MINERALOGRAPHIC REPORT

THE OREGON MINE

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INTRODUCTION

This report was compiled during April 1966, in accordance with the requirements of the Geology 409 course, taken at the University of British Coulmbia during the 1965 - 1966 session.

The diagnostic properties, chief associations, and textures of minerals identified in fourteen hand specimens and eighteen polished sections are described. An attempt was also made to outline the geologic history of the deposit and determine its temperature of formation. Special emphasis was placed on the distribution and mineralogical association of the native gold present.

THE OREGON MINE *

LOCATION

The position of the mine is 49° 120° S.E. It is located about 8 miles by road from Hedley, B. C., and 1½ miles east of the Hedley - Nickel Plate Road.

PRODUCTION

In 1949, Kelowna Mines Hedley Limited optioned the property from F.H. French and associates. Production began in 1950 and continued to 1955. During this period, a total of 32,463 tons of ore was mined, yielding 25,284 oz. of gold.

In 1956, a controlling interest in the property was acquired by the Cariboo Gold Quartz Mining Company Limited, and a new company, French Mines Limited was formed. Production began in 1957, in which, a total of 4,394 tons of ore was milled yielding 1,940 oz. of gold and 120 oz. of silver.

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* British Columbia, Report of Minister of Mines, 1957.

THE OREGON MINE

GEOLOGY

The ore deposit is a gold - bearing scarn developed in sedimentary members of the Triassic Nicola Group. It is a generally flat lying, northwest trending, irregular body, approximately 620 feet long, 40 - 80 feet wide, and up to 12 feet thick.

MACROSCOPIC EXAMINATION

The general size range of the hand specimens studied was 1" by 1" to 3" by 4". They consisted essentially of a dense greyish green and brownish red scarn material, throughout which the metallic minerals were randomly disseminated, and localized into larger segregations. The ore minerals did not appear to be uniformly distributed - for example, three specimens contained an average of 30% chalcopyrite, 15% bornite and 1% safflorite, yet bornite and chalcopyrite were found to be noticably lacking in the remaining samples. Arsenopyrite likewise, was confined only to a few specimens, and here it occurs in amounts of 10 - 15% as coarse (5 - 10 mm.) prismatic crystals, associated with coarsely crystalline calcite. In other samples, molybdenite or bismuth telluride were the dominant minerals. Of the two, molybdenite was found to be less pervasive, being confined largely to veinlet-like segregations, and localized disseminations. Bismuth telluride was found to be uniformly disseminated in a large number of samples, as segregations and individual crystals having average diameters of 1 - 2 mm., but reaching, in a few cases, diameters of 8 - 10 mm. A lustrous tin white appearance, platey cleavage, and soft nature allows this mineral to be readily recognized without optical aids, regardless of fine grain size. Native gold, too, can be often recognized in the hand specimen due mainly to its conspicuous deep yellow colour. Some of the gold occurs as blebs having diameters up to .4 mm., but the majority of it is of considerably finer grain. Some larger segregations appear to be due to localization in minute fractures or shears. The gold generally appeared to be associated with the bismuth telluride but no sympathetic variation in the distribution of the two could be recognized. A tin white cobalt bearing material, probably safflorite, was discovered in four hand specimens, in which it occurred as euhedral crystals, up to 2 mm. in diameter and sparsely disseminated in the scarn.

The following mineral percentages were estimated from the total material studied:

gangue	70%
chalcopyrite	14%
bornite	7%
arsenopyrite	4%
bismuth telluride	2%
safflorite	1.5%
molybdenite	1.5%

MICROSCOPIC EXAMINATION

THE MINERALS

BORNITE

: bronze colour, purplish tarnish

: good polish, medium hardness

: occurs as irregularly-shaped segregations; often replaces safflorite

: usually associated with chalcopyrite

CHALCOPYRITE

: yellow colour

: medium hardness, good polish

: occurs usually with bornite, along grain boundaries, or as exsolution lamellae; to a lesser extent, associated with bismuth tellurides

TETRAHEDRITE

Check

: light grey, brownish tint

: isotropic

: medium hardness

: occurs generally as rims along chalcopyrite-gangue boundaries, or chalcopyrite-bornite boundaries

: not common

SPHALERITE

: light grey, darker than tetrahedrite

: slight internal reflection (brown)

: isotropic

: strong (+) Zn microchem. rea ction

: only a few blebs were noted

MOLYBDENITE

: white to grey colour

: soft

: platey crystals; often as elongate aggregates of crystals

: strong pleochroism

: strong anisotropism

: individual crystals are about 150 microns in length; aggregates reach 1500 microns in diameter.

