a bit rough in spots.

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# GEOLOGY AND MINERALOGY OF THE WINDPASS MINE
# NORTH THOMPSON VALLEY MAP AREA
# BRITISH COLUMBIA

BY

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## ACKNOWLEDGEMENT

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The Windpass Mine in the North Thompson Valley map area contains many features different from most Canadian mines, both as to mineralization and geological setting. Cobaltite, Bismuth Tellurides, and gold occur within a replacement zone in a differentiated basic sill. Transportation to the mine[1] is provided by a dirt road branching from the main Thompson River Road near the south end of Dunn Lake, the distance to the mine being about 12½ miles from the town of Chu Chua on the C.N.Ry. The branch road to the mine is believed to have been deserted since 1939.

## HISTORY

<u>References</u>: Annual Reports of the Minister of Mines of British Columbia for the years: 1917, 1921 - 1927, 1931 - 1939, and Bulletin No. 20, pt. 3, pp. 26,27.

The Windpass Group consisting of three claims was staked on June 7th, 1916, by Olie Johnson, T.H. Campbell, and Oscar Horgen. The quartz vein[2] outcropping near the center of Windpass No. 1 was stripped for 200 feet and two shipments of ore (31½ tons, and 29 tons) were sent to the smelter. The returns were quite favorable, but the property was not worked again until 1921 when a shaft and some drifting was done. As the

1 see figure 1.
2 see figure 1.

