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MINERALOGRAPHY OF THE HIGHLAND BELL ORE

(Geology 409)

ARTHUR DARRYL DRUMMOND

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Introduction

The Highland Bell Mine near Beaverdell in the Greenwood Mining District has been a producing property on Wallace Mountain for many years. This silver deposit has produced between 20 and 25 million ounces of silver from 1912 to 1945. The deposit was thought to be of shallow depth for many years. This report deals with the mineralogy of ore which was uncovered recently at a lower level.

Location and Accessibility

Wallace Mountain, on which the Highland Bell Mine is situated, lies approximately 21 miles east of Penticton and approximately 31 miles north of Greenwood. The town of Beaverdell near Wallace Mountain is on the west fork of the Kettle River.

Motor roads allow access to Beaverdell from Carmi to the north and from Greenwood and the Trans-Canada Highway to the south.

Acknowledgements

The author wishes to thank Mr. J. Donnan for the use of equipment required in making the necessary polished sections. Thanks also to Dr. R. M. Thompson for assistance in the preparation of this report.

General Geology

In the Beaverdell area, the Wallace group of volcanic and minor sedimentary rocks outcrop. The greatest part of which has been referred to by L. Reinecke (1915) as Mesozoic. These volcanics have been intruded and metamorphosed by the Westkettle quartz diorite batholith of Jurassic age and by the Beaverdell quartz monzonite batholith of Eocene age. Curry Creek series of sediments of Oligocene age lie unconformably over the older rocks. An unconsolidated glacial drift overlies the uplands and alluvium is found on the valley floors.

The only rocks involved with this deposit on Wallace Mountain are the Westkettle quartz diorite and the metamorphosed Wallace volcanic-sedimentary group.

History of The Deposit

The first claims staked on Wallace Mountain in 1889 were allowed to lapse. All the more important claims were located between 1896 and 1897. Two small settlements sprang up on the Westkettle which were called Beaverton and Rendell and which were united under the name Beaverdell in 1900. Mining activity in the district increased slowly with the Highland Bell Mine being formed in 1936 through the amalgamation of Highland Lass Ltd. and Bell Mine Ltd. In 1946, Sally Mines Ltd. was acquired. A 50-ton mill was placed in operation by September 1950 permitting treatment of a much lower average grade of ore than was previously shipped to the Trail smelter since 1936.

Recent Development

The main Highland Lass sections opened on 10 levels and the Idaho section opened from 7th to 10th levels. The Bell section is connected with the Lass mine by a long tunnel and by several raises driven from Lass 4th level to the lowest Bell mine level. Sally section opened by a 510 foot shaft. The previously abandoned Beaver shaft has been made accessible again.

Production

Milling on the property commenced in September 1950 with the ore mined previously being shipped to the Trail smelter. The value of output of silver, lead, zinc, gold and cadmium in recent years follows:

Year	Tons Handled	Output Value
1935-53	105,457	$6,544,683
1954	12,785	485,955
1955	13,220	484,994
1956	14,322	589,949
1957	15,779	663,630
Total	161,563	8,769,211

Production figures for 1958 and 1957 were not available at the time of writing. The figures for 1956 in which 14,322 tons were shipped had a gross content of gold, 221 oz.; silver, 642,472 oz.; lead, 304,791 lb.; zinc, 390,395 lb.; and cadmium, 3,289 lb.

Megascopic Examination

The Highland Bell ore contains galena, sphalerite, pyrargyrite, tetrahedrite, polybasite, chalcopyrite and pyrite. The galena and sphalerite appear generally in bands of about one-quarter of an inch to about one inch across. Pyrite which was found in nearly every piece of ore examined is usually in bands separating ~~bands of~~ galena and sphalerite. (See Fig. 1) However, all the specimens examined were not banded and in the unbanded specimens, the ore minerals appear in a random distribution. The galena and sphalerite can be massive as well as banded with the pyrargyrite in association with the galena. The dull grey tetrahedrite is in most of the specimens and a blacker, more metallic appearing mineral is also found. This blacker mineral is thought to be the silver sulpho-salt, polybasite. Specks of chalcopyrite were observed in the ore.

