

CONTACT GROUP

600022

Geology 409

Assignment #4

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INTRODUCTION

The Contact group, 2 miles northwest of Cassiar, was staked in 1951 by G. Davis and W. Puritch. (Gabrielse, 1963)

Most of the ore minerals occur in hornfels, skarn and marmorized limestone, between the Cassiar Batholith to the west and a porphyritic granite stock to the east. Aplite, pegmatite and basalt dykes are present.

The metamorphic rocks are remnants of the easterly dipping limb of a syncline. To the north, rocks are thrust easterly on fault planes which dip at low angles to the west. At the base of the marmorized limestone is a bedding plane fault. Locally, the limestone is highly deformed.

Three types of mineralization are present.

- (1) Pyrite, bismuthinite, molybdenite, scheelite, and cosalite occur in quartz veins restricted to the porphyritic rocks.
- (2) An irregular body of pyrrhotite associated with andradite - scapolite skarn occur along the southern exposure of the marmorized limestone. The pyrrhotite is largely altered to marcasite and contains minor amounts of chalcopryrite.
- (3) A complex association of metallic minerals in two veins that strike roughly east and dip 75° to 80° S. in the marmorized limestone. To the west the upper vein stops abruptly at the bedding fault between the marble and the hornfels. 100 feet east and 100 feet lower, the vein passes under talus. Over this distance, the vein averages 3 to 4 feet. The lower vein, about 1 foot wide in one exposure, but generally obscured by talus, strikes northeasterly and dips 70° S.

The vein is banded parallel with the walls and contains mangiferous magnetite, galena, sphalerite and pyrite mainly. Metallic minerals present in minor amounts are: molybdenite, pyrrhotite, arsenopyrite, alabandite, chalcopryrite, tetrahedrite, dyscrasite, native antimony,

bismuthinite, native silver, pyrargyrite, marcasite and wad. Chief gangue minerals are calcite, quartz and chodonite. Dolomitization is the chief wall rock alteration.

About 25 polished sections and numerous hand specimens were examined from these mineralized zones. However, the main emphasis in this report is placed upon type 3 mineralization.

MEGASCOPIC

Minerals recognized in the hand specimen were magnetite, galena, pyrite, native sulfur, scheelite, chalcopyrite, pyrrhotite and sphalerite. Sulfur and scheelite were observed only in the quartz vein, and were not seen in any polished sections. A fibrous, lead-grey mineral was observed associated with the vein quartz, but was not identified until examined in polished section (cosalite). The secondary minerals observed were limonite, wad, marcasite, and hydrozincite (it gives a bluish white fluorescence and a good zinc test).

The hand specimens are mainly fine-to coarse-grained galena. The magnetite in many of the samples has altered to limonite, so that the samples have a yellow to reddish brown oxidation coating. Coatings of secondary manganese give a dark, earthy appearance to many of the samples. Most specimens are extremely weakly magnetic to strongly magnetic, depending on the amount of magnetite and pyrrhotite present. The hydrozincite appears to always associate with sphalerite. The vein quartz has a yellowish coating in places as a result of scheelite, sericite and native sulfur.

Quartz, sericite and calcite were the only gangue minerals observed. Quartz occurs as both vein quartz and as crystals growing into vugs (within the quartz vein). Calcite was observed to occur mainly as inclusions within the ore minerals.

MICROSCOPIC

Minerals

- (a) Galena (PbS) - Galena was identified by its colour (white), hardness (B), isotropism and cleavage (perfect, cubic).
- (b) Jacobsonite (manganian magnetite? (15% Mn) an X-Ray will be required to confirm identification) - Jacobsonite was identified by its hardness (F), isotropism, magnetism and crystal form (octahedral and dodecahedral cross section). The colour was anomalous (pinkish grey) as a result of the high manganese content.
- (c) Pyrrhotite (Fe_{1-x}S) - Pyrrhotite was identified by its colour (cream), hardness (C+), anisotropism (light yellow, blue, red, black) and its magnetism.
- (d) Marcasite (FeS_2) - Marcasite was identified by its colour (pale brass yellow), hardness (F), anisotropism (yellow, blue, brown) and its association with pyrrhotite.
- (e) Pyrite (FeS_2) - Pyrite was identified by its colour (pale brass yellow), hardness (F) and isotropism.
- (f) Chalcopyrite (CuFeS_2) - Chalcopyrite was identified by its colour (brass yellow), hardness (C) and its weak anisotropism.
- (g) Cosalite ($2\text{PbS} \cdot \text{Bi}_2\text{S}_3$) - Cosalite was identified by its colour (galena white), hardness (B), anisotropism (cream, black) and the etch tests.

Etch tests:

HgCl_2	- negative
KOH	- negative
KCN	- negative
HCl	- negative
FeCl_3	- negative
HNO_3	- effervesces and stains black
Aqua Regia	- negative

- (h) Sphalerite ($(\text{Zn},\text{Fe})\text{S}$) - Sphalerite was identified by its colour (grey),

hardness (C), isotropism and a positive microchemical test for zinc.

No sphalerite in this suite gave an internal reflection, even with the carbon arc.

(i) Tetrahedrite ($5\text{Cu}_2\text{S} \cdot 2(\text{Cu}, \text{Fe})\text{S} \cdot 2\text{Sb}_2\text{S}_3$) - Tetrahedrite was identified by its colour (grey, but lighter in colour than sphalerite), hardness (D) and its isotropism.

(j) Pyrargyrite ($3\text{Ag}_2\text{S} \cdot \text{Sb}_2\text{S}_3$) - Pyrargyrite was identified by its colour (bluish white), hardness (slightly greater than galena), anisotropism (grey, reddish-brown) and ruby red internal reflection.

(k) Arsenopyrite (FeAsS) - Arsenopyrite was identified by its colour (whiter than galena), hardness (F), anisotropism (yellow-green, black, blue), crystal form (rhombic cross-sections) and the etch tests.

Etch tests:

HgCl_2	- negative
KOH	- negative
KCN	- negative
HCL	- negative
FeCl_3	- negative
HNO_3	- stains grey- black (no effervescence)
Aqua Regia	- negative

(l) Alabandite (MnS) - Alabandite was identified by its colour (blue grey), hardness (similar to galena), isotropism, and its reaction to HCl (vigorously effervesces, giving off abundant H_2S fumes, and tarnishes black).

(m) Dyscrasite (Ag_3Sb) - Dyscrasite occurs only as minute grains. It was identified by its colour (silver white, with pinkish tint), hardness (slightly greater than galena) and anisotropism (green, black).

(n) Antimony (Sb) - Antimony, also, occurs only as minute grains. It was identified by its colour (silver white), hardness (similar to galena) and isotropism.

(1) Limonite (mixture of hydrous iron oxides) - Limonite occurs as a secondary mineral in fractures in the ore. It was identified by its colour (grey), internal reflection (orange - brown) and a bead test for iron.

Abundances

The minerals and their abundance in the polished sections are:

Type 1

Pyrite	- 70%
Cosalite	- 30%

Scheelite and sulfur were not found in the polished section.

Type 2

Pyrrhotite	- 60%
Chalcopyrite	- 2%

The secondary minerals and their abundance in the polished section are:

Marcasite	- 30%
Limonite	- 8%

Type 3

Galena	- 58%
Sphalerite	- 16%
Jacobsite	- 9%
Pyrrhotite	- 5%
Pyrite	- 2%
Chalcopyrite	- 1%
Tetrahedrite	- 1%
Arsenopyrite	- 1%
Pyrargyrite	- traces
Alabandite	- traces
Dyscrasite	- traces
Antimony	- traces

The secondary minerals and their abundance in the polished sections are:

Marcasite	- 5%
Limonite	- 2%

Textures

The main textures observed in this suite are shown in the photographs.

