600123

BOX 409.

PROBLEM 4.

PROVIDENCE ORE

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MARCH 30, 1962.

Providence Mine

Introduction

The Providence Mine is situated on the northside of Providence Creek about 1 mile north of Greenwood. The mine has been operated intermittently from 1896 to the present time.

The Providence claim lies almost entirely within the highly altered rocks that border the large granodiorite stock which crops out on either side of Boundary Creek at Greenwood. Some of the altered rocks resemble silicified argillites, whereas others are green tuff.

Ore shoots occur within a quartz-calcite vein that strikes north 50 degrees east and dips 40 to 65 degrees southeast. The vein has an average width of one foot and is, reportedly, traceable underground for over 1,200 feet.

Two groups of faults are recognizable. The older group, which is pre-mineralization in age, strikes north 30 to 50 degrees and dip gently northeast. In most instances, the hanging wall has moved downward with respect to the foot-wall thus indicating normal faulting. Offsets along these faults range from a few feet to 80 feet. The main vein is generally enlarged where it

intersects these pre-mineral faults. The younger faults generally strike north 30 degrees west to north 10 degrees east and are steeply dipping. These younger faults are post-mineral and offset the vein as well as the pre-mineral faults.

The main ore minerals are; galena, sphalerite, pyrite, chalcopyrite, tetrahedrite, argentite, pyrargyrite, and native silver and gold.

According to R.B. Forbes[1] the total production prior to 1930 was 5,750 tons, which yielded 3,225 ounces gold, 746,951 ounces silver, and 187,689 pounds lead.

References: [1] B.C. Dept of Mines: Lode Gold Deposits of B.C. Bull 1, pp84-85 (1932). B.C. Dept. of Mines: Ann. Rept. B.C. Minister of Mines, 1896, 1897, 1904, 1906, 1918, 1919 1920, 1921, 1925, 1928, 1934, 1945, 1953, and 1960 Canada Department of Mines and Resources, Geological Survey Paper 45-20: Greenwood-Phoenix area, B.C. D.F. McNaughton (1945).

MEGASCOPIC

MOST OF THE SPECIMENS APPEAR TO HAVE BEEN TAKEN FROM OUTCROP. THE COUNTRY ROCK IS A GREEN SILICEOUS MATERIAL, POSSIBLY AN ALTERED VOLCANIC ROCK. THE VEIN GANGUE IS MASSIVE, FRACTURED AND SHEARED CALCITE AND QUARTZ. BRECCIATED OUT 9
SECTIONS OF THE COUNTRY ROCK ARE FOUND IN THE VEIN. MINERALIZATION OCCURS ALONG THE MAROON FRACTURES IN THE VEIN. WHERE TWO FRACTURES INTERSECT MASSIVE REPLACEMENT OCCURS. THIS INDICATES THAT MINERALIZATION OCCURRED LATER THAN THE GANGUE MATERIAL.

THE FOLLOWING METALLIC MINERALS WERE DETERMINED BY MEGASCOPIC STUDY OF THE HAND-SPECIMENS:

STIBNITE	40%
GALENA	35%
PYRITE	10%
TETRAHEDRITE	10%
CHALCOPYRITE	3%
PYRARGYRITE	2%
ARGENTITE	TRACE.

THE PERCENTAGES GIVEN ARE THE ESTIMATED PERCENTAGE OF ONE MINERAL TO THE TOTAL METALLIC CONTENT OF THE VEIN. THE METALLIC MINERALS MAKE UP ROUGHLY 25% OF THE VEIN.

MICROSCOPIC

THE FOLLOWING MINERALS WERE IDENTIFIED FROM THE 13. POLISHED SECTIONS.

1. SPHALERITE (ZnS)

POLISH GOOD; ISOMETRIC; COLOUR GRAY; HARDNESS C; RESIN-COLOURED INTERNAL REFLECTION: EFFERVESCES WITH AQUA REGIA; NEGATIVE TO ALL OTHERS. NOTE-SHOWED EXSOLUTION OF CHALCOPYRITE.