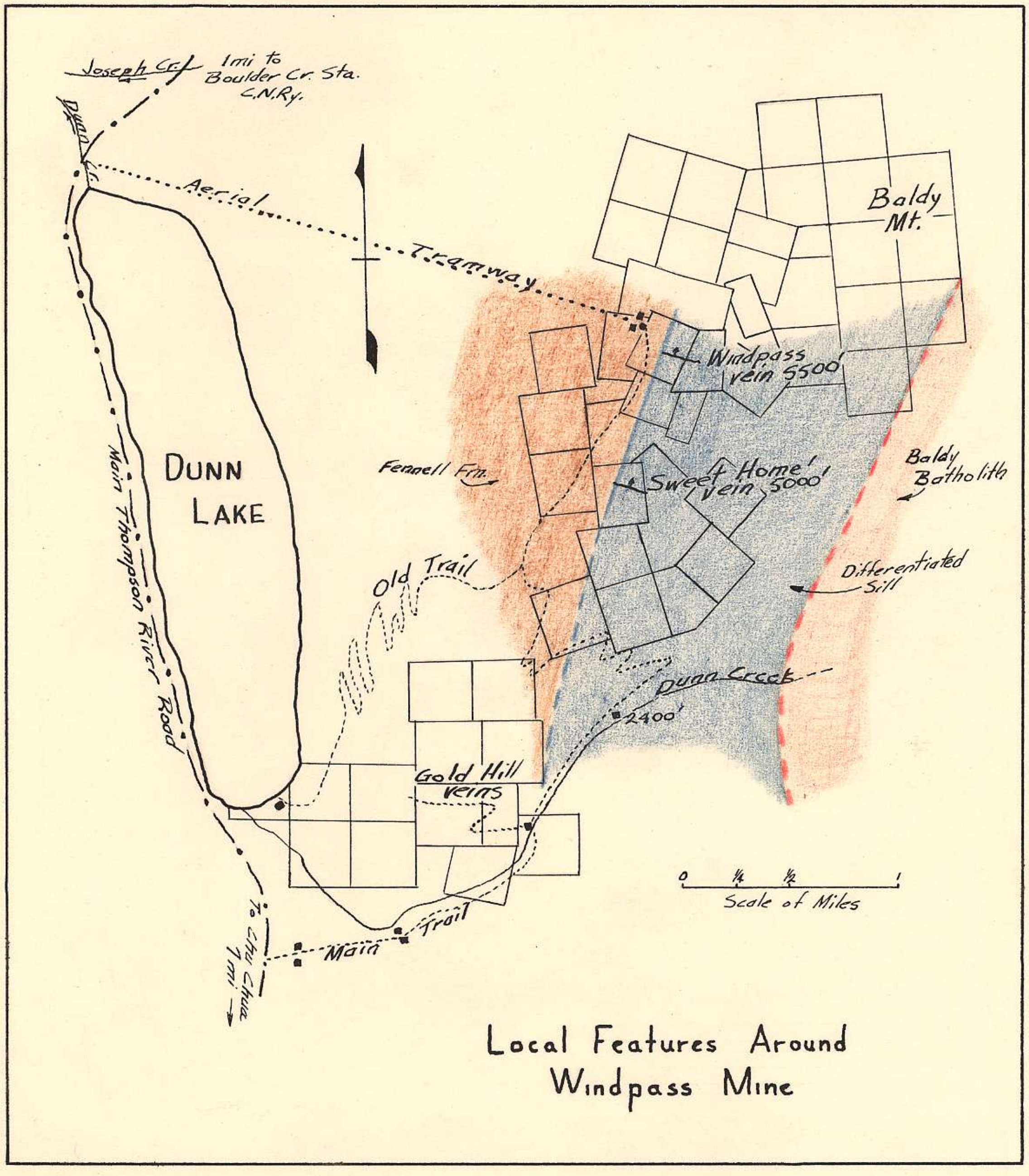

Joseph Cr.
1mi to
Boulder Cr. Sta.
C.N.Ry.
Aerial
Tramway
Baldy
Mt.
Windpass
vein 5500'
Sweet Home'
vein 5000'
DUNN
LAKE
Fennell Fm.
Baldy
Batholith
Differentiated
Sill
Old Trail
Main Thompson River Road
Dunn Creek
2400'
Gold Hill
veins
0 1/4 1/2 1
Scale of Miles
To Chu Chua
1 mi
Main Trail
Local Features Around
Windpass Mine

