A MICROSCOPIC STUDY OF HIGHLAND BELL ORE FROM NO. 8 LEVEL

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C O N T E N T S

Introduction

The following report was written as a part of the Geology 9 laboratory course on microchemistry and polished section microscopy at the University of British Columbia. The purpose of the course is to enable the student to identify ore minerals in polished sections using the microscope, to determine the size of mineral grains, to recognize the sequence of mineral deposition or paragenesis, and to decide whether mineralization is hypogene or supergene. The report itself contains information about a specific suite of mineral specimens chosen from a particular property or mine. The contents of the report should indicate the degree of grinding required for metallurgical separation, the minerals present, and the behaviour of the ore at depth.

Source of Specimens

The mineral specimens to be studied were collected at the Highland-Bell mine, a small silver, lead, zinc property, by Dr. H. V. Warren. The Highland- Bell mine is located on the west side of Wallace mountain at Beaverdell, B. C. , a small town on the Kettle Valley Railway about 60 miles east of Penticton, B.C.

Geology of Beaverdell Area

The Wallace group, essentially an assemblage of volcanic rocks, was intruded by the Westkettle Quartz Diorite in Jurassic time, and this Batholith was in turn intruded by the Beaverdell Batholith of Quartz Dioritic composition during the Eocene Epoch. Reinecke[1] in his report suggested that the Beaverdell Batholith was the source of mineralizing solutions that deposited the ore minerals in the competent rock of the Westkettle Batholith.

Geology of Highland-Bell Mine

The Highland-Bell mine consists essentially of a mineralized vein which averages about one foot in width and strikes northwest and dips northeast. The vein is displaced by a series of strong normal faults that strike northwest and dip southwest. The structure is further complicated by numerous small faults and slips that do not follow any simple pattern.

1. Reinecke, L., Ore Deposits of the Beaverdell Map Area, Canada Geological Survey, Mem. 79, No. 65, Geol. Series, 1915.

The vein seems to be very persistent along its dip but present developments indicates that its length is restricted by incompetent rocks of the Wallace Group and fractured zones.

Preparations and Methods of Study

A series of specimens were selected to show the relations of the various ore minerals. Six bakelite polished sections were prepared, two of which were superpolished. Two of the six sections were chosen to exhibit polybasite and the remainder were chosen to exhibit tetrahedrite, pyrargyrite, sphalerite, etc. In spite of careful selection of the material, no tetrahedrite was recognized in the sections. The work was carried out using the methods recommended by Short[1]. Etch tests were used extensively and were found to be particularly reliable in most cases.

Mineralogy

The following minerals were seen and identified: quartz, pyrite, arsenopyrite, sphalerite, chalcopyrite, galena, polybasite, pyrargyrite, and native silver. Previous workers reported stephanite, tetrahedrite, and argentite but these minerals were not identified by the author.

Quartz - Quartz, which was determined by its hardness and colour, occurs in two distinct forms and ages. The first type of quartz is massive and is megascopically veined by solid sulphides including pyrite and arsenopyrite. The massive variety also veins pyrite and sphalerite. The second type of quartz is euhedral

1. Short, M.N., Microscopic Determination of the Ore Minerals, United States Geological Survey, Bulletin 914, 2nd Edition, 1940.

and seemingly has no definite age but is probably later than the pyrite, arsenopyrite, and most of the sphalerite.

Pyrite - Hardness, colour, and surface markings were used to recognize pyrite. It is occasionally euhedral but is commonly fractured and veined by quartz and sulphides.

Arsenopyrite - Arsenopyrite was spotted by its colour, hardness, and rhombic form. It was replaced by chalcopyrite in one specimen but was commonly euhedral.

Sphalerite - Sphalerite was most readily recognized by the rods and dots of chalcopyrite exsolved in it but colour, hardness, and amber-coloured internal reflection were useful.

Chalcopyrite - Chalcopyrite was readily spotted by its hardness and colour. It is closely associated with sphalerite and arsenopyrite and occurs in two ways. It is found in sphalerite as random dots and oriented lines, probably as the result of exsolution. Massive chalcopyrite also veins the sphalerite with the exsolved dots and rods.