Fig. 1 Photograph Showing Banding in The Ore

Microscopic Examination

The usual methods of microscopic identification were used and the following minerals were found: galena, sphalerite, pyrite, tetrahedrite, polybasite, pyrargyrite, chalcopyrite and arsenopyrite.

Sphalerite

The sphalerite is a dark variety indicating that the sphalerite contains some iron. It occurs in two ways: firstly, as distinct bands which may be small or large, and secondly, as small grains within sections of massive galena. This second occurrence of sphalerite may indicate an environment of simultaneous deposition.

This mineral is not pure as it exhibits a mottled texture of minute chalcopyrite blebs exsolving from the sphalerite. (See fig. 2) The size of the blebs averages 7 microns.

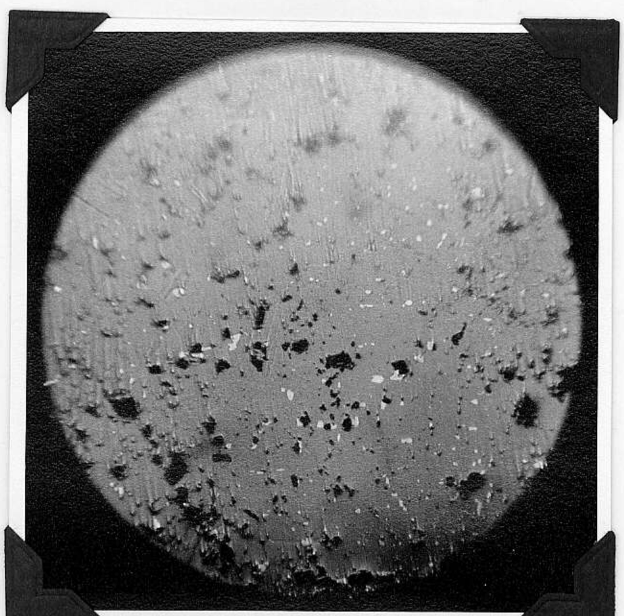

Fig. 2 Microphotograph of Chalcopyrite Exsolution Blebs - (495X)

According to Edwards (1954), sphalerite and chalcopyrite are capable of some degree of solid solution at temperatures above 350 degrees Centigrade to 400 degrees Centigrade. Solutions of chalcopyrite in sphalerite unmix at about these temperatures.

Galena

This abundant mineral occurs in bands and in fine-grained massive pockets. The grains in the pockets are up to one-eighth of an inch across. The galena shows very minute, randomly oriented blebs of tetrahedrite which range in width from a few microns to about 10 microns. They do not represent the only tetrahedrite present as there are many large distinct grains in the galena. The blebs show a smooth mutual boundary texture with the galena and may indicate an environment of simultaneous deposition. The galena is being replaced by the silver mineral and by the tetrahedrite. The large distinct grains of tetrahedrite show the replacing of the galena but the blebs do not indicate replacement. Galena is replacing the pyrite as core replacement of pyrite grains is seen. (See Fig. 3)

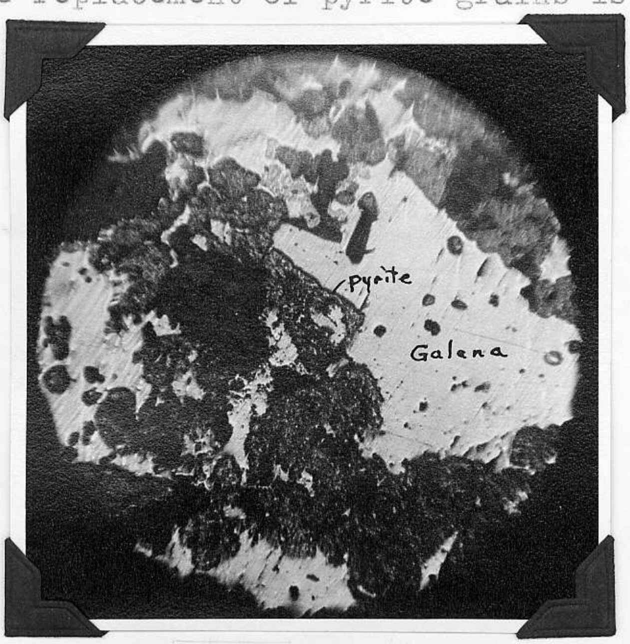

Fig. 3 Microphotograph Showing Core Replacement Of Pyrite - (456X)

