Should be typed!

Sloppy

2nd class.

The mineralogy of the Kay Group Omineca Mining Division, British Columbia.

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University of British Columbia.

1957.

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Introduction.

The Kay Group of claims, a silver-gold property, is located 36 miles by truck road from Takla Landing on the hillside west of the Bralorne Takla mercury mine in the Omineca Mining Division.

The area was first brought into prominence in the year 1868 when gold was discovered on Silver Creek by Ezra Evans, Twelve-Foot Davis and a party of prospectors. On Vital creek a considerable quantity of placer silver-amalgam was found with the gold.[1]

The discovery of cinnabar by J.G. Gray of the Geological Survey in 1937 sparked fresh interest in the area and lead to the staking and development of mining properties along the Pinchi Fault zone. The silver-gold Kay showing was discovered by R. McKee in 1944 and the claims were optioned by Leta Explorations. Development work consisted of an adit following the fault zone and several surface trenches. Assays from surface showings carried up to 100 oz. of silver per ton and an appreciable gold content but underground values were disappointing and the option was dropped.[2]

The Geological Survey has been active in the area for several years and in 1949 published a map and memoir by Dr. J. E. Armstrong in which the Kay Group and Pinchi Lake belt are described.

Mineralographic studies have been carried out at the University of British Columbia and a short report on the Kay Group by Dr. H. V. Warren

1. R. G. McConnel, (1894).
2. J. E. Armstrong (1949) pp 172-173.

has been published.[3]

Acknowledgments

The mineralographic studies were carried out under the direction of Dr. R. M. Thompson to whom the writer is indebted for much valuable advice. Information from the memoir by Dr. Armstrong and the paper by Dr. H. Warren have been embodied in the following report.

3 H. V. Warren, (1946).

Local Geology.

The Kay Group mineralized zones occur in northwest trending blue-grey Cache Creek limestone. There is a band of crushed argillite nearby and several feldspar porphyry dykes cut both the limestone and argillite. The mineral deposits lie along a fault zone 25 feet wide with a steep dip and strike parallel to the crushed argillite band (N15W). The ore bodies consist of lenses several feet wide and in excess of 20 feet long. The fault zone[4] is probably part of the Pinchi fault zone.