Abbreviations of minerals identified in the photographs are:

gn - galena	pg - pyrargyrite
sl - sphalerite	ab - alabandite
jb - jacobsite	dc - dyscrasite
po - pyrrhotite	sb - antimony (native)
py - pyrite	cs - cosalite
cp - chalcopyrite	mc - marcasite
thd - tetrahedrite	lm - limonite
apy - arsenopyrite	qtz - quartz

The range in grain size, as observed, is:

Galena	- massive
Sphalerite	- massive
Pyrrhotite	- massive
Jacobsite	- 45 microns to 700 microns
Pyrite	- massive
Chalcopyrite	- small, exsolution blebs, less than 1 micron long, up to massive grains, 3,000 microns across
Tetrahedrite	- small exsolution blebs, about 5 microns across, up to massive grains 2,500 microns across
Arsenopyrite	- 5 microns to 1000 microns
Pyrargyrite	- 40 microns to 550 microns
Alabandite	- small, myrmekitic fingers from 4 to 150 microns long
Dyscrasite	- 10 microns to 240 microns
Antimony	- 4 microns to 240 microns

Type 1

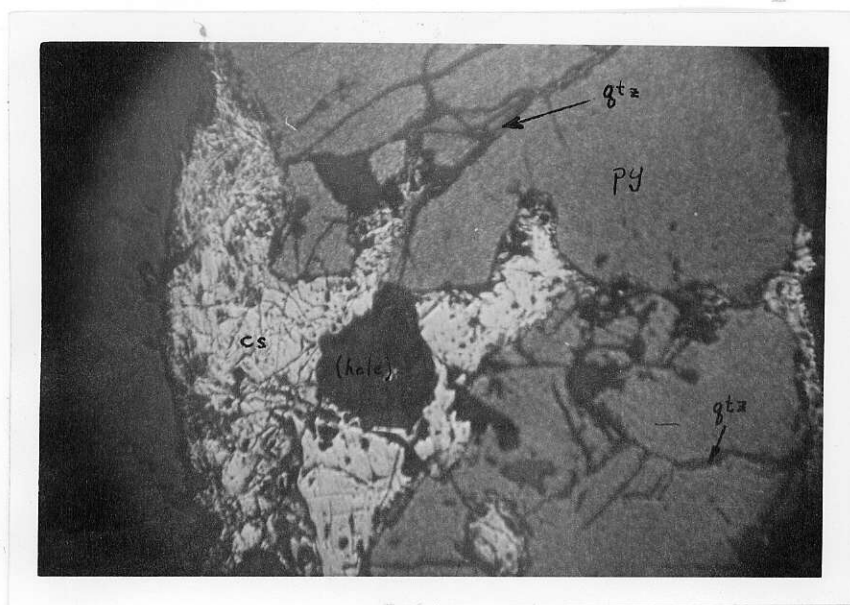


Figure 1
Cosalite and quartz filling fractures in pyrite x 30

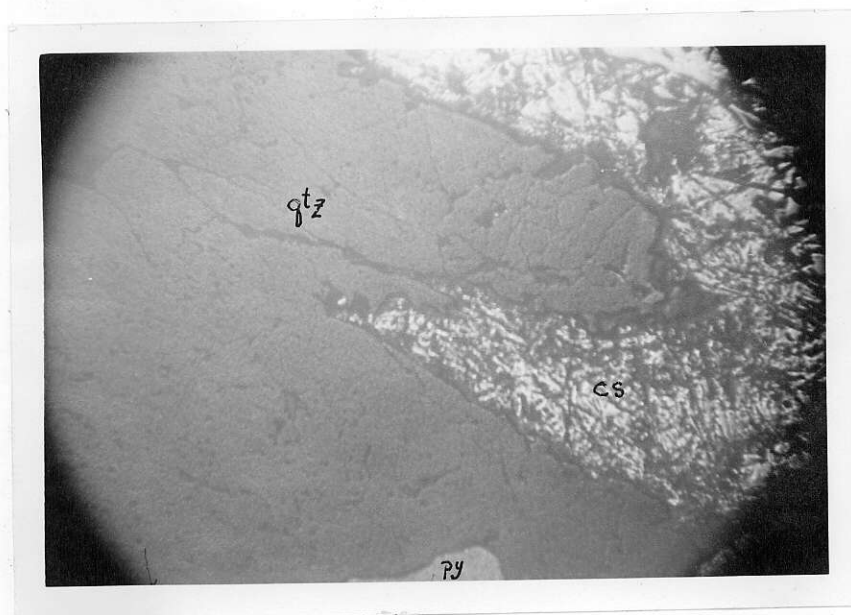


Figure 2
Cosalite filling fractures in quartz x 30

Type 2

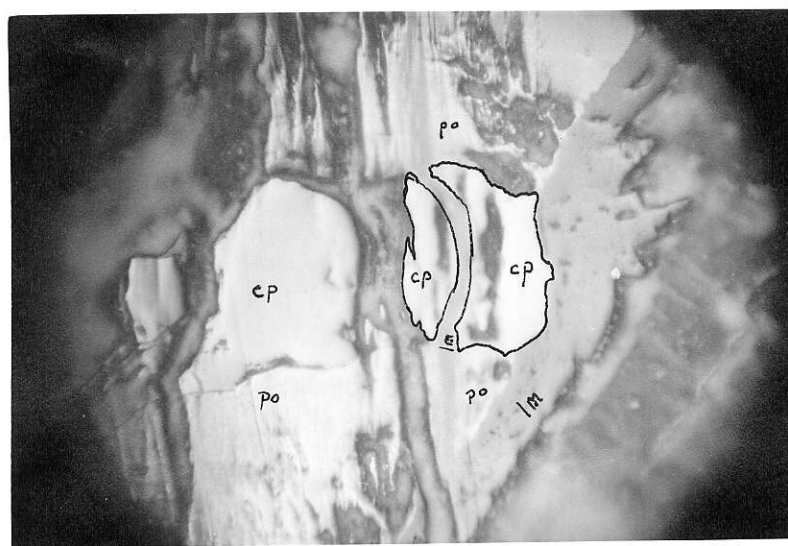


Figure 3

Limonite filling fractures in pyrrhotite and chalcopyrite. Chalcopyrite is probably later than pyrrhotite x 160