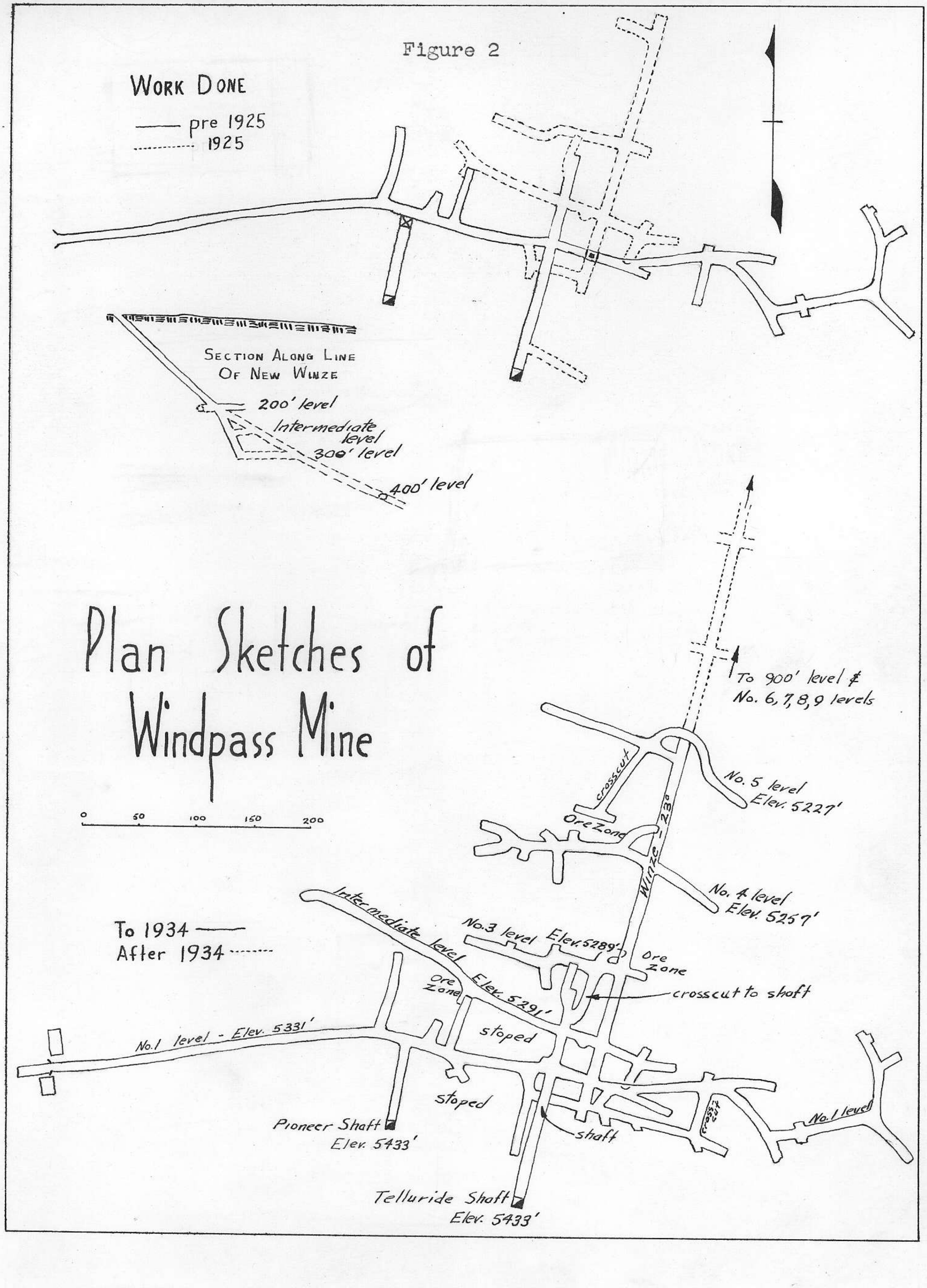
Figure 1

results continued to be encouraging, General R.G. Edwards Leckie and associates bonded the property in the fall of 1922. Development work continued favorably, with two shafts and the No.1 level connecting them to the main adit being completed by September 1923.[3] In 1924 further works, consisting of two short winzes and some diamond drilling, were done; apparently indicating that the ore did not continue to depth. However, in February 1925, B.N. Sharp acting for Engineer Gold Mines, Limited bonded the mine. This company discovered that the winze of the previous year had passed into the footwall of the ore shoot, and by the year's end approximently 900 feet of work had been done establishing further ore reserves. The values continued to be erratic, and the company released the property in 1926 with estimated reserves of between 200,000 and 300,000 dollars. That fall the owners with A.W. Davis managing reopened the mine planning to build a small mill to concentrate the ore; unfortunatly this plan failed. A small flurry of interest rose in 1931 owing to the gold demand, however the property was not put into operation until 1933.

In 1933 the Windpass Gold Mining Company Limited was formed, a mill and camp site cleared near the north end of Dunn Lake, and a 2½ mile aerial tram connecting them to the mine built. By March, 1934, the 50-ton mill was completed and shipping 60 tons of concentrates per month to Tacoma. The next major development work done was in 1937 when the inclined shaft was sunk to the 900 foot level and lots of drifting done on the 7, 8, and 9 levels. During 1938 work was suspended in the lower levels and focased upon the pillars in the upper workings. The mine was closed down

3 for sketches of the mine see figure 2.

Figure 2



Work Done
pre 1925
1925
Section Along Line Of New Winze
200' level
Intermediate level
300' level
400' level
Plan Sketches of Windpass Mine
0 50 100 150 200
To 900' level & No. 6, 7, 8, 9 levels
crosscut
No. 5 level Elev. 5227'
Ore Zone
Winze - 23°
No. 4 level Elev. 5257'
To 1934
After 1934
Intermediate level
No. 3 level Elev. 5289'
Ore Zone
crosscut to shaft
Ore Zone
Elev. 5291'
stoped
No. 1 level - Elev. 5331'
stoped
Pioneer Shaft Elev. 5433'
shaft
crosscut
No. 1 level
Telluride Shaft Elev. 5433'

early in 1939.

Total production of the mine from its opening in 1933 to its closing in 1939 was 84,059 tons — yeilding 34,246 ounces gold, 1,568 ounces silver, with minor values in copper.

