600180

A MINERALOGRAPHIC REPORT ON THE SILVER QUEEN GROUP

Submitted in accordance with the requirements for completion of the course in Geology 409

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Little too much geology
otherwise OK.

CONTENTS

ILLUSTRATIONS

PREFACE

This report deals with a mineral property named the Silver Queen Group which was investigated by Moneta Porcupine Mines in the summer of 1957. The program involved chiefly diamond drilling (with an X-ray drill) and some trenching. This report presents the results of the examination of some mineralized specimens from this property. The writer wishes to thank Moneta Porcupine Mines for the use of maps and drill records, and Dr. R.H. Seraphim of that company for his assistance. Thanks are also due to Dr. R.M. Thompson for his helpful advice, and to J. Donnan for the preparation of the thin sections.

Paul Seder
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May, 1958

INTRODUCTION

This report will present a description of a silver prospect, the Silver Queen Group. The description will be primarily mineralographic, but a brief outline of the general and local geology will also be given.

Location

The Silver Queen Group consists of fifteen claims and is located twenty-two miles northwest of Lytton, British Columbia, and twenty-five miles south of Lillooet, British Columbia. The group covers most of two hanging valleys which are located on the south side of the valley of the west fork of Cottonwood Creek (see Figure 1).

The area is accessible by a trail which follows Stein River and also by another trail which follows Silver Creek (not shown on Figure 1). The Stein River trail is in fair condition and suitable for packhorses. Two water-crossings not served by bridges suitable for packhorses can be forded by horses after the high water season, which occurs in late spring and early summer. Several places suitable for landing a

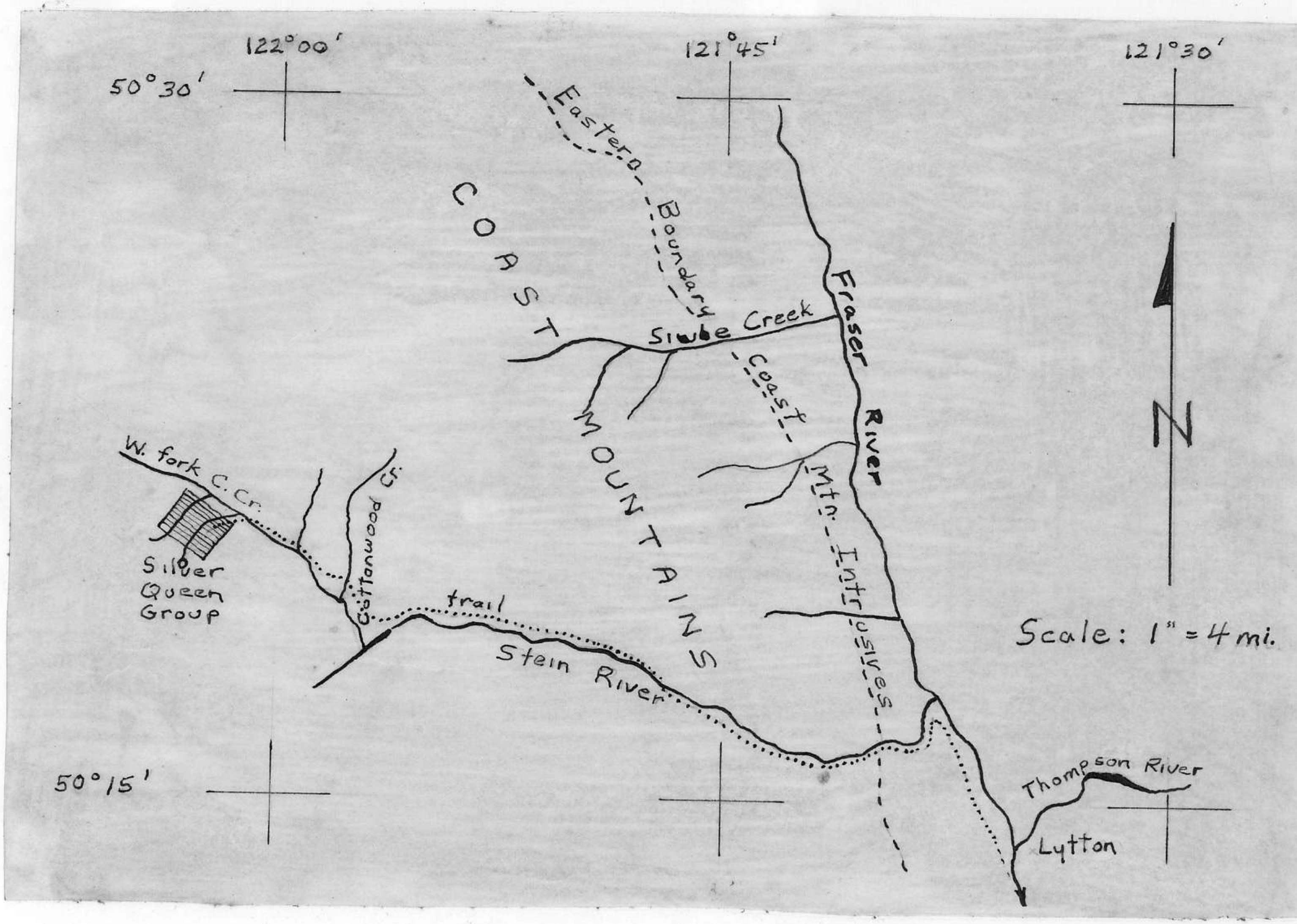

Figure 1: Showing the location of the Silver Queen Group

helicopter are present within the vicinity of the mineral claims.

Physiography

The Silver Queen Group lies within the Coast Mountains about twenty miles west of their eastern boundary (see Figure 1). The reticulate valley pattern typical of the Coast Mountains in general is also present in this region, the predominant valley trend being east-west reflecting the general drainage pattern toward the Fraser River.

