Rocking in the Yukon

Yukon
Economic Development

Economy 2000
A Yukon Partnership

Rocking in the Yukon

An introduction to mineral resources in the Yukon

March, 2000

Yukon
Economic Development

revised March, 2000

ISBN 1-55018-914-X

For more information, contact:

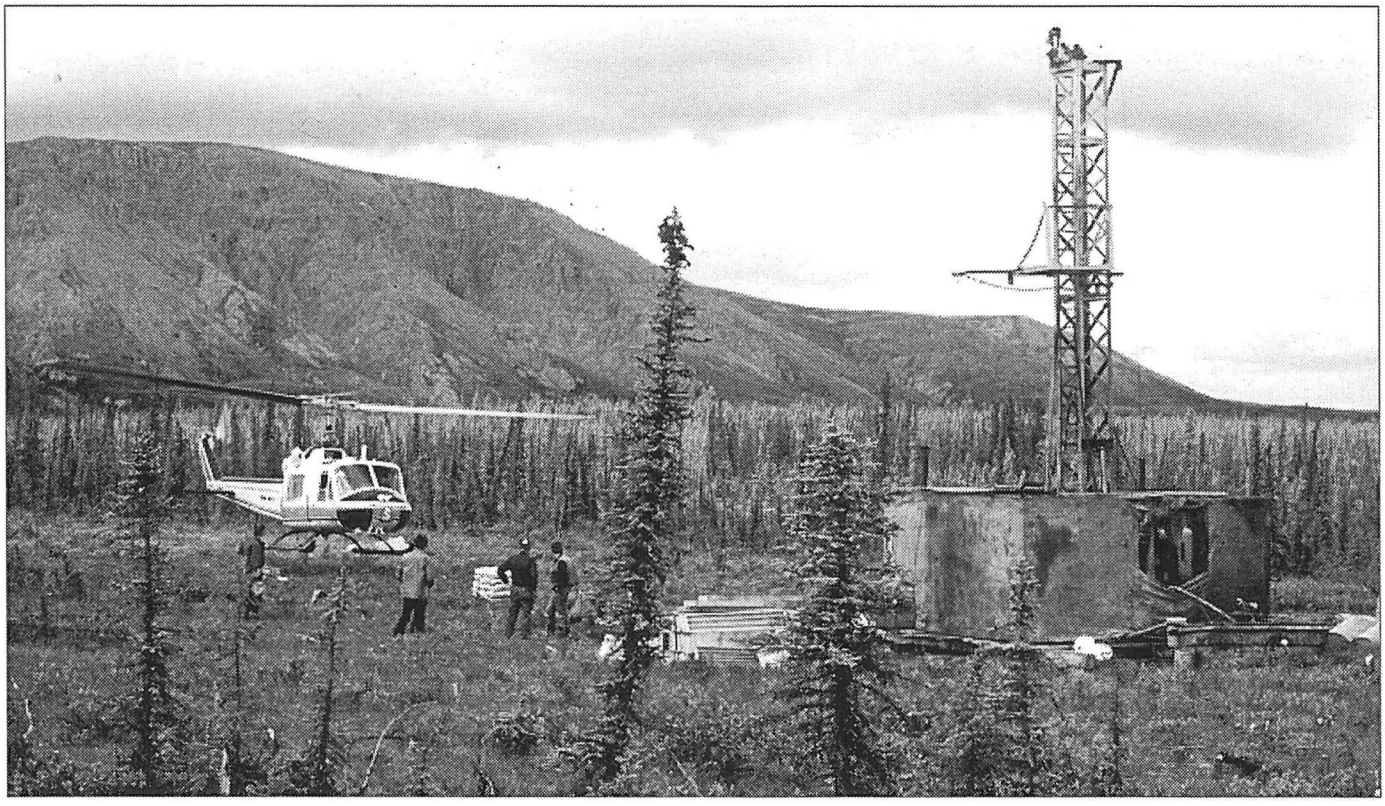
Department of Economic Development
Yukon Government
Suite 400-211 Main Street, Box 2703
Whitehorse, Yukon Y1A 2C6
Phone: (867) 667-5466
Fax: (867) 667-8601

Cover photo: Geologist at work in the Kudz Ze Kayah area, 110 kilometres southeast of Ross River. (Photo: Don Murphy)

Production: K-L Services, Whitehorse, Yukon

CONTENTS

Drilling crew on coal exploration property, Bonnet Plume Basin, early 1980s.



Rod Hill

INTRODUCTION

Everyday we rely on an endless list of products that require the mining of metals. It is difficult to imagine life today without items such as lead in batteries, gypsum in wall board and gold and silver in computers.

Many products that originate from mining can be recycled. Old cars are melted and transformed into items such as toasters or building materials. This process also relies on mining because smelters need coal to provide power for recycling and other newly-mined metals are added to produce alloys for a variety of new products.

It is also important to note that there have been significant changes in the way mining is conducted that have lessened the impact on the environment.

This booklet addresses these issues and answers the questions about where minerals are found, what metals are common in the Yukon, how the industry adjusts to global market changes and how environmental regulations affect mineral exploration and development.

We hope this information gives you a good understanding of the importance of our mining industry and the benefits it provides to many Yukon people.

Figure 1. ***(Top) Grant Abbott, Shirley Abercrombie. (Bottom, from left to right) Tanya Gates, Diane Emond, Jo-anne vanRanden, Bill Lebarge, Ali Wagner, Robert Deklerk, Mike Burke, Leyla Weston, Don Murphy, Gord Nevin, Dennis Ouelette, Lee Pigage, Craig Hart, Ken Galambos, Danièle Héon, Maurice Colpron, Jeff Bond, Kaori Torigai, Julie Hunt, Melanie Reinecke, Grant Lowey, Charlie Roots, Panya Lipovski, Anna Fonseca, Mark Nowasad. Missing: Monique Shoniker, Tammy Allen and Jason Adams.***

YUKON FACTS

Population	31,305 (June 1999)
Area	483,450 square kilometres (4.8% of Canada's total land area)
Major sectors	government, mining, tourism
Gross domestic product	$1,131 million (1997)
Value of mineral production	$113 million (1998)
Mineral exploration	$15.4 million (1998)
Mineral development	$6.0 million (1998) (DIAND)
Fur production	$200,000 (estimated 1998)
Primary forest production	323,500 cubic metres (1997-1998)
Tourism expenditures	$46.7 million (1994)
Retail trade	$311.6 million (1998)
Minimum wage	$7.20 per hour (1998)
Average weekly earning	$657.93 (June 1999)
Value of real estate transactions	$88.2 million (1998)
Average house selling price (Whitehorse)	$152,400 (1999, second quarter)
Median rental rates (Whitehorse)	1 bedroom, $630 (June 1999) 2 bedrooms, $675 (June 1999)
Commercial lot price (Whitehorse)	$34 per square foot
Power rates	first 1,000 kilowatt hours, 9.86 cents per kWh over 1,000 kilowatt hours, 10.45 cents per kWh
Industrial rate	first 2,000 kilowatt hours, 8.31 cents per kWh over 2,000 kilowatt hours, 10.45 cents per kWh
Property taxes (Whitehorse, 1998)	residential, 1.27% of assessed value non-residential, 1.41% of assessed value
Corporate taxes	15% of taxable income, 2.5% for manufacturing companies
Personal income tax	50% of the basic federal tax
Sales tax	federal goods and services tax 7%, no territorial tax

MINING: AN IMPORTANT PART OF THE YUKON'S ECONOMY

Mineral exploration and production have been the most significant non-government economic forces in the Yukon for over 100 years. Since 1986, the mining sector has accounted for as much as 28 per cent of the Yukon's Gross Domestic Product. For this reason, the Yukon's infrastructure, support services and skilled workforce are geared towards supporting the mining industry.

According to Industry Canada, between 1993 and 1998, the runaway leader of Yukon products exported to the world was zinc and lead concentrates. For a small economy, the Yukon makes a relatively significant contribution to global lead and zinc production. In 1996, production from Yukon mines accounted for 2.1 per cent of total world zinc production and 3.2 per cent of total lead production.

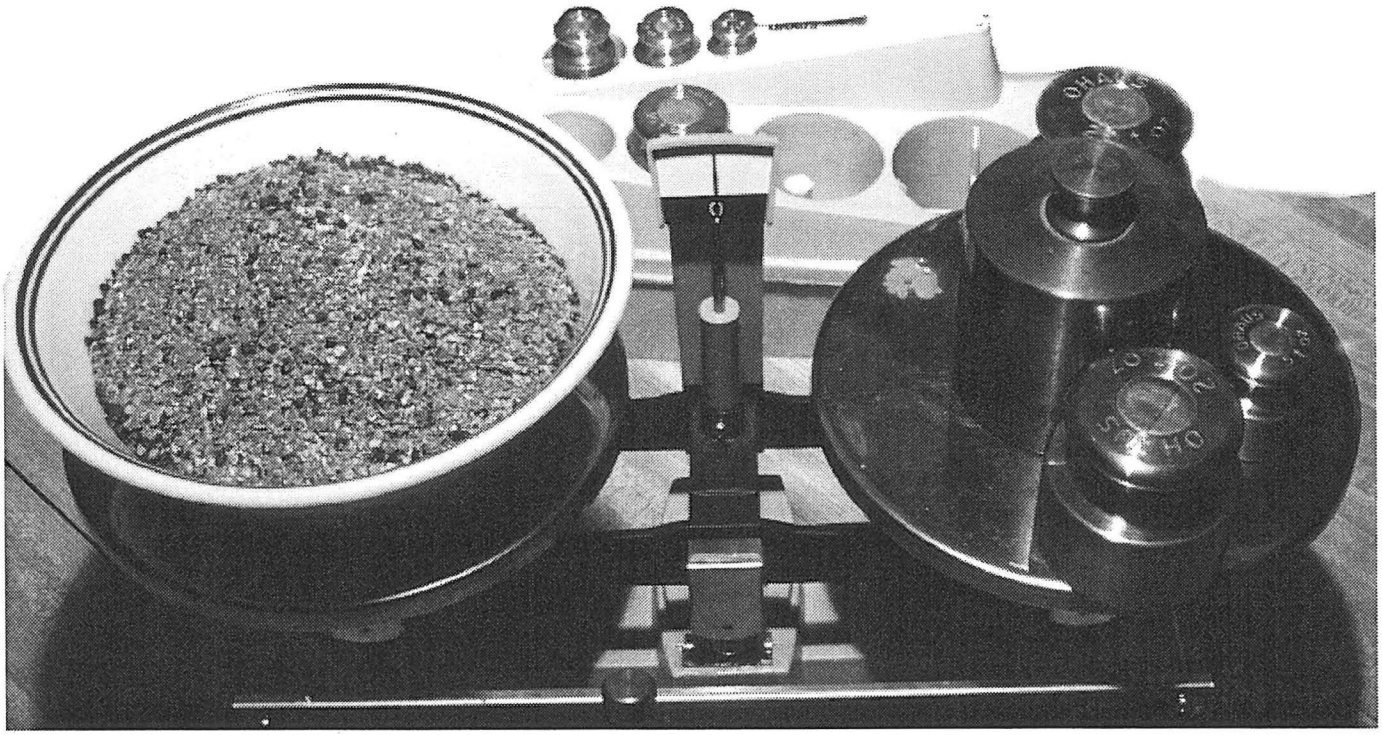
When fully operational, the giant lead–zinc mine at Faro has historically accounted for an estimated 12 to 15 per cent of the Yukon's Gross Domestic Product, and an estimated 70 to 85 per cent of the Yukon's mineral production.

In 1998, the Brewery Creek gold mine and Mount Nansen gold and silver mine continued production. Construction of the new Minto copper-gold-silver mine contributed $6 million in mine development expenditures. Gold exploration accounted for more than 60 per cent of $15.4 million in exploration expenditures.

1997 Yukon Gross Domestic Product*

Business sector	*Millions of dollars (1992)*	*Per cent of total Yukon GDP*
Total Yukon GDP	*997.9*	
Mining, quarrying and oil wells	*117.7*	*12%*
Construction	*97.9*	*10%*
Retail and wholesale trade	*87.7*	*9%*
Transportation and storage	*57.4*	*6%*
Communication	*35.9*	*4%*
Manufacturing	*6.2*	*1%*
Renewable resources (agriculture, fishing, trapping, logging, forestry)	*4.8*	*0.004%*

*from *Yukon's GDP by Industry, Information Sheet # 65.04-98.12,* Yukon Bureau of Statistics, 1998



Yukon Government

Weighing gold with a scale, Bleiler placer mine.

UP AND DOWN: WHY?

Mining, like any other business, is driven by a combination of supply and demand. The need for the metal-based products that we use every day – such as cars, building supplies, appliances, and parts for planes, engines, medical equipment and other items – drives the demand for raw and finished metal products.

The location and quantity of mineral-rich deposits depend on geological factors. The best find is near-surface rock with a high content of minerals (high grade). It is more expensive to extract minerals when they are less concentrated or more dispersed (low grade). However, global conditions impact where the extracted minerals will come from, where they will be processed, how much they are worth, and, therefore, who will make a profit. The mining and metal industries, like many other businesses, are highly competitive at a world level.

Global factors, such as the price of metals, directly affect the profitability of a mine. If the mining company cannot sell its product for a profit, it must stop producing. Over the years, the law of supply and demand creates a cycle of ups and downs.

In some cases, political events around the world affect the supply of a particular mineral. For example, when China released tonnes of tungsten on the market in the 1980s, the price decreased significantly. Many mines, including the Cantung mine north of Watson Lake, could not compete with this cheaply produced ore and therefore had to close. The Chinese reserves are decreasing and, as a result, the price of tungsten is slowly rising. One day, it may reach the threshold that makes the Cantung mine profitable and allow it to re-open.

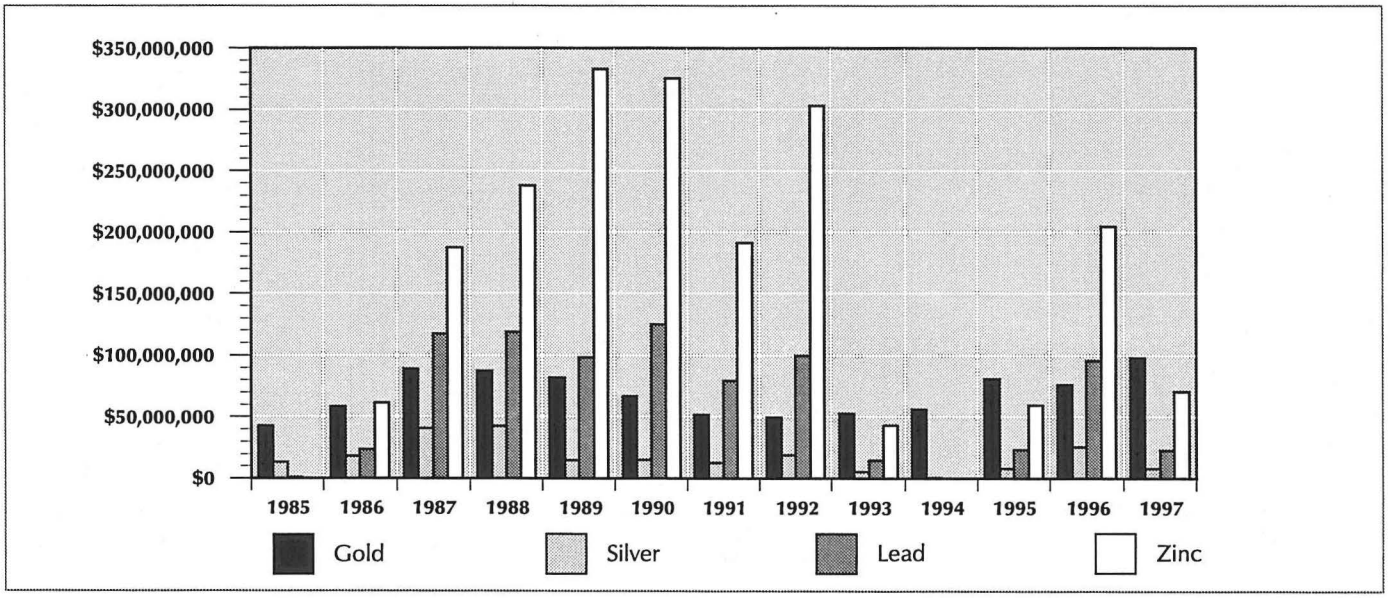
The investment climate is driven by the possibility of return. Many factors affect the attractiveness of a country and economic sector at a particular time. Political instability, lack of skilled labour or infrastructure, and access to resources can add risk or cost to mineral resource extraction.

Exploration activity also follows this supply and demand cycle and is subject to the conditions of the investment climate. However, the abundance of significant mineral

Providing power for industry

Aishihik Lake, the only multi-year reservoir on the Whitehorse-Aishihik-Faro power grid system, was built in the late 1970s to provide affordable electricity to large mining projects. The reservoir has a 2.7-metre storage range and can generate 18.5 Gwh of electricity per foot of water stored. This potential power source makes residential, industrial and commercial development possible as it significantly reduces the dependence of Whitehorse on diesel power, particularly in the winter. Diesel power is more expensive and has a greater impact on the environment.

Value of mineral production in the Yukon. (Yukon Bureau of Statistics)



Money spent on mineral exploration flows to local businesses

Studies in other jurisdictions demonstrate the positive economic impact of mineral exploration. Manitoba reports that every dollar spent by government through its mineral incentive program generates nearly $5 in mineral expenditures, plus an additional $2 in business income. In Alaska, at least 65 per cent of a total $35 million in certified exploration expenditures flows directly to local businesses.

deposits in the Yukon ensures that there will always be interest in our resources.

ECONOMICS OF SCALE

The Yukon still has potential for the discovery of near-surface world class mineral deposits. However, exploration trends in the Yukon, and other factors, seem to indicate that in the future, smaller deposits with shorter life-spans will be more common – much like the mines developed since the late 1980s (Mount Skukum, Ketza River, Brewery Creek, Sa Dena Hes and Mount Nansen). Currently, almost all Yukon exploration projects in the advanced permitting stages fall into this "short mine life" category. Even the largest of current advanced exploration projects are considering mines with an expected life of 10 to 12 years. These mines require much smaller capital investment and therefore may be easier to finance.

NEW TECHNOLOGY

Mining has become increasingly efficient, and new technologies have made lower grade (previously unfeasible) deposits economically viable. Increased process efficiency and streamlining, combined with the economics of scale, have made large volume mining viable in short time periods. These trends are reflected in the metal prices on the stock market: the prices show consistent downward trends. This is not due to reduction in value, but reflects the competitive nature of mining at consistently lower prices.

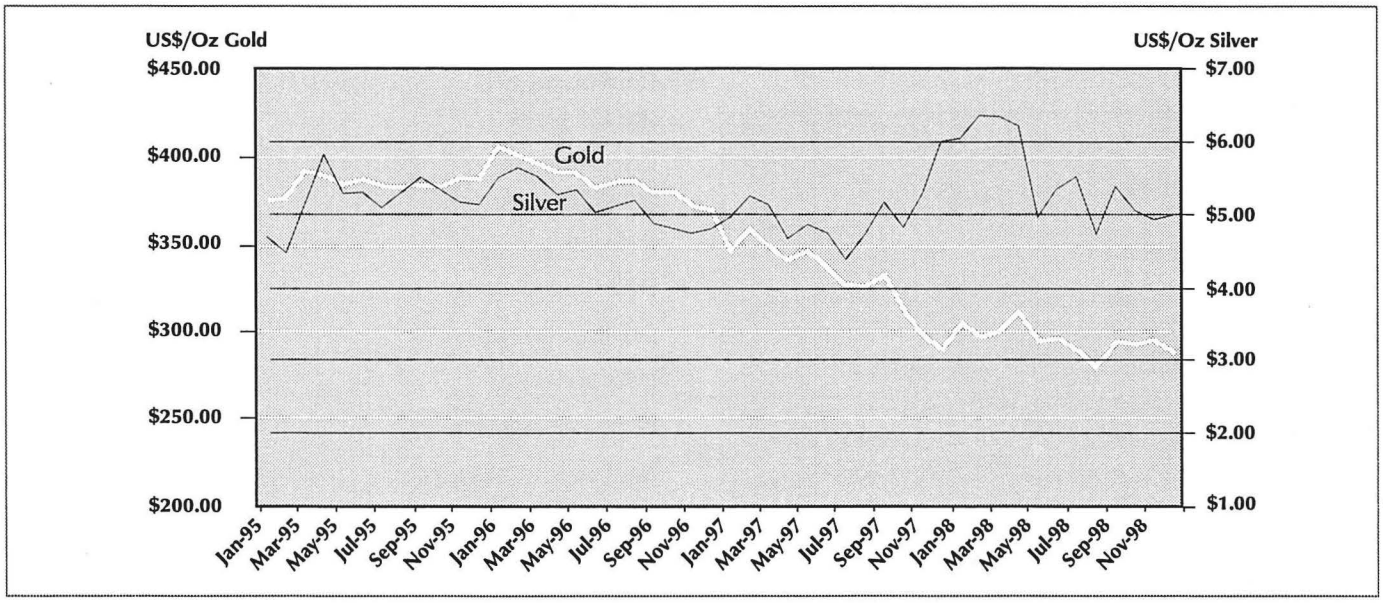
WORK OPPORTUNITIES

Despite its cyclical nature, the mining industry is still key to the Yukon economy. Although exact figures are difficult to find, it is generally agreed that hard rock mines employ more than 1,000 people in good mining years. In a typical year, an estimated 600 to 700 people are directly employed in gold placer mines. In a territory of about 32,000 people, this direct employment from mines has an important economic impact. These figures do not

Placer mining *is the process of using water and gravity to recover gold from gravel.*

Hard rock mining *requires crushing and processing rocks to separate the metals from the rock.*

Gold and silver prices. (Yukon Bureau of Statistics)



include others who are involved in mineral exploration such as prospectors, geologists, surveyors and construction workers.

The economic impact of mining extends well beyond those who work at the mines or those who are looking for new mines. Economists refer to this as a "multiplier" and multiply the number of jobs in a sector to derive the total impact on a region. In the Yukon, the multiplier for the mining industry is 1.5. This means that for every person employed in mining, an additional half job is created elsewhere in the economy providing services to mining, such as selling heavy equipment to mines or packing groceries for camps. In provinces where secondary processing of ore occurs, or additional value is added, such as the manufacturing of finished products, the multiplier effect is larger.

When mineral exploration thrives, everyone benefits. Just look through the phone book and you'll find many businesses that benefit from a healthy mining industry. These range from hotels and aircraft charter companies to expediters and communications companies. Vehicle and equipment rental companies, businesses selling office and building supplies, mechanics, surveyors and tradespeople, all share in the extra work generated by mining projects, even at the exploration stage. Mining projects also mean additional business for fuel and grocery suppliers and restaurants.

Most Yukon communities are affected by the economic activity that results from the mining industry. Most of the Yukon's roads were developed because of mining projects. These roads are now access routes for many tourist and recreational destinations. They keep goods, services and people circulating easily between communities and are a legacy of the Yukon's mining history.

Skagway remains key to Yukon mining success

Located only 160 kilometres from Whitehorse by an all-weather road, the port of Skagway is a deep-water, ice-free year-round port in Alaska. With facilities that include a 10,000-square-metre ore concentrate storage warehouse and 100,000 square metres of open storage, it has been designed and equipped to handle out-bound ore concentrates from Yukon mines. Water depth is 12.8 metres at the dock face and the docks are commonly used by large ore transport ships. The port of Skagway is 760 kilometres closer to Japan than the port of Vancouver.

Goods and services typically purchased by mines

Accommodation
Air support
Air transportation
Aircraft charter
Airfreight
Airstrip management
Architectural services
Assay services
Automotive supplies
Baking
Banking services
Bearings and seals
Belts, liners and fasteners
Boilers
Building supplies
Bus and taxi services
Clothing
Compressors and spares
Computers and computer supplies
Concentrate handling
Cooking and catering
Core boxes and storage racks
Crushing and grinding
Diesel oil
Drill steel and bits
Drilling contractors
Dust collectors
Electrical supplies
Electronic appliances
Engineering services
Engines (gas and diesel)
Expediting services
Explosives
Fans and blowers
Filters and cloth
Fire fighting equipment
Furniture
General contractors
Generators
Geochemical services
Groceries
Heating systems
Hoses, tubes and fittings
Lumber and timber
Medical supplies
Office services
Office supplies
Paint
Pilot services
Reagents and supplies
Repairs and replacement parts for machinery and vehicles
Rescue and safety equipment
Road maintenance
Shelving
Storage sheds
Telephones and communications
Tools
Water treatment

MAJOR METALS FOUND IN THE YUKON: GOLD, SILVER, LEAD, ZINC, COPPER

Gold

Gold has been highly valued for thousands of years. Approximately 3,540 tonnes of gold are consumed annually in the western world. Jewellery manufacturing accounts for close to 80 per cent of gold use, but gold has many other important uses.

