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A MINERALOGICAL STUDY
OF ORES FROM
THE BEAVERDELL MINING CAMP
BRITISH COLUMBIA

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Introduction

This report has been prepared from a microscopic study of polished sections of ores from the Beaverdell Mining Camp. The work was conducted in the laboratories of the Department of Geology of the University of British Columbia.

The writer wishes to express his appreciation to Dr. H. V. Warren, under whose direction this work has been carried out, for many ideas and suggestions and much valuable assistance in the examination of sections. The writer is also indebted to Mr. J. Donnan and Mr. R. M. Thompson for assistance in the preparation of the sections.

The Mining Camp

The Beaverdell Mining Camp lies in the valley of the West Kettle River about thirty miles north of the American Boundary. The camp is served by the Kettle Valley Railroad with a haul of more than 200 miles from Vancouver and about a hundred from Trail.

The Highland Bell Mine is the only important producing mine at present. Most of the other properties are closed down or are being operated by the Highland Bell Company.

General Geology

The geology of the district has been described by Leopold Reinecke.[1] The oldest rocks in the region are the members of the Wallace Group. These are faulted, but little-folded sediments of Triassic and Jurassic age. The group consists of coarsely crystalline limestone and fine-grained hornfels at the base with overlying metamorphosed tuffs and andesitic flows and coarse-grained basic intrusive sills and dykes.

The rocks of the Wallace Group have been intruded by the quartz-diorite of the Westkettle batholith - correlated by Reinecke with the Jurassic phases of the Okanagan composite batholith. The batholith covers an area of 200 square miles. The rock is, locally, rather gneissic and has been severely metamorphosed along certain shear zones, with the development of sericite, epidote, and chlorite. The batholith is extremely irregular in outline, the intrusion being probably by stoping and assimilation. The batholith has been cut by later block faults.

The Westkettle batholith has been cut by the Beaverdell quartz-monzonite stock. The stock is about two miles in diameter in the valley-bottom near the Camp. The

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

stock is considered by Reinecke to be of Eocene age. McKinstry[2] believes it to be a differentiate of the same parental magma as the Westkettle batholith. The ore-bearing veins occur as a halo about the Beaverdell stock and are undoubtedly genetically related to it.

Ore Deposits

Veins

The veins occur in the Westkettle batholith and strike in a general east-west direction. Most of them dip to the south but a few dip vertically or to the north. Although the veins may vary from a few inches to eight feet in width, the ore streaks are rarely more than a foot wide. In places the vein becomes a shear zone with a number of parallel ore-streaks. Although large vugs and comb structure occur, they are rare, whereas small vugs are quite common and are partly filled with native silver, charcopyrite, pyrargyrite and other late minerals. The vein-filling consists of quartz, pyrite, arsenopyrite, sphalerite, galena, tetrahedrite, pyrargyrite, small quantities of other metallic minerals, calcite and fluorite.

The veins have been cut by late faults of, commonly, small displacement. The productive parts of the veins are

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2.

restricted to the Westkettle batholith - the veins becoming unproductive in the Wallace Group. As the Beaverdell batholith is approached the veins increase in base metal (lead and zinc) content and decrease very markedly in silver.

Minerals

The following metallic minerals have been identified in polished sections of the ore - pyrite, arsenopyrite, sphalerite, galena, tetrahedrite, pyrargyrite, stephanite, chalcopyrite, argentite, and native silver. Worthy of note are:

Sphalerite - The sphalerite is dark in color indicating a high iron-content. Chalcopyrite is found veining and replacing sphalerite. In section 3 chalcopyrite occurred throughout the sphalerite in rods and dots which suggested exsolution. At one place, however, the sphalerite was cut by an irregular veinlet of chalcopyrite which had been offset by later adjustment of the strained crystal along cleavage planes. For this reason, the series of rods and dots is thought to be formed by slicing up of ribbons of calcopyrite veining and replacing the sphalerite along cleavage planes. Figure 1 illustrates this point.

Galena - Galena occurs veining and replacing sphalerite and other early minerals and has, in turn, been veined and replaced by the later minerals. The cubic cleavage planes of the galena have been warped due to stress and thus confirm the strained condition of the crystals postulated in the preceding paragraph.

