

ARCTIC HAS GREAT RICHES, BUT GREATER CHALLENGES

Surging demand for oil, gas, gold and other raw materials is fueling interest in the icy northern wastelands of Canada, Russia, Scandinavia and Alaska. But the Arctic is not for the faint-hearted.



An aerial view of Agnico-Eagle's Meadowbank mine and processing facilities in Nunavut, Canada photographed on June 28, 2011. REUTERS/EUAN ROCHA

BY DAVID LJUNGGREN AND EUAN ROCHA
IQALUIT, NUNAVUT/
BAKER LAKE, NUNAVUT, AUG 31

AT THE RIM OF THE Arctic Circle in Canada, gold mining firm Agnico-Eagle is learning how tough it is to operate in a

remote region with temptingly large, but frustratingly inaccessible, reserves of oil, gas and minerals.

Commentators rarely mention nightmarish logistics, polar bears and steel-snapping cold when they confidently predict that as the Arctic warms up, melting

sea ice and shorter winters will open up the expanse to exploration.

But the rosy words obscure the reality of working in an icy wasteland that stretches across Russia, Scandinavia, Alaska and Canada. And rather than making life easier, the warming of the Arctic and the thawing



UP NORTH: The massive ore storage dome at gold mining firm Agnico-Eagle's Meadowbank mine in Nunavut. To date, it is the only mine working in Nunavut and it has cost the company a total of \$1.5 billion so far. **REUTERS/EUAN ROCHA**

“WITH ASSETS UP HERE IN THE NORTH, YOU NEED BIG TONNAGE OPERATIONS, YOU CAN’T HAVE A SMALL FOOTPRINT GIVEN THE COST.”

of its permafrost could make operating here even more complicated.

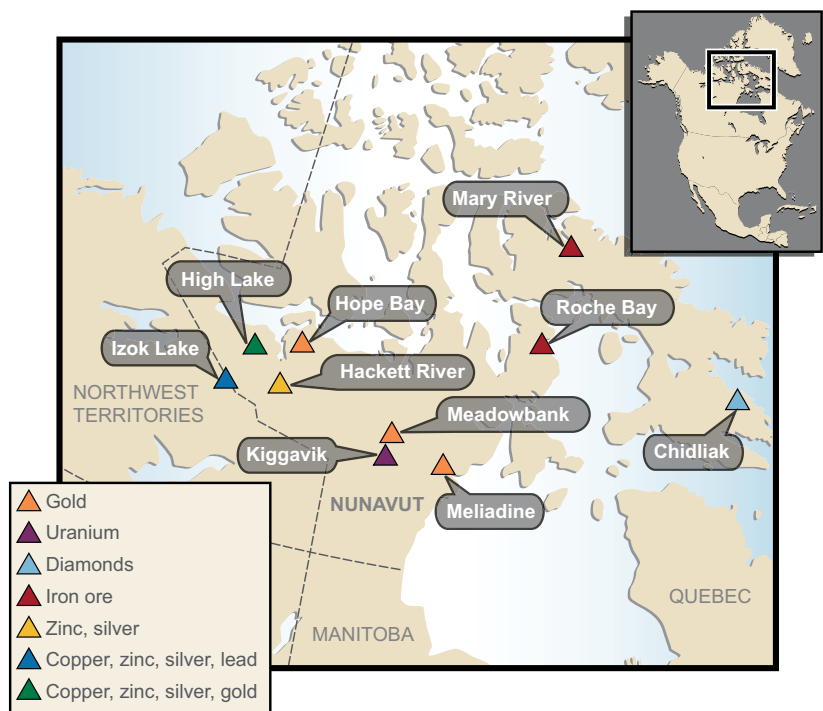
A closer look at the far northern Canadian territory of Nunavut, one of the most promising areas for exploration, reveals challenges so huge that the Arctic may well turn out to be a niche market where big firms with a serious tolerance for risk and adversity develop a handful of major deposits.

