of it has not been explored or even mapped in detail. These conditions mean there is huge potential to find many more hidden mineral deposits. These same conditions mean there are fewer options for economic development in the North (forestry, farming, ranching, manufacturing, etc.) and that means minerals are the North's economic advantage.

The North has an immense variety of rocks, many of which have been and can be converted to wealth.

Rich mining history and legacy

Modern resource development has a rich and strong history in the North – it is a legacy which spans over 80 years across both territories. New mines have been developed in the North in every decade since the 1930s.

Long before explorer Martin Frobisher mined for what he thought was gold on Baffin Island in 1576, Inuit and Dene peoples discovered local copper made better tools than bone and ivory.

Over a 100 years later, the 1898 Klondike Gold rush struck and some sought fame and fortune by exploring into the interior of the NWT.

One prospector, E.A. Blakeney, had a gold sample assay an astounding 2.158 ounces per ton. Many more adventurers would follow, like prospectors Gilbert Labine, who discovered radium and silver at Great Bear Lake, and C.J. (Johnny) Baker who discovered gold along Yellowknife Bay.

Several deposits were found in the decades that followed as mining helped open and build the North. Among the most recent exciting discoveries was the diamond find in 1991 by geologists Chuck Fipke and Stu Blusson at Point Lake, NWT. This opened a new era of exploration and mining, with unprecedented benefits and Indigenous participation.

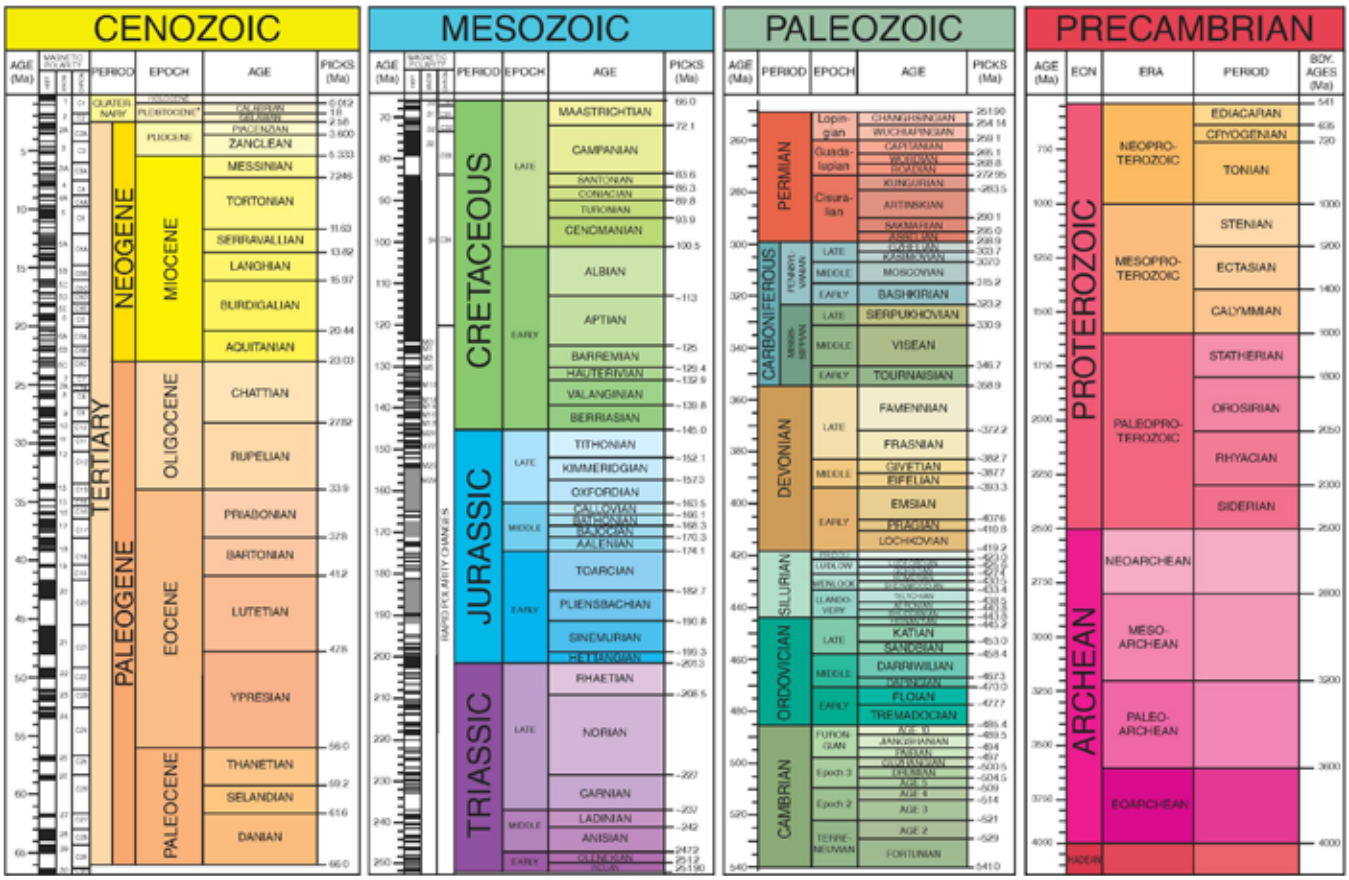
Photo: NWT Archives/Holman Photohistorical and Oral History Research

The Hope Bay property, in Nunavut's Kitikmeot region, was originally discovered by Inuit prospector Noel Avadluk. Noel staked the area in 1964 and the mine is named for his stepdaughter Doris Kallak.

Meanwhile, in Nunavut, after falling to zero mineral production in 2010, the industry has re-emerged with gold and iron discoveries brought into production earlier in this decade.

In the fall of 1935, Geological Survey of Canada Geologist Norman Jennejohn found visible gold at Yellowknife Bay. The find triggered a frantic rush to get claims staked before freeze up. This led to discovery and development of the Con Mine (pictured circa 1947-48), Yellowknife's first gold mine.
Photo: NWT Archives/ Henry Busse fonds/N-1979-052: 1913

Geologic time scale spans over four billion years



Source: Geological Society of America

Photo: NWT Archives/Henry Busse fonds/N-1979-052: 5435

Yellowknife has a rich history of gold mining. In 1961, a Giant Mine worker poses with about 300 kilograms, or 660 pounds, of gold worth about $340,000 at that time.

Photo: Douglas Wilkinson fonds/Nunavut Archives/N-1979-051: 2316.

Nunavut's first Inuit miners at the North Rankin Nickel Mine which operated from 1957 to 1962. The town of Rankin Inlet, in Nunavut's Kivalliq region, was originally built alongside the mine.

EXPLORATION AND MINING SPAN SEVERAL CENTURIES

2010s

- Meliadine (gold) 2019 – present
- Amaruq (gold) 2019 – present
- Gahcho Kué (diamonds) 2016 – present
- Mary River (iron) 2014 – present
- Hope Bay (gold) 2017 – present

2000s

- Meadowbank (gold) 2010 – present
- Snap Lake (diamonds) 2008-15
- Jericho (diamonds) Nunavut's first and, so far, only diamond mine, produced 789,000 carats 2006-08
- Diavik (diamonds) 2003-present

1960s

- Pine Point (zinc, lead) 1964-88 NWT's only railway and Taltson power facility built for mine; ore reserves transported to BC, community built with the mine
- Cantung (tungsten) Located on NWT-Yukon border, open pit in 1962 and went underground in 1974, Chinese mines flooded world markets, tungsten prices plummeted, and Cantung suspended mining in 1986, reopened 2002-03, 2005-15
- Echo Bay (silver and copper) 1964-75
- Tundra (gold) 1964-68
- Camlaren (gold) 1962-63 1979-81
- Terra (silver) 1969-85

1990s

- Ekati (diamonds) 1998-present
- Colomac (gold) 1990-91, 1994

1970s

- Akaitcho Supercrest (gold) 1973-81
- Nanisivik (zinc, lead, silver) 1976-02 Canada's first Arctic mine, Gov. of Canada builds port, airport, town
- Norex (silver) Operated 1970-71 and 1978-82
- Silver Bay (silver) 1971-72, 1976-79
- Hope Bay (silver) 1973-75

1980s

- Polaris, world's most northern lead-zinc mine, 1,120 kms north of Arctic Circle
- Cullaton Lake (gold) 1981-84
- Salmita (gold) 1983-87

- Mon (gold) 1989-97 (1965-75, 200 tonnes mined/milled on site)
- Lupin (gold) 1982-05, Ulu deposit first Nunavut resource with an Inuit Impact Benefit Agreement, was signed in 1996