The topography has been greatly modified by Pleistocene glaciation and such glacial features as U-shaped valleys, hanging valleys, horns, arretes, cirques and tarns are common.

General Geology

The Coast Mountains are a huge batholithic complex of mainly Upper Jurassic to Upper Cretaceous age. They are composed typically of such rocks as quartz diorite and granodiorite. The southeastern portion of the Coast Mountains are composed typically of a biotite granodiorite.

Local Geology

Introduction

The country rock in the region of the Silver Queen Group is also a biotite granodiorite, but the biotite,

Figure 2: Showing core specimens of four rock types found in East Creek. A,B - granodiorite; C, E - greenstone; D,F,G - rhyolite breccia; H - creek rhyolite. Core specimens are about 3/4 inch in diameter.

Figure 3: Showing two specimens of granodiorite; one containing a small galena vein. Large piece is about five inches across.

especially in the mineralized areas is largely altered to chlorite. The granodiorite is cut by numerous greenstone dykes. Also exposed in several places in the creeks and on the ridges is a dense, white rhyolite which at one exposure appears to cut the greenstone. Minor amounts of basic volcanics overlain by rhyolite are exposed on the ridge separating East and West creeks.

Rocks

Granodiorite: The granodiorite constitutes the major rock-type in the mineral claim area and has a normal granitic texture. It is light grey in colour and contains up to ten percent mafic, chiefly dark green chlorite. Table 1 on the following page summarizes the minerals present in the granodiorite and their average percentage.

Figure 4: Showing a core specimen of granodiorite
Magnification: 2X

TABLE 1

Mineral	Percentage
Quartz	30
Plagioclase (An_{25-30})	30
Orthoclase	20
Chlorite (penninite)	10
Muscovite - sericite	5
Epidote) Pyrite) Hematite)	5

Near the mineralized areas, the granodiorite commonly has a bleached appearance due primarily, to the absence of mafic mineral. Microscopic examination of the granodiorite suggests that the chlorite was formed from the mesothermal alteration of biotite (Schwartz, G.M., 1958).

Rhyolite: As observed in the field the rhyolite is a dense, creamy-white colour. In most specimens the occasional bleb of quartz can be seen. In drill hole specimens, small black specks are observed which are thought to be galena and/or sphalerite.

Megascopically, there is no discernible difference between the rhyolite exposed on the ridge and that exposed in East Creek and they are mapped as one unit (see map in pocket). The ridge rhyolite has volcanic flow structural relations, but the contact relations of the creek rhyolite are dyke-like (steeply-dipping contacts, chilled selvedge, etc.).

Petrology

Table 2, below, summarizes the mineral composition and percentage of the rhyolite.

TABLE 2

Mineral	Percentage
Quartz-feldspar groundmass	50
larger fragments	10
Carbonate (calcite)	15
Muscovite-sericite	15
Clay minerals	10
Pyrite	minor

The ridge rhyolite is extremely fine-grained except for a small percentage of larger, angular fragments of quartz and feldspar which produce a "microbreccia" texture. A discernible banding is apparent in thin-section which probably represents flow banding.

The creek rhyolite is also fine-grained but much less so than the ridge rhyolite. The quartz-feldspar grains are equant and present an aplitic texture. The creek rhyolite contains no larger fragments of quartz or feldspar.

The microscopic and structural evidence suggests that the creek rhyolite is an aplitic counterpart of the ridge rhyolite and probably represents the feeders for the volcanic flows represented by the ridge rhyolite.

General Description:

Greenstone: The greenstone occurs as irregular, often ramifying, dykes up to several feet in width cutting the granodiorite. It is a dense, dark green, aphanitic rock of indefinite composition, although many specimens are noted to contain abundant chlorite and epidote. Much of the epidote occurs as yellowish-green patches up to a half inch in diameter. Although the greenstone contacts were irregular, they were sharp and abrupt and no appreciable alteration was noticed on either side of the contact.

Petrology:

Table 3, below, summarizes the mineral composition and percentage of the greenstone.

TABLE 3

Minerals	Percentage
Chlorite	35
Epidote	25
Carbonate (calcite)	20
Feldspar	10
Clay minerals	10
Pyrite	minor

Advanced propylitization and carbonatization have almost completely altered the rock and little of the original constituents remain. Small feldspar rods are probably primary but are now largely altered, chiefly carbonatized.

Mineral Deposits

Introduction

At several places on West Creek and East Creek and at one place on the ridge separating the two creeks, galena veins and other mineralized zones occur which were found to contain silver. These veins and mineralized areas were sampled and silver values of 20 oz. per ton to 40 oz. per ton were common and a few values of 60 oz. per ton to 80 oz. per ton were also obtained.

The mineralization occurs in veins in the granodiorite and varies from a fraction of an inch to several feet in width. The veins consist chiefly of galena, sphalerite and pyrite; galena being the most abundant mineral. The veins occur exclusively in the granodiorite and are apparently terminated where they intersect greenstone or rhyolite. A description of the veins is given below. The letters (A, B, C, etc.,) refer to the letters assigned to the veins and other mineralized zones on Map 1 which is in the pocket, on the inside of the back cover.

Veins

A. The mineralization in this area occupies a zone about five feet in width dipping more or less downstream at an angle of about seventy degrees. The galena occurs as coarse-grained masses or pockets in altered (chloritized) granodiorite. Running through the zone in irregular seams are gange or clay bands. The zone is bordered by well-jointed granodiorite to give it definite limits or walls. The attitudes of the joints which are more or less rectangular in pattern do not correspond to the attitude of the mineralized zone. Fair to good silver values were obtained across the five foot width.