## GEOLOGY

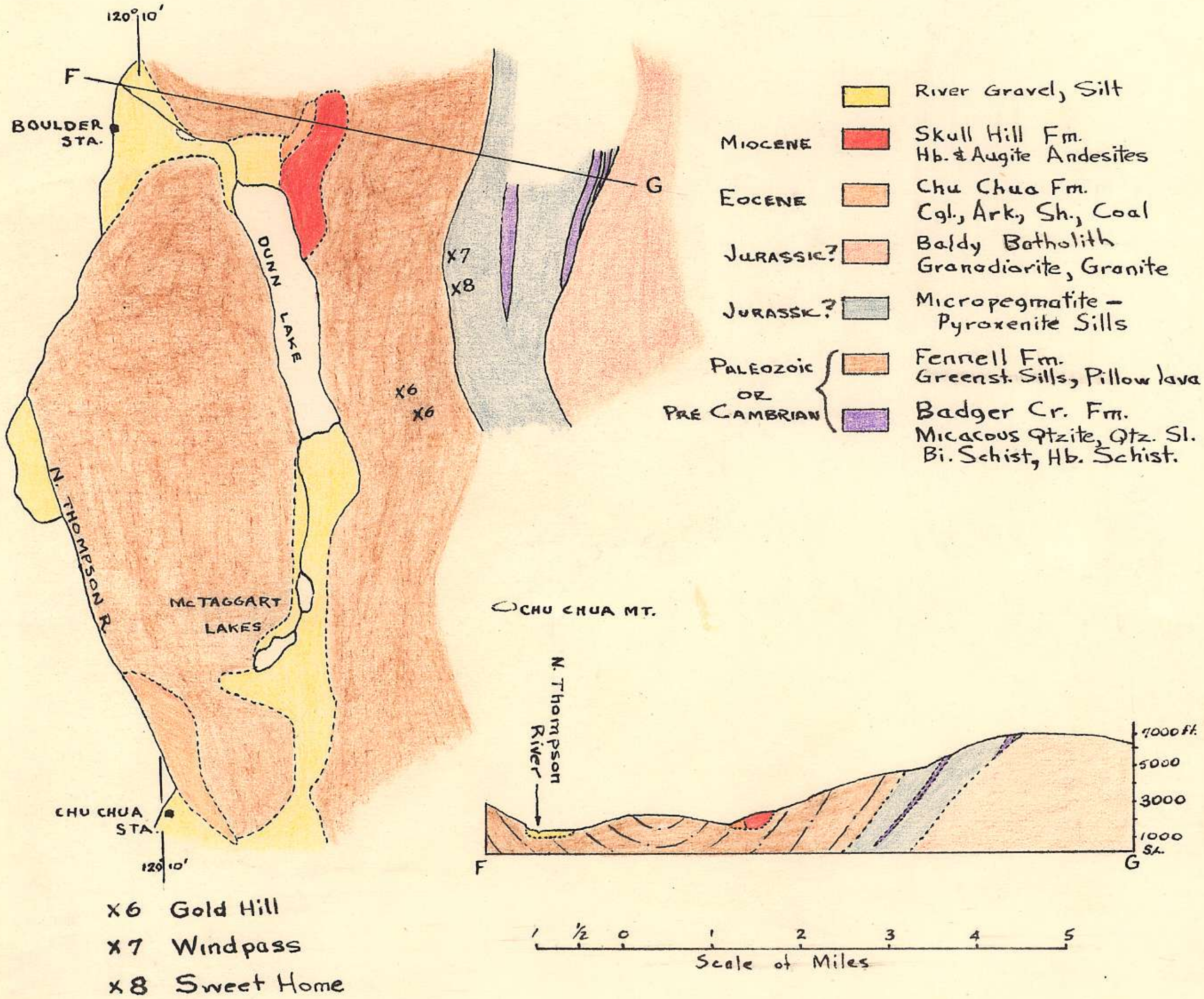
References: Uglow, W.L., Geol. Surv., Canada, Sum. Rept., 1921, pp. 99-100.
——— Economic Geology, Vol. XXI, No. 3, pp. 285-293.
B.C. Dept. Mines, Bull. No. 20, pt. III, pp. 26-27.

The following table gives a summary of the rocks in the vicinity of the mine.

| Formation | | Lithology |
|---|---|---|
| Mesozoic (?) | Baldy Batholith | Granite<br>Porphyritic Granodiorite |
| Jurassic (?) | Sill | Quartz Diorite - Pyroxenite |
| intrusive contact | | |
| Pre Cambrian or early Paleozoic | Fennell Formation | Ellipsoidal greenstone with lenticular masses of thin-bedded grey or white chert.<br>Volcanic Breccia |

There is some doubt about the age of the Pre Cambrian Formations; they may be the Cache Creek Group of Permian age. The deposit occurs in the upper acidic facies of a micropegmatite-pyroxenite sill just east of the boundry of the Fennell Formation.[4] This sill is believed to be differentiated with the top or acidic portion to the west, and the basic pyroxenite portion to the east; it has been mapped for over 4 miles in length and varies from 1 to 1½ miles in width. The Baldie Batholith, a biotite-granodiorite with granite phases, intrudes this sill on its eastern border.