1930s

- El Bonanza (silver) 1934-36, and 1965
- Rich/Burwash (gold) 1935
- Contact Lake (silver, uranium) 1930s, 40s, and 70s
- Rycon (gold) 1939-58
- Negus (gold) 1939-52
- Con (gold) began in 1938 with annual record of 117,115 ounces set 52 years later, 1.5 kms deep, power from Con's hydro supplied Yellowknife
- Eldorado (radium, uranium, silver, copper) opened in 1933 at Great Bear Lake to mine radium, later Canada's first uranium mine, then produced silver, 1931-41, 1942-60, and 1977-82

1910

Three expeditions sail from Newfoundland to Baffin Island seeking placer gold, none found, one expedition shipwrecked and rescued by competitor

1909

Mica and graphite mined by Robert Kinnes at Niante Harbour near Kimmirut

1762

Hudson's Bay Company explorers William Christopher and Moses Norton visit Qamani'tuaq (Baker Lake) looking for minerals, fur, and the Northwest Passage

1950s

- North Rankin Inlet Nickel (nickel, copper, platinum) Nunavut's first Inuit miners 1957-62
- Rayrock (uranium) 1957-59
- Discovery (gold) Operated briefly in the 1950s and 60s with a small community built to service mine, distinction of producing 1 million ounces from 1 million tons rock

1770-72

Explorer Samuel Hearne, guided by Matonabee treks to Arctic Coast near Kugluktuk seeking Coppermine River, thought to be rich in copper

1576

Explorer Martin Frobisher mines 1,000 tons of shiny yellow mineral, unfortunately it was iron pyrite (fool's gold)

1940s

- Giant (gold) first brick poured in 1948 and the mine closed in 2004, with 7 million ounces produced, roasting, a process to remove gold from arsenopyrite ore, resulted in 237,000 tonnes of arsenic trioxide stored underground and managed by Giant Mine remediation project
- Ruth (gold) 1942 and 1959
- Ptarmigan and Tom (gold), originally mined during the Second World War, production hauled to nearby Giant mine for processing, 48 people employed with 15% Indigenous 1941-42, reopened 1986/7-97
- Thompson-Lundmark (gold) 1941-43, 1947-49
- Outpost Island (gold, tungsten) 1941-42

Mineral resources cycle – how it works

Exploration finds, and mining produces, the minerals and metals modern society needs, including green technologies like electric car batteries and wind turbine magnets.

The mineral resources cycle, describes the various activities to find, extract, and produce minerals and metals. It begins with early exploration, and with continued success, moves to deposit discovery then through development and into production, and finally, concludes with closure and reclamation.

Every step of the cycle provides economic opportunities. Companies work with public and Indigenous governments and communities to ensure local benefits and environmental protection.

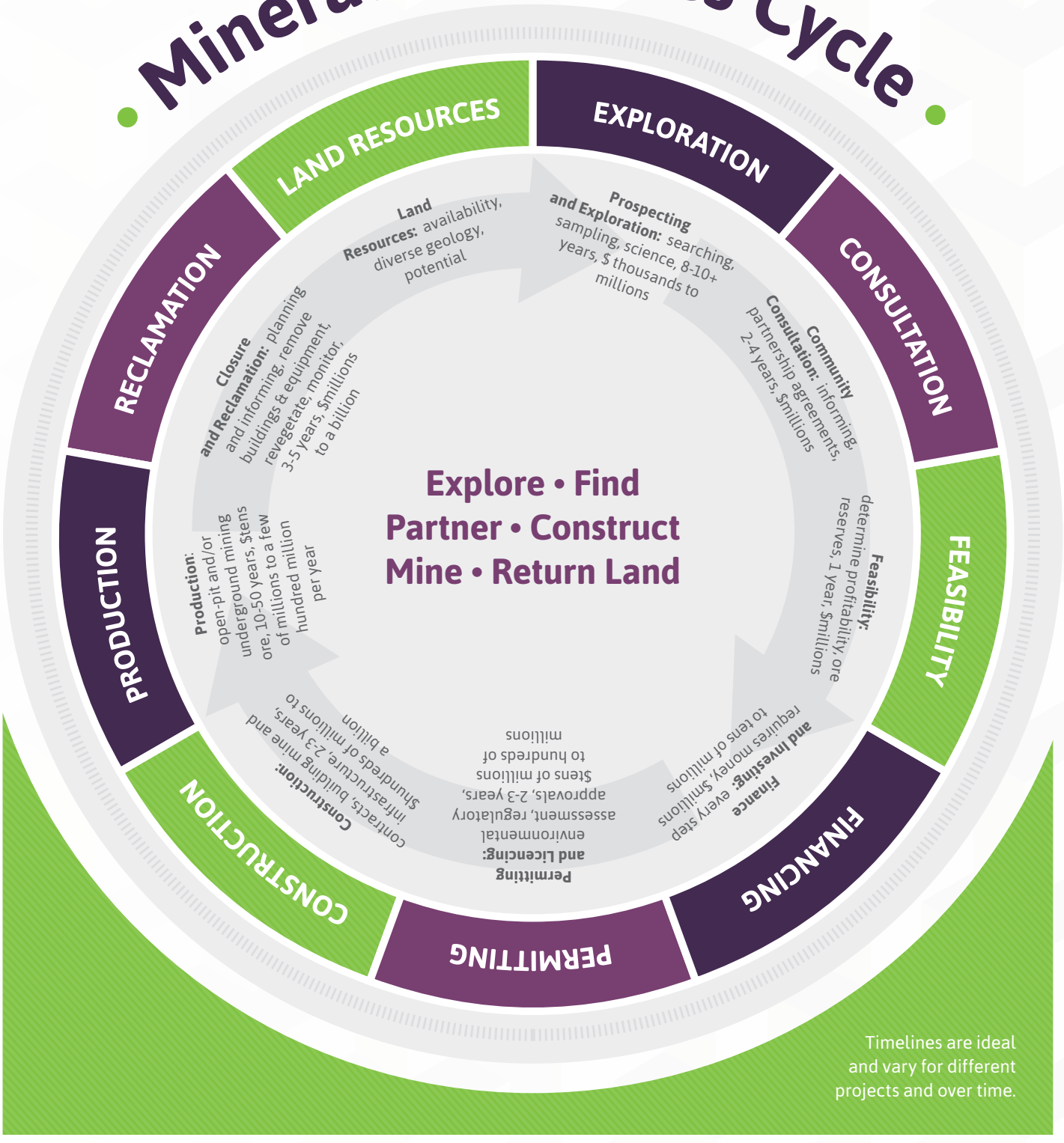
There is only one step in the cycle where mining companies make money – production. This phase comes after hundreds of millions of dollars, and in some cases over a billion dollars, has been spent. During production, mines have annual operating costs which can easily exceed $100 million.

Mine	Discovered in...	Production started in...	Years it took...
Pine Point	1898	1964	66
Nanisivik	1911	1976	65
Prairie Creek	1928	2022?	>90
Polaris	1960	1982	22
Lupin	1960	1982	22
Mary River	1962	2014	52
Hope Bay	1988-99	2017	18-29
Meadowbank	1987	2010	23
Meliadine	1989	2019	20
Back River	1989	2021?	32
Ekati	1991	1998	7
Diavik	1993-94	2003	11
Gahcho Kué	1995	2017	22
Snap Lake	1996-97	2008	12
Nico	1996	2022?	>25
Hackett	1969	?	>50
Izok	1974	?	>45
Kiggavik	1979	?	>40

DID YOU KNOW?

Since 2000, exploration and mining companies across Canada have signed over 400 partnership agreements with Indigenous governments and communities.

Mineral Resources Cycle



Timelines are ideal and vary for different projects and over time.

DID YOU KNOW?

Miners put in the hours – in 2017, miners at seven sites across the North worked 12.8 million hours and got paid three quarters of a billion dollars.

Exploring – finding the 'one in a thousand'

Exploration is a risky business; only one in a thousand projects become a mine.

And only one in 3,333 becomes a world-class mine.

Clearly, it's difficult to find a mine. It takes years, even decades for an exploration target to become a mine. That's why we need more sharp-eyed 'rock detectives' to help keep the northern mining industry strong and generating benefits.

Governments recognize this opportunity and support exploration and mining because they realize industry creates jobs and business activity, and taxes and royalties. Prospectors and geoscientists initially stake mineral claims and then collect rock samples. These explorers use a variety of geoscience tools, specifically geology, geochemistry, and geophysics.

