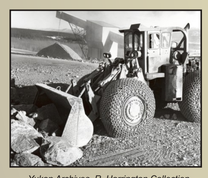
# Overview

## History

The Whitehorse Copper Belt consists of a string of over 30 copper occurrences roughly distributed parallel to the Alaska Highway. After the discovery of copper near Whitehorse in 1897 by prospectors on their way to the Klondike, the first claims were staked in 1898, and by 1899, most of the presently known deposits had been found.

Since then, mining has occurred in several episodes. High grade ore was extracted from nine underground mines between 1909 and1920, and shipped by train to southern smelters. Mining ceased after the First World War and resumed in the early sixties. By then, modern exploration and mining methods, grouping of individual claims into large claim blocks by major mining companies, rising copper prices and successful financing led to the outlining of new copper resources and the establishment of the infrastructure needed to mine them.

*Yukon Archives, Hamacher Fonds, Hougen Collection*
*A team of 12 horses hauls a 20-ton boiler to the Pueblo mine (ca. 1910).*



*Yukon Archives, R. Harrington Collection*

Six mineral deposits were mined in this second phase, mostly by open pit. The Little Chief mine was also mined by underground methods. All mining activity ceased when ore at the Little Chief mine was exhausted in 1982. Reserves of almost 3 million tonnes, distributed between five deposits, remained unmined.

The economic influence of the copper mines had a significant impact on transforming Whitehorse from a transportation hub to a stable community. The proximity of the town made this mining camp a very attractive one to work in. The Little Chief operation alone hired approximately 200 people for over 10 years. More than 10 million tonnes containing an average of 1.5% copper and significant values in gold and silver were mined between 1898 and 1982.

## General Geology

The copper minerals of the Whitehorse Copper Belt occur in a very specific geological setting called a copper skarn deposit. Skarn deposits form deep in the earth's crust where hot, fluid-rich molten rock material called magma cut through sedimentary rocks rich in lime, such as limestone. The interaction between the hot fluids in the magma and the limestone actually create a new rock type called skarn. Two types of skarns occur in the Copper Belt, each defined by its own set of characteristic minerals.

Iron skarn, also called magnetite-serpentine skarn, is dark grey to black and green, and contains mainly magnetite (a magnetic mineral) and serpentine. The other type, called calc-silicate skarn because the minerals are rich in calcium and silica, contains mainly brownish red garnet and light to dark green diopside, along with other minerals. Economic copper minerals, like bornite, chalcopyrite and malachite, can occur in either one of the types of skarns but the magnetite skarns are mostly richer in copper. Gold, silver and other metals are also found with the copper minerals.

***limestone***

+

***granodiorite magma***

=

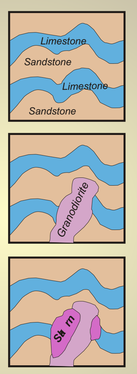
***calc-silicate skarn or Magnetite skarn***

Magmatic rocks can vary in composition. Here it is called a granodiorite. Once cooled, the rock shows a mixture of light and dark minerals. The limestone can vary in colour from white to grey to almost black, and it can be massive or banded. In the Copper Belt, the copper deposits are commonly located where specific lime-rich sedimentary layers occur near the granodiorite, and where the contact between the two rock types is wavy or irregular.

**Time 1:**
tilting and folding of sedimentary rocks

**Time 2:**
Intrusion of granodiorite magma into sedimentary rocks

**Time 3:**
interaction between hot magma and limestone produces skarn deposit




**Formation of skarn deposit**
**Cross-section view**

# Access through Municipal Landfill

## 1- War Eagle

*490443E, 6734179 N*

*War Eagle North: sedimentary beds dip towards the south at left; red iron oxide alteration at right.*

This deposit was originally staked by Sam McGee, who was made famous by a Robert Service poem. Underground mining in the early 1900s was followed by open pit mining in the early 1970s.