[4] see figure 3 for regional geology.




# Geology In Vicinity Of Windpass Mine

Figure 3

## STRUCTURE and MODE OF OCCURANCE OF THE ORE

References: B.C. Dept. Mines Rept., 1925, pp. 167-170.
Uglow, W.L., Economic Geology, Vol. XXI, No. 3, pp. 285-293.

The deposit pinching and swelling from 1 to 10 feet in width, occurs within a shear zone striking E-W and dipping northerly 35 to 80 degrees. Later cross-fracturing with NW-SE strike and steep dips intersects the main shear zone. The mineralizing fluids followed these later fractures up into the main shear zone where the deposit was localized; this is evidenced by a fairly smooth hanging wall but a broken footwall containing many stringers of ore running down the later set of fractures. The deposit terminates on the east against a shear zone intersecting the main shear zone at a low angle, and on the west against the Fennell Formation. Appearances indicate the ore to be of the replacement type with the characteristics of the deposit changing from discontinuous lenses of lodestone carrying free gold in the east, to a psuedoquartz vein breaking into low grade stringers as it enters the Fennell Formation on the west.

## MINERALOGY

Handspecimen Observations:

The wall rock varies between pyroxenite and a white feldspathic rock (quartz diorite), with the mineralization varying from complex massive sulphides to disseminated metallics in quartz. The complex sulphide ore contains pyrrhotite, chalcopyrite, marcasite, cobaltite, and some magnetite; with the marcasite characteristically occuring as "cockscomb" crystals in solution vugs in the pyrrhotite. Scattered amounts of andesine (?) appear as phenocrysts in the sulphides indicating that the ore formed by replacement of the sill. The quartz ore contains chalcopyrite, magnetite, tellurides, gold, and bismuthinite. Specimens of coarse magnetite are composed of octahedrons cemented together, as seen under the binocular microscope. The lodestone present carries chalcopyrite, pyrrhotite, and either bismuth or bismuthinite. Because of the gradation of the deposit from one end to the other, many varieties of ore occur.

Microscope Observations:

The grain size of the various minerals varies to such an extent that it becomes almost insignificant. Chalcopyrite and pyrrhotite grade from inclusions within one another to massive hosts. The chalcopyrite under low power (x45) appears as pinching and swelling veins cutting the pyrrhotite with mutual boundries; occasionally chalcopyrite is seen to replace pyrrhotite, and these relationships might indicate that the chalcopyrite entered when the pyrrhotite was in a highly viscous state. Small crystals of pyrite and rounded masses (¼mm to 1mm) of magnetite occur trapped in the chalcopyrite and pyrrhotite.

Cobaltite is hard to distinguish in polished section and is identified primarily by its color and hardness. Cobaltite is later than pyrrhotite, but its relationship with chalcopyrite is obscure as it is not seen in contact in any of the hand-specimens available. Uglow[5] states (p.287) "Chalcopyrite was found to be in cutting relations to the cobaltite in all cases examined...." On page 289 he states, "Chalcopyrite is younger

[5]Uglow, W.L., Economic Geology, Vol. XXI, No. 3, pp. 285-293.

than the cobaltite and replaces all the earlier minerals of the deposit."

Bismuthinite, the two bismuth tellurides (Joseite A and Joseite B), native bismuth, and gold usually occur together and near cobaltite. It is only in the quartz ore that these minerals are found without cobaltite nearby. There Joseite is seen as filling veins $\frac{1}{2}$ inch long by 200microns wide, and surrounding blebs of bismuthinite with mutual boundries. The similarity of tetradymite's formula to those of the Joseite group is sufficiently close to hint at its presence in the ore. Tetradymite is not seen in a cursory examination of the polished sections, but bismuth tellurides can only be told apart by X ray and it is probably present. The only tellurides determined by X ray where Joseite A and Joseite B. The group of minerals above mentioned occur in all forms of the deposit: lodestone, massive sulphide, and quartz. The gold is usually found as myrmekitic intergrowth with native bismuth, to a lesser degree as masses next to bismuth tellurides, and as "free gold". Free gold can be seen 1/50mm to 1/80mm. in diameter within the quartz ore. Native bismuth occurs as blebs varying between 650microns and 100microns in diameter; bismuthinite as blebs 200microns in diameter, and as stringers 200microns by 3.4mm.; and bismuth tellurides as blebs $\frac{1}{4}$inch to 100 microns in diameter. The gold shows some replacement features against the tellurides. This group of minerals appears to be a separate stage of mineralizing fluids late in the sequence.