During what is called grassroots exploration, geologists are hoping to find clues signalling a hidden mineable mineral deposit. They use a variety of tools from geological mapping to examine any rocks that might be exposed, to geochemistry (sampling soils, water of rivers, lakes, and streams, and even plants) to find clues. They will likely use geophysical techniques that measure rock's magnetism, electrical conductivity and resistivity, and/or the gravity of the target area.

If all clues spell 'we think we've found something,' they bring in drills to collect rock cores or rock chips.

Now begins more expensive work of advanced exploration as explorers try to answer big questions; how big is it, is it one piece or many, and is it strongly mineralized (rich) or weak?

To determine size and grade, a deposit is sampled extensively to calculate amount of material in a deposit. This is known as the resource.

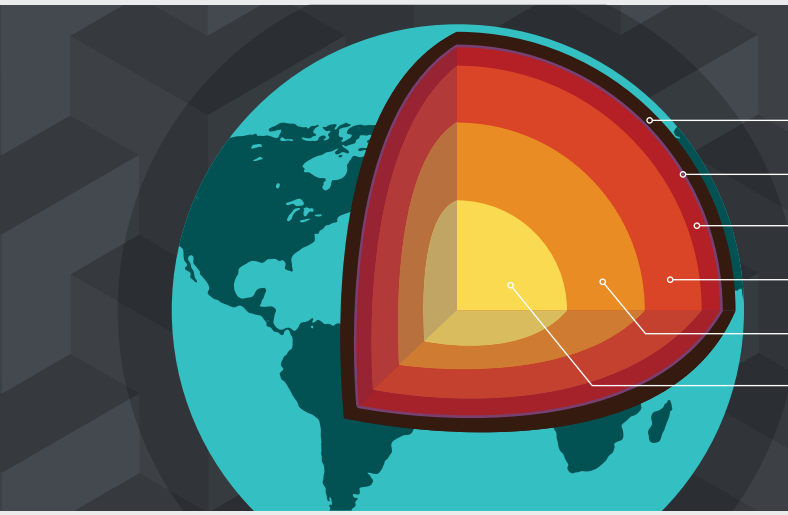
Many drills may be brought in simultaneously to drill for samples to get answers more quickly. Sometimes bigger samples than what a drill can provide are required, and companies construct and an access tunnel, know as a ramp, or a shaft, and go underground to extract a larger sample for processing.

Source: Fraser Institute

DID YOU KNOW? *The Pine Point deposit near Hay River, NWT was discovered in the late 1800s by fur traders and only started mining in 1964.*

John Tugak, with a passion for the land and geology, is an Inuit prospector from the Kivalliq Region. He completed a prospectors course in Arviat and in 2017 he received three mineral exploration agreements from Nunavut Tunngavik Incorporated, including the Fat Lake and Turquetil Lake gold properties and the Heninga Lake base metal property. John was inducted into the Nunavut Mining Hall of Fame in 2018.

Photos: John Tugak



Structure of the Earth

The structure of the Earth is divided into layers. These layers are both physically and chemically different.

Photo: NWT Mine Training Society

With licences, tags, maps, and tools in-hand, aspiring prospectors learn to stake claims. The NWT Geological Survey and the Mining Recorders Office – divisions of the NWT Government's Department of Industry, Tourism and Investment – partner with the NWT Mine Training Society, TerraX Minerals, and NWT & Nunavut Chamber of Mines to deliver a prospectors training course near Yellowknife.

Photo: Dunnedin Ventures

The Kahuna property is an advanced diamond project owned by Dunnedin Ventures. Pictured is the exploration camp located 26 kilometres north of Rankin Inlet.

Community consultation – building partnerships

The success of developing a resource responsibly and successfully depends on community consultation.

Companies looking to construct a mine meet early and often with local communities giving everyone an opportunity to communicate information and ask questions. It is also an opportunity to address concerns, get feedback, and share knowledge.

Key to the successful outcome is recognizing the best results come from partnership. Everyone shares in responsibilities of a potential development and its benefits.

Community consultation occurs throughout all mining cycle phases.

Photo: Diavik

During community consultation, mining company representatives met often with local community residents. In the mid 1990s, Diavik's Erik Madsen (currently General Manager of Sustainability with De Beers Canada) talks with local community members near the Diavik mine site.

Photo: Diavik

DID YOU KNOW?

Diavik is a world leader In alternative energy

Diavik operates the NWT's only large-scale wind farm and the world's largest wind-diesel hybrid power facility. Funded by the joint venture partners, Rio Tinto and Dominion Diamond, the four 9.2-megawatt turbine wind farm is operational to -40°C. It began delivering power to the mine's grid in September 2012, and it provides ten per cent of power needs. Through 2018, it had reduced diesel fuel usage by 26.6 million litres and reduced emissions by 73.2 tonnes of CO2. Reducing fuel also means reduced seasonal winter road fuel hauls by about 80 loads, also lowering overall CO2 emissions. The extreme location of the mine meant a highly innovative design was needed for the turbines; one which also included adjustments made during the first several months of operations. To eliminate frost accumulation Diavik adapted the blade heating system de-icing technology, and retrofitted the base with heating. As well, monitoring wind variations is important to assist in achieving optimum results, ensuring wind power is successfully integrated into the wind-diesel power system.

Feasibility study – is the deposit profitable?

Companies produce feasibility studies to determine if a deposit is profitable to be mined.

This intensive study combines all they know of the deposit – size and quality (measured by orebody grade), metallurgy (how much metal can be recovered), current and future market prices for the commodity, or commodities, to be mined, labour and material costs, the size and type of mine being proposed, environmental and community considerations, and projected operating costs. Other factors include global supply and demand, political stability, regulatory complexity, labour availability, and community support.

Key questions and answers in feasibility are how much it will cost to build and operate how long it takes the mine's profits to pay off the initial capital, which includes the exploration, environmental assessment and construction, and investment.

Mineral reserves, or ore reserves, are valuable and legally, economically, and technically feasible to extract. This detail provides the highest level of confidence about the deposit. Additionally, mineral resources can also be studied. Mineral resources are potentially valuable and may become economic.

Photo: Agnico Eagle

Geologists Roxanne Takpanie and Robert Fraser studying core samples at Agnico Eagle's Meliadine mine.

In Canada, mineral deposit information is often public protecting investors with knowledge that it meets a high professional, national standard.

If the feasibility study and its many factors suggest profitability, the project can be advanced to regulatory and permitting phases. Ultimately, the project owners decide if they want to commit funding to build the mine.

Finance and investing – high risk, big reward

Every step of the mining cycle requires money.

The prospector requires money for a prospector's licence and materials for exploring.

To keep a mineral claim in good standing, the government landowner requires prospectors and exploration companies spend minimum amounts. If they do not, the claim lapses, is turned back to the government, and the land is freed up annually for others to explore.

Junior mining companies – companies that do not own operating mines – often require larger financial backing. Operating in the remote north means even higher costs. For example, drill rigs are helicoptered to targets. Juniors may acquire financing by raising capital through public stock markets. This spreads the risk allowing potential investors to buy shares.

Another route is to obtain financing from larger global resource companies. Sometimes, junior's exploration costs are funded for a share of potential future wealth. Or, the larger company may offer to purchase all the junior's shares.

Photo: Chamber of Mines

Nunavut Tunngavik Inc. and Chamber of Mines representatives at the Association for Mineral Exploration Roundup conference in Vancouver. This annual event attracts potential investors from around the world.

Critical to the entire enterprise is a system know as 'open access' allowing a prospector or explorer on public lands to search for minerals.

In the North, it is estimated that less than 70 per cent of the land is available for mineral exploration. The remaining 30 per cent is closed due to conservation, land claims, and land use plans. Limited access to land reduces the probability of exploration success.

Photo: Dominion Diamond

DID YOU KNOW?

North America's largest gem quality rough diamond weighs 552.7 carats

A yellow diamond unearthed in October 2018 at the Diavik Diamond Mine is by far the largest rough gem-quality diamond ever found in North America.

The stone measures 33.7mm x 54.7mm and far surpasses the previous reported record held by the Diavik Foxfire. The Foxfire gem, weighing 187.7 carats, was recovered in 2015.

Photo: De Beers Canada

In December 2010, De Beers submitted its Gahcho Kué Environmental Impact Assessment (one copy shown) to the Mackenzie Valley Review Board. The project received board approval in July 2013. Pictured is De Beers Canada Permitting Manager Paul Cobban. Gahcho Kué, a De Beers/Mountain Province Diamonds joint venture, would become Canada's fifth diamond mine, of which four have been constructed in NWT and Nunavut.