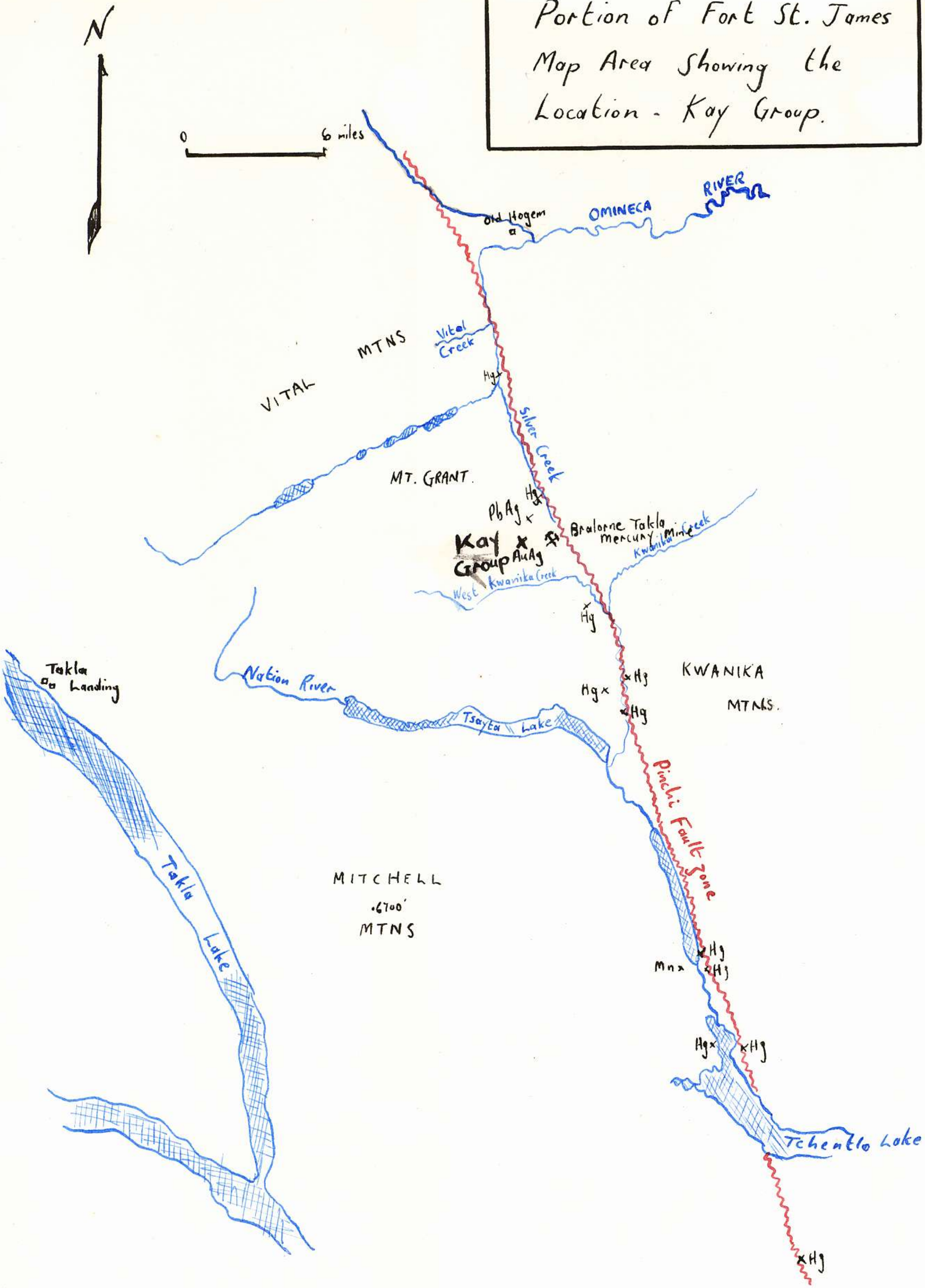
Scope of work and sample numbering system.

The samples available consisted of several pounds of ore ranging in size from chips to fist sized pieces. The sample numbering established by previous workers was continued and some new numbers were created. A number of samples were selected which appeared to display in sum all the different textures and minerals of the ore.

Nineteen polished sections were prepared (18 mounted and one unmounted). These polished sections and the rocks from which they were obtained were carefully numbered as described is Appendix No. 1. Six X ray powder photographs were taken and accompany this report.

4 Armstrong (1949) PP. 172-173.

Portion of Fort St. James Map Area Showing the Location - Kay Group.



Megascopic description of ore.

A large part of the ore is composed of felted or radiating acicular stibnite with a sooty grey tarnish. Deep red resinous sphalerite, arsenopyrite and pyrite are plainly visible in massive forms with very little gangue present. A mineral, later identified as Jamesonite appears associated with pyrite and arsenopyrite. The jamesonite has a lead-grey colour and a distinct cleavage.

Prominent weathering products are displayed.

(a) Green - yellow oxidation product = ? orpiment

(b) A very pearly encrusting mineral on weathered surfaces = ? binheimite, $Pb_2 Sb_2 O_6 (O, OH)$

(c) red resinous encrusting mineral which like (b) seems to be associated with jamesonite.

(c) is encrusted by (b) = ? binheimite.

x ray checks?

The ore is, in places, quite vuggy and acicular stibnite projects into open spaces.

Microscopic descriptions.

Details of individual minerals present.

Stibnite, $Sb_2 S_3$ a soft white strongly pleochoic and anisotropic mineral, easily develops an excellent polish but tending to break in porous specimens. Multiple twin lamellae are common, giving, under crossed nicols, a wood grain appearance. Frequently occurs as radiating aggregates with extinction position parallel to individual elongate prisms. Average grain size is 900 × 100 μ and maximum seen was 3mm × 200 μ, under crossed nicols.

