Base Metals

Copper, Lead, and Zinc

Society as we know it would grind to a halt without the so-called base metals: copper, aluminium, lead, zinc, nickel, and tin. Motor vehicles and airplanes are laden with base metals, as are modern appliances, telecommunications devices, and the power generation and distribution systems that supply them. The information highway would be a footpath in the absence of base metals.

New Brunswick is fortunate to have a globally significant base-metal mining district located southwest of Bathurst. In this district, the ores are referred to as massive sulphide; an extremely fine-grained mixture dominated by pyrite (iron sulphide) along with base-metal sulphide minerals: chalcopyrite (copper-iron sulphide), galena (lead sulphide), sphalerite (zinc sulphide) as well as minor amounts of silver, gold, and a host of other metals in trace amounts. Since 1952, 45 deposits containing a pre-mining resource in excess of 500 million tonnes of a massive sulphide mineralization have been identified. Although not all these deposits are economically viable, no fewer than 10 have produced ore and three others have had significant underground development.

How were they formed?

The volcanic and sedimentary rocks containing the massive sulphides were formed on the floor of an ancient ocean approximately 470 million years ago. During a short (1–3 million year) hiatus in submarine volcanic activity, metal-laden hydrothermal fluids vented onto the sea floor. The metals in these fluids precipitated to form layers of iron and base-metal sulphides. Over time the deposits were buried and subsequent movement of the Earth's crustal plates closed the ocean basin hosting the deposits, which squeezed these rocks and uplifted and folded them into extensive mountains, building what would ultimately become the Appalachian Mountains.

BASE METALS

Brunswick No. 12 Mine

The largest of these deposits, the world-famous Brunswick No. 12, is located 23 km southwest of Bathurst and was discovered in 1954 during one of Canada's largest staking rushes. The deposit was huge: 1200 m long, extended to 1150 m below surface, and had a maximum thickness of 200 m. The Brunswick No. 12 Mine went into operation in 1964 and produced continuously until the ore body was exhausted in 2013. During its lifetime 136,643,367 tonnes of ore grading 3.44% lead, 8.74% zinc, 0.37% copper, and 102.2 g/t silver was produced. This deposit was among the largest of its type in the word, and the richest in terms of metal value.

This ore body was mined from underground, using several methods over the years. Much of the deposit was mined by a technique called open stoping, whereby vertical openings (20 m x 15 m x 30 m) were blasted to fragment blocks of ore bounded by un-blasted material. The fragmented ore was then removed from the base of the opening and passed to the bottom of the mine for crushing before being hoisted to surface for milling. The voids created by mining were filled using a technique called paste backfill, where a liquid mixture of tailings (waste material from the mill) and cement is pumped into the opening and allowed to cure like cement.

The Brunswick No. 12 Mine was at the forefront of mining technology advancement. For example, the Weasel, a remote-controlled unit used to drill holes for explosive charges, was developed in-house. Remotely controlled front end loaders (scoops) and trucks were used to remove rock and ore from blasted areas. The Brunswick No. 12 Mine was among the first to implement an advanced and comprehensive micro-seismic system to monitor stresses in the rocks to facilitate safe mine planning.

In the mill, ore was ground to a powder and mixed with frothing agents in flotation tanks. As gangue (waste materials) sank to the bottom of the tank, sulphide minerals stuck to the froth on the surface. Various chemical reagents were used to selectively float (as foam) specific sulphide minerals. These foams were skimmed off and dried to produce separate concentrates of: lead-silver, copper, zinc, and a bulk concentrate containing a mixture of metals. The lead-silver concentrate was sent to the smelter at Belledune where it was refined into copper matte, antimony-lead alloys, silver-gold doré, and bismuth alloys in successive steps. The other concentrates and smelter products were shipped throughout North America, Europe, Asia, South America, North Africa, and the Far East.

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