Trail Creek M.D.

A Mineralographic Study of the
MAYFLOWER - BLUE BIRD CLAIMS
Rossland Mining District

A report submitted in partial satisfaction of laboratory requirements for the course Geology 409 - University of British Columbia, given by Dr. R. M. Thompson.

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✓ RMT
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ACKNOWLEDGEMENT

I wish to express my appreciation for the aid given me by Dr. R. M. Thompson and Mr. A. Davidson in the identification of certain minerals, as well as confirmation of the identification of the bulk of the minerals listed herein.

I would further wish to acknowledge the Report by Dr. W. H. White to the B. C. Minister of Mines (1949), from which the history and general geology of the Rossland Area was derived.

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Mineralographic Studies:

DIAGRAMS

LOCATION:

The Mayflower and Blue Bird claims are situated in a basin, about 7200' south of the Town of Rossland. The basin is drained by northerly flowing Gopher Creek; the Blue Bird group lies on the western slope of this creek, the Mayflower on the eastern slope. The location of Rossland is 49° 117° S.W.

HISTORY:[1]

Staking in the Rossland camp which was started during the late 1880's, generally centered around the Red Mountain gossan zone. Location of the Mayflower group in 1899 initiated development which continued intermittently until 1911. This early work was centered on the South Vein, some 300' to the S.E. of the Main (North) Vein. In 1939 work began on an adit from the bottom of Gopher Creek Valley. The drift was driven easterly on the Main vein and included a crosscut driven southerly in an attempt to intersect a continuation of the South vein.

Recent exploration by Rossland Mines, Ltd., included geological and geophysical surveys along an east-west strip about 3 mi. long by 1½ mi. wide. This work was started in 1946 and continued until 1952 when production ceased.

The surveys were supported by diamond-drilling and limited production. Up to 1949, 17 diamond-drill holes were driven for a total of 2,342 ft. of drilling.

Production began in 1948, the ore being trucked to the Whitewater mill at Retallack for treatment. Total production for the years 1948-1949 amounted to 681 tons. Gross contents of the ore shipped in this two year period was: Gold, 55 oz.; Silver, 5,254 oz.; lead, 32,053 lb.; zinc, 86,958 lb.; and cadmium, 297 lb.