B. This vein varies from twelve inches to eighteen inches in width for an exposed length of about twenty feet. It strikes obliquely into the creek in the downstream direction and dips at about seventy degrees away from the creek into its west bank. The vein varies from a fine-grained to massive texture on the footwall side to a medium-grained texture and a distinctly sheet-like appearance parallel to the dip on the hangingwall side. The chief mineral is galena. A sample taken across the vein gave fair silver values. Where it was observable, the walls are relatively unjointed granodiorite.

C. This is a cut in the east bank of East Creek which exposes a five foot section of highly altered granodiorite. The exposure consists chiefly of a light gray clay which possesses a distinctly granitoid appearance but which can be pulled off the walls with hands and shaped quite easily. A sample of this material gave fair silver values even though only sparse galena was noted.

D. This vein is about eight to ten inches in width, strikes about parallel with East Creek and apparently has a vertical dip. It consists of thin bands of sulphide (mainly pyrite with some galena and sphalerite) alternating with "bleached granodiorite". The granodiorite is termed "bleached" because it contains little or no mafic mineral and the feldspars have a chalky look although they are quite hard. The walls are granodiorite with widely-spaced joints.

E. This vein is exposed in West Creek and varies between ten to fourteen inches in width, strikes almost at right angles to the creek and dips about eighty degrees downstream. It consists mainly of fine to medium-grained galena and fine-grained to massive sphalerite. Surface samples across this vein gave some very good silver values. This vein also contained a gange or clay layer of variable thickness. The wall rock is moderately-jointed granodiorite.

F. This vein which strikes obliquely across West Creek with a high dip occupies a zone about eighteen inches wide. It consists mainly of coarse-grained masses of galena in altered (chloritized) granitic rock. The wallrock is moderately-jointed granodiorite.

G. A cut on the east side of the ridge separating the two creeks exposes several inches of soil underlain by two to three feet of an oxidized scree. This scree is in turn underlain by amygdaloidal basalt, the amygdules being filled with a pale blue calcite. The scree contains small to large fragments of granodiorite and basalt which are loosely cemented together by a red, earthy material. Many of the fragments are coated with pyrolusite. A sample of the scree gave fair silver values. An attempt to locate the vein under the scree was not successful.

Which means what -

Mineralogy

The following description is based on the microscopic examination of eight polished sections of ore mineral specimens obtained from the veins discussed above. The minerals identified in the polished sections are listed below in decreasing order of relative abundance. A more detailed examination of the material from each vein would probably reveal typical differences in the mineralogy of different veins such as a change in the relative abundance of one mineral with respect to another or the absence of minor minerals in one and not the other. On the whole, though, on the basis of the field examinations made, it is felt that the general characteristics of the veins are quite similar.

Galena: (Pb, Ag?)S ?

Polish: good

Colour: white

Hardness: B (low relief)

Texture: coarse-grained

Anisotropism: none, isotropic

Cleavage: triangular pits indicate well-developed cubic cleavage

Association: with sphalerite, pyrite, tetrahedrite(?) polybasite(?).

Galena commonly comprises about fifty per cent of the ore mineral content of the polished sections and is the most prominent mineral in the field exposures. It occurs usually as large, irregular, coarse-grained masses and commonly surrounds such minerals as sphalerite, pyrite, tetrahedrite(?) and polybasite(?) (see Appendix). In some places galena is veined along cleavage planes by gangue and by sphalerite (see Plate 12, Appendix). On one specimen it was noticed that galena surrounded a smooth bleb of chalcopyrite. On several specimens fragments of pyrite were noted to be irregularly "veined" by galena (see Appendix, Plate 18). In a few places galena occurs as small, rounded fragments in sphalerite or gangue.

Pyrite: FeS_2

Polish: rough to good

Colour: pale brass yellow

Hardness: F-G (high relief)

Texture: fine to coarse-grain equant masses, cubes and pyritohedrons

Anisotropism: none, isotropic.

Cleavage: none

Pyrite is commonly an abundant component in the sections. It occurs surrounded by gangue, sphalerite and galena and, in some places, is "veined" by galena or sphalerite (see Appendix, Plates 10, 11 and 18).

<u>Sphalerite</u>: (Zn,Fe)S

Polish: smooth

Colour: grey

Hardness: D (moderate relief)

Texture: fine to coarse-grained and massive

Anisotropism: none, isotropic

Twinning: conspicuous lamellar twinning to give a "chevron" pattern commonly.

Internal reflection: light to dark brown.

Sphalerite generally comprises about thirty per cent of the ore minerals present in the sections observed. It commonly contains oriented trains of small blebs and rods of chalcopyrite (see Appendix, Plate 15). Sphalerite usually occurs as medium-grained to massive masses and veins. The massive portions are commonly observed as feathered projections into the gangue (see Appendix, Plate 7). The sphalerite also occurs as rounded fragments in galena (see Appendix) and in gangue. In several places the sphalerite contains inclusions of pyrite and the pyrite fragments are often intruded by the sphalerite.

<u>Chalcopyrite</u>: $Cu_2S \cdot Fe_2S_3$

Polish: good

Colour: yellow

Hardness: C

Texture: small oriented blebs and rods in sphalerite.

Anisotropism: weak

Microchemical tests: The chalcopyrite was too fine to isolate for a test but a test for copper on the sphalerite gave a good positive result.

Chalcopyrite comprises five to ten per cent of the ore minerals in the sections. It occurs exclusively in the sphalerite except for one place where a small bleb was noted surrounded by galena.

<u>Tetrahedrite:</u> $5Cu_2S \cdot 2(Cu,Fe)S \cdot 2Sb_2S_3$
(Some Ag, Zn, Bi, Hg and Te may be present)

Polish: fair to good

Colour: grey (lighter than sphalerite)

Hardness: B-C (slightly higher relief than galena)

Anisotropism: none, isotropic

Etch tests: $HgCl_2$, KOH, KCN, $FeCl_3$, HCl negative
HNO_3 stains iridescent.