Gold is not affected by air and is a good conductor of heat and electricity. These attributes make it appropriate for jewellery, electronics, dentistry and coins. Gold is a soft metal that is often alloyed to increase its strength. It is biologically benign and will not corrode or tarnish, since gold is unaffected by moisture or oxygen. The purity of gold is described by the carat scale, with pure gold called 24 carat, or 1,000 fine.

Gold plays an integral part in hundreds of aircraft applications including radar equipment, windshield glass and navigation circuitry. Today's cars use gold to ensure the performance of airbags through gold-coated electrical contacts, and all high-performance vehicles use gold contacts and connectors in wheel controls to prevent spinning and loss of traction.

Gold contributes to the efficiency and quality of our modern technologies. Gold components are found in cameras, home computers, camcorders and televisions, and are used in wiring, electronic circuitry and microchips.

Silver

A total of 14,593 tonnes of silver was produced globally in 1997.

Silver has the highest thermal and electrical conductivity of any metal. It plays an integral part in the photographic process. It is used in the manufacture of film, photographic paper, photocopy paper, X-ray film and photo-offset print plates, as well as other minor light-sensitive products.

Silver is used in contact and conductor products for the electrical and electronic industry, and in mirrors, dental amalgams, bearings and many other end products. Its most visible uses are in jewellery and silverware.

Lead

Lead is the world's fifth most-used and most-recycled metal. Annually, over five million tonnes of lead metal are produced in the western world. Close to 80 per cent of lead in the western world is recovered, with most recycled lead coming from batteries.

Refined lead consumption has grown at a rate of two per cent per year, and has been driven by a sharp rise in battery consumption. Battery manufacturing accounts for over two-thirds of all lead consumption. Other end uses include alloys, pigments, chemicals and semi-fabricated sheets.

For batteries, the dominant use of lead is in car batteries (the average car battery contains 10 kilograms of lead) and batteries used in electric vehicles such as wheelchairs and golf carts. Battery-powered vehicles are worldwide favourites for special transportation and material handling needs. The batteries that power these vehicles are virtually emission-free, can be easily manufactured in high volumes for a low cost, and are made with readily available and recyclable lead.

Battery-powered vehicles are the perfect alternative when extra safety is needed. For example, they are used for airplane push-back vehicles to provide safe power which is free from sparks. The total absence of exhaust fumes also allows them to be easily used within enclosed work spaces.

Hospitals, telecommunication networks and computers rely on batteries during power interruptions. Even advanced wind and solar power systems rely on batteries for supplemental power.

Lead also helps control noise and air pollution and provides radiation protection to patients, health care professionals and workers in the nuclear industry. In addition, lead is still used in traditional applications such as the making of fine crystal and leading for stained glass windows.

Despite its importance, lead is toxic and can cause adverse health effects if ingested and absorbed into the bloodstream. Through industry initiatives, better education and legislation, the risks associated with lead exposure have been greatly reduced.

Zinc

Zinc is the world's fourth most-used metal, after steel, aluminum and copper. About 6.5 million tonnes of zinc metal are consumed annually in the western world in a myriad of uses from automobiles to roofs, from coins to faucets, and from vitamins to lozenges. Zinc consumers include galvanizers, die casters, brass and oxide manufacturers, and pharmaceutical companies. Western world refined zinc consumption has grown at a rate of 2.5 per cent per year since 1980.

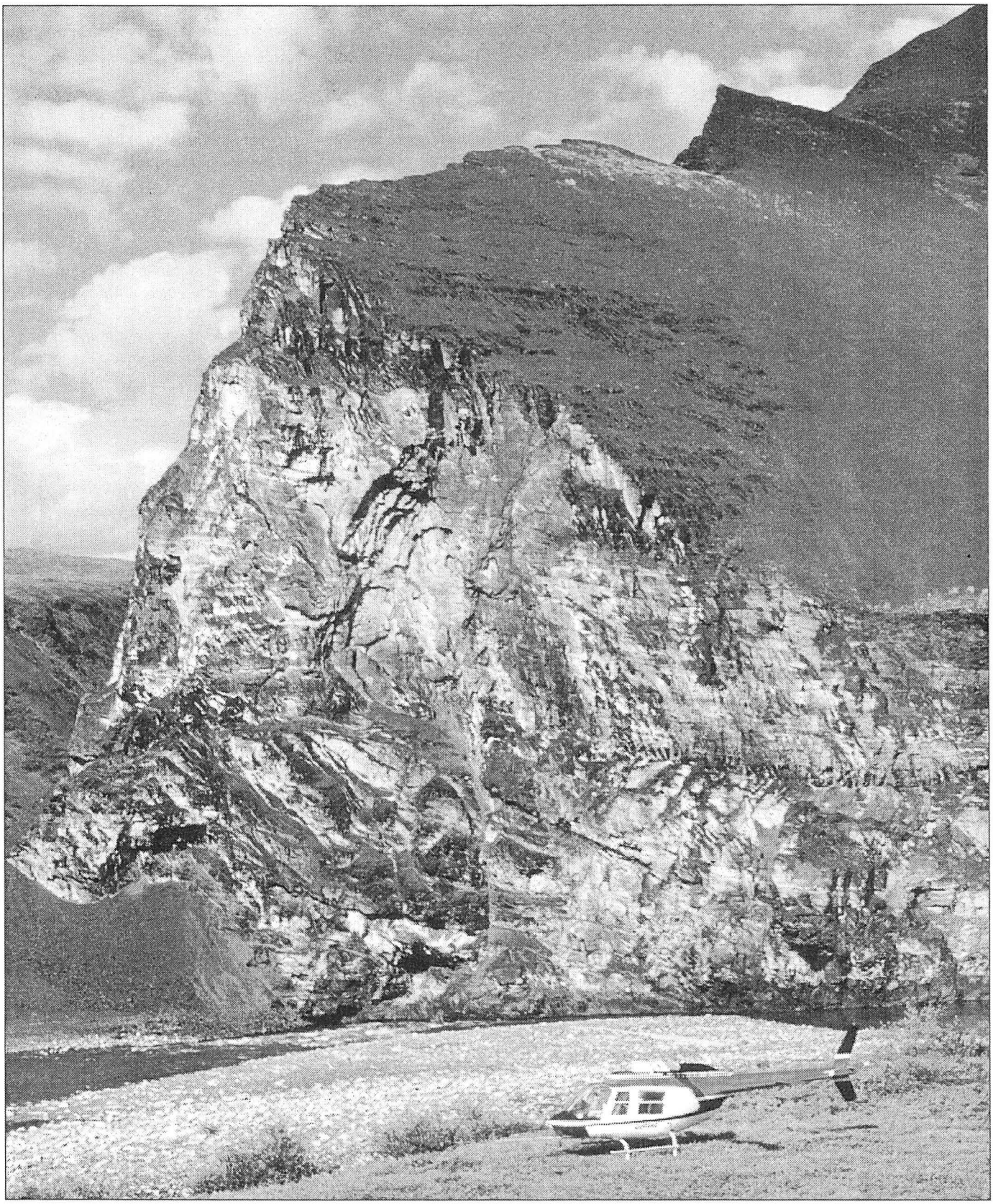
Zinc is completely recyclable without any loss of its physical or chemical properties. It is essential for human health. The healing properties in zinc compounds are used in sunblocks, baby lotions, dandruff shampoos, cosmetics and lozenges.

Copper

Approximately 11 million tonnes of copper are consumed in the western world each year. Refined copper consumption has grown about three per cent per year since 1980. The wire and cable market accounts for about 70 per cent of copper use.

Copper is a preferred material for superior electrical or thermal conductivity, thus making it a prevalent material in building construction. In a home, copper can be found in building wire, plumbing tubes, fittings and valves, brass goods, appliances and hardware. Copper has been a popular architectural metal for centuries and can be seen throughout the world on government buildings, churches and offices.

Copper combines with zinc to make brass and with tin to form bronze. These decorative alloys are found in a variety of products, from furniture to architectural accents to musical instruments.



Rod Hill

The National Museum of Nature sent a crew to look for unique lazulite in phosphate-rich ironstone in the Rapid Creek area in northern Yukon.

GEOLOGY: THE YUKON'S UNIQUE RESOURCE

The Yukon's geology is complex and full of surprises. Over the years, areas previously explored for minerals have been revisited with innovative technology and geological modelling, resulting in the discovery of new deposits. The tumultuous geological history of the Yukon's rocks, combined with the fact that our large territory has not yet been fully explored, creates the potential for large discoveries.

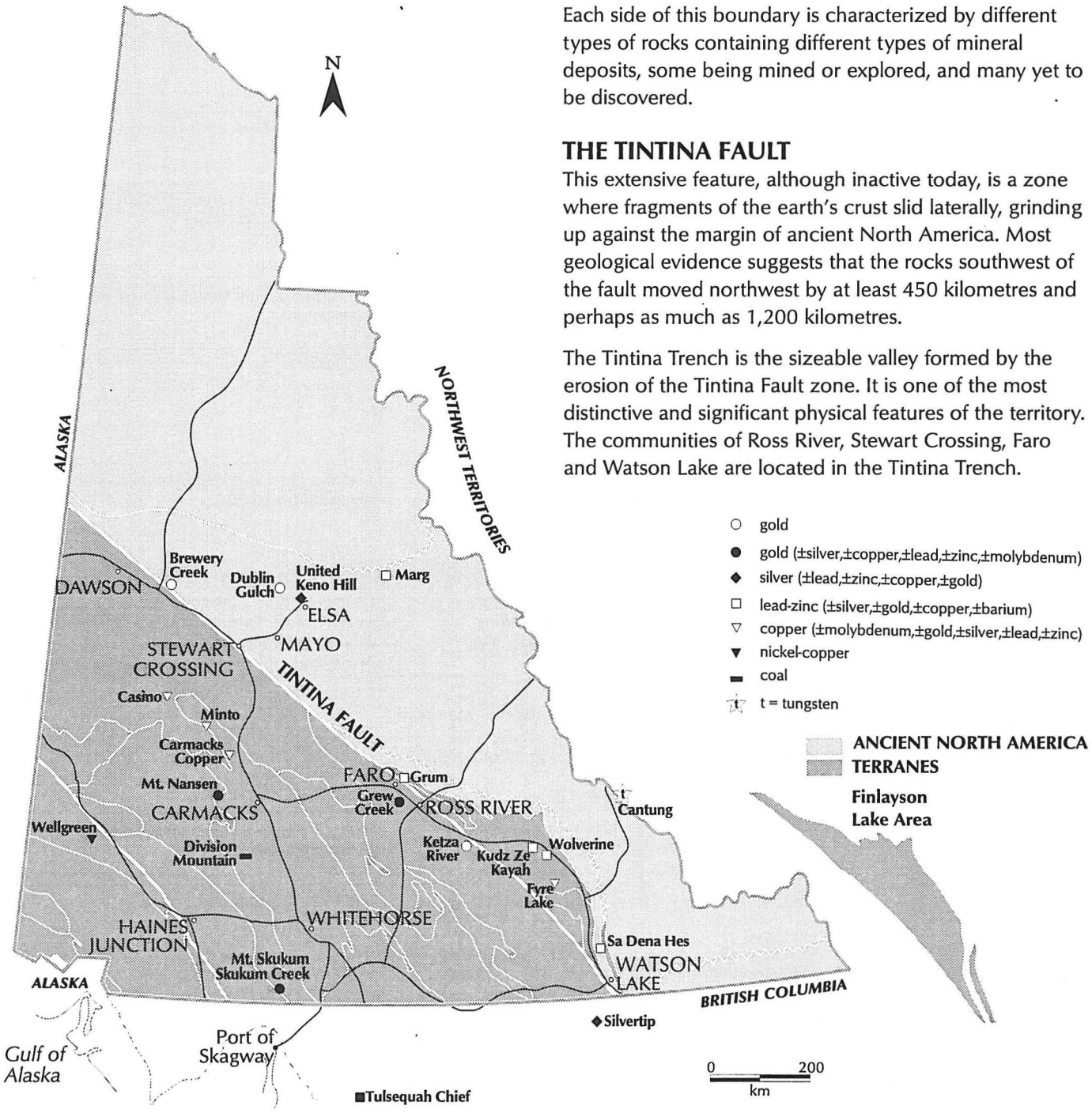
The Yukon's geology can be roughly split into two rock groups: those north of the Tintina Fault and those south of it. This dividing line cuts northwest to southeast across the territory from Alaska to northern British Columbia.

Each side of this boundary is characterized by different types of rocks containing different types of mineral deposits, some being mined or explored, and many yet to be discovered.

THE TINTINA FAULT

This extensive feature, although inactive today, is a zone where fragments of the earth's crust slid laterally, grinding up against the margin of ancient North America. Most geological evidence suggests that the rocks southwest of the fault moved northwest by at least 450 kilometres and perhaps as much as 1,200 kilometres.

The Tintina Trench is the sizeable valley formed by the erosion of the Tintina Fault zone. It is one of the most distinctive and significant physical features of the territory. The communities of Ross River, Stewart Crossing, Faro and Watson Lake are located in the Tintina Trench.



YUKON TOP MINING PROJECTS, 2000

Property	Reserves	Status
OPERATING MINES		
Brewery Creek Viceroy Resource Corporation	**Mineable reserve:** 11,800,000 tonnes 1.13 grams/tonne gold	55,000 ounces of gold production expected in 1999.
UNDER CONSTRUCTION		
Minto Asarco Inc./Minto Explorations Ltd.	**Mineable reserve:** 6,510,000 tonnes 2.13% copper, 9.3 grams/tonne silver 0.62 grams/tonne gold	Water license is signed. Construction has commenced. Production decision depends on metal prices.
DEVELOPMENT PROJECTS		
Keno Hill United Keno Hill Mines Ltd.	**Geological resource:** 838,758 tonnes 4.58% lead, 3.76% zinc 1022.06 grams/tonne silver	On hold.
Dublin Gulch New Millenium Mining Ltd.	**Mineable reserve:** 50,400,000 tonnes 0.93 grams/tonne gold	Undergoing final stages of environmental assessment.
Kudz Ze Kayah Cominco Ltd.	**Mineable reserve:** 11,300,000 tonnes 0.93% copper, 1.52% lead, 5.89% zinc 133.0 grams/tonne silver 1.34 grams/tonne gold	Environmental screening report complete. Water license is signed.
Carmacks Copper Western Copper Holdings Ltd.	**Mineable reserve:** 14,109,800 tonnes 1.01% copper, 0.51 grams/tonne gold	Undergoing final stages of environmental assessment.
Division Mountain Coal Cash Resources	**Geological resource:** 52.9 million tonnes 2.42% residual moisture 28.45% ash, 25.79% volatiles 43.18% fixed carbon, 0.43% sulphur 5,216 kCal/kg (9,328 BTU/lb)	On hold.
Wolverine Expatriate Resources/ Atna Resources	**Geological resource:** 6,237,000 tonnes 12.66% zinc, 1.33% copper, 1.55% lead 370.9 grams/tonne silver 1.76 grams/tonne gold	Metallurgical studies and pre-feasibility planning underway.
EXPLORATION PROJECTS		
Wolf Atna Resources/ YGC Resources	Zn-Pb-Ag volcanogenic massive sulphide target Inferred resource of 4.1 million tonnes grading 6.2% zinc, 1.8% lead and 84 grams/tonne silver	Delineation drill program complete (6,625 m, 30 holes). Deposit strike length 600 m, down-dip length 450 m, good continuity of sulphide mineralization, deposit is open.
Mt. Skukum/Skukum Creek Goddell Omni Resources Arkona	**Mineable reserve:** *Rainbow Zone:* 956,949 tonnes @ 6.3 grams/tonne gold, 193.5 grams/tonne silver *Kuhn Zone:* 148,781 tonnes @ 8.78 grams/tonne gold, 167.70 grams/tonne silver *Goddell Zone:* 900,000 tonnes @ 7.0 grams/tonne	On hold.
Fyre Lake Pacific Ridge Exploration	**Preliminary resource**: 15.4 million tonnes within which 8.2 million tonnes grade 2.1% copper, 0.11% cobalt, 0.73 grams/tonne gold	Preliminary reserve estimate based on wide-spaced drill holes.
Clear Creek Redstar Resource Corporation	Gold-bismuth and gold-arsenic intrusive-related targets.	1999 drill program complete.
Scheelite Dome Copper Ridge Explorations inc.	Intrusive-related gold prospect.	1999 drill program complete.
Ice Expatriate Resources Ltd.	Drill-indicated mineral resource of 4,561,863 tonnes grading 1.48% copper, including 3.4 million tonnes of near-surface mineralization at same grade.	Additional exploration planned.

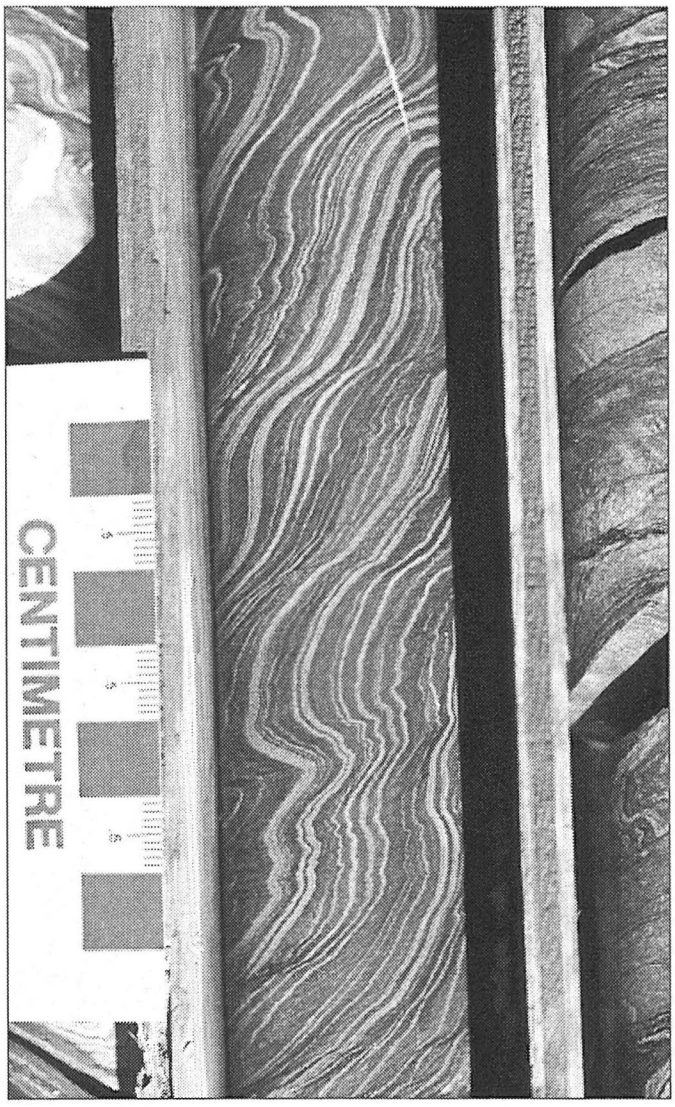
GOOD OLD NORTH AMERICA

Northeast of the Tintina Fault are the components of the ancient North American continent which is underlain by a very old stable part (craton) of the Canadian Shield.

Exploration has led to the discovery of copper-lead-zinc deposits. Gold, copper and uranium have been found in breccia. Breccia refers to rocks shattered by very hot gases and fluids heated by deep molten rock or broken by fault movement. In the process of this rock splitting, minerals are precipitated and cement the rock fragments together.

Important lead-zinc deposits are found in a large area of sedimentary rocks called the Selwyn Basin. Most of the Yukon's base metal production comes from these rocks, most notably the world-class deposits near Faro. Near Elsa, silver-zinc-lead veins occur along a 30-kilometre belt and have produced more than 6.4 billion grams (or 186 million ounces) of silver.

Left: ***Rock core from a diamond drill, Vangorda Formation.***
Right: ***550 million-year-old folded brown and green shales of the Hyland group, east of the McQuestern River.***



Lee Pigage

Danièle Héon

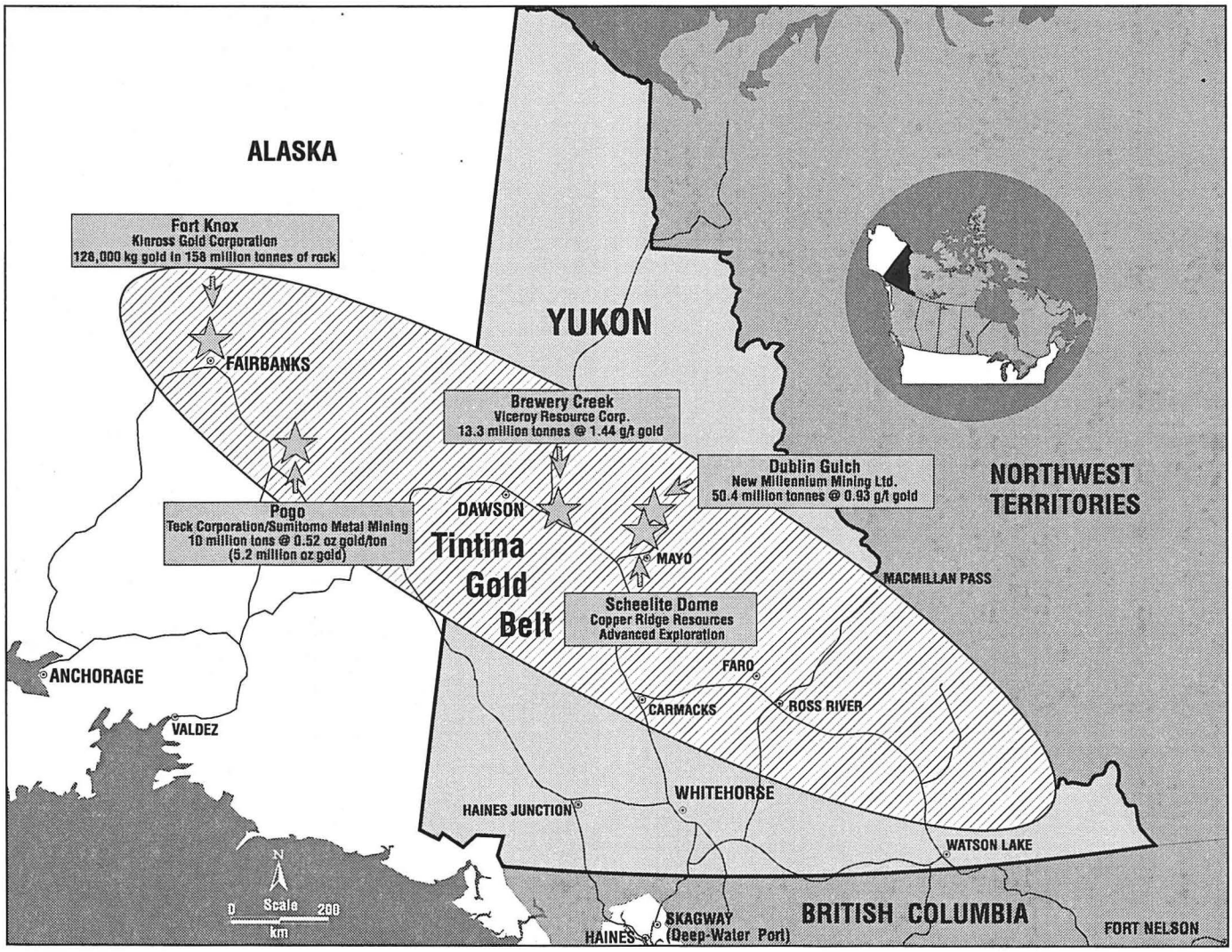
The Tintina Gold Belt: the gold rush of the new millennium?

In 1998, exploration in the Yukon was largely concentrated in the Tintina Gold Belt, the region running between Alaska and the Northwest Territories, containing mineral deposits rich in gold, silver, tin and tungsten. This belt has produced over 30 million ounces of gold. It contains an additional 40 million ounces of gold reserves, three producing gold mines and at least four recent, large discoveries that are moving towards production. Several large deposits in Alaska have been found within this geological zone, including the high-tonnage, low-grade (Fort Knox) gold deposit near Fairbanks.

In geological terms, much of the Yukon's portion of the Tintina Gold Belt is underlain by an array of 92-million-year-old granitic rocks belonging to the Tombstone Plutonic Suite. This suite, or family of rocks, consists of plutons spread across a 550-kilometre zone situated between Dawson City and MacMillan Pass. Mineralization is concentrated in the plutons but exploration has revealed that economic deposits may be present even in the surrounding rocks. The Brewery Creek mine, the Yukon's first heap leach gold mine, is related to rocks belonging to the Tombstone Plutonic Suite.

The Tintina Gold Belt also hosts world class tungsten deposits (Cantung mine and the Mactung deposit), an extremely large uranium resource, and various tin and copper occurrences. Mines within the Tintina Gold Belt have produced 190 million ounces of silver and more than 500,000 ounces of placer gold.

Major gold deposits in the Tintina Gold Belt.



THE ACCRETED TERRANES
...new kids on the block

Southwest of the Tintina Fault, the accreted terranes, or smaller fragments of the earth's crust, were carried around on oceanic plates until they collided with the margins of ancient North America 160 million years ago. This period of accretion occurred between then and 120 million years ago.