Etch tests HNO_3 tarnishes brown after a few minutes and efferveses slowly. HCl tarnishes irridescent; KCN stains differentially pale brown. KOH gave the characteristic reation for stibnite in one second producing a heavy orange stain. $FeCl_3$ and $HgCl_2$ were negative.

Arsenopyrite, FeAsS, a white (whiter than jamesonite), see Plate 2, anisotropic mineral with blue-grey and greenish interference colours. Hardness (F), sections slowly take an excellent polish. Form is commonly euhedral with rhombic cross sections. Overaye grain size is 200 - 300 μ under crossed nicols, grains have very straight edges.

Etch tests HNO_3 1:1 efferveses, slow in starting, zonal texture developed by tarnish. HCl KCN $FeCl_3$ KOH and $HgCl_2$ negative.

'X'ray powder photograph confirmed arsenopyrite.

Jamesonite, $4PbS \cdot FeS \cdot 3Sb_2S_3$, a white soft (B) strongly anisotropic and distinctly pleochroic mineral with cleavage parallel to the elongate lath form. Interference colours buff - violet. Twinning parallel to elongation direction present but not common. The grain size under crossed nicols varies, maximum is 1 mm x 50 μ.

Etch tests HNO_3 1:1 slowly tarnishes irridescent and efferveses slowly. KOH produces a faint stain. $FeCl_3$, KCN and $HgCl_2$ negative.

Microchemical test failed to indicate Bi or Sb. ?

'X'ray powder photograph gave a characteristic jamesonite spectra.

Sphalerite, ZnS, a soft (c) grey isotropic mineral with deep red internal reflection and cleavage in three directions giving triangular pits. Average grain size 400 µ. Takes an excellent polish. May carry small blebs of chalcopyrite.

Etch tests - most reagents negative, aqua regia develops cleavage.

Pyrite, FeS_2 a pale yellow isotropic mineral commonly fractured but sometimes in euhedral grains, hardness F, takes a poor polish highly refletting. Contains native gold inclusions.

Etch tests HNO_3 fumes tarnish, HCl, KCN, $FeCl_3$, KOH, $HgCl_2$ negative

Berthierite, $FeS \cdot Sb_2S_3$, a white-grey to brownish strongly pleochoic mineral taking an excellent polish. Interference colours violet - greenish yellow and hardness D. Lamellar twinning was seen on a long exposure photographic plate under crossed nicols Plate 3. Couldn't you see it otherwise

Etch tests HNO_3 irridescent tarnish and slow effervesence. $FeCl_3$ produces an irrideseent tarnish and develops structure. KOH solution immediatly turns green and produces an irrideseent tarnish.

Microchemical test positive for iron

X ray powder photograph confirmed Berthierite.

Tetrahedrite $(CuFe)_{12} Sb S_{13} \pm Pb$. or possibly ? Freibergite, $(Cu Fe Ag)_{12} Sb_4 S_{13}$; a pale grey brittle mineral of hardness D taking an excellent polish isotropic, cleavage distinct, intimate association with sphalerite and arsenopyrite and containing bleb inclusions of chalcopyrite which are closely associated with a mineral which is white or of a lighter grey shade than the enclosing tetrahedrite.

Etch tests Aqua regia efferveses and stains irridescent. HNO_3 1:1 produces an irridescent tarnish and effervesence from cracks. HCl negative.
? $FeCl_3$ negative indicating tetrahedrite rather than Freibergite.
KCN positive carefully checked indicating tetrahedrite
KOH produces a slight irridescent tarnish
$HgCl_2$ brown stain produced around gangue minerals possibly indicating Freibergite.

Microchemical tests. The ammonium bichromate test was repeated several times but failed to indicate the presence of silver. An amorphous yellow precipitate indicated lead. The chloride test gave an immediate white precipitate upon adding HCl. Possible AgCl crystals took the form of black cubes, skeletal crystals and formless crystals.[5]

X ray powder photograph proved tetrahedrite but could not differentiate the Freibergite variety.