Type 3

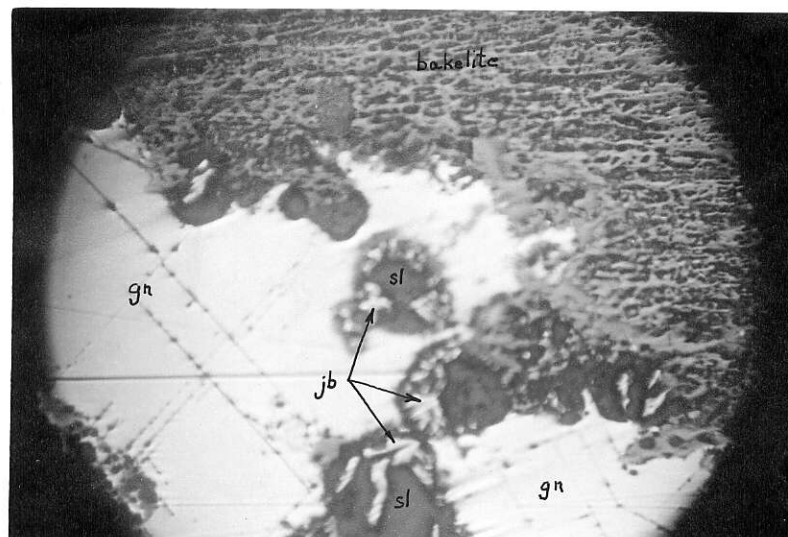


Figure 4
Subhedral crystals of jacobite corroded by sphalerite x 45

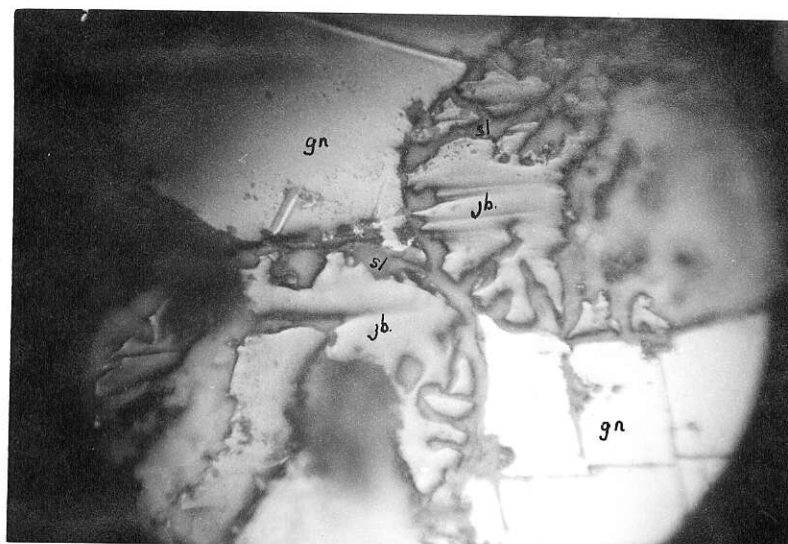


Figure 5
Subhedral crystals of jacobite corroded by sphalerite. Galena formed later than jacobite, and sphalerite formed later than galena x 160

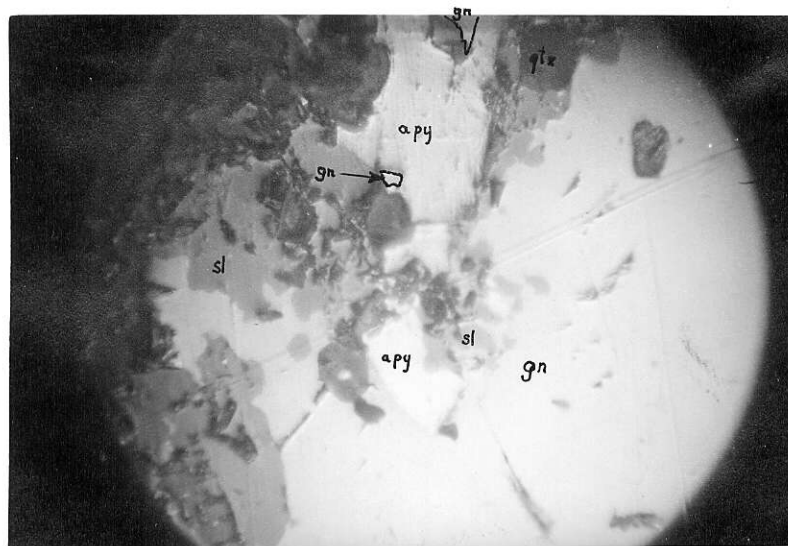


Figure 6
 Arsenopyrite replaced by galena, which has been replaced by sphalerite
 x 160

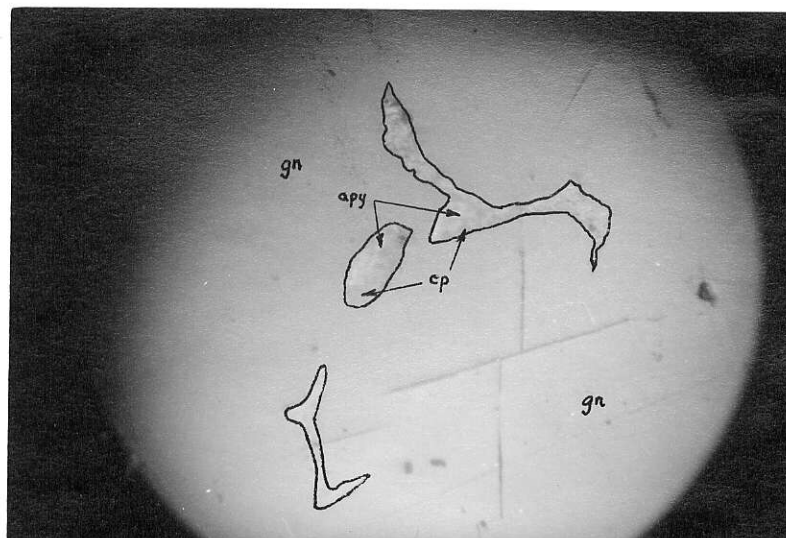


Figure 7
 Mutual boundary relation of arsenopyrite and chalcopyrite x 160

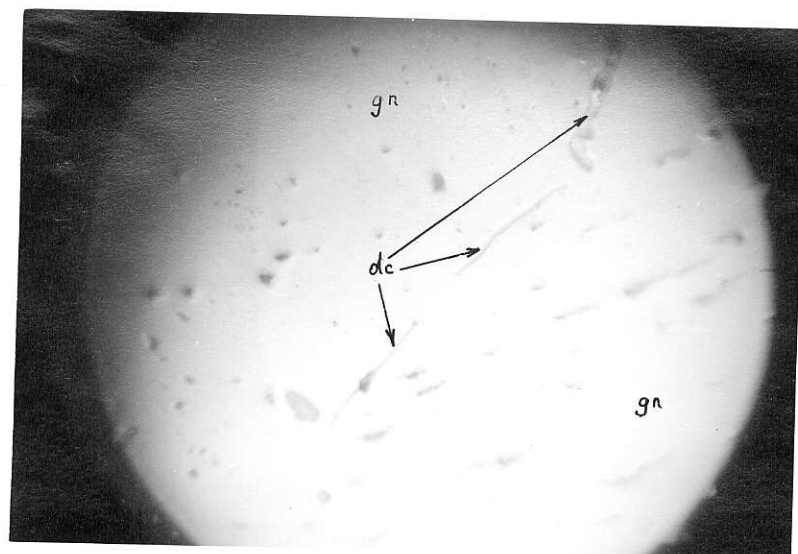


Figure 10
The same as Figure 9 x 160

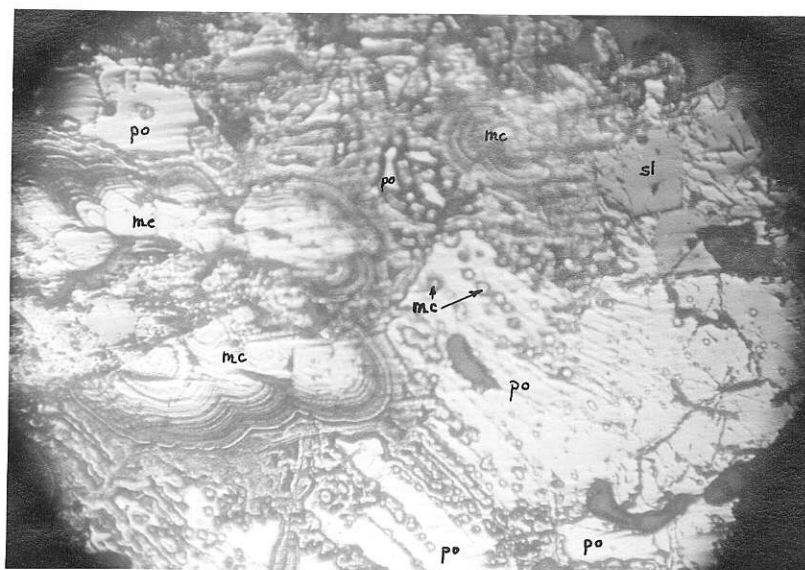


Figure 11
Concentric banding resulting from the alteration of pyrrhotite
to marcasite x 45