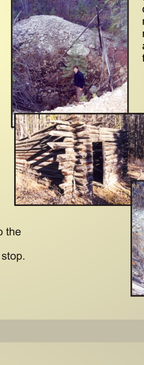
This calc-silicate rock occurs totally within sedimentary rocks. The contact with the igneous granodiorite is not exposed in the pit; it is assumed to be located about 300 m east of the pit. The ore minerals are chalcopyrite and bornite, with some molybdenite, a silvery molybdenum mineral. Some large, gold-coloured boulders in the bluish black rock waste dump, near the current tire dump, show nice examples of skarn.

The War Eagle North still shows evidence of copper mineralization at the bottom of the pit. It could not be mined economically due to the pit design. Since used as a land-fill site, the pit is now filled in with about a 30 m thickness of garbage.

The southern extension of the deposit, which proved to be small and shallow, is outlined by the War Eagle South excavation. The one wall is now revegetated with trees; scrap metal now outlines the eastern edge of the excavation.

## 2- Anaconda/ Copper Queen/ Rabbits Foot

*492063 E, 6734906 N* *491951 E, 6734915 N*
*491876 E, 6734845 N* *491839 E, 6734851 N*
*491907 E, 6735086 N*



Old excavations and outbuildings dating from the early 1900s are distributed west and south of the landfill road. Many are well mineralized in malachite (green), bornite (bluish black) and garnet (reddish-brown). Some trenching was done in the 1990s.

*Park at the landfill gate and go to the left (south), keeping to the outside of the electric fence till the end of the clearing. The first workings are located there. Other workings are distributed parallel to the dump road, between the electric fence and the "Don't trash the planet" sign.*

Malachite is visible on the west wall of Rabbitsfoot Canyon, just north of the entrance to the landfill on the Alaska Highway. This limestone outcrop is near the contact with the granodiorite. Observe it while driving by; the high speed traffic make it a poor choice to stop.

# Access through Copper Belt Mining and Railway Theme Park.

## 3- Copper King

*492201 E, 6733801 N*

*Looking at the Copper King adit area from the Fish Lake Road.*

Jack McIntyre staked this first claim of the Copper Belt in 1898, and episodic underground mining took place until the First World War. This calc-silicate skarn deposit is hosted in a pendant, or island, of sedimentary rocks totally surrounded by granodiorite.

The original adit has been covered over, but some old timbers can be seen through the waste material, near McIntyre Creek. Some machinery remains.

Good mineral samples can be found in the waste dump just south of the creek and in the trenches and pits located on top of the rock bluff as well as south of it.

*Underground workings used to "skylight" here but have since been bulldozed and levelled.*

*Malachite (green) and azurite (blue, above); garnet (honey-coloured, left).*

*Road access to the Copper King is through the Copper Belt Mining and Railway Theme Park. A rough road (take a right at the power line) leads to the adit area on the south bank of McIntyre Creek (top photo). A left fork leads to the workings on the south side of the bluff (bottom photos). A short dirt road branching off Fish Lake Road also leads to the adit area but the small bridge across McIntyre Creek has been washed out.*

## 4- Carlisle

*492415 E, 6733672 N*

This is all that remains of the Carlisle, a small underground mine from the turn of the last century. Signs of copper mineralization can be found in the calc-silicate waste material that now covers the old mine site. This deposit is located on the same limestone pendant as the Copper King.

*Located at the junction between the 10K and the Powerline ski trails (Whitehorse Cross Country Ski Club), this occurrence is accessed by 4WD vehicle following the same access road as to the Copper King and by taking a series of left forks. Park before the snowmobile club trail sign and walk to the ski trail.*

# Access via Fish Lake Road

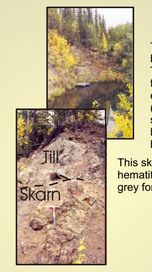
## 5- Fish Lake Road lookout

*491792 E, 6733207 N*

This lookout offers a good exposure of the granodiorite and a great view of the McIntyre meltwater channel (see stop 9). Notice the the steep banks and flat, narrow creek bed, distinctive features of a long-lived meltwater channel developed in bedrock.

Upstream, the channel is wider and shallower since it is eroding softer, less resistant glacial sediments.