Several copper-gold-molybdenum and copper-gold deposits, including the Mount Nansen gold mine, and the Carmacks Copper and Minto projects, are found within a 100-kilometre belt in terranes located in central Yukon.

...Finlayson Lake area

South of Ross River, massive sulphide discoveries have attracted national interest, spurring an exploration boom in 1995 and 1996. These deposits contain large concentrations of copper, zinc, lead, gold, silver and cobalt. Extensive exploration of this area, known generally as the Finlayson Lake area, has been ongoing.

What about coal?

Seven sedimentary basins which host coal deposits have been identified but there has been limited exploration in many areas and reserve potential is unknown.

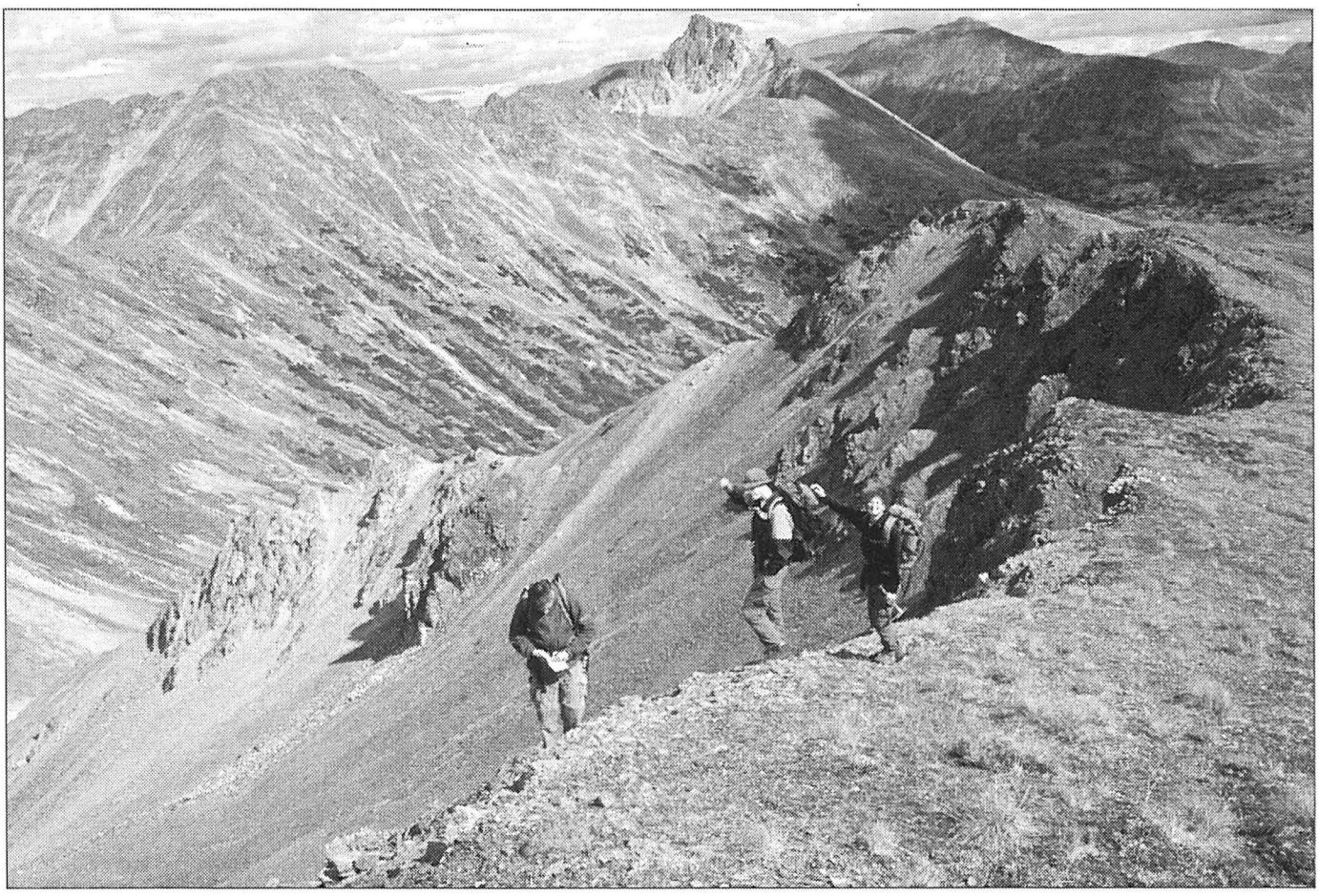
Large tonnage potential has been identified in the Bonnet Plume area in northeastern Yukon.

There has been growing interest in thermal coal at Division Mountain, a Cash Resources project near Whitehorse, where the capacity for significant tonnage was recently recognized. This deposit has the potential to fuel a growing local industrial power demand and meet the requirements of Asian markets.

***Lavas** are molten rock extruded upon the surface.*

***Pluton** is a body of igneous rock formed when deep molten rock intrudes into other rocks (host rocks) and cools.*

Looking across the Ings River, near the Campbell River, Pelly Mountains, east of the Tintina Trench.

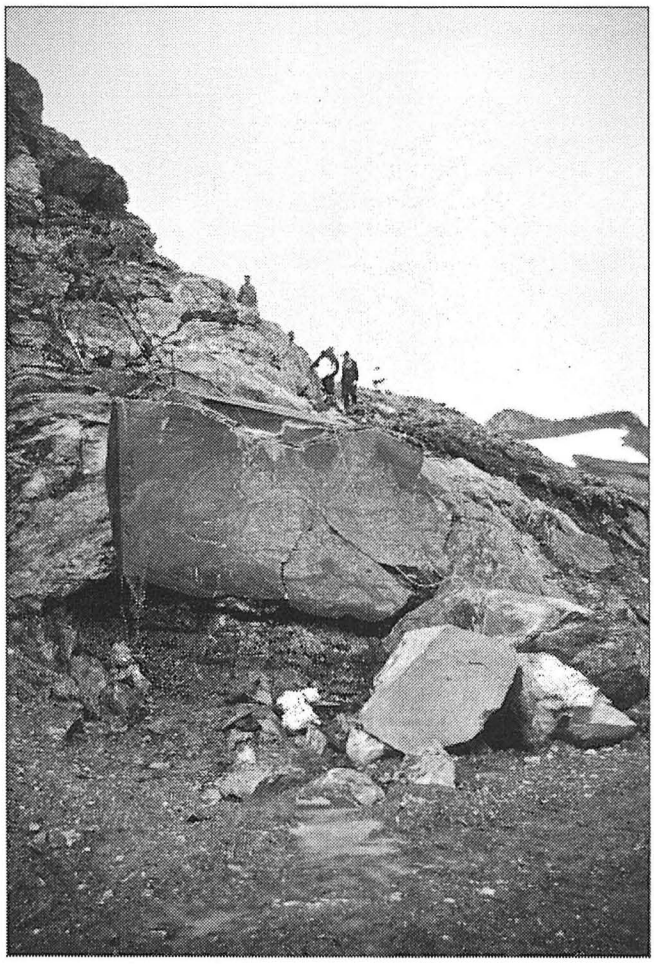


Don Murphy

YUKON GEM RUSH?

Canadian gemologist Brad Wilson is convinced the geological conditions in the Yukon offer good potential for finding some of the rarest gemstones in the world. He's been coming to the Yukon regularly over the past 20 years from his home in Kingston, Ontario.

"I'm looking for gemstones like rubies, sapphires, aquamarine, garnets, topaz and tourmaline," Wilson said. "There are several geological environments in which sapphires occur and one of those environments is in the Yukon. I've found opaque sapphire." These gems form in the centre of the earth and are tossed out by volcanoes. The magma, which encases the gems, gradually weathers away over millions of years. Any hard crystals, showing a six-sided shape or spindle shape, should be examined.



Dennis Ouellette

Largest Nephrite jade discovery in the world, King Arctic Mine, north of Watson Lake.

According to L. Walton, in *Exploration Criteria for Gemstone Deposits and Their Application to Yukon Geology,* many deposits were found by accident. This book suggests that the easiest way to find Yukon rubies and sapphires is to look in streams that lie in areas where volcanic activity occurred and which escaped glaciation. Gemstones can also be found in placer concentrate.

The discovery of diamond-bearing kimberlite in the Northwest Territories has generated a lot of interest in the potential discoveries of gems. In the Yukon, the potential for other gemstones exists and it is quite possible that areas previously prospected, as well as new areas, may show some promise as gem targets.

"I've found some very interesting light green and brownish garnets," Wilson said. "Very few mines in the world are actively producing green garnet. For many years, green garnets were exceedingly rare, and the prices were very high. If I could find a green garnet locality here, that would be great."

Placing a value on gemstones is very difficult since there is no standard grading system for coloured gemstones as there is for diamonds. Instead, value is based on beauty, rarity, durability, the stone's history and the deposit from which it was mined. Many gems have industrial uses even if they are not "gem quality." For example, corundum, a relative of rubies and sapphires, is mined for its use as an abrasive, polishing or grinding agent.

Favourable geology also exists for tourmaline, aquamarine, topaz and gem garnet in several areas in the Yukon.

In 1998, Vancouver-based Expatriate Resources reported a discovery of emeralds in the Yukon but kept the location confidential. In 1999, Expatriate Resources announced that the emeralds had been discovered on one of their exploration properties near Finlayson Lake. The company has commissioned a team of gem experts to evaluate the find. Gem-quality emeralds are extremely rare and much work is needed to recover and appraise the rough gems.

EXPLORATION: ONLY THE FIRST STEP TO OPENING A MINE

The complex process of finding ore bodies that can be mined at a profit is a difficult task that is often poorly understood. Establishing a producing mine is the result of a long process.

Exploration starts with prospectors looking for rock outcrops with unusual amounts of metal-bearing minerals. The next stage is the increasingly intensive evaluation of promising prospects.

PROSPECTING...
or the search for the needle in a haystack

Successful prospecting involves much more than identifying minerals. It requires the use of any information that may give clues to the location of a deposit.

Good prospectors do their homework well before the field season when they go out into the bush. They study maps showing information about the glacial history, geology, geochemistry and geophysics of the areas in which they are planning to work. Before entering the field for the short summer season, most prospectors will have a clear idea of the geological feature they are working on and what minerals they hope to find.

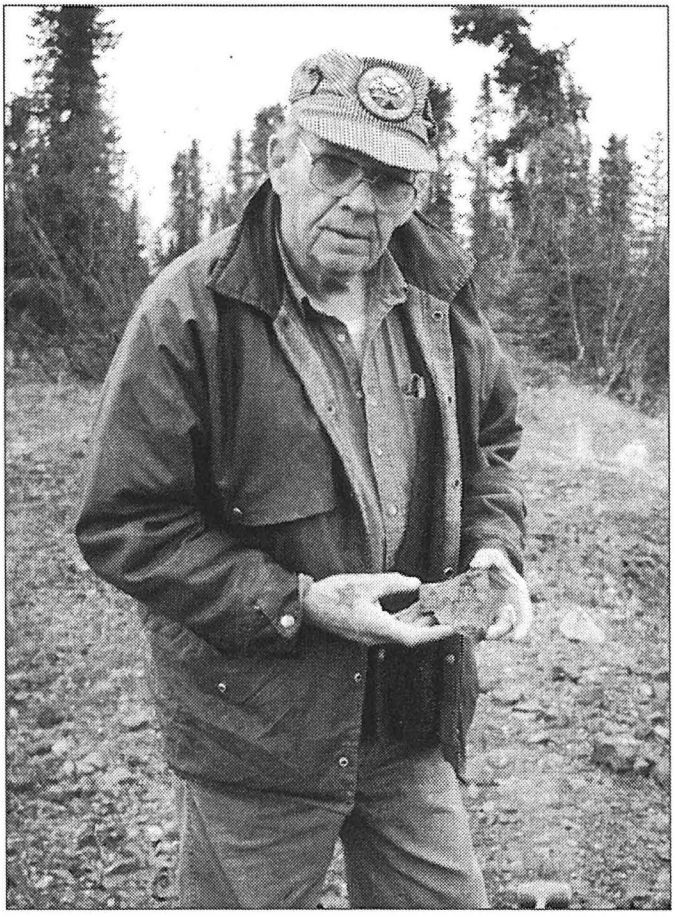
Prospectors will continue their detective work in the field by taking soil and stream sediment samples to be analysed for their metal content. Minerals in bedrock leach into the soil and are transported downhill in run-off water to settle as silt in stream bottoms. Every deposit is characterized by a particular group of metals. Soil or silt samples with higher than normal amounts of metals are strong clues to the possible presence of deposits.

Prospectors also use information on previously evaluated claims to choose where and how to work. Prospectors are required to spend $100 per year in research, analysis or work to maintain each claim. They are also required to file assessment reports to government agencies on the work that they have done. If these conditions are not met, the claims lapse and the assessment reports become public information, available at mining recorders' offices.

Typically, ore bodies are found after the claims have been worked several times by different owners. For this reason, information contained in assessment reports is very useful.

The environmental impact due to prospecting is usually low to non-existent as crews and camps are small (one to five people), and travel is by foot, boat and occasionally by helicopter or floatplane. These are low-budget, low-technology and low-impact activities.

Experienced prospectors have many skills, from map reading to wilderness survival in addition to knowing rocks.



Ken Galambos

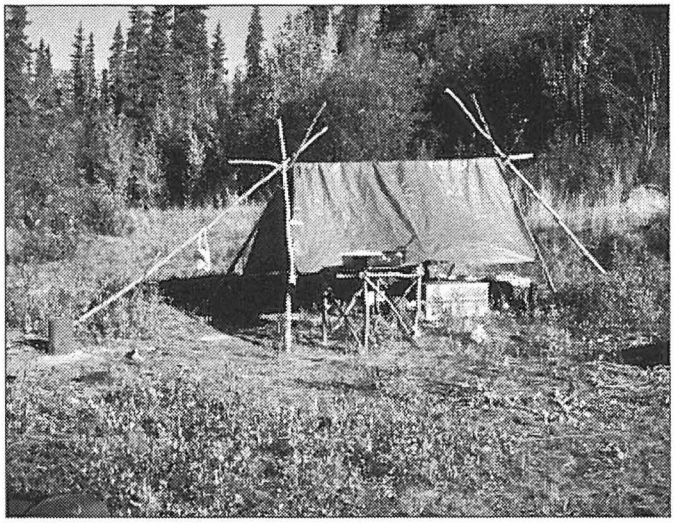
Science of exploring

Over the last ten years, an average of $25 million was spent annually on exploration in the Yukon.

Exploration is distinct from mining. A complex industry, the detective work of exploration involves as much art as science. The process of discovering and evaluating mineral deposits requires constant decision-making as it involves many intangibles.

Jeff Bond

Getting ready for the field; air photographs are one source of information.



Jeff Bond

Field office at a small camp.

Staking

If a prospector or mining company discovers signs of mineral wealth, they may then choose to stake a mineral claim over their find. Mineral claims are staked according to regulations defined in the federal *Yukon Quartz Mining Act*. After a claim is staked, the prospector or company records the claim at the mining recorders' office. In 1998, 2.9 per cent of the total Yukon land base was listed as registered under the provisions of the *Yukon Quartz Mining Act*. In any given year, only a small fraction of the staked land in the Yukon benefits from actual geological work or prospecting.

EXPLORATION
It looks good...let's go back and do some more

If the results obtained during prospecting are promising, more money may be invested for an intensive exploration program. To reveal more information about the kind of deposit, and its possible size and grade, trenching by hand or machinery down to bedrock and drilling will be required. Airborne geophysical surveys are sometimes useful to find or delineate mineral deposits without anyone setting foot on the ground.

Extensive exploration is usually necessary to evaluate a promising mineral occurrence. Most claims change hands many times before a mine is established. On average, it takes three companies and many years of exploration to discover and develop a mine in the Yukon. Fifty million dollars may have been spent on exploration by this time.

Even though a large amount of money may be spent on exploration, the chances of finding a mineable deposit are low. In the Yukon, since 1898, only a very small percentage of all known mineral occurrences have become mines.

Percentage of Yukon land under mining claims

Status as of November, 1998	***Total surface (square km)***	***Percentage of Yukon land base***
Total Yukon land base	*483,450*	
Iron and mica claims	*340*	*0.07%*
Quartz mineral claims (including leases which allow for prospecting only)	*14,052*	*2.9%*
Placer claims (standard, discovery and co-discovery)	*1,598*	*0.33%*

Note: Staked claims are not necessarily being actively explored.

Summit Air crew loading sample bags.

Exploration is carried out by individual prospectors and mining companies. Senior (large) mining companies have income from producing mines and may or may not fund exploration. In-house junior (smaller) mining companies are in the business of exploration only. Junior companies finance their year-to-year operations by selling shares on risk or venture capital stock exchanges such as the Vancouver Stock Exchange. This kind of stock exchange recognizes the high risk of exploration but also the high reward if a mine is found.

As of 1999, federal mining land use regulations regulate exploration activities such as trenches, roads and drill pads, and waste disposal. Together, these regulations and good camp management practices reduce the short- and long-term impacts of exploration.

Right: ***Wall tents are used in larger exploration camps, Mount Hundere.***

Administration

The Yukon's mineral, land and water resources are administered under federal legislation by the Department of Indian Affairs and Northern Development.

Hard rock mineral resources are administered under the Yukon Quartz Mining Act. Placer claims and leases are administered under the Yukon Placer Mining Act. Anyone 18 years of age or older may locate, record and hold claims in the Yukon. Royalty rates for hard rock mining are complex and based on profit, not production.

Negotiations for the transfer of these responsibilities to the Yukon government are presently underway.

How do prospectors start their investigation?

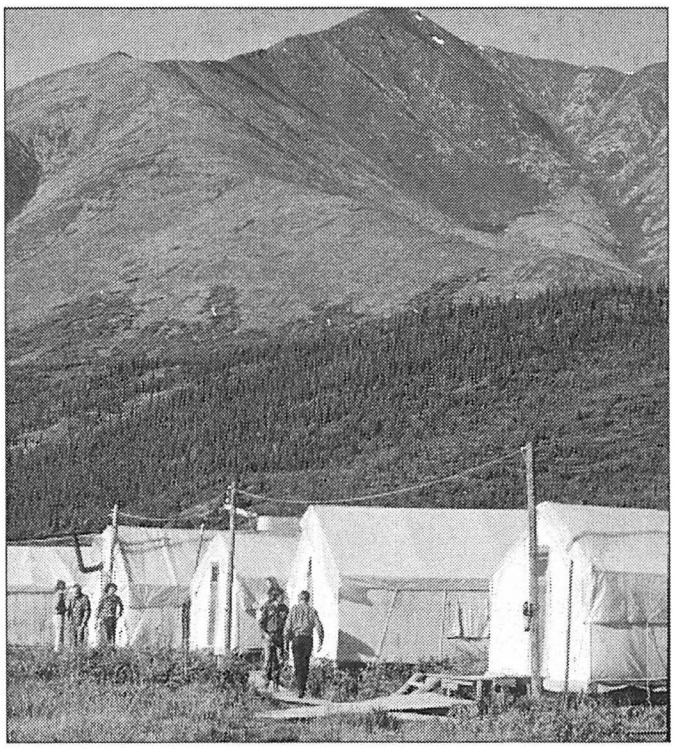
Geochemical maps from the Geological Survey of Canada show the locations of stream silt samples that have been analysed for metal content. These samples tell a prospector what rocks and minerals may be upriver of a certain place. If a sample is unusually high in a particular metal, there may be a deposit upstream from the sample location.

The Yukon Geology Program geologists offer technical information, maps, reports and logistical advice.

The Yukon Geoscience Forum in November, the territory's annual mining information exchange, is an essential conference for most prospectors. Mining companies and government geologists give presentations at the forum on recent and ongoing research, activities and findings.

Known Yukon mineral deposits are described in the Yukon MINFILE, which is available in booklet, diskette or CD-ROM. This, and other geoscience information products, can be purchased at the DIAND Exploration and Geological Services office in Whitehorse.

The DIAND library in the Elijah Smith Building (Whitehorse) carries a wide variety of publications on Yukon geology and mineral occurrences.



Rod Hill

FEASIBILITY STUDIES AND PERMITTING

It looks really good, good enough to open a mine...

After a significant ore reserve has been discovered and evaluated, a detailed feasibility study, often in several stages, will be carried out to determine if a property can be economically (profitably) mined. The start-up costs required to get a mine up and running are high and raising this money is often a critical factor. Like any other business, a mine must make a profit and show sufficient return on the investment for its shareholders.

The size of the operation, its life expectancy, the method of mining, a development plan, capital and operating costs, financing, and an energy source will be some of the many considerations examined during this feasibility study.

The regulatory permitting process, which includes an assessment of environmental impacts, is dependent on many of these considerations, so it is also carried out at this time.

A decision to mine or not is made at an early point in the feasibility study. This will be based on both economic considerations and the progress of environmental impact studies. The market values of the metals that would be produced by the mine are significant factors in this decision, yet extremely difficult to predict.

Potential mines do not open – and producing mines close down – if the price of their product goes below a certain level. If there is a decision to go ahead, more detailed feasibility studies will be carried out and the application for a water license will be made.

CONSTRUCTION AND PRODUCTION

Upon receiving a water license, the construction of the mine infrastructure will begin. A final production decision will be made during the construction phase.

How do prospectors make money?

Prospectors focus more on "grassroots" exploration, covering large areas and finding where promising indicators appear. Generally, they have limited funding and cannot completely assess a mineral property.

Often, prospectors will turn to a junior or major mining company and "option" a promising mineral property to the company. The option agreement allows the company to earn interest in the project by doing work on the property and paying option payments to the original claim holder (the prospector).

In most cases, prospectors need to raise money to look for mineral deposits. They earn revenue by selling the rights to further explore an interesting property or to mine a deposit.

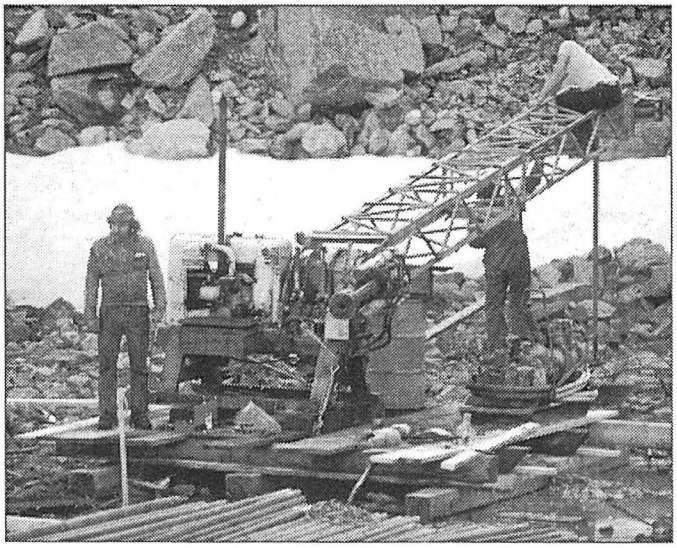
Prospectors can enter a wide range of relationships with a mining company, from selling an idea about an area, to selling mineral rights, to partnerships or grubstake agreements.

Only a small fraction of all mineral occurrences examined lead to the discovery of a mineable ore reserve and the establishment of a mine. Since 1898, two per cent of all mineral occurrences investigated have resulted in the development of a "producer" ranging in size from the Faro lead-zinc mine to small producers of jade.

Drilling

Diamond drills, which can drill to great depth (several thousand feet), produce cores of rock that can be analysed to determine mineral content. Drilling is expensive, so drill targets are chosen carefully.

An extensive drill program can be carried out to determine the extent and grade of a deposit and allow an ore reserve calculation. This determines, in part, the economic feasibility of mining that deposit.



Rod Hill

Working on a diamond drill.

RECLAMATION AND ABANDONMENT

When the ore body is exhausted, the buildings and equipment are removed. Reclamation is completed to encourage the area to return to a natural state.

There have been many changes in the regulations dealing with the environmental impact of mining in the Yukon. Companies must now provide plans and insurance that ensure reclamation work and mine abandonment will take place in a satisfactory manner.

In the Yukon, as in the rest of Canada, mines that have gone into production during the last five to 10 years have undertaken extensive research into reclamation and incorporated their reclamation objectives into their daily operations. With an abandonment plan in mind from the start, tailings, overburden and structures are dealt with in such a way that their final disposition is feasible and affordable. It makes sense for the environment – and it makes a lot of sense financially.

