

GEOLOGY 409

600272

KAY GROUP, OHENICA MINING DISTRICT

1964

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## SUMMARY

The mineralization of the Kay Group occurs in a small fault zone, associated with a sheared argillite and feldspar porphyry. The following primary minerals were found: pyrrhotite, pyrite, marcasite, arsenopyrite, sphalerite, tetrahedrite, chalcopyrite, jamesonite, native gold, andorite, stibnite, berthierite galena, an unknown Bismuth mineral and a hydrocarbon. A brief and incomplete study of the secondary minerals was undertaken and goethite, realgar, orpiment, scorodite, gypsum, bindheimite, valentenite and various other amorphous or ill defined alteration products were found. From the characteristics of the ore, the deposit was classified as either xenothermal or epithermal

## INTRODUCTION

The Kay Group was originally staked in 1944. It is located on a hillside west of the Bralorne Takla mercury mine; the main showing being between 4300 and 4500 feet. The property is located 36 miles by road from Takla Landing. The property was optioned to Leta Explorations in 1945, but was dropped in the same year.

## GENERAL GEOLOGY

The area is underlain by a blue-grey limestone of Pennsylvanian and/or Permian age. A band of crushed argillite occurs near the showing and several dykes of feldspar porphyry cut the limestone and the argillite. The deposit lies along a fault zone 25 feet wide and strikes  $15^{\circ}$ W of N, and follows approximately along the crushed band of argillite. The fault dips vary from  $60^{\circ}$ N to  $75^{\circ}$  SW.

Mineralization can be traced along the surface for 700 feet, with the ore occurring in lenses, the largest of these lenses is several feet wide and about 20 feet long. The ore minerals determined in the report (GSC Memoir 252) are as follows in the order of abundance: stibnite, jamesonite, arsenopyrite, sphalerite, pyrite, andorite, argentiferous tetrahedrite, native silver, quartz and realgar. An analysis of the andorite (GSC Memoir 252) follows:

Pb:	20.89%
Ag:	9.18%
Cu:	1.45%
Fe:	2.07%
Zn:	0.50%
As:	0.76%
Sb:	41.07%
S:	21.83%
insoluble:	1.83%

Assays from the surface exposures went up to 100 oz/Ton of silver and an appreciable content of gold, but underground development was disappointing.

The fault zone crossing the property probably forms part of the pinchi Lake fault zone.

#### PROCEDURE

The specimens from the Kay Group were first studied under the binocular microscope and certain ore minerals and oxidation products were noted. The microscope work consisted of the inspection of about 50 polished sections using the mineralographic microscope, accompanied by etch tests and microchemical analysis. X-ray powder photographs were taken to confirm certain ore minerals and secondary minerals.

#### MEGASCOPIC DESCRIPTION

Only a few ore minerals could be identified positively from the hand specimen. These were stibnite, jamesonite, sphalerite, tetrahedrite, arsenopyrite and pyrite.

The ore usually occurred in two ~~different~~ types, as massive ore, or as open space fillings. These two textures are strongly controlled by the type of rock they occur in, the massive ore was more closely related to the incompetent sheared argillite, and the open space fillings confined to the competent, partially sericitized feldspar porphyry.

The ore minerals in the massive zone are invariably arsenopyrite, pyrite, argentiferous tetrahedrite, sphalerite and minor sulphosalts. Occasionally massive zones of pyrite are visible, but arsenopyrite is the major sulphide. Some small quartz lenses resembling quartz rods followed the foliation

of the sheared argillite. Pyrite is the only sulphide in these lenses. Quartz veins ( $\frac{1}{4}$  in. to 2 in. in width) follow approximately parallel to the foliation of the argillite but occasionally cross the foliation. Pyrite is the main sulphide with some sphalerite. The veins are often locally zoned, pyrite predominant in the centre, with sphalerite increasing outwards to the edge of the vein. At the edge of the vein sphalerite is predominant but gives way to the sulphosalts. In a few instances the outward extremity of this ill defined zoning is characterized by stibnite displaying an open work texture.

The fissures in the open space fillings are usually very thin (less than  $\frac{1}{4}$  in. in width) to about 1 inch in width.) In the closed portion of the vein, quartz and sphalerite alternate as the major fillings, while in the open cavities stibnite crystals predominate, with minor quartz crystals. In the larger cavities well formed sphalerite tetrahedrons also occur. Stibnite usually occurs alone as dense radiating crystals, fine hair-like crystals or compact radiating masses enclosed entirely by the quartz gangue.

#### MICROSCOPIC DESCRIPTION

Fourteen sulphides and sulphosalts and one hydrocarbon were determined or verified by microscopic analysis. These are listed below, followed by a description of various relationships, associations and properties.

a.) nickeliferous pyrrhotite	$(\text{Fe Ni})_{1-x}\text{S}$
b.) pyrite	$\text{Fe S}_2$
c.) marcasite	$\text{Fe S}_2$
d.) arsenopyrite	$\text{Fe As S}$
e.) sphalerite	$(\text{Zn Fe})\text{S}$ to $\text{ZnS}$
f.) tetrahedrite	$(\text{Cu Fe Ag})_{12} \text{Sb}_4 \text{S}_{13}$
g.) chalcopyrite	$\text{Cu Fe S}_2$
h.) andorite	$\text{Pb Ag Sb}_3 \text{S}_6$
i.) jamesonite	$\text{Pb}_4\text{Fe Sb}_6 \text{S}_{11}$
j.) stibnite	$\text{Sb}_2 \text{S}_3$
k.) berthierite	$\text{Fe Sb}_2 \text{S}_4$
l.) galena	$\text{Pb S}$
m.) gold	$\text{Au}$
n.) bitumen	hydrocarbon
o.) unknown	"B <sub>1</sub> " mineral

a.) Nickeliferous pyrrhotite

Pyrrhotite was seen only in one section. Its appearance, which first seems to be somewhat incongruous with the other low temperature associations, can be attributed to a previous period of mineralization, (Plate 1). The pyrrhotite is invariably associated with early pyrite and sphalerite (var. marmatite) and in places has been altered to marcasite.

b.) Pyrite

Pyrite is associated with all stages of mineralization. The pyrite with the pyrrhotite occurs as small, bright yellow perfectly formed cubes. The alteration of pyrrhotite to marcasite has not affected these cubes (pyrite after pyrrhotite may exist, (Plate 1).