For all the talk of a bonanza there is just one mine working in Nunavut today - Agnico-Eagle's Meadowbank operation, which has cost a total of \$1.5 billion so far. The gold mine, literally in the middle of nowhere, is surrounded by dikes that keep a series of shallow lakes at bay. Temperatures plunge to minus 50 degrees centigrade (minus 58 Fahrenheit) in winter, bringing with it the risk of almost instant frostbite and mechanical failures.

Most workers have to be flown in, as long as the often foul weather cooperates. The only land access is a gravel road the company built to Baker Lake, a small town 70 miles (110 km) to the south. The road - which was supposed to cost \$275,000 a km to build -

Mining projects in Canada's Nunavut territory

Tough operating conditions and almost total lack of infrastructure mean only major mining firms will be able to exploit Nunavut's mineral resources.



Source: Nunavut government's 2010 overview of mineral exploration, mining and geoscience



Reuters graphic/Stephen Culp

came in at \$550,000 per km.

It's no surprise that Agnico-Eagle chief executive Sean Boyd concedes such projects are not for the faint of heart.

“With assets up here in the north, you need big tonnage operations, you can't have a

small footprint given the cost structure,” he said.

SHORT SHIPPING SEASON

THERE IS VIRTUALLY no infrastructure in Nunavut, a 810,000 square mile (2 million



THINK BIG: The SAG Mill and Ball Mill at Agnico Eagle's Meadowbank mine in Nunavut. REUTERS/EUAN ROCHA

square km) expanse of rock and ice twice the size of western Europe. Dotted across the territory is a largely unskilled aboriginal Inuit population of just 33,000.

Heavy equipment, spare-parts and diesel fuel all arrive during a short summer shipping window, first by barge and then along that costly road.

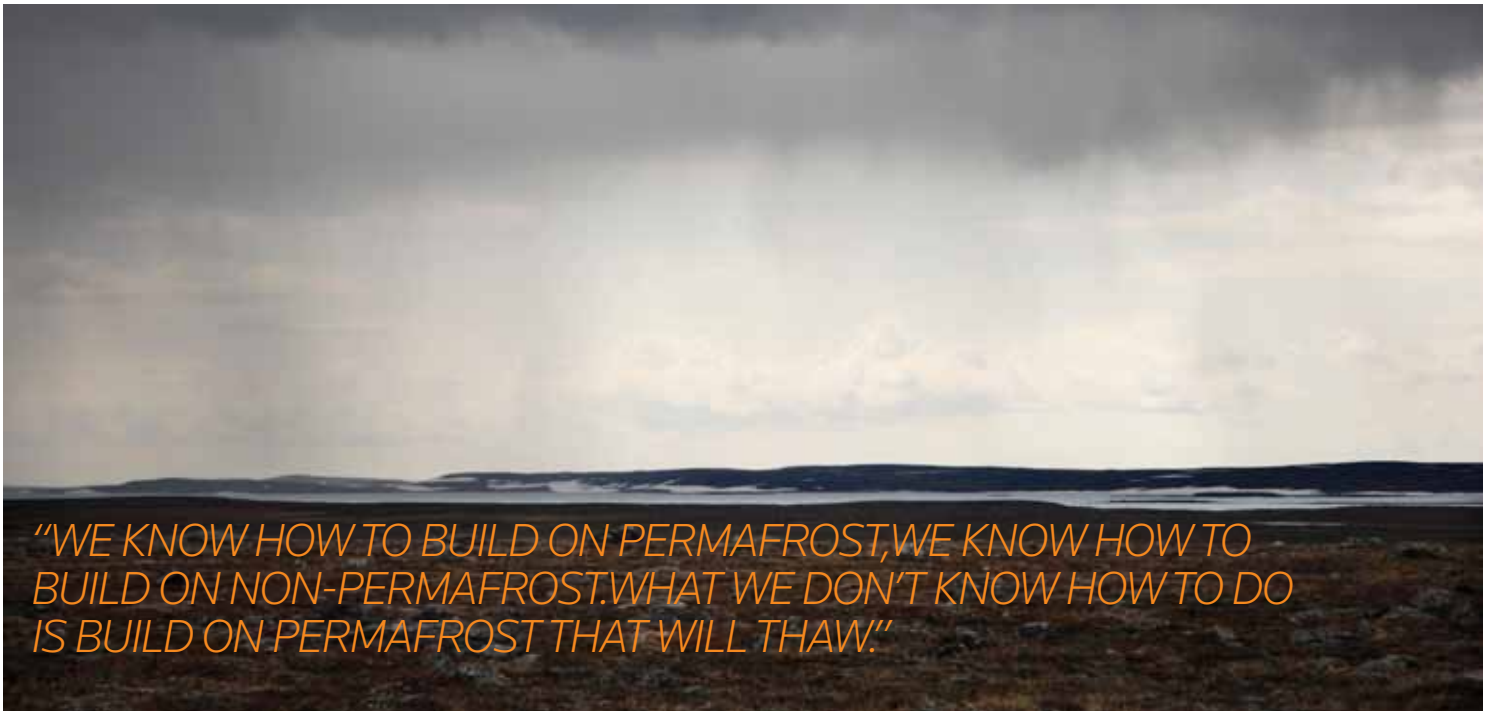
"It's hard to believe we are in the geographic center of Canada, because simple things like parts for an emergency breakdown have to be flown in," said Agnico-Eagle's President Ebe Scherkus. "What the last 16 months has taught us is there's long-term planning and then there's very long-term planning on a site like this."

