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R.M.T.

A REPORT ON THE MINERALOGY OF THE HARRISON GROUP, LINDQUIST LAKE, BRITISH COLUMBIA.

by

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A REPORT SUBMITTED TO

THE DEPARTMENT OF GEOLOGY, UNIVERSITY OF BRITISH COLUMBIA,

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

IN GEOLOGY 524.

APRIL 1, 1950.

TABLE OF CONTENTS

ABSTRACT

A previous study of specimens from the Harrison Group of mineral claims had disclosed the occurrence of the telluride minerals hessite and tetradymite, associated with cosalite, galena, sphalerite, chalcopyrite, arsenopyrite, pyrite and native gold.[1] As the amount of native gold in evidence did not approximate that indicated by assays, the collection of some relatively massive and unweathered specimens by Dr. H. V. Warren and Dr. R. M. Thompson in the summer of 1949 led to a further study of the mineralogy being made. As a result of this later work, the additional occurrence of the telluride minerals tellurbismuth and altaite was determined and many new relationships were observed. The presence of each of these telluride minerals and that of cosalite was confirmed by X-Ray powder pattern photographs.

1 Young, J. W., "A study of the Mineralogy of the Harrison Group, Whitesail Lake." Unpublished Report, University of British Columbia, Department of Geology. 1946

ACKNOWLEDGEMENTS

This mineralographic study was carried out in the Department of Geology at the University of British Columbia, under the supervision of Dr. H. V. Warren and Dr. R. M. Thompson, professors of Mineralogy. The unfailing attitude of cooperation shown by these members of the instructional staff was greatly appreciated, as their advice and suggestions proved to be invaluable aids throughout this work.

The writer is also indebted to Mr. J. A. Donnan, technician in the Geology Department, for his excellent instructions in the techniques of preparing bakelite mounts and their subsequent polishing by both the Graton-Vanderwilt process and individual hand methods. Confirmatory identification of several of the minerals was performed by Dr. R.M. Thompsen with X-Ray powder pattern photographs. The cooperation of several of the fourth year geology students in the taking of miorophotographs was also appreciated.

The previous report on the mineralogy of the Harrison Group was of great assistance in the present work.[2] Specimens dealt with previously were reviewed to make comparisons and to propose several new paragenetic relationships for the mineralization.

2 loc. cit.

INTRODUCTION

The Harrison Group of Mineral Claims was discovered and staked during 1943, by the Harrison brothers of Wistaria, B.C. The presence of megascopic tetradymite and associated high assays for gold and silver were sufficient to attract many mining companies to this property in subsequent years. A program of diamond drilling and surface exploration was undertaken by Pioneer Gold Mines Limited during 1945 and 1946. In all some 3700 feet of diamond drilling was carried out by this company.[3]

The claims covering the surface showings are located some 1300 feet above and some 5 miles by trail from the west end of Whitesail Lake, Omineca Mining Division. At an average elevation of 4000 feet, the area between Lindquist Lake and the west end of Whitesail Lake is very mountainous, being only a few miles east of the summit of the main Coast Range. Numerous glaciers occur above the 5000 foot level and snow often lingers until July even along the lower river valleys.

3 Annual Report of the Minister of Mines, British Columbia, 1946, p. A71.

GENERAL GEOLOGY

The Harrison Group of claims are located astride the eastern contact of the Coast Range Batholith, which trends almost due west in this locality. A buff coloured, silicified contact zone up to fifty feet in width exists between the gneissic quartz-diorite of the batholith and the Hazelton Group, which here consists of black slate, tuffaceous argillite, thin bedded tuffs and some coarse volcanic breccia. The East-West trending contact dips steeply (60°) to the south-west. The Hazelton Group strata strike almost parallel to the contact zone, but dip steeply (70°) to the North.[4]

Along the intrusive contact a zone of quartz stringers occurs over a width of some one hundred feet. The more important veins are in the quartz-diorite and approximately parallel the contact. The drilling has shown that there is probably only one main East-West vein with several branching northerly and northwesterly trending veins on both sides of the contact. The main vein averages five feet in width wherever intersected by drill-holes, but since it dips flatly to the North (45°), the main mineralization may have been localized in the main vein and its branches within and adjacent to the altered contact zone.[5]

4 loc. cit.

5 Personal conjecture.

MINERALOGY

A Macroscopic

Approximately 3% of the vein matter is sulphides. Those present and in order of abundance are pyrite, sphalerite, chalcopyrite, arsenopyrite, galena and cosalite. The cosalite is found only in a few isolated parts of the veins, and in minor amounts. It rarely can be determined in hand specimens, probably because it occurs closely associated with galena.

The silver telluride hessite and a bismuth telluride can be detected in hand specimens. They occur as fine, lead-gray to black streaks along small fractures in quartz or as coatings 1 mm. or so thick along fracture surfaces throughout the massive sulphide. Some museum type specimens of tetradymite were collected by Young, these being foliated masses showing the micaceous cleavage and splendent metallic lustre.

The mineralization is almost wholly along fractures in the quartz veins. There seems to be no general pattern to the fracturing and there is a great variation in the size of the openings. Some of the coated surfaces of mixed tellurides seem to be slickensided, indicating some movement after the main mineralization.

Some carbonate material can be noted around the borders of the various minerals and filling small fractures in the quartz. The bismuth and silver tellurides tarnish black while a bright blue-green tarnish is prevalent on areas of tellur-bismuth containing intergrowths of altaite.

Numerous beads of silver and an occasional one of gold can be "sweated" from hand specimens of vein material placed in a hot stove for several hours. No native gold has been observed macroscopically, nor has any ever been panned from the mineralized quartz.

B Microscopic

1 Sulphides

Pyrite occurs in large subhedral grains throughout the mineralized quartz, in some parts of the vein apparently constituting the main sulphide. It is much fractured, with fillings of galena, sphalerite, chalcopyrite, and occasionally tetradymite, along these fractures.

Arsenopyrite is more abundant in sections than would be suspected from the hand specimens. It takes a better polish than pyrite and yet stands in relief above the base metal sulphides. The characteristic brown and violet polarization colours can readily be noted. Few euhedral grains are present. Arsenopyrite is associated with almost all of the other sulphides and tellurides, as it occurs filling fractures in quartz which were later re-opened with deposition of the sulphides and tellurides. It is not fractured to the same degree as pyrite.