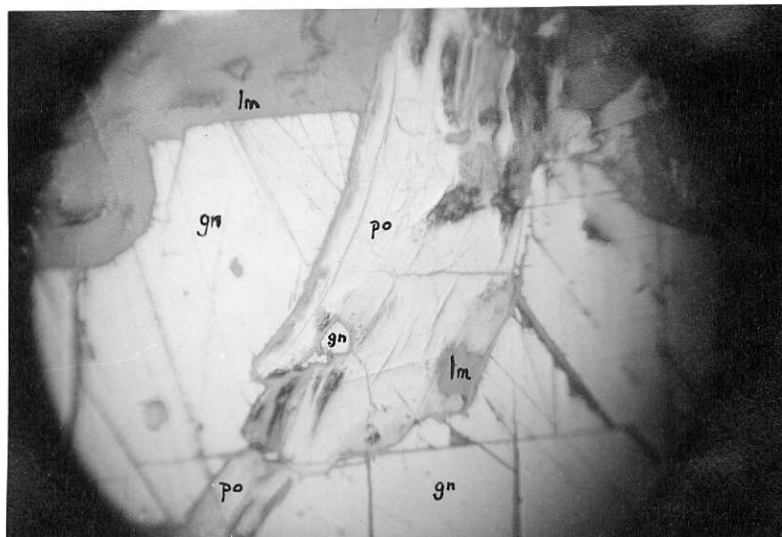


Figure 8
Galena replaced by pyrrhotite. Secondary limonite alteration is present x 160

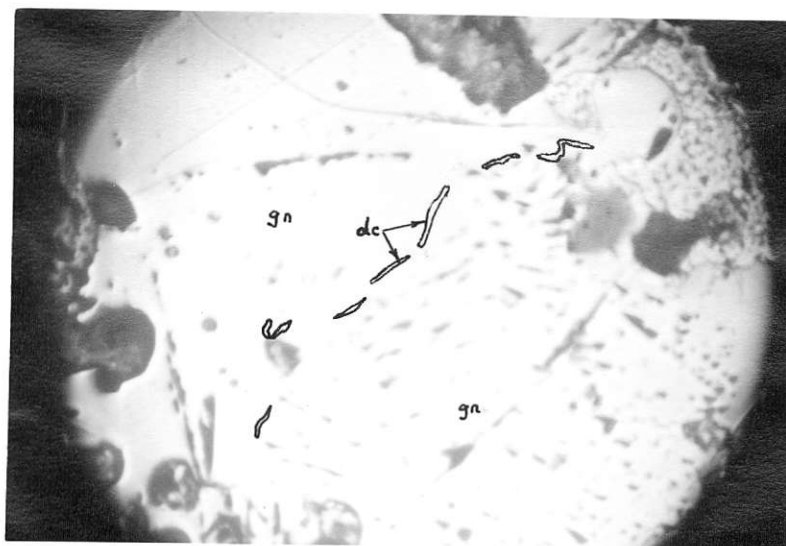


Figure 9
Steel galena formed by stress. Dyscrasite enveloped the coarser grained galena during the stress x 45

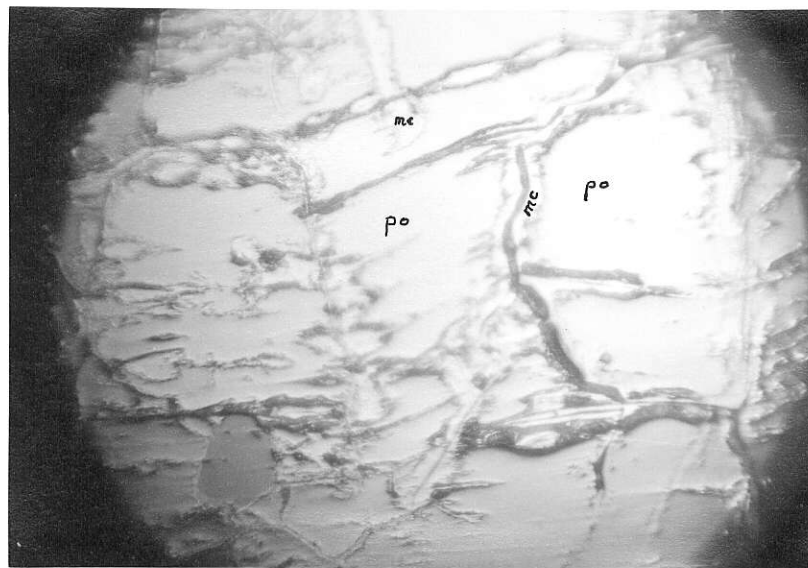


Figure 12
Pyrrhotite altering to marcasite x 160

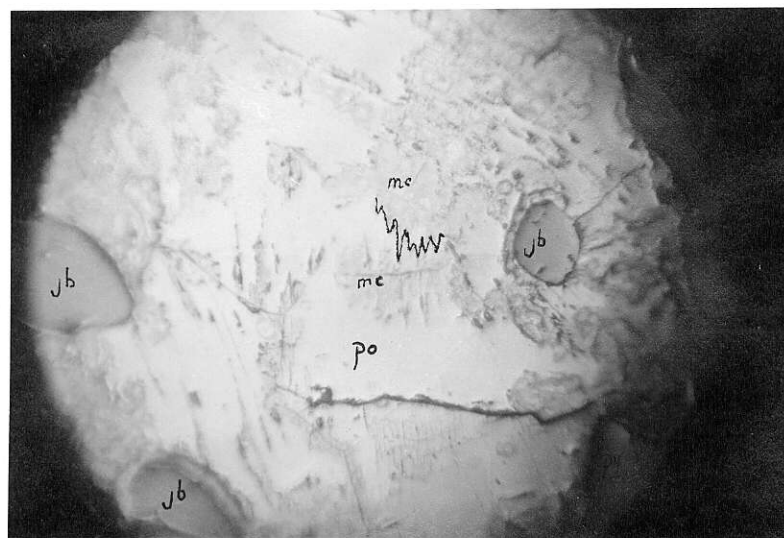


Figure 13
Pyrrhotite altering to marcasite x 160

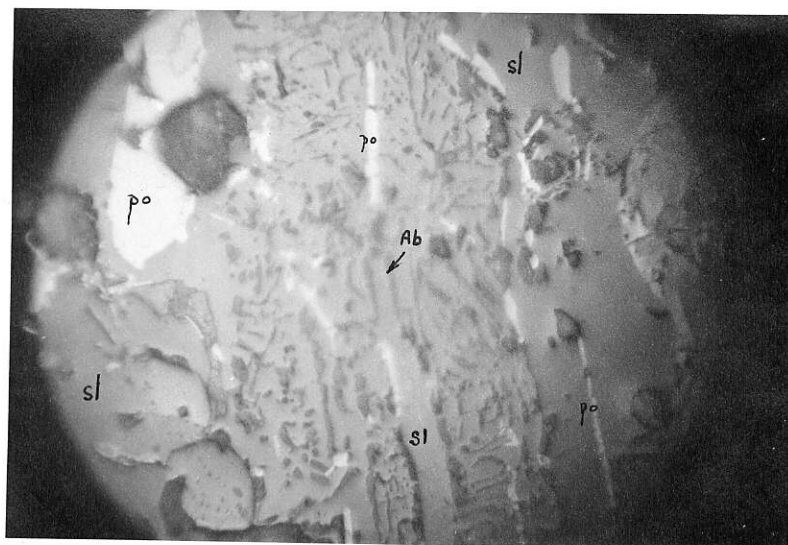


Figure 14
Exsolution of pyrrhotite along crystallographic planes of sphalerite
x 160