Permitting and licensing – every step is regulated

Permits and licences are issued by regulators authorizing an activity or use of a site. The process of permitting and licensing a mine occurs upon completion of the project's environmental assessment. The water licence, among the site's most important licences, sets conditions and limits on water usage and water quality limits.

In the Northwest Territories, diamond mining companies and Indigenous governments signed nation-leading impact benefit agreements, also known as participation agreements. The mining companies also formalized their commitments through socio-economic monitoring agreements with the Government of the Northwest Territories. Similarly, mines operating in Nunavut signed Inuit impact and benefit agreements. These documents outline commitments to training, employment, and business benefits, community investment, and transparency. These agreements created the most modern mechanisms to support community-based monitoring, participation, and management.

In the North, modern agreements reflect an industry dedicated to local benefits.

Construction – building the mine

With exploration, environmental baseline study, community consultation, feasibility study, environmental assessment, permitting and licencing, and funding secured, the project's owner has all the pieces to move to mine and related infrastructure construction.

Infrastructure includes, processing, power, water treatment, and sewage treatment plants, equipment maintenance shops, storage and office spaces, fuel and explosives storage facilities, roads, and tailings pond dams.

In remote off-grid no year-round road access location, the infrastructure also includes an airport and accommodations complex with rooms for workers, cafeteria, kitchen, medical centre, and recreational common areas like a gymnasium.

Construction requires hundreds of workers with customized skills. Often, the number of workers required to build a mine is more than the number of operations' workers.

This phase generates training, employment, and business opportunities. Mining companies work with local communities to ensure benefits.

Often, northern residents and businesses with construction contracts join the operations phase. A project's viability often hinges on winter ice road access or requires new road construction.

Photo: Dominion Diamond

Construction of the Ekati Diamond Mine, Canada's first diamond mine, was completed in 1998. Over one-third of the construction workforce was northern.

Photo: Agnico Eagle

In 2019, Nunavut's newest mine, Meliadine, poured its first gold in February, and achieved commercial production May.

Production – turning rock into benefits

The production phase, which includes ore extraction and processing, is the most well-known part of mining and when the money/revenues are finally generated.

OPEN-PIT MINING

Open-pit mining occurs on surface and is generally the cheapest method. Rock doesn't have to be moved long distances and large hauling equipment can be used. It does not require more expensive systems like ventilation and communications as are needed for underground mining.

Open pits are designed and engineered for drilling and blasting the orebody and waste rock.

The design also ensures pit wall slope safety.

To access the orebody, first the overburden (rock, soil, and silt) is removed.

Open-pit mines may be circular or oblong and include several mining levels known as benches. Roads, known as ramps, allow access to the orebody. The size and depth of an open pit is a balance of how much worthless waste rock must be mined to gain access to valuable ore. The size of the first bench is critical as each subsequent bench is smaller. The amount of waste rock compared to ore mined is called strip ratio.

The open-pit mining cycle includes drilling ore and waste rock, loading drill holes with explosives, blasting, ore loading and hauling to stockpiles for processing, and waste rock loading and hauling.

Photo: Dominion Diamond

By converting rocks to riches, the NWT's three diamond mine have created enormous wealth through employment and business benefits, community contributions including donations, sponsorships and scholarships, and through royalties and taxes paid to governments. Pictured, a excavator operator loads a haul truck at Ekati, Canada's first diamond mine which began rough diamond production in 1998.

Production – turning rock into benefits (Continued)

UNDERGROUND MINING

Underground mining is more complex and more expensive than open-pit.

Decline tunnels (ramps) are constructed for orebody access. Another access method is to construct vertical shaft with a headframe and hoist to move workers and ore; with the tunnels, water storage and removal, power, communications, and ventilation systems, underground maintenance shops, and even offices are constructed.

The mining method chosen depends on orebody characteristics. Veins are often mined using stopes which involve excavating portions of ore creating cave-like voids. Massive orebodies are also usually mined using bulk mining methods by creating stopes. There are many types of stope mining.

If the orebody is tabular (flat and dipping), room-and-pillar methods are commonly used. This method involves removing large quantities of ore to create 'rooms' with overlaying rock supported by columns known as 'pillars'. Block cave mining involves creating a block of ore which collapses causing it to break making transport easier.

Underground mining cycle often includes backfilling voids and supporting tunnel walls, including bolting, engineered concrete, and screening.

Exploration drilling of the orebody is also conducted underground. This is important because finding new ore generates more wealth for all involved and can extend the mine life ensuring benefits flow beyond original projections.

Photo: Diavik

Underground at Diavik, a heavy equipment operator, using remote technology, loads kimberlite ore.

Photo: Dominion Diamond

With its three diamond, mines, Ekati (Misery pit shown above), Diavik (below right), and Gahcho Kué (below left, conveyor and process plant shown), the Northwest Territories is the world's third largest rough diamond producer by both volume and value. To mine the diamond-bearing kimberlite orebodies, open pit and various types of underground mining methods are used. The mines are located in Canada's subarctic, where it's winter eight months of the year and temperatures often drop below minus 40 degrees.

Photo: De Beers Canada

Photo: Diavik

DID YOU KNOW?

Canada's minerals sector employed 634,000 people in 2017 and that there are about 150 different jobs at a mine.

Processing – separating minerals and metals from waste rock

Once the ore, which is a mix of valuable minerals and waste rock, has been brought to surface, it must be processed to recover or concentrate the valuable minerals.

The first step is size reduction through crushers. Conveyor belts then carry crushed ore to huge rotating steel drums, called grinding mills, where it is mixed with water and sometimes chemicals. The resulting product is wet, finely ground rock.

With gold and silver, the cheapest recovery method is to separate metals through chemical and weight differences.

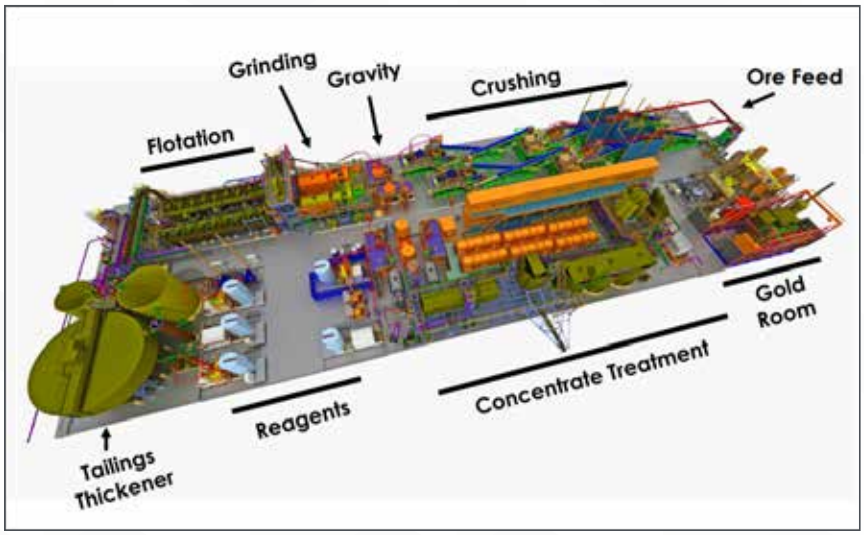
If the minerals and ore can not be gravity separated, chemicals such as cyanide dissolve the gold and silver. Carbon leaching is often used to collect metals.

To recover base metals, such as copper, lead, zinc or nickel, ground ore is fed into large tanks, or flotation cells, filled with a soapy chemical solution whipped into a froth with blowing air. Ore minerals stick to the bubbles and are carried to the top of the tank where a continuously-skimming blade collects the ore-laden froth. Waste rock or tailing is left behind. The concentrated wet ore is separated from the solution using filters.

Diamond ore processing does not require chemicals to separate the diamonds from kimberlite. Diamonds have unique properties of high density, hardness, and luminescence enabling separation. In the process plant, diamond ore is combined with water and ferrosilicon (magnetic sand) in cyclones which separate diamonds and indicator minerals using density. Diamonds are separated from indicator minerals by using X-rays to trigger a unique characteristic of diamonds – diamonds glow under this kind of light. Photo-electric sensors direct strategically-placed air blasts to collect the diamonds. Grease tables are also used to collect the diamonds. Diamonds are hydrophobic so they stick to the grease.

Wherever possible, chemical solutions are recycled to be used several times before being pumped into disposal areas, along with waste minerals. These engineered areas, known as tailings ponds, are designed to prevent any materials from escaping.