The only secondary mineral seen is marcasite, which replaces pyrrhotite as veinlets along fracture planes. Where a fracture extends through chalcopyrite the marcasite replaces the chalcopyrite only slightly. The marcasite appears to be the result of the change in conditions brought about by the final introduction of gangue throughout the ore.

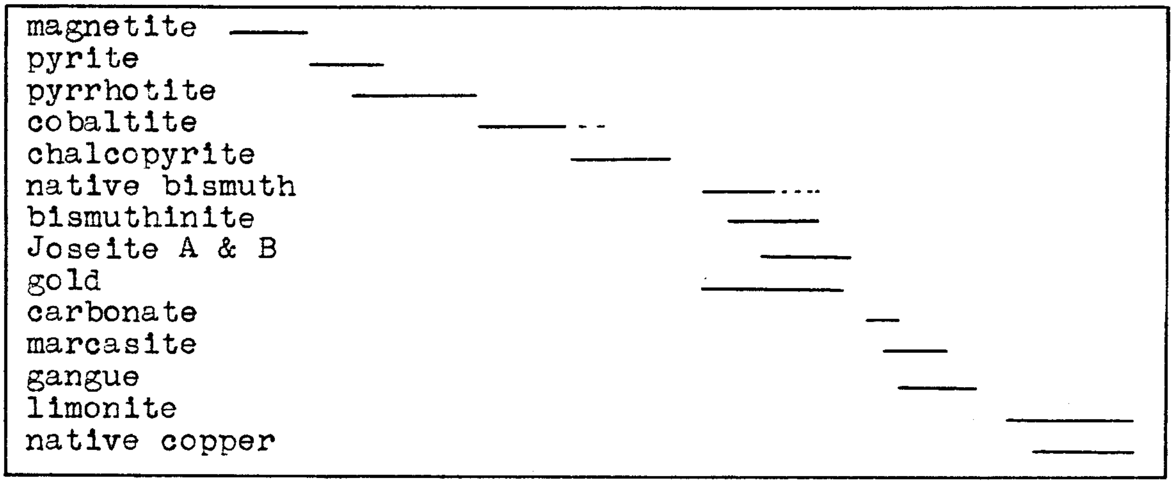
Gangue:

The main gangue is quartz with very minor amounts of carbonate, the carbonate is usually microscopic, but may form up to 5% of a specimen. That the carbonate was introduced late in the history of the deposit is seen by its replacement of pyrrhotite and its occurance in the middle of marcasite fracture fillings. Limonite occurs as filling small cracks in magnetite, lodestone, and the massive sulphides where marcasite replaces the pyrrhotite. That limonite penetrates to some depth is seen by its presence in the No. 6 level east, approximately 236 feet below the surface. The limonite no doubt extends to greater depths but samples indicating this are lacking.

Paragenesis:

The paragenetic relationships indicate two major stages of mineralization. The first stage consisting of pyrite, magnetite, pyrrhotite, chalcopyrite, and cobaltite; and the second stage of bismuth, bismuthinite, bismuth tellurides, and gold. The introduction of gangue and the ensuing formation of marcasite, might be considered a third stage culminating with the formation of native copper and limonite as a result of supergene weathering.

A tentative paragenetic sequence is presented:




Pyrite was not seen in contact with magnetite ,nor cobaltite with chalcopyrite, and therefore their relationships were not determined. The "gangue" listed in the above sequence did not effervesce with HCl, was softer than quartz, and is therefore called "gangue".