Pyrite, with minor arsenopyrite is very common as a wall rock alteration in the feldspar porphyry, but pyrite alone occurs in the silicified sheared argillite. Massive pyrite, showing very few crystal faces occurs associated with the wall rock, and massive arsenopyrite. Sphalerite, jamesonite and andorite often fill fractures in the pyrite. Pyrite, with a porphyritic texture, occurs in jamesonite (Plate 2), the jamesonite effectively rounding some of the pyrite crystals.

Pyrite also occurs in the low temperature sphalerite phase, as small spheroidal blebs within the sphalerite. The more Fe the sphalerite contains, the more conspicuous the pyrite becomes.

c.) Marcasite

The marcasite forms as small, pale yellow radiating crystals, which under crossed nicols display well developed twin lamellae. The marcasite is an alteration product of pyrrhotite, and is concentrated around the pyrite but does not replace it.

d.) Arsenopyrite

A large percentage of the arsenopyrite forms tightly intergrown, crystalline aggregates. The open spaces between crystals are usually filled with quartz, sphalerite and/or tetrahedrite. Like the pyrite some arsenopyrite occurs as single highly corroded crystals in jamesonite (Plate 2).

Some of the massive arsenopyrite has been cataclastically deformed on a small scale. Arsenopyrite also occurs as wall rock alteration with the pyrite.



## e.) Sphalerite

There are three distinct sphalerites in the ~~site~~<sup>suite</sup>. The first, the variety marmatite<sup>is</sup> associated with the pyrrhotite. The internal reflection of this variety is very dull to almost non-existent. The second sphalerite is the most predominant variety. In the hand specimen its colour is reddish to reddish brown, and in the polished section it has an orange red internal reflection. Plates 3, 4 and 5 show the typical textural relationships ~~and ore relationships~~ of the sphalerite. Occasionally exsolved chalcopyrite is present. The third sphalerite is easily recognized by its red to yellow internal reflection and its association with calcite, galena and occasionally bitumen (Plate 6 and 7). This sphalerite is locally zoned from relatively high Fe content (estimated at about 2 - 3%) to very low Fe content (estimated at about 0.1%), forming the red to yellow sphalerite respectively. The yellow sphalerite is much coarser grained than the red variety.

## f.) Tetrahedrite (Var. Freibergite)

Tetrahedrite is very restricted in its occurrence, either as fillings between the crystals of arsenopyrite or as rounded blebs in jamesonite. The tetrahedrite in the arsenopyrite is occasionally very massive, (these gave a good bichromate test for silver). Large exsolution blebs of chalcopyrite are common, but more so in the jamesonite association than in the arsenopyrite.

## g.) Chalcopyrite

Chalcopyrite occurs as minute exsolution blebs in sphalerite seen only under high power, <sup>and as</sup> larger exsolution and/or reaction products in the tetrahedrite. The blebs in sphalerite are randomly distributed.

## h.) Andorite

The source of most of the silver values from the property was from the andorite. The following properties were used to determine the mineral.

## Optical:

Colour: white to white grey  
 Hardness: B  
 Anisotropism: distinct - colours grey to tan to brownish  
 to light blueish  
 Habit: massive grains to stubby corroded aggregates

## Etch tests:

aqua vega: effervesces vigorously, stains iridescent to black  
 $\text{HNO}_3$  : etches slowly, stain rubs off  
 $\text{HCl}$ ,  $\text{KCN}$ ,  $\text{FeCl}_3$ ,  $\text{HgCl}_2$ : negative

## Microchemical:

Pb: positive  
 Sb: positive  
 Ag: positive, difficult to obtain, it was found that the  
 chloride in ammonia test was the most satisfactory.

The andorite occurred as isolated grains, which displayed a coarse grained mosaic under crossed nicols. The association of andorite with the antimony minerals and sphalerite was invariable ~~and no exceptions were seen.~~ The massive andorite grains were associated with the stibnite and berthierite (Plate 8), while the andorite with jamesonite occurs as relict grains or pods. (Plate 9).

## i.) Jamesonite

The following properties of jamesonite were observed in the determination of the mineral.

## Optical:

Colour: white - greyish white  
 Hardness: B  
 Anisotropism: light grey - dark grey - dark blue - pale brown  
 strong  
 Cleavage: perfect basal  
 Habit: stubby flatish blades

## Etch tests:

$\text{HgCl}_2$ : negative  
 $\text{KCN}$ : negative  
 $\text{FeCl}_3$ : negative  
 $\text{KOH}$ : tarnishes iridescent as a multicoloured mosaic, rubs off  
 leaving a differential etch product - starts slowly  
 $\text{HCl}$ : negative

## Etch tests:

HNO<sub>3</sub>: stains black immediately, fumes tarnish and give off sulphur

## Microchem:

Pb: positive  
 Sb: positive  
 Fe: very weakly positive  
 S : positive

Jamesonite commonly occurs as very massive aggregates with minor tetrahedrite with chalcopyrite, sphalerite, pyrite and relict arsenopyrite (Plate 2). The early minerals (pyrrhotite, cubic pyrite, marmatite, and marcasite) are found only in the massive jamesonite (Plate 1). Good cleavage sections are well developed in the massive material.

More commonly, but in lesser quantity, jamesonite is associated with other sulphosalts. It is also interstitial fillings between arsenopyrite crystals. In the latter case jamesonite blades curve around the euhedral arsenopyrite. Its association with stibnite can almost be classified as rare, but it is very commonly associated with andorite.

## j.) Stibnite

The greyish white to white colour, the radiating habit, and the very distinctive KOH test (bright orange precipitate which does not rub off) were all that were needed for the identification of stibnite in the polished section.

In the majority of cases stibnite with berthierite occurred as isolated radiating masses in a gangue of quartz. Stibnite usually predominates over berthierite and in places only stibnite in quartz was found. (Plate 4). Berthierite and stibnite were found as orientated intergrowths (Plates 10 and 11), with the size of the intergrown lamellar blades varying from very minute rods of one in another to very coarse aggregates of both. Stibnite was more commonly associated with other sulphides, but it never constitutes more than 50% of the sulphides in this environment.