Chalcopyrite is usually associated with sphalerite, either as contiguous masses or as microscopic blebs following the cleavage traces of the sphalerite. Thin veinlets of chalcopyrite alone are noted filling fractures in the quartz and pyrite.

Sphalerite occurs as massive areas occuping relatively large spaces in the quartz. It can be recognized by its isotropic character under polarized light, mouse grey colour and yellow-brown internal reflection. Both oriented and irregularly distributed inclusions of chalcopyrite are always present in the sphalerite. That some of these chalcopyrite blebs are the result of ex-solution along the crystallographic planes of sphalerite is entirely possible. The irregularly distributed masses of chalcopyrite may be remnants, as where adjacent masses of these two sulphides are noted, the sphalerite exhibits contacts that are concave towards the chalcopyrite. This may be taken as evidence of replacement, but is alone inconclusive. Sphalerite ranges from minute areas 100-200 microns in size up to large masses several centimetres across.

Galena is noted as occurring only in limited amounts by itself. Its presence has been regarded as being indicative of higher assays.[6] Tongues and irregular masses of galena can be noted around the border of tetradymite (Plate Y-1). These can be considered as residual areas of galena, but other

6 Young, op. cit., p. 6

relationships indicate that in part the galena is later than tetradymite (Plate 10). Where veinlets of tetradymite do transect galena, these end abruptly in sphalerite, only a few microns past a galena-sphalerite contact. Galena is intimately associated in time and occurrence with tetradymite and cosalite. The relationships between these three minerals will be discussed under cosalite.

The etch reactions of galena agree with those listed by Short.[7] The presence of triangular pits and isotropic character under polarized light are usually sufficient to identify any large grains of galena. Against large masses of tetradymite, galena has a bluish grey tinge, while hessite exhibits a rougher surface and duller grey colour. Small areas of tetradymite in galena look creamy yellow, whereas altaite appears white in the same surroundings.

<u>Cosalite</u> ($2PbS.Bi_2S_3$) was discovered by Young in only one isolated part of the main vein and in minor amounts.[8] It was not noted in the more massively mineralized sections. In reviewing Young's section (Whitesail No. 17) containing the cosalite, a faint intergrowth texture was noted with one nicol inserted in the microscope. Fairly strong pleochroism of at

7 Short, M. N., "Microscopic Determination of the Ore Minerals", U.S.G.S. Bull. 914, p.115.

8 Young, op. cit., p. 7.

least one of the minerals was noted under high magnification. Under crossed nicols both appeared anisotropic. However, it was realized that a strongly anisotropic mineral such as cosalite would impart a false anisotropism to an intimately associated isotropic mineral. Cosalitewas assumed to be the main groundmass, since it had been identified by Young as entirely composing this particular section.[9]

Etch Reactions were as follows:

	For the Intergrowth	For Cosalite (after Short)
$HgCl_2$	positive brown on some areas only	Negative
KOH	negative to both	Negative
$FeCL_3$	positive only on one of intergrown minerals	Negative Mostly
KCH	negative to both	Negative
HCL	positive to same one of intergrown minerals as was $FeCl_3$	Negative
HNO_3	positive to both	Positive

A series of minerals were indicated by these etch reactions, depending upon whether the mineral intergrown with cosalite was anisotropic or isotropic. An X-Ray powder pattern photograph of the intimate intergrowth showed the presence of cosalite and galena, with the lines for the latter mineral being predominant. The previous etch reaction, if applied to the table of isotropic minerals, would fit galena perfectly.

9 Young, p. 41.

On preparation of another section of cosalite and thorough examination under X-nicols, it was noted that in some areas the galena was in excess of the cosalite (Plate 11), whereas in other areas interlocking cosalite crystals formed areas 1 mm. or so across, with only a few small areas being apparently galena (Plate 12). It should be stated that in no area could these two minerals be distinguished except by etching with 1:1 solution of HCL. A series of etch tests were performed on mounted specimens of cosalite and galena from the Cariboo Gold Quartz Mine. Dr. Warren lists cosalite as being negative to HCL[10] and this was confirmed by the standardization tests. Galena is very positive to HCL.

Numerous laths of tetradymite transect cosalite and galena alike. These vary from thin intersecting lamellae to tabular laths 200-300 microns long (Plate Y-2). Tetradymite exhibits a creamy yellow colour adjacent to cosalite or galena. These tetradymite laths do not show any enlargement where they intersect. However, there is a noticeably feathery edge to many of the laths, showing a progressive replacement from the main tabular body outwards into the cosalite-galena intergrowth. The laths definitely follow some predetermined structural lines in the original host.

10 Warren: H.V. "An Occurrence of Cosalite in British Columbia" University of Toronto Studies, Geol. Ser. #42,1939.

Argentite (Ag_2S) was noted in only one section, where two irregular areas of less than one hundred microns were present in tetradymite. Those areas appeared dark gray against the tetradymite and isotropic under polarized light. They were at first assumed to be slightly oxidized galena, which in adjacent areas can be noted in tetradymite. The keen eye of Dr. Warren detected a lack of the slightly bluish gray tinge shown by galena against tetradymite.

Etch Reactions for Argentite were as follows

$HgCL_2$	positive, brown to purplish irridescent stain
KOH	negative
KCN	positive, black stain
$FeCL_3$	positive, irridescent stain
HCL	positive, blackens mineral
HNO_3	positive, bluish irridescent stain

As a result of these etch reactions, either argentite or hessite was indicated. The mineral was removed for X-Ray purposes by Dr. Thompson. Since a mixture of tetradymite and the unknown was removed, the resulting powder pattern photograph did not clearly indicate whether the unknown was hessite or argentite. As the mineral was very sectile and showed none of the prominent polarization colours so common in hessite of this suite, the identification as argentite is proposed. The black tarnish first noted on this mineral also tends to confirm this identification. No areas of this mineral were noted in any of the other sections.

2 Tellurides and Native Gold

Tetradymite (Bi_2TeS_3) occurs sparingly in the sections prepared by this writer. In several of Young's sections the main constituent is tetradymite, evidently prepared from selected specimens. In polished sections this bismuth telluride appears bright white, with a creamy yellow tinge against bluish gray galena. Wavy cleavage traces are often prominent. Under polarized light the polarization colours vary from light gray to yellowish gray. Tetradymite may be present as massive plates of interlocking grains, as revealed under crossed nicols or as intersecting laths throughout the cosalite-galena intergrowth.