The tetrahedrite occurs as small, usually regular blebs in galena and within the galena but at galena-sphalerite boundaries (see Appendix, Plates, 9, 14 and 16). It is distinguished from the polybasite(?) by its lack of anisotropism. It is relatively scarce, comprising less than one per cent of the metallic minerals present.

Polybasite(?) $8(Ag,Cu)_2S \cdot (Sb,As)_2S_3$

Polish: good, smooth

Colour: grey, about the same as tetrahedrite(?)

Hardness: B (same relief as galena)

Anisotropism: very strong; yellowish green to dark blue or violet

Internal reflection: none observed.

Etch tests:

$HgCl_2$	- iridescent to blue stain
KOH	negative
KCN	corrodes and turns black very quickly
$FeCl_3$	negative
HCl	negative
HNO_3	iridescent stain

The polybasite(?) occurs as small generally regular masses in galena, (see Appendix, Plate 13). It is also very scarce, comprising less than one per cent of the metallic minerals present. No internal reflection was noted but the anisotropism and etch evidence are typical for polybasite. Uytenbogaardt (1951) reports that some polybasite does not show internal reflection. The fragments were too small to do more definite work on them.

Paragenesis

A paragenetic sequence suggested by the textures described and illustrated is given below and summarized by the Vanderveer diagram in Figure 5. In this diagram the main hypogene minerals are arranged around a circle and are represented by small numbered circles whose size represents the relative abundance of the mineral. The number represents its position in the paragenetic sequence. Lines join the circles of the minerals which are observed in contact with each other and the arrowhead indicates the mineral being replaced. The width of the lines suggests the relative intensity of replacement.

The gangue zones associated with most of the veins suggest shearing and general fracturing preceded or accompanied the influx of hydrothermal solutions. These solutions deposited pyrite and, later, sphalerite. The sphalerite carried chalcopyrite in solid solution which exsolved on cooling. The sphalerite partially replaced the pyrite. Subsequently, due to a change in the nature of the hydrothermal solutions caused by a change in temperature, pressure or the influx of new solutions, galena bearing silver in solid solutions was deposited which actively replaced both the sphalerite and pyrite. Upon cooling, the galena exsolved any silver in excess of 0.1 per cent as tetrahedrite and polybasite.