Illustration: TMAC



What's inside a process plant?

This illustration of TMAC's process plant at its Hope Bay mine shows the main processes needed to extract the gold from the ore.

Waste rock management

Mining processes generate two kinds of waste products: pieces of rock from the mining operations and fine rock materials and perhaps chemicals from the mineral processing operations.

Waste rock is permanently stored at the mine site in hills or used for filling or constructing roads and other infrastructure.

Processed rock is permanently stored in what are called tailings ponds at some mines to reflect they also contain chemicals, or processed kimberlite containment ponds at diamond mines, to reflect the non-chemical processing systems used there.

The waste will be secured during mining, and permanently managed during the closure and reclamation phase.

Photo: Diavik

Waste rock, foreground, from Diavik Diamond Mine open pits. Above, centre, is the mine's processed kimberlite containment area.

Closure and reclamation

Closure and reclamation is the process of returning the mine site as closely as possible to its original condition. This includes preparing the workforce and local communities and governments. It includes removing equipment, and buildings, and site work such as contouring waste rock piles, revegetating land, and environmental monitoring.

No mine lasts forever, as eventually the minerals in a deposit run out or become uneconomic to mine.

Mining is a temporary process taking from as little as a few years to as much as even 100 years.

Many years ago, there was little thought given to cleaning up a site after mining, and when closure plans were made, the work was left for when mining was finished. Today, mining companies plan for closure even before they construct the mine, which allows efficiencies to be found during mining which results in what is know as progressive reclamation.

Reclamation, restoring the site after mining concludes, is part of the mine's overall commitment to environmental protection.

Photo: Diavik

Revegetation plots at the mine site assist in the study of local species to determine how local plants and grasses will be incorporated into closure and reclamation.

Operating mines – where it works

The North's vast land is home to several operating mines. In 2019, producing mines included three diamond mines in the Northwest Territories and two gold and one iron mine in Nunavut. The newest, Agnico Eagle's Meliadine project, was due to achieve commercial production in May 2019.

EKATI DIAMONDS

- *Exploration work as early as 1981 and development work started in mid 1990s*
- *Lac de Gras, Northwest Territories, 300 kilometres northeast of Yellowknife*
- *Operated by Dominion Diamond Mines, part of privately-owned Washington Group*
- *Ekati, from the Tlicho word meaning 'fat lake', is Canada's first diamond mine*
- *Indigenous peoples said quartz veins in the granite resembled caribou fat*

DIAVIK DIAMONDS

- *Exploration started in 1991 with staking by Aber Resources*
- *Lac de Gras, Northwest Territories, 300 kilometres northeast of Yellowknife*
- *Over $1 billion of wealth generated per square kilometre of footprint*
- *Owned by Rio Tinto (60% and operator) and Dominion Diamonds (40%)*
- *Three award-winning dikes allow access four kimberlite pipes under shallow waters of Lac de Gras*

GAHCHO KUÉ DIAMONDS

- *Located at Kennady Lake, 280 kilometres northeast of Yellowknife, Northwest Territories*
- *Owned by De Beers Canada (51% and operator) and Mountain Province Diamonds (49%)*
- *12 year mine life*
- *Deposit discovered in 1995 by Mountain Province Diamonds with De Beers joining the joint venture in 1997*
- *Gahcho Kué means big rabbit, from the Indigenous name for the arctic hares in the region*

HOPE BAY GOLD

- *130 kilometres south of Cambridge Bay*
- *Owned and operated by TMAC Resources*
- *Doris deposit first to be mined, Madrid and Boston deposits expected to commence production in 2020 and 2022*
- *Over $1.5 billion has been invested in infrastructure at TMAC Resources' Doris Mine, and its Madrid and Boston gold deposit camps*

MEADOWBANK GOLD

- *Owned and operated by Agnico Eagle*
- *Open-pit mine located in Nunavut's Kivalliq Region, 300 kilometres west of Hudson Bay, 70 kilometres north of Baker Lake*
- *Production from 2010 to 2019 plus another seven years with Amaruq deposit*
- *Amaruq, which means wolf in Inuktitut, located 50 kilometres northwest of Meadowbank*

MARY RIVER IRON

- *Located on Baffin Island, in Nunavut's Qikiqtaaluk Region*
- *Operated by Baffinland Iron Mines, jointly owned by ArcelorMittal and Nunavut Iron Ore.*
- *Amongst the richest iron ore deposits ever discovered, includes nine-plus high-grade iron ore deposits*

North's newest mine achieves commercial production May 2019

Potential new mines – what's on the horizon

In addition to its operating mines, the North has several well-advanced projects that could become operating mines – bringing potential new opportunities for northerners.

NORTHWEST TERRITORIES

NT – Prairie Creek – Lead, Zinc, Silver *(NorZinc, formerly Canadian Zinc)*

NT/YT – Mactung – Tungsten *(GNWT owned)*

NT/YT – Howard's Pass – Lead, Zinc *(Selwyn Chihong)*

NT – Indin Lake – Gold *(Nighthawk Gold)*

NT – Nico – Cobalt, Gold, Bismuth, Copper *(Fortune Minerals)*

NT – Courageous Lake – Gold *(Seabridge Gold)*

NT – Yellowknife City Gold – Gold *(TerraX Minerals)*

NT – Nechalacho – Lithium, rare earth elements *(Avalon Advanced Materials)*

NT – Kennady North – Diamonds *(Mountain Province Diamonds)*

NT – Pine Point – Lead, Zinc *(Osisko Metals)*

NUNAVUT

NU – Back River – Gold *(Sabina Silver and Gold)*

NU – Chidliak – Diamonds *(De Beers)*

Nunavut is rich in other promising potential resource developments.

- Izok *(Zn, Cu, Pb, Ag)*
- Ulu *(Au)*
- High Lake *(Zn, Cu, Pb, Ag, Au)*
- Hackett River *(Zn, Pb, Cu, Ag)*
- Seal *(Zn)*
- Roche Bay *(Fe)*
- Angilak *(U)*
- Kiggavik *(U)*
- Naujaat *(D)*
- Committee Bay *(Au)*

Why mineral resources work for the North

Mines in the Northwest Territories and Nunavut contribute enormous benefits. The cumulative effects are positively staggering. Mines are the largest private sector employer and the largest contributor to the two territories' economies.

EMPLOYMENT – CREATING JOBS

Mining is the largest private sector employer in the North and the largest employer of Indigenous peoples. Employment is one of the biggest benefits mines create and mining jobs are among the highest paid in Canada. Over 7,500 people currently work at the seven mines operating in the NWT and Nunavut.

Northern residents, with a small population and limited mining-related skills, have captured one-third of this opportunity. This is significant, but the gap is an opportunity for companies, governments, communities, and northern residents to work together to increase local employment.

In the NWT, in 2018, northern employment at NWT mines was 47% while in Nunavut it was 20%. Mining companies remain committed to employing and training residents.

Since 1996, diamond mining in the NWT, and renewed mining in Nunavut since 2010, have created over 80,000 person years of employment. One person year equals one full time employee working a 12 hour shift for 14 days through 13 rotations at a mine site. This is called a 'two and two' rotation. Put another way, 80,000 person years of employment is the same as 2,000 people employed for 40 years!

Photo: NWT Mine Training Society

Mining offers a variety of challenging, high-paying careers. Many of the jobs in mining require specialized skills and as a result, the key to success is education and training.

Photo: TerraX

At TerraX Minerals' Yellowknife City Gold project, workers log core samples.

DID YOU KNOW? *Federal-owned MV Arctic, was world's first ice-breaking cargo vessel, it hauled Polaris and Nanisivik ore from 1982 to 2002.*

Creating new companies and growing existing ones

Mines create new businesses and help existing companies expand and gain expertise for future growth. Since 1996, mining companies have spent over $18 billion in the North. Of this, several billion is with Indigenous northern businesses. Two-thirds of every dollar the North's mines spend on daily operations and construction goes to local companies. In 2018, the North's six mines spent a total of just over $1.5 billion with local businesses.

Photo: Diavik

Mining companies have generated significant training, employment and benefits for northern Indigenous communities.

DID YOU KNOW? *Polaris mine concentrator was built on a barge in Quebec, towed to Little Cornwallis Island, and placed at site.*

Training – programs designed for mining and miners

Through training, mines are creating new and more specialized skills opportunities for northerners.

One of the biggest opportunities is through supporting apprenticeships which lead to trained trades accredited journeypersons. Skilled tradespeople, including electricians, mechanics, millwrights, instrumentation technicians and the many other trades are vital to mines and to all communities.