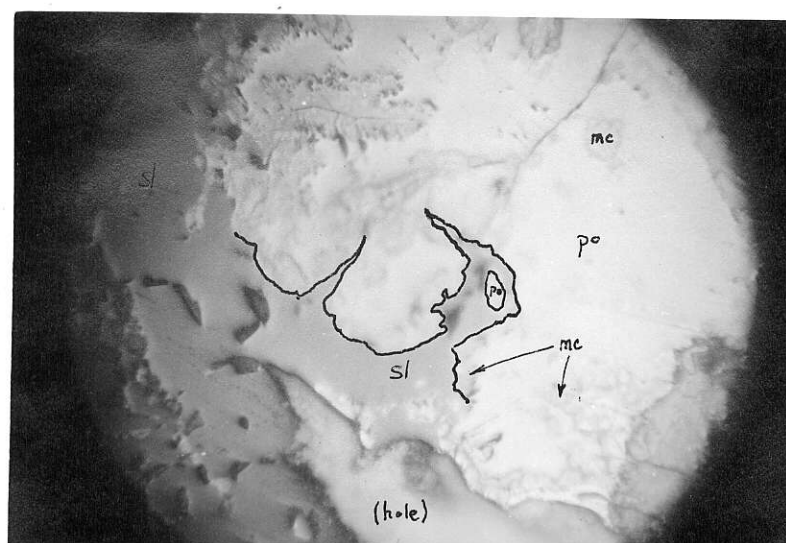


Figure 15
Replacement of pyrrhotite by sphalerite x 160

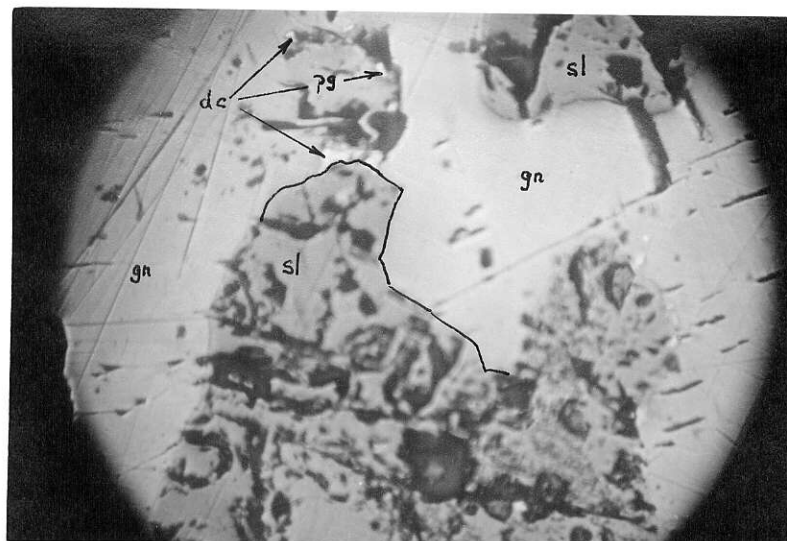


Figure 16
Replacement of galena by sphalerite along cleavage planes x 45

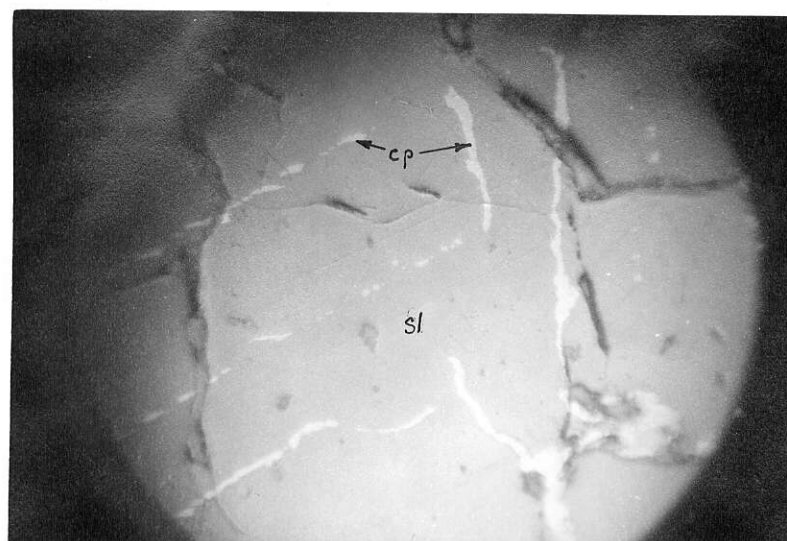


Figure 17
Exsolution of chalcopyrite along crystallographic planes of
sphalerite x 160

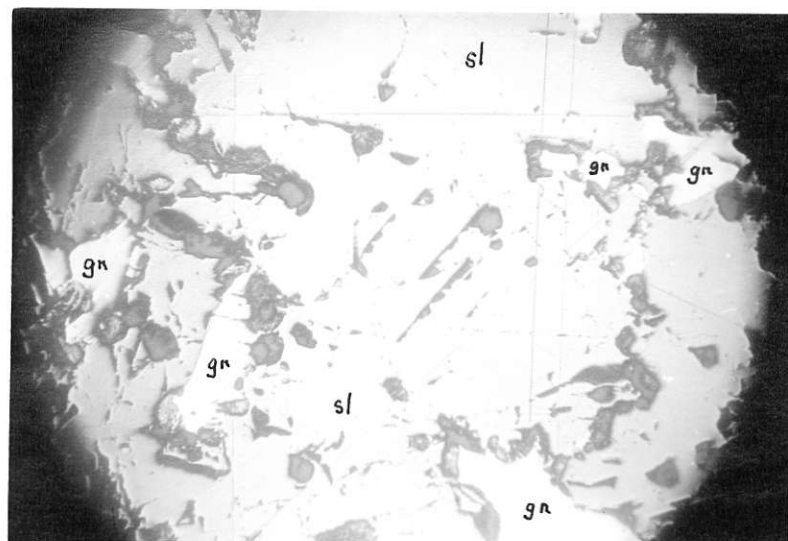


Figure 18
 Triangular pits in sphalerite resulting from the dodecahedral cleavage of sphalerite x 45