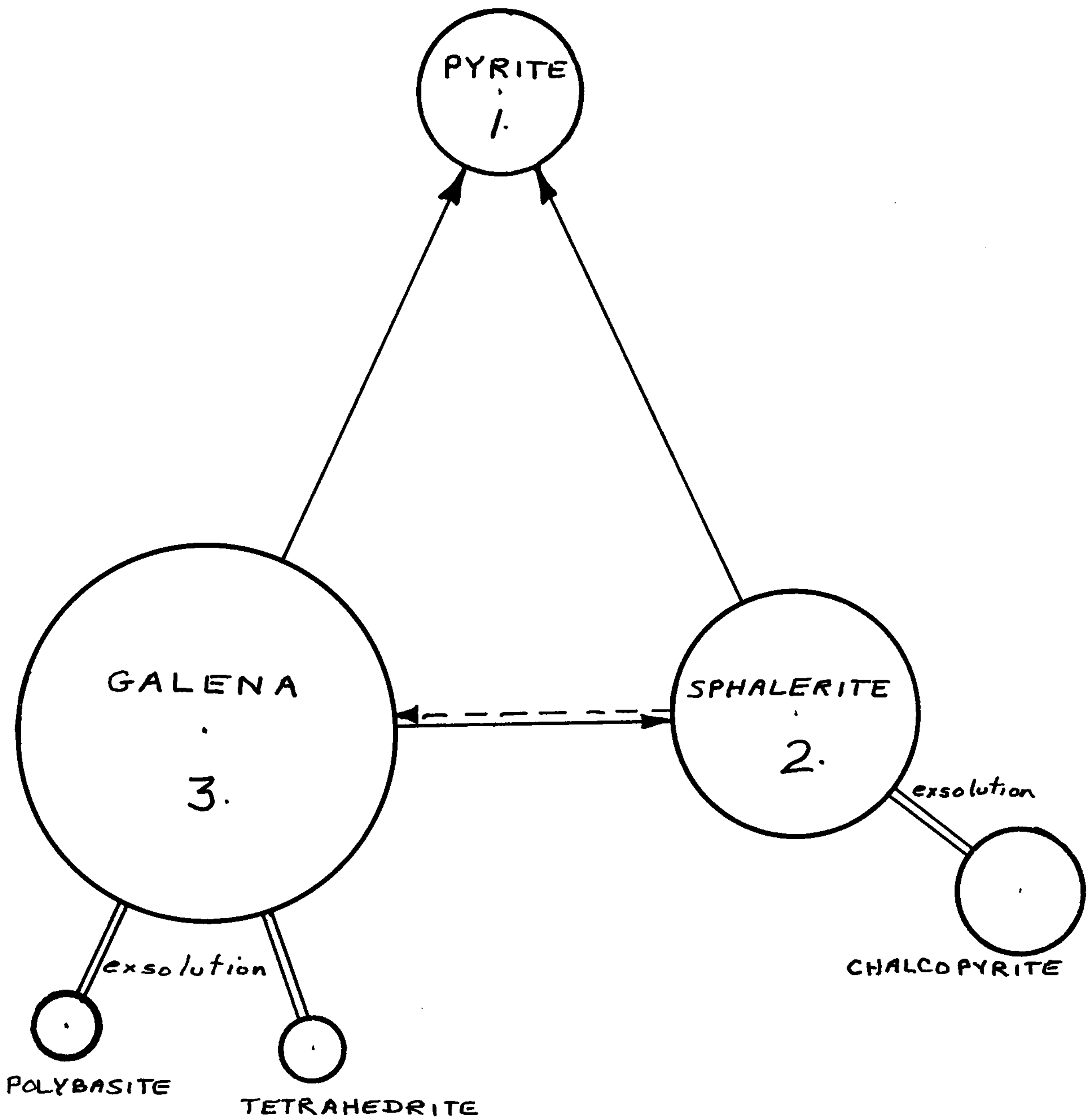

Figure 5: Paragenesis of the Ore Minerals, Silver Queen Group

The mineral assemblage, the exsolution temperature of sphalerite-chalcopyrite (Edwards, 1954, p. 92), and the wallrock alteration indicates that the Silver Queen veins represent a mesothermal deposit.

Because the assays obtained from the veins were commonly near or better than 30 oz. per ton, and the occurrence of silver minerals in the specimens examined are scarce, the galena probably carries up to 30 oz. per ton of silver (Edwards, 1954, p. 110). Microchemical tests for silver were made on the galena, but they were indefinite or negative. It is reported, though, that microchemical tests for silver in argentiferous galena are generally unsuccessful (Short, 1940, pp. 192-204), so that it is quite possible and probable that most of the silver reported by the assays is that contained in solid solution in the galena.

Subsurface Geology

On the basis of assay reports and an examination of the property by one of their geologists, Moneta Porcupine Mines secured an option on the Silver Queen Group in order to make a more definite evaluation of the property. In the summer of 1957, they undertook a program of, chiefly, diamond drilling and some trenching.

The drilling revealed that the shear zones which were mineralized on the surface were still present at depths of 100 feet or so. Little information was gained concerning the mineralization of the zones at depth as the drill (an X-ray type) did not retrieve much core from these zones. The small diameter rods could not retain the altered, soft material in these zones. A little galena and minor amounts of other sulphides were obtained from these zones, but not in the amounts expected from the surface exposures. The assays of the material from these zones revealed quite low silver values.

In all the diamond drillholes sulphide zones are intersected. These zones vary from a few inches to several feet in length (of core), and are of more or less two distinct types. One type consists of bleached granodiorite containing up to ten per cent of pyrite as veinlets and finely dissemin-ated grains. The bleached appearance of the granodiorite is due to the relative absence of mafic mineral. The second type of sulphide zone consists of granodiorite containing up to twenty per cent chlorite; dark, fine-grained sulphides, and pyrite in stringers and as finely disseminated grains. The assays showed that the former type, the "bleached" sulphide zone, commonly possessed the higher silver values, generally along with the lowest lead and zinc values. Even these "high" silver values were relatively low though. The fracturing in these sulphide zones was noticed to be considerably more profuse and closely-spaced than in the country rock in general.

Conclusion

The mineralization of the Silver Queen Group occurs in veins occupying shear zones in granodiorite. They consist mainly of galena, sphalerite and pyrite and are of the mesothermal type. The veins also contain silver which commonly assays between twenty to forty ounces per ton on surface exposure. Subsurface exploration by drilling, although inconclusive, seems to indicate that silver content and mineralization in general declines with depth. In the writer's opinion, further and more careful exploration might reveal more promising mineralization in this area, but such work is deemed economically unrealistic at the present time.

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APPENDIX

Photomicrographs of thin sections of rocks discussed under Local Geology

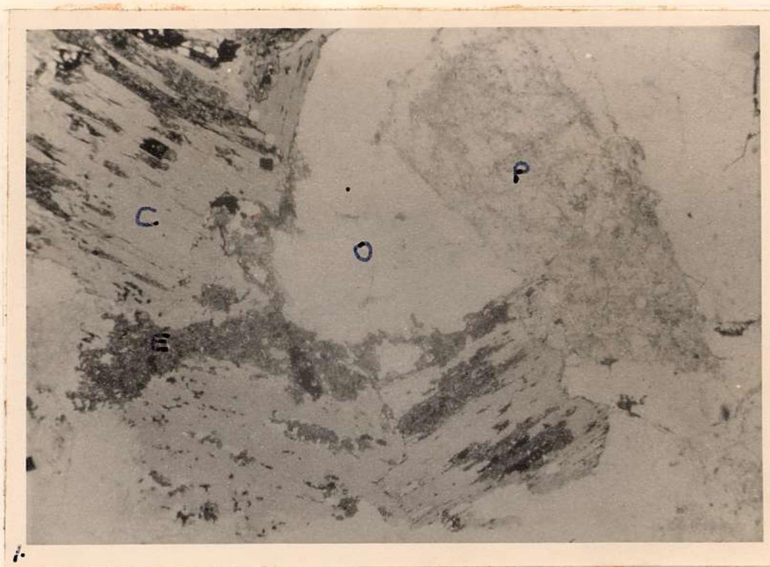


Plate 1: Photomicrograph with uncrossed nicols of granodiorite. C is chlorite (penninite); O, orthoclase; P, plagioclase. Magnification: 23X

Plate 2: Photomicrograph with crossed nicols showing alteration (particularly, sericitization) of the feldspars, particularly the plagioclase. Magniciation: 70X

Plate 3: Photomicrograph with crossed nicols showing myrmekitic texture in granodiorite produced by quartz blebs in orthoclase. Magnification: 325X.