## k.) Berthierite

The following properties of berthierite were used to determine the mineral.

## Optical:

Colour: white to grey white; reflectivity < stibnite  
 Hardness: B, > stibnite  
 Anisotropism: \ extinction, very strong  
                   dark blue - grey - white  
 Association: stibnite, sphalerite

## Etch test:

KOH: negative or very weak, slow iridescence  
 HNO<sub>3</sub>: slowly etches  
 HCl, KCN, FeCl<sub>3</sub>, HgCl<sub>2</sub>: negative

## Microchem:

Fe: Positive

Sb test: could not be used due to its close relationship to stibnite

The occurrence of berthierite was covered in conjunction with the occurrence of stibnite.

## l.) Galena

As a minor constituent of the ore, galena occurs only with the low Fe sphalerite, and like the low Fe sphalerite, it does not occur with the other sulphides and sulphosalts of the suite. The following relationships between the galena and sphalerite were found: coarse grained galena and sphalerite displaying a caries texture, galena as coarse grains enclosing the sphalerite, angular galena fragments in the core of the sphalerite grain, and as thick protrusions into the sphalerite. Galena also occurred as massive grains <sup>that have been</sup> replaced by calcite and "anglesite" (Plate 12), and as very fine irregular veinlets in a calcite gangue.

## m.) Gold

The ore assayed an "appreciable" amount of gold but only five specks from one section were seen. The gold is associated with the massive pyrite zones, but all the visible gold was seen as flakes within the sphalerite which was interstitial to the massive pyrite (Plate 13).

## n.) Bitumen

The hydrocarbon gave an amorphous X-ray pattern but did show some crystalline properties in the polished section.

## Optical properties

Colour: pale yellowish (jet black in the hand specimen)

Hardness: D<sup>-</sup>, very brittle

Pleochroism: distinct - composed of very fine grained crystallites (1 micron) when observed carefully under high power displayed a yellowish to purple pleo-chroism.

Anisotropism: strongly undulating extinction

## Etch tests:

Negative to all standard reagents.

The bitumen occurred as brecciated fragments in a calcite gangue, often associated with the low Fe sphalerite (Plate 7).

## o.) Unknown

The identity of one mineral could not be determined. It occurs as very fine irregular veinlets cross cutting the sphalerite, and rarely cross cutting the andorite<sup>(plates)</sup>. These veinlets are in the order of 100 to 150 microns across. The following properties were found for this mineral.

## Optical properties:

Colour: pale white to pale yellowish white  
 Hardness: D sphalerite  
 Anisotropism: weak to distinct, blueish to greyish

## Etch tests:

HNO<sub>3</sub>: etches very lightly  
 Aqua ~~regia~~: attacked, but has a greater resistance  
 to attack than sphalerite, tarnishes.  
 HCl, KOH, KCN, FeCl<sub>3</sub>, HgCl<sub>2</sub>: negative

## Microchemical tests:

Bi: positive

Mittichenite has been suggested as a possibility,  
 but no definite answer <sup>was</sup> available.

PARAGENESIS

From the mineral relationships found by microscopic investigation of the ore, three separate phases of mineralization were determined. They are, in order from first to last as follows:

- a.) Early sphalerite phase
- b.) Middle sphalerite phase
- c.) Late sphalerite phase

## a.) Early sphalerite phase:

The ore minerals composing this phase were pyrrhotite, pyrite, sphalerite, quartz and marcasite. This is only a very minor phase and except for what is seen in Plate 1, most of the evidence has been destroyed by subsequent mineralization.

The actual paragenetic sequence is somewhat obscure but figure\*1 depicts the order as best as possible. The pyrite apparently crystallized first as small well-formed cubes and the rest of the sulphides are interstitial to it. The pyrrhotite,

interstitial to the pyrite, has been altered to marcasite.

b.) Middle Sphalerite phase

The paragenetic sequence of the sulphides, sulphosalts and their respective alteration products is illustrated by figure 2.

Mineralization began with the crystallization of euhedral pyrite and arsenopyrite as well rock alteration, scattered crystals and as coarse grained aggregates. The two minerals are usually not commonly associated when massive. Sphalerite and tetrahedrite often filled the open spaces in the massive arsenopyrite, but are usually found in areas deficient in the early minerals. The tetrahedrite was contemporaneous with the sphalerite, but the period of sphalerite crystallization persisted much longer than the tetrahedrite (see fig. 4). The occurrence of the tetrahedrite marked the very brief appearance of copper in the solution and the beginning of the antimony. Some sphalerite crystallized between the massive pyrite grains and apparently incorporated some gold from the pyrite.

Andorite formed essentially later than and replaced the sphalerite but in part was contemporaneous. The unknown bismuth mineral followed during what was a minor lull in mineral deposition. Mineralization was resumed by the deposition of quartz, most of it interstitial to the previous minerals but some formed euhedral crystals.

The final stage of mineralization consisted of the antimony minerals jamesonite, stibnite and berthierite. The

relationships between the former and the latter two are not clear as they were rarely seen in contact. The minerals crystallized out in whatever openings were available for them, however, all of them have replaced the andorite (Plates 8 & 9). The two zones, jamesonite and stibnite and berthierite seem to have been segregated from each other as they both form massive zones of ore but are separate from one another.

