PO Box 188, Britannia Beach, BC, Canada, V0N 1J0 | Phone: 604-896-2233 | Fax: 604-896-2260 | www.bcmm.ca

MINING TECHNIQUES

THE MINE

There are a lot of important aspects of the mine. Let's look at them one-by-one:

Ore	Tunnels	Conditions Underground
Ventilation	Drilling	Explosions
Mucking	Safety	

ORE

- Chalcopyrite is the main copper ore found at Britannia
- Britannia ore was very copper rich
- Zinc, lead, silver, gold and cadmium were also extracted

This was what it was all about. The mountains around Britannia are rich in a mineral known as chalcopyrite (pronounced 'kal-ko-pie-rite'). This mineral is rich in copper and so is a copper ore, i.e. a mineral rich in a metal. In most cases, for an area to be worth mining, at least 1% of the rock needs to be made up of the ore. At Britannia up to 8% of the rock contained the ore. In other words, this was a very copper rich area. When the mine closed in 1974 it was operating at 1.25% ore – which is still enough to make a profit.

The miners did not drill randomly. Before they started a new tunnel or shaft, they would drill cores of rock. These cores were cut in half lengthways. One half was sent to the mine's Assay House. Here, geologists studied the cores to see if the rock was worth mining. The other half of the core was 'filed away' in Core Sheds.

But we all love a bargain! At Britannia there was more than a two-for-one deal. The rocks contained more than just copper ore. Other minerals contained other metals, and in large quantities too. Over the mine's 70 year life, this is what was extracted:

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Metal	Pounds	Tons	Kilograms	Equal to
Copper	1300 million	650,000	590 million	3250 jumbo jets
Zinc	274 million	137,000	124 million	675 jumbo jets
Lead	34 million	17,000	15.4 million	85 jumbo jets
Cadmium	1 million	500	450,000	2.5 jumbo jets
	Ounces			
Silver	6 million	188	170,000	31 elephants
Gold	500,000	15.6	14,000	2 (fat!) elephants

TUNNELS

- There are over 210 km of tunnel around Britannia
- The vertical shafts stretch 1750 metres in height

There are over 210 km (150 miles) of tunnel around Britiannia. Stretch them all out in a single line and it would almost reach from Vancouver to Seattle! Some of the individual tunnels are up to 16 km (10 miles) long.

Vertical shafts connect the tunnels. From top to bottom, there is a difference of 1750 metres in height, and the lowest tunnel is a staggering 600 metres below sea level.

CONDITIONS UNDERGROUND

- Early miners usually worked a 12 hour shift, 7 days a week
- A union formed in the 1940s which helped improve working conditions

Life as a miner was very hard. They worked 12 hours a day, 7 days a week in the early 1900s. It was dark, wet, cold, noisy, exhausting, dangerous and the only fresh air was back at the surface. As the years went by, conditions did improve though. Technology improved, and the formation of a union in the 1940s also forced the mine managers to improve standards.

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VENTILATION

- Fans were needed to blow fresh air through the tunnels and shafts constantly

The further underground you go, the less oxygen there is. The tunnels needed mechanical ventilation to blow fresh air into them. In fact, this is so important that many large mining companies employ ventilation engineers whose full time job is to make sure there is enough air in the mine.

'Primary ventilation' in a mine is usually done with very large fans built at some of the tunnel entrances. These fans either push or pull air through the mine. 'Secondary ventilation' was also used in working areas of the mine, where smaller fans and tubes made sure that enough air was blown into the areas where miners were spending most time.

DRILLING

- Early miners used hammers and chisels
- Later, mechanical drills were run on compressed air
- Water is needed to stop rock dust floating in the air, causing silicosis

We think of a drill as being something electrical. Why would we use muscle-power to drill something when electricity can make it easier? But of course in the early days of the mine, it wasn't that easy.

There were different drills used at Britannia through the years:

Single Jack The first type of drill. A miner held a chisel against the rock and hit it with a hammer. They gave the chisel a quarter-turn before the next hit to stop the chisel getting stuck.

Double Jack Like the Single Jack, only with two miners; one to hold a bigger chisel, the other to hit it with a sledge-hammer.

Both these methods were slow and exhausting. They were dangerous too and caused many injuries. It's easy to miss a chisel when you hit it with a hammer in daylight. Try doing it by candle-light!

As technology improved, mechanical drills were introduced:

Jackson Drill Used from 1906, this was mechanical, but still relied on the miner's muscle-power to hand-turn a crank that made the drill hit the rock, back and forth like a piston in a car. A ratchet turned the drill rod so that it didn't stick in the hole.

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Wood Drill
This was the first drill run on compressed air

Wood Drill Used by 1912, this drill works like the Jackson drill, only is run by compressed air, not muscle-power. It was faster, but did have some big problems. It was very heavy, needing at least three men to move it. The noise was awful, and because ear protection wasn't used in the early days, many miners became deaf.

The drill's biggest problem was the huge amounts of rock dust it produced. The dust contained tiny shards of crystalline silica – normally called quartz. When breathed in, these shards scar the lungs, leading to an often-fatal disease known as 'silicosis'. This led to the drill's nickname of the 'widow maker'. Early efforts to reduce the risk by using masks, or wetting the rock face didn't work very well. It wasn't until drills were modified to use water to dampen the dust that the problem was solved.

Stoper Drill Used by 1920, this was a very successful type of drill. It is run by compressed air, and has a water hose which feeds water through the drill bit. So the rock dust is turned to wet mud in the drill hole and runs off harmlessly. It can also drill straight up, or at an incline, and can drill a hole up to 4 metres in length. Stoper drills are still used today.