In March, a fire destroyed the kitchen and forced the firm to evacuate over 300 employees and operate the mine with a skeleton crew. A new multimillion dollar kitchen will arrive later this summer.

Such travails help explain why Nunavut was for so long an insignificant player, although there are other problems too.



TRUCKING: A truck at Agnico-Eagle's Meadowbank gold mine. Heavy equipment, spare-parts and diesel fuel all arrive during a short summer shipping window, first by barge and then along a 70-mile gravel road. REUTERS/CHRIS WATTIE



"WE KNOW HOW TO BUILD ON PERMAFROST, WE KNOW HOW TO BUILD ON NON-PERMAFROST. WHAT WE DON'T KNOW HOW TO DO IS BUILD ON PERMAFROST THAT WILL THAW."

WASTELAND: A view of the Tundra landscape around Meadowbank's open-pit mine in Nunavut, June 28, 2011. **REUTERS/EUAN ROCHA**

The harsh climate closes down many exploration sites from October to March. Polar bears prowl and snowstorms slash visibility. There is little or no sunlight for three months a year in the far north and low winter temperatures mean metal starts to snap, oil thickens and helicopters stop flying.

Even in the summer months, the weather can be a challenge for pilots. A First Air Boeing B-737 jet crashed near the Nunavut settlement of Resolute Bay on Aug 20, killing 12 people. Eyewitnesses said the area had been foggy at the time.

And if that was not enough, companies will need to work out how to access their sites in warming weather, and how to cope with the gradual thawing of the permafrost, the frozen layer of soil that sits about two meters under the surface.

"We know how to build on permafrost, we know how to build on non-permafrost. What we don't know how to do is build on permafrost that will thaw," said University of Ottawa professor Antoni Lewkowicz, a leading permafrost expert.

SOFTENING PERMAFROST

IN PARTS OF THE CANADIAN and U.S. Arctic, buildings are already starting to collapse and roads crumble as the frozen ground warms up.