Etch Reactions for essentially pure tetradymite of this suite agree with those listed by R.M. Thompson[11]

$HgCL_2$	negative
KOH	negative
KCN	negative
$FeCL_3$	positive, irridescent stain
HCL	negative
HNO_3	effervesces, irridescent to black stain

11 Thompson, R. M. "The Telluride Minerals and their Occurrence in Canada," American Mineralogist, Vol. 34, 1949, p. 370

As mentioned previously, galena, hessite and argentite are impurities within tetradymite. Galena and argentite are located near the edge of the telluride grains, while hessite is not thus restricted. Where grayish black alteration is present on tetradymite, small areas of native gold are common (Plate Y-2).

Tellurbismuth (Bi_2T_3) is the most abundant telluride in the unweathered specimens collected during 1949. Tellurbismuth appears pinkish white in polished sections and more distinctly so against the bluish white of altaite or creamy white of tetradymite. No traces of cleavage were noticed in the numerous sections containing tellurbismuth, although it possesses the same foliated habit as tetradymite.

In polarized light this mineral appears more strongly anisotropic than tetradymite (dark to yellowish gray). Minute blebs and vermicular masses of altaite are usually present throughout (Plates 5,6,7,8). Against hessite there is often a selvage of tellurbismuth free from altaite intergrowths (Plate 2), while there is a marked variation in the texture of the intergrowth elsewhere.

Etch Reactions for Tellurbismuth are as follows

$HgCl_2$	negative
KOH	negative
KCN	negative

Fcl_3	positive, irridescent stain
HCL	negative
HNO_3	positive, effervesces

These are identical with those for tetradymite. Dr. Thompson reports the etch reactions for tellurbismuth as being variable.[12] Where the pinkish tinge is not noticeable, these two bismuth tellurides are indistinguishable in polished sections. The identification in this work was confirmed by X-Ray photograph.

<u>Altaite</u> (PbTe) is noted as graphic intergrowths in tellurbismuth or as minute areas in galena. Only one large mass of altaite was located, this presenting smooth contacts with hessite (Plate 2). It is lighter in colour than galena and faintly bluish white against pinkish tellurbismuth.

<u>Etch Reactions for Altaite are as follows</u>

$HgCl_2$	negative
KOH	negative
$FeCl_3$	irridescent stain
KON	negative on large areas, positive on intergrowth blebs
HCl	brown to irridescent stain
HNO_3	effervesces, irridescent to dark gray stain

<u>Hessite</u> (Ag_2Te) is common throughout much of the mineralized quartz. It is probably next to tellurbismuth in abund-

12 Thompson, p. 368.

ance. In polished sections it is light gray, darker than galena, and with distinctive anisotropism. A mosaic pattern of alternating orange and blue areas is present under crossed nicols (Plate 2). In reflected light the surface is often pitted and fractured. Hessite is closely associated with the other tellurides, as isolated remnants in tellurbismuth (Plate 3), or in tetradymite.

Etch Reactions for Hessite are as follows

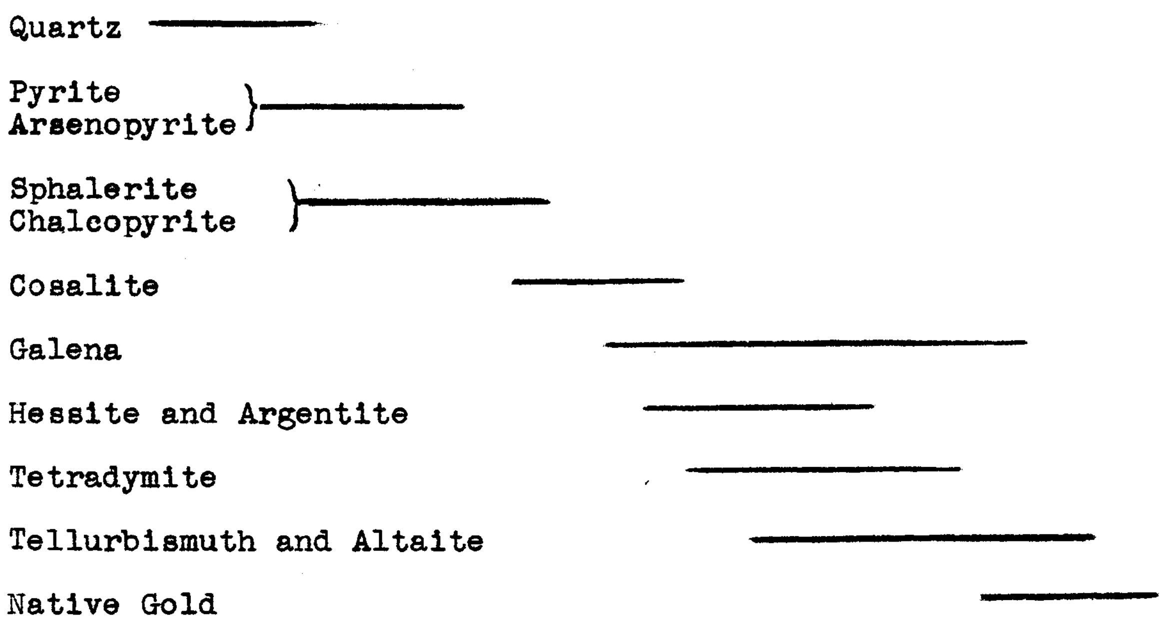
$HgCl_2$	light brown to irridescent stain
KOH	negative
$FeCl_3$	quickly stains irridescent (cannot be removed by buffing)
KCN	negative
HCL	black stain
HNO_3	irridescent to black (cannot be removed by buffing)

Native gold occurs in very fine equidimensional grains within tetradymite and galena, also as narrow zig-zag veinlets in hessite. The veinlets within the silver telluride appear very much paler in colour than the rounded blebs within tetradymite. This may be a matter of colour background or may be an indication that the native metal within hessite is more nearly electrum. Much of the gold in tetradymite is apparently related to areas of alteration, as is also that gold occuring adjacent to the various tellurides in quartz. It is probable that loci of gold deposition, at the end of the mineral sequence, would also consititue localities vulnerable to hydrothermal and meteoric solutions. The close association of native gold to the tellurides tetradymite and hessite suggest that these two mineral may be auriferous. No native gold was noticed within sphalerite, pyrite, chalcopyrite, arsenopyrite or tellurbismuth.