Galena - Galena was most easily identified by triangular pits, brightness, and hardness. Galena, polybasite, and native silver are easily contrasted where they occur in the same field but where they are alone the presence or absence of triangular pits and etch test are most helpful.

Polybasite - Polybasite was dtermined by its brightness, lack of triangular pits, hardness, and etch tests. Preliminary examinations of specimens indicated much tetrahedrite but later hardness and etch tests disproved this indication.

<u>Pyrargyrite</u> - Pyrargyrite was easily recognized by its blue-grey colour and its internal reflection. In the specimens examined it is closely associated with galena and polybasite.

<u>Native Silver</u> - Native silver was spotted by its brightness, hardness, and etch tests. It was found only in one section and seemed to be deposited with polybasite.

<u>Discussion of Sections</u>

<u>Number #1</u>

The first section studied contained a veinlet of polybasite in massive and euhedral quartz. A small tongue of native silver, chalcopyrite and sphalerite protruded into space between the polybasite and quartz. Most of the native silver rimmed the polybasite but rounded blebs of native silver and chalcopyrite occurred well within the main mass. This occurrence was taken to indicate simultaneous deposition and indicated that some of the native silver in the mine is primary.

(See next page for photographs of Section No. 1)

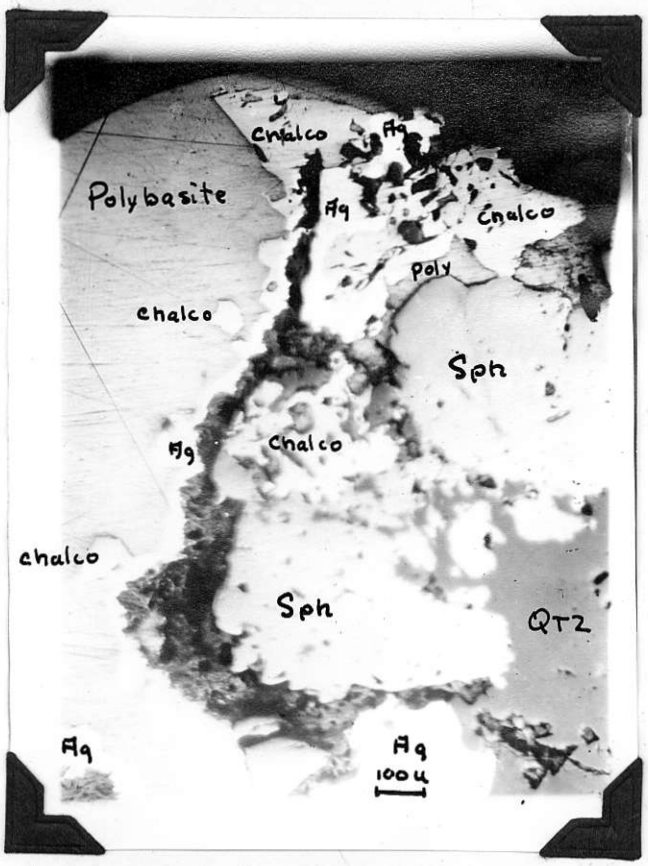

Figure No. 1

Tongue of native silver, chalcopyrite, and sphalerite lying between polybasite and quartz.

Magnification=70.