Yet for all the challenges, high commodity prices are persuading companies to look again at deposits which were once too



HOT AND COLD: Gold is poured during a tour of Agnico-Eagle's Meadowbank Mine. Outdoors, temperatures plunge to minus 50 degrees centigrade in winter. **REUTERS/CHRIS WATTIE**



SMALL TOWN: (Left) Boats lie on the beach in the center of Iqaluit, capital of the Canadian Arctic territory of Nunavut. (Right) Local Inuit stand outside of a college in Iqaluit, June 14, 2011. **REUTERS/DAVID LJUNGGREN**

expensive to exploit and there is something of an exploration boom. Companies spent C\$30 million (\$30.6 million) on exploration in Nunavut in 1999, a figure that is set to hit C\$325 million this year.

Nunavut has significant advantages over its Arctic rivals such as Russia, Alaska and Norway -- land tenure is secure, the politics are stable, the territory is vast and has a nicely varied geology.

"It is what we like to call in exploration elephant country," said Brooke Clements, president of junior mining firm Peregrine Diamonds. "There's still the potential to find really big world class deposits."

Yet geological mapping is grossly inadequate and prospecting from scratch so costly that it's hard to know what riches Nunavut may still be hiding.

Peregrine found a promising series of diamond-bearing kimberlite rock formations near Iqaluit after three summers of collecting up to 30 soil samples a day by helicopter, at the cost of C\$1,000 per sample.

The federal government, keen to kick-start development, has launched a project to examine 20 relatively small areas deemed to have potential, and then release the data.

"We find a haystack and industry finds the needle," said Linda Richard, the project coordinator. That said, most of the major deposits now under consideration have been known about for decades.

Along with Peregrine and its joint venture

partner BHP Billiton, Xstrata, ArcelorMittal, Areva, Newmont and China's MMG are variously pursuing gold, diamonds, iron ore, lead, zinc and uranium in Nunavut.

STAGGERING SUMS NEEDED TO START PRODUCTION

STILL, THE AMOUNT SPENT on exploration is tiny compared to the staggering sums needed to start production. Newmont has spent \$2 billion so far on its Hope Bay gold deposits in western Nunavut and there is no guarantee a mine will ever be built.

Baffinland, owned 70 percent by ArcelorMittal, is proposing to invest C\$4.1 billion on a 149 km railway and two ports - not to mention a special fleet of giant ships - to exploit the huge Mary River iron ore deposit on Baffin Island. This is slated to produce 21 million tons of ore a year for 21 years.

The message is clear: Nunavut is not the place for small fry.

"It is inherently the case that operating in the North ... is more expensive and so it's generally the larger organizations that can take on those green field developments," said Baffinland president Tom Paddon.

Baffinland's proposed railway is in an area of relatively cold permafrost, but that could change.

"They certainly have to be taking climate change into consideration ... It's not a terribly warm place but the potential is that it could become a great deal warmer in the next

century," said Lewkowicz.

"There's a real economic question, as well as a science and engineering question, associated with building on permafrost that if not going to thaw, is at least going to warm."

One solution is to drive piles deep into the frozen layers to support roads, buildings and railways. The other is to install a series of costly thermosiphons, giant special coolers that help keep the ground firm.

"The economics of a mine up here are a lot different than the economics of a mine somewhere else down south," said Bernie MacIsaac, head of Nunavut operations for the federal Aboriginal Affairs and Northern Development ministry.

SUMMER SWAMPS

THE WARMING CLIMATE will also hit drilling firms, which produce samples that determine if a mine is built. Permafrost is covered in a layer of soil that can quickly turn to swamp in summer, making it hard to operate tracked vehicles or move around without using helicopters.

"The warmer it gets, the tougher it gets ... For every dollar you spend on drilling you spend two on helicopters," said Francis McGuire of Canada-based Major Drilling, one of the world's largest drilling firms.

"We like things for us to be fairly cold because we want things to freeze ... We want a bit of snow, particularly on ice, because a bit of snow will insulate the ice, but we don't

want a lot of snow because then we can't move."