ARSENOPYRITE

: very hard > safflorite

: white; creamy tint against safflorite

: anisotropism strong; colours distinct

: etch tests:

FeCl (-)

HNO_3 (+) ; turns brown during etching

: microchem.

Co (-)

: occurs as relicts of euhedral crystals replaced by gangue; commonly intergrown with safflorite

: usual range of grain size, 650 - 1400 microns

COBALTITE

: very hard > safflorite

: white, slight pink tint

: isotropic or slightly anisotropic

: cleavage evident in some grains

: occurs as relicts of euhedral crystals - rectangular and triangular outlines often still present

: etch tests; negative to all reagents

: microchem. tests;

Co (+) Fe (-)

: Average grain size; 400 - 600 microns

SKUTTERUDITE

: white colour

: hard

: isotropic

: etch tests;

$HgCl_2$ (-)

KOH (-)

KCN (-)

HCl (-)

$FeCl_3$ (-)

HNO_3 (+), deep etch

: microchem.

Co (+), Fe (+)

: uncommon

NICCOLITE

: pinkish colour

: hard

: distinct anisotropism

: occurs as equidimensional grains in safflorite

: etch tests;

$HgCl_2$ (+), slight brown tarnish

KOH (-)

KCN (-)

HCl (-)

$FeCl_3$ (-)

HNO_3 (+), effervescence, deep etch

: average grain size, 450 - 550 microns

: uncommon

SAFFLORITE

: white, bluish tint against arsenopyrite

: hard < arsenopyrite

: slightly pleochoic

: anisotropism strong, often very bright blue and yellow colours

: occurs as corroded remnants of euhedral crystals

: associated with arsenopyrite, and also bornite

: etch tests;

$HgCl_2$ (-)

KOH (-)

KCN (-)

HCl (-)

$FeCl_3$ (+), but only after 10 minutes; brings out scratches

HNO_3 (+), slow effervescence, deeply etches surface (stronger etch than for arsenopyrite)

: microchem.;

Co (+), Fe (+), Ni(-)

: most grain diameters are in the range 400 - 800 microns

BISMUTH TELLURIDES

Two bismuth telluride minerals were found:

TELLURIDE A .

: white colour

: very soft, good polish

: occurs as angular blebs, dispersed through the gangue of some samples; less commonly confined to minute vienlets (length of veinlets; 1000 microns; width; 15 - 20 microns); forms smooth boundaries with gold, telluride B., and chalcopyrite

: distinct anistropish;blue and brown colours

: generally associated with gold and telluride B., less often with chalcopyrite

: etch test;

$HgCl_2$ (-)

KOH (-)

KCN (-)

HCl (-)

$FeCl_3$ (+), deeply etched certain grains, tarnished others

HNO_3 (+), tarnishes mineral black

AQUA REGIA, same as HNO_3

: microchem.;

Te (+), strong

Bi (+), but weak

: grain size varies commonly between 40 - 800 microns

TELLURIDE B.

Native Bismuth

: white, strong reddish tint (tarnish?)

: polish fair, surface appears rough

: very soft

: occurs as angular blebs dispersed in gangue

: weakly anisotropic

: associated with gold, telluride A., and less often, chalcopyrite; forms smooth boundaries with those minerals

: etch tests;

$HgCl_2$ (-)

KOH (-)

KCN (-)

HCl (+), deep etch

$FeCl_3$ (+), dark grey tarnish

HNO_3 (+), black tarnish

AQUA REGIA (+), rapid black tarnish

: grain size usually in the range 40 - 200 microns

Thus, the reddish hue and positive HCl etch are distinctive properties of this telluride; it may be tellurbismuth.