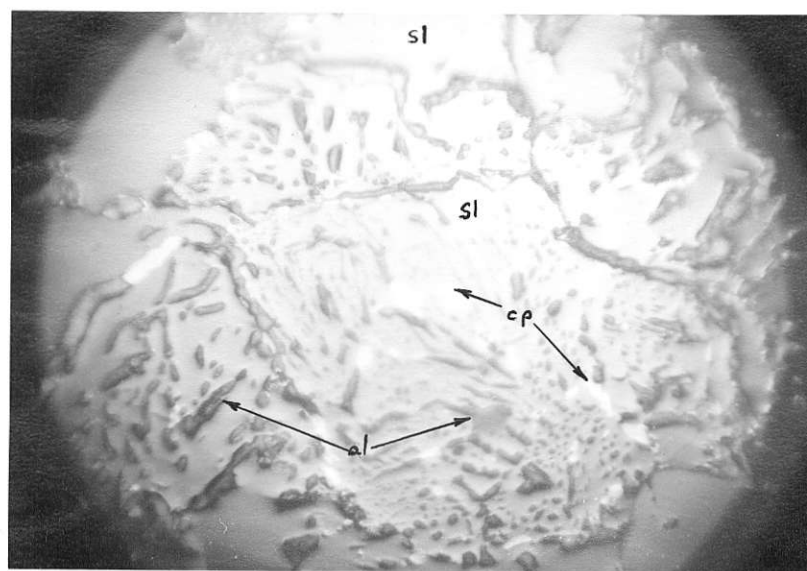


Figure 19
 Myrmekitic exsolution of alabandite from sphalerite (alabandite has been etched with HCl) x 160

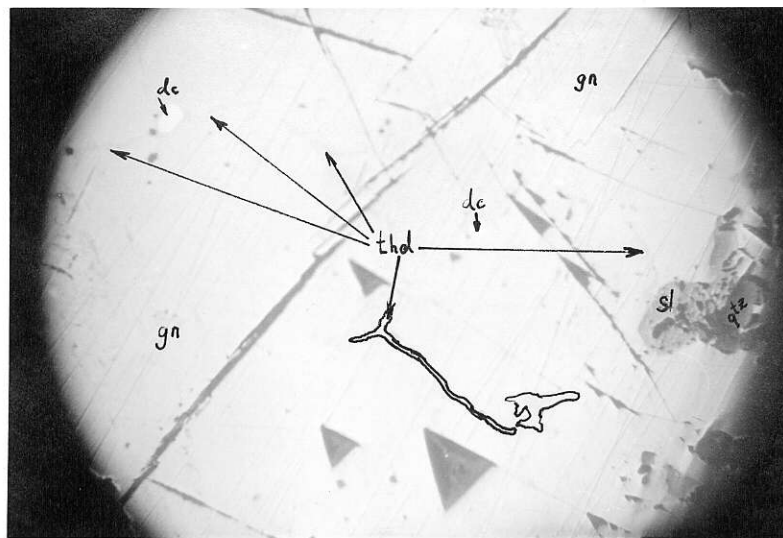


Figure 20
Myrmekitic exsolution of tetrahedrite from galena x 45

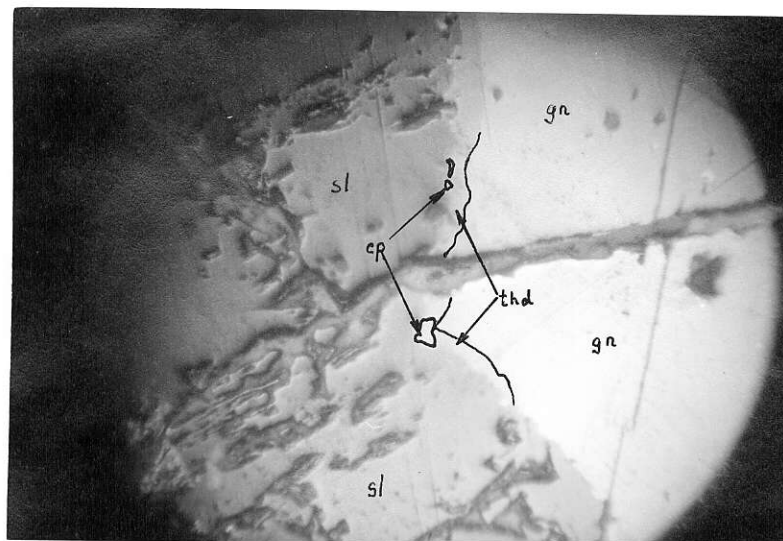


Figure 21
Exsolution of tetrahedrite from galena along the mutual boundary
contact with sphalerite x 160