c.) Late sphalerite phase

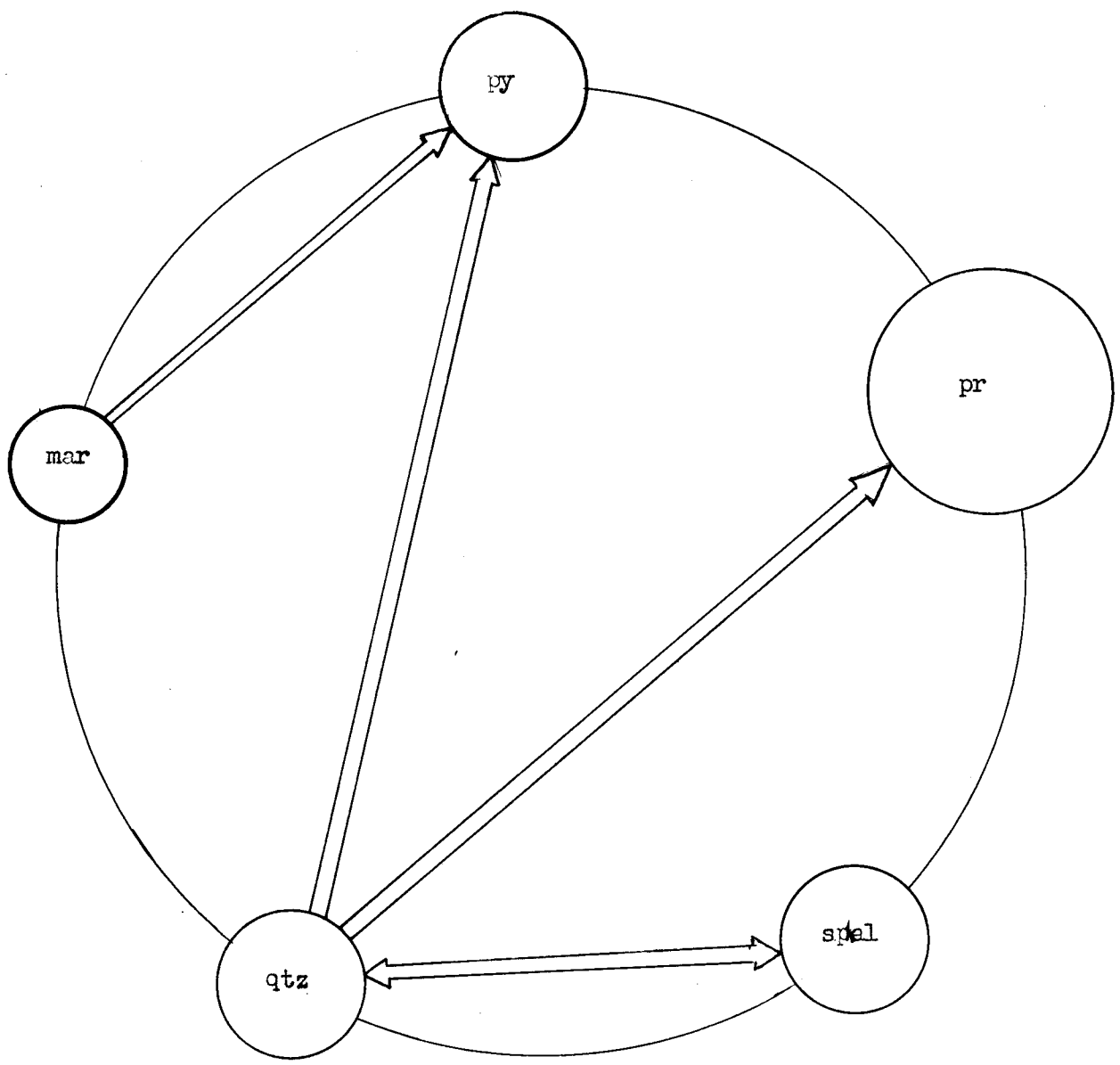
This phase is somewhat out of place with the previous sequence of mineralization. The sulphides consist of very different sphalerite and pyrite with galena in a gangue of calcite. Quartz is only a minor constituent of the gangue. Bitumen also occurs very commonly as angular fragments scattered throughout the calcite. Added with the fact that no hand specimens of the ore were seen, its location in the paragenetic sequence has been arbitrarily chosen as the final phase of mineralization.

Reddish brown sphalerite containing minute, well rounded pyrite crystals was deposited first. This red sphalerite is locally zoned from red to a coarse grained yellow sphalerite, but in a majority of cases sphalerite mineralization ceased abruptly with no zoning, at the edge of the coarsely crystalline calcite gangue. Some of the gangue was deposited contemporaneously with the sphalerite, but most was deposited later. Galena occurred sporadically throughout, but most of it appeared when the sphalerite gangue ratio was about 1:1, which appears to be after the deposition of the majority of the sphalerite. These late calcareous solutions also carried with them some