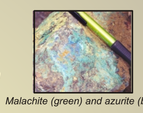
*This stop is located on the Fish Lake Road, 1.5 km west of the Alaska Highway.*




*7A- This plaque, located on the Fish Lake Road, at the entrance to the Icy Waters fish farm, lists the name of the six miners who perished in the accident.*

## 7- Pueblo

*490417 E, 6732051 N*



*Malachite (green) and azurite (blue)*

The Pueblo was the largest of the early mines, but still a small deposit by modern standards. The old mine workings are now covered by the fish farm development. Outcrop at the southern end of the small lake consists of a bouldery till (see box 8) overlying oxidized (rusty) copper skarn, indicating that glaciers eroded the bedrock down to the level of mineralization before depositing the till.

This skarn is unusual as it contains specular hematite (specularite), a non-magnetic metallic grey form of iron oxide.

*Pueblo Mine, Yukon Archives, John Scott Fonds*

The Pueblo was a "wet" mine in an area cut by many faults. A cave-in occurred in 1917 trapping nine miners. A diamond-drill crew established a speed record by pushing an 85-foot (26 m) drift in 72 hours, and in doing so rescued three survivors.

# Access via Copper Haul Road / North

## 8- Till at McIntyre Marsh Viewing Platform

*490387 E, 6732025 N*

Till deposits are left over after moving glaciers scraped the underlying bedrock, carrying clay, silt, sand, pebbles and boulders in the ice, and then the sediment-laden meltwater plastered the resulting mixture on the surface of the bedrock like smearing peanut butter on a piece of bread. Layering at the top of the section indicates later modification by streams.

The top brownish layer results from of weathering of the till. White crumbly **caliche** (calcium carbonate), seen as horizontal or vertical layers and seams, formed from the evaporation of groundwater.

## 9- McIntyre Creek Meltwater Channel

*491806 E, 6728386 N*

*McIntyre meltwater channel, oblique air photo.*

Meltwater channels were formed at the end of the last ice age. Meltwater flowed off the side of valley glaciers, carving channels roughly oriented parallel to the main valley direction, as water was flowing parallel to the ice-filled valley. The resulting channels are mostly steep-sided valleys with flat bottoms, they now contain only small streams and marshes.

The meltwater carved through (or eroded) glacial sediments and bedrock and in doing so exposed some of the copper occurrences. Many of the early workings, such as the Pueblo, Copper King, Empress of India and Big Chief, are located in or adjacent to meltwater channels. Without this erosion, these deposits may have remained buried and left undiscovered.

Modern McIntyre Creek flows in a meltwater channel that can be observed from several vantage points on the haul road.

## 10- Till-Haul Road

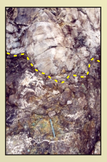
*492171 E, 6727809 N*


Till (see stop 8), was transported by glaciers and deposited on top of the granodiorite. The dashed line marks the surface of the rock outcrop before it was covered by glacial deposits.

## 12- Spring Creek

*493142 E, 6726927 N*

This occurrence consists of two main showings. A first excavation shows abundant pink banded and massive garnet, along with malachite, bornite, epidote and quartz.



The second is a sluffed-in adit 0.5 m X 1 m wide, located on a sharp contact (yellow dash in left photo) between limestone (above) and an irregular skarn zone (below) that contains epidote, garnet, malachite, azurite and quartz.

These workings are at the end of a bulldozer trail built to support a drilling program during the 1970s.

## 13- Empress of India

Work on this skarn between 1900 and 1910 included trenches at the top of the bluff, and two adits in limestone at the base of it. This showing has never been drilled.

The trenches contain bornite, chalcopyrite, malachite, azurite, epidote, garnet, actinolite and abundant quartz, at the skarn-limestone contact. The garnet here is unusual (photo top right); its amber colour is due to its lower iron content than that of the more common red variety.

Another **adit** is located on the west bank of the creek, driven through barren (unmineralized) limestone.

Two excavations are located 100 m apart. One contains many colourful minerals such as epidote, actinolite, quartz, amber-coloured garnet, calcite, malachite and azurite. An impressive malachite-stained face is located a bit further to the south (photo above left).

## 11- Limestone Haul Road

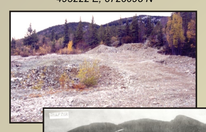
*492725 E, 6726665 N*

Banding between white and grey limestone is visible at the northern end of this large outcrop.

