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THE WHITEHORSE COPPER BELT - A COMPILATION
Exploration and Geological Services Division, Yukon
Indian and Northern Affairs Canada
1984 - original notes by P.H. Watson
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GENERAL GEOLOGY

The Whitehorse Copper Belt lies within the Whitehorse Trough, a northwest trending island arc complex of upper Paleozoic to Jurassic age. Within a 32 km. long, northwest trending belt, copper-bearing skarns occur mainly in upper Triassic Lewes River Group carbonate and clastic rocks, along the west contact of a Cretaceous quartz diorite batholith.

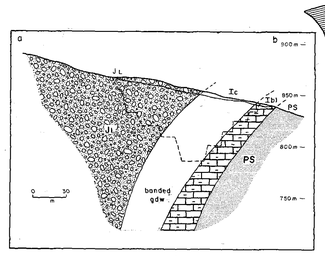
The carbonate units are both dolomitic and calcareous. In general, dolomitic units host magnetite-serpentine skarns, with red to brown garnet, bornite greater than chalcopyrite and valleriite. Calcareous units host magnetite-free wollastonite skarns with beige to yellow garnet, chalcopyrite greater than bornite and molybdenite.

HISTORY

Copper was first discovered in the Whitehorse area in 1897. The first claim, the Copper King, was staked July 6, 1898, by Jack McIntyre. Most of the presently known deposits were staked by 1899 with several properties shipping small ore tonnages between 1900 and 1912. The Pueblo Mine produced 127,000 tonnes between 1912 and 1920.

The next major production period began in 1967, when New Imperial Mines Limited began mining the Little Chief open pit. In 1968, production also came from the Arctic Chief open pits. Both these areas were shut down in 1969, and in 1970 the War Eagle pit came into production. In 1971, mining also took place at the Black Cub South and Keewenaw pits, until operations were suspended in mid-year. The company name was changed to Whitehorse Copper Mines Limited and production began again in December 1972, from the Little Chief-Middle Chief underground mine. In December 1982 the ore body was exhausted and all mining operations in the Copper Belt ceased. Between 1898 and 1982, approximately 10 million tonnes of 1.5% copper, with values in gold and silver, were mined.