GOLD

: yellow colour, deeper yellow than chalcopyrite

: soft, sectile

: good polish, slightly stippled surface (under high power)

: occurs as angular blebs dispersed randomly in gangue; forms smooth boundaries with the tellurides; occasionally with telluride in minute vienlets which are about 800 microns long and 20 microns wide

: weak anisotropism, sometimes quite distinct

: etch tests;

$HgCl_2$ (-)

KOH (-)

KCN (+), weak etch

HCl (-)

FeCl (-)

HNO_3 (-)

AQUA REGIA (+), reddish irridescence

$AgNO_3$ (-)

: grain size; large variation, 5 - 1000 microns but common range is 8 - 45 mircons

MINERAL PERCENTAGES

The relative percentages among the metallic constituents in the polished sections were estimated to be:

chalcopyrite 25%

safflorite 25%

bornite 15%

arsenopyrite 13%

molybdenite 12%

cobaltite 5%

bismuth telluride A 2%

bismuth telluride B 1%

tetrahedrite .... <1%

niccolite.................... <1%

skutterudite .... <1%

sphalerite .... <.1%

These figures, however, should be regarded with caution due to the non-uniform distribution of the minerals.

In three telluride - rich samples, the ratio of gold to telluride was estimated to be about 1:30, and gold concentration appears to increase somewhat with increased telluride content.

DISCUSSION OF SIGNIFICANT TEXTURES

Arsenopyrite, safflorite and colaltite occur as remnants of euhedral crystals, partially replaced by gangue and late metallic minerals. They appear to be comtemporaneous, although some textures, such as shown in figure 1, suggest that safflorite had replaced arsenopyrite, and it is noteworthy, too, that safflorite often contains blebs of arsenopyrite, It is apparent, however, that these minerals and probably niccolite and skutterudite as well, were formed at an early stage, before a second period of gangue formation.

The later introduction of gangue, which corroded and replaced the earlier hard metallic minerals, was followed by the deposition of the copper minerals, tellurides, gold and molybdenite. Of these minerals, gold and the tellurides were probably emplaced first. That is, textures, such as shown in figure 2, are fairly common and are interpreted here, as the exsolution of chalcopyrite in the vicinity of the telluride-bornite grain boundaries -- in other terms, the telluride is earlier than either the bornite or chalcopyrite. An alternate view, is that the telluride replaced the bornite, causing the remobilization of chalcopyrite, and its subsequent segregation into the crystallographic planes of the bornitehost; such a mechanism is, however,considered unlikely. Mutual boundaries between gold and telluride suggest they were formed, more or less, simultaneously. In figure 3, molybdenite appears to have replaced arsenopyrite in long interfingering projections; a veinlet of gold in the arsenopyrite is abruptly terminated by these projections, thus indicating, that the gold is earlier than the molybdenite. The cross cutting relationship of gold in arsenopyrite confirm that it is later than arsenopyrite. In some instances, gold occurs in molybdenite elongated along, and parallel with, the cleavage directions of molybdenite and also, cuts across individual blades. An overlapping of deposition or remoblization of the gold are probable explanations for the occurrence of gold in two stages of the paragenesis. The relationship between the copper minerals and molybdenite is not clear -- due to lack of firm evidence to the contrary, it is supposed that they were formed contemporaneously. Among the copper minerals, exsolution textures such as shown in figure 4 provide evidence that chalcopyrite exsolved from the bornite, while the preservation of such textures may be indicative of rapid cooling. Tetrahedrite characteristically forms various rim textures in chalcopyrite and against chalcopyrite gangue boundaries, suggesting that it too, exsolved from the same system.

In conclusion, three stages of formation are indicated by textural relations:

1. formation of early gangue, and the deposition of arsenopyrite, cobaltite, safflorite, skutterudite and niccolite
2. introduction of a later gangue
3. deposition of bismuth tellurides, gold, molybdenite, bornite, chalcopyrite and tetrahedrite.

