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APR 11 1981

EXPLORATION

RECEIVED APR 14 1981 EXPLORATION

To	Chief Geologist, Exploration, (TW Muraro)	Date	6 April 1981
From	Geologist, ERL, (JA McLeod)	File No.	
Subject	Fish Lake - Ore Microscopy	Reference	V81-134R

860973

Eleven samples were submitted to the laboratory for sectioning and microscopic study. Nine of the samples were pieces of drill core from DDH 81-1. The remaining two samples were from surface material. A study of the drill core samples in reflected light was undertaken to determine opaque mineralogy, mineral associations, textural features and locations of precious metals to provide information for recovery preditions. The hand samples were studied in transmitted light for purposes of rock identification.

The samples submitted to the laboratory bore the following sample identities and were assigned laboratory numbers.

LAB NO.	FIELD NO.	
R81:1643	81-1 - 110.6'm	QFP
1644	81-1 - 220.7'm	M or Fdio
1645	81-1 - 276.4'm	fdio or Seds
1646	81-1 - 284.65'm	"
1647	81-1 - 294.7'm	
1648	81-1 - 303.9'm	QFP
1649	81-1 - 308.3'm	QFP
1650	81-1 - 316.1'm	QFP
1651	81-1 - 348.1'm	Felsic
1652	3-17-1	
R81:1653	3-17-2	

MICROSCOPIC DESCRIPTIONS:

Sample R81:1643 is estimated to contain about 5% opaque material and the mode is as follows, based on visual estimates.

Magnetite:	~50%
Hematite:	~20%
Ilmenite:	~ 5%
Chalcopyrite:	~20%
Bornite:	<1%
Leucoxene:	~ 5%

Magnetite grains and aggregates may reach 1.5 mm in size. The larger grains are rounded and anhedral while the smaller grains, which fall in the size range 0.1 to 0.2 mm, are more enhedral. Magnetite is variably altered to hematite and sometimes is intergrown with ilmenite. Magnetite abundance is greatest at veinings. Abundance and grain size decreases outwards into host rock.

Blebs of chalcopyrite and chalcopyrite-bornite composites may reach a maximum size of 0.2 mm with the average being about 0.1 mm. These grains are generally irregular

Signed

in outline. The bornite-chalcopyrite contacts are smooth and of a mutual boundary nature. These copper minerals generally occur free although some form partial rimmings on magnetite. The chalcopyrite(bornite) grains are concentrated in envelopes around quartz-carbonate veinlets or are included in the veinlets. The concentration of copper minerals is like that of magnetite, becoming less abundant away from veinings.

Leucoxene, an alteration product of mafic minerals, occurs in minute grains in a spotty fashion throughout the rocks.

Sample R81:1644 is extimated to contain upwards of 5% opaques and the mode is estimated to be:

Magnetite:	~10%
Hematite:	~60%
Ilmenite:	~ 5%
Chalcopyrite:	~20%
Bornite:	~1-2%

Hematite after magnetite forms aggregates to 2.0 mm in size. Hematite is more coarse grained adjacent to quartz veins. Finer grained material (0.1 to 0.3 mm) is more crystalline and is disseminated in the host rock. Ilmenite is also noted with hematite-magnetite.

Chalcopyrite is almost entirely restricted to rims (envelopes) or cores of quartz and quartz-carbonate veinings. These grains may reach 1.0 mm and are irregular in outline. The majority of chalcopyrite grains fall in the 0.1 to 0.5 mm size range. Chalcopyrite-bornite intergrowths are noted in a small number of cases. The contacts are smooth. Some bornite appears altered to chalcocite-digenite. Most chalcopyrite(bornite) is free but some is intergrown or developed interstitially to hematite-magnetite grains. A few minute grains (a few μms to 10's of μm) of chalcopyrite are included in hematite. A few grains of chalcopyrite also enclose 10 - 30 μm grains of rutile. One minute grain of pyrite ~10 μm in size is included in chalcopyrite.

Sample R81:1645 contains about 8% opaque material and the mode is estimated to be:

Magnetite: / Hematite:	~75%
Bornite:	~15%
Chalcopyrite:	~10%
Chalcocite:	Tr.
Native Au:	Tr.

The rock is a extensively fractured/sheared specimen. Shears, seams and veinlets contain magnatite altering to hematite. Most are 1 mm wide or narrower while one is 2 - 3 mm wide. The magnetite-hematite may be concentrated at fracture intersections and grains will exceed 1 mm.

The principal copper mineral is bornite in grains to 0.3 mm in size and having a hackly or irregular outline. Chalcopyrite occurs in a similar size and shape as bornite. Intergrowth of chalcopyrite and bornite is common with grain boundaries being smooth and simple. Some bornite is also altered to chalcocite. The copper minerals are usually associated with quartz veinings and siliceous replacements. They may also be intergrown with magnatite-hematite. The intergrowths are usually of a simple nature with copper minerals replacing or in contact with the iron-oxides.

One minute 3 μm grain of native gold is seen enclosed in bornite.

Sample R81:1646 contains about 1% opaques and the mode is estimated as:

Magnetite:	~55%
Hematite:	~45%
Chalcopyrite:	Tr.
Bornite:	Tr.
Pyrite:	Tr.

Magnetite is partially altered to hematite. It is disseminated throughout the section in anhedral grains that average 0.1 mm. Grains may reach 0.25 mm in a quartz-gypsum veinlet. Two grains of pyrite about 0.2 mm in size have a ragged shape and are noted in the hosting rock. Chalcopyrite is present only as a few grains to 0.1 mm in size and are usually found in a quartz-gypsum veinlet. Chalcopyrite may contact magnetite in a simple manner. However, a couple of chalcopyrite grains are included in magnetite. One composite of chalcopyrite-bornite is seen in a veinlet. This grain is about 20 μm in size.

Essentially the section studied is barren and does not reflect the grade of the 10 foot interval from which it was selected. However, there is some indication that small copper losses might be expected due to chalcopyrite inclusions in magnetite.

Sample R81:1647 contains at least 3% opaques and the mode is estimated to be:

Magnetite:	~40%
Hematite:	~35%
Ilmenite:	~ 5%
Chalcopyrite:	~20%
Bornite:	~<1%
Chalcocite:	~Tr.

At least five different sets of fractures are noted. These are replaced by quartz, quartz-gypsum and quartz-chlorite. The largest fracture is 0.5 mm wide.