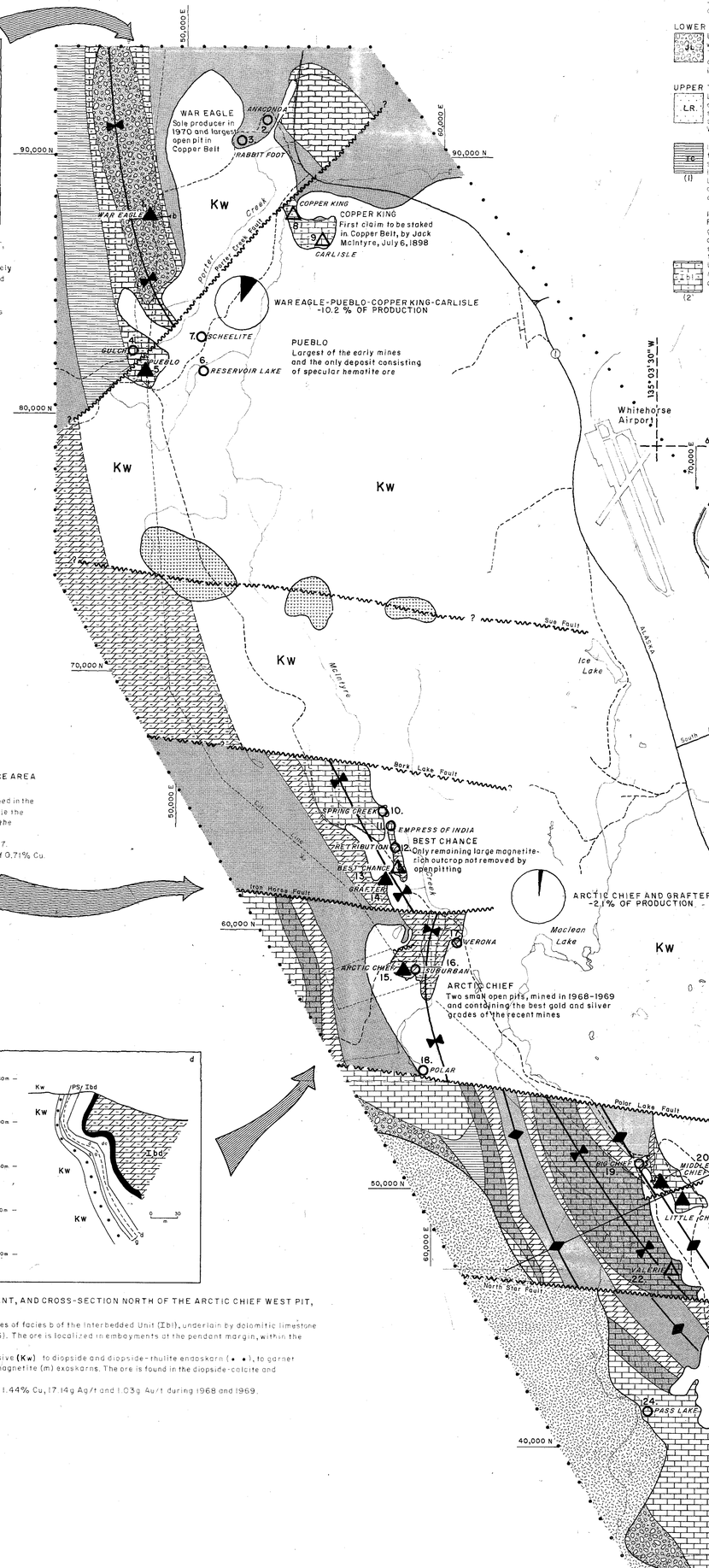
The summary table at the bottom groups 36 occurrences in the Copper Belt by host rock type; it indicates readily visible distinctive ore and skarn mineralogy and lists development, production/reserves and grade information for each occurrence.



GEOLOGICAL CROSS-SECTION OF THE WAR EAGLE DEPOSIT, LOOKING 350° (after Morrison, 1981)

The deposit is located on the east limb of a syncline, approximately 300m west of the intrusive contact. The ore is found in banded garnet-diopside-wollastonite skarn (limestone and siltstone of facies c of the Interbedded Unit (Tc)).

The War Eagle open pit (outlined) produced 894,000 tonnes of 1.25% Cu, 8.57g Ag/t, 0.22g Au/t and 0.005% MoS_2 in 1970.



LEGEND

QUATERNARY

QM — MILES CANYON BASALT - thin, grey to black, vesicular basalt flows, commonly with columnar jointing and in some places, olivine. Scoria, flow tops and intercalated breccia and tuff are commonly reddish in colour.

MID-CRETACEOUS

KM — MOUNT McINTYRE PLUTON - pink to grey, locally granophyric, monzonite to quartz monzonite.

Kw — WHITEHORSE BATHOLITH - grey, equigranular, medium to coarse grained, biotite-hornblende quartz monzonite to granodiorite and hornblende quartz diorite. The interior part of the batholith is a uniform massive quartz monzonite - granodiorite while the margins and apophyses are locally coarser-grained quartz diorite.

LOWER TO MIDDLE JURASSIC

JL — LABERGE GROUP - poorly sorted greywacke and sandstone with interbedded argillite and siltstone (no calcareous units). To the west, coarser material and conglomerates consisting of volcanic and granitic clasts are found. The unit is interpreted as fanglomerate.

UPPER TRIASSIC

LR — LEWES RIVER GROUP - a mixture of calcareous and dolomitic siltstone, sandstone and mudstone; pyritic siltstone, sandstone, argillite, limestone, dolomite and fragmental rocks, subdivided into the following eight units within the Whitehorse Copper Belt:

Tc (1) — INTERBEDDED UNIT, FACIES c - equal portions of non-fossiliferous, pyritic siltstone and calcareous siltstone to sandstone, with occasional thin carbonate beds. Partially laterally equivalent to, and partially overlying Grey Limestone, this unit is interpreted as having been deposited in a lagoon receiving sediments from erosion of a foreland on one side and carbonate reefs on the other.