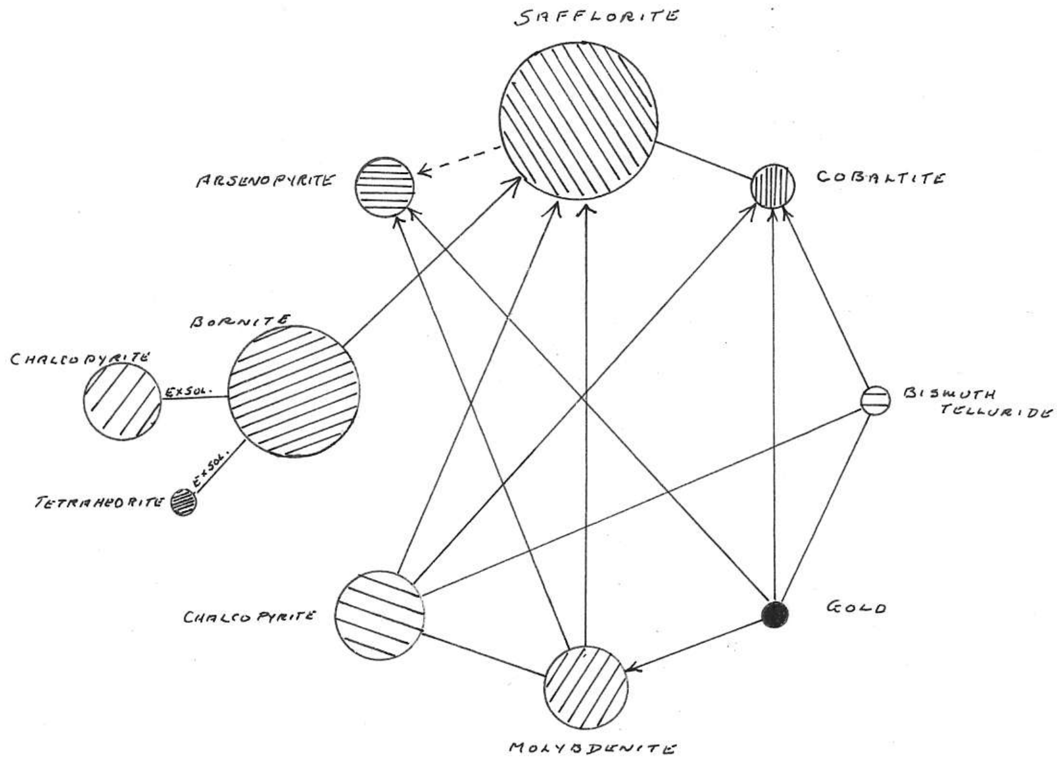
Some overlapping of stages 2 and 3, and within stage 3, most likely took place.

Paragenetic relations between the ore minerals are illustrated on page 13.

TYPE OF DEPOSIT

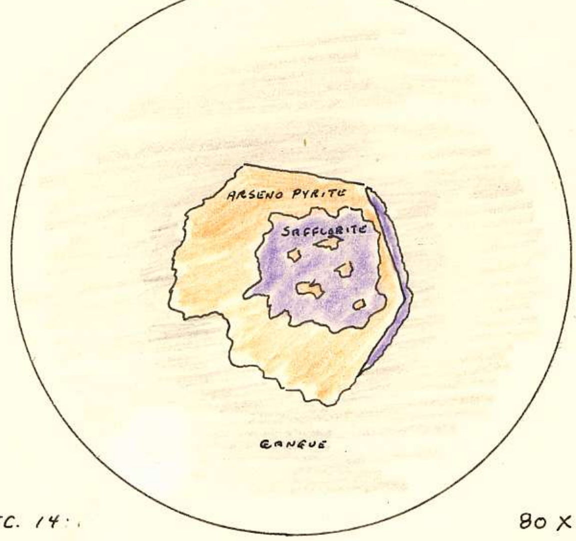
The scarn gangue material, and the distribution of metallic minerals in the scarn are characteristic of a pyrometasomatic deposit. The deposit was probably formed within the temperature range 550 - 450°C, in that the early minerals are diagnostic of formation temperatures greater than 500°C but less than 600°C, while the bornite-chalcopyrite exsolution took place below 475°C. The lower range of temperature is, of course, difficult to arrive at.