Anhedral to subhedral magnetite altering to hematite is widely disseminated. These grains average 0.1 mm. In fractures, particularly where fractures intersect, aggregates of magnetite-hematite have developed and may exceed 0.5 mm. A few grains of ilmenite are present with magnetite.

Copper minerals are chalcopyrite and minor bornite. They form simple composite grains. Grain size may exceed 0.3 mm but the average grain size range in 0.05 to 0.15 mm. The copper minerals are located in fracture envelopes or within the fractures. A small percentage of chalcopyrite-bornite is in contact with magnetite, in a simple and mutual boundary manner. A few minute grains (10 - 30 μm) of chalcopyrite or bornite form inclusions in magnetite. Chalcocite, although quantitatively insignificant is noted, developed at the expense of bornite. A few minute grains of rutile are also noted in contact with or included in chalcopyrite.

Sample R81:1648 contains about 10% opaques and the mode is estimated to be:

Magnetite: } Hematite: }	~30%
Pyrite:	~50%
Chalcopyrite:	~20%
Bornite:	~<1%

A minimum of five vein sets are noted. The majority of opaques occur in these veins or as envelopes to them.

The opaque assemblage of magnetite and chalcopyrite appear related to quartz veinlets and may occur in or enveloping the veinlet. Magnetite altering to hematite forms grains to 0.5 mm and aggregates >1 mm. Chalcopyrite grains are very irregular in shape, may reach 0.5 mm and normally fall in the range 0.1 to 0.2 mm. There is intergrowth between magnetite and chalcopyrite. The majority of this material forms simple contacts. However, inclusions of one mineral in the other are noted. These inclusions fall in a size range of 20 - 50 μm.

The assemblage pyrite-chalcopyrite is associated with two vein types, a sericite-carbonate filled fracture and a gypsum vein. The gypsum related mineralization has pyrite grains to 0.3 mm in size and aggregates to a mm. The pyrite is anhedral, fractured and replaced by chalcopyrite. The chalcopyrite is very ragged in form and is usually peripheral to the fracture (vein) and pyrite. Some chalcopyrite grains are complexly intergrown with pyrite. Grain size may range from about 10 μm to 0.5 mm with the majority falling in the size range 0.1 mm to 0.2 mm. Some ragged patches of chalcopyrite have 20 - 50 μm inclusions of rutile.

The second pyrite-chalcopyrite assemblage has some magnetite associated. Here the the pyrite forms discrete anhedral grains up to 0.5 mm in size but average 0.2 mm. They are often in contact with ragged chalcopyrite grains and masses. The chalcopyrite grains are similar in size to pyrite. Some chalcopyrite replaces pyrite along hairwidth fractures or may occur as minute inclusions. This is a source of potential copper loss. Minute grains of rutile are also noted included in chalcopyrite and pyrite(10 - 30 μm).

Sample R81:1649 contains less than 1% total opaques most of which is hematite after magnetite (skeletal grain outlines) and about 10 grains or blebs of chalcopyrite in the 10 - 20 μm size range. The rock is a felsite dyke and is virtually barren.

Sample R81:1650 contains about 3% opaques and the mode is estimated to be:

Pyrite:	~70%
Chalcopyrite:	~25%
Hematite:	~ 2%
Ilmenite:	~ 2%
Native Au:	Tr.

Mineralization is restricted to two fractures or veins only.

The first fracture contains pyrite and chalcopyrite. Pyrite grains and aggregates are elongate up to 1 x 0.2 mm in size. The pyrite occurs in envelopes around a gypsum veinlet and is hosted by quartz-carbonate material. The pyrite appears to have undergone deformation (fracturing) with many grains of pyrite having a shard-like appearance. This may have been the result of refracturing adjacent to the quartz-carbonate and replacement with gypsum. Chalcopyrite associated with pyrite occurs as hackly grains up to 1.0 x 0.5 mm with most grains averaging 0.1 mm. The chalcopyrite may occur free or in contact with pyrite as rimmings, simple contacts or replace pyrite along very thin fractures.

The second mineralized fracture is a very thin quartz veinlet that has been refractured and locally healed by gypsum. Chalcopyrite occurs in patches in the envelope. These patches may reach 1 mm in size but the individual grains are ratty and average 0.2 mm.

Four grains of native Au are noted in contact with a hackly chalcopyrite grain. They range from a 1 μm bleb to a angular 6 x 12 μm grain.

Magnetite and hematite after magnetite are present in trace quantities only, as disseminations in barren host rock or in barren veinlets.

Some small copper losses will be encountered due to pyrite-chalcopyrite intergrowths and fineness of some chalcopyrite in the μm size.

Sample R81:1651 contains about 3% opaques and the mode is estimated to be:

Chalcopyrite:	~60%
Pyrite:	~30%
Bornite:	~Tr.
Magnetite-Hematite:	~ 5%
Tennantite:	~ 3%

Chalcopyrite is related to veinlets or veinlet envelopes of quartz-sericite. The grains are irregular in shape and may reach several tenths of mm's. The minimum average is 0.1 mm. Most chalcopyrite is free from other opaques.

Pyrite is concentrated in one location, that is at the edges of a 1 to 1.5 mm gypsum veinlet. The pyrite is hosted by quartz-sericite minerals. The pyrite in this envelope is fractured and deformed, occurs in grains up to 2 mm x 0.3 mm and is replaced along hairwidth fractures by chalcopyrite. Chalcopyrite may also be included in pyrite in 10 - 30 μm sized blebs. Most chalcopyrite in contact with pyrite is of a simple locking nature.

One grain of bornite is noted, rutile is included in some chalcopyrite as 10 - 30 μm inclusions. Magnetite-hematite is present as a few disseminated grains in the host rock and a few grains are seen in contact with chalcopyrite.

Tennantite is noted in simple boundary contact with chalcopyrite in several grains. Analysis of two tennantite grains indicate that it is not a Ag - rich variety. The largest grain noted is 150 x 15 μm.