2. GALENA. (PbS)

POLISH GOOD; ISOMETRIC; COLOUR ARSENO WHITE; HARDNESS B. SHOWED GOOD Δ PITS; EFFERVESCED AND TURNED BLACK WITH HNO_3;

3. TETRAHEDRITE ($5Cu_2S.2(Cu,Fe)S.2Sb_2S_3$).

POLISH GOOD; ISOMETRIC; COLOUR GRAY. HARDNESS D; TARNISH WITH HNO_3; NEGATIVE TO ALL OTHERS.

4. CHALCOPYRITE ($CuFeS_2$)

POLISH GOOD, LIGHT YELLOW COLOUR, HARDNESS D+ SLIGHTLY ANISOTROPIC

5. STEPHANITE ($5Ag_2S.Sb_2S_3$)

POLISH GOOD, COLOUR GREENISH GREY; HARDNESS C+, ANISOTROPIC; POLARIZATION COLOURS LIGHT TO DARK VIOLET; NO INTERNAL REFLECTION NEGATIVE TO ALL ETCH TESTS (TESTS NOT SIGNIFICANT SINCE GALENA INTERFERRED). OCCURRED AS EXSOLUTION BLEBS IN GALENA.

6 PYRITE (FeS_2)

POLISH FAIR, COLOUR BRASS YELLOW; HARDNESS F+

7, PYRARGYRITE ($3Ag_2S.Sb_2S_3$)

ISOTROPIC; COLOUR BLUE-GREY; HARDNESS C.

RUBY-RED INTERNAL REFLECTION; POLISH GOOD; TARNISH WITH HCl, TURNS BROWN WITH KCN, IRIDESCENT WITH KOH;

8 NATIVE SILVER

POLISH GOOD; ISOTROPIC; SILVER WHITE COLOUR. HARDNESS B; SECTILE (TOO SMALL FOR ETCH).

GANGUE: QUARTZ AND CALCITE.

MINERAL PERCENTAGES (FROM POLISHED SECTIONS).

ESTIMATED AVERAGE PERCENT OF TOTAL METALLIC MINERALS ARE AS FOLLOWS.

SPHALERITE	40 %
GALENA	30 %
TETRAHEDRITE	8 %.
CHALCOPYRITE	4 %
STEPHANITE	6 %
PYRITE	10 %
PYRARGYRITE	2 %
NATIVE SILVER	TRACE

TEXTURES:

NO OUTSTANDING TEXTURES WERE EVIDENT IN THE POLISHED SECTIONS OTHER THAN EXSOLUTION. CORRODED PYRITE IN THE PRESENCE OF SPHALERITE, TETRAHEDRITE, AND GALENA INDICATES THAT PYRITE WAS THE FIRST METALLIC MINERALS FORMED. SPHALERITE APPEARS TO BE REPLACED IN PART BY GALENA AND TETRAHEDRITE (SEE FIG. 2). EXCELLENT EXSOLUTION OF CHALCOPYRITE FROM SPHALERITE WAS EVIDENT IN POLISHED SECTION NUMBER 13 (SEE FIG 4). STEPHANITE, PYRARGYRITE AND TETRAHEDRITE ALL APPEAR TO HAVE BEEN EXSOLVED FROM GALENA. SOME OF THE TETRAHEDRITE ALSO SEEMS TO BE PRIMARY (SEE FIG 2).

Is there some that isn't?

PARAGENESIS

THE PARAGENESIS OF THE METALLIC MINERALS IS PRESENTED IN THE FORM OF A VAN OR URE DIAGRAM.

THE MINERAL SEQUENCE IS AS FOLLOWS; YOUNGER DOWNWARD.

QUARTZ - VEIN RANGE.

PYRITE

SPHALERITE; - CHALCOPYRITE (EXSOLVED).

TETRAHEDRITE & GALENA; STEPHANITE, PYRARGYRITE BEING EXSOLVED FROM THESE AND POSSIBLY SOME TETRAHEDRITE FROM THE GALENA.