Some carbonate material fills the interstices between various minerals and also fractures in all the sulphides and tellurides. This may be assumed to have accompanied the gold deposition. The particular carbonate was not identified. It is widespread in occurrence but only in minute amounts.

PARAGENESIS

The proposed genetic sequence is outlined graphically below.



Quartz is the earliest mineral formed, as the main sulphides fill fractures in it. Some quartz penetrates fractures in pyrite.

Pyrite is the earliest sulphide deposited, as the irregular fractures in pyrite are occupied by all of the other sulphides except arsenopyrite.

Arsenopyrite was probably contemporaneous with pyrite. It has proved to be less susceptible to fracturing. The later sulphide mineralization has probably occurred along reopened fractures in the quartz, where pyrite and arsenopyrite had been deposited previously.

Sphalerite and Chalcopyrite are considered to overlap genetically, as their contacts are not conclusive of any replacement nor of any succession.

Galena is later than sphalerite and chalcopyrite in the sequence, for embayments of galena into sphalerite were noted. Galena also penetrates along sphalerite-chalcopyrite grain boundaries. Most of the galena is earlier than tetradymite (Plate Y-1), but some galena can be noted following the wavy cleavage of the telluride (Plate 10). Thus chronologically, galena is here considered to cover a considerable range.

Cosalite and galena exhibit a "pseudo-eutetic texture" over large areas. Both of these minerals are present in excess of the actual intergrowth. Galena alone is typically massive, although very finely crystalline. Cosalite commonly consists of a mass of interlocking, plumose grains, showing the typical fibrous habit (Plate 12). Some of the noticeably fibrous grains (under crossed nicols) are indicated by a light HCL etch to be galena rather than cosalite. The writer concludes from this that galena is pseudomorphous after cosalite and thus replacing it. This is substantiated by the actual form of the intergrowth as exhibited in Plate 11. Indeed, the texture here only resembles an intergrowth because of the replacement of the distintly fibrous cosalite by galena.

The laths of tetradymite have a definite relationship to this replacement. Where large single laths of tetradymite are present, even slight etching with HCL fumes and examination under crossed nicols reveals that the replacement by galena is restricted to an area on one side of the tetradymite lath. The other side is found to be massive cosalite. Where intersecting laths of tetradymite are present as in Plate 13, the maximum replacement by galena is adjacent to these. Thus replacement of cosalite by galena can be concluded to have been facilitated in those areas made more accessible by transecting laths of tetradymite. The localization of the replacement to one side of a large tetradymite lath indicates that the tetradymite was present in the cosalite prior to the partial replacement of the latter mineral by galena.

Hessite was not noted replacing or filling fractures in any of the sulphides. However it does occur as apparently residual grains in tetradymite and tellurbismuth (Plates 3,7). It is thus considered the first telluride mineral deposited.

Argentite is placed in the same time category as hessite on a purely logical basis. It may be much earlier and may have suffered replacement by the other sulphides. However, as it occurs as two rounded residual areas in tetradymite, it is genetically placed with the silver telluride.

Tetradymite contains remnant grains of galena and hessite. The laths of tetradymite in cosalite are shown previously to be earlier than galena. Galena also follows the wavy cleavage traces of tetradymite in some cases (Plate 10). The thin intersecting tetradymite laths are related to the larger tabular bodies and masses of this same mineral. In one area of section (Whitesail No. 17) the fine lattice-work of tetradymite is joined to a single large transecting lath, in cosalite partially replaced by galena along this lattice-work. Any need for proposing ex-solution of tetradymite in cosalite to form the lattice texture can be disregarded in favour of replacement. Several of the large tabular masses show irregular fingers of tetradymite extending into the cosalite.

The directional control exercised, evidently by the original cosalite, on the replacing tetradymite is remarkable and yet confusing. One large lath was noted as being parallel to and yet some 50 microns from the generally straight boundary between two massive cosalite grains. The intersecting laths strike at various angles, yet have a fairly regular general pattern wherever present. They cannot be related to the cleavage of cosalite but may be following two other prominent elements of the atomic arrangement. The intersecting planes thus followed may be at angles of 90° in an ideal section.

Tellurbismuth is rarely in contact with tetradymite, yet where such is the case, the relationship seems to be one of replacements by the sulphur free variety. This is in accordance with the general sequence shown, this being towards a decreasing sulphur content. In the area shown by Plate Y-3 laths of the pink tellurbismuth, not visible in the photograph, occur in the white tetradymite. In one instance, a lath of tetradymite transects both tellurbismuth and altaite (Plate8,9).

Tellurbismuth almost invariably contains blebs and rods of altaite in various shpes and sizes, the whole constituting a graphic intergrowth. Such intergrowths of these two tellurides have been reported by various workers.[13] In this suite both minerals are present in excess of the intergrowth, yet with only tellurbismuth in excess immediately adjacent (Plates 2, 8). There is a complete lack of recognizable replacement features between these two minerals. They necessarily are grouped as having been deposited simultaneously. Both are sulphur free tellurides, so that they are probably closely related in time of deposition, although no true eutetic is proposed.

Native gold is probably the last mineral formed, as it veins hessite and occurs in equidimensional grains in the other tellurides and galena. Only one grain of gold was

13 Thompson, p. 362.

noticed in tellurbismuth, which is less altered than tetradymite. The loci of gold deposition are areas susceptible to later altering solutions, being definitely related to residuals of galena or hessite in tetradymite, or to replacement laths of tetradymite in cosalite.

CONCLUSIONS

Several conclusions with respect to the sequence of mineralization have been stated previously in this report. As a result of a study of Young's size and mineralogical distribution tables,[14] and certain observations made throughout this present work, certain other conclusions can be formed.

1 Native gold occurs in hessite, tetradymite, cosalite and galena. This gold is considered to account for the low Ag:Au ratio shown for total distribution in products of between 70 and 100 mesh size. The ratio reaches a high in the 100 mesh product and then is constant for 150,200 and -200 mesh products. The highest silver and gold assays are obtained in the -200 mesh product. This indicates that much of the gold values either come from the same mineral as the silver, or from a mineral that responds to crushing in almost the identical manner as the silver bearing mineral. The obvious conclusion is that the silver telluride contains gold in its chemical composition, thus contributing almost all of the silver values and a major portion of the gold as well. The majority of hessite grains examined did not contain any native gold.