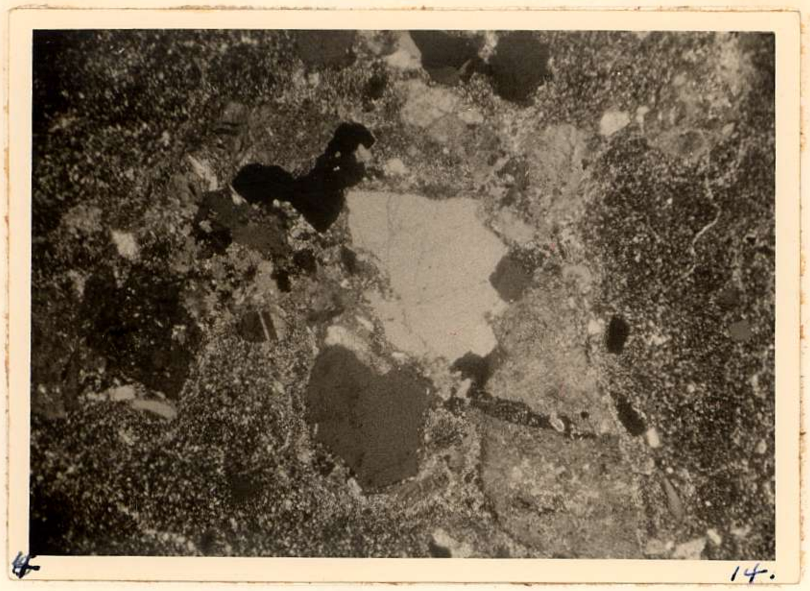
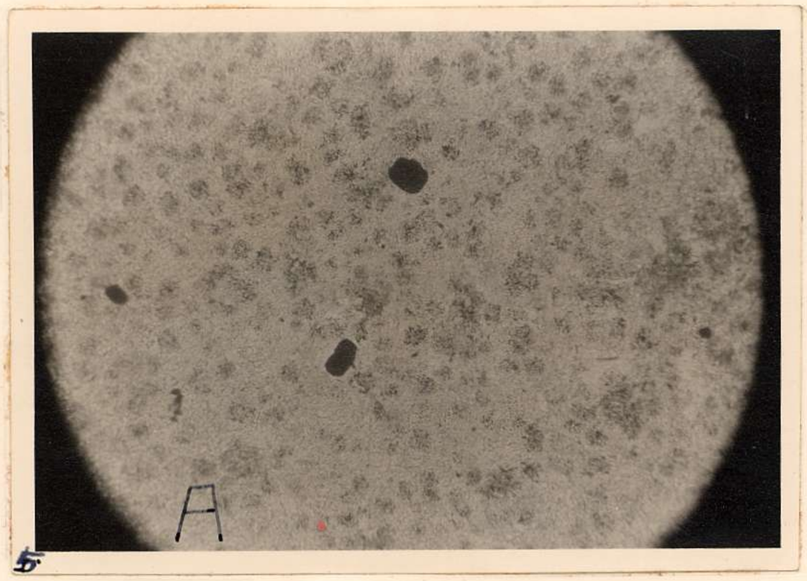


Plate 4: Photomicrograph with crossed nicols of material obtained from transition zone between granodiorite - creek rhyolite contact. Note coarse-grained, angular fragments of granodiorite in fine-grained matrix of rhyolite groundmass. Magnification: 28



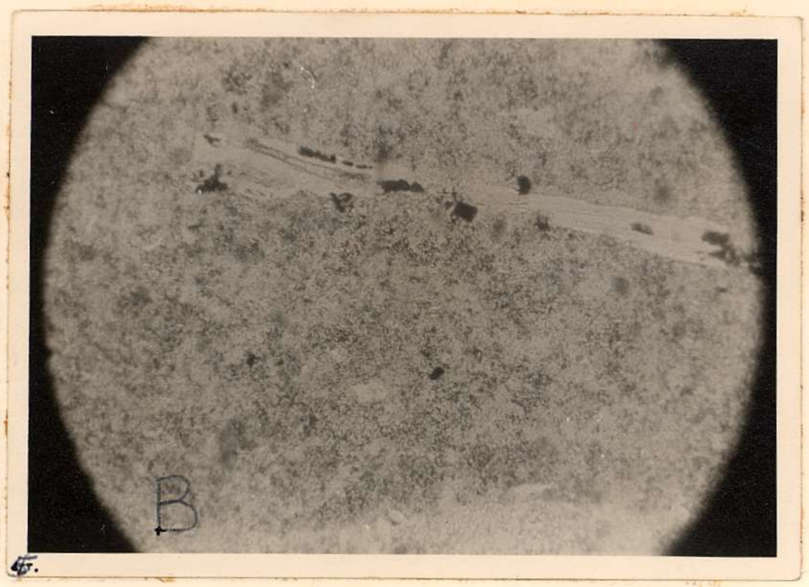


Plate 5: Photomicrograph with uncrossed nicols showing two specimens of rhyolite: A, creek rhyolite, and B, ridge rhyolite. The light gray speckling represents chiefly sericite and carbonate alteration, and illustrates the aplitic texture in the creek rhyolite and the finer texture and faint flow banding in the ridge rhyolite. The black specks are pyrite and the colourless rod in B is muscovite. Magnification: 70X

6.

Plate 6: Photomicrograph with crossed nicols of greenstone. The white material is mainly carbonate. Note the rods of carbonate pseudomorphous after feldspar. The dark material is chiefly chlorite and epidote. The lineation on the left-hand side is an epidotized fracture in the rock. Magnification: 70X

Photomicrographs of polished sections containing the minerals discussed under Mineralogy.