ARGENTITE

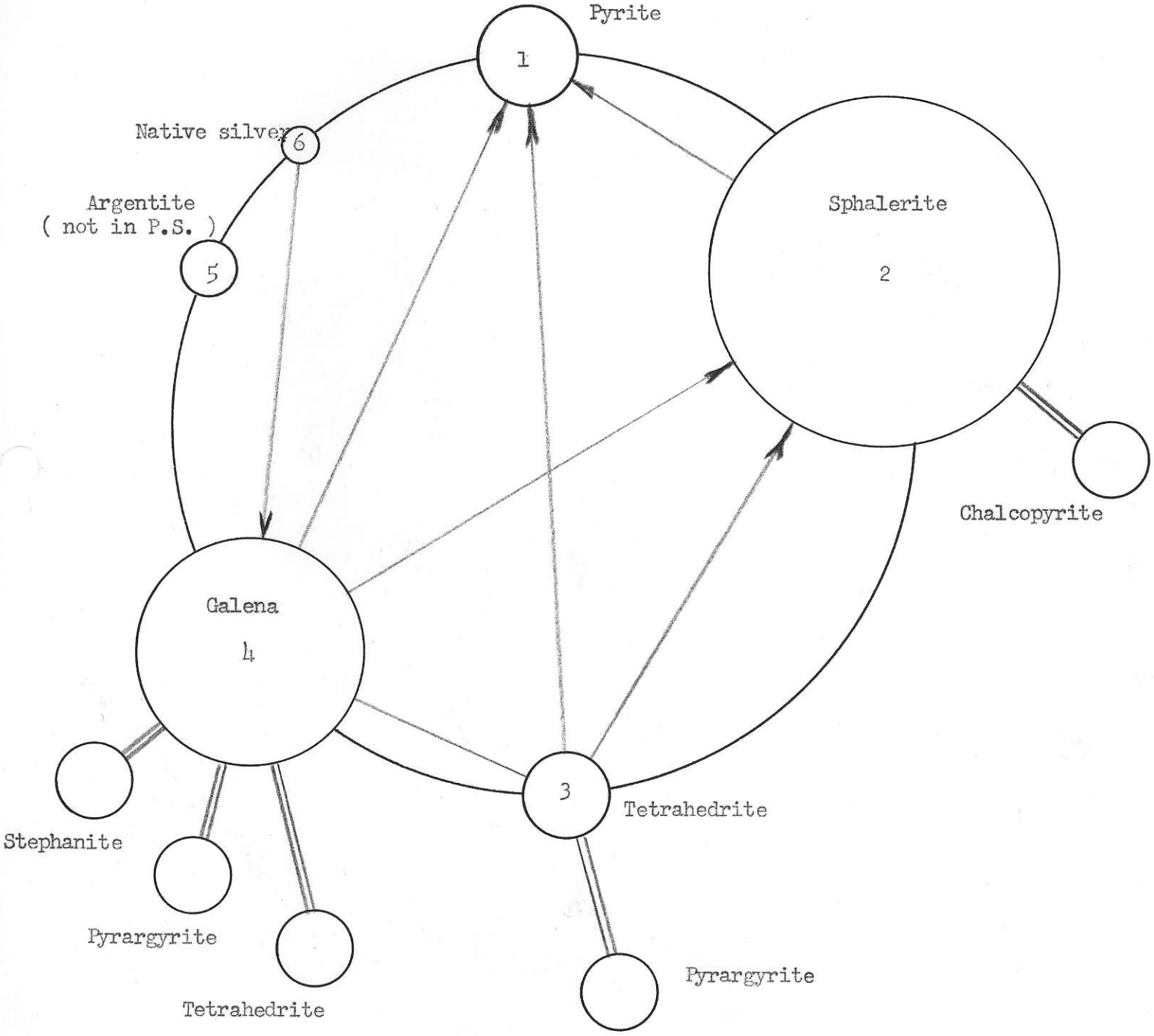
NATIVE SILVER.