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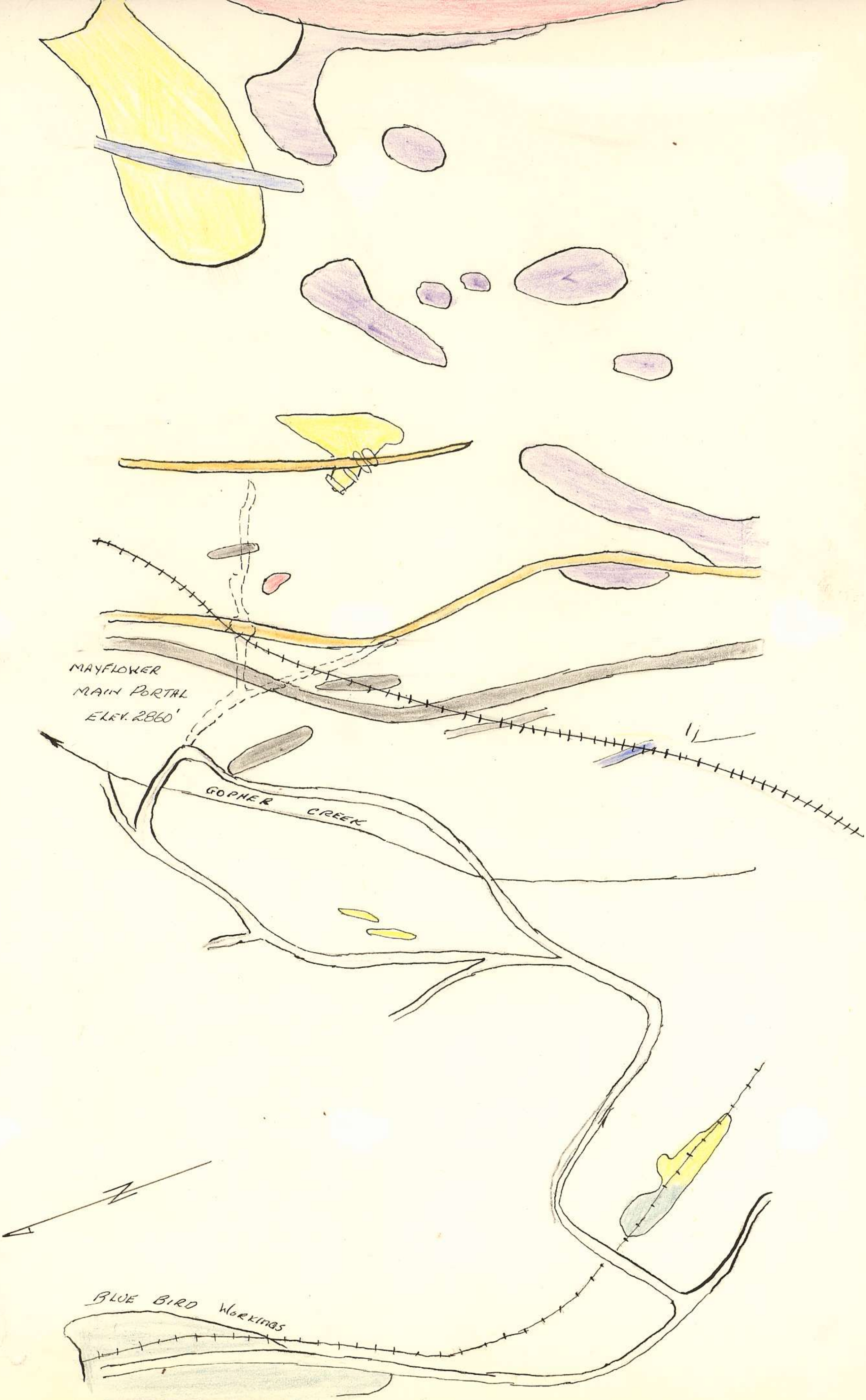
[1] W. H. White, Rep't of the Minister of Mines (1949), pp.157-163.

Figure 2:

Surface Geology of the Mayflower and Blue Bird Workings

🟥	Granite Porphyry	🟪	Conglomerate
🟩	Slate	🟨	Augite Porphyrite
🟦	Diorite Porphyry	⬛	Mica Lamprophyre
🟧	Non-Mica Lamprophyre		


MAYFLOWER
MAIN PORTAL
ELEV. 2860'
GOPHER CREEK
N
BLUE BIRD WORKINGS

GENERAL GEOLOGY:

The dominant rock type of the area is an extensively brecciated "augite porphyrite". To the southeast this rock gives way to a conglomerate consisting of augite-porphyrite, granite, diorite, and quartz pebbles in a silty matrix. Preferantial replacement of the matrix by epidote is a common feature. The augite-porphyrite - conglomerate contact is claimed to represent an erosional surface

Across the valley of Gopher Creek, about 1000' S.W. of the Mayflower workings, the augite-porphyrite is in contact with the thin-bedded siliceous slates of the Mount Roberts formation. This contact dips vertically and strikes N 20° E, the slate bedding paralleling the contact. Further north, the slate in the Blue Bird workings strikes N 15° W and dips 50° westerly.

These rocks are intruded by diorite and granite porphyries and by mica-, and non-mica lamprophyric dikes. The dikes and diorite porphyry form the oldest intrusions. The granite porphyry outcrops to the east of the area.

The lamprophyre dikes are both numerous and of considerable economic interest. While both the lamprophyres contain about 15% biotite, the distinction is that in the mica lamprophyre, the biotite is easily visible with a hand lens.