Gold, Au, see Plate I a yellow highly reflecting soft sectile mineral occuring as irregular blebs enclosed in fractured pyrite. The grain size is 20 - 60μ and grains may be readily seen with the aid of a hand lens on polished surfaces.

Etch test to distinguish from possible chalcopyrite. KCN produced a tarnish after a few seconds.

5. Short, pp. 202 - 203

<u>Unknown mineral (thought at first to be Andorite)</u> - a white mineral, hardness D taking an excellent polish black streak cleavage distinct and mineral is strongly anisotropic interference colours pinchbeck brown, violet and grey. This mineral was only found closely associated with stibnite in the form of short laths and diamonds and was immedially differentiated from stibnite by immersing the section in KOH for a few seconds. The unknown mineral stands out clearly against the orange altered stibnite. The grain size under crossed nicols ranged from 60 - 600 μ

<u>Etch tests</u> Aqua regia produces a tarnish rapidly.
HNO_3 1:1 slow effervesence and orange irridescent tarnish
HCl 1:1 irridescent tarnish.
$FeCl_3$ slight tarnish after 5 minutes.
KCN doubtfull positive test.
KOH and HCl_2 negative.

<u>Microchemical test</u> used the routine as laid down by Short (P. 267) and obtained results which seemed to confirm andorite.

<u>X ray</u> powder photograph indicated that the mineral was not andorite. The 'd' spacings are listed in the appendix.

<u>Chalcopyrite</u>, occuring as ① small blebs and veinlets in both tetrahedrite and sphalerite (hairline size) and ② in partial rims around a stibnite veinlet. ③ as small replacements of chalcopyrite guided by fractures.

? <u>Realgar</u> AsS - brownish yellow mineral associated with fractures cutting pyrite arsenopyrite and jamesonite.

? <u>Bindheimite</u> $Pb_2Sb_2O_6$ occuring in two forms
a. as a very pearly encrusting mineral on the weathered surface of jamesonite and arsenopyrite
b. as a red resinous mineral encrusting jamesonite and arsenopyrite. See scetch.

Under the microscope both forms were found to be cryptocrystalline.

Textural relationships of minerals

Fig. 1

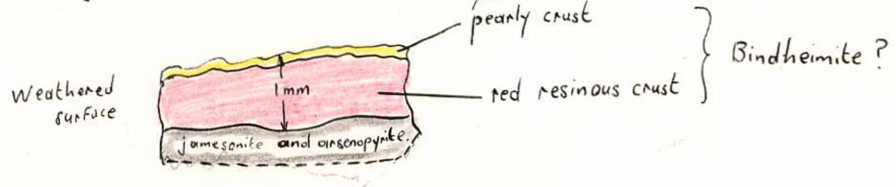


Fig 2.

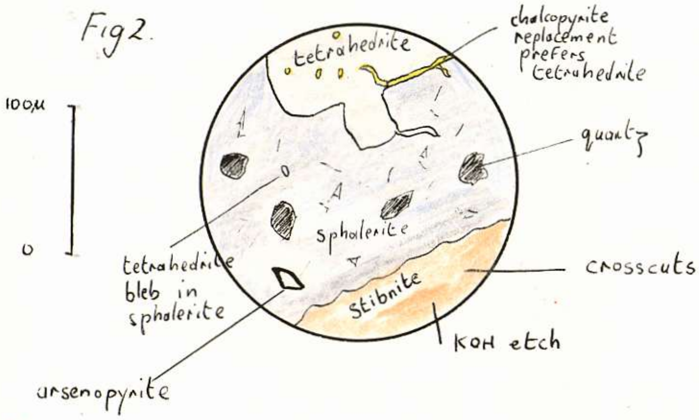


Fig. 2.
From section #2. Shows cross cutting relationship of stibnite. Rim replacement of tetrahedrite and sphalerite by chalcopyrite and replacement of sphalerite by tetrahedrite. × 204