CALCITE WAS PROBABLY FORMED DURING THE DEPOSITION OF THE METALLIC MINERALS.

CLASSIFICATION

The Providence ores have been formed by hydrothermal processes. From megascopic study of the handspecimens it is evident that quartz was deposited first and completly filled the fissure cavity. Later shearing forces fractured the vein quartz making it permeable to mineral bearing solutions. These solutions, initially hot, first deposited pyrite and upon cooling deposited sphalerite, chalcopyrite, galena, tetrahedrite, stephanite, pyrargyrite, argentite and native silver. Calcite was also brought in by these solutions.

VAN DE VEER DIAGRAM SHOWING THE PARAGENESIS OF THE METALLIC MINERALS AT THE PROVIDENCE MINE



FIGURES

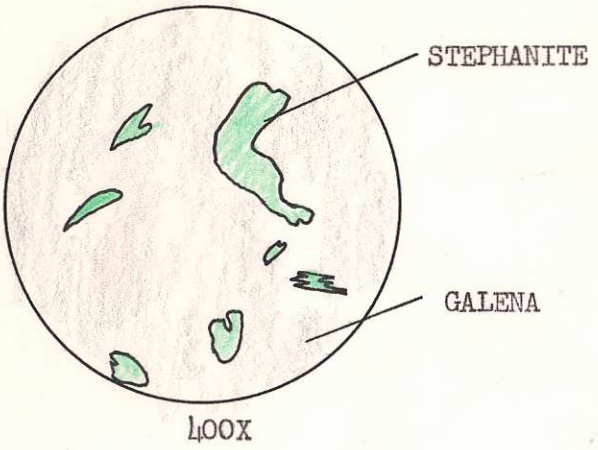


Figure 1

Figure 1 shows the exsolution of stephanite from galena. (P.S. # 6)

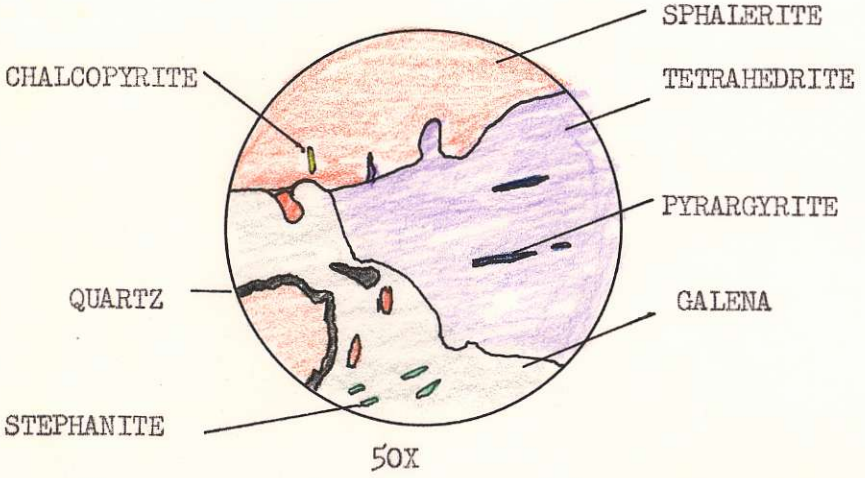


Figure 2

Figure 2 shows the relation of the various minerals to each other. (P.S. # 6)