INTERBEDDED UNIT, FACIES b - Facies b consists of alternating, massive, white to grey carbonate sandstone and laminated, black carbonate mudstone, with local interbeds of pyritic siltstone, sandstone and conglomerate. It includes the two following sub-facies:

Tbl (2) — Limestone Sub-Facies - this limestone-dominant unit makes up the upper part of the facies, interpreted as off-reef and off-bank erosional accumulations.

Tbd (3) — Dolomitic Limestone Sub-Facies - Dolomitic rocks are restricted to the lower sub-facies. The unit represents off-reef and off-bank erosional accumulations.

GL (4) — GREY LIMESTONE - discrete and stacked lenses of light grey weathering, fossiliferous limestone cap many of the low hills in the area. The unit grades down into Black Limestone and interfingers with the overlying Interbedded Unit. Six lithofacies based on fossil types were identified by Morrison (1981). The unit is interpreted as being widely spaced, framework patch reefs, developed along the bank margin.

BL (5) — BLACK LIMESTONE - carbonaceous limy mud with variable fossil content and 2 - 5% carbonaceous material, grades upwards into Grey Limestone and is in sharp contact with the underlying Dolomite. The unit has been divided into three distinct lithofacies based on fossil content and is interpreted as a subtidal, shallow dipping mudstone bank with local patch reefs.

D (6) — DOLOMITE - two light coloured lithofacies make up 90% of this unit. The remaining 10% is made up of 3 lithofacies, all containing black mudstone, which are concentrated as interbeds near the top of the unit. The environment is interpreted as a tidal flat with local euxinic tidal pools and channels.

PS (7) — PYRITIC SILTSTONE AND SANDSTONE - rusty-weathering, dark red-brown to dark grey, massive siltstone with hornfelsic texture is locally laminated and contains 2 - 5% pyrite. Pyritic siltstone is poorly sorted and contains interbeds and lenses of sandstone, grit and tuff. In some areas it forms the upper part of graded sequences within the sandstone unit. The unit was formed in a shallow marine to intertidal area with restricted water movement, such as near shore, back beach lagoon, overlying beach sands.

FR (8) — FRAGMENTAL ROCKS - volcanic breccia and tuff of basalt to basaltic andesite composition, containing intercalated conglomerate, sandstone and minor limestone, outcrops mainly to the west of the area shown. Diamond drilling has indicated that this material underlies the other units in the central part of the Copper Belt.

DYKES - Dykes are common throughout the map area, and can be divided into the following four types:
a) dark grey to black, aphanitic to very fine grained basalt and porphyritic basalt dykes believed to be feeders to Miles Canyon Basalt;
b) grey porphyritic andesite dykes believed to be associated with sub-volcanic portions of Eocene and Late Cretaceous plutonic suites;
c) grey to green, very fine grained andesite - dacite dykes (sometimes porphyritic);
d) pink to grey monzonite to quartz monzonite dykes, believed to be related to the Mount McIntyre pluton.

SKARNS

En — Endoskarn - skarn assemblage developed in the intrusive rocks

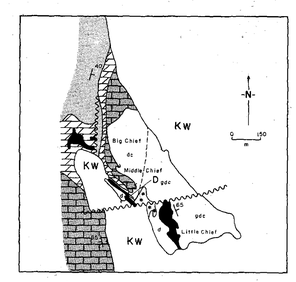
En-Ex — Endoskarn-Exoskarn - skarn assemblage developed in both the intrusive and sedimentary rocks

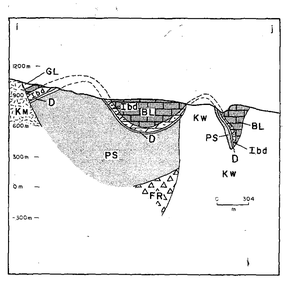
■ m — massive to banded magnetite-rich
g — massive garnet
d — massive diopside
dc — massive diopside-calcite
dcg — banded diopside, calcite, garnet
gdc — massive garnet-diopside-calcite
gwc — massive to banded garnet-wollastonite-calcite
gdw — banded garnet, diopside, wollastonite