2 Several pertinent factors concerning the possible treatment of the complex 'ore' should be considered. The first of

14 Young, pp. 17-29.

these concerns the preceeding conclusion, that hessite contins gold in its chemical composition. Whether this gold is recoverable has not been indicated by any work completed to date. Another factor is that although fine grinding seems to yield the best assay results, it may not be economically conducted as a milling process. The presence of arsenopyrite may constitute an injurious effect to cyanidation processes. The possible recovery of Pb and Zn should also be investigated.

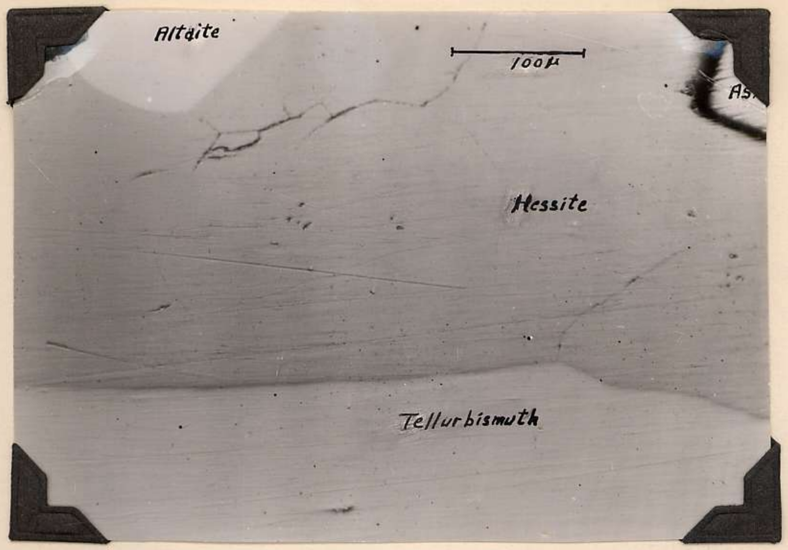


Plate 1. X168

Smooth contacts of altaite, hessite and tellurbismuth.

As = Arsenopyrite

Plate 2. X168

Approximately the same area, under X-nicols. Altaite tellurbismuth intergrowth at lower left.

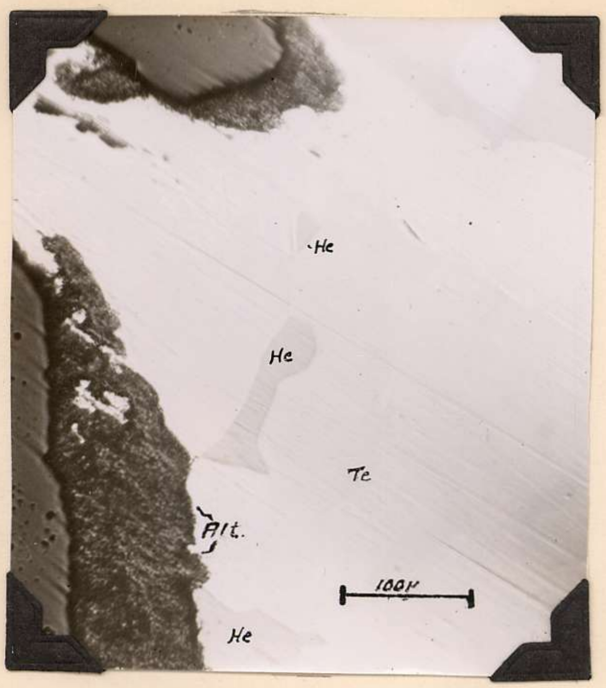


Plate 3. X168

Isolated remnants of hessite in tellurbismuth.

He = Hessite
Te = Tellurbismuth

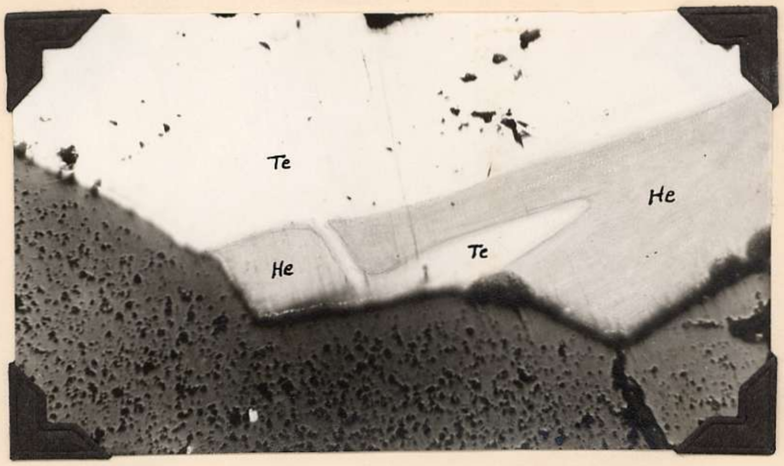


Plate 7 X168

Tellurbismuth veinlet cutting hessite and apparently replacing same.

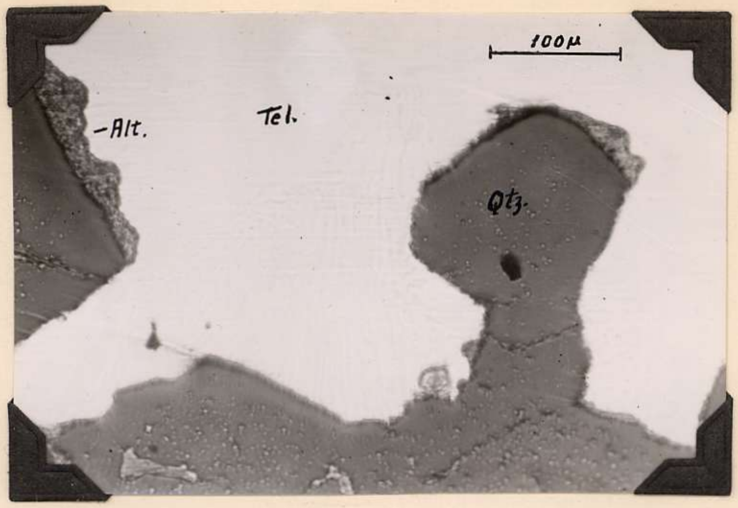


Plate 5. X168 One nicol.

Filling of tellurbismuth (Tel) in quartz. Alteration (Alt.) of the tellurides. Intergrowth of altaite barely visible.