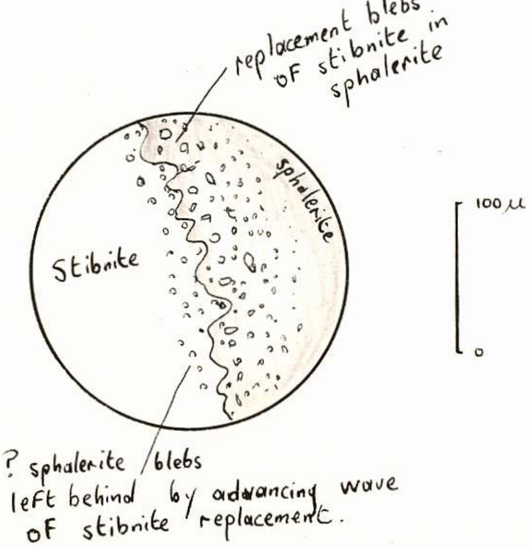


Fig. 3
From section # 24 shows replacement of sphalerite by stibnite? × 204
Fig. 4 demonstrates that the sphalerite must be replacing stibnite.

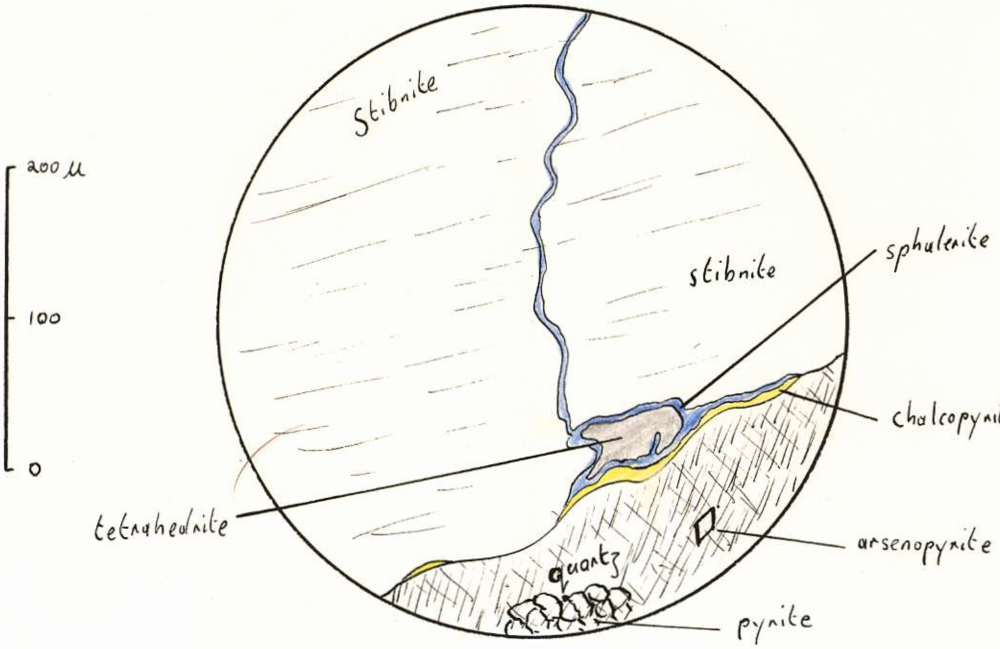


Fig. 4

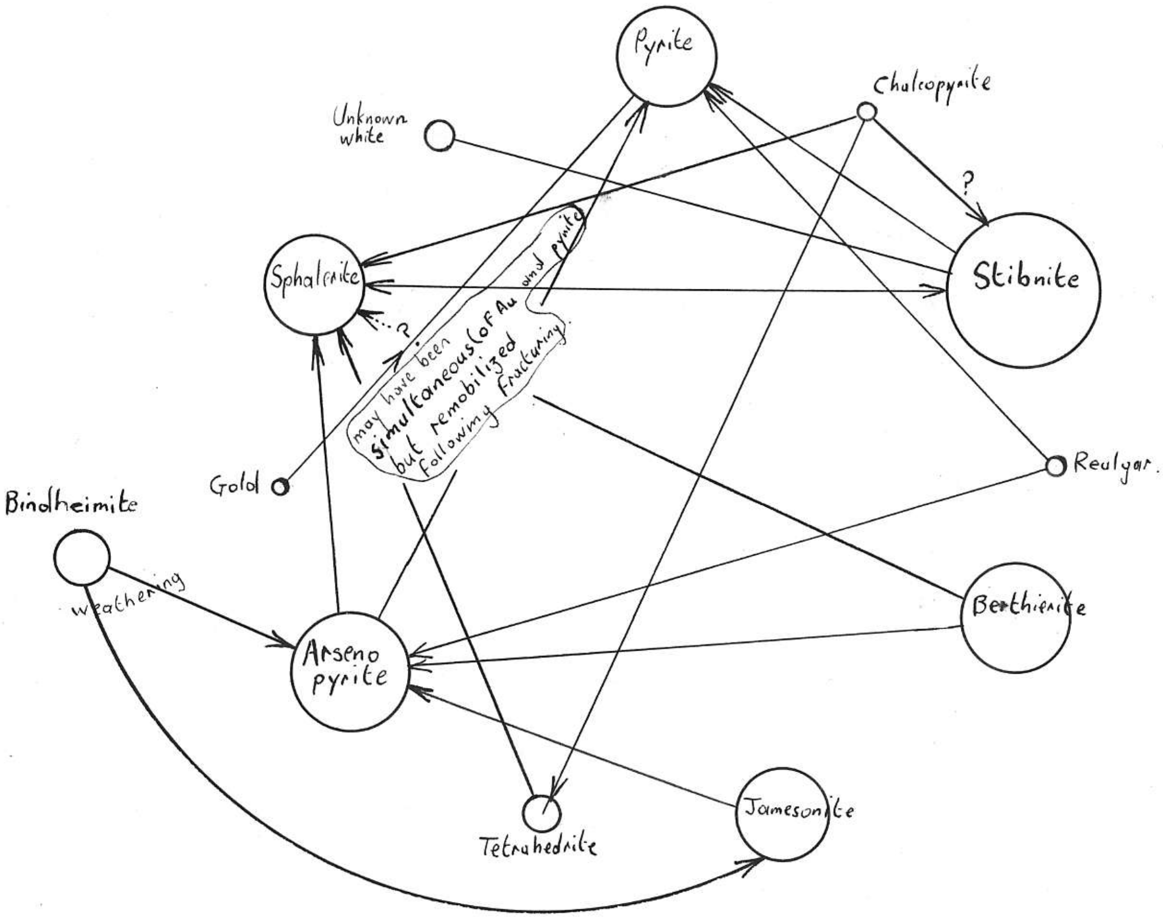
Section # 24 a stibnite veinlet (1 mm across) cuts quartz containing arsenopyrite and pyrite also sphalerite. In places the veinlet is rimmed by chalcopyrite. Figure 3 shows the same vein but the relationships in that case seemed to indicate replacement of sphalerite by stibnite. Fig. 4 clearly shows that the sphalerite is later than the stibnite. Therefore, the wave of replacement in Fig. 3 was moving toward the stibnite before replacement ceased.

If it is sphalerite.

Paragenesis.

Vandveer diagram.

Paragenetic sequence of Kay Group mineralization - mainly open space filling.



Minerals arranged in order of abundance.

Primary

		Percentage of total ore minerals
Stibnite	Sb_2S_3	38
Arsenopyrite	$FeAsS$	17
Sphalerite	ZnS	12
Berthierite	$FeS \cdot Sb_2S_3$	10
Pyrite	FeS	10
Jamesonite	$4PbS \cdot FeS \cdot 3Sb_2S_3$	10
Tetrahedrite	$(CuFe)_{12}SbS_{13}$	2
Unknown white	(a silver lead antimony mineral)	0.5
Realgar	AsS	0.5
Chalcopyrite	$CuFeS_2$	trace
Gold	Au	trace

Native silver, reported by Dr. Warren[6], was not detected.