▲ Production > 10,000 tonnes
△ Production < 10,000 tonnes
△ Known Reserves > 10,000 tonnes
○ No Known Production

Syncline
Anticline

SCALE 1:25000
Miles 0 1 2 Miles
Metres 1000 500 0 1000 2000 3000 Metres



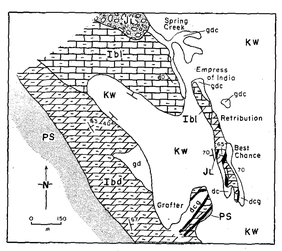


DETAILED GEOLOGICAL MAP AND INTERPRETED CROSS-SECTION, CHIEF MINE, OF THE LITTLE CHIEF PENDANT LOOKING 335° (after Morrison, 1981)

The Little Chief pendant is interpreted as a carbonate 'flap' within the edge of the Whitehorse batholith (Tenney, 1981). The Little and Middle Chief deposits are faulted segments of the same skarn. All three bodies are found in the Dolomite unit (D), which is underlain by Pyritic Siltstone (PS) and overlain by Black Limestone (BL) mixed with the dolomitic sub-facies of facies b of the Interbedded Unit (Ibd).

The schematic cross-section covers 2.75 km from the Mount McIntyre Pluton in the west, to the Whitehorse batholith in the east.

The Little Chief open pit produced 1,128,000 tonnes of 1.29% Cu from 1967 to 1969. The underground operation produced 7,620,000 tonnes of 1.53% Cu, 6.51g Ag/t and 0.58g Au/t from 1972 to 1982.

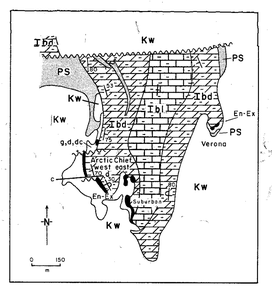


DETAILED GEOLOGICAL MAP OF THE GRAFTER-BEST CHANCE AREA (after Morrison, 1981)

The Grafter, Best Chance and Retribution mineralized skarns formed in the dolomitic sub-facies of facies b of the Interbedded Unit (Ibd), while the Empress of India and Spring Creek mineralized skarns formed in the overlying limestone sub-facies of facies b (Ibl).

The Grafter deposit produced 12,200 tonnes of 6% Cu prior to 1917.

The Best Chance deposit contains an estimated 447,000 tonnes of 0.71% Cu.

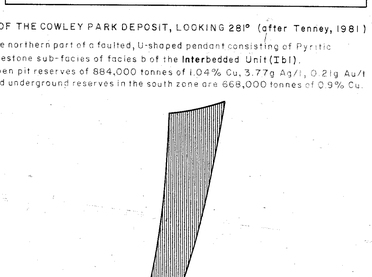


DETAILED GEOLOGICAL MAP OF THE ARCTIC CHIEF PENDANT, AND CROSS-SECTION NORTH OF THE ARCTIC CHIEF WEST PIT, LOOKING 355° (after Morrison, 1981)

The U-shaped pendant consists of a core of the limestone sub-facies of facies b of the Interbedded Unit (Ibl), underlain by dolomitic limestone of facies b of the Interbedded Unit (Ibd) and Pyritic Siltstone (PS). The ore is localized in embayments at the pendant margin, within the dolomitic unit (Ibd).

The cross-section illustrates the zoning from the unaltered intrusive (**Kw**), to diopside and diopside-thulite endoskarn (• •), to garnet endo- and exoskarn (g), to diopside (d), diopside-calcite (dc) and magnetite (m) exoskarns. The ore is found in the diopside-calcite and magnetite exoskarns.