On-site training occurs at the mines and is also available through several other opportunities.

Through 2016, industry has supported NWT Mine Training Society programs with $12.1 million in cash and in-kind investments since 2004.

Through its training plan Mining the Future, MTS has targeted training in several areas including, mineral process operating technician, camp cook, cook apprenticeship, heavy equipment operator, geoscience field assistant, introduction to underground mining, underground mining, and general construction. Most recently, the MTS has undertaken a series of 'safety boot camps' designed with industry input.

Students from the underground miner training and mineral process operator training programs are provided paid term training positions at the mines and most are hired full-time.

The Geoscience Field Assistant training program is yet another way northerners can gain industry-related skills. NWT and Nunavut offer prospecting courses.

The Qikiqtani Inuit Association is leading the Qikiqtani Skills & Training for Employment Partnership (Q-STEP) project. Q-STEP is an Inuit training and employment project launched by QIA in partnership with Baffinland Iron Mines with support from the Government of Canada, Kakivak Association, and the Government of Nunavut.

Community well-being – improving the quality of life

Successful mining companies operate in partnership with communities. This ensures local benefits, including training, employment, and business.

Additionally, mining companies provide financial support through donations, sponsorships, and through scholarships demonstrating their commitment to community wellness.

Through scholarship programs, the mines invest significantly to support higher education. Because of the mines, several thousand northerners have benefited from several million dollars in scholarship funding which has assisted students in their educational pursuit and career development.

Photo: Diavik

The North's mining companies invest in communities through support for community cultural programs and events, and by volunteering. Diavik's German Villegas volunteers at a local event.

Reconciliation – Indigenous peoples and industry

Through its training, employment, business, and community investment work, the minerals industry is making great strides with Indigenous reconciliation.

In 2015, the national Truth and Reconciliation Commission issued 94 calls to action for all Canadians to join in the goal of Indigenous reconciliation. Call to action #92 asks the corporate sector to take steps that would see meaningful consultation and respectful relationships with Indigenous Peoples and their land and resources, including equitable access to jobs and training with long-term sustainable benefits. The call to action would also have businesses provide education to staff on Indigenous history.

Chamber of Mines members working in the North demonstrate their commitment through many initiatives and are delivering results.

The North has a unique national success story where Indigenous and territorial governments, communities, Inuit regional organizations, and industry have significantly changed the role of Indigenous peoples in resource development.

Safety – highest value at every mine

There is a shared commitment to mining safely, securely, efficiently, and profitably, without harm to people or environment.

All the mines have training, policies, procedures, analyses, and interactions that focus on making sure safety is part of everyone's work activity – all the mining companies believe zero harm is achievable and all injuries are preventable.

All mine sites have facilities staffed with trained medical teams. All have emergency response teams (ERTs) comprised of volunteers from their workforces.

Photo: De Beers Canada

Members of the Gahcho Kué ERT compete at the annual mine Workers' Safety Compensation Commission annual mine rescue competition during NWT & Nunavut Chamber of Mines Mining Week in Yellowknife.

Photo: De Beers Canada

A Paul Bros Nextreme Inc. employee at work at De Beers Canada's Gahcho Kué diamond mine. Paul Bros Nextreme, an Indigenous NWT company based in Yellowknife, has been operating in the North since 1978.

Northern mines have won several regional and national safety awards!

Safe at Work = Safe at Home

SAFETY IS FIRST FOR ALL

At a mine, health and safety is part of every work task. Companies have training programs, and standards, policies, procedures, and systems, and are governed by regulatory and reporting requirements. Everyone plays an important and necessary role in their own safety and the safety of others.

Safety in action

- employee family assistance programs
- ZERO tolerance for harassment
- safety shares
- safety interactions
- 'take five' safety reviews
- risk assessments
- job hazard analyses
- post incident reviews
- air quality testing
- noise level measuring
- WHMIS
- gymnasium and fitness facilities
- healthy choices meals
- buddy system

Gearing up

- reflective clothing
- protective eyewear and footwear
- helmet or miner's hardhat with light
- harness for working at heights
- hearing protection
- gloves
- personal emergency device PED
- radio communications
- self rescuer portable oxygen device
- automation – remote equipment operation
- signage

The rates

- industrial sites track lost time injuries (LTIs) and medical treatment cases (MTCs)
- to calculate all injury frequency rates - (MTCs+LTIs) X 200,000/hours worked = AIFR

Trained professionals

- Medical clinics with physician assistants, nurses
- emergency response teams
- occupational health staff

Environment – highest level of protection

Meeting environmental protection requirements before mining can begin is only part of the story.

Throughout the life of the mine, all operations are monitored to ensure emissions of waste materials are kept within safe and allowable limits. When mining ceases, the mine must ensure it leaves behind a properly reclaimed site which will not become an environmental hazard.

Through the approval and permitting processes everyone is provided the opportunity to participate.

Detailed evaluations of projected environmental effects are completed and documented for submission to various boards including the Mackenzie Valley Environmental Impact Review Board, the Nunavut Impact Review Board, and regional boards established under Indigenous claims.

In addition, baseline studies to document, amongst other things, fisheries resources, wildlife, water quality, vegetation and stream and lake sediment, are mandatory. These will help identify any significant wildlife or fisheries resources, and rare, threatened or endangered plants or animals that could be affected by mine development.

The new mining projects in the NWT and Nunavut represent a new generation of environmental philosophy and management. The effort centres on minimizing the impact of mining and on direct community involvement in environmental stewardship through traditional knowledge and community oversight. The depth of the detail that goes into the planning before permits and approvals are granted is evident in documents such as the environmental impact reports that must be prepared and then defended to the public.

New northern mines have set world-class standards in environmental policy and innovative technology. From wildlife management to water quality to energy conservation, they set the standard against which all future northern mining projects will be measured.

Additionally, northern mining companies are required to provide financial guarantees. Known as closure or reclamation bonds, these commitments made by the company, provide security that there is money in place for reclamation.

Photo: De Beers Canada

Kimberley Balsillie, an environment officer at the Gahcho Kué Mine, collects a water sample.

DID YOU KNOW?

The Earth's oldest rock, tonalite gneiss, was found at Acasta River, NWT, in 1989; It's 3.962 billion years old!

Giant Mine – a big role in defining Yellowknife

Giant mine was a major employer and played a big role in the development of Yellowknife.

Many people came North to work at Giant; to build a life for themselves and their families and to benefit from the opportunity and experience the rugged frontier with its new growing community.

The federal government constructed the Snare hydro plant to service the Giant mine and the growing community of Yellowknife. The mine created jobs and played a part in the community. One donation included the lumber for Yellowknife's first arena, the Gerry Murphy Arena.

Giant produced over seven million ounces of gold from 1948 to 2004, contributed $2 billion to the NWT's gross domestic product, and generated $2.7 million in revenues (all in 2002 dollars).

Several companies have owned Giant mine, including Royal Oak Mines.

Tragically, nine workers died as a result of a deliberate explosion which occurred during a labour dispute at the mine in 1992. A mine worker was later convicted of nine counts of second degree murder.

When Royal Oak Mines went bankrupt in 1999, the Government of Canada became responsible for cleaning up the Giant site and allowed Miramar Mining Corporation to haul Giant Mine ore to its mill at Con Mine until Giant Mine was finally closed in 2004. Of note is the fact that Newmont Mining (Miramar Northern Mining) is paying all costs associated with the remediation of Yellowknife's other gold mine, Con. As part of that reclamation, Con's iconic headframe, Yellowknife's tallest building, was removed in 2016.

ENVIRONMENTAL LEGACY

As a result of Giant mine gold roasting process, the site requires major environmental work.

Over the lifetime of Giant, 237,000 tonnes of arsenic trioxide were permitted to be collected and stored in fourteen underground chambers at the mine site. The arsenic trioxide resulted from the gold roasting process.

Through the Giant Mine remediation plan, there is a focus on the long-term containment and management of the stored underground arsenic trioxide waste, demolition and removal of on-site buildings, water management and treatment, and the remediation of all surface areas including the tailings ponds.

Federal and territorial governments are the proponents of the Giant Mine remediation project which is funded through the Federal Contaminated Sites Action Plan. The Giant Mine working group includes federal, territorial, municipal, and Indigenous governments' representatives. It is estimated that clean-up costs for the site could be as much as $1 billion. For the project, there is a commitment to ensure local benefits by employing local residents and through local businesses for contracts.