Secondary

Bindheimite	$Pb_2Sb_2O_6$	trace.

6. Warren (1946) pp71-72

Temperature of Formation.

The association of realgar and stibnite both minerals characteristic of hot spring deposits and the proximity of the Bralorne Takla cinnabar mine on the same fault zone indicate a low temperature of formation. The deposit is accordingly classed as epithermal temperature 50°C – 200°C.

Conclusions

meaning

The Kay Group 'ore' is classed as being of epithermal origin and consequently would not be expected to continue to any depth. The devopment work proved a marked decrease of grade with depth and perhaps this was near the bottom of the mineralized zone. The mineralizing solutions probably ascended up the fault zone to the present 'ore' zones and deposited the minerals mainly in open spaces. It is suspected that there were at least two periods of mineralization. This is suggested by the fact that stibnite is seen to be both pre-sphalerite and post-sphalerite.

The presence of stibnite berthierite and realgar would create an ore dressing problem.[7] These minerals dissolve in an aqueous cyanide solution forming complex cyanides and causing an excessive consumption of cyanide. The alternative to a cyanide gold extraction process would be the amalgamation process but here too the presence of certain minerals especially stibnite and berthierite presents a problem. These minerals contaminate the surface of amalgam and thus tend to

7. Edwards (1954) pp. 172-174.

prevent gold from adhering too and being absorbed by the amalgam. Realgar, tetrahedrite pyrite and arsenopyrite also tend to inhibit gold amalgamation. In addition arsenopyrite in particular causes excessive mercury losses. The stibnite would have to be removed as much as possible by a Flotation process prior to any attempt at gold extraction. A valuable byproduct would be produced in this way current price of antimony on the metals market is $0·3659 per lb. (United States dollars)

Not from this ore!

Kay 23

Plate 1.

Gold (tinted) associated with fractured pyrite. Jamesonite white partly cements pyrite fragments grey mineral is quartz × 65.

Plate 2 Arsenopyrite (white) and jamesonite (light grey) cut by a fracture filled with quartz and mineral fragments. Jamesonite occurs as laths and as diamond shaped pseudomorphs after arsenopyrite X 65.

Kay 25

200μ

100

0

↑ lamellar twinning faintly shown

Plate 3 Berthierite, showing fine lamellar twinning. Crossed nicols under exposed × 204.

In this section berthierite is seen to cut across sphalerite grains.

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Appendix number 1.

Sample marking

Previous workers numbering	Information supplied	1957 polished section and hand specimen marking	Minerals present.
Group # 1		Kay or PS 1	
2		2	sphalenite stibnite chalcopyrite, tetrahite
3		3	
5		5	
6		6	
8		8	
12		12	
13		13	
14		14	
Number 1 Pit	"Pyrite sphalerite in crushed silicified argillite"	27	
#3 Kay	"FeAsS ZnS"	28	{ arsenopyrite sphalerite tetrahedrite.
#2 Kay	"Kay outcrop"	29	{ Jamesonite and arsenopyrite
—	—	21	
—	—	22	{ Bindheimite? on weathered surface
—	—	23	← gold in pyrite.
—	—	24	{ stibnite arsenopyrite pyrite
—	—	25	{ Berthienite
—	—	26	
—	—	30	
—	—	31	{ Stibnite and unknown white mineral (Ag Pb Sb)

Appendix Number 2.

Unknown white mineral 'X' ray results.

'd' spacing		Intesity
3.3807	± .01	6
3.2573	'	10
2.8526	'	8
2.7215	'	7
2.4996	'	3
2.2582	± .004	4
2.0873	'	broad 2lines?
1.9256	'	1
1.8672	'	1
1.7737	'	4
1.6846	± .002	3

ASTM card index indicates?