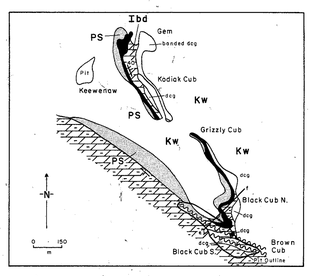
The Arctic Chief East and West pits produced 223,000 tonnes of 1.44% Cu, 17.14g Ag/t and 1.03g Au/t during 1968 and 1969.

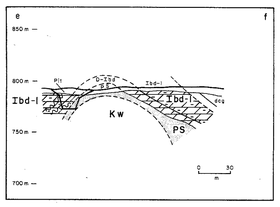


GEOLOGICAL CROSS-SECTION OF THE COWLEY PARK DEPOSIT, LOOKING 281° (after Tenney, 1981)

Mineralization is concentrated in the northern part of a faulted, U-shaped pendant consisting of Pyritic Siltstone (PS) overlain by the limestone sub-facies of facies b of the Interbedded Unit (Ibl).

The main zone has estimated open pit reserves of 884,000 tonnes of 1.04% Cu, 3.77g Ag/t, 0.21g Au/t and 0.066% MoS_2. Estimated underground reserves in the south zone are 668,000 tonnes of 0.9% Cu.





DETAILED GEOLOGICAL MAP OF THE KEEWENAW-GEM-BLACK CUB SOUTH AREA, AND CROSS-SECTION THROUGH THE BLACK CUB SOUTH AND NORTH DEPOSITS, LOOKING 305° (after Morrison, 1981)

The Gem, Kodiak Cub, Grizzly Cub, Black Cub North, Black Cub South and Brown Cub deposits formed in an interbedded limestone and dolomitic limestone unit (Ibd), which is underlain by Pyritic Siltstone (PS) and cut by closely spaced basaltic dykes (not shown). Mineralization at Keewenaw is found in an oval, pipe-like zone of diatreme in the granodiorite.

The Keewenaw open pit, (outlined on map) produced 159,000 tonnes of 0.95% Cu in 1971 and remaining reserves are estimated as 202,000 tonnes.

The Black Cub South open pit (outlined on map and section) produced 180,000 tonnes of 1.33% Cu, 12.34g Ag/t, 0.24g Au/t and 0.008% MoS_2 in 1971. Reserves are estimated as: Gem - 625,000 tonnes of 1.01% Cu; Kodiak Cub - 57,000 tonnes of 1.18% Cu; Black Cub North - 156,000 tonnes of 0.82% Cu.

ACKNOWLEDGEMENTS

This map represents a compilation of both published and unpublished information on the Whitehorse Copper Belt.

The major source of information is an unpublished Ph.D. thesis by Gregg W. Morrison.

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Compilation by P.H. Watson
Drafting by R. Lewis

It is recommended that reference to this report be made in the following form:

Watson, P.H., 1984. The Whitehorse Copper Belt - A Compilation; Exploration and Geological Services Division - Yukon, Indian and Northern Affairs, Canada, Open File, 1:25,000 scale map with marginal notes.