Sample R81:1652 studied in transmitted light is estimated to contain the following mineralogical mode:

Plagioclase:	~50%
Microlites: / Felsite:	~15%
Chlorite:	~15%
Carbonate:	~15%
Opaques:	~ 5%

Enhedral to subhedral crystals of labradorite plagioclase (An_{56}) average 2.0 mm with exceptional grains to 5 mm. The plagioclase exhibits strong oscillatory zoning. They should probably be termed porphyritic as they are set in aphanitic groundmass consisting of feldspar microlites and cryptofelsite. The groundmass contains patches of chlorite and carbonate of extremely fine grained size. Some patches of carbonate and chlorite have developed pseudomorphs after unidentified crystals (possibly plagioclase and mafics). These pseudomorphic patches may reach several mm's in size. A few percent of opaques (iron oxides) in grains from 0.05 to 0.2 mm are present in patchy concentrations and are believed to be the result of mafic breakdown.

The texture of the rocks and the plagioclase composition suggests that it is a intermediate rock type and may represent a dyke or flow. The rock is extensively altered by carbonate and chlorite. It may be a hypabyssal derivative of the quartz diorite intrusive.

Sample R81:1653 studied in transmitted light is estimated to contain the following mode:

Plagioclase:	~ 45%
Felsite:	~ 20%
Carbonate:	~ 20%
Chlorite:	~ 10%
Opaques:	~1-2%
Sericite:	~1-2%

Fresh appearing labradorite plagioclase (An_{60}) are euhedral to subhedral (slightly broken) and may reach 5 mm in size but average 2 mm. The plagioclase shows strong oscillatory and reverse zoning. The groundmass is a cryptofelsite. Carbonate is extensively developed throughout the groundmass and replaces some plagioclase. In one instance a amphibole outline is composed of carbonate and chlorite. Chlorite is also present in the groundmass. Minor sericite is developed with carbonate on some plagioclase. Opaques are present as iron oxides in patches, probably the result of mafic alteration.

This rock is nearly identical to the previous sample and is believed to be a intermediate dyke or flow rock.

DISCUSSION:

The opaque mineralogy of the diamond drill core is tabulated in Table 1. In general, magnetite altering to hematite and chalcopyrite are the principal minerals by volume. These minerals are highly localized, developing in veinlets or in envelopes around veinlets (replaced fractures). Grain size reaches a maximum at or in veinlets and diminishes outwards into the host rock. Bornite occurs similarly to chalcopyrite. Very minor chalcocite has developed with or from bornite.

Native gold is noted in two sections studied and occurs in contact with or as inclusions in chalcopyrite and bornite. This would suggest that the gold would be recovered in the copper concentrate. Silver minerals were not identified. The native gold carries a few percent silver (SEM-EDX analysis). Tennantite which can carry several percent silver in the crystal lattice was examined by SEM-EDX. No silver was detected in the two grains examined. This may not be the case for all tennantite throughout the Fish Lake deposit. In general the precious metals would be expected to travel and report together. If this is the case silver should be recovered in the copper concentrate.

The majority of copper should be recovered in standard milling and floatation.

There will be some minor copper losses due to interlocking between chalcopyrite-bornite and magnetite or pyrite. Also, a very small amount of copper is present in grains that are less than 50 μm in size. This might cause additional small losses. It is expected that the extractive process will be quite efficient although a regrind might be considered if the recoveries are not acceptable.

The two rocks examined petrographically are believed to be intermediate dyke rocks or flows. They have been so altered by carbonates and chlorite as to obliterate any mafics which would aid in their identification.

Appended to this report is a number of photomicrographs with captions illustrating the mineralogy and texture of the ore minerals.