Although snowfall could increase as temperatures rise, Nunavut is currently so dry and cold that the average snow cover is only around 2 feet (0.6 metre) in winter, when frozen lakes and rivers can be turned into ice roads for the heavy trucks that supply the mines.

One such road, stretching 370 miles (600 km) to the Diavik and Ekati diamond mines in the Northwest Territories and then to the abandoned Jericho diamond mine in western Nunavut, costs around C\$35 million a year and operates for around eight to 10 weeks.

A warming Arctic could shrink the season and drive up costs. Indeed, one reason



LOCALS: Eva Aariak, premier of Nunavut, stands in front of a traditional Inuit print in her office in the capital Iqaluit. Nunavut has a largely unskilled aboriginal Inuit population of just 33,000. **REUTERS/DAVID LJUNGGREN**

given for Jericho's closure in 2008 was the unusually short life of the ice road in 2006, which meant some equipment had to be flown in. The University of California predicts that by 2050, increasing temperatures mean Canada could lose nearly 155,000 square miles (400,000 square km) of land accessible by winter road, an area slightly larger than Germany.

"With the ice melting and thinning and forming fewer months throughout the year, that could cause serious, serious nightmares for exploration in the North," said Benoit Beauchamp, who heads the Arctic Institute of North America at the University of Calgary.

And global warming will not necessarily help shipping. At the top of the world lies a permanent ice cap which is continually trying to force chunks of rock-hard permanent ice down into shipping channels. A large ice plug currently blocks the way but if it were to melt there would be nothing to stop icebergs from moving south and tearing holes into ships.

A more immediate threat is the almost total lack of infrastructure in Nunavut, which has no major ports and only one public road of any length. The departure lounge at Iqaluit's tiny airport is basically a large room and when three flights leave at the same time, as they do most afternoons, the result is mildly chaotic.

Other crucial services are also lacking. Some survivors from the recent crash in Resolute Bay had to be flown to a hospital in the federal capital Ottawa, some 2,100 miles (3,380 km) to the south.

WANTED: PORTS, ROADS AND AIRPORTS

"IT'S LUDICROUS WHEN you really look at the lack of resources or infrastructure that we have," grumbled Nunavut Premier Eva Aariak. She wants more help from the federal government, which in turn cites financial constraints as well as the lack of a formal land use plan for Nunavut.

After 17 years of negotiations, a draft might be ready later this year. Things move slowly in the North.

Companies gripe about a complex regulatory regime that means it can take years to get approval for projects. The Inuit, torn between the urgent need for jobs and a desire to protect the environment and wildlife they rely on for food, have an effective veto over most development.

Firms wanting to open a mine often have to strike special agreements with the Inuit, typically to cover compensation

for environmental disturbances and offer guarantees of employment.

"The upfront capital costs of working in Nunavut for a mining company are very, very high," said Chris Hanks of Newmont. "Are those agreements going to make or break projects? Probably not. But do they figure into the bigger range of economics that do make or break projects? Yes."

Nunavut would not start making real money from royalties until it struck oil. That day seems decades away, even though the U.S. Geological Survey estimates the Arctic as a whole contains 22 percent of the world's undiscovered, technically recoverable resources of oil and gas.

The one area of Nunavut known to contain energy reserves is in and around the ice-clogged waters of Ellef Rignes island - a slab of rock in the far north with the worst weather in Canada.

"It's a terrible place to get to ... It's a bad location; it's just a really difficult place to work," said Keith Dewing, who leads a team of government scientists studying where the most promising energy reserves might be.

"Our level of understanding up there is just not all that great in so many areas ... If someone came to you and said 'Hey, is there a resource there?,' it's embarrassing but you have to say 'You know what? I'm really not sure.'"

Even if oil were discovered in large quantities, it might never be extracted. A spill the size of the Gulf of Mexico disaster would be far tougher to handle, given the lack of infrastructure, the weather and the impact on wildlife which the Inuit rely on.