Tetrahedrite - This mineral occurs extensively throughout the specimens - but particularly those rich in galena and sphalerite. The grey-copper veins and replaces sphalerite to a limited extent. In contact with galena, however, it gives evidence of extensive replacement of that mineral. Although the galena-tetrahedrite relations tend to be somewhat obscure, the preponderance of evidence leads to the conclusion that the tetrahedrite is later than the galena.

Pyrargyrite - This is the common ruby-silver mineral of the deposits and the only one identified in the accompanying sections. Polished sections of the mineral have a distinctive bluish cast. The etch reactions and microchemical tests confirmed as far as it is reasonably possible that the ruby-silver of the accompanying sections is pyrargyrite rather than any other ruby-silver. The pyrargyrite replaces tetrahedrite and, to a lesser extent, the galena. Pyrargyrite also occurs partly filling small vugs. (see specimen 4)

Stephanite (Brittle Silver) -

This mineral was observed in only one section - No. 4. The mineral was identified on the basis of microchemical tests, etch reactions, and polarization colors. It did not occur in contact with many minerals so that its precise relation to the other minerals could not be obtained. Green fluorite seemed to be growing around what appeared to be a euhedral crystal of stephanite. The stephanite was extensively replaced by native silver.

Argentite - Argentite was not common in the sections examined. In one section it was observed to be replacing sphalerite and being replaced by chalcopyrite.

Chalcopyrite - Chalcopyrite is not abundant. It occurs in most grains of sphalerite but rarely elsewhere. In section 4, however, it occurs replacing pyrargyrite and is, in turn, replaced by native silver.

Native Silver - Native silver occurs extensively as "wire silver" in the hand specimen and as a replacement of tetrahedrite, pyrargyrite, stephanite, or chalcopyrite (also argentite) in polished section.

The gangue minerals are quartz, calcite, and fluorite. The quartz, according to McKinstry, occurs in three generations. The sections studied, however, were not very satisfactory for the determination of the generations of quartz, so this could not be confirmed. Both calcite and fluorite are rare in the sections (most of the calcite was dissolved out during the etch-tests).

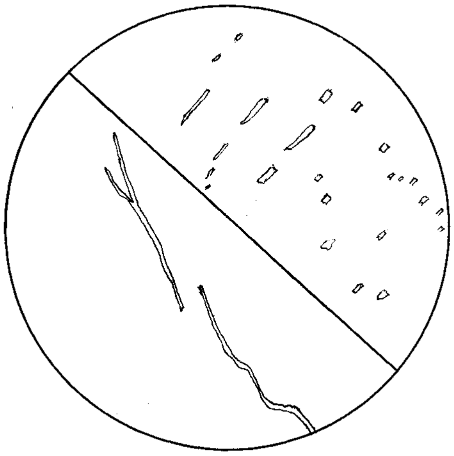


Fig. 1

Section 3.

Ribbons and dots of chalcopyrite in sphalerite.

Sliced veinlet of chalcopyrite in sphalerite.

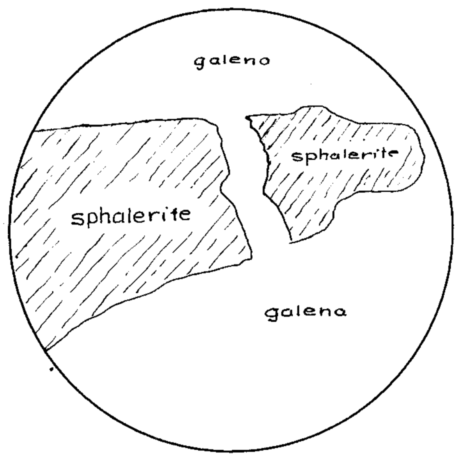


Fig. 2

Section 1.

Galena veining sphalerite.

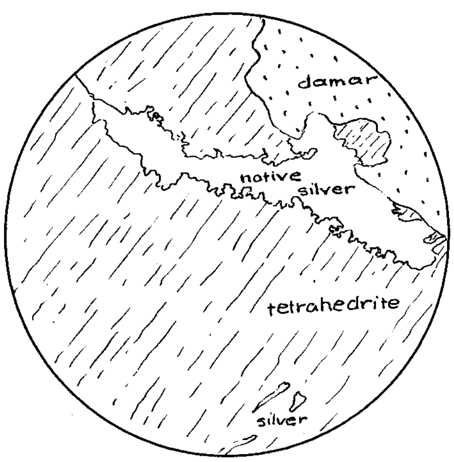


Fig. 3

Section 2.