The dike swarm trends generally slightly west of north, and dips moderately easterly. The dikes were emplaced along shear zones and in conjunction with the shear zones, form a major ore control.

Mineralization, with the possible exception of pyrrhotite, post-dates the dikes. The greatest widths and highest grades are generally found along dike contacts where mineralization terminates. Ocassionally the dikes are fractured allowing mineralization to embay and partially replace the dike material.

MINERALOGRAPHIC STUDIES:

1) Pyrrhotite; $Fe_{1-X}S$

Megascopic:

Examination of hand specimens show pyrrhotite as brownish yellow mineral generally associated with pyrite, from which it is distinquished mainly by color and hardness.

Microscopic:

Color, brownish cream; hardness, C+; strongly anisotropic, colors being bluish grey to reddish brown; powder is magnetic.
HNO_3 stains surface brown. HCl, KCN, $FeCl_3$ are negative.

Pyrrhotite is found in all the specimens associated most often with pyrite and sphalerite. It represents an estimated 20% of the sulfide content.

2) Pyrite: FeS_2

Megascopic:

In the hand specimens, pyrite occurs as disseminated grains in replacement bands. Its yellow color and hardness = 6 serve to identify it.

Microscopic:

Color, brass-yellow; hardness, F; isotropic; texture is granular in cubic and rectangular outlines. Frequently fractured and invaded by quartz and sphalerite veins.

Pyrite is the most abundant sulfide, representing an estimated 30% of total sulfide content. Its superior hardness gives pyrite a high relief in the polished sections.

3) Arsenopyrite: FeAsS

Megascopic:

Arsenopyrite was not identified in the hand samples.

Microscopic:

Color, galena white; hardness, F; anisotropic, colors yellow to blue; found as diamond-shaped prisms. HNO_3 stains iridescent. HCl, KCN, & $FeCl_3$ negative.

Microchemical:

Ammonium Molybdate with 1:7 HNO_3 yielded small, yellow ammonium arseno-molybdate crystals. (K,Hg)thiocyanate solution precipitated iron. An open-tube test yielded SO_2, favouring arsenopyrite rather than loellingite.

Arsenopyrite exhibits high relief in polished sections. It appears associated with pyrite, and in areas invaded by quartz, the pyrite appears to have been preferentially replaced by quartz, leaving the arsenopyrite in a quartz matrix. This order of replacement appears to hold true for boulangerite as well; the arsenopyrite appearing as prisms of high relief in a boulangerite background. Arsenopyrite comprises an estimated 15% of the total sulfide content.

4) Sphalerite: ZnS

Megascopic:

Sphalerite appears as a reddish-brown mineral of resinous luster generally associated with pyrite in the hand samples.

Microscopic:

Color, grey; isotropic; hardness, C; shows red internal reflection under inclined light. HNO_3 stains surface black; HCl drop turned yellow; KCN & $FeCl_3$ were negative.

Microchemical:

The $K_2Hg(CNS)_4$ test brought down zinc, but was inconclusive for Cadmium. This may have been due to a masking effect by the zinc salt. It remains suspected that the cadmium is associated with the sphalerite.

Sphalerite is found replacing pyrrhotite and pyrite. Sphalerite is found replacing calcite in one speciman (fig. 7) indicating it is later than the calcite. It appears that sphalerite is replaced by quartz (fig. 10). Galena and Boulangerite also replace sphalerite. Sphalerite comprises an estimated 15% of the sulfide content.

5) Galena: PbS

Macroscopic:

Galena appears as cubic-cleavage crystals in the hand specimen. This, as well as the grey color, hardness = 2½, and heavy S.G. serve to distinguish the mineral.

Microscopic:

Color, galena-white; hardness, B; isotropic; surface spotted by small triangular pits along cleavage planes.

HNO_3 turns surface black; HCl & KCN negative; $FeCl_3$ stains surface iridescent and after 1 min. stains the surface a deep brownish-red.