The Nunavut government, which is keen to develop the economy to help ease serious social problems among the Inuit, seems almost bemused by commentators linking climate change to a surge in mining activity.

"Most of the word that's out there is from (people) who have never visited Canada, (they) say that 'The ice is melting, the ice is gone'. Nothing is going to happen for many years yet ... I've got to say we're quite happy with what's happening now," said Peter Taptuna, minister for economic development.

(All figures U.S. dollars unless otherwise indicated)

(\$1=\$0.99 Canadian)

(Writing by David Ljunggren; Editing by Cynthia Osterman and Claudia Parsons)



TREASURE HUNTER : Jennifer Pell, chief geologist for the mining firm Peregrine Diamonds, stands on a hill above Iqaluit, capital of Nunavut, June 14, 2011.
REUTERS/DAVID LJUNGGREN

ARCTIC GEOLOGISTS WANTED; ONLY THE BOLD NEED APPLY

BY DAVID LJUNGGREN
IQUALUIT, NUNAVUT, AUG 31

ONE MEMORABLE ARCTIC trip in a battered DC-3 twin-engined propeller plane still makes Tom Hofer laugh nervously.

"They were having problems with it and the pilot came back ... and said 'If I yell at you that you need to do something for me, I want you to open the back door and I want you to throw out all this fish we have on board,'" he recalled.

Welcome to the gigantic deserted Canadian Arctic territory of Nunavut, home to supposed mineral riches and a stupendously challenging climate where temperatures often dip below minus 40 Celsius (minus 40 Fahrenheit.)

According to Hofer, executive director of the Northwest Territories and Nunavut chamber of mines, that's the point "when things start to break." You don't go outside unless you have to. You keep crucial engines running 24 hours a day.

And when the weather warms up, you need to keep an eye out for polar bears.

These are living conditions that deter all but the hardest professionals.

One of those is Jennifer Pell, chief geologist with mining firm Peregrine Diamonds <PGD.TO>, who spends months

a year working in one of the world's most desolate regions, where animals easily outnumber humans.

She concedes polar bears "don't always listen to what I think they should do," and takes no chances.

"You make sure that if you have got a crew out that is not right with the helicopter, that they're armed. And you make sure there's a firearm in the helicopter ... before you land it, you fly around and look for moving white things," she said.

Pell is quite used to taking a helicopter into the mountains with a stranger, a week's worth of food and a small tent. After decades of work spent variously in Brazil, Guinea and Canada she is still enthused by the search for diamonds.

"You're trying to find something, you're trying to solve puzzles, you're trying to understand the earth. It's like a big detective hunt," she said.

Others are fussier and this, combined with the challenges of working in the Arctic and the availability of jobs in more pleasant places, explains why some experts predict shortages of specialized labor in years to come.

Francis McGuire of Canada-based Major Drilling <MDI.TO> says it can take five years to teach someone how to drill in the Arctic. The next problem is getting them to live for

months in a camp in the middle of nowhere, even when they can earn up to C\$120,000 (\$122,000) for six months' work.

"Things have become much more comfortable in the last 10 years because now if you don't give them satellite Internet they're not going. It used to be 'Guys, bring a book', and now it's 'What do you mean I can't Skype my girlfriend every night?'" he said.

"It's hard to attract people, hard to train people, and even some of your trained people that have done it say 'I spent the last five years up there, I don't want to do it this season.'" he said. "Personally, I don't know how people are going to do all the drilling they want to do up North and expect the quality. We're going to have to dilute the quality."

The potential shortages stretch to geologists, says Karen Costello, manager of mineral resources at the office of the federal aboriginal affairs ministry in Nunavut.

At recent mining trade shows and conferences, she said, "there were lots of people who were looking to hire geologists and it wasn't just the junior companies, it was also some of the seniors."