# Access via Haul Road/ Central

## 14- Grafter

*493222 E, 6726095 N*

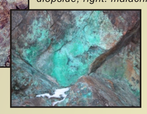


This small deposit produced 12,200 tonnes of high grade ore (6% copper) by underground mining in the early 1900s. A vertical shaft led to three levels, the deepest being about 150 m below the surface. The headframe, shop, boilers and other equipment have all been dismantled, and the area has been levelled. Exploratory drilling conducted in 1974 and in 1990 did not lead to further development.

*Yukon Archives, John Scott Fonds.*

The deposit is a steep and pipe-shaped magnetite-serpentine skarn close to the diorite contact. Chalcopyrite is the main ore mineral. Epidote, malachite and massive red garnet and fine-grained diopside can be found in the loose bulldozed material.

Try to locate some small hand trenches in an outcrop of *magnetite* skarn in the trees, just south of the main open bulldozed area. *493277E, 6726092N*



*Left: classic calc-silicate skarn consisting of coarse reddish brown garnet with fine-grained light green diopside; right: malachite coating.*

A few trenches in skarn, and a large diameter steel tube marking the location of a diamond drill hole (drill casing), are located a few hundred metres up the road to the west. The gradual contact between the limestone, skarn, and granodiorite can be determined from the exposed rocks. *493193 E, 6726054N*

*Ruins of a century-old tram, between the Grafter and the Copper Haul road.*

## 15- Best Chance

*493414E, 6726350 N*

The name of this small deposit, originally staked as the "Last Chance" claims, was changed when results proved encouraging. Underground mining in the early 1900's was followed by some drill testing in the 1950s, which outlined a small deposit considered uneconomic at the time.

The outcrop consists of spectacular magnetite skarn, containing brassy yellow chalcopyrite and bornite. Did you bring a magnet? In places, copper is altered to bright green malachite; very little serpentine is present, which is unusual for a magnetite skarn.

A series of old excavations are located around the main outcrop, next to the Haul Road, and further east in the trees. The white cement pillar on top of the outcrop is a geodetic survey monument.

*Robert Stroshein, former geologist for Hudson Bay Mining and Smelting Ltd, carefully inspects a century-old high-grade mine site. Note the malachite staining on the rock face.*

## 16- Grafter extension

*493383 E, 6726302 N*

This outcrop, located across the haul road (west side) from the Best Chance, demonstrates the formation of a skarn at the contact between limestone and granodiorite.


## 17- Granodiorite

*493525 E, 6726033 N*



This good exposure of granodiorite occurs on the east side of the haul road. Notice the straight parallel fractures, called joints. Observe the salt and pepper texture caused by the light and dark minerals, feldspar and hornblende respectively.

## 19- Whitepass spur line

*494766E, 6724182 N*



In 1907, the White Pass and Yukon Railways started to build a spur line to connect the Pueblo mine to the main railway; it was completed in 1910.

The Copper Haul Road was built by New Imperial Mines in 1969, and followed the same course as the railway. Where the valley bottom is flat, the rail bed can still be seen just east of the Haul Road. After almost 100 years, the berm and break in slope are still visible.

## 18- Arctic Chief




Two separate pods of dark magnetite-serpentine skarn with brown and green garnet-diopside skarn occur on the west flank of a pendant of sedimentary rock enclosed in granodiorite. The Arctic Chief West was mined underground in the early 1900's. Both deposits were later mined as two separate open pits in the late 1960's. These deposits were quite rich as they contained 1.5% copper with the highest silver and gold grades of the recent mines. A third zone, the Arctic Chief South, was not rich enough to be mined.

This is a popular area for mineral collecting; rock falls are common so use caution and stay away from the pit walls.

### Arctic Chief west

*493605 E, 6725078 N*
**Private, phone 633-3677 for permission to access**




*Arctic Chief West pit, Dave Tenney (former New Imperial Mines mine geologist) for scale. Note the disrupted fold in the banded limestone*

The west pit contains a lens of magnetite skarn at the contact between limestone and granodiorite. The dark and rusty skarn lens stands in contrast with the light grey limestone. Folding is evident in the pit wall. Yellow serpentine is present. Note the timbers sticking out half-way up the north wall, marking the location of an old mining tunnel.