Photo: CIRNAC

The remediation of Giant Mine includes freezing of underground chambers and stopes that contain arsenic trioxide dust, a byproduct of the gold roasting process. Thermosyphons will be used to establish a frozen zone around these areas which will be maintained at -5C or colder.

Leading the way through government legislation

Today, Canada is a global leader in mining responsibly and has much legislation designed to protect the environment. With Canada, the territories have legislation that applies to exploration and mining. Indigenous land claims and agreements include requirements and responsibilities linked to resource development including community-based oversight and monitoring.

Much has changed in how Canada and the territories mine. Where once society had few rules around development, today's mineral resources industry is highly regulated.

Below are some of the main pieces of legislation governing the mineral resources industry.

- NWT and Nunavut safety acts
- NWT Mine Health and Safety Act and Regulations
- Mackenzie Valley Resources Management Act
- NWT Mining Regulations
- Nunavut Mining Regulations
- NWT and Nunavut waters acts
- Explosives Act
- NWT Wildlife Act
- Nunavut Environmental Protection Act
- Nunavut Environmental Rights Act
- Nunavut Wildlife Act and Regulations
- Nunavut Lands Claims Agreement
- Workers Compensation and Safety
- Canada and NWT mining regulations
- Canadian Environmental Protection Act
- Canadian Environmental Assessment Act
- Fisheries Act
- Metal and Diamond Mining Effluent Regulations
- Navigable Waters Protection Act/Navigation Protection Act
- Species at Risk Act
- Migratory Birds Convention Act
- Transportation of Dangerous Goods Act

Photo: TCWRJV

DID YOU KNOW?

NWT's diamond mines build the world's longest heavy haul ice road

Called the Tibbitt to Contwoyto Winter Road, this 'ice artery' is built every year by the diamond mining companies so they can resupply their sites northeast of Yellowknife. The road, when built to its maximum, stretches 600 kilometres into the tundra, and is operational for about 10 weeks each winter. Early northern ice road construction dates to 1960 when John Denison began building winter roads for Discovery and Tundra gold mines; mine owners were looking for economical alternatives to expensive air transportation. Back then, building ice roads was often more dangerous than driving on them and much time was spent hauling vehicles out of water. Today, technology plays a major role as the ice is profiled for thickness, total gross vehicle weight is matched to ice strength, speed limits are enforced, and road design ensures ice blowouts at portages are prevented. There are road camps for maintenance crews and facilities at two locations provide rest stops for drivers. The maximum on-ice speed is 25 kilometres per hour and 30 kilometres per hour on portages. Ice Road Truckers, first filmed in 2007, made the road, and some northerners, famous. While the show was extremely popular, builders and road users deserve the most credit for their attention to safety. In 2007, the winter road was among the safest highways in the world. That year, 11,740 truckloads were hauled with only nine minor incidents which resulted in one minor injury.

Climate change – mining has important role to play

Fossil fuel is a requirement in the remote and cold north where mines must operate equipment, generate their own electricity and maintain their own infrastructure.

Given the high costs involved, mining companies work hard to use fuel efficiently, and in so doing, reduce greenhouse gas emissions.

Northern mines focus on improving energy usage; reducing greenhouse gas emissions and realizing savings – the subarctic climate demands attention to energy efficiency.

In today's operating environment, mining has a clear role to play when it comes to clean technology. The industry produces raw materials for renewable energy products, like wind turbines, solar panels, and electric cars. For example, lithium batteries, which are increasing substantially in demand, require cobalt. The NICO project contains significant amounts of cobalt in addition to its gold, bismuth, and copper and would become an NWT source of this raw material the world needs to transition to a low carbon future. Similarly, the Nechalacho project has lithium and rare earth metals.

Measuring mining's future success will include how innovatively and responsibly it produces many metals and minerals to fuel the green economy and incorporates the resulting technologies at its respective resource developments and operating mine sites.

Photo: Dominion Diamond

To haul larger amounts ore and reduce fuel usage, Dominion introduced road 'trains' at the Ekati mine. A road train consists of one engine unit towing multiple trailers.

Infrastructure legacy – building makes it better

Investing in infrastructure is a good idea to grow any economy. The North has Canada's largest infrastructure deficit. Lack of infrastructure is holding back economic development.

Historically, the federal government invested in infrastructure for mining development. Mining then helped pay off that infrastructure. When mining finished, the infrastructure remained adding to industry's positive public legacy.

Examples include Snare hydro power built for Yellowknife and its mines, Taltson hydropower plant, Great Slave Lake railway for the Pine Point mine, roads to Yellowknife and Pine Point, marine shipping and ports in Nunavut.

By supporting and enabling mines and their economic contributions, government recouped their infrastructure investment. As a bonus, that legacy infrastructure is still serving the North and Canada. After a 40-year infrastructure investment gap, two NWT transportation projects were announced in 2018.

These include the Tlicho all season road and funding to advance the Mackenzie Valley Highway. In 2019, a $411.8 million 28-year contract to design and construct the Tlicho road was announced. It includes 20 per cent Tlicho Government equity ownership. Improved year-round road access will open up vast areas of prospective geology by reducing exploration and mining costs. The Tlicho road will improve the economic viability of the NICO and Indin Lake projects.

Investment in the Slave Geological Province and the Grays Bay Road and Port project remain important projects which would improve access to mineral deposits considered uneconomic due to lack of access.

Another opportunity is reducing power costs. Power is a significant cost to both remote communities and mines, and substitution of fossil fuels is not always feasible. In 2019, $1.2 million in start-up funding was announced to review and update feasibility work associated with Taltson hydropower expansion.

The NWT 2030 Energy Strategy includes a vision to expand the Taltson hydropower system to connect the North and South Slave electricity systems, link them to southern Canada, and supply communities and mines with cheaper, renewable, and green power. Not only would this reduce green-house gas emissions, but cheaper grid power north and south of Great Slave Lake would reduce community cost of living, could help several mining projects and would sustain and grow mining in the NWT.

Similarly, a link is being proposed to connect the Kivalliq region to lower cost Manitoba hydropower.

DID YOU KNOW?

The North's minerals industry has contributed legacy infrastructure

Mining played a key role in the development of communities including Yellowknife and Rankin Inlet. Industry was a partner for transportation and power infrastructure, including highways to Yellowknife, Pine Point, and Fort Resolution, railways to Hay River and Pine Point, all three NWT hydro-electric facilities, and marine shipping and ports. Mines also have developed technical innovations including high efficiency diesel power, award-winning rockfill dikes, wind power, and engineered ice 'highways'.

Minerals in our lives – what do we make from them?

Canada is resource rich and knowledge of the land and its resources is fundamental to the ability to explore, develop, and participate in responsible resource development.

The quality of human life has changed enormously with the development of non-renewable resources. Fuel (natural gas, oil, and coal) keeps people warm, provides clean, hot water, and helps transport people. Plastics (petrochemicals) are needed in manufacturing, telecommunications, construction, and for modern textiles for clothing.

Metals and minerals are critical for vehicles, buildings, infrastructure, electronics, and equipment including surgical instruments. Virtually all devices that allow our modern technology to function require minerals and metals from mines.

Mining, because of how its products are part of everyone's lives, is in fact everywhere.

Since the 1930s, the North has produced these minerals for world needs.

COBALT
rechargeable batteries | portable electronics | electric vehicles | stationary storage cells | smart phone contains five to 50 grams of cobalt while an electric vehicle contains four to 30 kilograms cobalt

DIAMONDS
Most northern diamonds are for jewellery | Rare and ancient | 3 billion years old

GOLD
jewellery | electronics | medical applications | investment

IRON
98% of iron ore makes steel | 2% for magnets | auto parts | catalysts | paints | printing ink | plastics | cosmetics | metallurgy | medicine | magnetic inks | electronics

LEAD
power storage and delivery | 80% for batteries for motor vehicles | pigments | ammunition

RARE EARTH ELEMENTS
15 REEs | electronics | clean energy | aerospace | automotive | defence | magnets in cell phones | televisions | computers | automobiles | wind turbines | jet aircraft

SILVER
coinage metal as early as 600 BC. | investment | solar panels | water filtration | jewellery | ornaments | tableware and utensils | electrical contacts and conductors | specialized mirrors | window coatings | catalysts | photographic and X-ray film disinfectants | microbiocides | medical instruments

SOAPSTONE
Carving

TUNGSTEN
alloys for strength | incandescent light bulb filaments | X-ray tubes | welding electrodes | superalloys | radiation shielding | military applications in penetrating projectiles | industrial catalysts | ammunition

ZINC
Galvanizing | Alloys for brass | tin | bronze | medical uses | household fittings | plumbing | heat exchange | skin cream | fertilizers | tires

DID YOU KNOW? *If it can't be grown, it must be mined.*

Taxes and royalties – sharing the wealth

MINING GENERATES SIGNIFICANT TAX REVENUES FOR GOVERNMENTS

Mining generate significant tax revenues for governments. Under the GNWT/federal government Devolution Agreement, the GNWT benefits from direct mine company taxation, as well as resource royalties.