Plate 7: Showing feathery projections of sphalerite (dark) into gangue (white). Reflected, oblique light. Magnification: about 50X

Plate 8: Showing sphalerite (dark), galena (G), and gangue (white). Reflected, oblique light. Magnification: about 25X

Plate 9: Photomicrograph showing galena (G) invading sphalerite (S) and containing fragments of sphalerite, pyrite (P) and tetrahedrite (T). Magnification: 30X

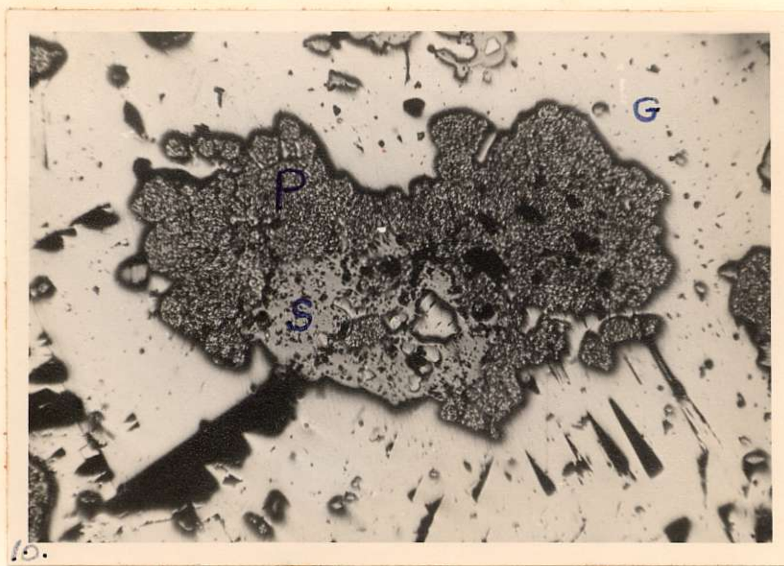


Plate 10: Photomicrograph showing galena (G) replacing pyrite (P) and sphalerite (S). Note triangular pits in galena. Magnification: 46 X

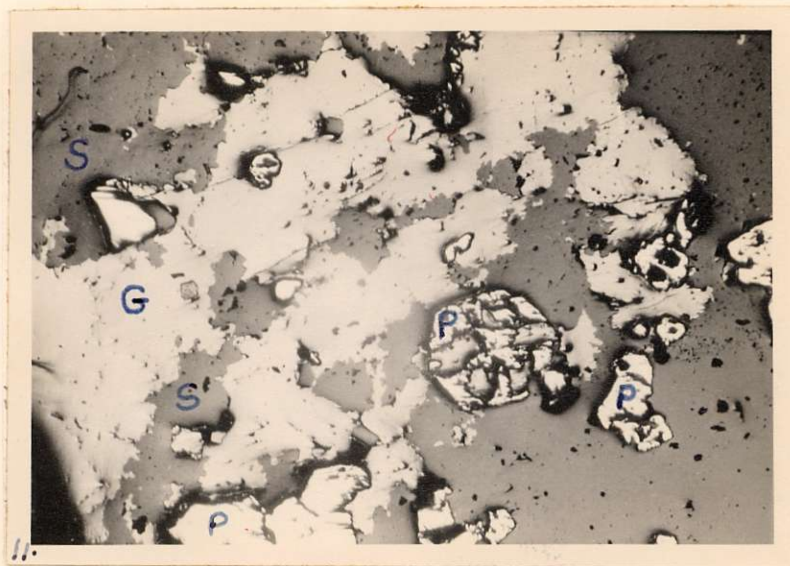


Plate 11: Photomicrograph showing galena (G), sphalerite (S), and pyrite (P). Note corroded crystals of pyrite being replaced by sphalerite. Magnification: 70X

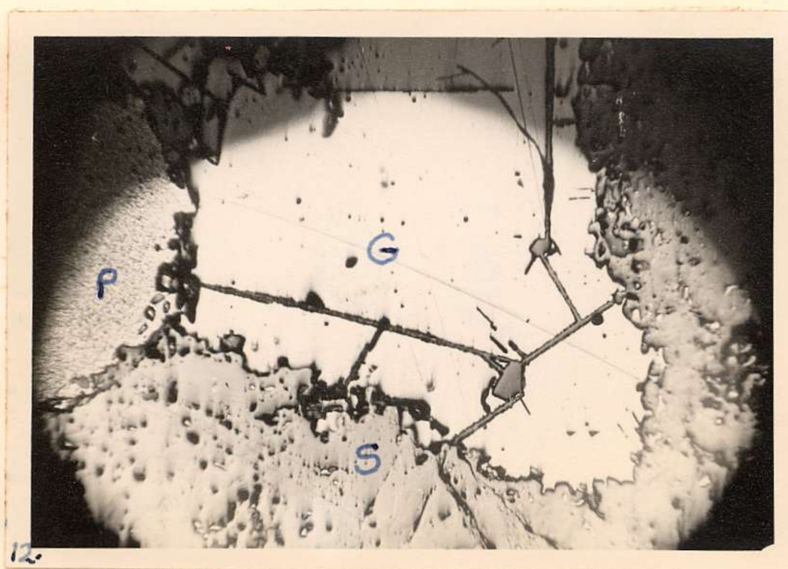


Plate 12: Photomicrograph showing galena (G) being replaced along cleavage planes by sphalerite (S). P is pyrite. White specks in sphalerite are galena and chalcopyrite the galena tends to have a dark border due to relief. Magnification: 30X.

Plate 13: Photomicrograph showing polybasite (?)(Po) in galena (G). S is sphalerite; Ga, gangue; P, pyrite. Magnification: 140X.

