On the road to Raglan: Rock reinforcement in conditions such as these requires special skill – and the right equipment is warmly welcomed.

Performing in PERMAFROST

With the ground permanently frozen to a depth of 425 metres, rock bolting at the Raglan nickel mine on Canada's remote Ungava Peninsula, had become a difficult and time-consuming procedure – until the switch to Swellex.

The Raglan mine is located in the extreme cold of northern Quebec, where the average annual temperature is –10 C with an average ambient temperature underground of –15 C.

One would think that such conditions would make mining a daunting task, but at Raglan the permafrost actually makes it easier.

Although the cold makes working conditions difficult, the ground is more stable because there is no water moving through fissures in the rock. With stopes of up to 30 metres wide and 105 metres long, ensuring ground stability is a high priority.

"The rock here is extremely competent," says Underground Mine Planner Ghislain Prévost at Raglan's Katinniq mine. "There are no ground stress problems, so our main consideration is the risk of falling blocks. Joint spacing is over 2 metres and we generally use 8 ft bolts for stability. But we're very careful to look for all joints in the rock and we use 12 ft bolts when we identify a potential wedge."

Previously, the mine used mechanical bolts and rebar set in resin for rock support. However, the mechanical bolts required periodic re-tensioning to be effective, which was labour intensive, and the use of resin posed significant logistical problems.

For example, using resin meant transporting an additional product to the mine site. In addition, ice prevents shipping during winter, so with only five shipments made to the mine each year, the resin needed to be stored and moved around the mine when it was needed.

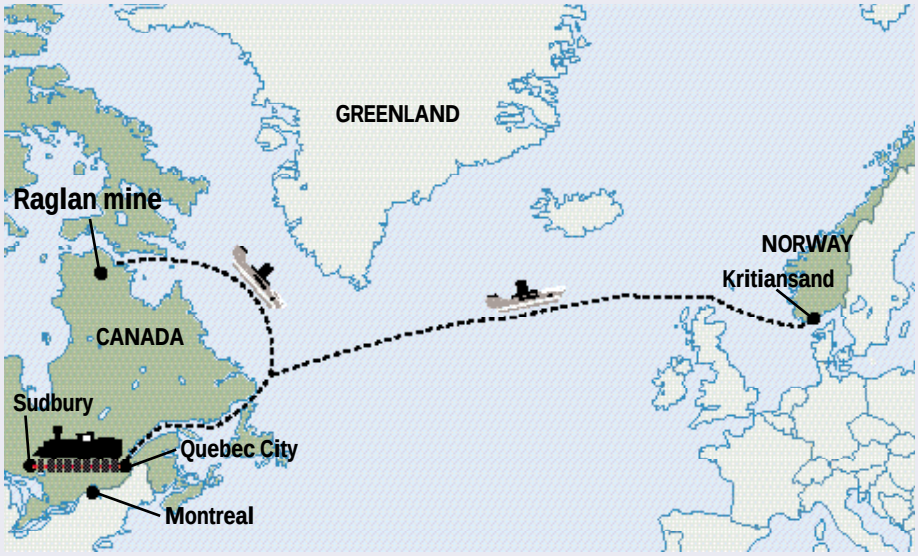
The severe temperatures at the site meant that the oil-based resin needed special heating boxes. The miners would often use too much of the resin, which lead to excessive fumes, creating a very unfriendly working environment.

"At one point, we lost some of the resin because the expiration date had run out," says Mr Prévost. "We had to make a special order and have it brought in by plane, which, needless to say, was very expensive."

Easy installation

After an extensive research and testing period, Raglan made the switch to Swellex bolts in 1999. Since then, they have been using Swellex almost exclusively in order to ensure consistent qual- ▶

In mining situations where the rock is extremely fractured, as in the illustration to the left and at Raglan mine, Swellex bolts help assist the rock mass to support itself and achieve its natural equalibrium.



From Canada to Norway: The eight-month shipping season permits six shipments per year to Quebec City, 250 km east of Montreal. From there, the ore travels about 1,000 km west by rail to Falconbridge's smelter in Sudbury, Ontario. The smelted material is then transported east back to Quebec City and then on to Falconbridge's refinery in Kristiansand, Norway.

ity of rock bolting while maximising productivity.

"The Swellex bolts are certainly easier to put in," says Raglan's Chief Engineer, Lee Weitzel. "The miner drills a hole, attaches the water line to the bolt's bushing head and inserts the bolt into the hole, then pumps it up to a pre-set pressure. The ease of installation has been a major plus, as it requires a minimum amount of training."

Adds Mr Prévost: "Not only are the Swellex bolts faster to install than mechanical or rebar bolts, but the quality of installation is much easier to monitor.

"Because the Swellex design requires water pressure to expand the rock bolt during installation, we have used a brine of water with calcium chloride to prevent it from freezing," says Mr Prévost.