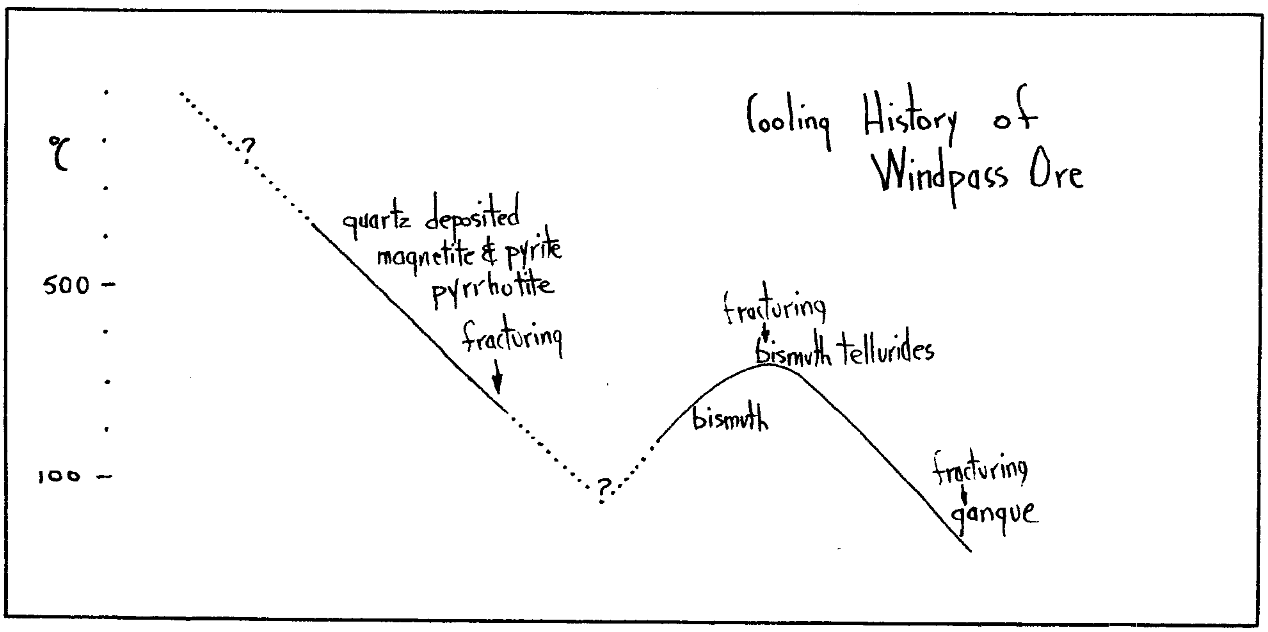
History of the Deposit:

Stress of the area occured forming the main shear zone and the other shear zone limiting the first on the eastern side. A set of NW-SE cross fractures next developed, perhaps as the Baldie Batholith neared the surface causing the gentle folding of the area. Because of the difference in the competency of the rocks, the fractures were maintained in the sill whereas not in the adjoining rocks.

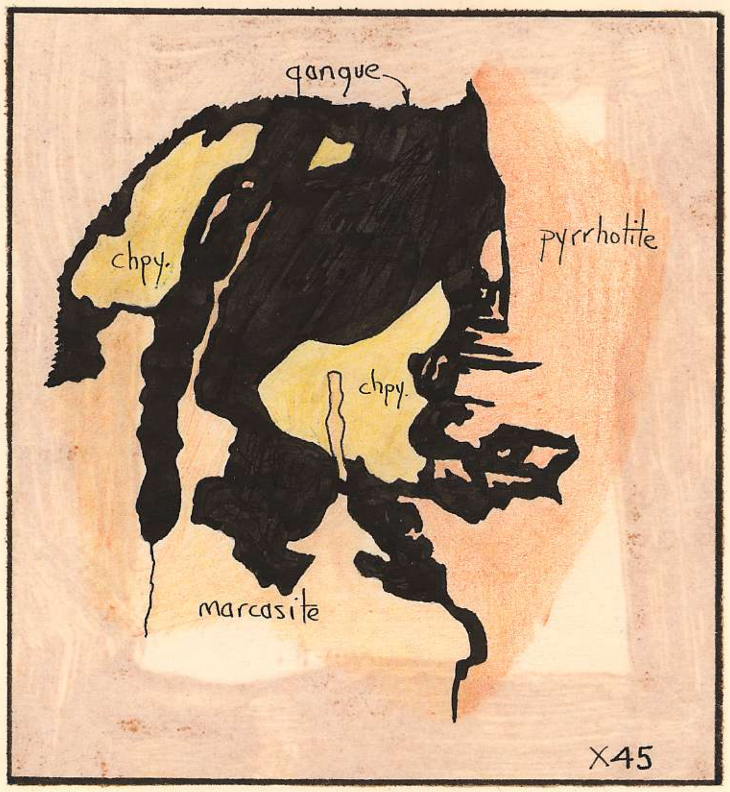
Silicious fluids were the first to enter the area; these were apparently dammed against the Fennell Formation to the west and extended only a short distance to the east. With further fracturing and lowering of the temperature, magnetite entered the area from the NW (as did all the fluids) filling further fractures to the east of the quartz forming the discontinuous steeply dipping lenses of lodestone and magnetite; some of the fluid entered the previously deposited quartz as it passed next to it.