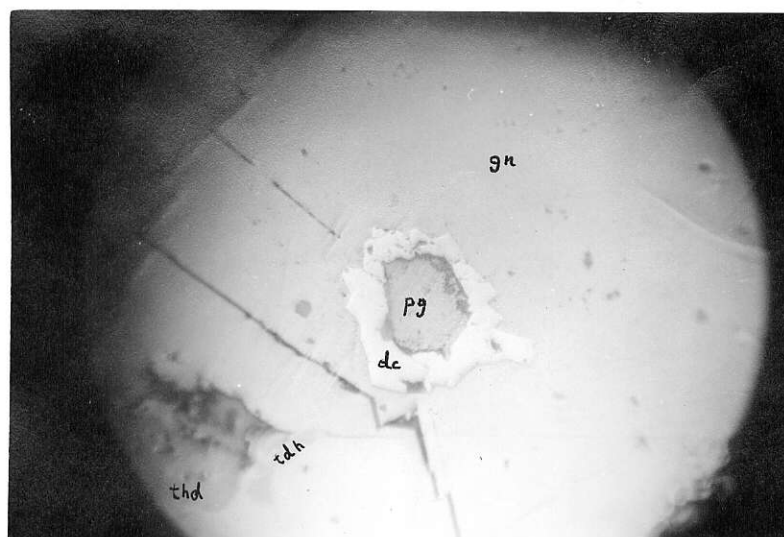


Figure 22
Rim texture, formed by replacement of pyragyrite by
dyscrasite x 160

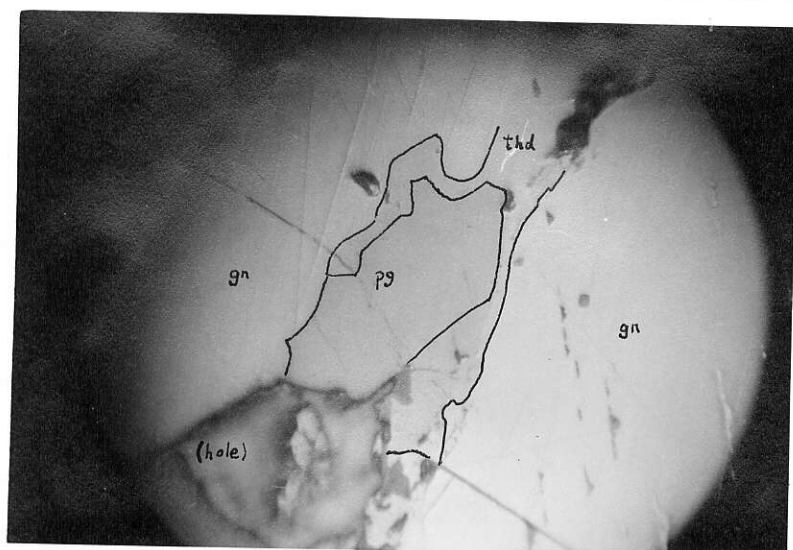


Figure 23
Replacement of tetrahedrite by pyrargyrite x 160

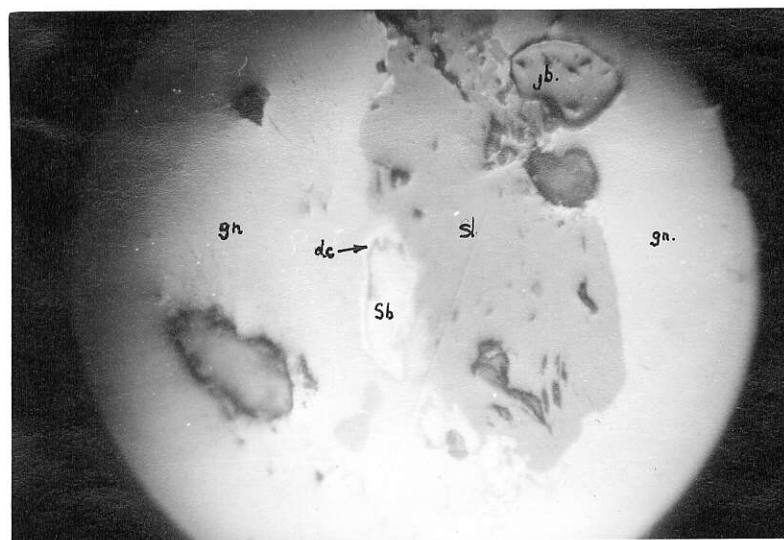


Figure 24
Rim texture, formed by replacement of antimony by dyscrasite
x 160

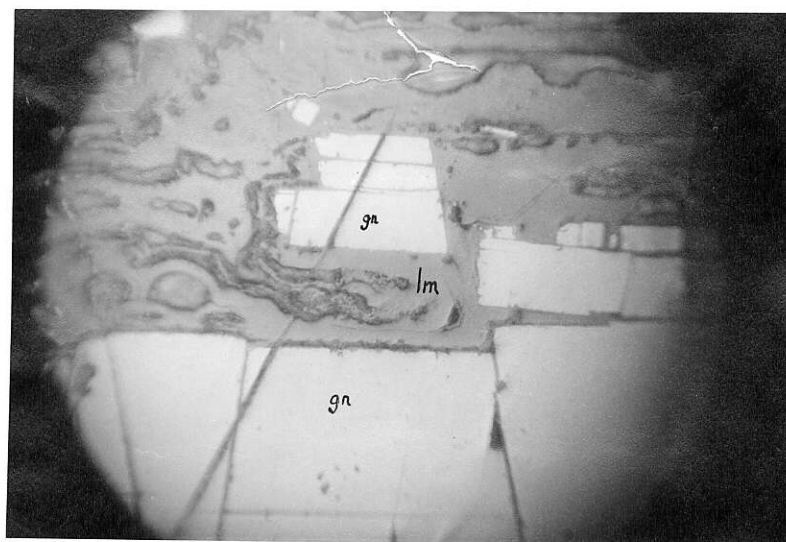


Figure 25
Vein of limonite filling open space x 160

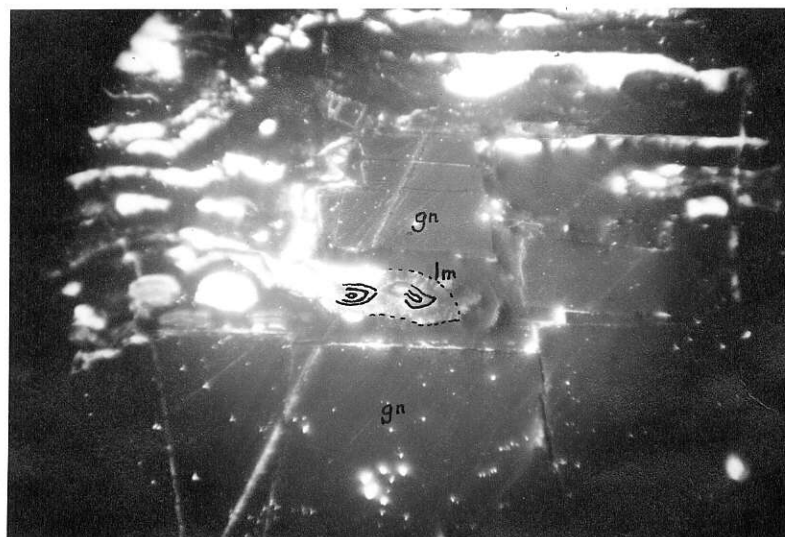
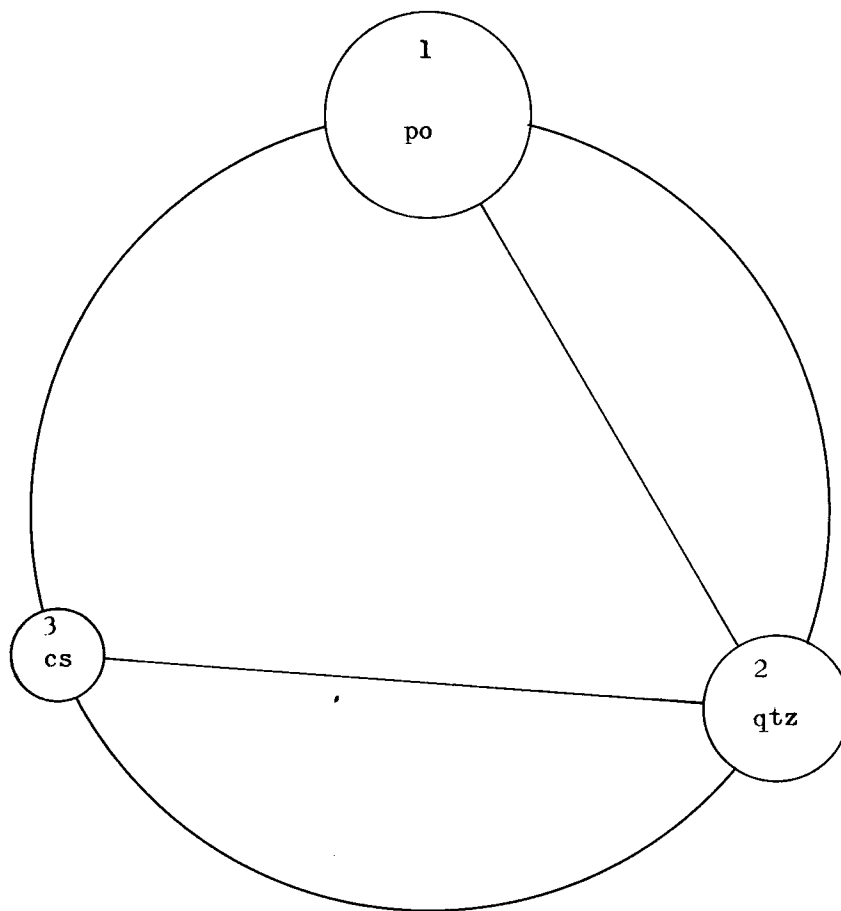