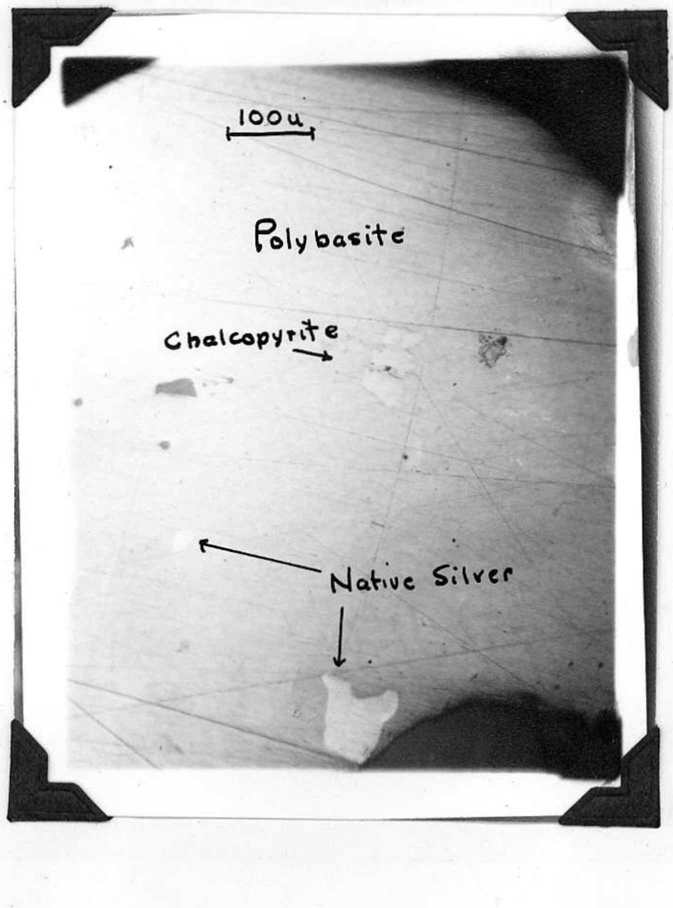

Figure No. 2

Native silver exsolved from polybasite.

Magnification= 120.

Number #2

Section No. 2 did not prove very useful in the microscopic study because it consisted mostly of pyrite which polished very poorly. The section indicated that arsenopyrite had replaced pyrite and in turn both had been veined by quartz.

Number #3

The third section studied was particularly interesting because one field showed the simultaneous deposition of galena, polybasite, and pyrargyrite. A photograph shows a remarkable pattern of pyrargyrite and galena that is strongly suggestive of exsolution. A second field shows pyrargyrite apparently grading into polybasite in a background of galena. A third field shows polybasite veining an exsolved mass of galena and pyrargyrite. This latter phenomenon was apparent only under polarized light and was the only definite suggestion the author had for the paragenesis of galena, pyrargyrite, and polybasite.

(See next page for photograph of Section No. 3)

Figure No. 3

Polybasite exsolved from galena.

Magnification = 120.

Number #4

The fourth section contained most of the ore minerals and showed some interesting veining, particularly of sphalerite. The sphalerite was veined by galena, chalcopyrite, polybasite, and pyrargyrite. Sometimes only one mineral veined the sphalerite but more often it was two or more closely intermingled sulphides. In one case polybasite and chalcopyrite, closely intergrown, veined sphalerite. One disturbing feature was noted. A vein in the sphalerite contained euhedral crystals of arsenopyrite. At first this was thought to indicate a later generation of arsenopyrite but the presence of euhedral crystals of arsenopyrite throughout the section suggest that later solutions carried the arsenopyrite into place. Another point of interest in the fourth section was the presence of much euhedral quartz in the sphalerite ~~while~~ whereas any quartz in the galena was largely corroded.

(See next page for photographs of Section No. 4)

Figure No. 4

Chalcopyrite and polybasite veining chalcopyrite-bearing sphalerite.

Magnification= 270.