Fig 1

Paragenesis Phase #1



Paragenesis Phase #2

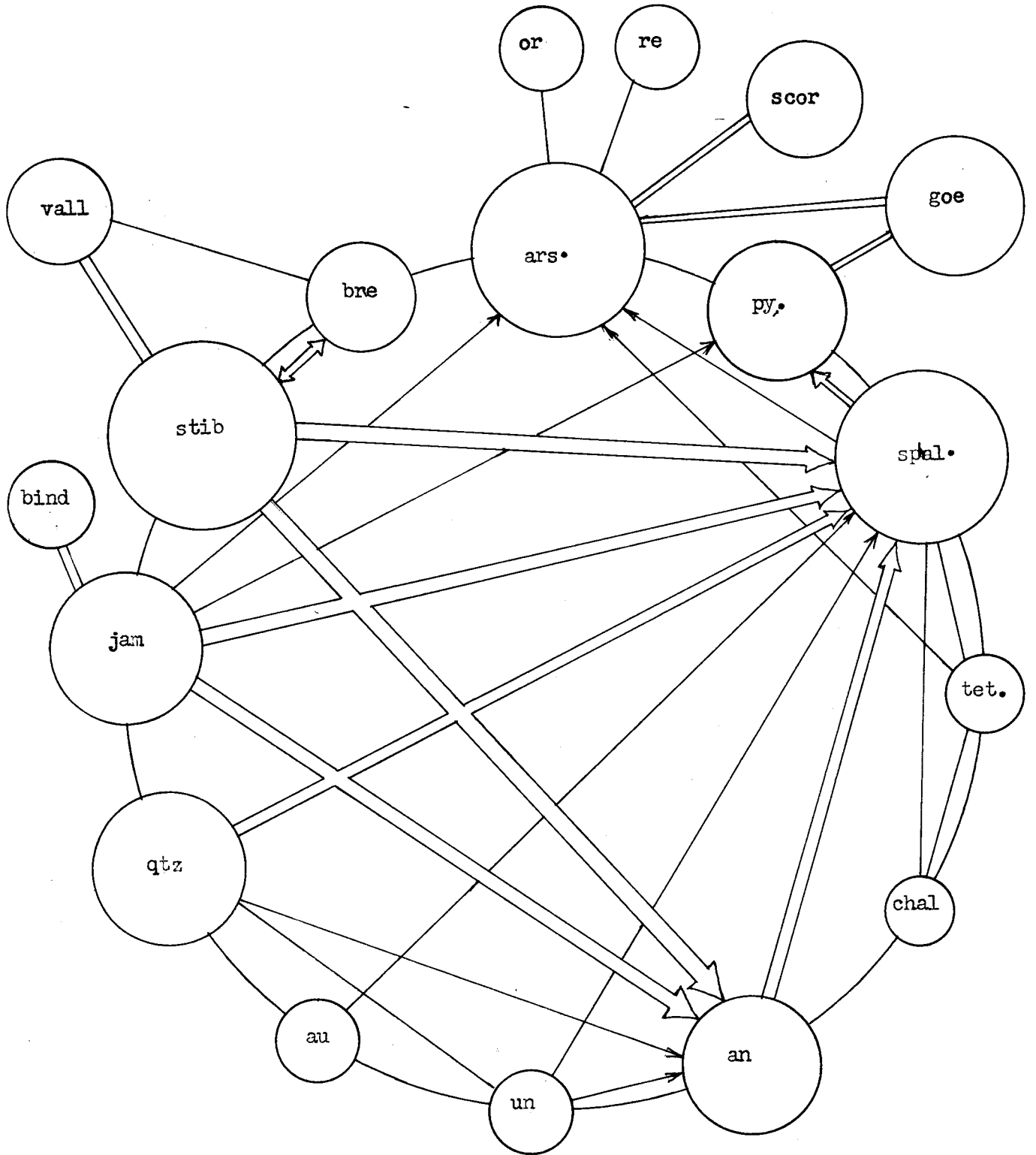


Fig 3

Paragenesis Phase #3

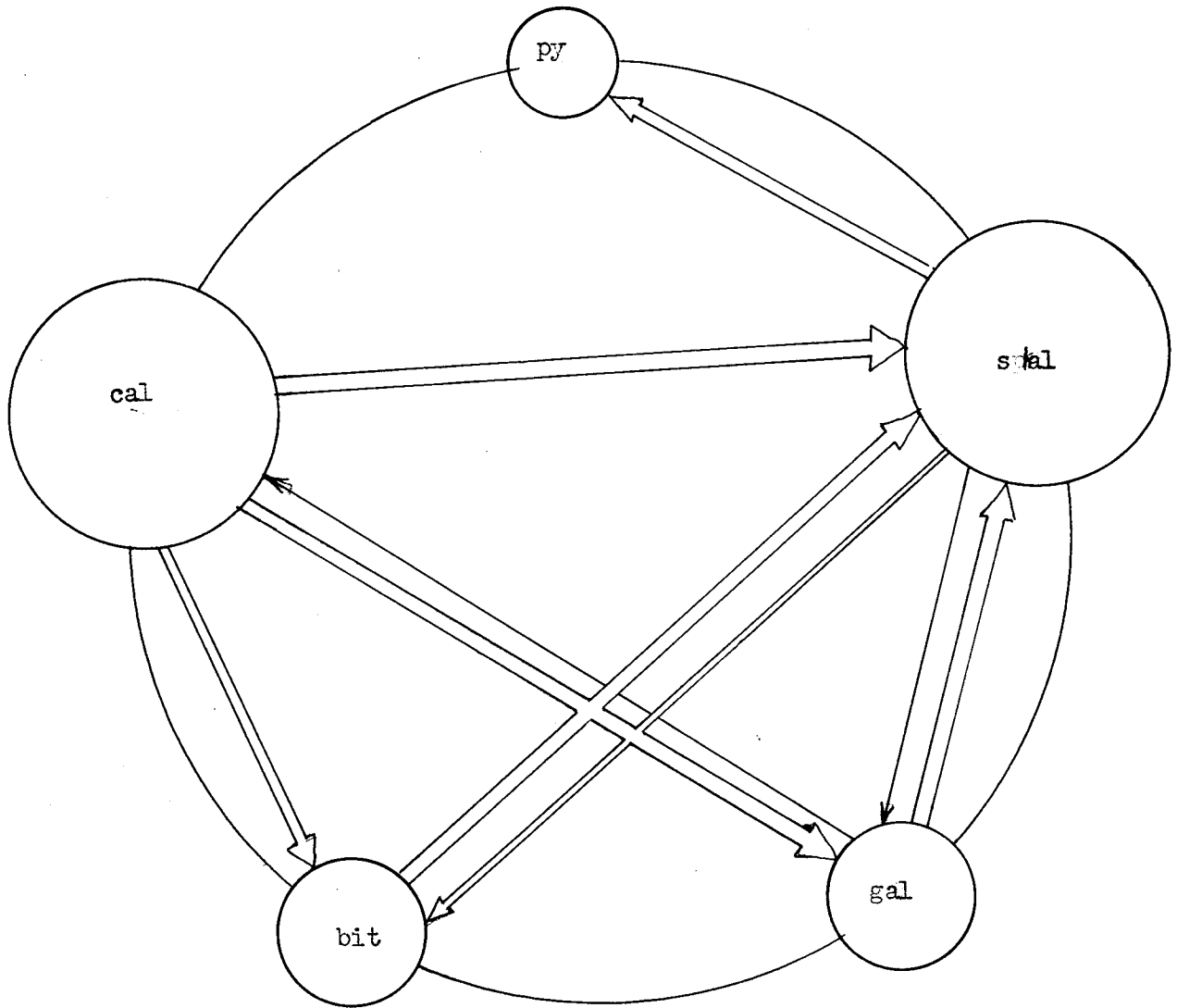


Fig 4

## Paragenesis of the Kay Group

	Phase # 1	Phase # 2	Phase # 3
pyrrhotite	—		
pyrite	—	—	—
sphalerite	—	—	—
marcasite	—		
arsenopyrite		—	
tetrahedrite		—	
chalcopyrite		—	
unknown		—	
andorite		—	
jamesonite		—	
stibnite			—
berthierite			—
galena			—
gold		—	
bitumen			—
quartz	—	—	—
calcite			—

bitumen, which occurred before the end of sphalerite mineralization. Rarely the sphalerite has replaced the bitumen (Plate 7).