DEPOSIT NAME	CODE No.	MAJOR HOST ROCK TYPE	DEVELOPMENT YEAR	DEVELOPMENT TYPE	DEVELOPMENT PRODUCTION (tonnes)	DEVELOPMENT RESERVES (tonnes)	GRADE Cu %	GRADE Au (g/t)	GRADE Ag (g/t)	GRADE Mo %	ORE MINERALS OTHER	Bo	Cp	Hm	Mt	Mo	Vl	ORE MINERALS OTHER	SKARN MINERALS serp	phlg	woll	gnt-r	gnt-b	gnt-y	SKARN MINERALS OTHER
Little Chief	21	dolomite	1898-1905 1967-1969 1972-1982	minor open pit u.g.	- 1,128,500 7,407,900		1.28 1.53	pres. 0.75	pres. 9.16		Ga, Pt Pd+	X	X		X	(X)	X	Cv, Cc, Py	X	X		X			
Middle Chief	20	dolomite	1898-1909 1972-1982	minor u.g.	part of Little Chief mine		1.55	0.34			Ga, Pt Pd+	X	X		X		X	Py, Po	X	X		X			trem
Big Chief	19	dolomite	1898-1909	minor			*0.56	0.34			Ga, Pt Pd+	X	X		X		X	Cc	X	X		X			
Valerie	22	dolomite	1899-1907	u.g.	127		*1.65	0.68			Ga, Pt Pd+		X	(X)	X			Po, Py, Ap	X			X			trem, actn
North Star	23	dolomite	1900's	minor			*0.7	0.09	0.05			X	X		(X)				X	X		X			trem
Arctic Chief	15	interbedded (dolomitic)	1899-1907 1968-1969	u.g. open pits	202 201,800		6.53 1.44	10.69 1.03	79.33 17.14		Ga, Pt Pd+	X	X		X		X	Cc, Tt, Py, Cp	X	X	(X)	X			
Grafter	14	interbedded (dolomitic)	1899-1907 1915-1917	u.g. u.g.	1,800 10,400		7.0 6.0	pres. pres.	pres. pres.				(X)	X		X	(X)	Py, Ct	(X)			X			trem
Best Chance	13	interbedded (dolomitic)	1899-1912 1954-1957	u.g. testing		447,000	0.71	0.03			Ga, Pt Pd+	(X)	X		X		(X)	(Cc)	(X)	(X)		X			trem, actn
Suburban	16	interbedded (dolomitic)	1900-1907	minor			*0.89	1.03			Ga+	X	X		X	(X)			X			X			
Verona	17	interbedded (dolomitic)	1900's	minor			*0.20	0.17			Ga+	X	(X)		X	(X)						X			
Gem	27	interbedded (dolomitic)	1967-1970	testing		625,000	1.01					(X)	X		X		X		X	X		X			

DEPOSIT NAME	CODE No.	MAJOR HOST ROCK TYPE	DEVELOPMENT YEAR	DEVELOPMENT TYPE	DEVELOPMENT PRODUCTION (tonnes)	DEVELOPMENT RESERVES (tonnes)	GRADE Cu %	GRADE Au (g/t)	GRADE Ag (g/t)	GRADE Mo %	ORE MINERALS OTHER	Bo	Cp	Hm	Mt	Mo	Vl	ORE MINERALS OTHER	SKARN MINERALS serp	phlg	woll	gnt-r	gnt-b	gnt-y	SKARN MINERALS OTHER
Kodiak Cub	28	interbedded (dolomitic)	1970	testing		57,000	1.18					X	(X)		X				X	X					
Grizzly Cub	29	interbedded (dolomitic)	1970	testing								X	(X)		X				X	X					
Black Cub N.	30	interbedded (dolomitic)	1970	testing		156,000	0.82					X	(X)		X				X	X		(X)			
Black Cub S.	31	interbedded (dolomitic)	1971	open pit	187,000	20,000	*1.33 1.25	0.24	12.34	0.008		X	(X)		X		(X)	Cc, Ct	X	X	(X)	(X)			actn
Brown Cub	32	interbedded (dolomitic)	1970	testing								X	(X)		X				X	X					
Railway	33	interbedded (dolomitic)	1900's	minor			*0.15						(X)		X										actn
War Eagle	1	interbedded (limestone)	1899-1915 1970-1971	u.g. open pit	900 899,000		5.7 1.25	1.03 0.22	68.57 8.57	0.005	Ga+	X	X		(X)	X						X		X	trem, actn
Pueblo	5	interbedded (limestone)	1899-1906 1912-1920	u.g. u.g.	635 127,000		*4.9 3.5	0.17	34.29		Sc, Ga+		(X)	X	(X)			Cy, Ct				X		X	trem
Gulch	4	interbedded (limestone)	1899-1907	minor																					
Anaconda	2	interbedded (limestone)	1898-1907	minor			*0.9	0.17				X	(X)	(X)	(X)				X			X		X	trem
Rabbit-foot	3	interbedded (limestone)	1899-1907	minor			*0.7	0.17				(X)	X			X		Sc	X			(late)	X	X	
Copper King	8	interbedded (limestone)	1898-1907 1915-1920	u.g. u.g.	517 4,800		*1.47	0.17	15.09	0.21		(X)	X		(X)	(X)		Sc.				X	(late)		X	actn, trem
Carlisle	9	interbedded (limestone)	1900-1910	u.g.	907		*3.58	0.34	51.4			X	(X)			X		Sc					X	X	trem
Spring Creek	10	interbedded (limestone)	pre 1907	minor								(X)	(X)		(X)			Cc				(late)	X	X	
Empress of India	11	interbedded (limestone)	1900-1910	u.g.								(X)	X	(X)		(X)		Sc, (Py)				X	(late)		X	