Yours truly,

J.A. McLeod

JAM/sw

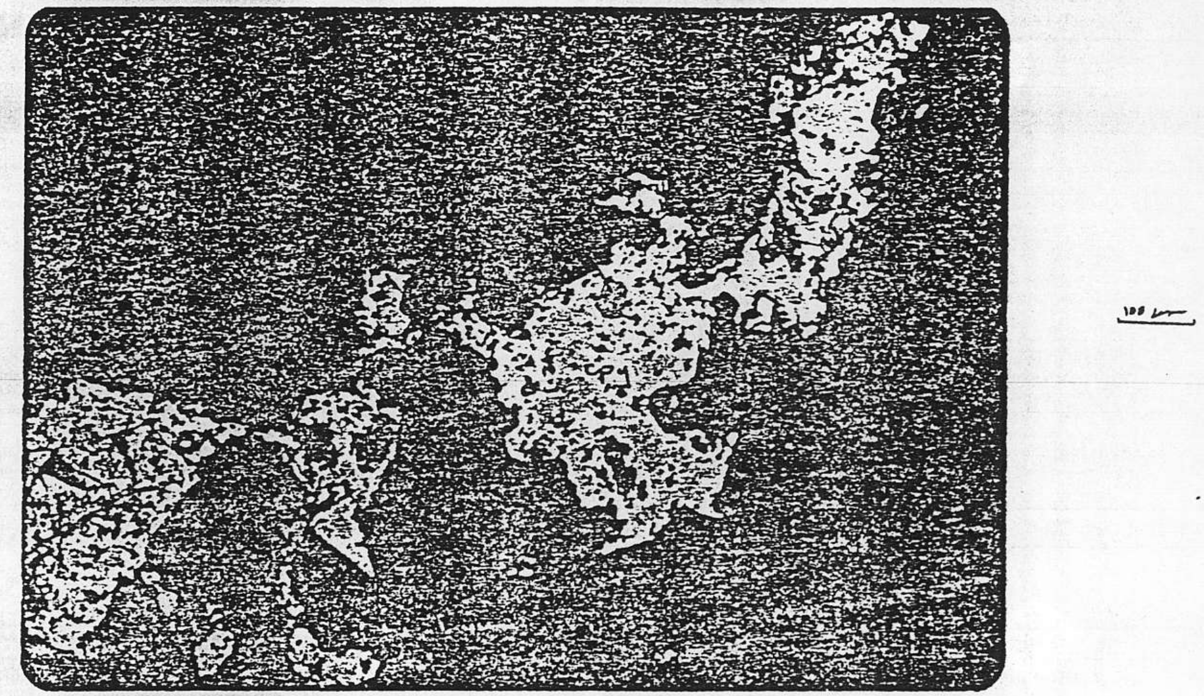
Dist: Ron Simkus, Kimberly

Appendices

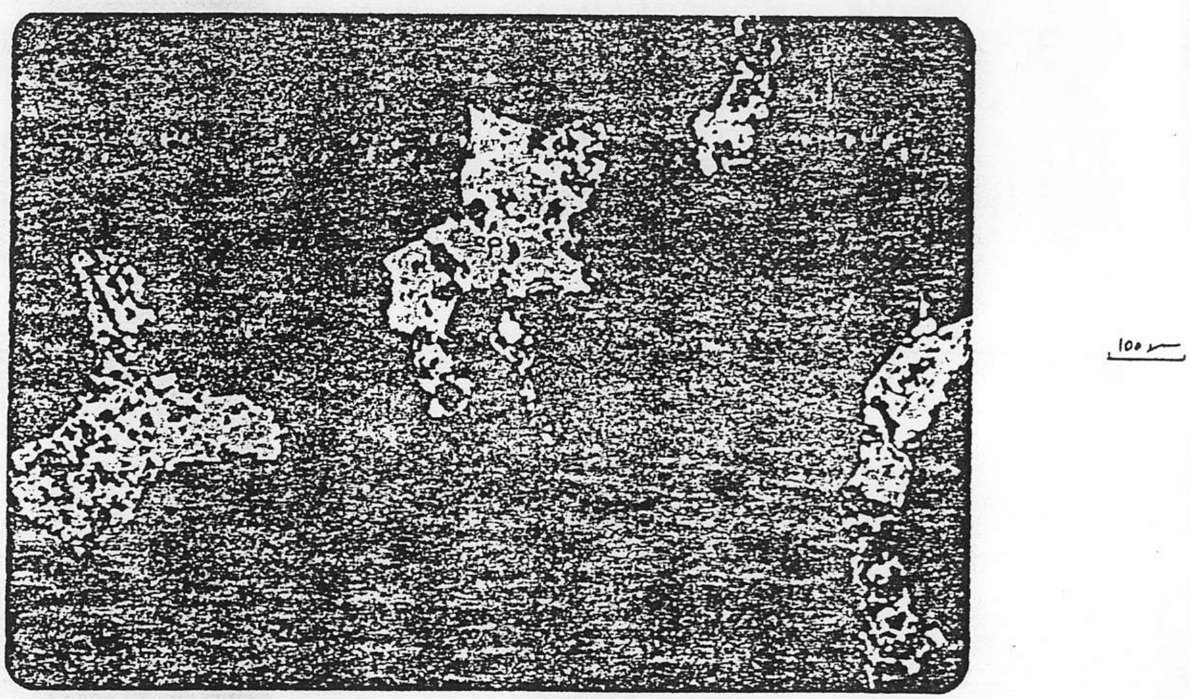
OPAQUE MINERALOGY TABLE 1.

Sample Number	Magnetite	Hematite	Ilmenite	Leucoxene	Pyrite	Chalcopyrite	Bornite	Tennantite	Native Au	Chalcocite	Total Opaques Section
R81:1643	50%	20%	5%	5%		20%	<1%				5%
1644	10%	60%	5%			20%	1-2%				5%
1645		75%				10%	15%		Tr.	Tr.	[illegible]
1646	55%	45%			Tr.	Tr.	Tr.				1%
1647	40%	35%	5%			20%	<1%			Tr.	3%
1648		30%			50%	20%	<1%				10%
1649		99%				1%					1%
1650		2%	2%		70%	25%			Tr.		3%
R81:1651		5%			30%	60%	Tr.	3%			3%

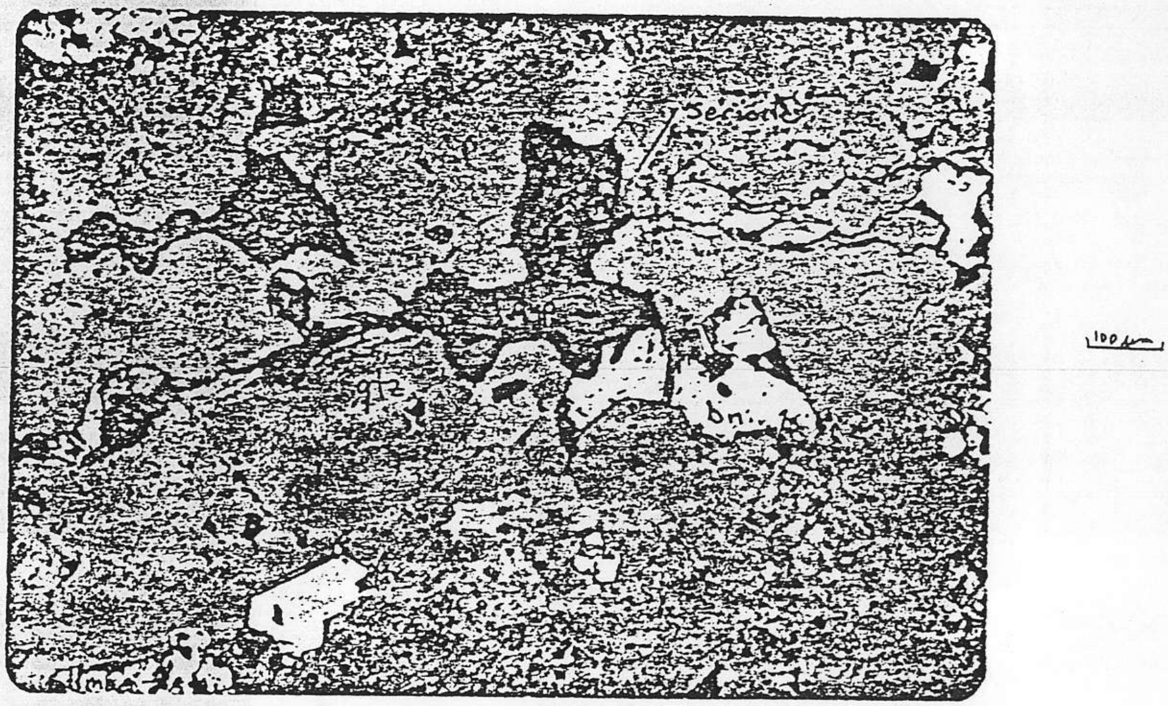
PHOTOMICROGRAPHS - FISH LAKE



R81:1644. Chalcopyrite-Magnetite-Hematite in a quartz-carbonate veinlet. Euhedral grain of rutile included in chalcopyrite. Minute bornite grains in chalcopyrite. Reflected light, magnification 80x.