PARAGENESIS



THE VAN DE VEER DIAGRAM

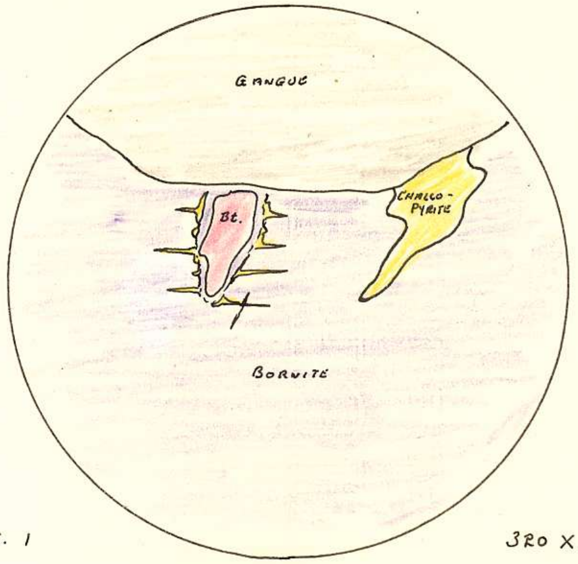
TEXTURE DIAGRAMS



SEC. 14 80 X.

FIG. 1

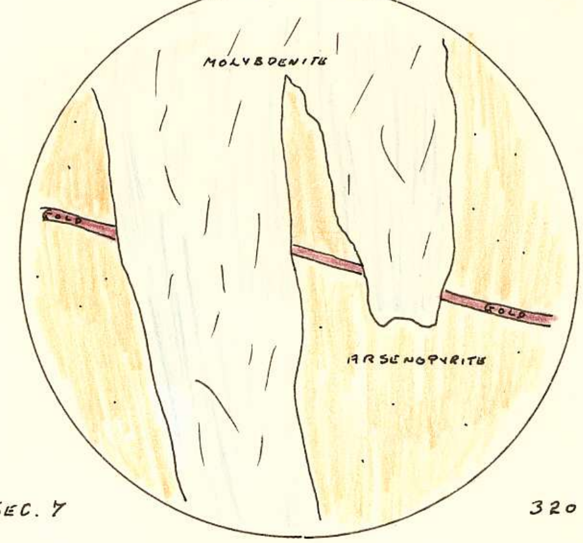
REPLACEMENT OF A EUHEDRAL ARSENOPYRITE CRYSTAL BY GANGUE AND SAFFLORITE



SEC. 1 320 X.

FIG. 2

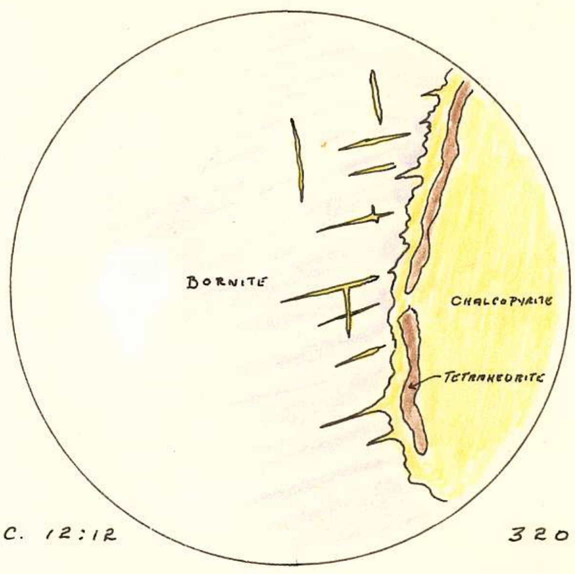
EXSOLUTION CHALCOPYRITE FORMED ABOUT THE BISMUTH TELLURIDE (Bt.) - BORNITE GRAIN BOUNDARY.



SEC. 7 320 X.

FIG. 3

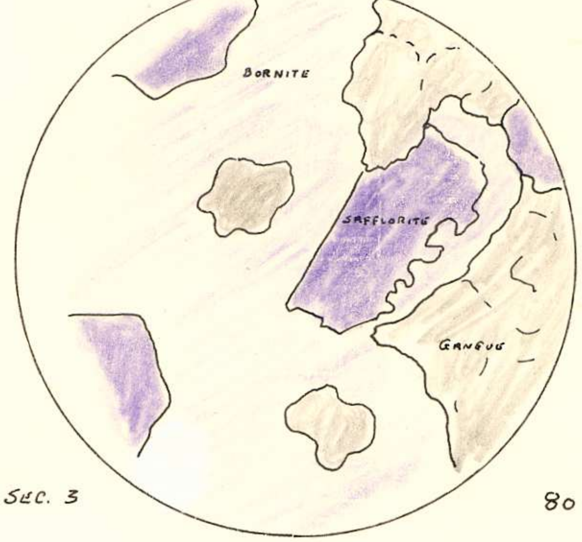
REPLACEMENT OF ARSENOPYRITE, AND AN INCLUDED VEINLET OF GOLD, BY MOLYBDENITE



SEC. 12:12 320 X.