Micrchemical:

The $(NH_4)_2Cr_2O_7$ test precipitated red $Ag_2Cr_2O_7$ prisms.

Galena constitutes an estimated 10% of the sulfides.

It tends to replace previous mineralization in the decreasing order: Pyrrhotite, Arsenopyrite, tetrahedrite, pyrite and sphalerite. It appears to post-date the quartz in that grains of galena are generally free of quartz blebs such as are found in the sphalerite and pyrrhotite.

6) Boulangerite: $5PbS:2Sb_2S_3$

Macroscopic:

In the hand specimens boulangerite appears as a grey accicular mineral not unlike stibnite. It has hardness about 3, and is generally associated with galena.

Microscopic:

Color, galena white; strong anisotropism, colors pale-yellow to bluish-grey; Hardness of B; in association with galena, found as elongated, optically-continuous laths randomly intersecting the galena cleavage planes. In areas of massive boulangerite, the individual crystals exhibit mutual boundries texture of no discernible elongation.

Microchemical:

The KI & CsCl test proved Sb. Additional leaching and KI brought down Pb.

Boulangerite, representing an estimated 8% of the sulfide content is a late forming mineral. In areas of galena, it is found in laths randomly intersecting the galena cleavage, indicating it is post-galena. In areas of massive boulangerite, galena is absent, likely due to total replacement by boulangerite. In areas, arsenopyrite is found in high relief against a boulangerite background.

7) Tetrahedrite: $5Cu_2S.2(Cu,Fe,Au)S.2Sb_2S_3$

Macroscopic:

Tetrahedrite was not observed in the hand specimens.

Microscopic:

Color, brownish-grey; Hardness of C; isotropic; HNO_3 tarnishes after 1 min. or longer; HCl, KCN, & $FeCl_3$ negative.

Microchemical:

$K_2Hg(CNS)_4$ proved copper.
KI & CsCl proved antimony.
Pyridine test yielded gold.

Tetrahedrite forms as small blebs replacing both galena and Boulangerite along crystal boundries. It appears as a late stage mineral and may be contemporaneous with boulangerite.
Tetrahedrite represents 1 to 2% of the mineralization.

8) Chalcopyrite: $CuFeS_2$

Macroscopic:

No chalcopyrite was seen in hand specimens.

Microscopic:

Color, brass-yellow; hardness, B; weakly anisotropic; HNO_3 tarnishes brown; HCl, KCN, &$FeCl_3$ negative.

Microchemical:

Pyridine test for gold proved negative

Chalcopyrite was observed in one slab only. In this, it replaced pyrite and sphalerite, and probably quartz, although the boundry relationship with quartz was not conclusive re. replacement. (see fig. 10)

Owyheeite: $8PbS.2Ag_2S.5Sb_2S_3$

Macroscopic:

Owyheeite was not observed in hand specimens.

Microscopic:

Color, galena-white; hardness B; strong anisotropism, colors yellow to steel-blue.
HNO_3 is slowly reactive and forms the best means of identification of Owyheeite. HNO_3 washed after about 15 sec. differentially etches boulangerite, leaving owyheeite as white colored laths. HCl, KCN, $FeCl_3$ are negative.

Micrchemical:

$(NH_4)_2Cr_2O_7$ precipitated red $Ag_2Cr_2O_7$ crystals.
KI & CsCl precipitated antimony
After leaching, KI precipitated lead.

Owyheeite occurs as laths exsolved along the boulangerite boundries. It is very difficult to distinquish between owyheeite and boulangerite, and I found it best to submerse the specimen in HNO_3,allowing the reaction to proceed for about 15 secs. before washing. This caused the unaffected owyheeite to stand out in the iridescently tarnished boulangerite.
While the quantity of owyheeite is estimated at about 2% of the total sulfide, it may well represent the major silver values of the ore.