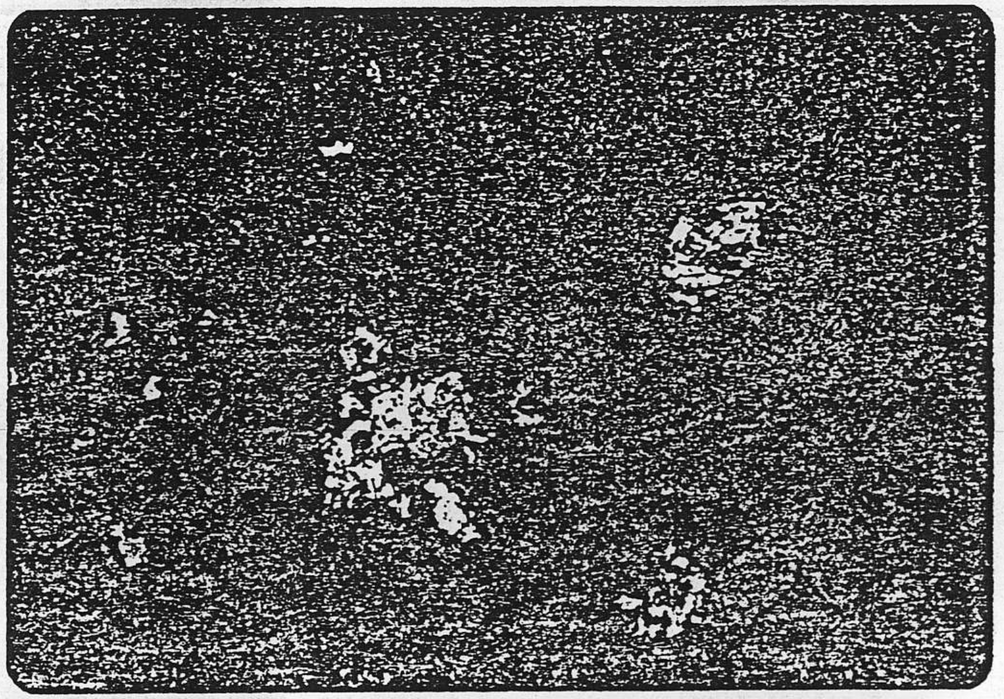


R81:1644. Irregular shaped chalcopyrite grains in the core of a quartz-carbonate vein. Reflected light, magnification 80x.

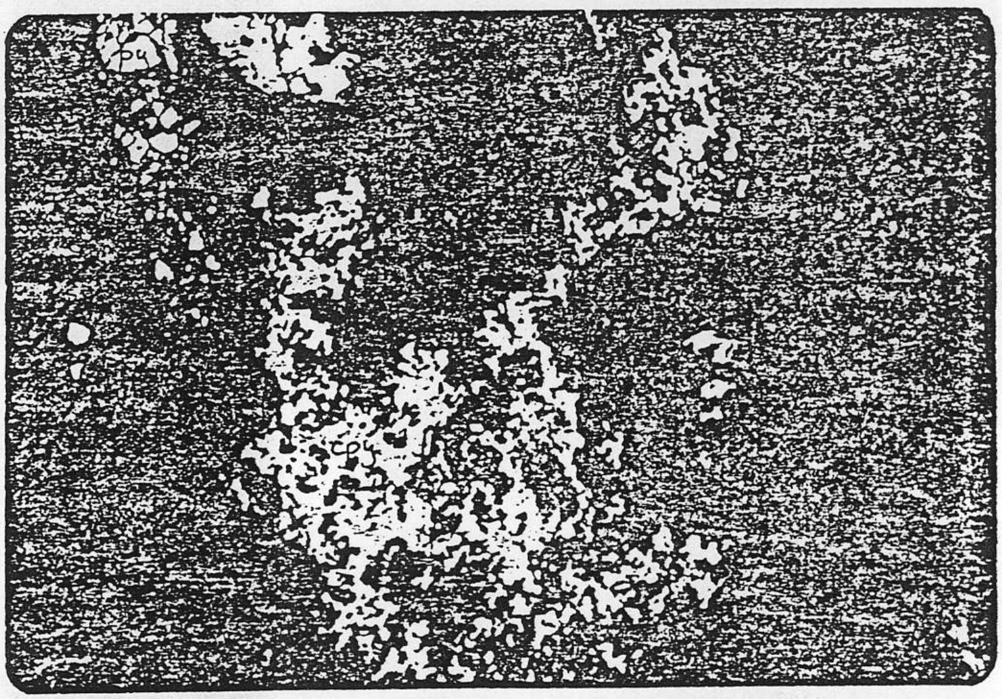


R81:1645. Bornite and magnetite in a quartz veinlet. The core of the vein has been filled with gypsum and some sericite. Mineralization is present in both the core and the envelope. Reflected light, magnification 80x.

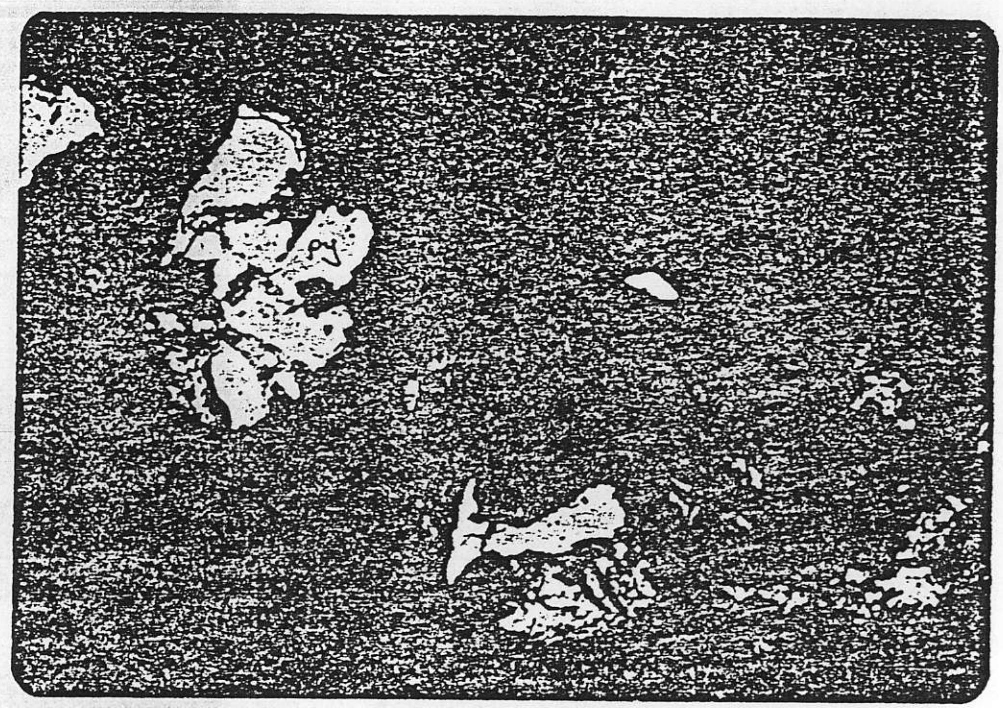
R81:1645. Bornite contains a bleb of native Au. Au contains a few percent Ag. Magnetite altering to hematite. Reflected light, magnification 400x.