Pyrrhotite, cobaltite, and chalcopyrite next arrived to occur in the newly deposited material. A lag in the sequence occured, followed by bismuth, bismuthinite, bismuth tellurides, and gold. The gangue minerals now arrived and marcasite formed; with prolonged weathering limonite and some native copper formed from the breakdown of some of the minerals in the deposit.

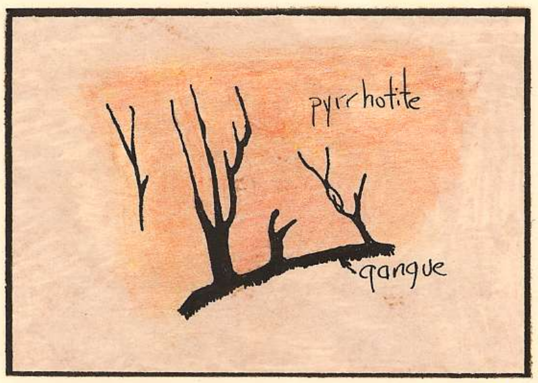
As has been stated, the mineralization occured in two stages: a high temperature group, and a moderate temperature group. The temperature of the deposit is represented in the diagram below. The deposit is classified as Xenothermal, a high temperature




deposit formed near the surface.

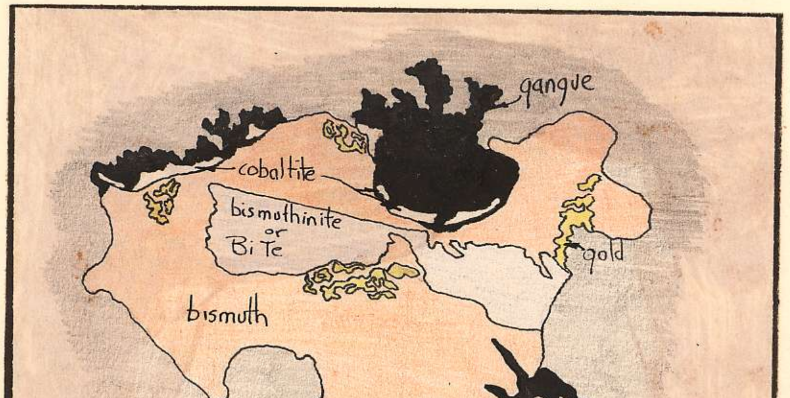



marcasite replacing pyrrhotite & chalcopyrite, and in return replaced by gangue.




X50

gangue replacing pyrrhotite




X55

myrmekitic gold in bismuth

PERCENTAGE RELATIONSHIPS OF THE MINERALS

| | specimen #675 | specimen #3406 | specimen #3405 | qtz. ore |
|---|---|---|---|---|
| | massive solphides | | | |
| Magnetite $(Fe_3O_4)$ | 1% | 1% | | 6% |
| Pyrite $(FeS_2)$ | 1% | 1% | | |
| Pyrrhotite $(Fe_{1-x}S)$ | 60% | 25% | 37% | |
| Cobaltite (CoAsS) | 5% | | 5% | |
| Chalcopyrite $(Cu_2S.Fe_2S_3)$ | 10% | 68% | 1% | 8% |
| Native Bismuth (Bi) | | | 1% | 1% |
| Bismuthinite $Bi_2S_3)$ | | | | 2% |
| Joseite A $(Bi_4\ {}_xTe_{1-x}S_2)$<br>Joseite B $(Bi_4\ {}_xTe_{2-x}S)$ | | | 2% | 2% |
| Gold (Au) | | | | |
| Marcasite $(FeS_2)$ | 20% | | 44% | |
| Carbonate | | | | |
| Gangue | 4% | 5% | 10% | 81%(qtz.) |