(\$1=\$0.98 Canadian)

(Reporting by David Ljunggren;
Editing by Claudia Parsons)

MAIN EXPLORATION PROJECTS IN CANADA'S NUNAVUT

FACTBOX



ROUGH LIVING: Workers at Agnico-Eagle's Meadowbank gold mine endure biting cold, the threat of polar bears and long months of isolation, in addition to the normal dangers of working at a mine. **REUTERS/CHRIS WATTIE**

HERE ARE some of the main exploration projects in the giant Canadian territory of Nunavut, listed by company:

AGNICO-EAGLE MINES LTD

The only mine operating in Nunavut now is Agnico-Eagle's Meadowbank mine in south-eastern Nunavut, which officially opened in June 2010. It has proven and probable reserves of 3.5 million ounces of gold and is expected to produce on average 350,000 ounces of gold per year, over a nine year period.

Agnico-Eagle also has high hopes for the nearby Meliadine property and has committed \$130 million over two years in exploration and development. Meliadine has reserves of 2.6 million ounces of gold.

ARCELORMITTAL

Baffinland -- owned 70 percent by ArcelorMittal -- is proposing to invest C\$4.1 billion (\$4.2 billion) on a 149 km (93 mile) railway and two ports to exploit the huge Mary River iron ore deposit in the northern part of Baffin Island. It will also commission a special fleet of cargo ships. The mine is slated to produce 21 million tons of very high purity ore a year for 21 years.

AREVA

France's Areva has identified three uranium deposits at Kiggavik in south-eastern Nunavut. These would support a 17-year mine-life based on annual production rate of approximately 2,000 to 4,000 tonnes of uranium in the form of yellowcake. Some local Inuit, alarmed by the Japanese nuclear reactor disaster this year, are worried about possible environmental risks and their resistance could drag out an already lengthy approval process.

MINMETALS RESOURCES LTD'S MMG UNIT

MMG owns Izok Lake and High Lake, two properties in western Nunavut which between them have reserves of copper, zinc, lead, silver and gold. MMG plans a substantial drilling plan at Izok Lake this year. The firm notes that a key challenge to successfully developing the deposit is moving the concentrates to market from this remote part of Canada with little infrastructure.

NEWMONT MINING CORP

The 80-km (50-mile) long Hope Bay property in western Nunavut contains three gold deposits with a total potential reserve

of up to 9.0 million ounces. Newmont, which plans to spend \$310 million on Hope Bay this year, has invested around \$2 billion so far.

PEREGRINE DIAMONDS/ BHP BILLITON

A joint venture between Peregrine and BHP working at Chidliak, some 120 km (75 miles) northeast of the Nunavut capital Iqaluit, has discovered more than 50 diamond-bearing kimberlite rock formations, seven of which have characteristics that are consistent with economic potential in Arctic settings. It plans to spend \$18 million this year on exploration.

XINXING DUCTILE IRON PIPES / ADVANCED EXPLORATIONS INC

Xinxiing Ductile Iron Pipes, a subsidiary of China's state-owned Xinxiing Pipes Group Co Ltd, has created a joint venture with Canada's Advanced Explorations Inc to develop an iron mine in Roche Bay, eastern Nunavut. Xinxiing says it will invest \$20 million to complete the mine's feasibility study, a further \$30 million upon completion of the study and fund up to \$1 billion for the development of Roche Bay. Advanced Explorations says Roche Bay could produce 1 million tonnes of iron nuggets a year and should be able to pay off its initial capital cost of around \$1.1 billion within the first five years.

XSTRATA

In June 2011, Xstrata unit Xstrata Zinc bought the Hackett River property in western Nunavut, which has promising reserves of zinc and silver, from a junior mining firm. It also bought part of another property in the far west of Nunavut. Xstrata said it would spend C\$50 million on exploration and complete a feasibility study on both properties within four years.

(Note, sums are in U.S. dollars unless otherwise noted)
(\$1=0.98 Canadian)

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