### Arctic Chief East

*493706 E, 6725162 N*





*Arctic Chief East pit (above); wedge of limestone totally surrounded by garnet-diopside skarn (right).*

Patches of dark magnetite skarn occur on the pit walls (with spectacular azurite and malachite) A wide granitic dyke cuts off the ore lens. Vertical drill holes, used to load explosives for blasting, are still visible on the north wall.

Large boulders at the entrance to the pit display very good examples of copper minerals (chalcopyrite, bornite, malachite) and skarn minerals (garnet, serpentine, diopside).

# Stops 20 to 24- Little Chief mining operations

## 20- Little Chief portal

*496326 E, 6722824 N*

The former entrance (marked with red arrow) to the Little Chief underground mine has been filled in with crushed rocks, making it impassable. A sloping tunnel (called a decline) led to the Little and Middle Chief deposits located further south, a shaft also provided access. The floor of a small building is all that remains of the old storage buildings,



*View looking west*



*Miners at the portal, circa 1970.*

*Yukon Archives Whitehorse Star Collection*

## 21- Mill Site

*496724 E, 6722803 N*

The former mill site was located west of the tailings pond. The underground ore was transported to the surface using a series of inclined conveyor ramps. It was stored in the cylindrical ore bin, and was then crushed and ground and made into a slurry. The copper minerals were separated chemically by flotation and then dried. The resulting copper concentrate was shipped by truck to Skagway, and by container-ship to Japanese smelters via Vancouver. The waste material was stored in the tailings pond (see stop 23).



*Yukon Archives Richard Harrington Collection*

*New Imperial Mines Ltd.: Surface buildings, circa 1970. The cylindrical tank was a storage bin for finely crushed ore.*

## 22- Big Chief

*496485 E, 6722482 N*



This impressive showing at the surface received the biggest name of the "Chiefs" but it did not extend at depth and therefore was never mined. Trenches and surface pits date from the turn of the last century.

Malachite from the Big Chief showing is visible from the haul road (top photo, looking east). A close up (bottom photo) reveals the details of the contact between grey limestone (right of dashed line) and dark green magnetite-serpentine-malachite skarn (left of line).



*Banded magnetite and yellow serpentine skarn*

## 23- Tailings and revegetation

*496929E, 6722798 N*




*View of the tailings pond looking east.*

The tailings pond contains the ground up silt- and sand-sized particles leftover from the milling process. These are impounded by berms (or levees) made of crushed rock. Tailings are several metres deep, are neutralized by the abundant limestone and contain no water, therefore pose no risk to the local groundwater. The main impact is from the dust created when strong winds blow across the fine-grained tailings.

Very little vegetation has naturally taken root on the tailings, due to poor soil conditions. A 2-year study by Craig and Craig (1) has shown that composting and irrigation sufficiently improved soil conditions so that planted native grasses survived and germinated, trees survived, wind erosion was reduced, and some birds and animals returned. Modern mining reclamation practices, put in place after the 1982 mine closure, now require that disturbed areas be revegetated after completion of mining. 23A *497258 E, 6723360 N*



*Planted grasses and pine seedlings thrive where compost was added to mine tailings (above).*




## 24- Little Chief pit

*496741 E, 6722062 N*

The Little Chief mine, which included the Middle Chief deposit, was the largest of the Copper Belt mines. It provided employment for approximately 200 people for more than 10 years.

Modern exploration methods outlined a deposit that was mined by open pit from 1967 to 1969. Drilling from the bottom of the pit outlined an even bigger deposit than what had been mined from the surface: 7.4 million tonnes were mined by underground operation from 1972 to 1982.



The deposit was a classic magnetite-serpentine skarn, with bornite, chalcopyrite and valleriite as the main ore minerals. Free gold was recovered during the milling process. Garnet-diopside skarn occur west of the ore lens and can still be seen on the remaining bench on the west side of the pit. The pink mineral thulite can be seen on some boulders.




*Top: Little Chief pit, looking northeast; Right: slumping ground on east side of pit, dashed line marks trace of scarp surfaces.*

Collapse and subsidence on the east side of the pit resulted from the failure of a crown pillar in the underground mine. The waste dump on the flat area further to the east yields better mineral samples and provides a safer collecting site than the edge of the mined-out pit.