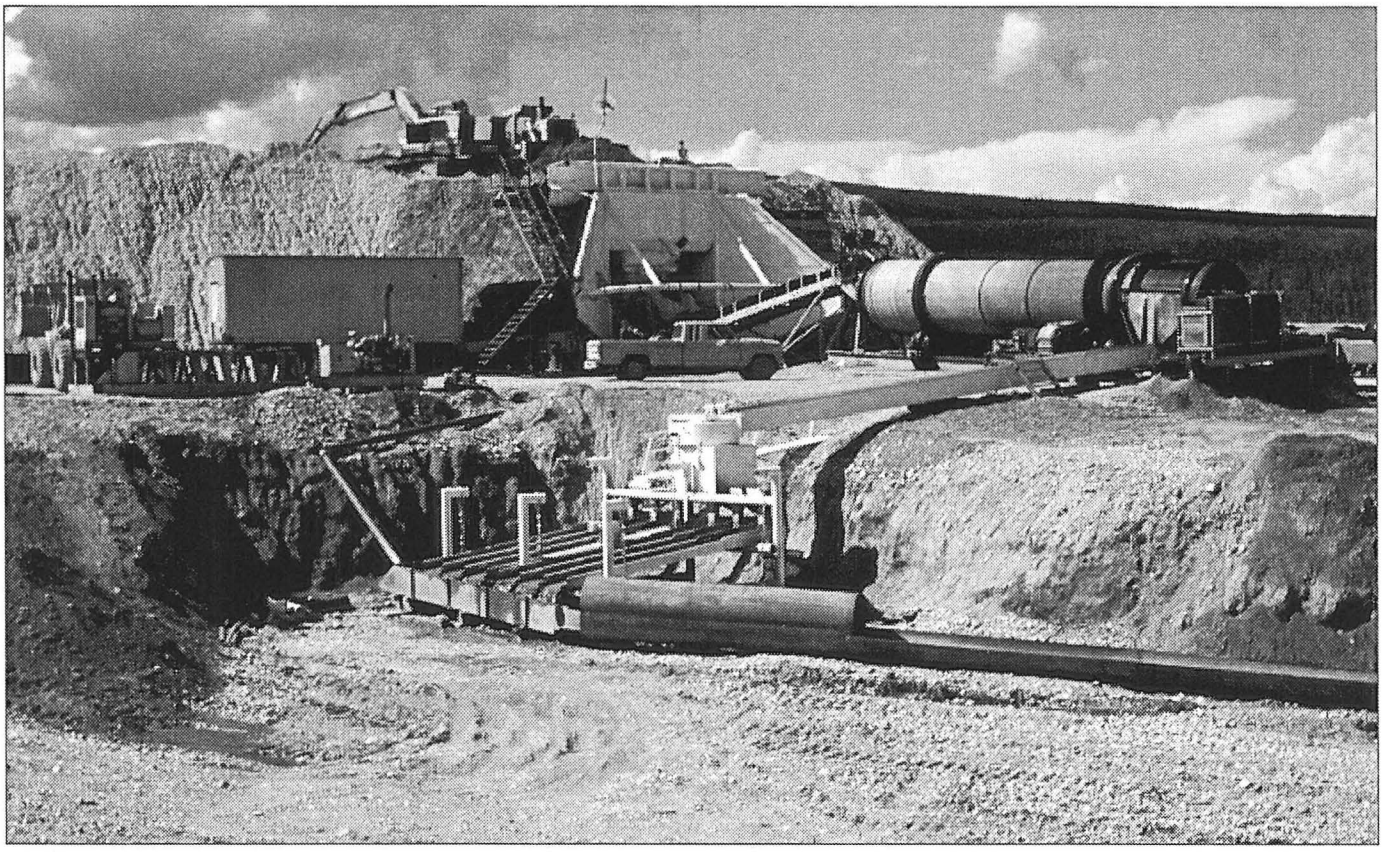
The reclamation of mines that opened before modern regulations were established is a difficult and expensive process, as is the case with many other past land uses. New regulations, and an overall expectation from the Canadian public, stress the importance of sound environmental management in the resource-based industries.

Industry is responding and changing. Canada is becoming a leader in reclamation technology and methods, bio-remediation and environmental research.

Rod Hill

Whenever possible, smaller and lighter excavators are used, in this case to sample a placer deposit (gold bearing gravel).

Placer operations can also involve construction and production planning, such as at this site on Hunker Creek, near Dawson City.



Jesse Duke

STAGES OF MINING

PERMITTING PROCESS STAGES		*YUKON PROJECTS*
	REGIONAL EXPLORATION	
	• Prospecting	*Finlayson Lake area*
	• Regional surveys	*McQuesten Intrusive Belt (Mayo to Dawson area)*
		Dawson Range Cu/Au Belt
	PRELIMINARY EXPLORATION	
	• Discovery of mineralization	*Wolf*
	• Delineation of mineral zone	*Division Mountain*
	• Magnitude of deposit	*Clear Lake*
		Grew Creek
Environmental baseline studies	**ADVANCED EXPLORATION**	*Hyland Gold*
	• Diamond drilling	*Marg*
	• Trenching	*Ice*
		Ketza River
	PRELIMINARY FEASIBILITY STUDY	*Mount Skukum/Skukum Creek*
Permitting process begins	• Ore reserves	*Wellgreen*
Company submits project overview	• Scale of operation	*Wolverine*
	• Development plan	*Fyre Lake*
Company submits Initial Environmental Evaluation (IEE)	• Capital costs	*MacMillan Pass – Tom, Jason*
	• Operating costs	*Howard's Pass*
	• Cash flow	*Casino*
	• Net present value	
	TEST MINING PROGRAM	
	• Sink shaft	
	• Obtain bulk sample	*Cantung*
	• Test ore continuity	*Silvertip*
	• Identify underground problems	*Dublin Gulch*
		Carmacks Copper
	FINAL FEASIBILITY	*Sa Dena Hes*
	• Similar to preliminary but more detailed	*Tulsequah Chief*
Water licence application	• Budget for operating and capital costs	*Kudz Ze Kayah*
	• Cash flow projection	
	CONSTRUCT MINE, MILL AND PLANT	
Water licence received		*United Keno Hill*
	PRODUCTION	*Minto*
		Cassiar
	RECLAMATION	*Brewery Creek*

JOBS: EMPLOYMENT OPPORTUNITIES IN THE MINING INDUSTRY

Images of a mine worker with pick and shovel in hand no longer apply to the changing mining workplace of today and tomorrow. A modern mine worker needs mathematics, computer technology and analytical thinking skills. Mining offers a variety of job opportunities for Yukoners. Each stage in the mining process opens the door for local employment.

Staking a claim or cutting line requires people experienced in working in the bush who have the ability to stay in remote camps for extended periods of time. First aid, map reading and compass skills are also important. As well, it is necessary to be in good physical condition.

Prospecting skills, acquired through years in the field, are still very important to mining companies who rely on seasoned prospectors to discover new mineral showings. Prospecting and exploration are basically detective work. Prospectors bring their own expertise and insight to a company's search for a resource.

Prospecting: a Yukon self-employment option

Anyone who is willing and able to work in the bush, and is enthusiastic about the challenge of searching for minerals, can be a prospector. You must first decide what minerals and what kind of deposit you want to discover. You need to decide what areas you are willing to work in and the distances you are willing to travel. There is a trade-off between easy access and unexplored ground.

Before exploring an area, visit a mining recorders' office to determine if the area is affected by First Nation land claims, or if it is already staked. Make sure you have looked at all available maps and reports. The library at DIAND is open for public research.

Staking a claim can be time-consuming and hard work. You only need to stake ground if you think you've found something significant or if you are worried about someone else staking it.

Camp cooks play a key role in any exploration program and for this reason they are usually well paid. If you have a bad cook, you have a problem!

Exploration requires many support services and people such as helicopter and fixed-wing pilots and mechanics.

There are opportunities for students and aspiring geologists to work with exploration geologists during the summer. The scientists in the Yukon Geology Program often hire student assistants.

Training opportunities can open up for Yukon people who are hired on as helpers. For example, diamond drillers are one group of workers still trained on the job.

Helicopter pilots work in remote areas.

Don Murphy

WHAT YOU CAN DO

statistician • process plant operator • floor hand • plumber • accounts payable clerk • materials clerk • truck driver • training supervisor • project manager • welder • human resources manager • occupational health and safety specialist • warehouse person • camp cook • geophysicist • market evaluator • geographic information system manager • mechanic's helper • mine manager • public relations officer • loader operator • first aid attendant • expediter • biologist • geologist • security officer •

Jeff Bond

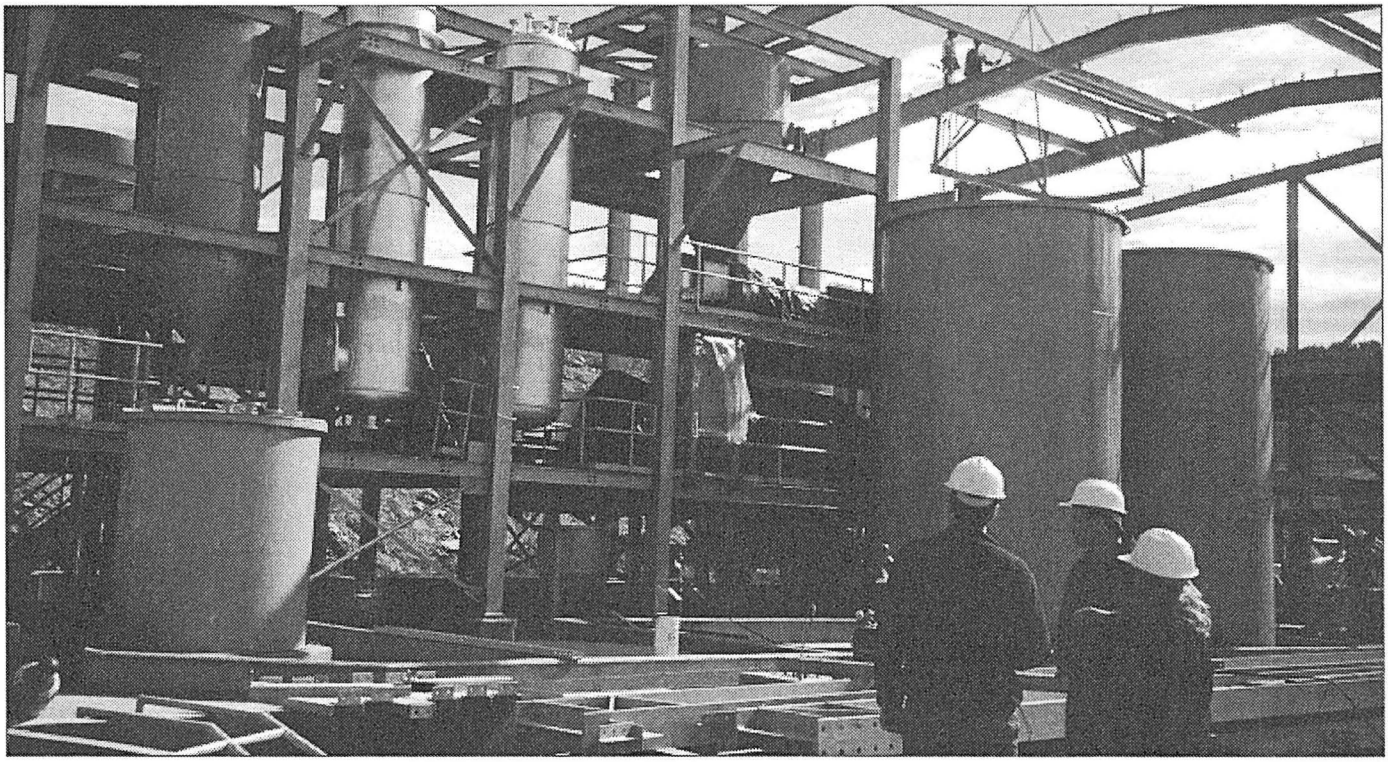
Jesse Duke

A new employment area is working with geographical information systems (GIS). Samples of soil, silt and rock are routinely collected during an exploration program. The people collecting this data use a global positioning system (GPS) to track the location of each sample. This information, as well as other data collected in the field, can be directly entered into computer databases.

If exploration reveals a potential mineral-rich deposit, the exploration company will hire surveyors to ensure that claims are in order and properly staked.

Once significant mineral resources have been confirmed, baseline environmental data will be collected. Biologists will identify what flora and fauna are in the area and study local ecosystems. Baseline information on creek water, such as natural pH, will be determined through a water-sampling program. Water quality and fish habitat will be inventoried.

Top: ***Float planes shuffle crews and supplies to exploration camps.***
Middle: ***Surveyors are needed at several stages during the life of a project.***
Bottom: ***Construction at the Brewery Creek Mine, 1996.***



Don Murphy

blaster helper • maintenance statistician • heavy equipment operator • geophysical technician • compressor operator • janitor • mechanical technician • environmental geologist • mining technician • scooptram operator • installation technician • cage tender • foreperson • personnel officer • lab technician • mill worker • assayer • instrumentation technician • claim staker • mining engineer • electrician • diamond driller • metallurgical technician • grader operator • power house operator • crusher operator • prospector •

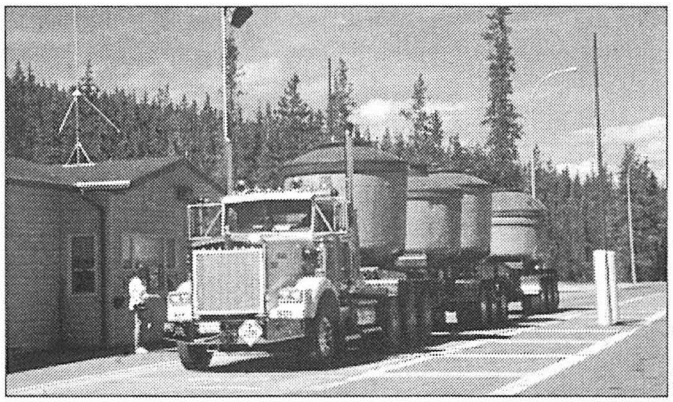
Once this baseline data is established, the condition of the environment can be monitored. Environmental assessment and monitoring are growing elements of the mining field.

Engineering firms design mines, test the construction designs, monitor the environmental impacts and plan for the reclamation of the site to its original state.

During the building and production phases, a variety of tradespeople are required including electricians, carpenters, millwrights, heating and ventilation technicians, truck drivers and backhoe operators.

Mills require system control people who can deal with the monitoring and automated equipment in a modern-day mill.

Many more Yukon people running their own businesses serve the mining industry. Construction companies are directly involved in building mills, roads, dams and dikes for mine sites. As with any large business, accountants, lawyers, clerical and secretarial services are required.



Yukon Government

The science of geology

Geologists study how the surface of the earth has formed over great time periods. It is like a jigsaw puzzle where important pieces of the story are discovered each field season. These discoveries enrich our lives by giving us knowledge about our planet. This is very important as it gives exploration geologists clues to where there might be important mineral deposits. The work of environmental geologists is to study and minimize the impact from mining.

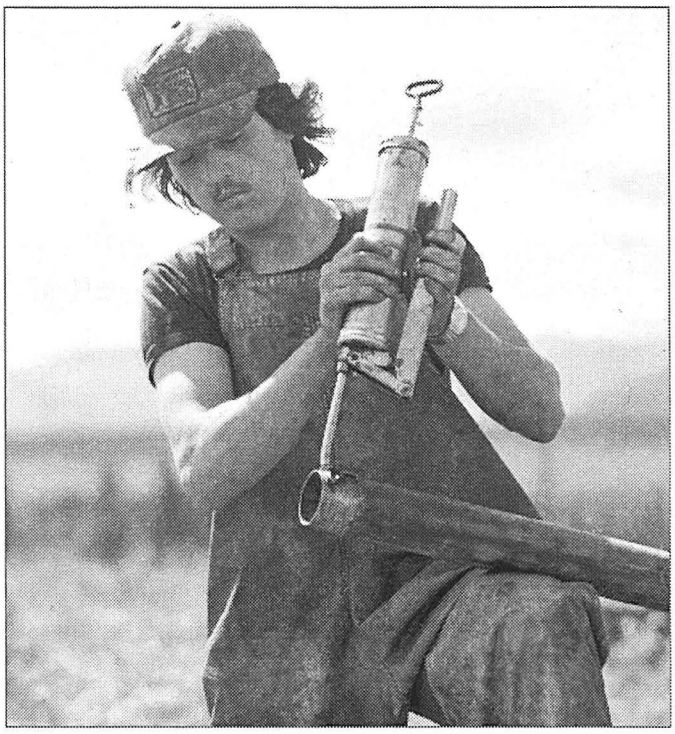
Top: ***Ore being transported to Skagway.***
Bottom: ***Geologist describing rock core samples.***

Yukon Government

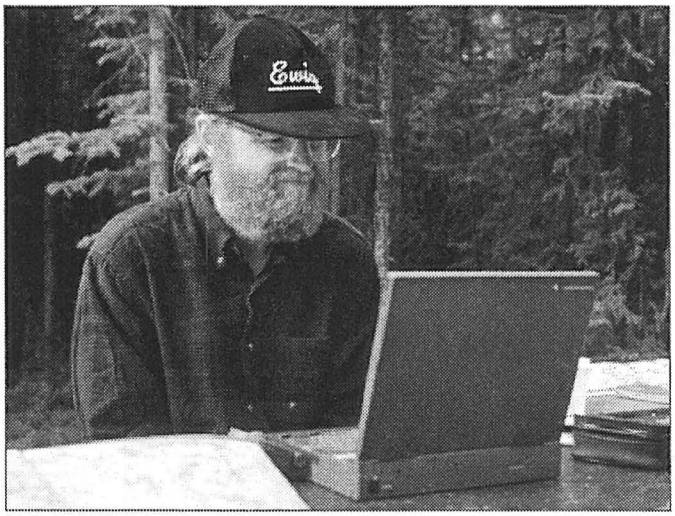
metallurgical engineer • water treatment plant operator • computer system analyst • camp manager • carpenter • chemist • environmental engineer • liaison officer • land agent • control room operator • derrick hand • millwright • mining supervisor • hydrologist • forklift operator • purchasing agent • labourer • market manager • equipment operator • industrial mechanic • finance manager • geochemists • plant shift supervisor • mill superintendent • investor relations officer • mechanical engineer •

Even after a mine shuts down, environmental technicians and engineers must complete monitoring and carry out reclamation work to prevent soil erosion and encourage the area to return to a natural state. Companies often hire contractors to carry out many of these jobs.

Top: ***Mining exploration crew member greasing the ends of drill pipes.***
Bottom left: ***Geologist entering data in the field.***
Bottom right: ***Geologists looking at rock cores.***



Yukon Government



Danièle Héon

Training opportunities in the Yukon

At different times, ***Yukon College*** *offers programs for entry-level mine training, including courses in industrial safety, tools, first aid, hydraulics, heavy equipment maintenance and welding. The majority of graduates find work.*

Mining companies may develop socio-economic agreements with First Nations. These agreements include training and employment opportunities.

The college program is aimed at providing this training and is often client-driven, tailored to different operations and communities. Residents of the community receive enrolment priority.

Often there is a hands-on component at the mine site. Carmacks-based sessions have held classes at BYC's Mount Nansen mine. The students learned how to use and maintain the company's equipment. This has also been done at Viceroy's Brewery Creek.

One Whitehorse session continued an extra six weeks after Golden Hill Ventures loaned its equipment to the program for practical training.

The ***Yukon Chamber of Mines*** *offers annual introductory and advanced courses in prospecting. These courses are recommended for people applying for funding through the* ***Yukon Mining Incentives Program****. A* ***Mine Training Trust Fund*** *has been created to ensure that both Yukon people and mining companies benefit from a trained local labour force. The fund is administered by the Yukon Chamber of Mines.*

Rod Hill

mine superintendent • archaeologist • journeyperson • accountant • environmental professional • nurse • dozer operator • geological technician • market researcher • surveyor • environmental technician • hoistperson • air controller • drafter • heavy-duty equipment mechanic • water truck driver • blaster • gas utility operator • secretary • survey technician • production and development miner • data entry technician • machinist •

MINING RESPONSIBLY: THE TIMES ARE CHANGING

The development of a mine impacts a relatively small area. In fact, less than 0.1 per cent of the Yukon is occupied by active mines.

To find mineable deposits, exploration must be carried out over extensive areas. Although less than four per cent of the land may be staked at a given time, a lot of those claims have no work done. Still, reducing the environmental impact of exploration is at least as important as ensuring the effects of mine development and production are negligible.

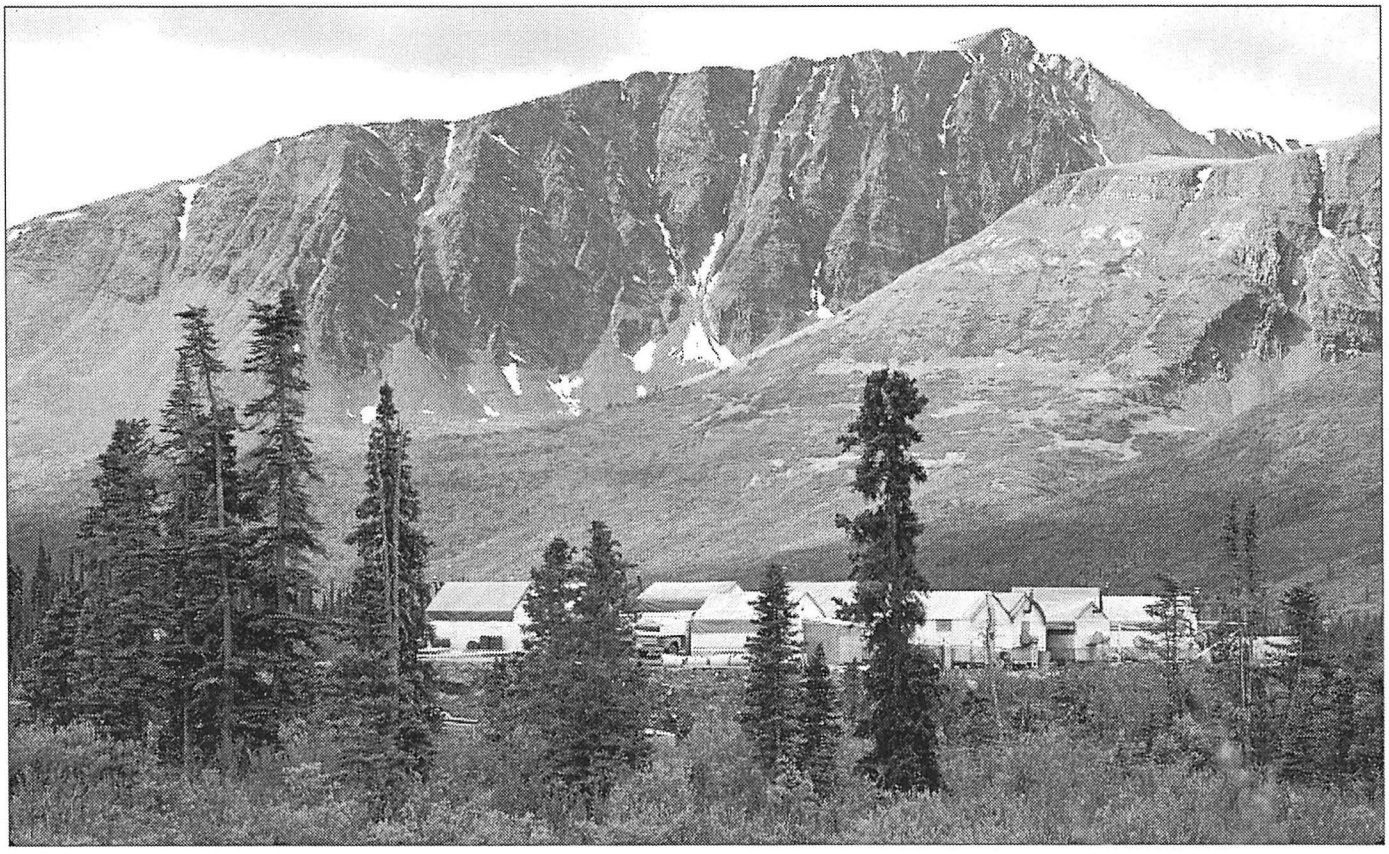
The new federal mining land use regulations now require environmental considerations. Many exploration companies have changed their operations independently of government regulations because of increased environmental awareness and improved technology.

Technological improvements include larger helicopters and smaller diamond drilling equipment. Until the late 1960s, diamond drills could not be moved by air. Instead, they were dragged through the bush, which involved cutting bulldozer access roads, creating access for other users at the same time.

Now, with larger helicopters and lighter drill equipment, the "footprint" left behind from drilling has gone from hundreds of hectares (the whole length of a road), to a few square metres. The risks of erosion are significantly reduced and new access roads are not created.

Another positive technological change involves the use of excavators instead of bulldozers for trenching. New small excavators offer many advantages over bulldozers. When trenching with a bulldozer, material must be pushed downhill and out of the trench, which is as wide as the blade of the bulldozer. However, the small bucket of the excavator can make a much narrower cut. It can remove the topsoil and set aside the organic material while digging

Mining exploration site in North Canol valley. Most mining camps now have no-hunting and no-fishing rules.



Yukon Government

deeper and piling the overburden on the opposite side of the trench.

When the trenching is completed, the material can be placed back in the order it was removed, helping to foster regrowth. The excavator leaves a smaller footprint which allows the vegetation to recover more rapidly and reduces the risk of erosion.

The excavators have much lower bearing pressure than bulldozers and do not destroy as much vegetation. They can be flown by helicopter, in pieces, into remote exploration sites, eliminating the need for access roads.