Pyrite

This mineral is the most abundant of all minerals observed in polished section. The pyrite is very fine-grained, usually exhibiting a sharp square outline and having a range in grain size from 130 to 585 microns. The pyrite like the galena and sphalerite occurs in bands and in pockets. Some euhedral grains are completely surrounded by galena, possibly indicating that the pyrite has exerted its crystal form in the galena. Thus, the pyrite probably formed earlier than the galena.

Pyrite is not replacing any of the other minerals but it is being replaced by the galena as seen in Fig. 3, page 7.

Silver Minerals (Pyrargyrite and Polybasite)

Pyrargyrite is generally more common than polybasite in this ore. The highly anisotropic polybasite makes it readily distinguishable from the pyrargyrite which is either moderately anisotropic or isotropic. According to M. N. Short (1940), pyrargyrite is apparently isotropic owing to its transparency. These two minerals are also distinguishable by the color of their streak, polybasite has a black streak and pyrargyrite has a red streak. The pyrargyrite is usually associated with the galena and in one specimen of "solid" galena, approximately 3% of pyrargyrite was found. This silver mineral was not always associated with the galena as some was observed in an intimate association with tetrahedrite (See Fig. 4, page 9). This association may indicate a simultaneous deposition of pyrargyrite, tetrahedrite and galena. The pyrargyrite is replacing the galena but it has a mutual boundary texture with tetrahedrite.

Polybasite is also associated with the galena. It is not usually found where the galena is massive but is found at the edges of the galena bands (See Fig. 5). The polybasite is in grains ranging in size from 7 microns to 260 microns across. It is replacing the galena as triangular cleavage pits of galena are seen as relics in the polybasite.

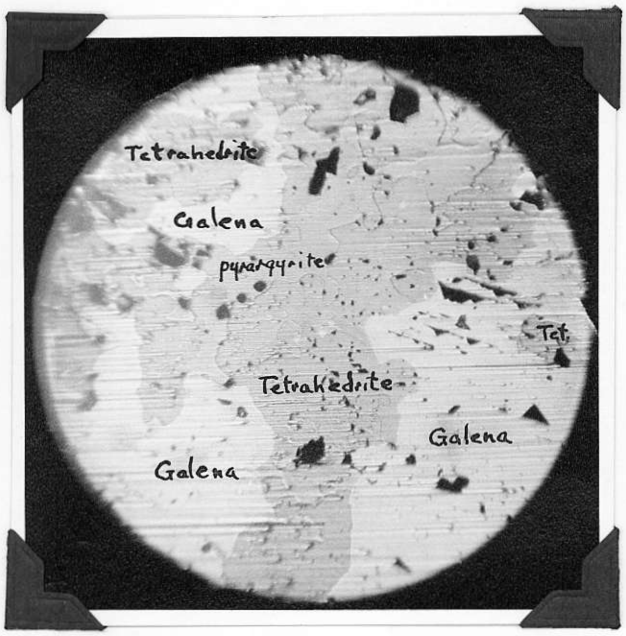

Fig. 4 Microphotograph Showing Pyrargyrite and Tetrahedrite in Galena - (683X)

(Notice triangular pit in tetrahedrite on right-hand side of photograph)