"The brine is injected at a pre-set pressure in about seven seconds, which makes it simple to monitor the entire installation process." Initially, Mr Weitzel was concerned that injecting the brine might cause corrosion, but says: "It hasn't been a problem."

At Raglan, all drifts are screened and all stopes are bolted. This year Raglan is budgeted to use 6,500 of the 2 ft Swellex bolts for fastening screens in the 5 m wide drifts, 50,000 of the 5 ft bolts used largely in wall rock, 62,000 of the 8 ft bolts used for the back and 2,000 of the 12 ft Super Swellex bolts as needed.

Raglan's wheels: The mine uses Wagner trucks for all underground operations, including production and backfilling.

Testing under way

Super Swellex, made of 3 mm steel, is designed for a 43 to 52 mm drill hole range and has a minimum tensile strength of 20 tonnes. Standard and Midi-Swellex are 2 mm thick and are designed for holes 32-39 mm and 43-52 mm, respectively.

The only non-Swellex rock support at

Stepping up customer service in Canada

In 1999 Atlas Copco stepped up its services to customers in Canada by moving its service department from Montreal to Sudbury, Ontario, in the heart of the mining industry.

Customer Service Representatives are now available seven days a week, with an additional after-hours system that ensures all calls will be returned within 15 minutes, day or night, weekday or weekend.

Says Ian Hale, Customer Service & Logistics Manager: "We are constantly striving to find better ways of supporting our valued customers.

"Over the past three years, through all the challenges we have faced, we have developed a group with the right attitude, focus and drive. Everyone understands that there is only one reason we are all here – to provide the best possible service to our customers."

Ian Hale, Customer Service & Logistics Manager: "We are here to serve."

RAGLAN: THE COLD FACTS

History
First mapped in the 1930s, Raglan was put into commercial production in 1998 by Falconbridge Limited at a cost of CDN 700 million.

Mining methods
Predominantly conventional shovel-and-truck open pit, with an underground mine at Katinniq. At Katinniq, there are two mining methods in use: long-hole stoping and cut and fill.

Although large stopes are not typical at the mine, a stope planned for 2003 will measure 160 metres long and up to 63 metres wide.

The orebodies generally occur as pods and dip at a 30- to 45-degree angle making it unfavourable for the development of long-hole stopes. At any given time, Katinniq has 10 stopes in operation, with only one or two being the more productive long-hole stopes. The rest are cut-and-fill which, despite being more labour intensive, account for over half of the 50,000–55,000 tonnes of ore Katinniq produces each month.

Reserves
19.5 Mt (2.85% nickel, 0.79% copper), as well as significant recoverable cobalt and platinum-group metals.

Transport
Raglan is accessible by air and linked by an all-weather road to ship-loading facilities at Deception Bay, about 100 km to the east. The nearest supply town is Rouyn-Noranda, about 1,600 km south.

Production
In 2000, Raglan's annual ore production capacity was increased by 25% to 1 million tonnes. In 2001 it produced 24,570 tonnes of nickel, 6,920 tonnes of copper and 320 tonnes of cobalt, all contained in concentrate.

Personnel
Raglan employs about 475 people with miners working a four-week-in, two-week-out schedule and shifts from 7 am to 7 pm.

The extreme conditions at Raglan make any mining operation a difficult task.

Raglan is for spans of 16 metres or more where shotcrete pillars and cable bolts in grout are used. However, in mid-2002 the mine will test Swellex's Extendable rock bolt for bolts up to 24 ft.

Commenting on the testing, Mr Prévost says: "With the success we have had with all the other Swellex bolts, I'm very confident that the Extendable bolts will be a lot better than the ones we have been using."

The Extendable Swellex essentially consists of up to three 8 ft bolts that screw together to achieve the added length without losing strength or ease of installation.

"The Swellex bolts have stood up remarkably well since we made the switchover," concludes Mr Weitzel. "In fact, we did pull tests on bolts two to three years after installation and they still have the same strength. We're more than happy with them.

Swellex goes Manganese

Atlas Copco's Swellex rock bolts have a long and successful history based on two simple advantages: safety and productivity.

The latest range of frictional bolts, called the Manganese Line, dramatically increases performance – thanks to a new steel composition and innovative heat treatment.

The high-strength Manganese Line now offers a higher loading capacity and, at the same time, enhanced elongation.

The new Manganese (Mn) 24, replaces the Super Swellex bolt and has a tensile strength of 24 tonnes, while the Mn 16 and Mn 12 bolts replace Midi and Standard Swellex bolts with tensile strengths of 16 and 12 tonnes respectively.

There is a full range of sizes to accomodate a wide variety of bolting operations. More information about the new Manganese Line is available at: **www.swellex.com**