GENETIC RELATIONSHIP:

Figure two gives a diagrammatical description of the paragenetic seguence of the ore minerals. It appears that the primary mineralization was pyrrhotite, probably associated with the lamprophyre dikes. Later mineralization was ~~probably~~ possibly associated with the granite porphyry intrusion. Pyrite and Arsenopyrite seem to have been deposited contemporaneously. Movement in the ore zone fractured the pyrite cubes and allowed first sphalerite, and then quartz to intrude; replacing the pyrrhotite and pyrite/arsenopyrite along the fractures. Quartz was slightly later than sphalerite, as locally, the sphalerite has undergone replacement by quartz. Temperature of this emplacement was likely of the order of 350° - 450° C.

A later period of mineralization emplaced galena and the copper minerals followed shortly by the antimonial sulfosalts.

There appears to be a zonal relationship between galena and chalcopyrite; the two were not seen together in the sections. Both replace sphalerite, and the presence of tetrahedrite in both galena and boulangerite leads me to suspect chalcopyrite was contemporaneous with, or slightly preceeded, the deposition of galena and the excess copper derived therefrom was incorporated in the tetrahedrite in areas of massive galena. Temperature of this period of mineralization was likely of the order 200°- 250°C.

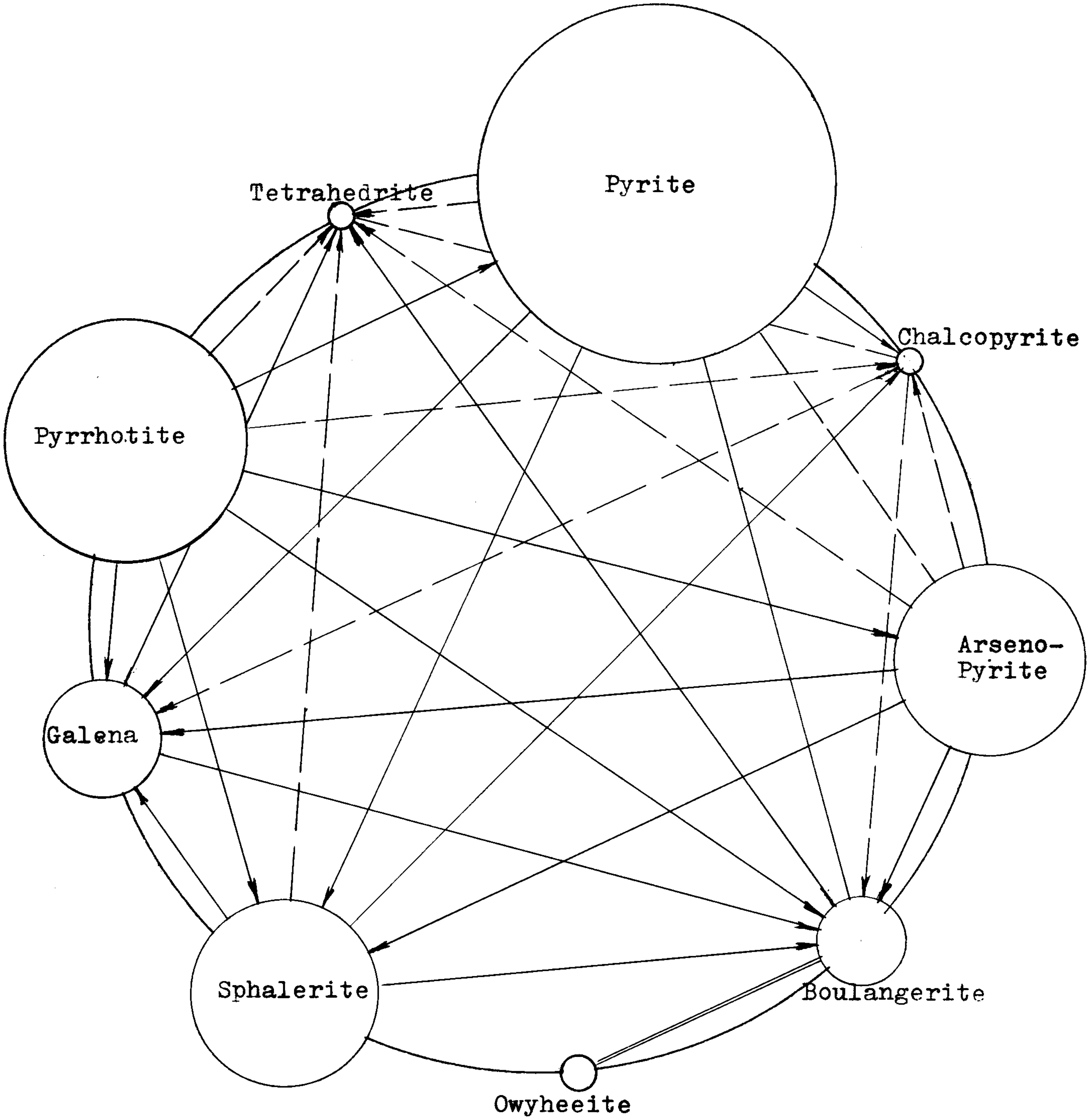


Fig. 2: PARAGENETIC SEQUENCE

- Relative sizes of circles indicate the estimated percentages of total sulfide.
- Solid lines indicate observed data
- Dashed lines indicate inferred data
- Lines with arrows indicate replacement in the direction of the arrow
- Lines without arrows indicate contemporaneous deposition
- Double lines indicate exsolution

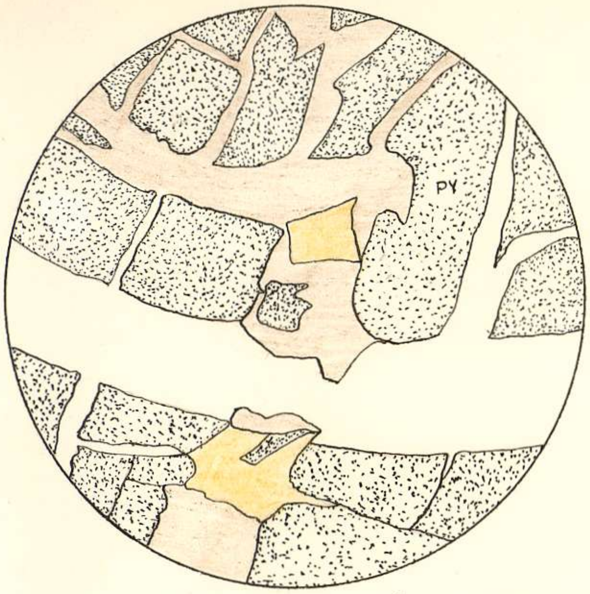


Fig. 3 Ø = 14mm.

Pyrite replacing Pyrrhotite (brown) later fractured and veined by quartz (white). Sphalerite (orange) replacing pyrrhotite.

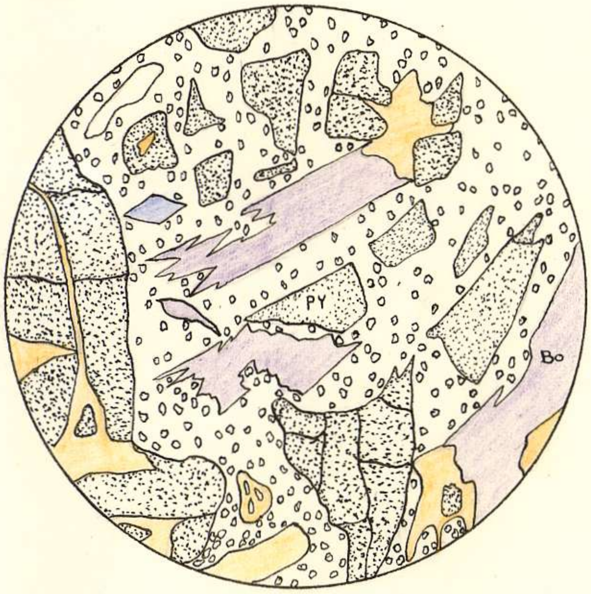


Fig. 4 Ø = 14mm.