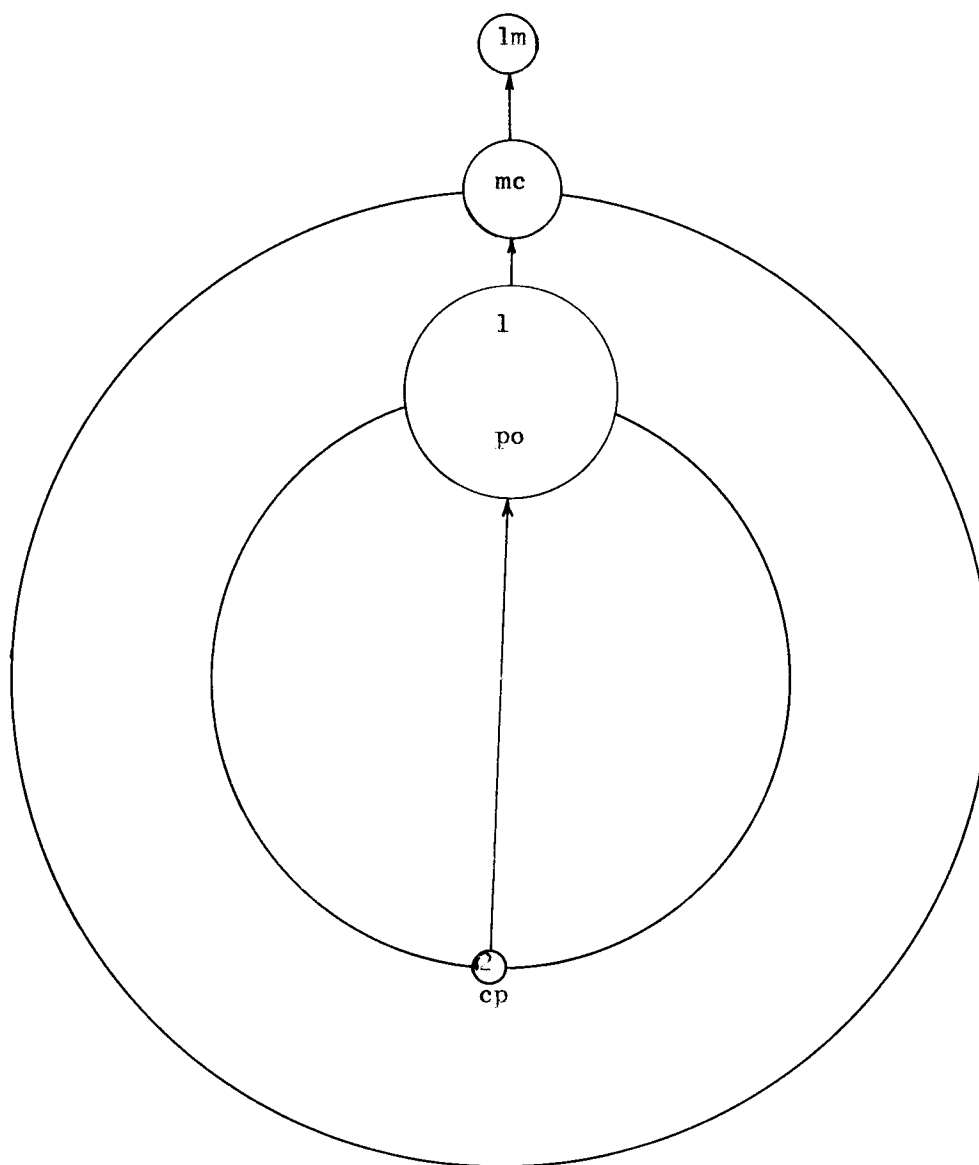
Figure 26
Vein of limonite filling open space. Crossed nicols x 160

PARAGENESIS

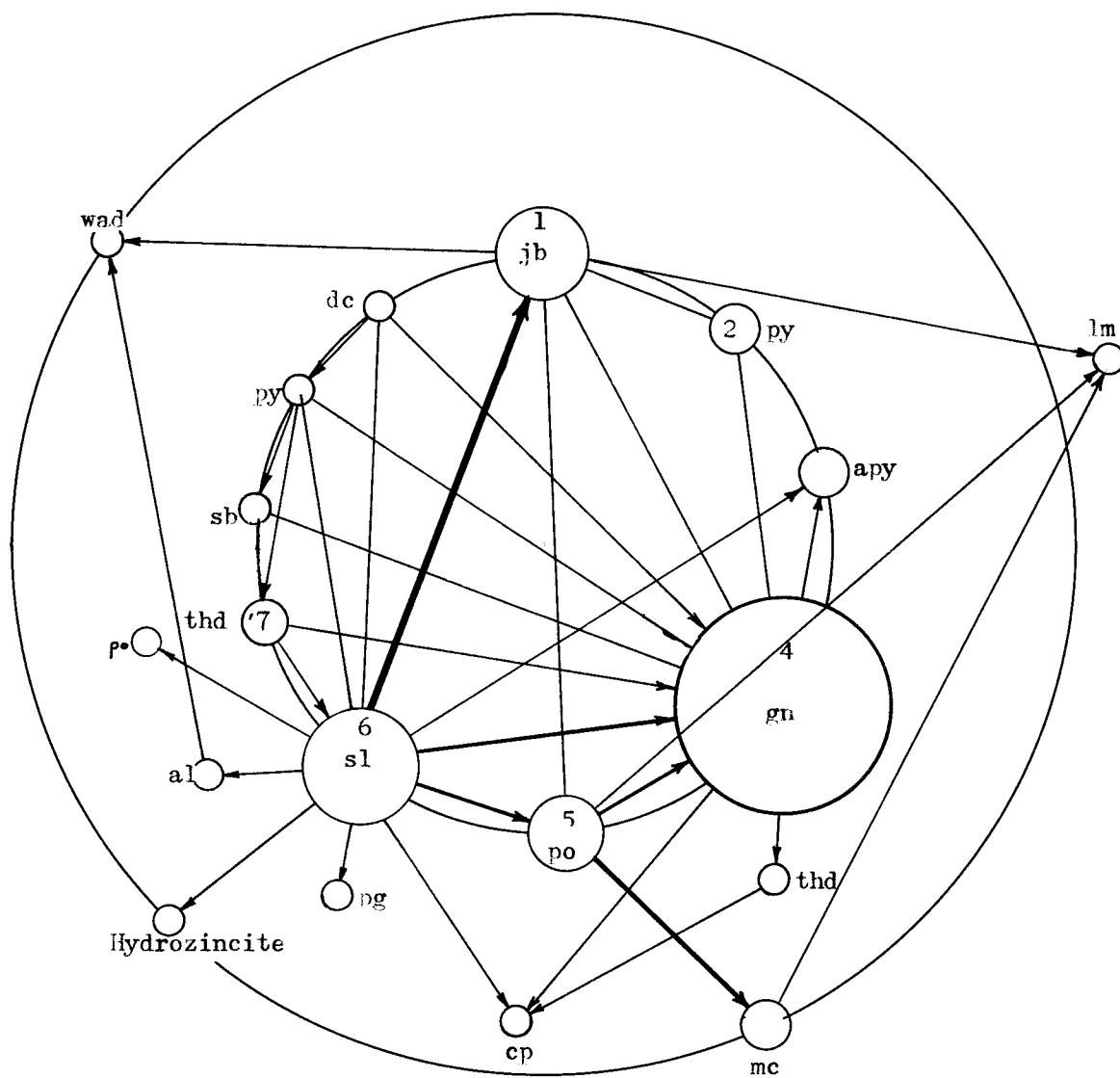
Type 1



Type 2



Type 3



TEMPERATURE OF DEPOSITION

The minerals present, and their textural relations, indicate that minerals in type 3 mineralization began forming at high temperatures, with unmixing occurring and lower temperature minerals forming as the temperature decreased.

As some minerals may be considered diagnostic of temperature of deposition (Edwards, 1960), it is seen that deposition was over a range of temperatures.

High temperature: - magnetite, pyrrhotite

Medium temperature: - galena, tetrahedrite

Low temperature: - pyrrargyrite

Note, however, that the textures indicate pyrrhotite was deposited after galena, not before. The reason for this may be that galena forms in both high and low temperature deposits also, and this may be an instance where galena was deposited at higher than normal temperatures.

From experiments it is known that chalcopyrite exsolves from sphalerite at 350 to 400 C. This also would indicate that the deposit was in the medium to high temperature range of deposition.

After cooling was complete, stress occurred, giving rise to steel galena. As a result of the stress, dyscrasite was redeposited around the coarse grained galena, appearing at first to be segregation to the grain boundaries.

REFERENCES

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1960

Gabrielse, H. - McDame Map Area, Cassiar District, British Columbia,
G. S. C. Memoir 319, 1963