#### TEMPERATURE OF FORMATION

No temperature indicators were available for the first phase of mineralization.

For the second phase two exsolution textures of chalcopryrite from sphalerite and tetrahedrite are available. The possible minimum temperatures ~~are~~ available for chalcopryrite-sphalerite exsolution ~~are~~ 650°C (Schwartz), 350 - 400°C (Bueger) and 550°C (Borchert). Edwards gives 500°C for the chalcopryrite-tetrahedrite system. This would fit the deposit into Lindgren's mesothermal pigeonhole. However the ore shows many characteristics of epithermal deposits, such as low temperature minerals (stibnite and Ag Pb sulphosalts) and open space fillings with crystalline cavities. The ore mineral ~~assemblage~~ ~~is~~ somewhat incongruous, with low temperature stibnite associated with the usually high temperature arsenopyrite. From this it is felt that the deposit may be classified as either xenothermal (high temperature and shallow depth) or as epithermal (Dr. White, 1964 - 408 lecture notes suggests epithermal deposits may form at temperatures greater than the 200°C as suggested by Lindgren.)

The late sphalerite phase probably formed as an epithermal deposit as indicated by the low Fe content of the sphalerite.

SOME GENETIC CONSIDERATIONS

The ore forming solutions of the early sphalerite phase were very iron rich as indicated by their mineralogy.

The solutions of the middle sphalerite phase were much more complex. The solution began as being very iron and arsenic rich but the arsenic was depleted very rapidly to form arsenopyrite. The iron occurs throughout but after the formation of pyrite and arsenopyrite it either forms as solid solutions in the minerals (as in tetrahedrite, andorite and sphalerite) or as minor constituents of the ore (as in jamesonite and berthierite). Copper and lead had local concentrations in the solution but were taken up in two different stages, the copper as tetrahedrite and chalcopyrite and the lead as andorite and jamesonite, the former being earlier than the latter. After the depletion of arsenic, antimony slowly made its appearance, first as a minor constituent but rapidly becoming more concentrated until at the end of the mineralization, stibnite (71.5% Sb) crystallized out.

The occurrence of bitumen in a hydrothermal deposit suggests two modes of origin. The first that the hydrocarbon was a primary constituent of ore forming solutions and the second that the hydrocarbon in the ore is a result of the solution assimilation <sup>of</sup> hydrocarbons from bitumenous shales or argillites. In this suite the latter case is preferred.

ALTERATION MINERALS

The determination of the secondary minerals was begun, but unfortunately due to the lack of time it was not completed. The following alteration products were found.

goethite	$\text{HFeO}_2$
realgar	$\text{AsS}$
orpiment	$\text{As}_2\text{S}_3$
gypsum	$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
scorodite	$\text{Fe}(\text{AsO}_4) \cdot 2\text{H}_2\text{O}$
valentinite	$\text{Sb}_2\text{O}_3$
amorphous red coating, associated with bindheimite, containing Fe	
bindheimite	$\text{Pb}_2\text{Sb}_2\text{O}_6 (\text{O}, \text{OH})$

goethite: as black shiny botryoidal crusts in cavities and surface exposures. On surface exposures it often grades into "limonite". Forms from the alteration of pyrite and arsenopyrite.

realgar and orpiment: as scattered subhedral crystals in small surface cavities. They are not very wide spread but stand out due to their brilliant colours. It forms from the alteration of ~~pyrite~~ and arsenopyrite.

gypsum: It occurs as flat cleavable encrustations, with some slightly striated crystal faces showing when it occurs in cavities. The calcium may have originated from near by calcareous sediments or from the very minor calcite in the quartz gangue.

Scorodite: It occurs as apple green reniform encrustations over arsenopyrite in cavities or as cruddy coatings on exposed surfaces. It is associated with a pink oxidation product which was not determined but was thought to be a form of scorodite. It forms from the alteration of arsenopyrite.

Valentinite:  $Sb_2O_3$

Physical properties

Colour: pale yellowish to dull greyish

Habit: fan shaped, radiating to rounded nodules highly fibrous habit (cleavage)

association: invariably on the stibnite crystals

X-ray determinations

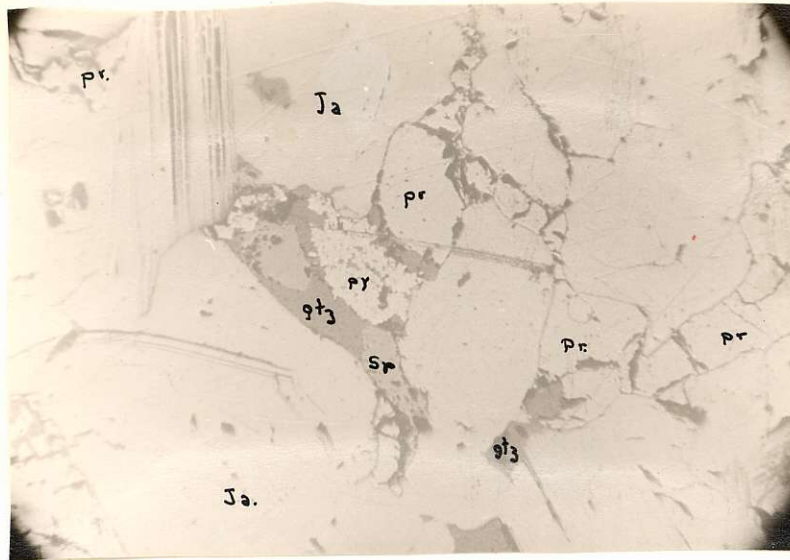
ASTM CARD		Observed lines	
I	d	I	d
17	4.57	2	4.58
		3	4.15
25	3.49	2	3.49
75	3.118	10	3.12
100	3.142		
		2	2.45
9	2.456	4	1.933
11	1.929	5	1.811
20	1.805	2	1.522
11	1.523		

The imperfect fit <sup>could be</sup> ~~is probably~~ due to admixed impurities of iron from the berthierite associated with the stibnite.