Native silver replacing tetrahedrite, showing the complex type of replacement typical of native silver.

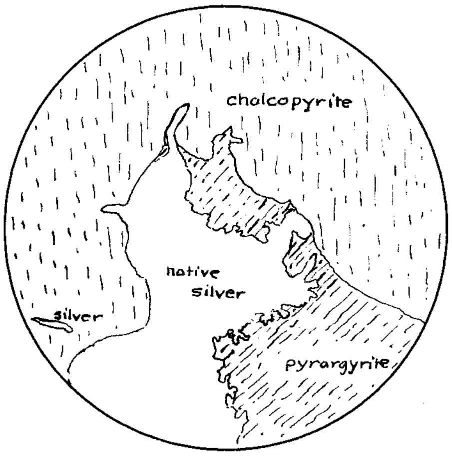


Fig. 4

Section 4.

Native silver replacing both pyrargyrite and chalcopyrite.

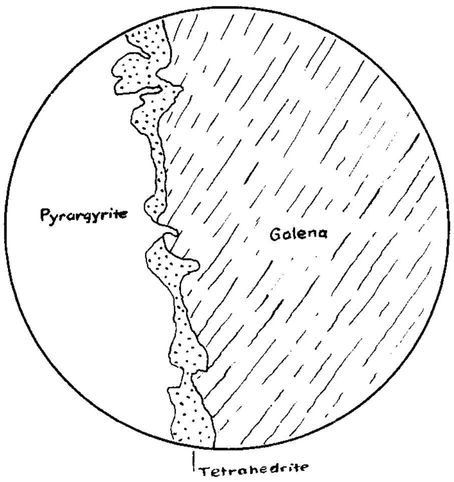


Fig. 5

Section 1.

Typical pyrargyrite-tetrahedrite-galena raltions. This is interpreted as replacement of tetrahedrite by pyrargyrite in preference to galena.

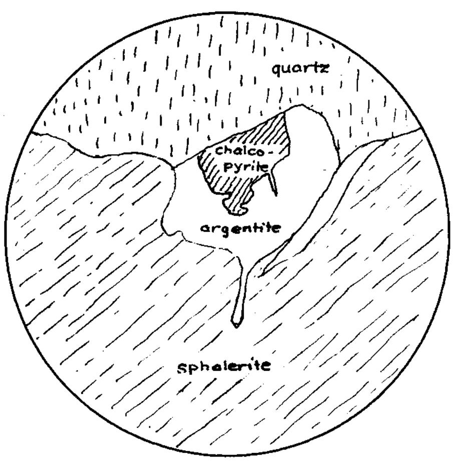


Fig. 6

Section 3.

Sphalerite replaced by argentite and the latter replaced by chalcopyrite.

Paragenesis

McKinstry's postulation of three generations of mineralization - based on a thorough field study of the veins, in conjunction with an examination of polished sections, still stands. The limited work of the writer tends to confirm McKinstry's work on all essential points. A little more data, however, tends to warrant the change of a few details.