TOTAL PRODUCTION FROM 11 DEPOSITS INTERMITTENTLY MINED DURING THE PERIOD 1898 TO 1982 WAS 10,130,000 TONNES OF APPROX. 1.5% Cu

DEPOSIT NAME	CODE No.	MAJOR HOST ROCK TYPE	DEVELOPMENT YEAR	DEVELOPMENT TYPE	DEVELOPMENT PRODUCTION (tonnes)	DEVELOPMENT RESERVES (tonnes)	GRADE Cu %	GRADE Au (g/t)	GRADE Ag (g/t)	GRADE Mo %	ORE MINERALS OTHER	Bo	Cp	Hm	Mt	Mo	Vl	ORE MINERALS OTHER	SKARN MINERALS serp	phlg	woll	gnt-r	gnt-b	gnt-y	SKARN MINERALS OTHER
Retribution	12	interbedded (limestone)	1900's	minor									X	X	X							(X)		X	actn
Sue	34	interbedded (limestone)		testing			*1.55	trace		0.74			X	X			X						X		actn
Cowley Park	35	interbedded (limestone)	1912 1970's	minor testing		open pit 884,000 668,000 0.9	*1.04 0.9	0.21 pres	3.77 pres	0.066 pres			X	X		(X)	X			(X)		X	(X)		X	
Pass Lake	24	limestone	1900's	minor			*0.4	trace					(X)	X		X								X	
Copper Cliff	25	limestone	1900's	minor									X	X	(X)	(X)									
Keewenaw	26	intrusive	1950's 1971	testing open pit	159,000	202,000	0.95 1.06	pres	pres	pres			X	(X)				Cy, Mi, Cc, Py Cv							
Reservoir Lake	6	intrusive					*1.0						X				X								Bo in sheeted quartz veins in hornblende granite
Scheelite	7	intrusive					*1.7	0.51			0.58% WO_3		X				X	Sc., Mi							quartz-carbonate-Sc vein
Polar	18	fault zone	1900's	minor																				Py, Cy	

NOTE: Ore minerals Bo-bornite, Cp-chalcopyrite, Hm-hematite, Mt-magnetite, Vl-valleriite, Mo-molybdenite, Cv-covellite, Cc-chalcocite, Py-pyrite, Po-pyrrhotite, Sc-scheelite, Mi - malachite, Ap-arsenopyrite, Tt-tetrahedrite, Ct-cuprite, Cy-chrysocolla

Skarn minerals serp-serpentine, phlg-phlogopite, woll-wollastonite, gnt-r-garnet-red, gnt-b-garnet-brown, gnt-y-garnet-yellow, trem-tremolite, actn-actinolite, in addition, diopside, epidote, calcite and thulite are present in most deposits

(limestone) Indicates limestone sub-facies of Interbedded unit facies b.

(dolomitic) Indicates dolomitic limestone of Interbedded unit facies b.

* Next to grade indicates representative assay rather than average grade based on tonnage. Grades indicated for small tonnages mined prior to 1960 often represent hand-sorted high-grade concentrates, rather than true grade of deposit.

+ Gallium, Platinum and Palladium reported by Kindle (1963) as 0.14g Pt/tonne, 0.07g Pd/tonne and 0.03-0.06% Ga.

X Major ore minerals

(X) Minor ore minerals

u.g. Underground

Canada