Plate 14: Photomicrograph showing tetrahedrite (?) (T) in galena (G). S is sphalerite; P, pyrite; Ga, gangue. Magnification: 70X

Plate 15: Photomicrograph showing oriented exsolution blebs of chalcopyrite (white rods and blebs) in sphalerite (S). G is galena. Oil immersion. Magnification: 670X

Plate 16: Photomicrograph showing bleb of tetrahedrite(?) (T) in galena (G). S is sphalerite; P, pyrite. The mass of light specks in the sphalerite in the lower left-hand corner of the photo is chalcopyrite. Oil immersion. Magnification: 670X

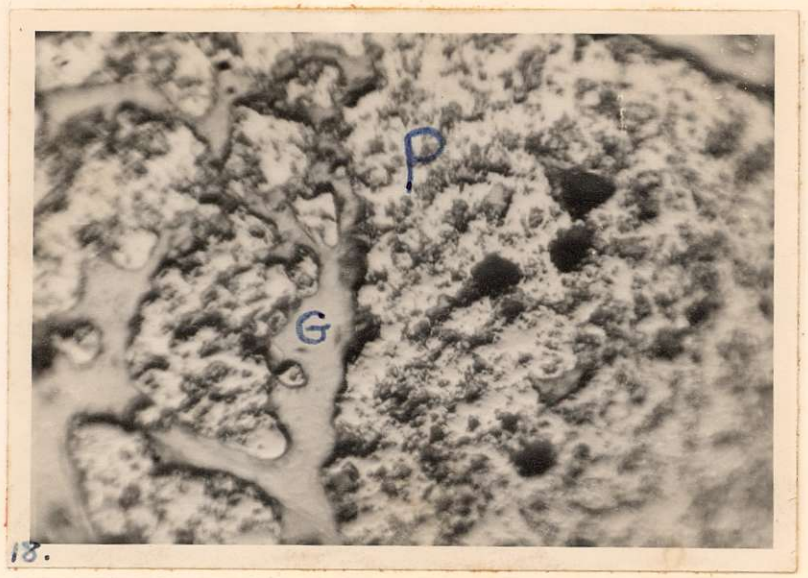
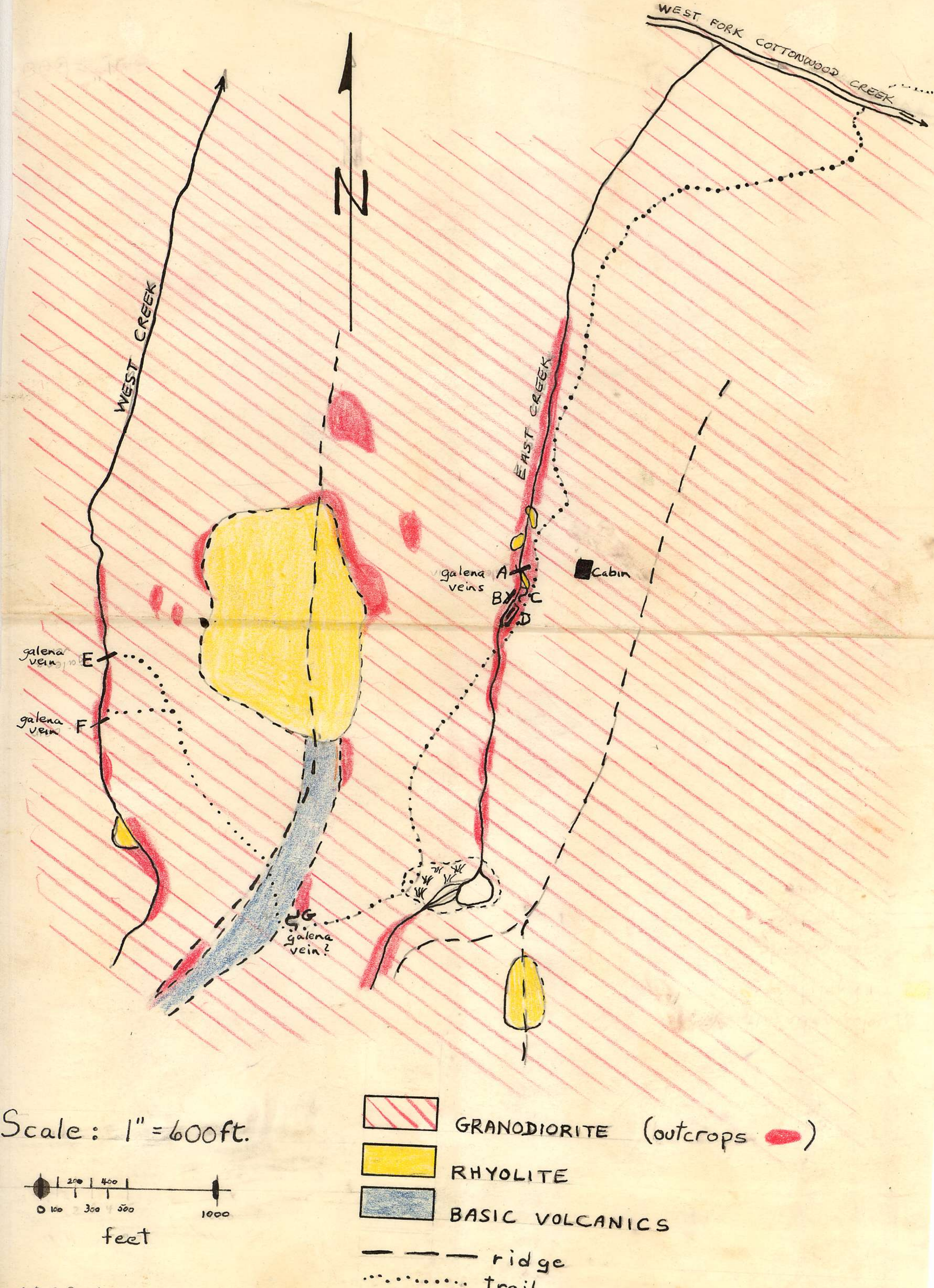


Plate 18: Photomicrograph showing the replacement of pyrite (P) by galena (G). Oil immersion.
Magnification: 670X

Geology of the Silver Queen



MAP 1.