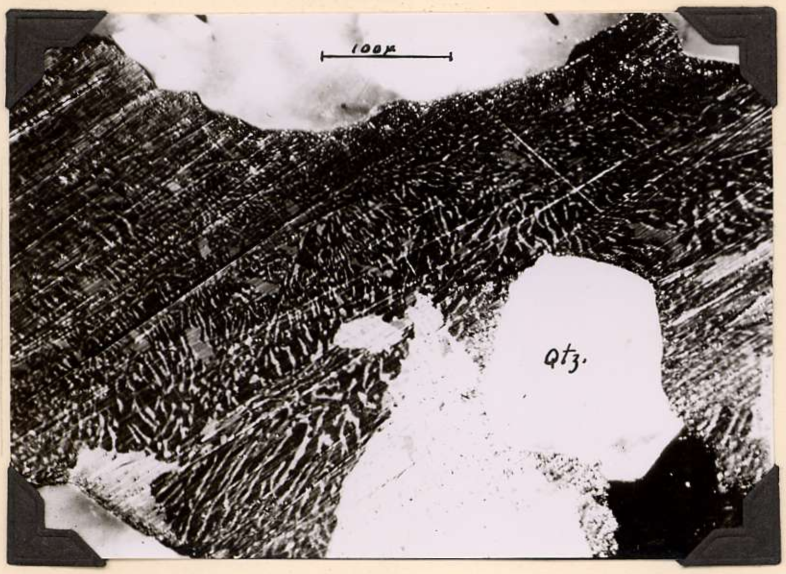


Plate 6. X168

Same general area, under X-nicols. Intergrowth of altaite (light rods) in same orientation over large area. Larger light areas are anisotropic tellurbismuth grains.

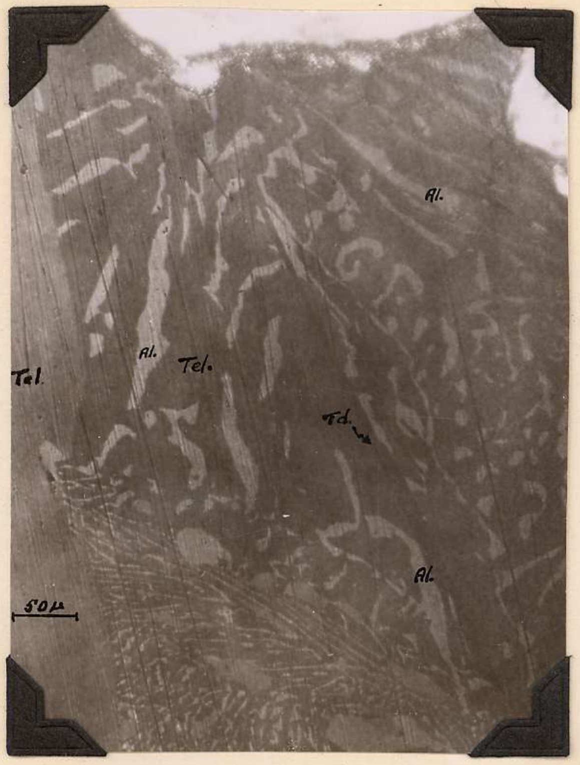


Plate 8. X168. X-nicols

Graphic intergrowth of altaite (Al) and tellurbismuth (Tel). Note selvage of pure tellurbismuth. Dark lath of tetradymite (Td) transects the intergrowth.

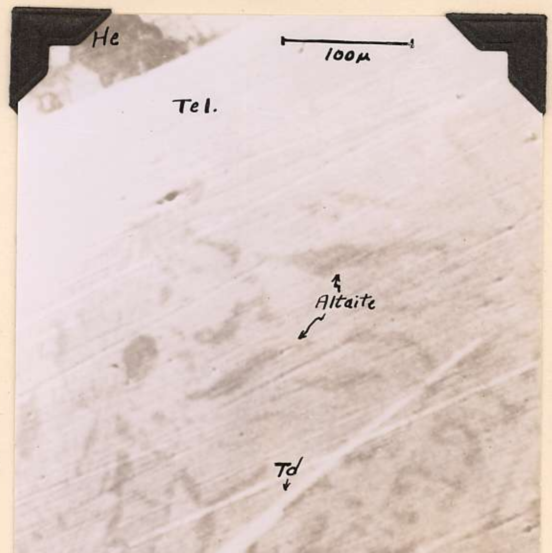


Plate 9. X168. X-nicols

Same general area, rotated ca 90° on stage. Tetradymite lath (Td) clearly visible.

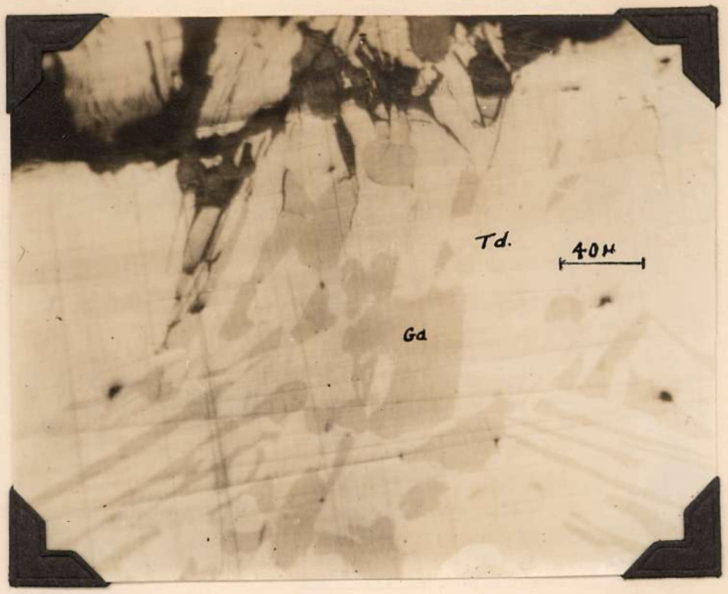


Plate Y-1. X270

Residual areas of galena (Ga) in tetradymite (Td)

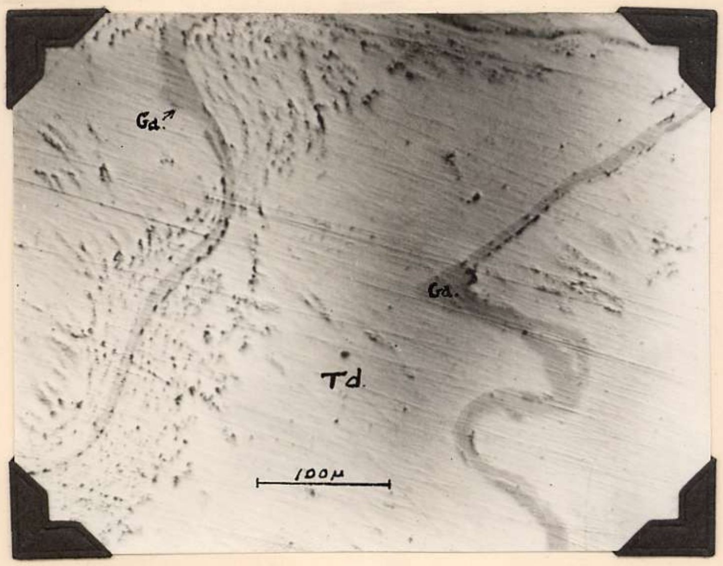


Plate 10 X168

Galena (Ga) following wavy and crenulated cleavage traces of Tetradymite (Td.)