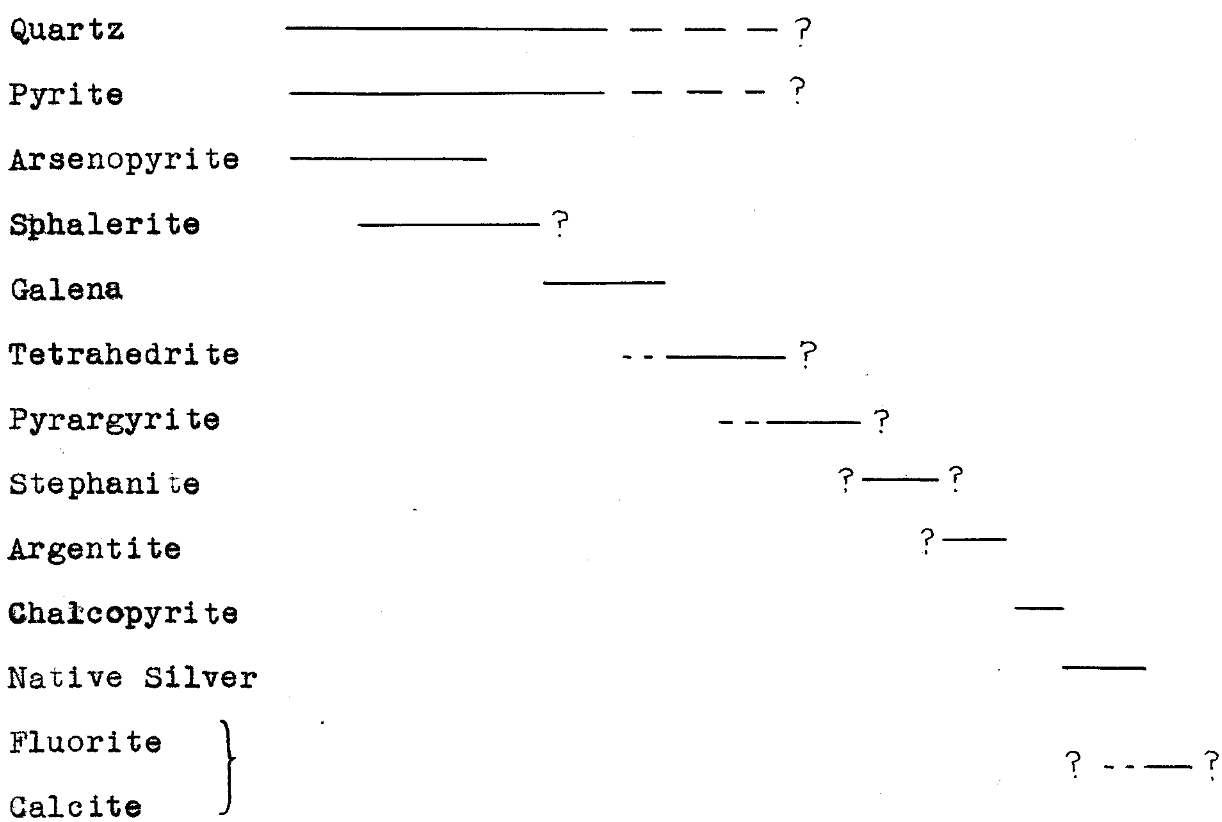
Chalcopyrite appears, according to the evidence at hand, to be later than all of the metallic minerals except native silver.

Stephanite is not mentioned byMcKinstry. There appears to be, however, little reason to doubt its presence. Its period of deposition, relative to the other minerals, is uncertain but it is probably a late mineral.

The galena, tetrahedrite, pyrargyrite relations are extremely difficult to prove, but the preponderance of evidence points to their deposition in that order.

There appears to be little doubt that the galena is later than the sphalerite.

The paragenesis of the deposits may be represented by the following diagram:



Hypogene and Supergene Considerations

The discussion has long raged as to whether silver ores, particularly those rich in ruby-silver, are hypogene or supergene. At Beaverdell a few pieces of evidence suggest a hypogene origin for the main silver mineralization.

1. Field observations at Beaverdell have shown that the zone of supergene alteration is very shallow-sulphides are encountered within ten feet of the surface and the water table within fifty feet. If the currently accepted idea of supergene

sulphides being deposited at or near the water table is valid, the ruby silvers which occur between 100 and 600 feet below the surface cannot be of supergene origin.

2. If the chalcopyrite is hypogene, all the other minerals except, possibly, native silver must also be hypogene. Supergene chalcopyrite has been reported in other mines (e.g., Copper Mountain) but in those cases it is associated with other secondary copper minerals such as chalcocite, covellite, etc. At Beaverdell there are no other copper minerals which might be secondary. It is logical, therefore, to conclude that the chalcopyrite is primary or hypogene and all the metallic minerals (except native silver) must, likewise,be hypogene. Whether the native silver is hypogene or supergene is an open question.

Conclusions

There seems to be little doubt that the main mineralization in the Beaverdell camp is primary or hypogene and the deposit will conform, as a general rule, with other epithermal bonanza silver deposits.

More than one silver sulfo-salt occurs in the ores (two have been proved by the author - and it is currently reported that there is at least one more.) In the design of a method of concentration, therefore, this must be taken into consideration and provision made to recover in the concentrates/all silver sulfo-salts - not just pyrargyrite.

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