Diamond drillers are much more sensitive about the drilling products they use. There is an effort to use drill mud with biodegradable additives rather than those that are petroleum-based.

Yukon exploration companies are also very conscious of wildlife. If there is an area where sheep are lambing in early summer, it is left alone until later in the season. The same considerations are given during the fall caribou rut.

Garbage is burned every night or taken out. Camps are moved by helicopter. Pilots are given strict instructions to avoid wildlife. Many camps prohibit hunting and fishing.

The growing use of GPS units in surveying also reduces the amount of disruptions on the ground. These small portable devices use satellite signals to provide a geographical position.

INCREASED COMMUNITY CONSULTATION

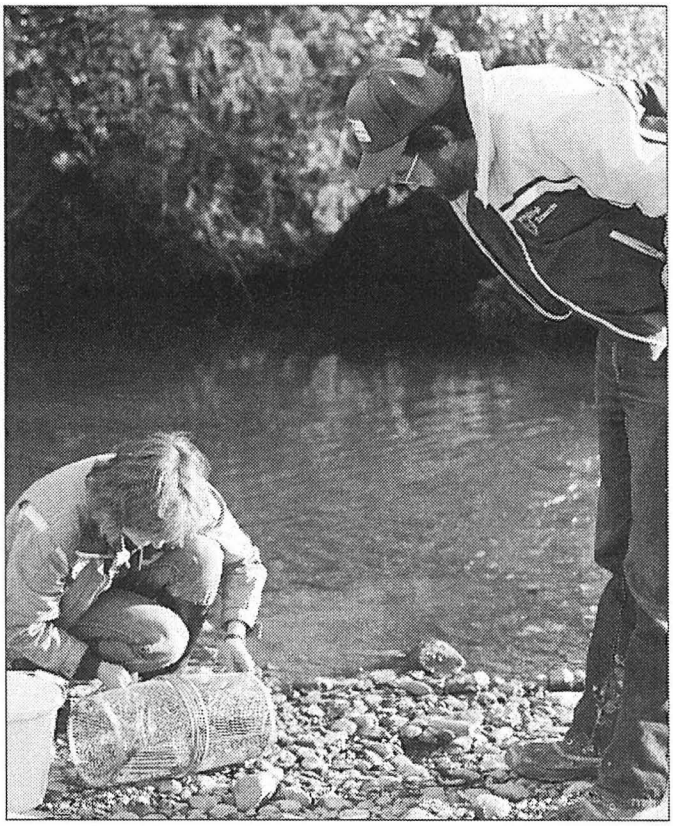
Exploration companies are also consulting more with First Nations, rural communities, outfitters and other user groups to minimize or avoid conflicts wherever possible.

At the end of the 20th century, the mining industry that is emerging is very different from that of even a decade ago.

CURRENT LEGISLATION

Several pieces of federal and territorial legislation directly deal with the mining industry. These are likely to apply to all mine development projects.

Impacts on water and fish habitat quality are part of the environmental studies undertaken.



Lee Pigage

New ways of mining mean less impact of the ground, less impact on the water and less impact on communities, including wildlife.

Yukon Government

MINING ENVIRONMENT RESEARCH GROUP

The Mining Environment Research Group (MERG) is a cooperative working group set up in 1998. It is made up of government agencies, mining companies, Yukon First Nations and non-government organizations for the promotion of research into mining and environmental issues in the Yukon. Participants bring their resources and knowledge to work cooperatively on mining environmental issues and projects.

An added feature of the research commissioned by the Mining Environment Research Group is that, in addition to the final technical report, the final project results must be provided in non-technical language. The results of research undertaken by MERG can therefore be disseminated to a broad audience, including the general public, First Nations and communities.

MERG members work cooperatively on several issues, including, but not limited to:

- the need to provide a mechanism to gather information specific to the Yukon natural environment,
- the need to focus on projects that identify best practices in mining activities that can reduce adverse environmental effects,
- the need to encourage projects and research that may identify solutions to potential problems before there are negative environmental effects, and
- the need to provide a forum for exchange of available information for the benefit of Yukoners or companies doing business in the Yukon.

MERG aims at providing a forum for members to use their resources and knowledge to work together on mining environmental issues and to identify priority areas for research.

There is also a need to coordinate projects which will provide useful information leading to increased confidence in predictions of environmental performance for the opening, operation and closure of mining facilities in the Yukon.

Project examples

- Comparison of native vs non-native cyanide degrading bacteria for cyanide detoxification, by Viceroy Resource Corp. and Microbial Technologies.
- Investigations into passive wetlands treatment of mine drainage to remove heavy metals at various sites at United Keno Hill Mine, central Yukon, by Laberge Environmental Services
- Assessment of long-term vegetation and site conditions at reclaimed Yukon mineral and coal exploration sites, by Mougeot Geoanalysis and S.P. Withers Consulting Services
- Adit ice plug prevention, by W.D. Mann Consulting
- Acid mine drainage kinetic testing, by Synergetic Technology/CESL Engineering
- Comparative analysis of best practices and environmental impacts of permafrost and freezing management techniques in northern climates, by the Yukon Conservation Society
- Winter low-flow stream measurements using the salt slug injection method, by Laberge Environmental Services
- Methods of encouraging natural vegetation succession and sustainable reclamation at Yukon mine and mineral exploration sites, by Laberge Environmental Services

When these projects are completed, the reports will be available on the Economic Development Branch web site (www.economicdevelopment.gov.yk.ca) and at all Yukon libraries.

- *Yukon Placer Mining Act* (federal) allows the staking of placer claims and leases.
- *Yukon Quartz Mining Act* (federal) allows the staking of mineral claims.
- *Canadian Environmental Assessment Act* (federal) requires an environmental impact assessment as well as a review of development projects that require federal approval, federal funding or federal disposition of land.
- *Territorial Lands Act* (federal) regulates land use activities. This act does not apply to mineral claims but will apply to the building or maintenance of access roads to mineral properties.
- *Yukon Waters Act* (federal) regulates water usage and controls the deposition of waste into Yukon waters, bridge and stream crossing. Because what happens to the land affects what is deposited in the water, provisions in water licenses often contain requirements related to the land, such as measures to stabilize waste dumps. The Yukon Territory Water Board is responsible for issuing water licenses.
- *Fisheries Act* (federal) provides for the protection of fish habitat, and alteration, destruction or disruption of fish and fish habitat including the regulation of stream crossings.
- *Yukon Mining Quartz/Placer Land Use Regulations* (federal) regulate the disturbances left by exploration programs and placer mining activities. Camp cleanliness and reclamation of trenches or mining cuts, roads and drillpads are mandatory and must comply with the regulations.

Depending on the size and type of the mine planned, the following regulations may apply or the following permits may be needed.

- Activity in areas identified or known to have special wildlife habitat values: permit issued under Section 4 of the *Wildlife Area Regulations* (federal). Environmental assessment is required.
- Activity in a migratory bird sanctuary: permit issued under *the Migratory Bird Sanctuary Regulations* (federal). Environmental assessment is required.
- Building or work such as bridges, dams, boom or causeway in, on, over, through or across any navigable water: the *Navigable Waters Protection Act* (federal) regulates such activities.

Jeff Bond

Top: ***A small exploration or prospecting camp has a very different impact on the land than a large mine site*** *(bottom).* ***Various acts and regulations, both at federal and territorial levels, deal with projects according to size and intensity of land use.***

Rod Hill

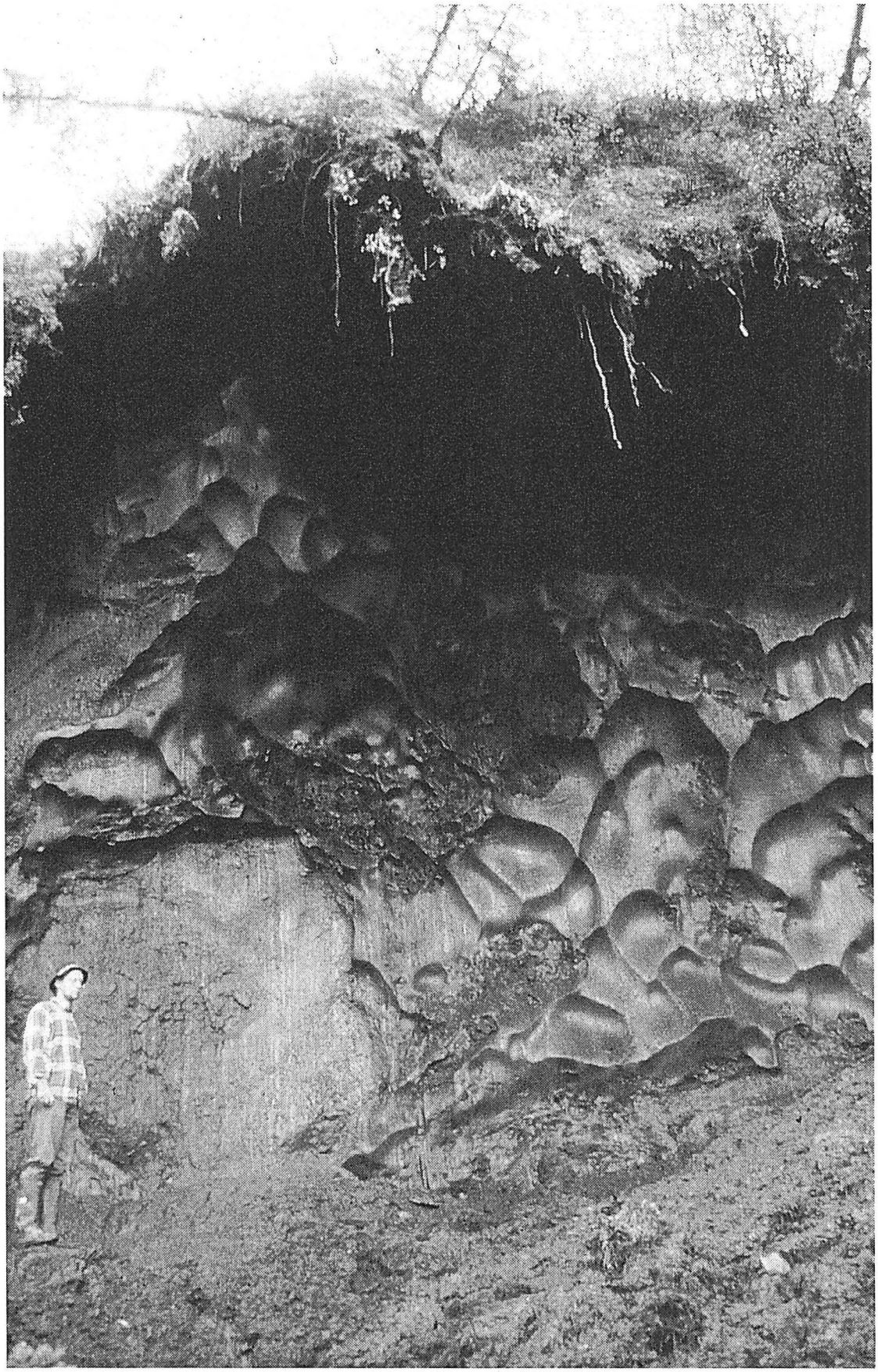
- The *Explosive Act* (federal) regulates permits issued for the storage or use of explosives.
- Approval to use, possess or import prescribed substance devices such as analyzers, chromatographs, calibrators, fixed and portable gauges, industrial radiography, logging, detectors, etc.: radioisotope license issued under the *Atomic Energy Control Act* and subject to the *Atomic Energy Control Regulations* (federal). Environmental assessment may be required

depending on the criteria listed in the *Canadian Environmental Assessment Act.*

- Approval to burn refuse: burning permit issued from April to September under the *Yukon Forest Protection Act* (Government of the Yukon). Environmental impact assessment is required.
- Approval to construct highway access: permit issued under *the Yukon Highway Act* which includes conditions regarding construction standards and gives permission to carry out construction (Government of the Yukon).
- Oversize trucking (concentrate hauling): *Bulk Haul Regulations* (Government of the Yukon).
- Archaeological, paleontological and historic site investigations in the field by an archaeologist: archaeological research permit issued under the *Yukon Archaeological Sites Regulations, Yukon Act* (Government of the Yukon).
- Fish and wildlife research and surveys: *Fish and Wildlife Research Permit* (Government of the Yukon)
- Aerial moose or caribou survey: *Sundry Permit under the Wildlife Act* (Government of the Yukon).
- Permit for fuel storage and handling and registration of stationary fuel tanks greater than 4,000 litres: special waste regulations under the *Environmental Protection Act* (Government of the Yukon).
- Operation of a diesel engine underground: permit issued under the *Blasting Regulations* (Government of the Yukon).
- Installation of plumbing in the camp: plumbing permit under the *Canadian Building Code, Building Standard Act and Regulations* (federal).
- Building permit for areas not included in municipal bylaws: building permit must meet criteria under the *National Building Code of Canada, Building Standard Act and Regulations* (federal).
- Electrical approval: electrical permit, must meet *Canadian Electrical Code, Electrical Protections Act and Regulations* (federal).
- Mixing and dilution, generation, handling, release or disposal of large quantities of special wastes: special waste permit issued under the *Environment Act* (Government of the Yukon).

Mining in the 1890s was done differently than today. Legislation regarding mining projects has also changed to deal with environmental concerns.

Government of the Yukon



Permafrost is a special consideration for mining projects. Very thick ice bodies are encountered in many parts of the Yukon, including here at a placer cut in the Hunker Creek area near Dawson.

C. Mougeot

MINING RESPONSIBLY

As society has become more environmentally aware, so has the mining industry

by Hugh Copland, Engineer of Mines, Mining Development, DIAND

Mining and the environment are often seen as polar opposites. But as society has evolved into a more environmentally aware community, so has the mineral industry. The situation in the Yukon is no exception.

Exploration and mining activities in the territory are permitted and monitored by the federal government. At the exploration stage, activities are governed by the new mining land use regulations under the *Yukon Quartz Mining Act*. This legislation ensures that environmental disturbances created by mining exploration activities are minimal and any adverse impacts are dealt with.

Increased use of helicopters and other advanced geophysical technologies ensure that mining activities leave a negligible impact. Indeed, significant ore deposits have sometimes been located without anybody ever having set foot on the ground.

Companies that wish to construct a mine go through a rigorous assessment procedure under the *Canadian Environmental Assessment Act*. First, baseline studies are undertaken to collect information on the natural characteristics of the general area. These include water quality, fisheries, wildlife, vegetation and traditional land uses. Baseline studies are important because they help determine the effects a mine may have on the environment once it is operational.

An environmental review committee, comprised of First Nations and federal/territorial government agencies, then examines the information. Public meetings are often held in communities closest to the project. The mine will only proceed to the licensing stage after the environmental review committee has reviewed the baseline studies and mine plans, and the federal government is satisfied that environmental effects will be negligible.

An important part of the environmental assessment is the abandonment and reclamation plan submitted by the mining company. This plan sets out how the land will be restored after the mine shuts down.

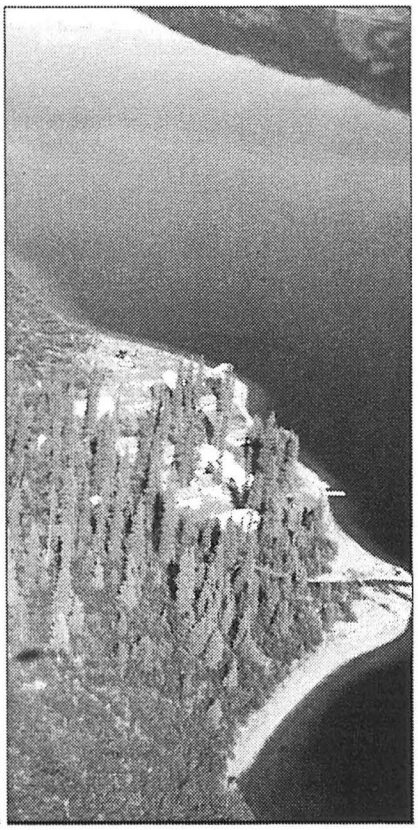
The preferred solution of both mining companies and the public is a "walk away" scenario, where the land is revegetated and no further maintenance is required. In some cases, mining companies, nearby communities and traditional land users may wish to develop reclamation plans that allow for a different use of the land.

For example, the City of Whitehorse has been using abandoned open pits from the old Whitehorse copper mine as landfill sites for a number of years.

Improved wildlife habitats, recreational opportunities or other industrial uses are all feasible post-mining land use options.

The fragility of the northern environment makes mining and reclamation an even more challenging aspect of mine planning in the Yukon. Proven southern procedures may not necessarily be a panacea in the north. For example, the heap leach process is common in the southwestern United States and in South America. In the Yukon, the Brewery Creek mine is the northernmost heap leach operation in Canada. Here, extreme winter temperatures have necessitated several design changes compared to southern heap leach pad operations.

The delicate balance between environmental protection and utilization of natural resources is always a challenge, especially for operators in the north who are continuously overcoming difficulties. With innovative thinking, technological advancement and an open dialogue between companies, government and the public, mining can maintain a balance with the environment that benefits all northerners.



Jesse Duke

Fyre Lake exploration camp.

First Nations and mining

Yukon First Nation people have been closely associated with the mining industry since its beginnings. Skookum Jim, Tagish Charlie and their American partner, George Carmack, are credited with making the discovery which started the Klondike gold rush.

Industry, governments and First Nation communities are gaining a better understanding of each others' needs and concerns by forming partnerships and working together. It is important for companies operating in the Yukon to work with First Nation governments to ensure that the economic benefits of mineral development are shared. As well, partnerships make it possible for exploration and other industrial activities to occur in conjunction with traditional land use.

There are 14 First Nations in the Yukon. Under the Umbrella Final Agreement, eight self-government agreements have been signed and negotiations continue on the remaining six.

BYG Natural Resources and the Carmacks/Little Salmon First Nation joined forces to create an analytical laboratory and exploration company.

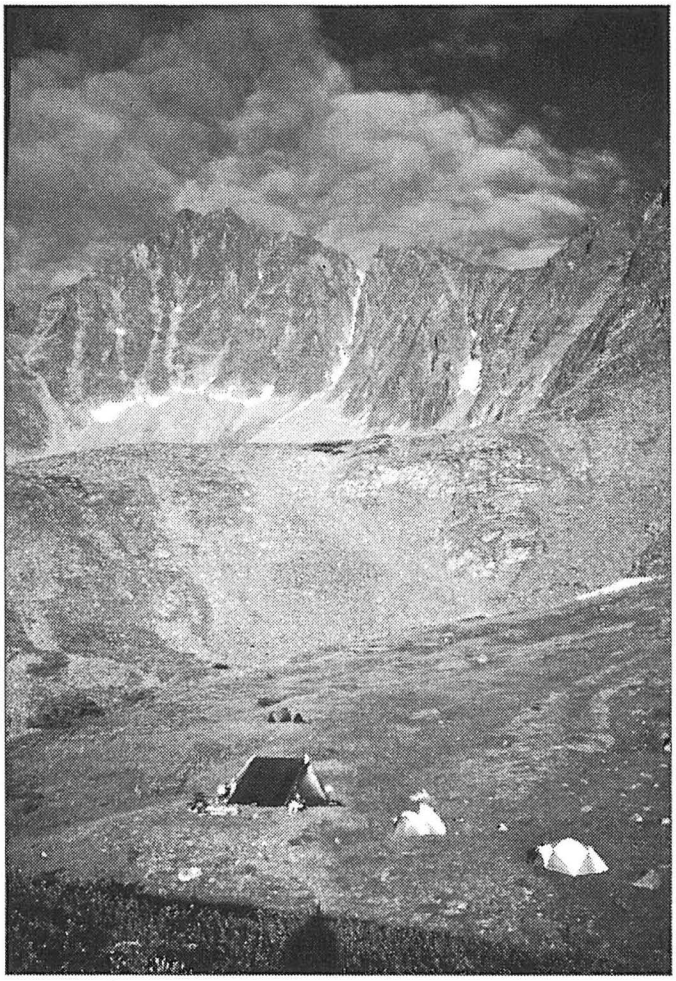
Tr'ondek Hwech'in Development Corporation, a First Nation company, built the access road to Viceroy Resource Corporation's Brewery Creek mine.

Ross River Dena Development Corporation has been very involved in the mining sector at the Anvil Range mine in Faro and the development of the Wolverine deposit. It is also working closely with Cominco to plan the development of the Kudz Ze Kayah property.

Nacho Nyak Dun in the Mayo area is working with United Keno Hill on mining opportunities.

Selkirk First Nation will see the first mining development on settlement lands in Canada. Minto Explorations Ltd. is developing a copper mine west of the Yukon River from Minto Landing. A socio-economic agreement with the First Nation provides employment and business opportunities at the mine.

It is important to note that final resolution of land claims has not been a condition for establishing a successful working relationship between a First Nation and a mining company. These agreements include elements about specialized training, scholarships, contracting opportunities, protection of traditional lifestyles and the environment.



Jeff Bond

Top: ***Government geologists who build bedrock geology maps and models often work in the field for several months at a time. This camp is near Antimony Mountain.***
Bottom: ***First Nation family.***

Yukon Government

RECLAMATION AT THE DIVISION MOUNTAIN PROPERTY

"When you design an exploration program with the idea of reclamation in mind, it is not as physically difficult or as expensive as you would think," said Rob Carne, an exploration geologist with 26 years of experience in the Yukon. Carne is a partner with Archer Cathro and Associates, an exploration consulting company which has operated in the Yukon for 32 years.

Carne is also the president of Cash Resources Ltd. and is in a good position to speak about the expense of reclamation on exploration projects. Cash Resources owns the Division Mountain property located about 90 kilometres northwest of Whitehorse. The property is estimated to contain 52.9 million tonnes of near surface, low sulphur thermal coal. Cash Resources worked on the project from 1992 to 1998.

Federal mining land use regulations (MLUR) under the *Yukon Quartz Mining Act* now ensure that environmental disturbances created by mineral exploration are minimal and that any adverse impacts are dealt with. The regulations set reclamation requirements for mineral exploration on quartz claims which were previously exempt. Prior to the introduction of MLUR, coal exploration was covered by the *Territorial Lands Act* and Cash Resources underwent a full permitting process.

If reclamation is not part of the exploration and planning process, it can be very expensive and difficult. From the beginning, the exploration program at Division Mountain was designed with reclamation in mind. "You can design your program to minimize the impact and the reclamation that will be required," said Carne.

Before Cash Resources built roads over areas underlain by permafrost, all the trees were cut with a chainsaw at ground level and removed. Every effort was made to preserve the ground cover vegetation so it would insulate the permafrost. "We have been driving on this road with pick-up trucks for three summers now and the permafrost is still there," said Carne, "because we took every care to not disturb the insulating moss mat."

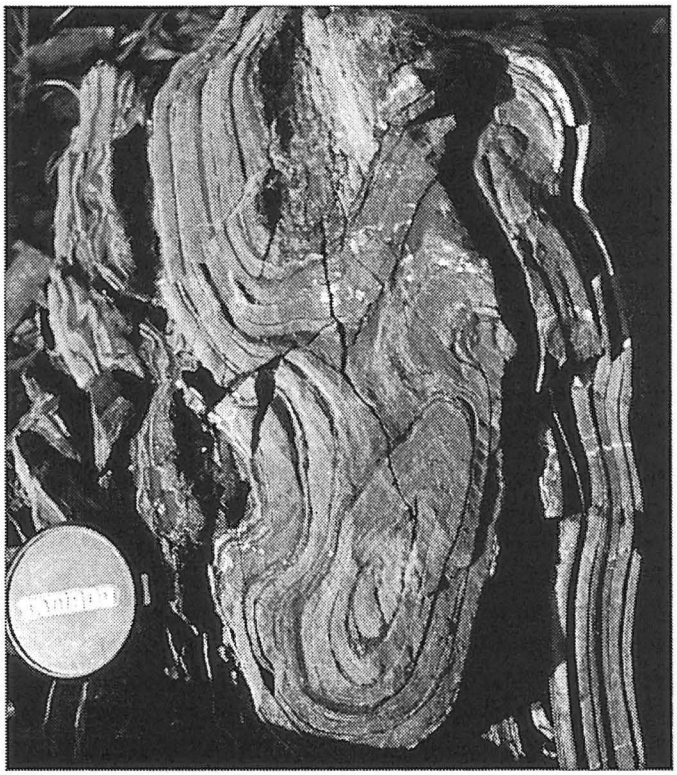
In the case of temporary roads used to access drill site not underlain by permafrost, an excavator was used to put the moss, trees and shrubs back over the surface. This sheltered new grass, encouraged its growth and prevented access in the winter.

In another situation, trenches were dug on drier ground during the summer to find coal seams which tended to be located under two to three metres of glacial till. In recent years, excavators, instead of bulldozers were used for trenching. Bulldozers can only push a wide swath of material downhill and cannot easily pull the material back into the trench. However, the narrow excavator bucket sets topsoil on one side of the trench and subsoil on the other and places the material back in the trench in reverse order. The area of disturbance is not much wider than the one metre width of the bucket, and the area will revegetate quickly because organic matter and roots are placed back at the surface.