Plate 11. X168
X-nicols

Intergrowth of cosalite (Cs) and galena (Ga). All white areas are positive to HCL, thus are galena. All grey and dark areas negative to HCL, thus cosalite.

Td = tetradymite lath.

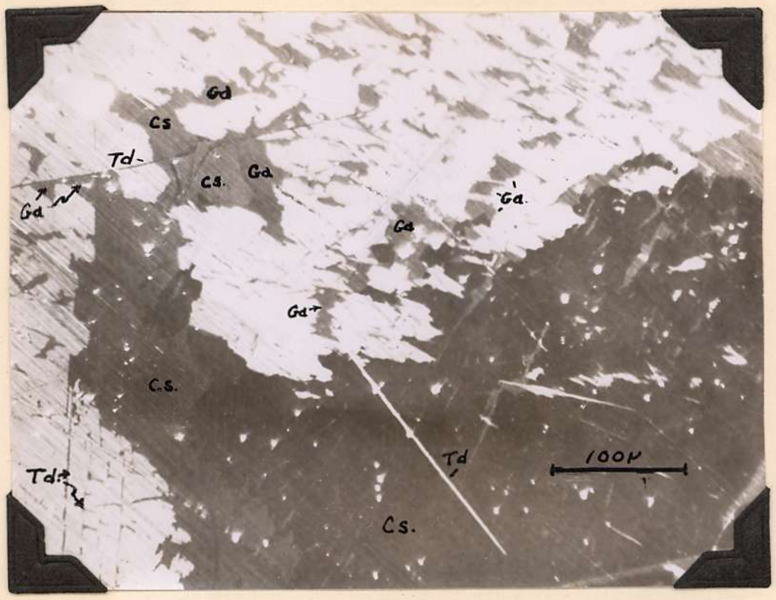


Plate 12. X168
X-nicols

Large areas of anisotropic cosalite (Cs) with minor areas of galena (Ga). Straight laths of tetradymite (Td) appear to transect both sulphides. Galena is replacing cosalite along tetradymite laths.

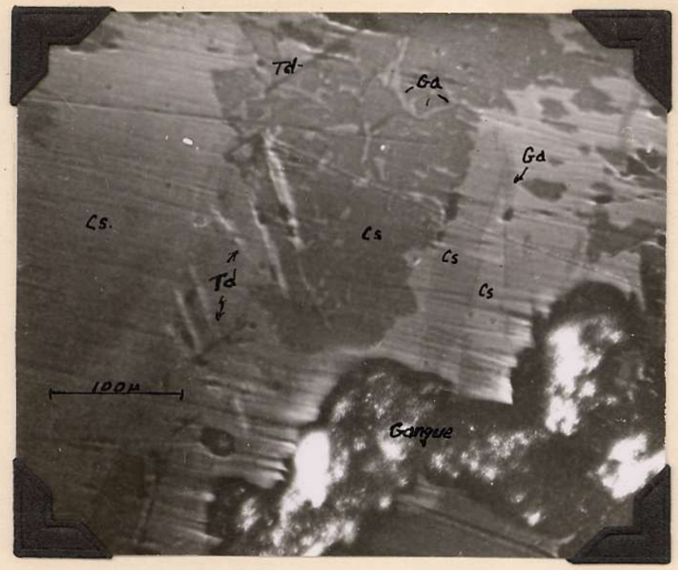


Plate 14. X168 X-nicols

Laths of tetradymite (Td) traversing cosalite (Cs) and galena (Ga) in two directions. Galena seems to follow grain boundaries of cosalite here.

Plate 13. X430 X-nicols

Lattice-work of tetradymite (Td)-white, in intergrowth of cosalite (Cs) and galena (Ga). All black is galena according to etch reactions.

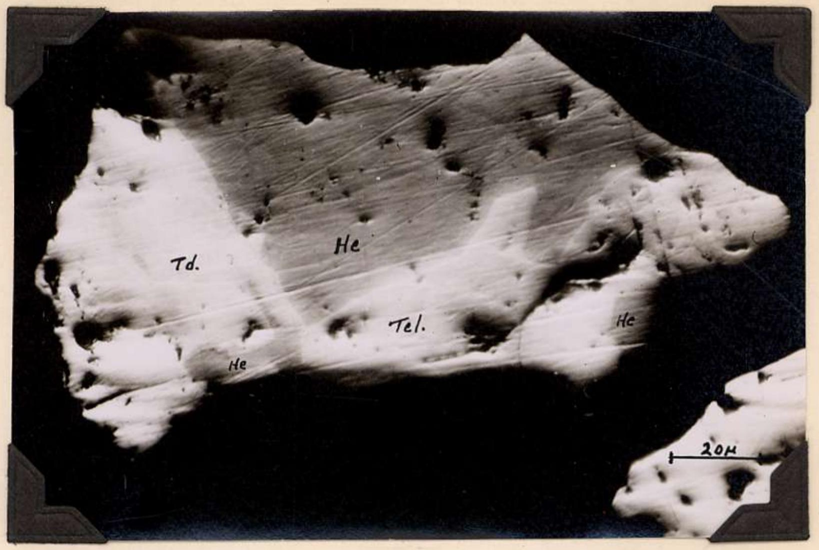


Plate Y-3 X570

Tetradymite (Td), tellurbismuth (Tel) and hessite (He) in contact.