Jack-Leg Drill This is a lot like the Stoper Drill, only it allows the miner to drill in almost any direction, making it very versatile. However it doesn't drill vertically, so the Stoper Drill is used when vertical holes need to be drilled. This drill is also still used today.

Long Hole Drills Developed in the 1940s, these drills allowed the miner to add drill rods one after the other, to make a very long drill. At Britannia, holes were drilled up to about 30 metres (100 feet) in length. To use the drill, one rod was drilled 4 feet into the rock. The drill was pulled away and an extension rod coupled onto the first. The drill was replaced and the whole process repeated.

Diamond Core Drill This was the drill used to get the cores for the geologists (see Ore). This drill was hollow, like a giant drinking straw. The drill bit was studded with industrially-made diamonds for drilling into the hard rock. When it was drilled into the rock, because it was hollow, the rock was lodged inside – like pushing that drinking straw into sand. So when the drill was removed, the miners could take the core and send it to the Assay Building to be assessed for ore. Diamond drills could core through hundreds of metres of rock.

Modern drills are of course much more sophisticated. Many are tractor-mounted making them easy to move around. Called 'jumbo drills', a tractor is usually equipped with two or three drills mounted on booms that can all be run by the one operator. The drills are still run with compressed air and use water to suppress the dust, though the tractors are diesel-powered. Smaller drills are still used in tighter situations.

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EXPLOSIONS

- Explosives were loaded into the drilled holes
- They were detonated in sequence, from the middle out to the edge

All this drilling was only the first part of the process. The holes were drilled, not to break up the rock, but so that explosives could be used to blow the rock apart.

Explosives come in different forms: dynamite, powders, or liquids known as slurries. Dynamite sticks were used at Britannia.

A big circle was drawn on the rock using yellow paint or chalk; this showed the miners where to drill – all holes had to be within the circle. Once drilled, the holes were loaded with explosives, either by hand, or with a compressed air loader. About 30 holes were needed in the circle to make an average sized tunnel. The holes in the centre were left empty as that let the rock fracture more easily when the explosive was detonated.

To help the blast be most effective, the explosives were primed to go off in a 'ripple' sequence – with the explosives in the middle going off first. With the central rock blasted away, the next circle of explosives would more easily shift the rock they blasted, and so on. Another way of maximizing the blast was to plug the holes with wood, sand or a special clay before detonation.

To detonate the explosive, a fuse is attached to a blasting cap. When the fuse explodes the cap, it detonates the explosive. Fuses can either be electrical, or by a burning fuse – like those seen time and time again in older films and cartoons. With electrical detonation, a timing delay is used in each blasting cap. With burning fuse detonation, the fuses were lit in sequence.

The last explosives to detonate are on the perimeter of the circle. Because the energy is released most easily in the direction of the void already created, it doesn't blast the rock on the outside of the circle, and often leaves the 'memory', or pattern of the drill holes left in the rock.

Explosions were detonated at the end of a shift. This way, it allowed the dust to settle and the fumes to disperse before the next shift started.

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Mucking Machine

This mucking machine from the 1920s has the ore scoop on the front, which tips up and over into the ore cart at the back.

MUCKING

- 'Muck' was the blasted rock and ore
- Early miners had to move the muck by shovel
- Mechanical mucking machines were used by the 1920s

So once the miners have all this blasted rock – known as 'muck' – how did they get it from the tunnel to the surface?

For a long time, once again, the only way was with muscle-power. The miners used a shovel to load the ore onto an ore car. Two miners on a 12 hour shift, could load 16 to 20 tons – about the weight of three elephants. Before the days of engine-powered cars, the ore cars were pulled by men and mules or horses.

'Mucking machines' were introduced in the 1920s and made life much easier for the miners. These power loaders were engine-driven, and scooped the ore into a bucket. It then lifted the bucket into the air and dropped the ore into a bigger car behind the scoop. They could do in one hour, what the two miners could do in 12 hours.

Mucking machines are still used today, only they're much bigger.

SAFETY

- Safety standards needed to be very high
- Explosives and detonators were always kept secure, dry, highly visible and separate from each other
- After blasting, tunnel walls and roofs were made safe

Mining is a very dangerous occupation, and mine safety was very, very important.

Explosives Red lights in the tunnel meant danger. They were placed where the explosive magazines (store boxes) were placed. Only enough explosives for 24 hours were stored in a tunnel, and care was taken to keep them clean and dry – wet explosives were unpredictable. Magazines were made from wood as they wouldn't spark, and the door would be kept locked shut. Also, a 1 metre high stone wall protected the magazine in case a train derailed, and the magazine was set right back into the rock.

At least 10 metres (30 feet) away, a red wooden box stored the fuses and blasting caps. The only time they were anywhere near the explosives was when they were loaded into the holes for detonation.

In modern mining, magazines are bright yellow as it makes them easier to see.

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Before explosives were detonated, the area was cleared and the tunnel was guarded to stop anyone going in. Just before detonation 'Fire in the Hole' was shouted.

Solid Tunnels To prevent rock from caving into a tunnel, three main methods were used – scaling, screening and bracing.

To scale the tunnel, miners poked and prodded at the walls with a very long crowbar, called a scaling bar. An example of a scaling bar from Britannia was 4 metres (12 feet) long. This way, loose rock was brought down in a controlled way.

Screening involved drilling holes into the roof and inserting expanding rock bolts. When fixed in place, the bolts helped 'pull' the outer rock back towards the solid rock further back.

Bracing tunnels meant placing steel arches inside the tunnel and then fitting large timbers between the arches and the tunnel wall – these were nicknamed 'bandaids'. This was used mostly in tunnels or mines where the rock was weak, e.g. in a coal mine. Most of the rock at Britannia though was hard rock, meaning that cave-ins were much less likely.