"Carried out in conjunction with exploration, reclamation should add no more than five per cent to your budget," said Carne. "It makes sense financially, and it significantly reduces short and long term impact of exploration projects."

Monkshood.

Lee Pigage



Don Murphy

Top: ***Contorted calcareous shale and siltstone, Clinton Creek area.***
Bottom: ***Sluice boxes come in all sizes and are an essential part of the processing of placer gravel.***

William LeBarge

PORTRAIT OF AN ENGINEER... Randy Clarkson

Whitehorse mining engineer Randy Clarkson spends a lot of time on airplanes. He takes with him tiny flakes of gold kept in a small lead-lined box. That gold has been mildly irradiated at the Slowpoke research reactor at the University of Alberta in Edmonton. Randy has taken this gold to placer mines in Guyana and Dawson City, and to a hard rock mill in northern Ontario. He uses it to evaluate the efficiency of sluice boxes to recover fine gold particles.

Randy feeds his tiny sample of irradiated gold into the head of the sluice box. Using a device called a scintillometer, he can measure accurately how much of the gold is recovered at the end of the sluicing process. If the sluice box is working correctly then all of the gold will be recovered in the collection area. If it isn't, a very precise estimate of the box's efficiency will be provided. Modifications to the sluice box can be made and it can be tested again.

Despite a rigorous inspection and licensing regime, radiation is a word that automatically triggers alarm. The gold that Randy uses is mildly radioactive. It has a half-life of 2.7 days and can be used for testing for approximately two weeks. After two months, its radiation level is back to normal. The average sample used weighs less than a gram and virtually all of it is retrieved in the course of a test.

Randy Clarkson started to test the gold recovery of sluice boxes in 1988 at the request of the Klondike Placer Miners Association. The first year, he used conventional methods which involved several people, D-9 Cats, and huge volumes of water. The following year, Clarkson came across a research thesis describing the use of nuclear tracers for similar tests. The method described in the thesis was improved and tested in the Yukon gold fields in 1989. Tests revealed that some mines were actually losing more gold than they were recovering while others were operating extremely efficiently.

This technology is now used world-wide. There is also a definite ecological advantage in knowing that an area has been mined in an efficient manner. For example, gravel tailings in the Dawson area are sometimes reworked with more sophisticated equipment in the hope of finding gold left behind by the previous generation of placer miners. Effective reclamation is much more likely to be successful if an area is considered mined out.

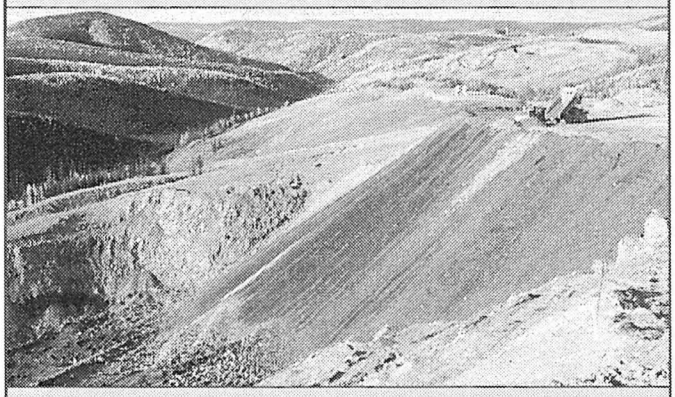
ROBERT E. LECKIE AWARD FOR OUTSTANDING RECLAMATION PRACTICES

awarded by the Department of Indian and Northern Affairs

For reclamation and site restoration efforts that go well beyond what is required by law, either by reclaiming land for which they had no obligation to reclaim, adding features to the land that enhanced the area and local community or returning mined land to a condition that is not only sound but aesthetically pleasing.

1999 WINNERS

HARD ROCK MINING AWARD
Viceroy Minerals Corporation
Brewery Creek Mine, Yukon



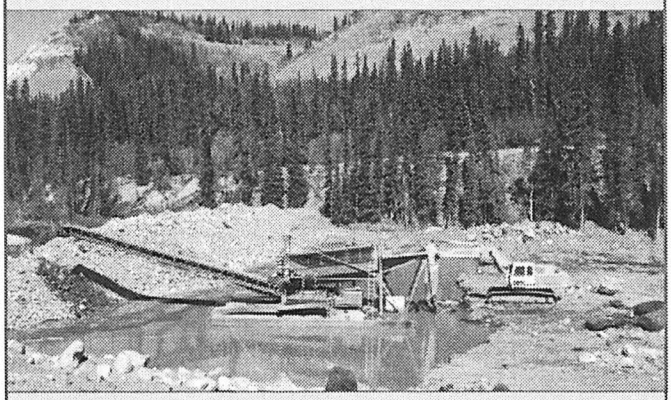
1997, active mining operations Canadian Zone waste dump.

1999, Canadian Zone after reclamation, beginning of revegetation.

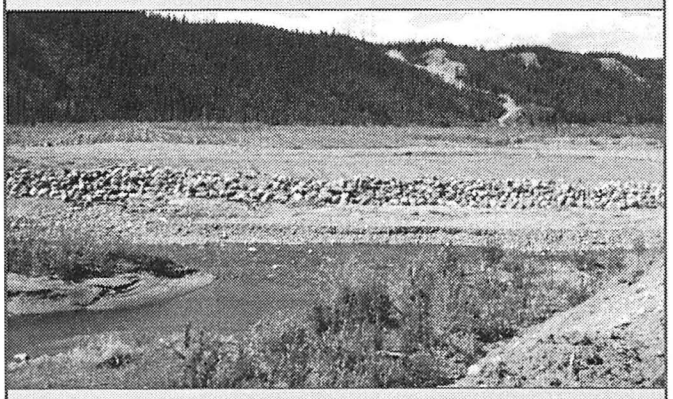
Viceroy Minerals Corporation won the 1999 Robert E. Leckie Award for its ongoing reclamation work on the Brewery Creek goldmine near Dawson City, Yukon. Viceroy has involved community and First Nations in the development and reclamation plans for the mine site from its earliest inception. Their first reclaimed pit is a credit to the research and planning that went into leaving the mined lands in a state that fits naturally into the surrounding valley. Restoration is a staged, on-going process and to date the majority of the company's first pit and waste dump has been reclaimed.

Photographs this page courtesy of Yukon Chamber of Mines

PLACER MINING AWARD
Al Dendys. Tic Exploration
Gladstone Creek, Yukon



Floating dredge in operation.



After reclamation, prior to natural revegetation.

Tic Exploration captured the the 1999 Robert E. Leckie Award for its placer mining reclamation practices on Gladstone Creek. Al Dendys has been mining on Gladstone Creek using two floating trommels and wash plants. The large-scale disturbance resulting from an operation of this size has been mitigated by excellent restoration work. The most impressive characteristic of this work is how quickly it follows extraction of the ore. Immediately following work in any given area, the tailings have been levelled, re-contoured and covered with fine material stockpiled during the preparation of the mining cut. To date, this is the finest example of progressive restoration work in the Whitehorse Mining District.

RECLAIMING THE LAND, PROTECTING THE WATER: PLACER MINING IN THE NEW MILLENNIUM

Increased environmental awareness has challenged the placer mining industry in the Yukon to meet ever better environmental standards. Placer mining is an important part of the Yukon's economy, directly supporting more than 600 families, as well as many service businesses. Placer claims occupy less than 0.5% of the Yukon land base; of this, less than one third is mined after initial exploration.

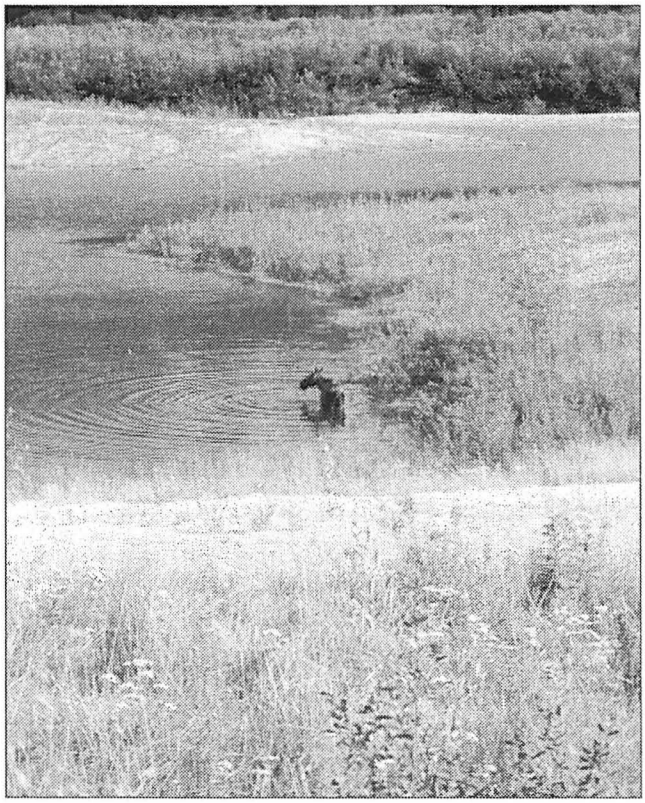
Placer mining in the Yukon is now regulated by a dual permit process: a Mining Land Use Permit and a water license.

LAND USE PERMIT

Over the last decade there have been many changes in the regulations dealing with the environmental impact of mining in Yukon. In December 1999, the Placer Mining Land Use Regulations (MLUR) came into effect and formalized reclamation standards for all exploration and mining activities on placer claims and leases. The new regulations ensure that all mining land use activities receive appropriate environmental screening and comments from stakeholders prior to receiving approval.

Placer exploration and mining activities are divided into four classes, based on increasing potential to have adverse effects on the environment. Classes are designated by specific thresholds for various activities such as: area of overburden to be disturbed, volume of trenching, length of road or lines constructed, number of person days per camp, and amount of fuel storage. If an activity exceeds any one of the thresholds, it is considered under a higher class and receives a more rigourous environmental screening. Class I includes grass roots prospecting activities such as camps with less than five people. Operating placer mines receive the highest level of environmental screening and must have a Class IV approval.

The most important component of this new permitting process is planning. Well thought out operating plans are good for protecting the environment and good for sound financial planning for placer miners. All class III and IV activities require a clear and detailed operating plan for either exploration or mining. The plan must include all activities to be undertaken, how and when reclamation will be carried out, and how any adverse effects will be mitigated.



Tara Christie

This lake was created in 1991 by miners as part of the reclamation work. Moose frequent it to eat the weeds.

With proper planning, reclamation can often be carried out progressively as part of ongoing mining and can be made more affordable and feasible. This is particularly important for small placer mines, which generally have limited equipment and resources.

The objective of reclamation is to leave the land in a condition of comparable utility for wildlife or humans as it was prior to disturbance, and where revegetation will occur naturally and rapidly. MLUR provide guidelines for best practices for the many aspects of reclamation such as re-contouring hillsides and banks, preventing long-term erosion, slumping and subsidence, and allowing for the re-establishment of the vegetative mat. Other aspects of reclamation include the removal of garbage and waste. Some placer miners have shown

their commitment to the environment by the clean up of garbage and scrap metal that has been abandoned by "older" mining operations or residents.

Mining inspectors from Indian and Northern Affairs must confirm that reclamation has been completed satisfactorily before the final abandonment of a property. Operators can no longer leave reclamation of the land until the final stages of mining. In order for a placer mine to be allowed to continue operating, inspectors must see ongoing efforts at reclamation in accordance with the mining plan.

WATER LICENCE

The release of fine sediment from placer mines was identified as an environmental concern as early as the late 1960s.

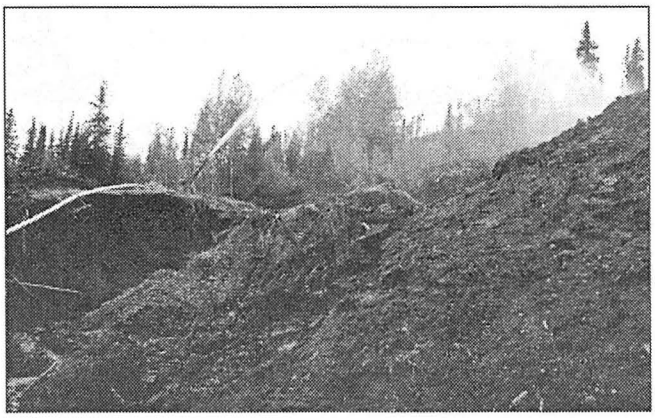
Regulations in evolution

Discharge from placer mining first began to be monitored after the establishment of the Yukon Territory Water Board (YTWB) in 1970. In 1986, government and industry began the process of developing regulations which would provide protection for fish and fish habitat, while giving the industry certainty. The process resulted in the Yukon

REVEGETATION AT WORK

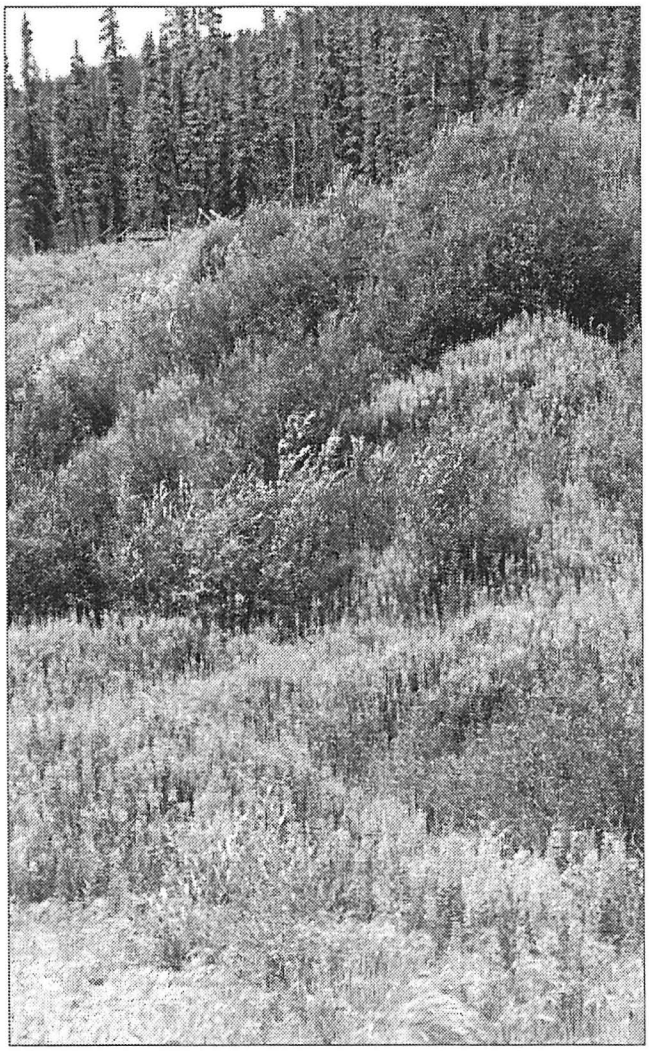
Revegetation takes place rapidly in most placer-mined areas, particularly on old ponds, fine tailings and re-contoured overburden. Within one to two years, native plants and grasses usually form an initial ground cover on fine-grained surfaces. Various types of willows are often the next pioneering shrub to grow in previously mined areas. These species provide a stabilized surface, prevent erosion and provide cover for wildlife within a very short period after mining.

Depressions such as old ponds, reservoirs or reclaimed mining cuts often fill with water providing wetlands for ducks and migratory birds. Huge flocks of sandhill cranes on their migration south have been noted to rest and overnight on open unfrozen ground occupied by settling ponds and placer tailings. The tender willows found in mining areas and tailing ponds are favored locations for browsing moose.



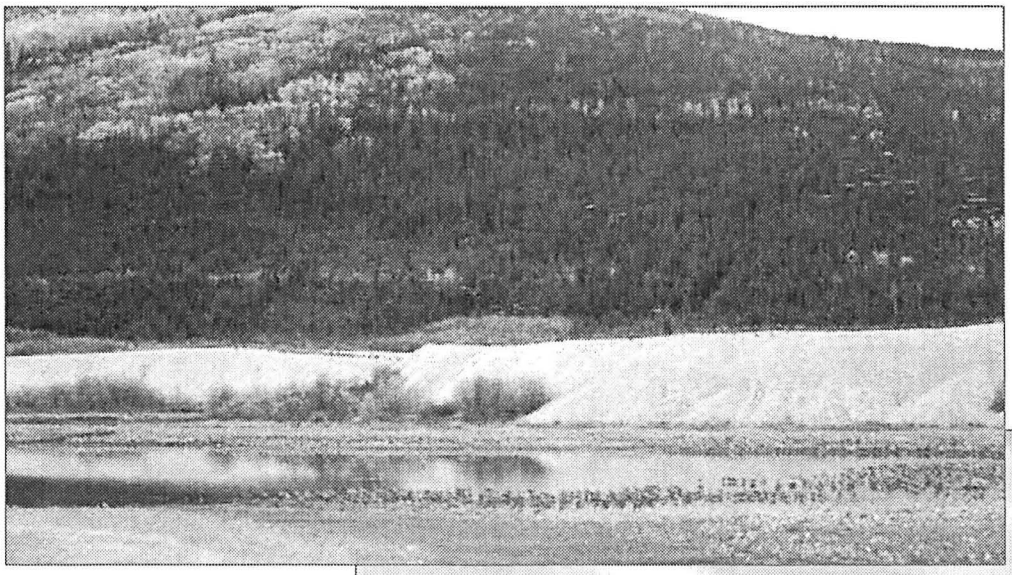
Mike McDougall

Bench during hydrolic stripping in 1986.



Mike McDougall

Same area in August 1991, five years after revegetation.



Tara Christie

Tara Christie

These sandhill cranes flew overhead in the fall of 1999. They landed on settling ponds, reclaimed ponds and frozen tailings piles over at least 4 km of Lower Dominion Creek (from the confluence of Gold Run to the confluence of Eureka.)

Fisheries Protection Authorization (YFPA) being established in 1988, followed by the Yukon Placer Authorization (YPA) in 1993. The YPA is based on scientific principles to protect fish from the negative effects of placer sediment, and provides for the protection, compensation, restoration and alteration of fish habitat. The YPA was also designed to meet the resource management requirements of the Canadian Environmental Assessment Act (CEAA) and the Final Umbrella Agreement of the Yukon First Nations.

Under the YPA, placer miners are required to apply for a water license from the Yukon Territory Water Board (YTWB), which requires detailed plans for water use, sediment discharge and stream and land reclamation. In 1999, the Yukon Placer Mining Land Use Regulations (MLUR) came into effect to provide environmental screening and formal reclamation standards for all exploration and mining land use activities on placer claims and leases, including activities that may not require water licenses.

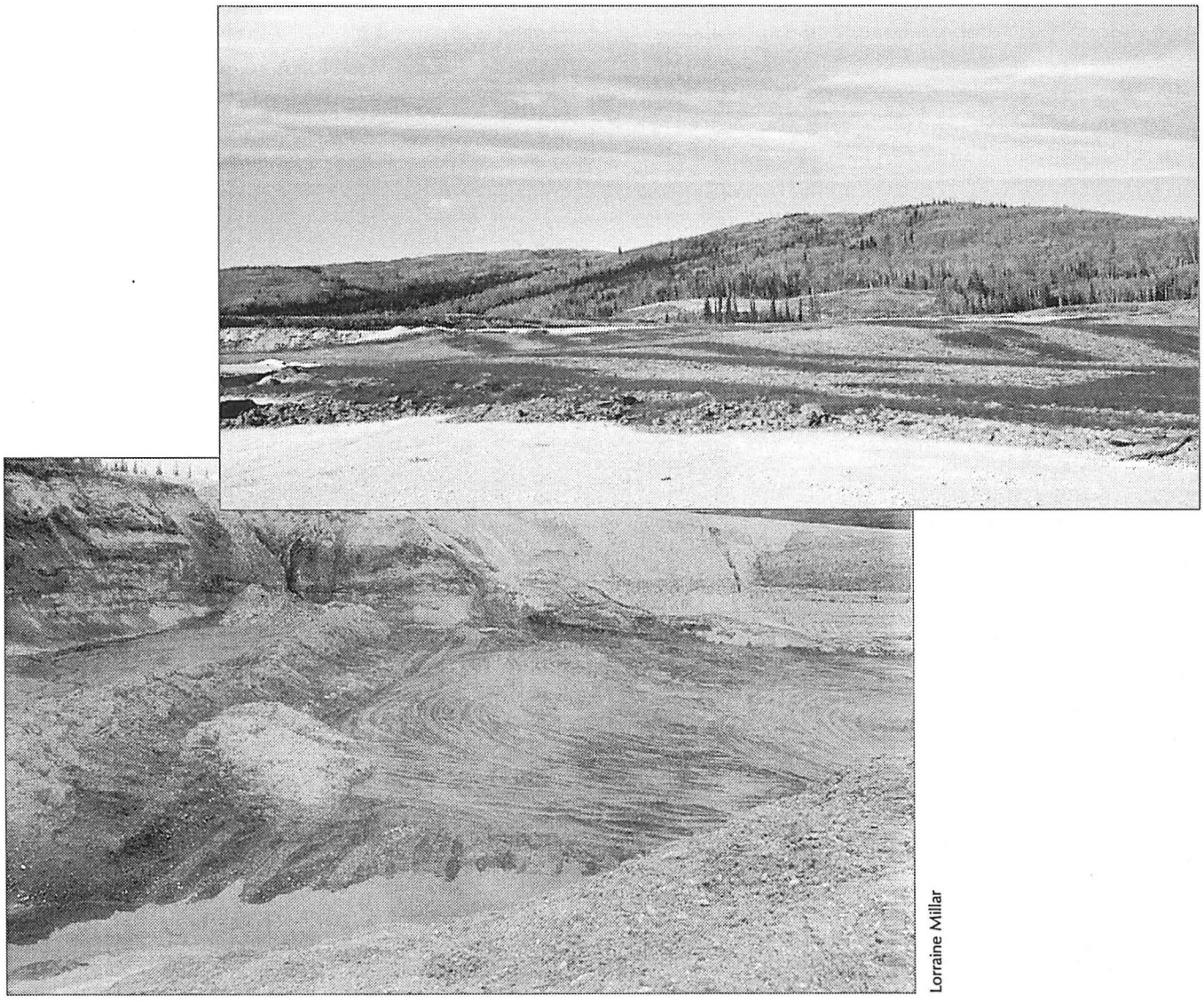
Water licenses set the allowable sediment discharge, limit the maximum rate of water use and restrict the type of mining in or adjacent to streams. It also requires the settling or removal of suspended sediment in discharge water and requires the stabilization of tailings and stream channels. The miner must provide detailed plans for diversions, drains, and the construction of settling ponds. All water licenses for placer mining require public hearings.

In order to manage streams and determine allowable discharges under the YPA, streams were classified into

five types based on their sensitivity to water quality and their fish producing capability. Type I streams sustain spawning and incubation of salmon, trout and char populations. Type II streams may support rearing salmon, trout and char. Type III streams support other freshwater species, but are not associated with salmoids. Type IV streams support past or present mining and are not seen to be important for the maintenance of fish populations. A Type IVA stream has fish(non-salmonid) and a Type IVB stream does not have fish. Type V streams (over 95% of Yukon streams) are unclassified and little is known about their fish populations or placer mining potential. A Type V stream must be assessed and classified to determine the level of habitat protection required before a mine can operate on it.

Can fish and placer mining share the same stream?