Sphalerite (orange) veining and replacing pyrite and pyrrhotite. Boulangerite replacing pyrrhotite and embaying and replacing sphalerite. Quartz replacing pyrrhotite in a "pepper and salt" textured manner.

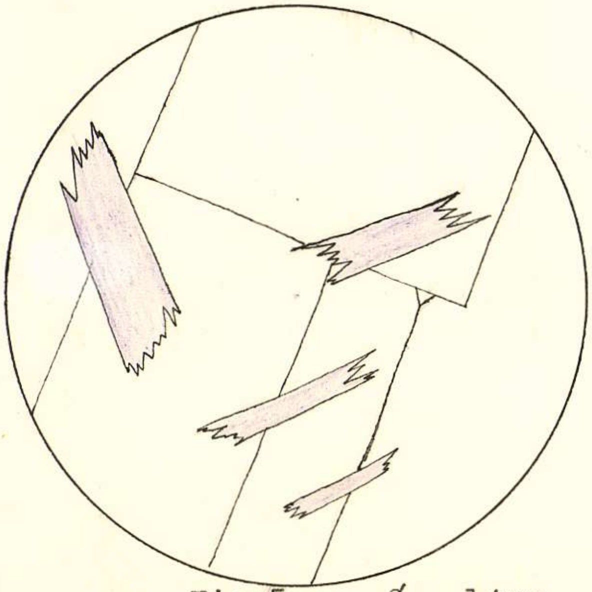


Fig.5 Ø = 14mm.

Boulangerite laths emplaced across cleavage planes of galena.

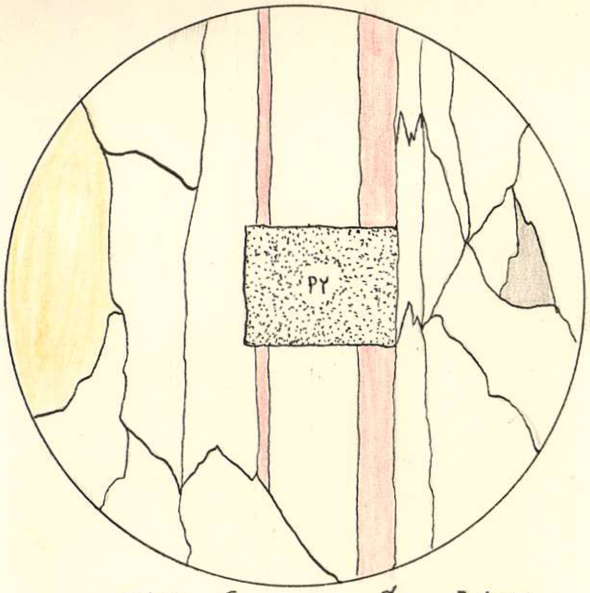


Fig. 6 Ø = 14mm.

Owyheeite (red) exsolution laths plated along crystallographic boundries of boulangerite background. Tetrahedrite (grey) replacing boulangerite along crystal boundries.