These are in addition to the many other taxes paid including, income, payroll, corporate, sales, fuel, and property taxes, and bridge tolls. Resource royalties are paid to the territorial government by mining companies and are profit based.

FUEL AND PROPERTY TAXES

Mines in the North pay taxes on fuel consumed at the mine sites, and they pay property taxes assessed on the value of their mine site assets. Since 2000, the NWT mines have collectively paid approximately $115 million in fuel taxes and approximately $230 million in property taxes.

The taxes are a bonus tax as the NWT and Nunavut are the only Canadian jurisdictions that levy property taxes at significant levels. Mines in remote provincial areas would not pay property taxes. Furthermore, the GNWT applies a fuel tax on off-road fuel consumption which mines do not pay in other jurisdictions.

Under the Tlicho land claim agreement, the Tlicho Government receives 95 per cent of the income taxes collected in their region; high-paying mining jobs are an important contributor.

DIAMOND ROYALTIES SHARED WITH NWT INDIGENOUS GROUPS

Under the terms of the Gwich'in, Sahtu and Tlicho land claim agreements, each of these groups negotiated a share of royalties generated by non-renewable resource industries in the Northwest Territories. Through 2016, over $40 million of diamond royalties have been shared with the three Indigenous groups.

Under NWT-federal Devolution, the Government of Canada agreed to share half its royalties with the GNWT, which in turn committed to share 50 per cent with nine Indigenous signatories to the devolution agreement. In its Communities and Diamonds 2016 Annual Report, the GNWT reports the 12.5 percent shared with indigenous governments cumulatively totals $12.5 million.

INUIT LANDOWNERS COLLECT ROYALTIES

In Nunavut, the Inuit land claim government, Nunavut Tunngavik Incorporated, owns land under all three producing mines. As a result, the Inuit collect virtually all the mining royalties paid. NTI is the largest private landowner and has many more opportunities for royalties.

GNWT REVENUES FROM DIAMOND MINING

Over the past decade, the Government of the Northwest Territories has collected an average of nearly $100 million annually, or a total of about $1 billion, in revenues from the diamond mines. Through corporate, property, fuel, and payroll taxes, diamond mining generates 44 per cent of the territorial government's revenue.

Since 2008-09, the GNWT has, on average, collected $71.3 million in royalties from the mines. The higher the mining production and profit, the more the NWT collects in royalties. *Source: GNWT 2018 Socio-Economic Agreement Report*

DID YOU KNOW?

In 2018 Baffinland set a new Canadian High Arctic shipping record by transporting 5.1 million tonnes of iron ore to steel makers around the world.

Vision for the future – keep exploring and mining

Today's northern minerals industry remains one with the potential to generate more opportunities and benefits. More rocks can be converted to more riches – transforming mineral wealth to better health for all.

Adding to the success will require action by mining companies, by investment from government and Indigenous groups, and from partnerships.

The approach between governments and industry will help ensure that we grow our minerals industry and that we help prepare communities and residents to take full advantage of the opportunities that a strong and healthy minerals industry and economy can provide. The mission driving industry's work is responsible and sustainable mineral exploration and development. This generates wealth for investors and attracts future investment. More importantly, the minerals industry contributes to training, employment and business benefits, and community wellness. Finally, it creates wealth for governments to deliver services and programs required by society.

In less than a generation, diamond mining has seen thousands of NWT residents trained with skills for long and productive careers in mining or other industries. Billions of dollars have been spent with northern and northern Indigenous companies, enabling them to build a strong foundation for the future.

In Nunavut, just a decade ago, there were no operating mines. But this has changed with renewed mineral developments and Nunavummiut are working hard to take part and benefit from employment and business opportunities.

A renewed vision for Canada's north – one which reflects that Mining North Works! for the Northwest Territories, for Nunavut and for Canada, will see the North become a strong contributor to Canada and one that will provide significant new opportunities for all northerners and all Canadians.

The NWT Mine Training Society's geoscience field assistant program is one of several programs providing northerners with skills to take part in opportunities created by the North's mineral resources industry. The five-week program involves many topics including prospecting, geology, claims staking and mineral tenure, geophysical surveys and grids, wilderness first-aid, WHMIS, communications, and much more.

Photo: NWT Mine Training Society

DID YOU KNOW?

The minerals industry is Canada's largest employer of Indigenous peoples, with over 16,500 jobs.

NUNAVUT MINE EMPLOYMENT

BIG BENEFITS - EMPLOYMENT OPPORTUNITY

Mining works to generate employment

Nunavut's operating mines – reviving mining jobs

Employment data in person years (1 person year equals 2,184 hours)

NWT DIAMOND MINES GENERATE BIG BENEFITS

SINCE 2003

234 trained trades journeypersons

68 trades apprentices including **46** northern, **20** Indigenous

15%
of total workforce are women

$12 million
invested annually in community development

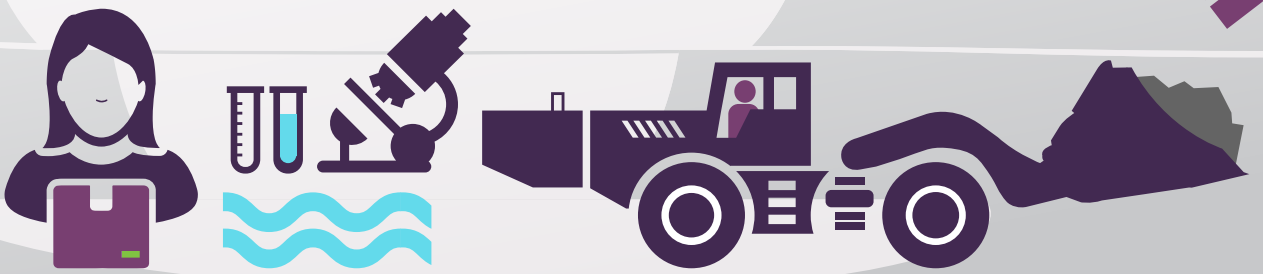
Over 1,500 NWT jobs
48% northern employment

ENORMOUS EMPLOYMENT BENEFITS SINCE 1996

Average of 1,000 NWT jobs each year for three decades

Over 29,000
Person years northern employment

Over 60,000
Person years total employment



Source: *Mines' socio economic monitoring reports*
One person year equals 2,184 hours of work

Mining North Works! – Our Partners

Thanks to all our Mining North Works partners!

Mining North Works! is produced by the NWT & Nunavut Chamber of Mines through its Mining North Works! public awareness program, a partnership of governments, industry, and various organizations.

Formed in 1967, the Chamber of Mines' members include individuals, exploration and mining companies, and service provider businesses, from the minerals sector. The chamber provides leadership on, and advocates for, responsible and sustainable mineral exploration and development in the NWT and Nunavut.

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NWT & NUNAVUT CHAMBER OF MINES

Government of Northwest Territories

AURORA GEOSCIENCES

Mine Training Society
NORTHWEST TERRITORIES

RioTinto

DE BEERS GROUP

Dominion Diamond Mines

TerraX MINERALS

SOLSTICE GOLD

Baffinland

DUNNEDIN ventures inc.

AGNICO EAGLE

KITIKMEOT INUIT ASSOCIATION

Sabina GOLD & SILVER CORP.

TMAC RESOURCES

Nunavut

NUNAVUT TUNNGAVIK

NUNAVUT MINING SYMPOSIUM

NUNA Group of Companies

Kiggikmeot Camp Solutions

HORIZON NORTH

Mining North Works!

NWT & Nunavut Chamber of Mines

NWT Office

103-5102 50th Avenue, Yellowknife, NT, Canada X1A 3S8

Tel: (867) 873-5281 | **Fax:** (780) 669-5681 | **Email:** pamgr@miningnorth.com

Nunavut Office

P.O. Box 1019, Unit 116, Tukturjuk Tower (8-Story)

Astro Hill Complex, Iqaluit, NU, Canada X0A 0H0

Tel: (867) 979-5291 | **Fax:** (780) 669-5681 | **Email:** generalmanagernu@miningnorth.com

Visit the website to learn more about all things mining!

MININGNORTHWORKS.COM

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