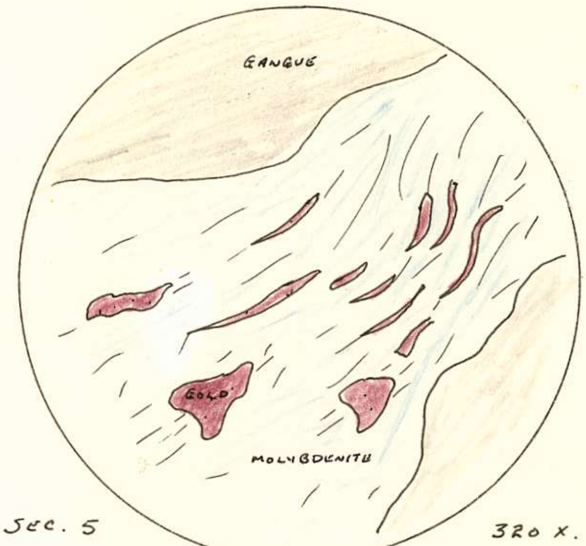
FIG. 4

EXSOLUTION CHALCOPYRITE IN BORNITE; RIM TEXTURE OF TETRAHEDRITE IN CHALCOPYRITE



SEC. 3 80 X.

FIG. 5
REPLACEMENT OF EUHEDRAL SAFFLORITE CRYSTALS BY GANGUE AND BORNITE.



SEC. 5 320 X.

FIG. 6
REPLACEMENT OF MOLYBDENITE BY GOLD ALONG CLEAVAGE DIRECTIONS AND ACROSS GRAINS

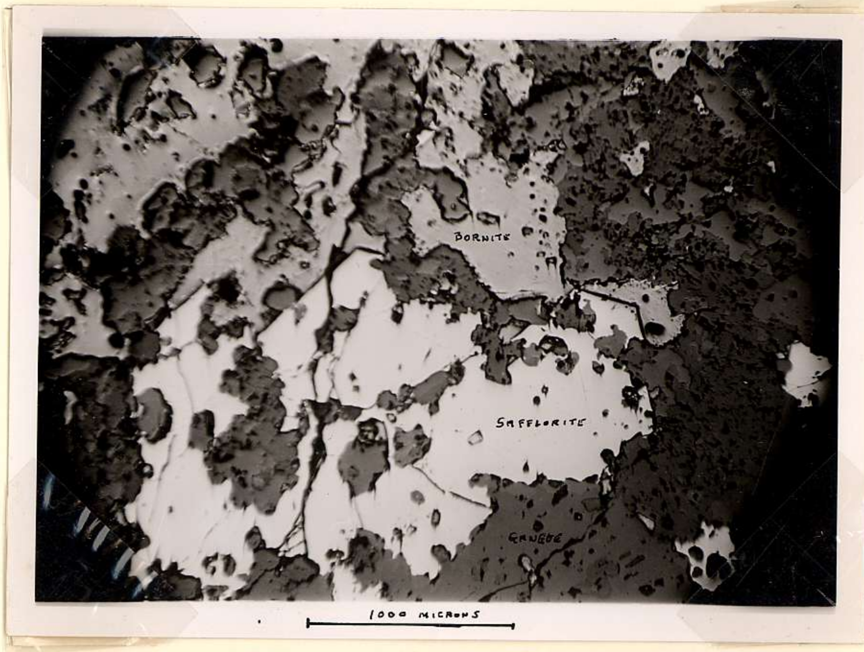


PLATE I

SEC. 10
LARGE EUHEDRAL CRYSTALS OF SAFFLORITE PARTLY REPLACED BY GANGUE AND BORNITE.