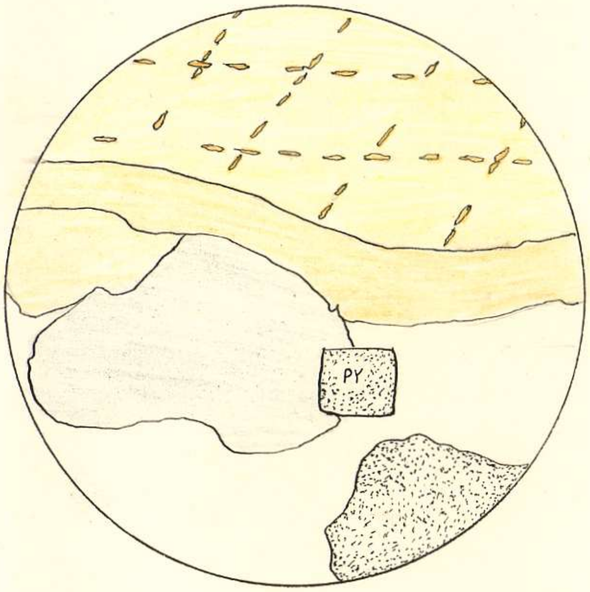


Fig. 7 Ø =1.4 mm.

Sphalerite (orange) replacing calcite along cleavage planes of calcite. Galena (green) replacing sphalerite and pyrrhotite preferentially over pyrite.

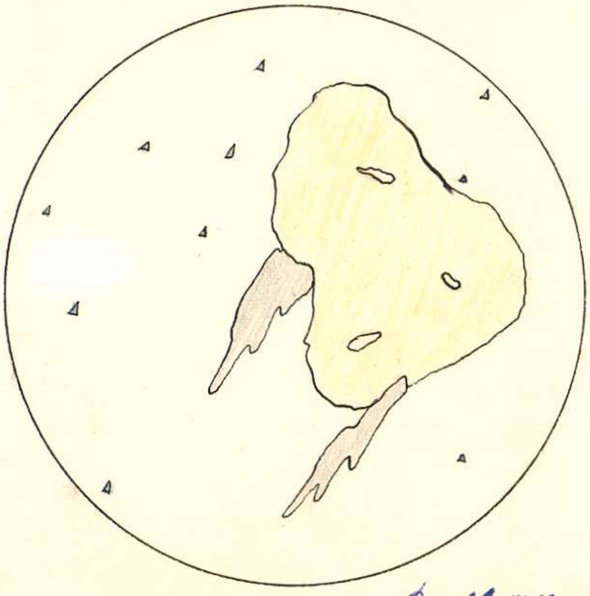


Fig. 8 Ø = 14 mm.

Sphalerite (orange) embayed and replaced by galena background. Tetrahedrite (grey) locally replacing galena along cleavage planes.

Fig. 9 Ø = 14 mm

Galena (green) and Sphalerite (orange) replacing pyrrhotite Background. Minor tetrahedrite replacing pyrrhotite.

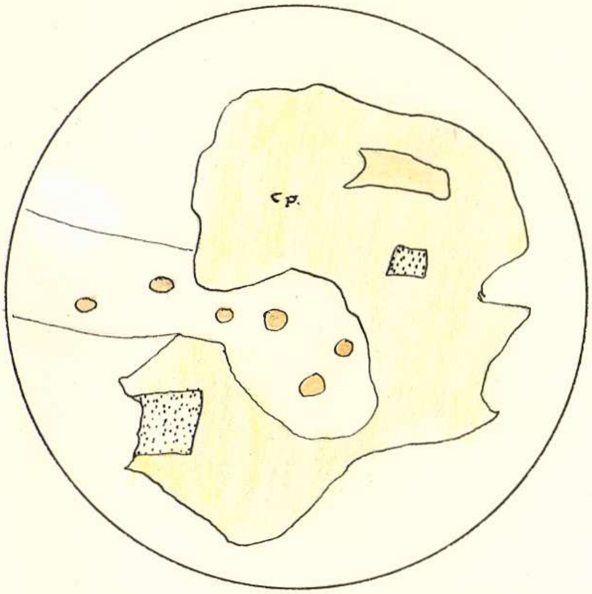


Fig. 10 Ø = 14 mm

Chalcopyrite embaying and replacing sphalerite and pyrite in a quartz matrix