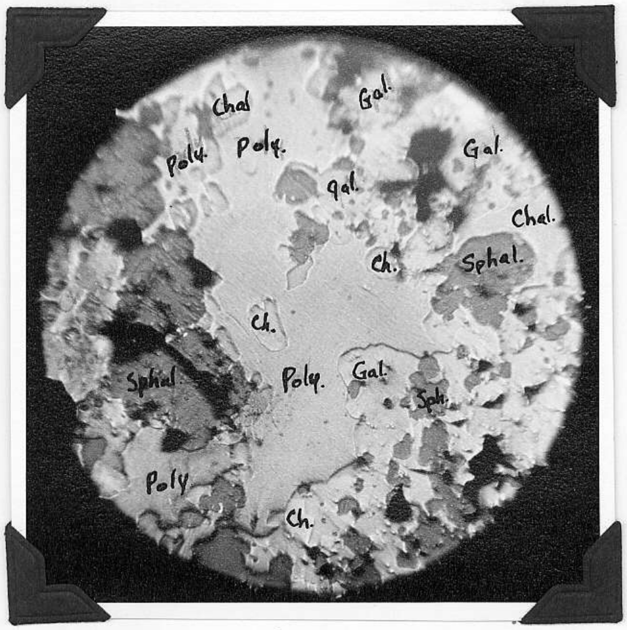

Fig. 5 Microphotograph Showing Large Polybasite Grain - (608X)

(The dark grey mineral is sphalerite and the chalcopyrite is seen as grains as it has coalesced after unmixing from the sphalerite)

Tetrahedrite

In general, the amount of tetrahedrite present in the ore is approximately equal to the combined amount of the silver minerals. It is associated with the galena and shows grains up to 780 microns across and is also intimately associated with pyrargyrite. The tetrahedrite is replacing the galena as a few cubic cleavage pits are found in grains of tetrahedrite (See Fig. 4, page 9). The question as to whether the tetrahedrite is silver-bearing can not be answered as the results of any such analysis is not available. No reference to previous work!

Chalcopyrite

The percentage of chalcopyrite in the ore would be expected to be low as the mineral is seen only as small grains (30 microns wide) or as exsolution blebs in sphalerite. (See

Fig. 2, page 6) Some chalcopyrite is also in irregular veinlets which cross sphalerite grains. With slow cooling of the ore fluids, some of the exsolved chalcopyrite could have coalesced to form these irregular veinlets which have a width of about 25 microns.

Arsenopyrite

This mineral is present only in minor amounts. It is found among grains of pyrite and has its usual wedge-shaped form. The size of the arsenopyrite grains would not be greater than 20 microns.

Paragenesis of the Ore Minerals

The paragenetic relations of the ore minerals are summarized in Fig. 6, page 12, using the method of Robertson and Vandeveer (1952). Each of the main hypogene minerals arranged around a circle is represented by a small numbered circle, its size representing its relative abundance and the number, its paragenetic position. Lines join minerals observed in contact and the absence of an arrow indicates simultaneous deposition. Where replacement occurs, an arrow points towards the host mineral. For example, pyrite and arsenopyrite are in contact and were deposited simultaneously. The pyrite is also in contact with galena but the galena is replacing the pyrite. The width of the lines suggest the replacement tendencies. Thus, pyrargyrite and tetrahedrite have a greater tendency to replace galena than galena has to replace pyrite. Supergene minerals were not observed in the ore specimens so none appear in the diagram.

The mineral formed by exsolution (chalcopyrite) is shown outside the main circle and attached by a double line to the host, sphalerite. According to Edwards, the exsolution of chalcopyrite from sphalerite occurs at a temperature about 350 to 400 degrees Centigrade, indicating that the deposit on Wallace Mountain is of relatively high temperature.