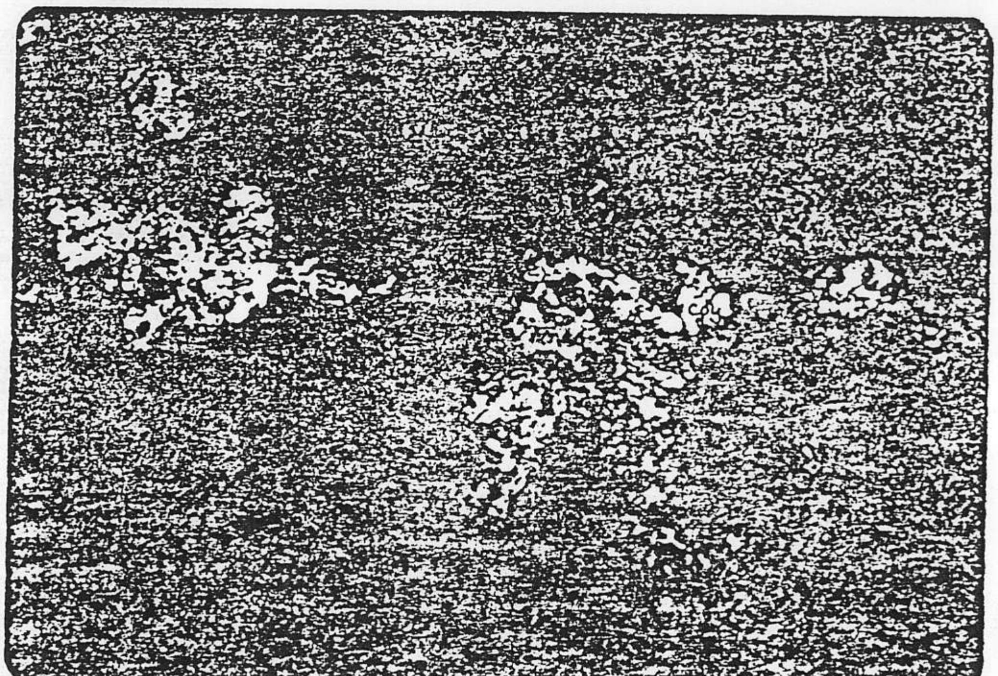
R81:1647. Chalcopyrite-magnetite-hematite-bornite in the envelope of a quartz veinlet (right side). Magnetite/hematite and chalcopyrite contact is smooth and of a simple nature. Reflected light, magnification 80x.



R81:1648. Ragged (irregular shaped) grains and aggregates of chalcopyrite in the envelope of a gypsum veinlet. Chalcopyrite related to sericite. Broken pyrite at the edge of the gypsum veinlet. Reflected light, magnification 80x.

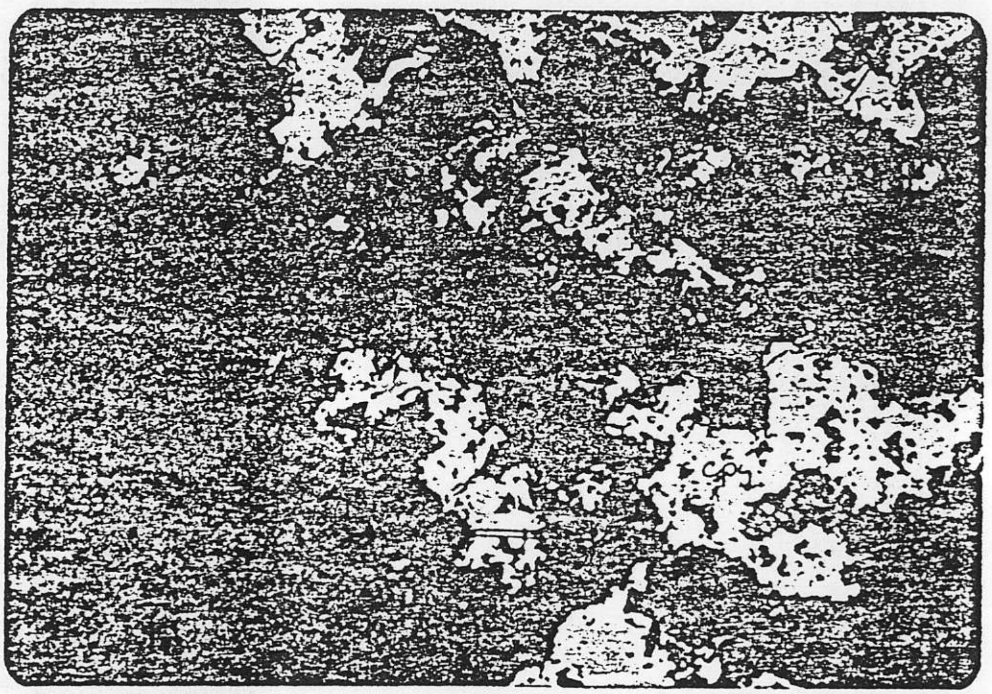


R81:1648. Pyrite-chalcopyrite-magnetite in a sericite fracture replacement. Chalcopyrite replaces pyrite and may form partial rimmings or mantles on pyrite grains. Chalcopyrite and magnetite are simply intergrown, however magnetite is quite fine grained. Reflected light, magnification 80x.