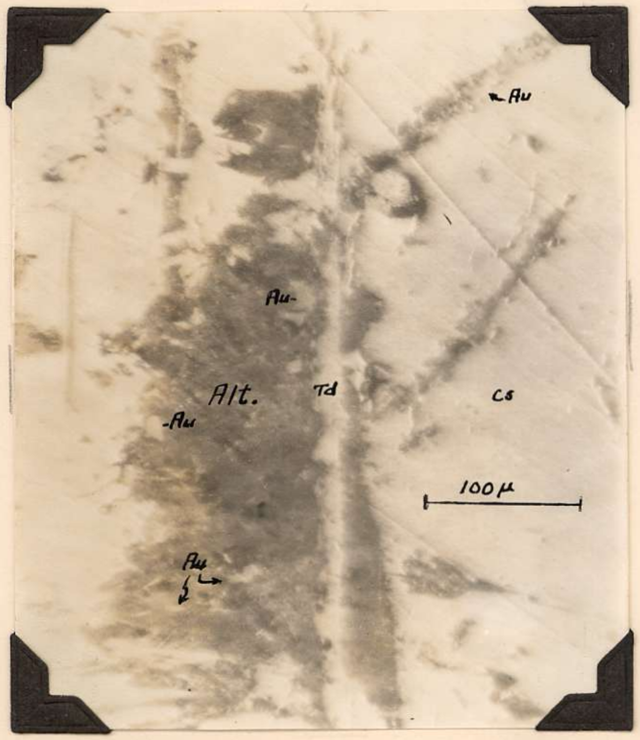


Plate Y-2. X200

Tetradymite (Td) lath in cosalite (Cs)-actually intergown with galena. Gold (Au) in alteration after galena and cosalite.

Plate Y-4 X570

Zig-zag veinlets of gold in hessite.

Plate Y-5 X200

Native gold in hessite (He)

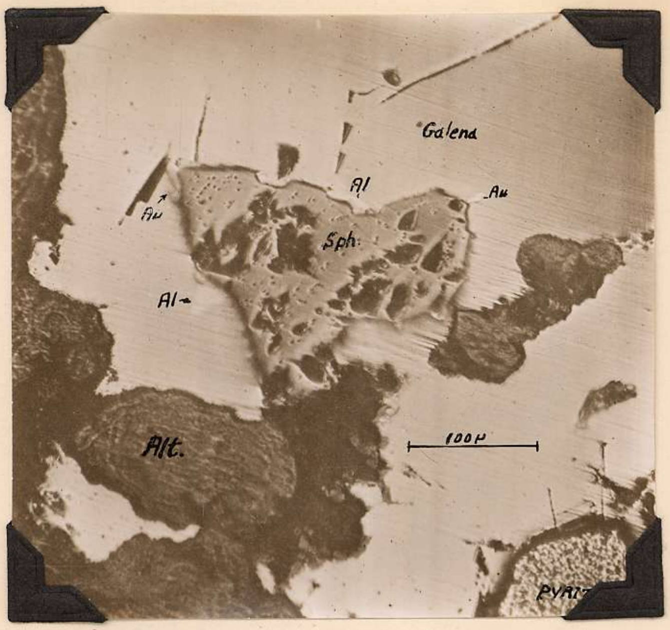


Plate 15. X168

Altaite (Al) and native gold (Au) around boundary of sphalerite (Sph). Groundmass is weathered galena.

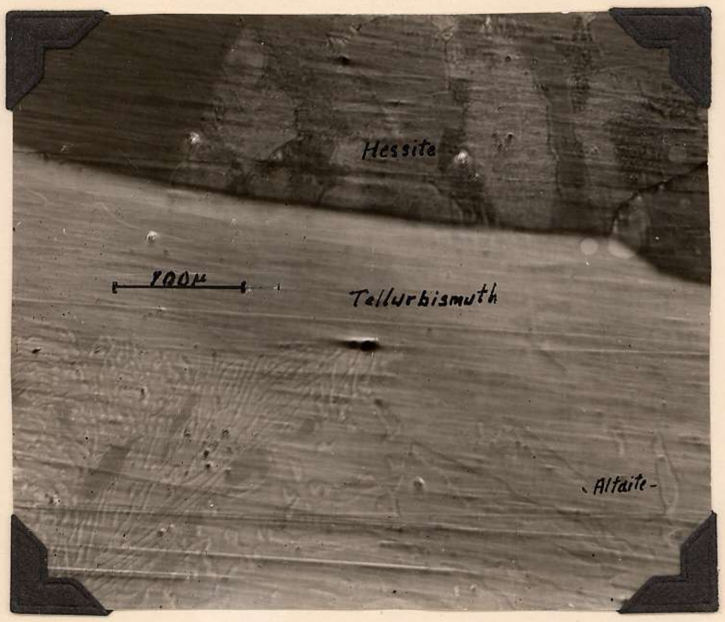


Plate 4 X168 X-nicols

Anisotropic mosaic of hessite and intergrowth of altaite and tellurbismuth.

ILLUSTRATIONS

MINERALOGICAL CONTENT of SECTIONS

Harrison Gold - Numbers of sections correspond with those of labelled hand specimens.

NUMBER	
1.	Pyrite and chalcopyrite mainly, few small grains of tellurbismuth, altaite and galena.
2,2A . . .	Chalcopyrite mainly.
3	Chalcopyrite, arsenopyrite and sphalerite.
4,4A . . .	Chalcopyrite.
5.	Pyrite, galena, chalcopyrite and sphalerite, altaite and gold.
5A	Galena and pyrite.
6.	Sphalerite, chalcopyrite and pyrite.
7,7A . . .	" " "
8.	Pyrite, chalcopyrite.
9,9A . . .	" "
10.. . . .	Hessite, Tellurbismuth, altaite, galena, chalcopyrite, arsenopyrite.
11A. . . .	Pyrite and chalcopyrite.
12,12A . .	Hessite, tellurbismuth and altaite, pyrite and arsenopyrite.
13	Hessite, tetradymite.
13A. . . .	Tellurbismuth and altaite, hessite, chalcopyrite, arsenopyrite.
T-1. . . .	Tetradymite, argentite, galena, gold.
T-2. . . .	Cosalite, galena, tetradymite.
T-3. . . .	Tellurbismuth, altaite, galena.

Whitesail (those of Young's sections studied in detail)

17	Cosalite and galena, tetradymite, gold.
15	Galena, tetradymite, hessite.
16	" " "
13	" " "
9A	Tetradymite, galena.
A7	Hessite, tetradymite and tellurbismuth (-100 galena tip)

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