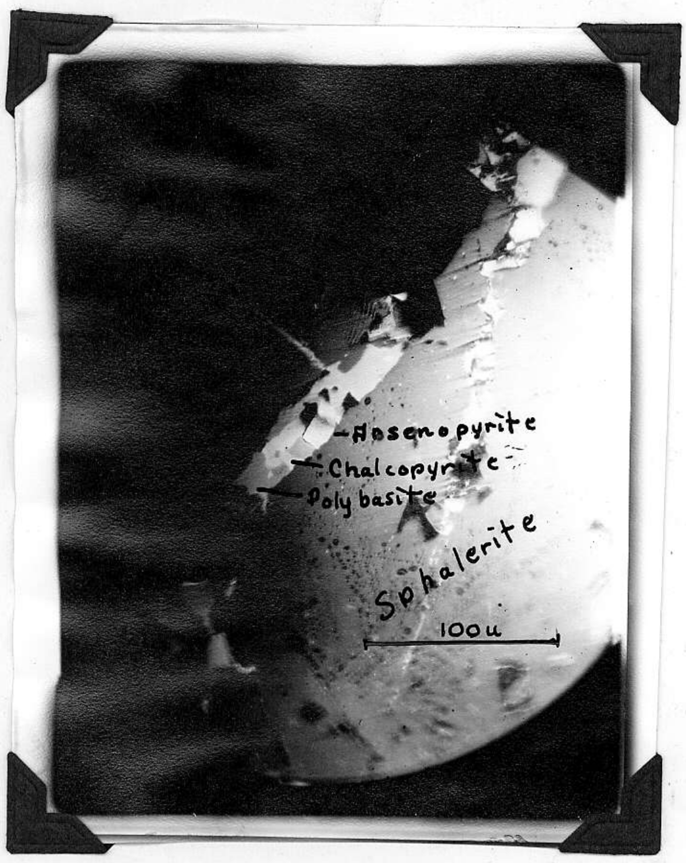

Figure No. 5

Euhedral arsenopyrite in vein of polybasite and chalcopyrite cutting sphalerite.

Magnification= 270.

Number #5

The fifth section contained galena, pyrite, sphalerite, and quartz but revealed no interesting or definite relations.

Number #6

The sixth section was made up of pieces of polybasite which revealed no interesting relations but which were useful in experimenting on etch tests for polybasite.

Paragenesis

The order of deposition showed much overlapping and some minerals, particularly quartz and chalcopyrite, were found to occur in more than one generation. The paragenesis is essentially as follows: quartz; pyrite; arsenopyrite; sphalerite; galena, pyrargyrite, polybasite, chalcopyrite, and native silver.

Quartz is established as the original vein mineral because it is megascopically veined by all other minerals including pyrite. It is not all of one generation because massive quartz can be seen cutting pyrite and sphalerite. Euhedral quartz occurs in sphalerite but is usually partially corroded where it occurs in galena. Crystalline quartz may be seen exhibiting comb structure[1] along the borders of polybasite veinlets.

1. Bateman, A.M., Economic Mineral Deposits, John Wiley and Sons, Inc., New York, 1942.

Pyrite is the second mineral to be deposited. It is sometimes euhedral but it is usually anhedral and fractured. The fractures are filled with sulphides and massive quartz.

The evidence for age relationships of arsenopyrite is less definite than for most minerals but in one section it apparently replaced pyrite. Arsenopyrite was replaced in one section by chalcopyrite but the fact that euhedral crystals occurred in veins of chalcopyrite and polybasite surrounded by sphalerite was anomalous. Euhedral arsenopyrite crystals in other minerals could have been carried by later solutions which freed them and cemented them in new positions. Arsenopyrite is placed before sphalerite according to Bateman's [1] table of diagnostic minerals.

The sections studied offered good evidence of the relative position of sphalerite in the paragenesis of Highland-Bell ore. It veins pyrite, contains exsolved chalcopyrite, and is definitely cut by galena, pyrargyrite, polybasite, and chalcopyrite. In places there is some suggestion that sphalerite was deposited simultaneously with galena but the deposition of the lead sulphide continued after zinc sulphide.

The deposition of pyrargyrite and polybasite was simultaneous with some of the galena and exsolution patterns in one specimen ~~is~~ are good proof. These two minerals are usually closely related and at times seem to merge into each other. In the sections studied some polybasite has apparently been deposited after pyrargyrite.

Chalcopyrite seems to have been deposited over a considerable period of time. It is found exsolved from sphalerite and from polybasite.