Bindheimite: It occurs as a yellowish green impure coating over the jamesonite. It is associated with a brown limonite and a translucent, reddish orange, brittle iron bearing substances. Bindheimite forms pseudomorphs after Jamesonite

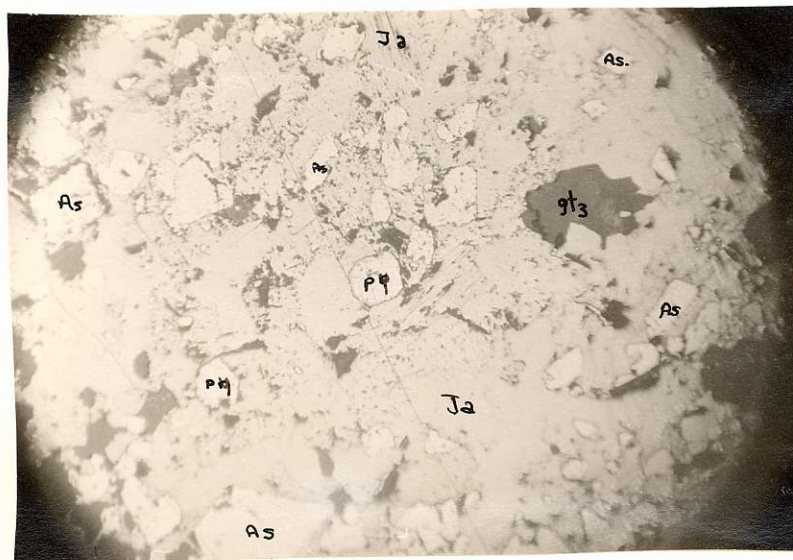


## Plate 1



Jamesonite (Ja) replaced the early mineralized sulphides  
pyrrhotite (pr), euhedral pyrite (py), quartz (qtz) and sphalerite (sp)  
(mag. low)

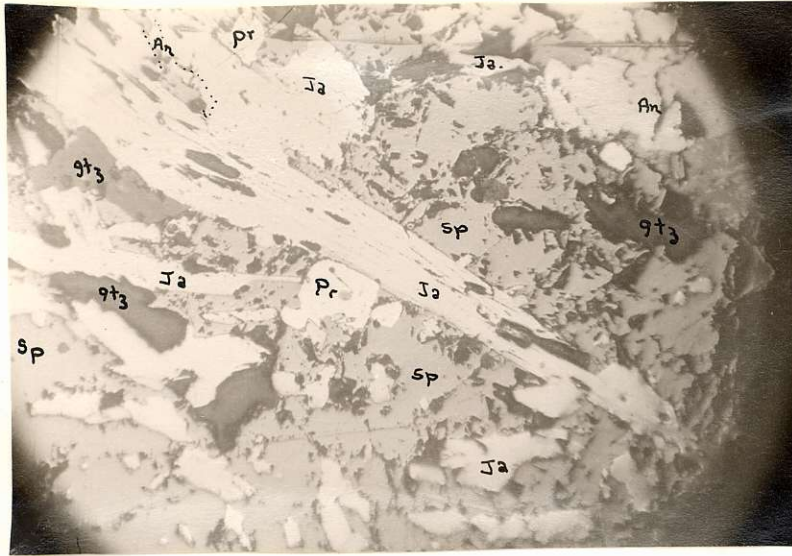
## Plate 2



Jamesonite (ja) showing later corrosion effects on pyrite (py)  
and arsenopyrite (as)

Mag: Med

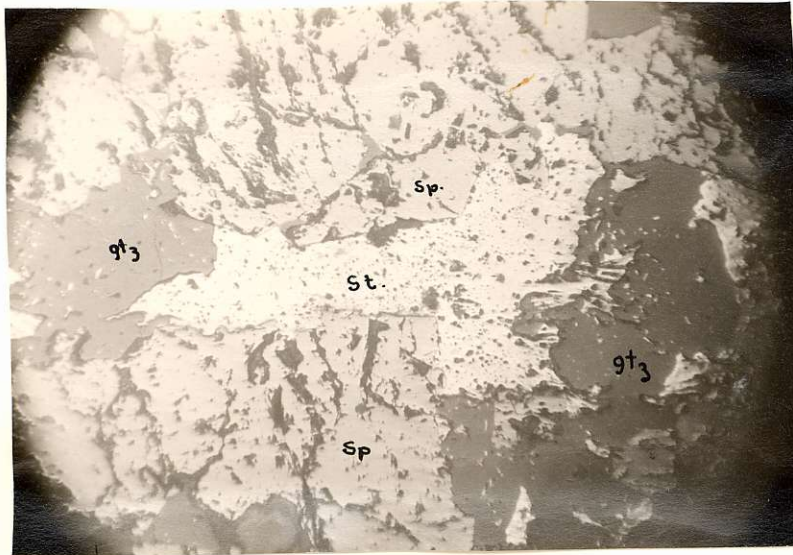
Plate 3



Jamesonite (ja) blades showing cross cutting relationships to the sphalerite (sp) and andorite (an)

(Mag: med)

Plate 4



Later stibnite (st) with quartz (qtz), filling in fractures in the sphalerite (sp)

(Mag: med)

## Plate 5



Andorite (an) replaced sphalerite (sp). Note that both have been fractured together. The white veinlets in the sphalerite is the unknown mineral.