# Access via Fireweed Drive/ Mary Lake subdivision

## 28- Keewenaw

*502145 E, 6715811 N*

This is the only mine in the Copper Belt where the copper minerals are hosted in the granodiorite, rather than in the sedimentary rocks. This type of rock is called an endoskarn, as the skarn formed within the intrusive rock. Boulders at the base of the waste dump display complex alteration and intrusive textures.

Highly oxidized rocks near the surface contain green copper-oxide, silicate and carbonate minerals. Deeper, where surface waters have not oxidized the rocks, the copper is in sulphide minerals such as in bornite, chalcopyrite, chalcocite and covellite (see the spectacular boulder lining trail to Wolf Creek, photo lower far right); there is no magnetite. Other skarn minerals include epidote, thulite and potassium feldspar. Native gold was reported. Late stage dark basaltic dykes are visible in the far wall of the pit.

This was the last open pit mined by Whitehorse Copper Mines. It shut down in June of 1971 due to falling copper prices. The lower part of the pit remains unmined.



*Variety of granodiorite textures (left and centre) with pink potassium alteration (left); mine waste dump (far right).*



*Chrysocolla, bornite, malachite (top left); Keewenaw pit looking north (top right); boulder of bornite, covellite, malachite (right).*

## 29- Gem

*502454 E, 6716089 N*



*The ground surface, stripped of the overburden, shows the distribution of white limestone and dark grey and green magnetite skarn.*

This large but low-grade magnetite skarn was stripped of the overlying glacial sediment in preparation for mining in 1970. Further study determined that the geometry of the deposit was more complicated than first thought and that the deposit would be uneconomic to mine, so development work on this zone was halted.

## 30- Black cub south

*502920 E, 6714905 N*



This deposit was discovered by modern geophysical techniques as the bedrock in the area is covered by thick glacial sediments. The magnetic and electrical properties of the ore body were in sharp contrast with those of the surrounding rocks. Mined in 1971 while the Little Chief deposit was being readied for underground mining, this magnetite-serpentine skarn deposit produced 170,000 tonnes of copper ore consisting of bornite and chalcopyrite, but also of chalcocite, native copper and cuprite. Other minerals present included diopside, actinolite, talc, chlorite and garnet.

The linear shape of the mined-out pit shows that the deposit was a steep and narrow lens, roughly parallel to bedding. It now provides a popular summer swimming hole.





*Counter clockwise: claim post on rock waste dump; open pit looking to northwest; limestone outcrop at the northern end of the waste dump.*

## 31- Cowley Park

*505918 E, 6715477 N*



This calc-silicate skarn deposit is unusual in that it contains significant amounts of molybdenite (like at the War Eagle), in addition to silver, gold and copper. A 5000 tonnes bulk sample was taken to test the recovery of the metals (photo to left). Reserves of 884,000 tonnes have been calculated but not yet been mined.

The steep tabular ore lens is 300 m long and is enclosed in calc-silicate skarn at the contact between limestone and granodiorite.

In addition to molybdenite, minerals include garnet, diopside, actinolite, tremolite, wollastonite, with disseminated chalcopyrite and bornite, and minor magnetite and serpentine.

*Walk around the cleared area, you'll discover many signs of past exploration.*





*Malachite on pit wall (left) and on closely-spaced fractures (right).*

## Pressed for time?

**The following stops offer a good overview of the main highlights of the Copper Belt:**

**3: Copper King**
**5: Fish Lake Road lookout**
**15: Best Chance**
**16: Grafter extension**
**18: Arctic Chief**
**20-24: Little Chief**
**28: Keewenah.**

YGS Open File 2004-15

# THE WHITEHORSE COPPER BELT, YUKON

## An Annotated Geology Map

Sheet 2 of 2


Compiled by Danièle Héon
April 2004

with contributions by:
Jeff Bond, George Gilbert, Dave Tenney, Forest Pearson, Robert Stroshein and Amy Stuart.



Yukon Geological Survey

Yukon Energy, Mines and Resources