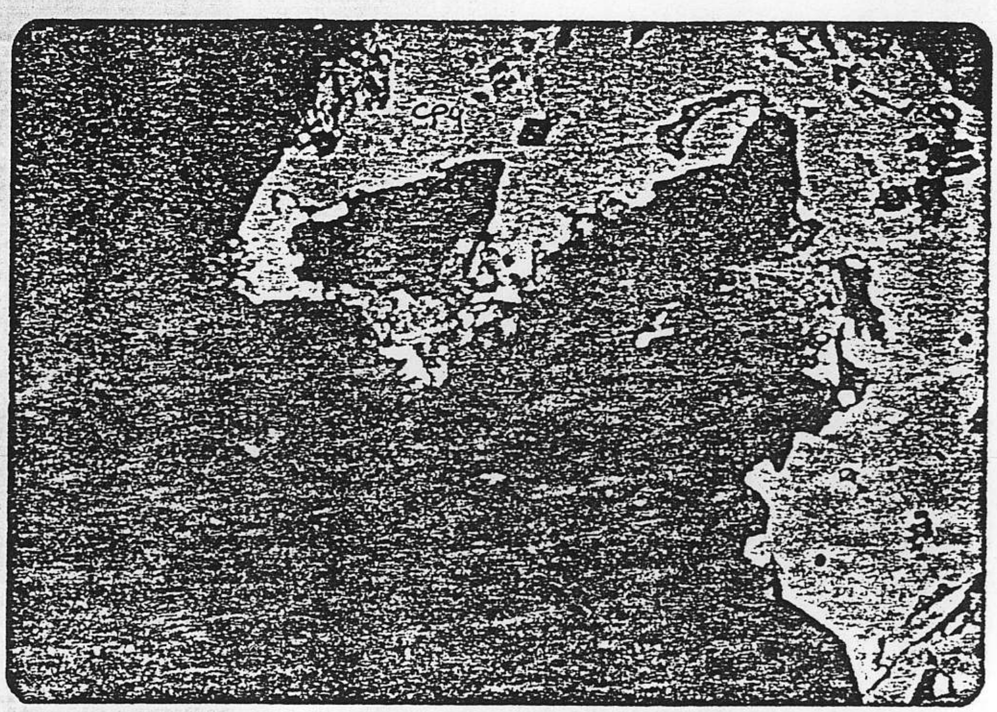


R81:1648. Chalcopyrite-magnetite (hematite)-rutile intergrowths in the envelope of a quartz veinlet. Reflected light, magnification 80x.

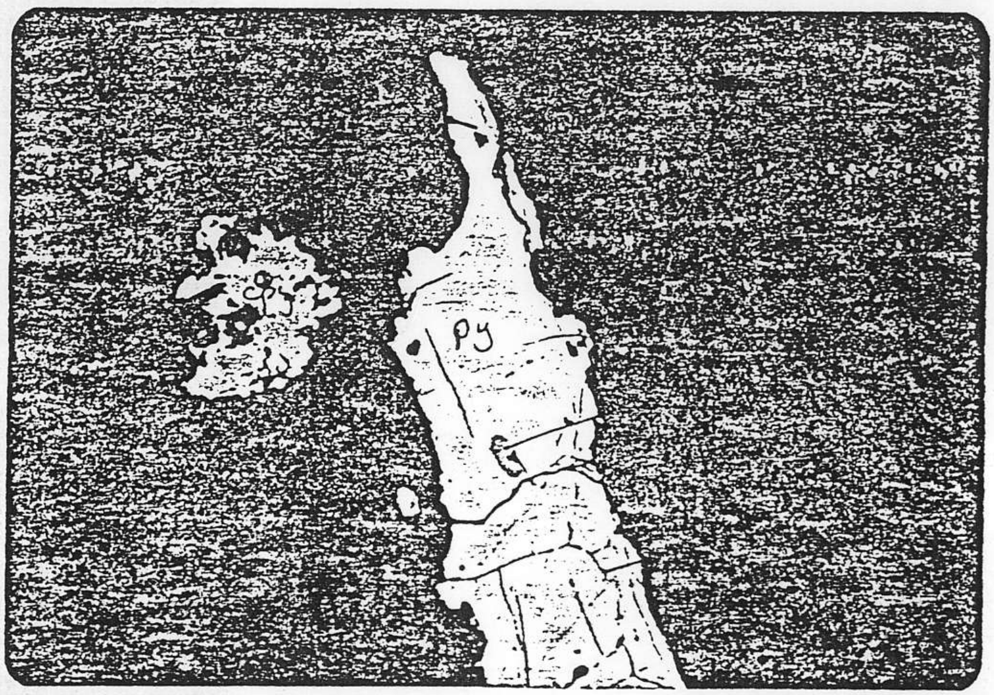
R81:1649. Pyrite and chalcopyrite in a quartz-carbonate envelope around a gypsum veinlet. Chalcopyrite replaces pyrite with smooth and simple boundaries. Chalcopyrite also replaces pyrite along thin fractures. Reflected light, magnification 80x.



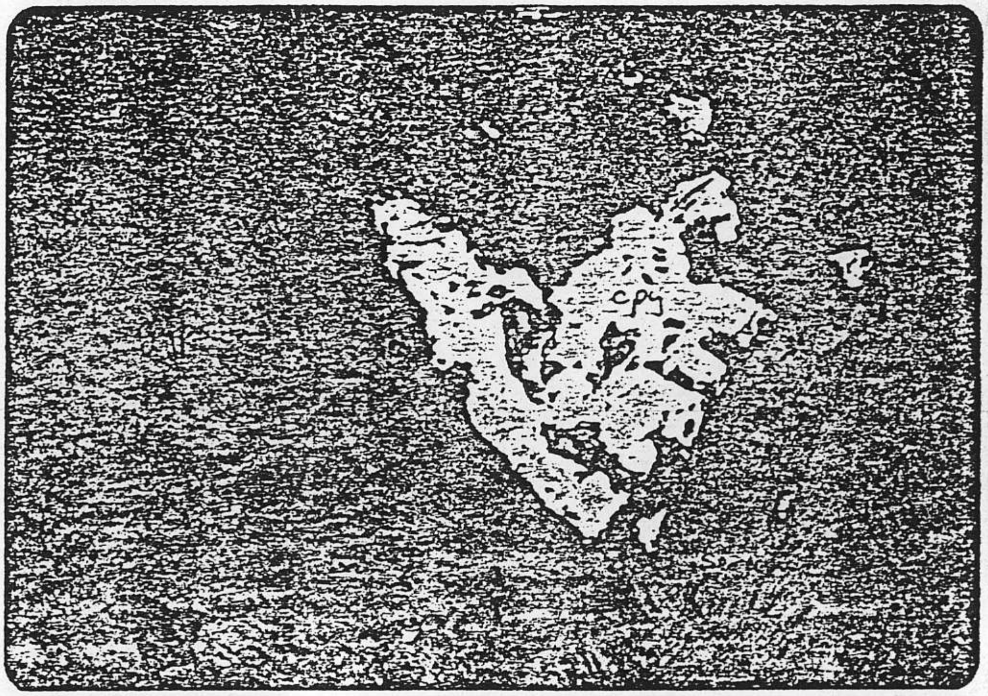
R81:1650. Irregular shaped patches of chalcopyrite in and enveloping a quartz veinlet. Also present is rutile and hematite. Not readily visible is native Au. Reflected light, magnification 80x.