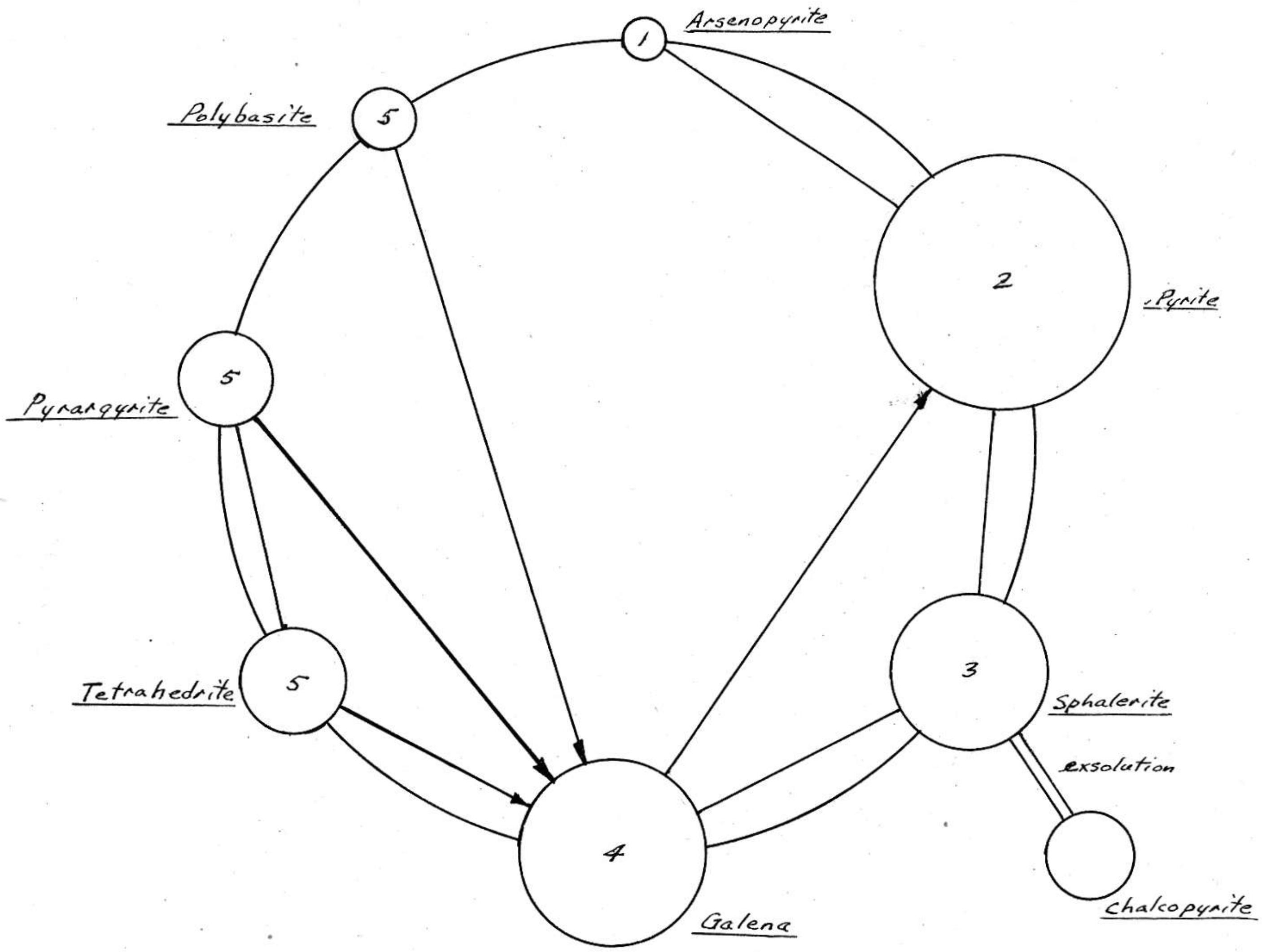

Fig. 6 Paragenesis of the Ore Minerals, Highland Bell Deposit

Conclusion

The high temperature and character of the Highland Bell ore deposit indicates an environment of simultaneous deposition. All minerals present in the ore except the chalcopyrite are primary and hypogene and were deposited simultaneously. ? The tetrahedrite, pyrargyrite and polybasite are replacing the galena and the galena is replacing the pyrite. The chalcopyrite has unmixed from the sphalerite at a temperature of about 350 to 400 degrees Centigrade, thus, indicating the temperature of the deposit. As the ore examined in this report is from the deepest part of the deposit, it is reasonable from the character and high temperature of the ore, to classify the Highland Bell ore deposit as hypothermal.

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No reference to work
by Dr Warren -
or Minister) mines.
Dunkaque) with
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