(Mag: med)

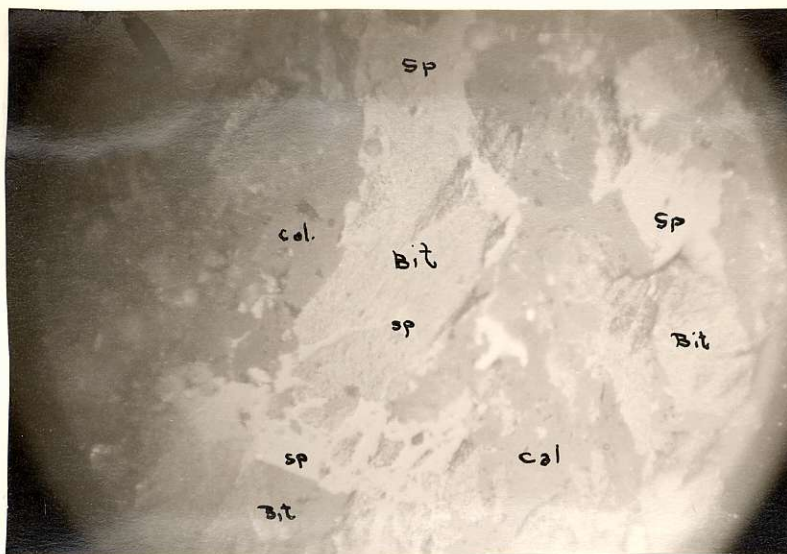
## Plate 6



Galena (gal) and sphalerite (sp) grain boundary relationships in a grey calcite gangue.

(mag: High)

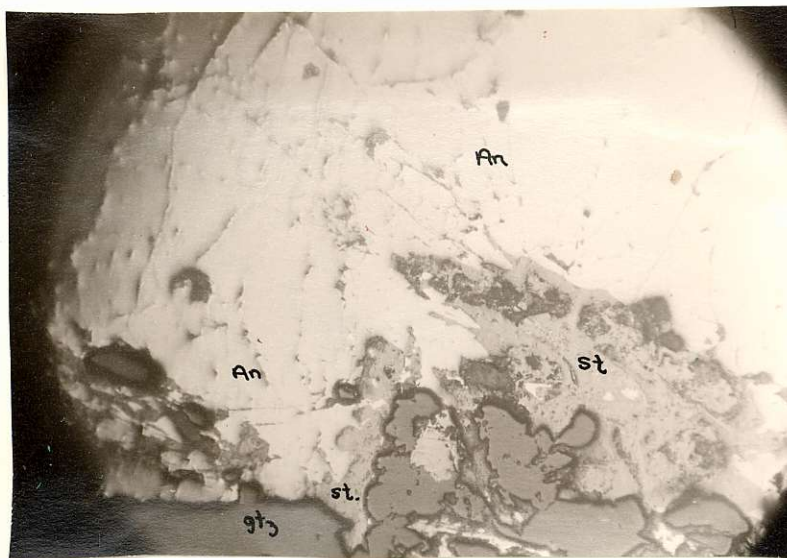
Plate 7



Sphalerite (sp) bitumen (bit) and calcite (cal). The sphalerite shows somewhat a penetrating and cross cutting relation to the bitumen.

(Mag: High)

Plate 8



Massive andorite (an) being replaced by stibnite (st) which has been etched by KOH.

(mag: med)

## Plate 9



Jamesonite (ja) blades have replaced andorite (an) and sphalerite (sp)

(Mag: med)

## Plate 10



Stibnite (st) blades orientated in berthierite (bre) blades, usually  
berthierite blades are orientated in the stibnite.

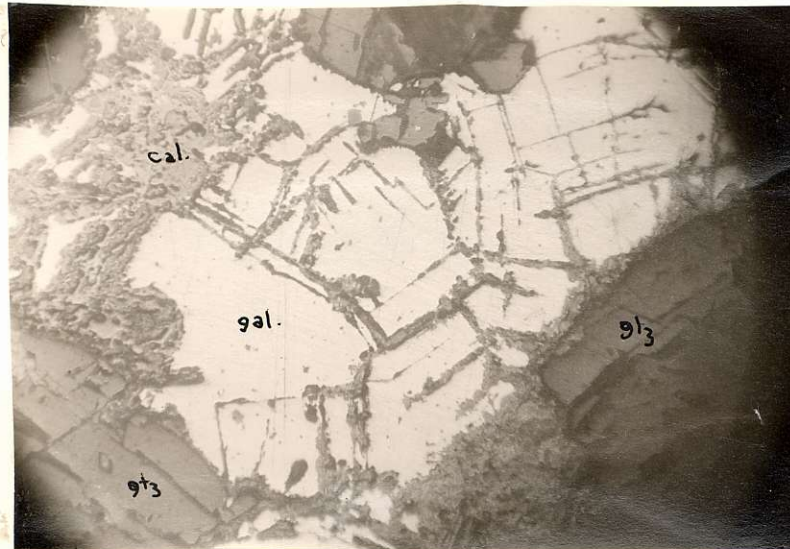
(Mag: med)

Plate 11



Plate 10 under crossed nicols  
(Mag. med)

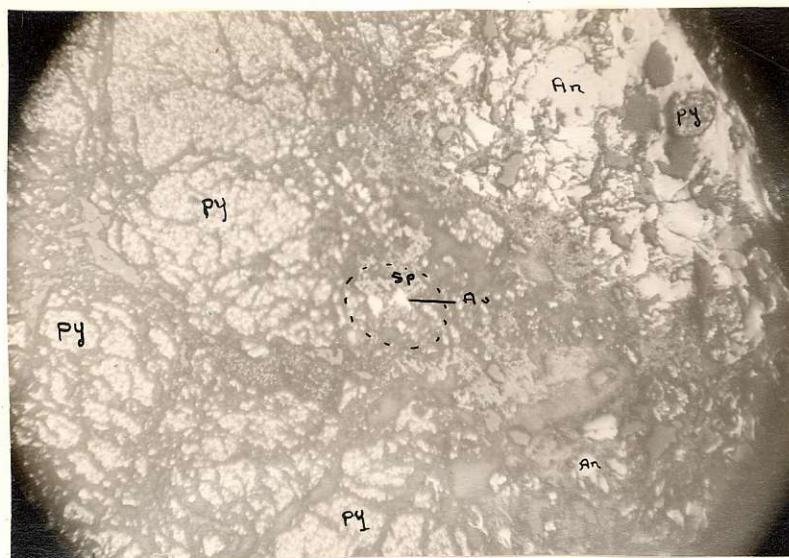
Plate 12



Galena (gal) being replaced by calcite and "anglesite" along the  
cleavage directions.

(mag. med)

## Plate 13



Gold (au) in sphalerite (sp) in massive pyrite (py). See inside the circle.

(mag med)

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