R81:1650. A close up of previous photo showing grain boundary contacts between native Au and chalcopyrite. Reflected light, magnification 400x.

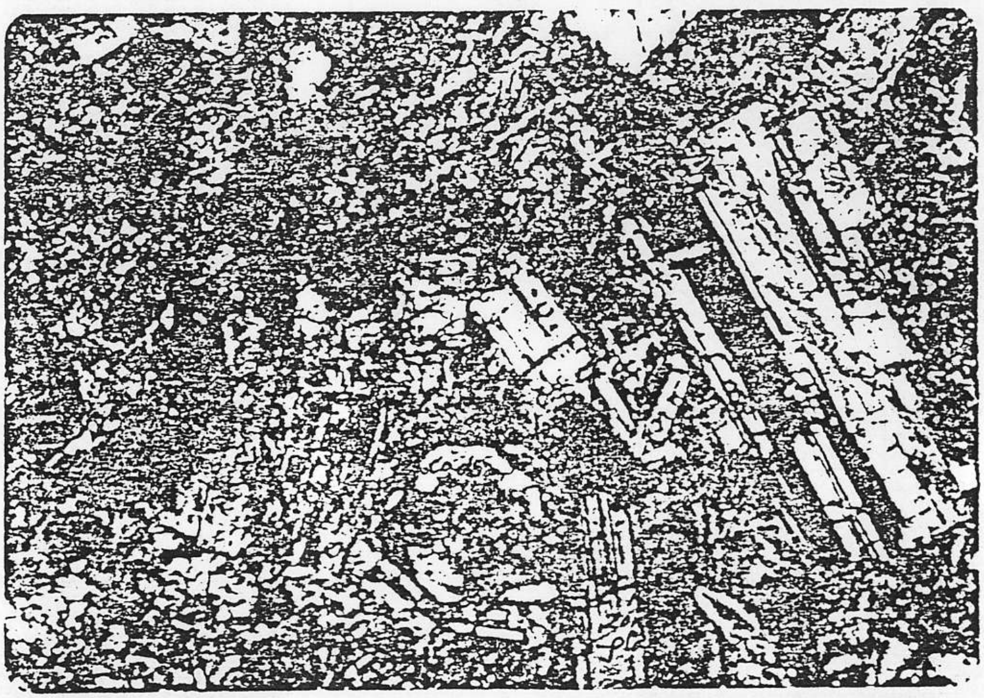


R81:1651. Chalcopyrite inclusion in pyrite in envelope of sericite around gypsum veinlet. Reflected light, magnification 80x.



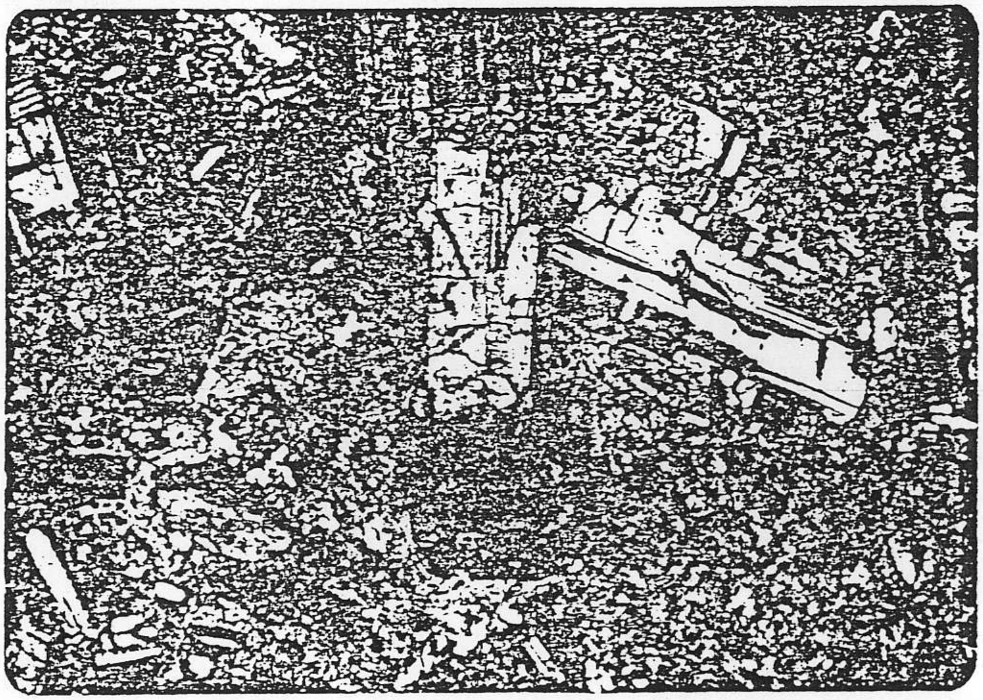
50μm

R81:1651. Chalcopyrite-tennantite-bornite intergrowth in quartz sericite envelope to gypsum veinlet. Reflected light, magnification 160x.



320μm

R81:1652. Labradorite phenocrysts in an altered microfelsite. Phenocrysts are zoned. Chlorite and carbonate replace much of the groundmass and in some places form large patches. Transmitted light, magnification 25x.



R81:1653. Oscillatory zoning in labradorite plagioclase phenocrysts. The microfelsite groundmass has been extensively altered to carbonate and minor chlorite. Transmitted light, magnification 25x.