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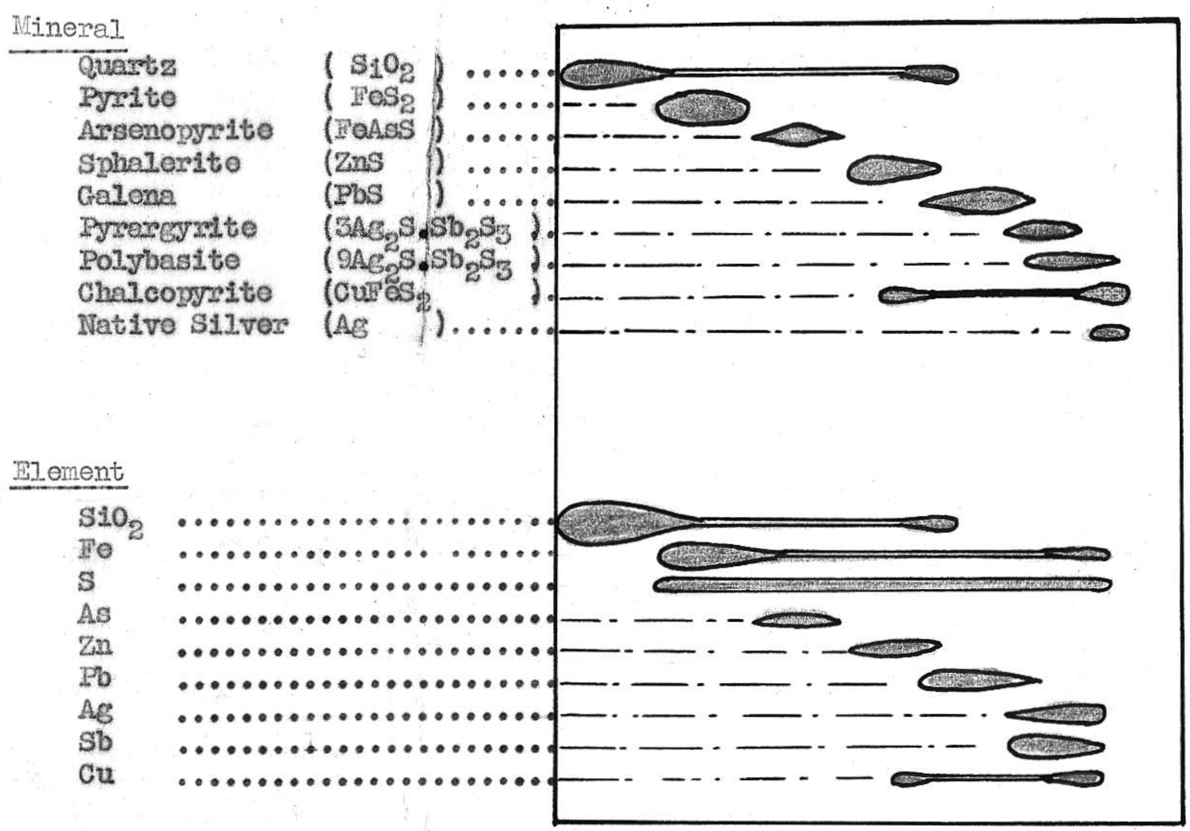
1. Bateman, A.M., Economic Mineral Deposits, John Wiley and Sons, Inc., New York, 1942.

Native silver was found in only one section and appeared to be exsolved from massive polybasite. It seems closely associated with chalcopyrite and these two minerals rim polybasite. This evidence suggests that the mineralizing solutions became increasingly rich in silver as deposition went on and that at least some of the silver found in Highland-Bell ore is primary.

Paragenesis Chart



Conclusion

(1) The minerals found in Highland-Bell ore from Number #8 Level are, in the sequence of deposition,

(a) quartz

(b) pyrite, arsenopyrite

(c) sphalerite, chalcopyrite, quartz

(d) galena, pyrargyrite, polybasite, chalcopyrite, native silver.

(2) The mineralization of the Highland-Bell ore is particularly coarse and should require little grinding to release the main ore minerals. The most notable exception is the presence of blebs and rods of chalcopyrite in sphalerite. This material averages from two to five microns in diameter.

(3) There is no evidence of secondary mineralization in the specimens studied from Number#8 Level of the Highland-Bell mine. The silver found in the first section is exsolved from primary polybasite.

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Bibliography

1. Bastin, E.S., and others, Criteria of Age Relations of Minerals, Economic Geology, vol. 26, #6, 1931.

2. Bateman, A.M., Economic Mineral Deposits, John Wiley and Sons, Inc., New York, 1942.

3. Reinecke, L., Ore Deposits of the Beaverdell Map Area, Canada Geological Survey, Mem. 79, No. 65, Geol. Series, 1915.

4. Short, M.N., Microscopic Determination of the Ore Minerals, United States Geological Survey, Bulletin 914, 1940.

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