Management of Type I, II, and III streams requires compensation for the disruption of important fish habitat before mining commences. On Type IV streams, the restoration of fish habitat is required after mining is completed. With the implementation of the YPA, new allowable sediment discharge standards were established. Discharge standards were set considering the sensitivity of the specific streams as determined by their classification. Streams with high sensitivity and fish values would be protected so that their productivity would not be decreased. Any portion of a stream identified as having fish or fish habitat needing protection is assigned an allowable concentration of sediment from placer



Lorraine Millar

Lorraine Millar

Bottom: ***Large placer mine (Ross Mining), before reclamation, August 1996.*** *Top:* ***Same mine, after reclamation, 1999.***

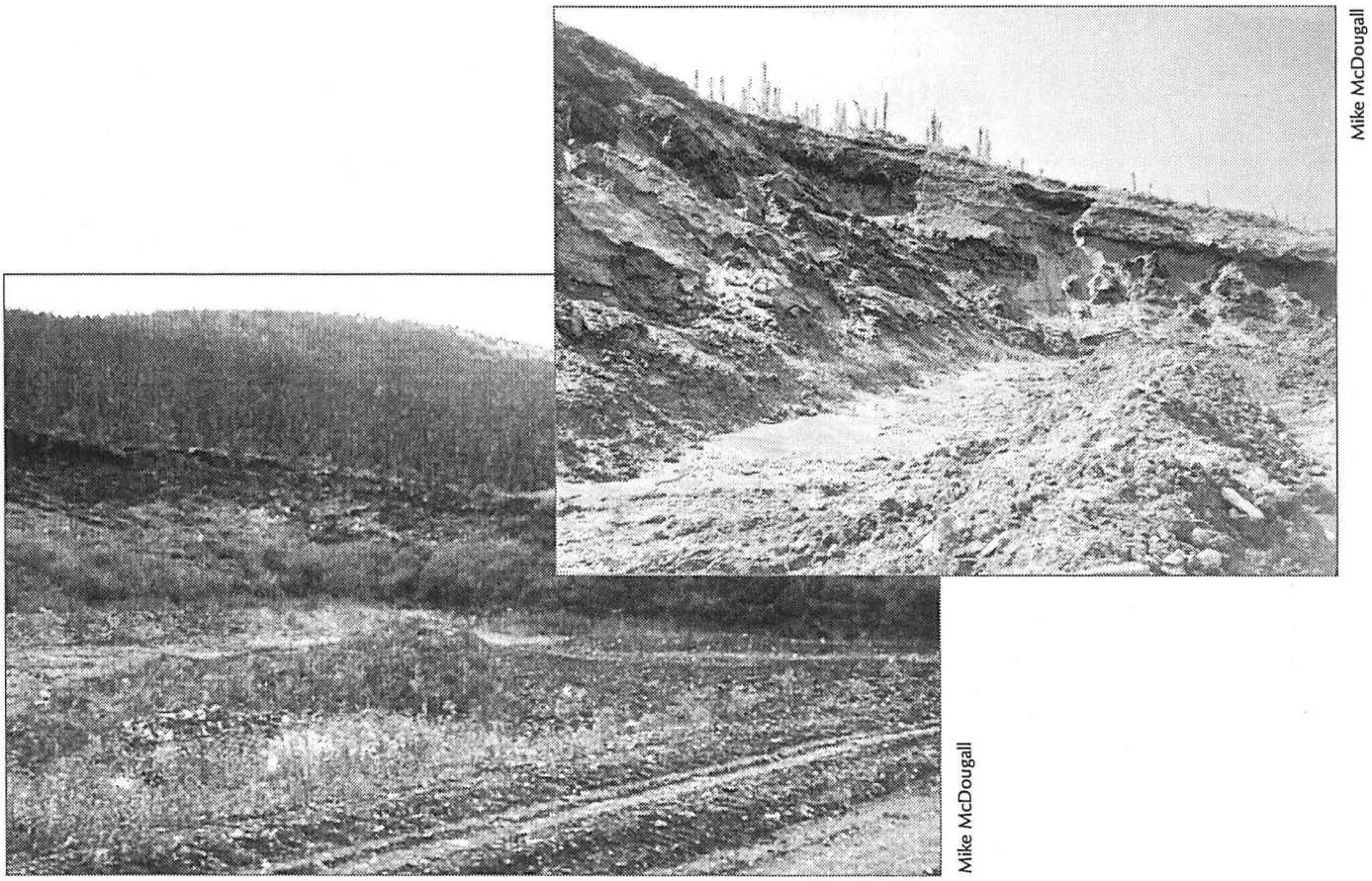
mining. This concentration is designed to put the sensitive portion of the stream at "very low risk." When more than one mine is on a stream which requires protection, each of the mines has a lower allowable standard. This ensures that their cumulative effect does not exceed the acceptable total sediment concentration in the area requiring protection.

Overall, the discharge standards reduce the total sediment added to placer streams, and dilution decreases the effects on stream productivity as the sediment moves downstream.

Both the construction of new stream channels and the restoration of disturbed ones must meet specific guidelines to ensure that the new channels are stable during and after mining. Restoration of stream channels must include constructing channels with similar channel dimensions, gradient, drop structures and fish habitat (which may include in-stream structures, bank cover and streamside vegetation). The design of the stream channel must incorporate the typical high volume flow, as well as design for unusual flood events which might occur.

Miners are encouraged to consider mining plans that do not involve disturbing existing streams when possible. In current placer mining, there are many miners who are working on bench claims or in wide valleys away from the creek who do not need to alter or divert the natural water course. Many of these operations have little or no discharge and instead recycle their processing water, removing the sediment before re-use.

The current regulatory regime to monitor land use and discharge by placer mining has been designed as a "made and administered in the Yukon" solution to meet the requirements for environmental screening and monitoring of mining under the Canadian Environmental Assessment Act (CEAA). Compliance with all regulations for placer mining is enforced by DIAND's Yukon placer inspectors. If you want to know more, please contact DIAND (Mining Land Use and Reclamation) or the Yukon Territory Water Board.



Mike McDougall

Mike McDougall

Bottom: ***60 Mile after reclamation, August, 1999.*** *Top:* ***Same site, stripping in ice-rich permafrost soils, April, 1996.***

PLACER MINING: GOLD IN THE WASH

The term "placer" is a Spanish word, meaning "a place where gold can be recovered from gravel." Placer mining is the technique of recovering gold from gravel. Throughout history, it has been practised around the world and the story of Homer and the Golden Fleece may refer to the sheepskins used in Asia to collect gold.

Placer deposits occur throughout the Yukon, though historically, most of the mining has taken place in the Klondike gold fields near Dawson City. This area is particularly favourable for placer deposits because it lies in the unglaciated part of the Yukon.

Most of the southern Yukon and large parts of the rest of North America were once covered by glaciers. Glaciers tend to rework and dilute placer gold deposits by mixing gold-bearing gravel with large amounts of other sediments. However, the glaciers stopped short of the Dawson area resulting in the rich gold deposits discovered along the Bonanza and Eldorado creeks. Approximately 80 per cent of the Yukon's placer gold is currently mined from the Klondike and other unglaciated parts of the territory.

Formation of placer deposits

Placer deposits consist of loose material (gravel, sand and clay) formed by the weathering of mineralized bedrock. As the bedrock breaks down, heavy minerals like gold, silver, platinum, tin, copper, tungsten and some gemstones are released. These minerals concentrate in layers because their relative weight (specific gravity) allows gravity and the natural flow of water to sink them to the bottom of creeks or a "hardpan" layer where they accumulate through time.

THE HEART OF DAWSON CITY'S ECONOMY

Placer mining is particularly important to the Dawson City economy and employs approximately 600 to 700 people a year. According to a 1994 Yukon government study, mining contributed 5,226 person months of employment per year, more than any other Dawson industry. The total

Placer operation in the Klondike area. Settlings ponds are visible in the forefront. Dark grassy areas were worked the previous year and are quickly revegetating.

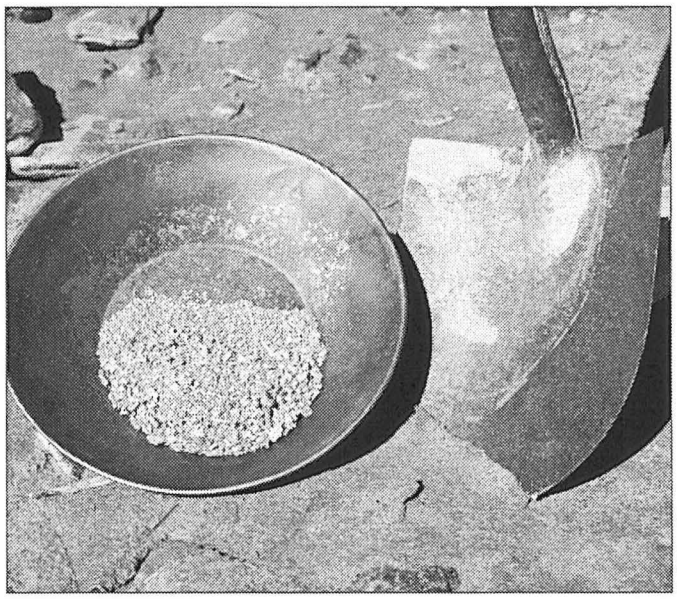
William LeBarge

The tools of the placer miner

*The **gold pan** is used to test prospective gravels for gold.*

*A **sluicebox** can vary substantially in size and design. It allows gold to settle while washing out gravel, sand and clay.*

***Water** is usually used as the transporting or washing agent to remove gold from sand and gravel. The water is often pumped from a stream into an elaborate system of pumps and settling ponds and is later returned once the fine sediments have settled. Water quality standards for Yukon placer mining streams are set by the Yukon Placer Authorization which establishes the allowable sediment that may be discharged into streams, based on fish habitat.*



Jeff Bond

Top, right: ***A particularly good day at work.***
Bottom: ***Panning is used to test gold occurrences in weathered rock or in gravel.***

Ken Galambos

income earned by placer mining was just under $22 million. This study was undertaken prior to the opening of the Brewery Creek mine so this figure is primarily from placer mining activity.

Placer mining also requires large amounts of fuel and parts for equipment maintenance and these purchases amounted to 75 per cent of the total spending of all other sectors.

The 1994 study also concluded that placer mining provided the greatest economic spin-offs to service businesses in the Dawson City area because of higher incomes, longer working hours, the capital-intensive nature of mining and the local purchases made there.

Also, many non-resident miners bring their families to Dawson for the summer, thus increasing the spending in the local economy. These people become part of the community.

William LeBarge

Jeff Bond

Top right: ***Gold rich gravel is dumped into a sorting box. Larger rocks come out in a pile and the finer particles run through a sluice box.***
Bottom right: ***Old mining shafts, dating from the late 1890s, are occasionally exposed by modern placer miners.***
Bottom left: ***Creek bottoms are sometimes placer mined more than once. Settling ponds are in the lower right corner. Lightning Creek area, near Keno Hill.***

Jeff Bond

Farming the gold fields

The gold fields of the far northwest are populated with the farm folk of the Canadian prairies. "The placer mine is the family farm of the north," said miner Mike McDougall. He lists a number of parallels between growing grain under the expansive skies of the prairies and sluicing for gold in the forested valleys of the Yukon.

The working environments and lifestyles are similar. In both cases, people work in isolated settings with their nearest neighbours several kilometres away. The "growing season" is short, as placer miners usually sluice from June to mid-September when the water and ground are not frozen.

Like farmers, placer miners need to work long, hard days, taking few holidays, to make their money within this narrow window. In some years, the crop is better than others. Like agriculture, the "crop" is an internationally traded commodity and the "grower" has no control over the price.

Skills and a working style learned on the family farm are essential in the placer mining business. Self-reliance is key and the successful operator must not only be able to run heavy equipment but to fix it as well.

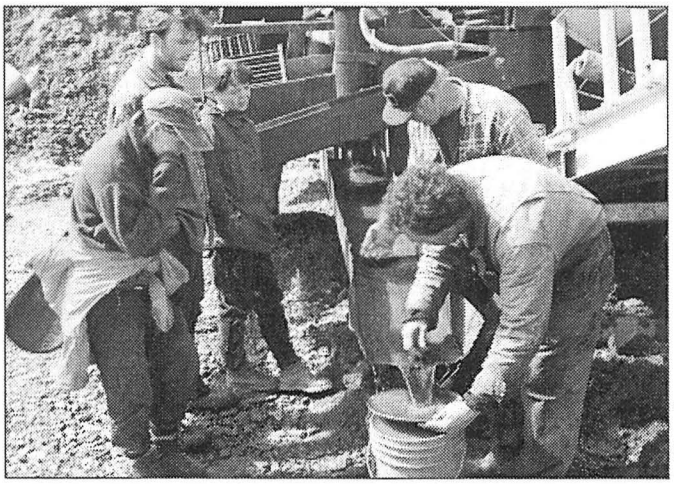
Veteran placer miner Norm Ross confirms that a lot of farm kids from Saskatchewan and Alberta gravitate to the gold fields of the Yukon, largely through word of mouth.

The mining process

Placer mining is the process of using water and gravity to recover gold from gravel.

After stripping the vegetation, topsoil and the overburden, gold-bearing gravel is excavated, screened and washed through a sluicebox. Lighter minerals such as silt and clay flow through while gold and other heavy minerals collect in the sluicebox which is regularly cleaned. The gold in this concentrate is finally isolated by separating it from the magnetic minerals by hand panning.

Once mining is completed, the tailings are flattened and the overburden and topsoil are returned to allow for natural revegetation.



Jeff Bond

William LeBarge

Jeff Bond

Small crews make the best of the long days to fit in all the work before fall. Families and students are often part of the placer operation.

RARE EARTH ELEMENTS AND JAMES DODGE

The rare earth elements (REE) are found in two horizontal rows at the bottom part of a periodic table of the elements. Elements like lanthanum, cerium, and neodymium bask in a kind of exotic remoteness. Many of the rare earth elements are actually quite common. However, it is unusual is to find them in large concentrations.

Traditionally, rare earth elements were used in the oil refining industry. In recent years however, new applications for REE have been found in high technology products and research. At the research level, REE have been associated with super-conductors, new battery compounds, low-cost automobile catalytic converters, high quality optics and lasers, and magnets found in most new electric motors. Although there are REE mines in California and Brazil, China controls over 70 per cent of world supplies.

Geologist James Dodge holds a rare earth claim, called the Lancer (from *Lan*thanum and *Ce*rium) deposit, in the headwater country of the Ketza River, south of Ross River. Dodge, who is 78 years old and still spends 60 to 70 days a year in the field, generally solo, holds several degrees in geology. He first worked in the Yukon in 1960 and has returned here frequently over the years.

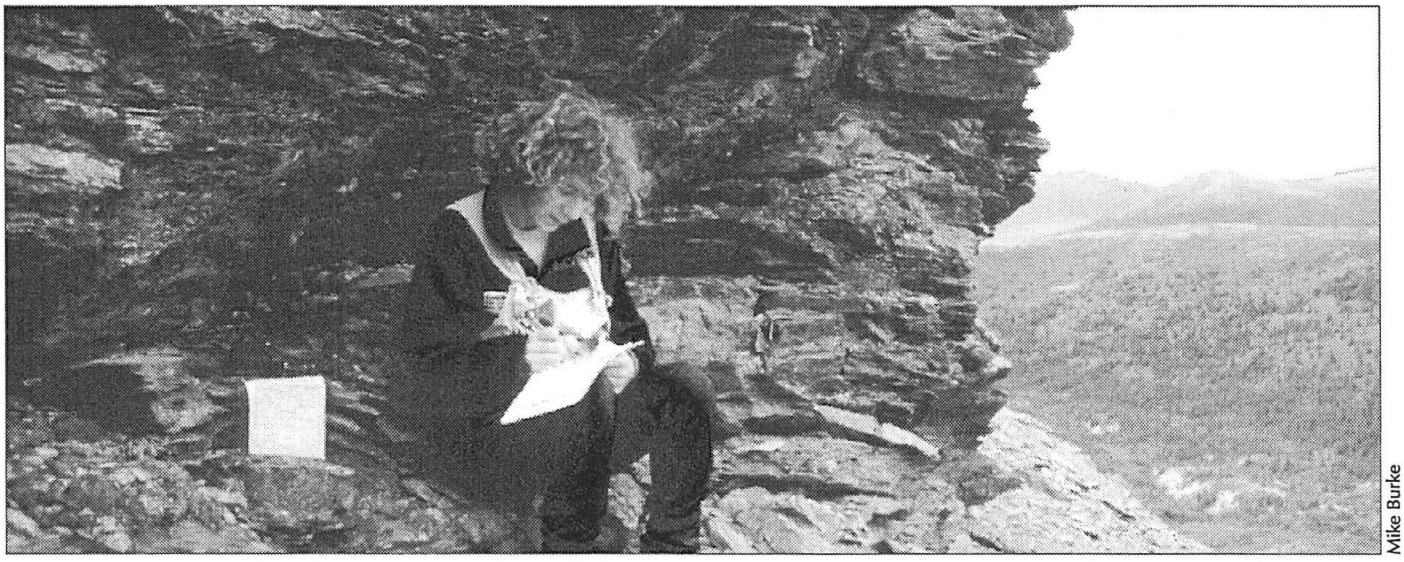
With the assistance of the Yukon Mining Incentives program, Dodge was able to survey the area. He found it contained a vein larger and richer than previously thought. Assay work, supported by the Canada/Yukon Mineral Development agreement, showed commercially viable concentrations of REE.

In addition to the 15 rare earth elements, the assay report also identified concentrations of niobium and yttrium. Niobium is used in the extremely strong steel alloys that find their way into rocket chassis and jet engines, among other applications. Dodge estimates the claim contains one to two per cent of known world reserves, which he tentatively values *in situ* at US$300 million.

So why isn't there a mine on the Lancer property right now? REE deposits are expensive to process. They are generally only found in extremely small particles. This means that the ore-bearing rock must be ground very finely, or as Dodge puts it, "finer than table salt but coarser than flour." This is both expensive and time consuming. Although the individual metals are often highly sought after by industrial users, the concentrate itself would have to be sold to one of a very limited number of specialized refineries in the world. These complications make it difficult to find venture partners.

If, however, rare earth applications continue to be found in the fast moving world of high technology research, then REE could quickly become a very valuable commodity indeed.

From their field observations, geologists produce and publish maps and reports that are available to the industry and the public. To work as a geologist requires a university degree in geology and many courses in science and mathematics.



Mike Burke

PLACER MINING INFORMATION

"The potential for new placer discoveries in the Yukon remains high."

William LeBarge, Placer Geologist, Yukon Geology Program

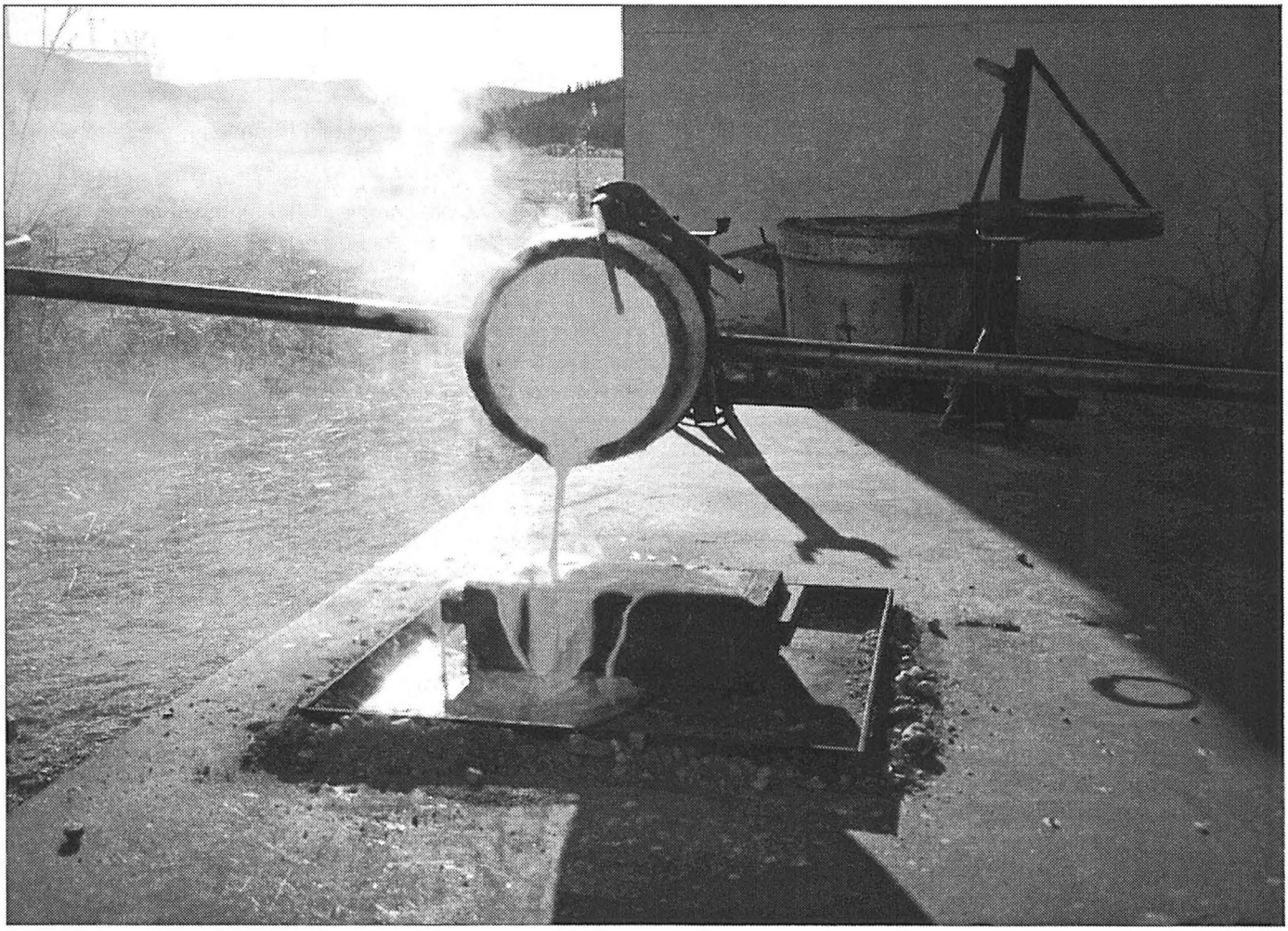
The first placer miners in the Yukon were First Nations who recovered native copper nuggets from the White River area in southwestern Yukon.

After 1850, prospectors and explorers began to report fine gold on river bars and coarse gold in the Fortymile and Sixtymile rivers. On August 17, 1896, the discovery of nugget gold on Bonanza Creek set off the Klondike gold rush.

Placer mining is still an important sector in the Yukon's economy. In fact, placer mining has contributed to the Yukon economy for over 100 years. In 1998, a total of 90,288 ounces of placer gold, valued at $31 million (Cdn), were produced from 161 placer mines employing approximately 600 people. Most of the placer operations are small and family-run.

Placer gold is getting more difficult to find as reserves in traditional placer mining areas decline. Most placer gold exploration and mining is concentrated in unglaciated areas of the Yukon. By expanding our knowledge of placer gold deposits and applying it to other areas, we may be able to discover new sources of placer gold in different geological settings.

Gold from a placer mine being poured into a gold bar.



Jesse Duke

BREWERY CREEK: A DIFFERENT KIND OF MINE FOR THE NORTH

Brewery Creek is different than other traditional hard rock mines in the Yukon because it uses the heap leach process to separate the gold from the rock. It allows the efficient and economic extraction of gold from deposits with a lower gold content and also cuts down significantly on the amount of energy required to extract and transport ore.

At the Brewery Creek mine, the ore is extracted from a series of small- to medium-sized open pits instead of one very large excavation. Gold deposits have been found in at least eight different zones and several other exploration targets exist for potential additional reserves.

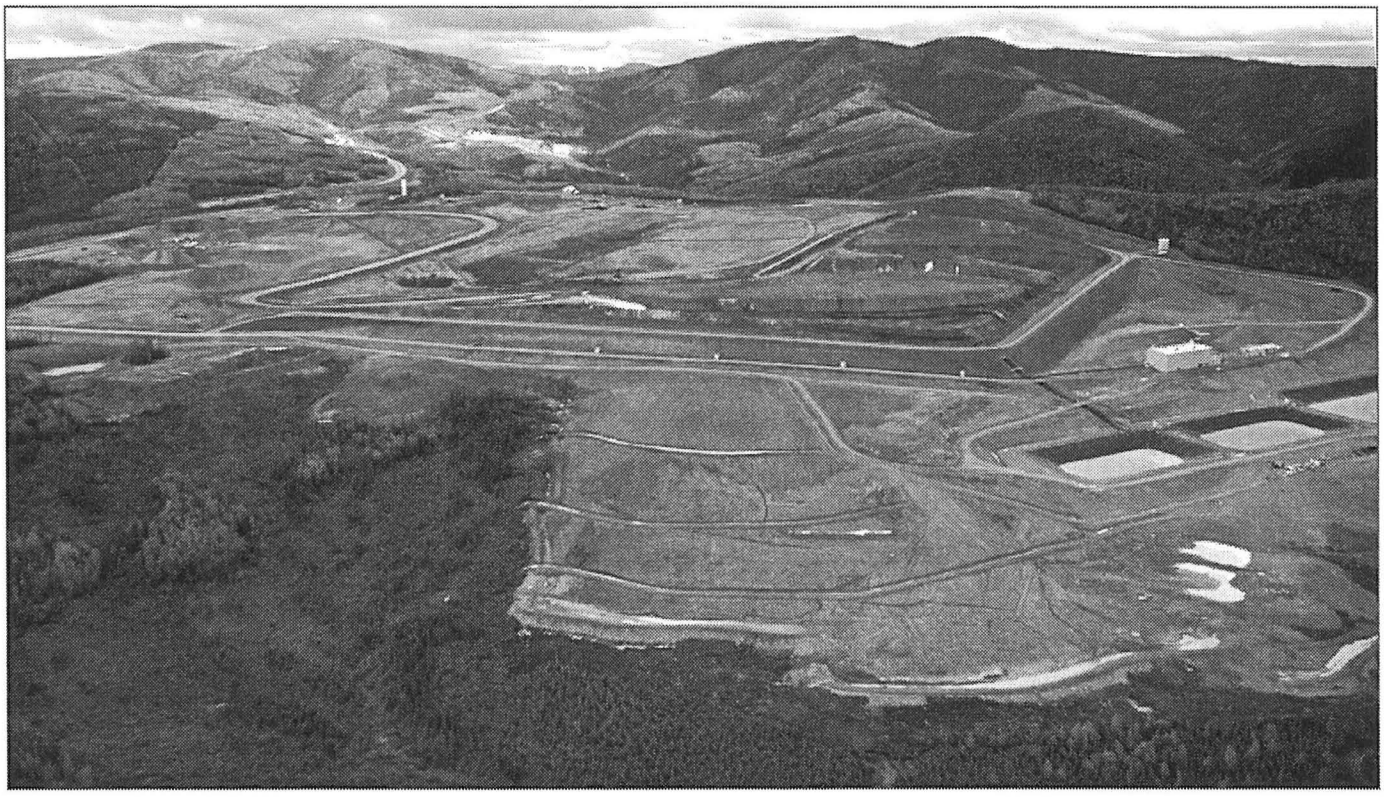
What is heap leach mining?