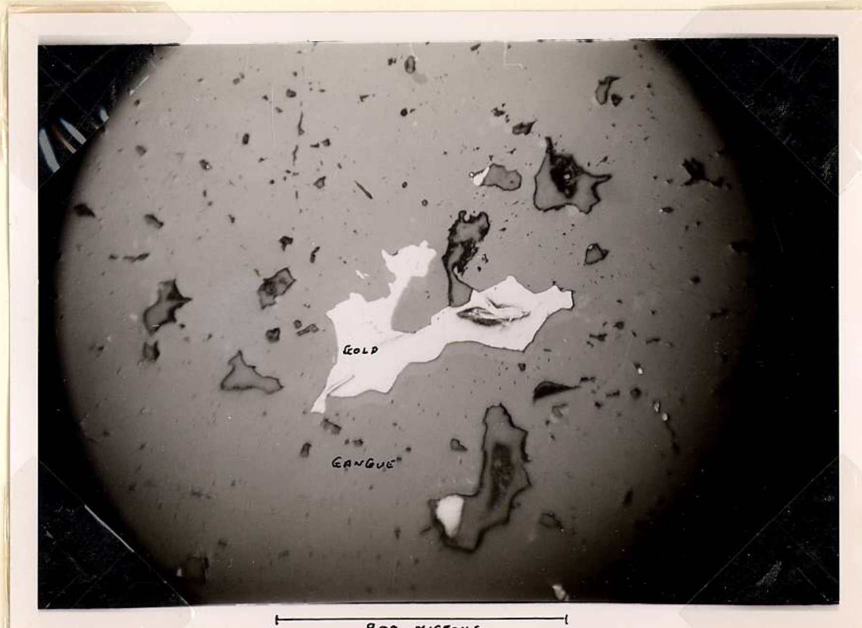


PLATE II

SEC. 2
LARGE "BLEB" OF GOLD WITH CHARACTERISTIC ANGULAR BOUNDARIES.

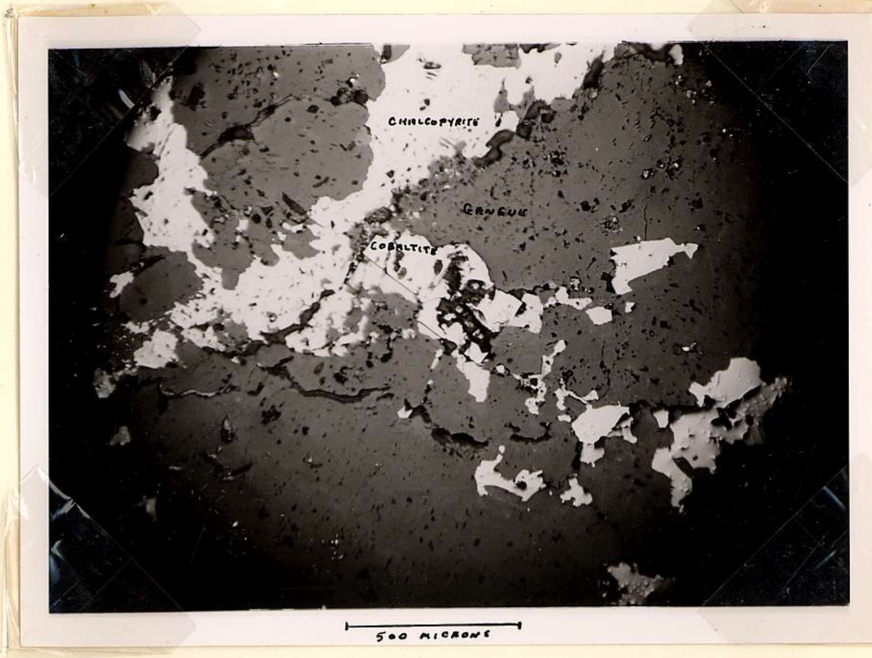


PLATE III

SEC. 4
REMNANTS OF EUHEDRAL COBALTITE CRYSTALS IN GANGUE: CHARACTERISTIC SHARP CONTACTS WITH CHALCOPYRITE

PLATE IV

SEC. 7
REPLACEMENT OF ARSENOPYRITE BY MOLYBDENITE.