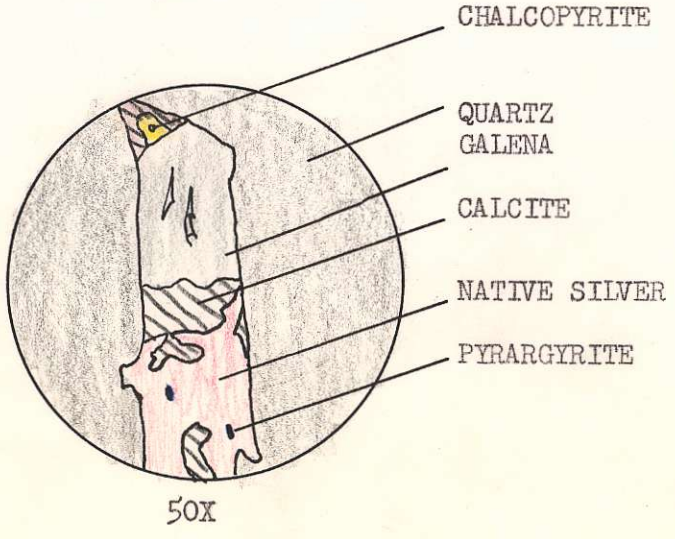


Figure 3

Polished section #5 was the only one that contained native silver.

FIGURES

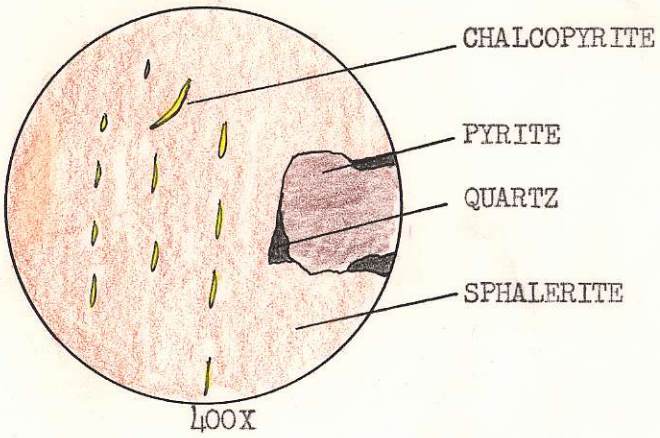


Figure 4

Figure 4 shows exsolution of chalcopyrite from sphalerite. (P.S. # B)

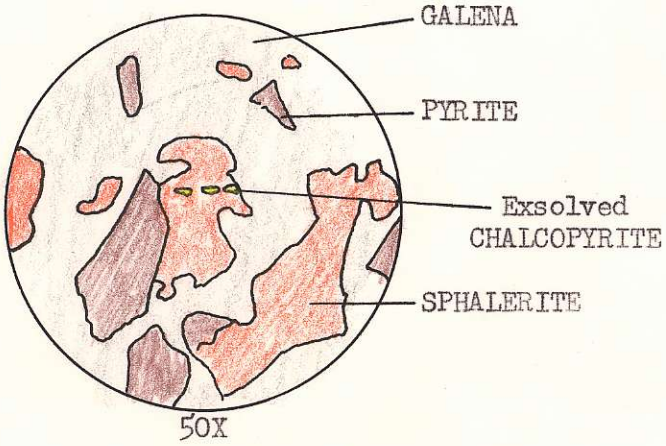


Figure 5

Corroded pyrite suggests replacement by galena and sphalerite. (P.S. # D)

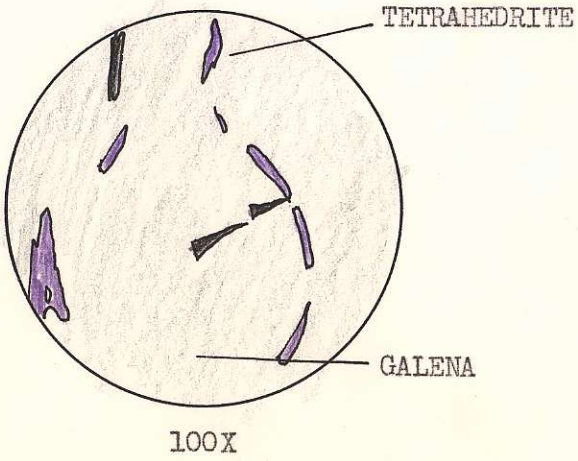


Figure 6

Possible exsolution of tetrahedrite from galena. (P.S. # 2)