Heap leaching is a method of separating the metal (usually gold) from minerals by dripping a dilute sodium cyanide solution through the ore and collecting the metal-rich solution at the bottom of the pad.

The host rock in which most of the gold is found is called limonitic-altered quartz monzonite. The upper 30 to 40 metres of rock have been severely weathered over the last thousands of years. This rock, which crumbles easily, has been preserved because the area has not been glaciated in the last two million years.

The gold is part of the chemical composition of pyrite (iron-rich) crystals, from which the gold cannot be fully recovered. Oxidation (weathering) breaks down the pyrite crystals and frees the gold from the original rock. This makes it leachable. In other words, it allows the gold to be separated when processed through a heap leach pad and collected as a separate gold-rich solution.

Heap leach pad and plant at Brewery Creek mine, 1997. As of September, 1999, Brewery Creek is the only operating mine in the Yukon.



Yukon Government

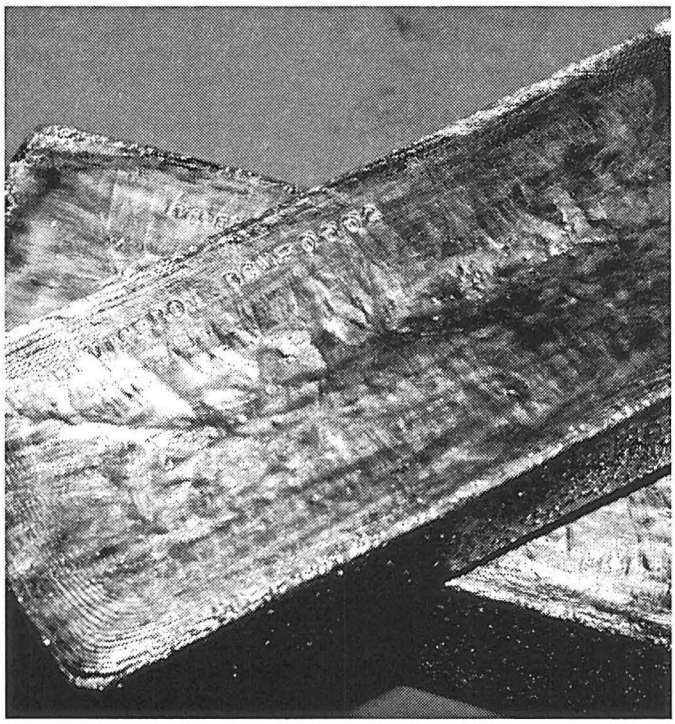
HOW THE HEAP LEACH PAD WORKS

At Brewery Creek, ore has been placed to form a 30-metre high leach pad. Perforated plastic pipes, about a metre apart, drip the cyanide solution that percolates through the rock, dissolving the gold and carrying it down through the heap.

Caustic soda is mixed into the solution to maintain a high pH, which keeps the cyanide from evaporating. Lime is also added to the ore when it is placed on the leach pad.

At the bottom of the heap are two composite liners of plastic and compacted silt to prevent any fluid from escaping. Above the top liner is a series of pipes that collect the solution and, with the help of gravity, transport it to a plant. This is a completely closed system so none of the solution is discharged to the environment. The gold-rich solution from the pad goes into the plant where the gold is recovered.

The heap solutions are warmed with exhausted gases captured from a waste oil burner and generator. Heating



Yukon Government

Top: ***Gold bars produced at Brewery Creek.***
Bottom: ***Kokanee zone at the Brewery Creek mine. The weathered rock is mined and processed.***

Don Murphy

the solution allows leaching of ore to continue though winter temperatures as low as minus 50 degrees Celsius. Ore loading on the heap is restricted to warmer months so that pockets of permanently frozen ore will not form within the heap.

The gold-rich cyanide solution is passed through the adsorption/desorption recovery plant where the gold is extracted with the use of carbon (burned coconut shells). Smelting into gold bullion occurs on site. The solution is then reconcentrated with caustic and cyanide, and circulated back to the pad.

SAFETY MEASURES ENSURE NO LEAKAGE

The original site for the Brewery Creek pad was found to be rich in permafrost. As this was a concern, another site was selected to eliminate the risk of ground instability due to thawing permafrost.

Underneath the pad, two layers of plastic made of one-millimetre thick, durable, puncture resistant, non-reactive PVC completely isolate the pad from the underlying surface. Beneath each PVC liner is a 30-centimetre layer of compacted silt. Between the liners, in a layer of gravel, is a leak-detection piping system. Solution getting past the first layer will show up in this system of piping.

Brewery Creek's double liner system is not common among heap leach pads. In the unique and extreme conditions of the north, different design criteria had to be

Viceroy Resource Corporation

In 1997, Viceroy Resource Corporation was named the environmental leader of the Canadian mining industry by the Social Investment Organization of Canada, a non-profit organization formed in 1989 to promote socially and environmentally responsible investment. The high environmental standards that Viceroy demonstrated in design, startup and operation will also be applied to mine decommissioning.

Drip lines are part of the leach pad, Brewery Creek Mine, 1997.

Yukon Government

followed. A rigorous permitting process resulted in the design specifications for construction of the pad exceeding the industry standard in the south.

MONITORING

In addition to the leak detection system, ground wells surrounding the lower extent of the leach pad are monitored on a quarterly basis for cyanide escaping into the environment. Nearby creeks are sampled on a monthly basis.

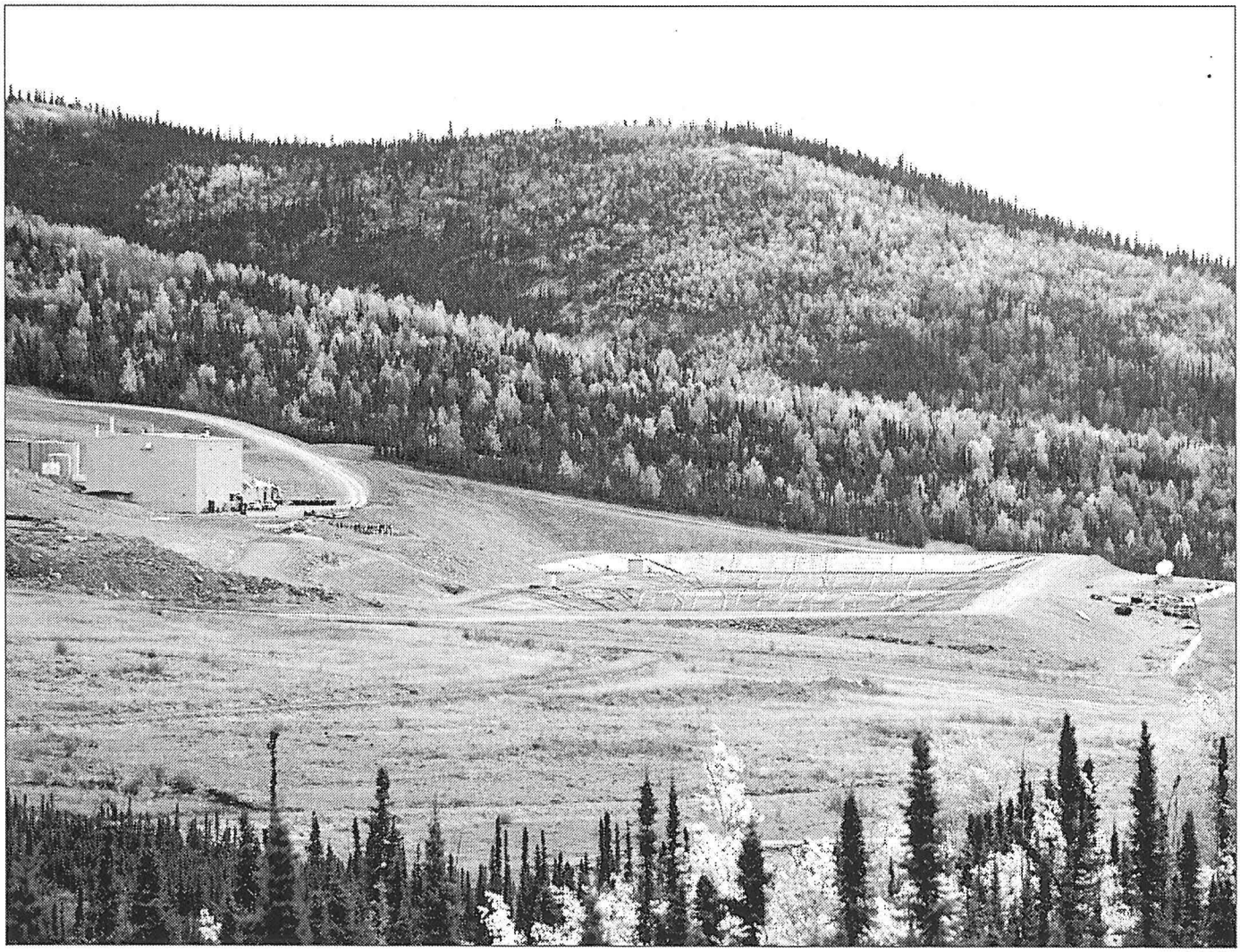
IS THAT PAD GOING TO BE LARGE ENOUGH?

New sections, or cells, of fresh ore are constantly built on to the pad. In a few years, a treatment facility will be built to wash spent ore from the first cells. The spent ore will be washed in a closed system and the water used will be treated before discharging. In times of extreme precipitation, if the amount of solution coming off the pads becomes more than the processing plant can handle, it can be diverted into one of two ponds, also double-lined and equipped with leak detection piping.

An additional overflow pond has been designed for a complete drain down of the leach pads, the processing plant and a one-in-100-year snowpack accumulation. Even in that unlikely scenario, everything would remain contained.

In the future, Viceroy plans to start the detoxification of some of the ore on the leach pad. Large amounts of rinsing water will be circulated onto a section of the pad and collected at the bottom to be treated. Once the rinsing water meets required standards, the ore will be left where it sits and reclaimed. Most of the side slopes will be recontoured, seeded and fertilized.

The collection ponds at Brewery Creek are covered with netting to stop waterfowl from landing in the dilute leach solution, 1997.



William LeBarge

YUKON MINE RECLAMATION: THE NEW GENERATION

At Viceroy Resource Corporation's Brewery Creek mine, the reclamation of waste rock, mined-out pits and used ore is an ongoing process. The people involved with reclamation at Brewery Creek – including the environmental coordinator, the environmental technician and the operations staff – feel fortunate that the ore deposits are being mined from a series of relatively small pits, instead of one large area. It is easier for reclamation to be ongoing, rather than delayed until most or all of the mining is completed.

The sequential mining of a number of ore reserves allows the backfilling of one pit with the waste rock from the next. Backfilling is the preferred method because it causes less site disturbance and the pit walls end up recontoured, making the area blend into the original landscape.

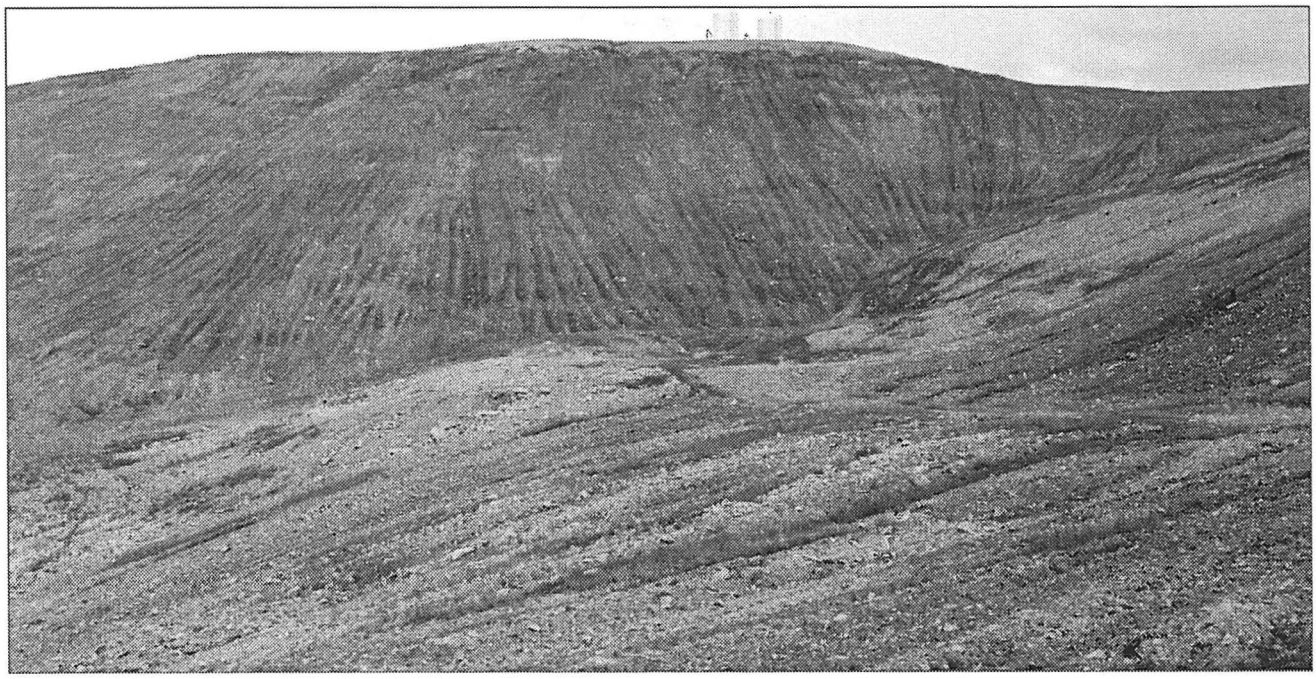
At Brewery Creek, over 70 per cent of mine waste rock will be disposed of in mine pits. The first pit mined was the *Upper Foster's*. Because it is smaller than the second reserve, *Canadian*, a waste rock dump had to be constructed adjacent to the larger pit. Some material from *Canadian* was also used in the construction of a haul road.

The first step in reclaiming waste rock is to recontour the slopes with heavy equipment until a stable, gentler slope is achieved. Then "growth media," the north's version of topsoil, is spread over the gentler slopes. Seeding, fertilizing, and monitoring of the vegetation growth follows.

The *Canadian* waste rock dump was recontoured, seeded and fertilized in 1997. The environmental staff is monitoring the area to see what native plants naturally come in on their own. Poplar, wild rose, and lupine commonly colonize the disturbed areas and the company also tries to seed native grass species, similar to those found locally. Recently, it has involved school students in a research project to test the successful replanting of local shrub species.

The ongoing process of reclamation has become a routine part of mining at Brewery Creek. The mine operations group works the recontouring in with all their other tasks. Mine planners are thinking ahead to the very end product. It saves time and money and makes reclamation and the abandonment plan environmentally and financially sensible.

The tailing piles at Brewery Creek are smoothed, recontoured and seeded. In a few seasons, the natural vegetation will colonize the disturbed areas.



William LeBarge

Danièle Héon

Strange things are done in the land of the midnight sun. (Robert Service)

APPENDICES

MINERAL RESOURCES BRANCH

SERVICES

The Mineral Resources Branch of the Department of Economic Development provides the following services to the exploration and mining community.

- Administers, in partnership with DIAND, the Yukon Geology Program.
- Maintains an extensive database of Yukon mining and exploration projects.
- Provides funding to individuals, partnerships and junior mining companies through the Yukon Mining Incentives Program.
- Provides information to potential investors on the Yukon's mineral potential and mining investment opportunities.
- Assists exploration and mining companies through the regulatory process by providing advice on contacts, processes and timing requirements.
- Disseminates information about the Yukon's exploration and mining industry and the work of the Yukon Geology Program by attending trade shows and mining conferences.
- Provides technical expertise on behalf of the Yukon government on regulatory review committees and working groups.
- Provides information about Yukon's mineral resources through the Department of Economic Development website at *www.economicdevelopment.gov.yk.ca.*
- Provides information on mining taxation, including the Yukon Mineral Exploration Tax Credit.

If you want to find out more about the Yukon's mineral resources, contact Jesse Duke, Yukon Mining Facilitator, 867-667-3422 or 1-800-661-0408, jesse.duke@gov.yk.ca.

PROGRAMS

The Yukon government currently offers three programs to encourage the development of the Yukon's mineral and energy resources: the Yukon Mining Incentives Program (YMIP), the Yukon Industrial Support Policy (YISP), and the Energy Infrastructure Loans for Resource Development Program. In addition, the government recently introduced the Yukon Mineral Exploration Tax Credit which will provide a 22 per cent refundable tax credit for two years beginning April 1, 1999. Combined, these initiatives ensure that the Yukon offers one of the best incentive programs in Canada.

Yukon Mining Incentives Program

This program is designed to promote and enhance mineral prospecting, exploration and development activities in the Yukon, providing a portion of the risk capital required to locate and explore mineral deposits. Grassroots programs (prospecting and grubstake categories) are conducted on open ground (crown land). Target evaluation programs are conducted on newly discovered prospects and projects covered by mineral claims, placer prospecting leases and claims, and coal licenses and leases. Technical assistance is offered to the industry upon request by the Yukon Geology Program staff.

Yukon Industrial Support Policy

The Yukon government continues to heavily invest in infrastructure at a higher per capita rate than any other Canadian jurisdiction but it recognizes this remains an issue in many regions of the territory. Under this initiative, the Yukon government enters into a development agreement with the resource development sector for projects that require road improvement or construction, energy supply, grid connections or related training programs for Yukon residents.

Energy Infrastructure Loans for Resource Development Program

This program assists the Yukon's resource development sector by helping to defer the capital cost of building energy infrastructure. The program provides loans to companies to help them create infrastructure to meet their energy needs.

> Information about these programs is available from Ken Galambos, Mineral Development Geologist, 867-667-5996 or 1-800-661-0408, ken.galambos@gov.yk.ca.

REFERENCES

Department of Economic Development

Yukon Mineral Exploration Tax Credit Bulletin.

The Tombstone Gold Belt: An Emerging Gold Camp. January 1999, 11 inches x 17 inches poster.

Yukon Annual Statistical Review 1998, 62 pages.

Yukon Mineral Property Update, December 1998, 48 pages.

Yukon Oil and Gas Regime Fact Sheets, January 1999, 22 pages.

Yukon Oil and Gas Strategy Draft for Public Comments, Spring 1999, 10 pages.

Yukon Short-term Economic Outlook 1999, 10 pages.

To obtain the above free publications contact:

Department of Economic Development
Suite 400-211 Main Street
Box 2703
Whitehorse, Yukon Y1A 2C6
Phone: 867-667-5466, toll free 1-800-661-0408
Fax: 867-667-8601

Yukon Geology Program

Publications List, March 1999. This paper includes lists of federal and territorial reports and maps on the regional bedrock mapping, mineral deposits, placer deposits, mineral assessment, gemstone exploration, geochemical, geophysical and environmental studies.

To order the above publication, contact:

DIAND Publications Desk
Phone: 867-667-3266
Fax: 867-667-3267

Environment Directorate

Permit Guide for Projects in the Yukon, November 1998.

To order the above publication, contact:

Environment Directorate, Indian and Northern Affairs Canada, Yukon Region
Phone: 867-667-3251

Web sites

Economic development
http://www.economicdevelopment.gov.yk.ca

Yukon Geology Program
http://www.yukonweb.com/government/geoscience/

Economic Development Library
http://199.247.148.81/libraries20/ecdev/Index.cfm?home

DIAND Yukon Region
http://www.inac.gc.ca/regions/yt/index.html

Yukon Chamber of Mines
www.yukon.net/ycmines

CONTACTS

DEPARTMENT OF ECONOMIC DEVELOPMENT

Yukon Government
Suite 400-211 Main Street
Box 2703
Whitehorse, Yukon Y1A 2C6
Phone *667-5466 (departmental)*
Fax *667-8601 (departmental)*
www.economicdevelopment.yk.ca

Trevor Harding
Minister
Phone 667-8416
E-mail gordon.voogd@gov.yk.ca

Maurice Albert
Deputy Minister
Phone 667-5417
E-mail malbert@gov.yk.ca

Jesse Duke
Mining Facilitator
Phone 667-3422
E-mail jesse.duke@gov.yk.ca

Lois Craig
Assistant Deputy Minister, Resource Management
Phone 667-5888
E-mail lois.craig@gov.yk.ca

Lori Walton
Senior Mining Development Advisor
Phone 667-5462
E-mail lori.walton@gov.yk.ca

Mary Hagerman
Administrative Assistant, Deputy Minister
Phone 667-5417
E-mail mary.hagerman@gov.yk.ca

Judith Balsor
Administrative Assistant, Mining Facilitator
Phone 667-3011
E-mail judith.balsor@gov.yk.ca

YUKON GEOLOGY PROGRAM

Mineral Resources Branch
Economic Development
Yukon Government
2099-2nd Avenue
Box 2703
Whitehorse, Yukon Y1A 2C6
Phone *667-8508 (reception and information)*
Fax *393-6232*

Grant Abbott
Chief Geologist, Regional Manager
Phone 667-8510
E-mail grant.abbott@gov.yk.ca

Shirley Abercrombie
Manager, Mineral Resources
Phone 667-3438
E-mail shirley.abercrombie@gov.yk.ca

Tammy Allen
Senior Geological Assistant
Phone 667-8518
E-mail tammy.allen@gov.yk.ca

Jeff Bond
Surficial Geologist
Phone 667-8514
E-mail jeff.bond@gov.yk.ca

Maurice Colpron
Project Geologist
Phone 667-8235
E-mail maurice.colpron@gov.yk.ca

Anna Fonseca
Mineral Assessment Geologist
Phone 393-7188
E-mail anna.fonseca@gov.yk.ca

Ken Galambos
Mineral Development Geologist
Phone 667-5996
E-mail ken.galambos@gov.yk.ca

Craig Hart
Project Geologist
Phone 667-8519
E-mail craig.hart@gov.yk.ca

Danièle Héon
Mineral Assessment Geologist
Phone 667-5398
E-mail daniele.heon@gov.yk.ca

Grant Lowey
Placer Geologist
Phone 667-8511
E-mail grant.lowey@gov.yk.ca

Don Murphy
Senior Project Geologist
Phone 667-8516
E-mail don.murphy@gov.yk.ca

Gordon Nevin
Spatial Data Manager
Phone 667-8481
E-mail gordon.nevin@gov.yk.ca

Lee Pigage
Project Geologist
Phone 667-8192
E-mail lee.pigage@gov.yk.ca

Charlie Roots
GSC Staff Geologist
Phone 667-8513
E-mail charlie.roots@gov.yk.ca

Monique Shoniker
Administrative Assistant
Phone 667-8508
E-mail monique.shoniker@gov.yk.ca

Joanne VanRanden
Mineral Assessment Geologist
Phone 667-8234
E-mail joanne.vanranden@gov.yk.ca

The area code for the Yukon is 867.

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

Exploration and Geological Services Division
345-300 Main Street
Whitehorse, Yukon Y1A 2B5
Phone *667-3201*
Fax *667-3198*

Grant Abbott
Chief Geologist, Regional Manager
Phone 667-3200
E-mail abbottg@inac.gc.ca

Michael Burke
Staff Geologist
Phone 667-3202
E-mail burkem@inac.gc.ca

Robert Deklerk
Minfile Geologist
Phone 667-3205
E-mail deklerkr@inac.gc.ca

Diane Emond
Environmental Geologist
Phone 667-3203
E-mail emondd@inac.gc.ca

Julie Hunt
Mineral Deposits Geologist
Phone 667-3829
E-mail huntj@inac.gc.ca

William LeBarge
Placer Geologist
Phone 667-3134
E-mail lebargeb@inac.gc.ca

Ali Wagner
Sales Manager
Phone 667-3201
E-mail wagnera@inac.gc.ca

OTHER USEFUL CONTACTS

Whitehorse Mining Recorders Office
(claim sheets, mining legislation information)
Phone 667-3190
Fax 667-3267

Publications Desk (DIAND)
Phone 667-3266
Fax 667-3267

Topographical map sales
Mac's Fireweed Books
Phone 668-6104
Toll-free 1-800-661-0508

Yukon Prospectors Association
Phone 668-7985
E-mail ypa@northland.com

Klondike Placer Miners Association
Phone 667-2267
Fax 668-7127

Yukon Chamber of Mines
Phone 667-2090
Fax 668-7127
E-mail ycmines@internorth.com