890057

MICROPROBE, THIN and POLISHED SECTION STUDY

ESKAY CREEK PROJECT

British Columbia

prepared for

CALPINE RESOURCES INC./CONSOLIDATED STIKINE SILVER LTD.
Vancouver, B.C.

by

GLOBO DE PLOMO ENTERPRISES
Douglas, Arizona

April 17, 1989

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17 April 1989

Chet Idziszek, President
PRIME EXPLORATIONS LTD.
Prime Capital Place
10th. Floor - Box 10
808 West Hastings Street
Vancouver, B.C.
CANADA V6C 2X6

Dear Mr Idziszek:

Enclosed are written descriptions and XES analytical data for your 13 samples sent last month. I am returning the slides, polished sections, rock remains, and photo negatives under separate cover by parcel post.

Each sample was studied optically in thin and polished section, and the polished section was analysed by XES prior to examination by electron optics. The descriptions of the samples will provide the detail you may find useful, but some general comments are in order as well.

One of the weak points of the study is determination of lithology. I believe these rocks to have been shaly/cherty sediments and volcanics that were metamorphosed, then sheared/brecciated, then severely altered hydrothermally as a part of the mineralization process. The alteration obliterated any metamorphic mineralogy once present, and indeed in some cases I couldn't tell if relic crystals were plagioclase - or andalusite - or something else. The alteration mineralogy is simple, mainly quartz -sericite. Locally there is phlogopite, and in general the micas were on a trend to become more magnesian with time. Barite was seen once, but the anomalous Ba in other samples remained unexplained.

Also unexplained by the study was the location of Mn, Mo, and Tl in the mineralogy. Failure to find minerals of these elements suggests that they are substituents in other minerals and thus below the detection limit of the probe. All other elements analysed were satisfactorily explained by the mineralogical findings.

The sulfides were introduced after shearing/brecciation ceased and seem quite contemporaneous with the wallrock alteration. The paragenesis is as follows: pyrite (first) - arsenopyrite - sphalerite (+chalcopyrite) - tetrahedrite - stibnite - cinnabar + gold - realgar (+calcite) - native arsenic - stibnite + cinnabar + polhemusite. A couple of other minerals were found but are very rare and there is insufficient information to fit them into the paregenesis.

It seems clear that gold traveled with mercury in this case, but considering the very high assays you report, I seldom saw gold. It is usually intimately admixed with cinnabar with a grain size up to and well under $\frac{1}{4}\mu$ and below the size limit for useful analytical resolution. Unfortunately, too, its mole weight is comparable to that of cinnabar so that no useful contrast is possible. The few larger gold grains seen (up to 20μ) are paragenetically of the same age, occur in the general vicinity of the Au-cinnabar intergrowths, and yet can account for only a tiny fraction of the gold present. In sum, I would estimate that 95%+ of the gold is in sub-micron sizes.

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It is possible, too, that the mineral of gold is in fact gold-amalgam, for it can only be said that certain domains within the early cinnabar "veinlets" are aurian, and all domains analysed gave high mercury readings as well. Whether all mercury is from interference with host cinnabar or not could not be determined. However, the few larger grains found were analysed, and they are not amalgam. They also contain no detectable silver. All of that element is tied to sulfosalts.

I trust that these data will be of value to you.

Sincerely,

Sidney A. Williams
SAW:bj

encls.

CA-001

The original rock is believed to have been a severely chilled basalt vitrophyre, possibly a subaqueous flow breccia. Textural detail has been almost obliterated by strong subsequent epizonal alteration.

Oval basalt fragments are still visible owing to clouding of the original glass base by leucoxene dust, and a few fragments display relic plagioclase microlites within the glass. Each fragment is altered differently. The glass may be replaced by sericite, or by nearly amorphous albite, or by dolomite. The matrix to the fragment relics is a paste of sericite which locally shows a crude foliation. Quartz crystalloblasts occur rarely in the matrix, engulfing inclusions of sericite and dolomite.

Sulfides are erratically disseminated, seeming to form preferentially in certain Fe-rich glass fragments. Arsenopyrite is the most abundant sulfide, as euhedral prisms that tend to concentrate in certain clasts, often in reticulated array. Less common is pyrite, as curious spongy spherules that show no spatial or paragenetic relationship to arsenopyrite. They tend to be dispersed in the foliated sericite matrix. No other opaque phases were found during optical or electron optical examination.

CA-002

The rock is a chertstone, a fragmental unit of uncertain origin. It is an aggregate of ¼mm fragments oriented with long axes parallel in a crude bedded fabric. The fragments (mere ghosts now) give no textural clues as to origin. They range from oval in outline to irregular lens-like patches, some of which are themselves fragmentals. Commingled with them are occasional round chalcedony patches, perhaps radiolaria originally.

Epizonal silicification has been intense, and all fragments are converted to cryptocrystalline to amorphous, cloudy chert. In a few places interconnected chalcedony patches have begun to form and they are free of dust-like inclusions, unlike the chert matrix. The rock is but by innumerable parallel veins of calcite in which quartz is a minor accessory. A few veins of like age are normal to these sheeted veins.

The cherty matrix is host to sharply euhedral arsenopyrite prisms that are sparingly disseminated with no sign of change whatsoever in the nearby chert. Far less commonly disseminated, and as small interstitial grains, is stibnite.

The sulfide assemblage associated with younger calcite veins is more complex. Commonly the calcite core contains stringers of granular realgar rimmed with botryoidal native arsenic. Embedded in the realgar core are irregular patches of stibnite that host small cinnabar inclusions.

CA-003

The rock is a cherty argillite. Its cherty domains resemble CA-002 closely and are cryptic fragmental rocks with no relict textures visible within them. These cherty domains were once interbedded with argillic material.

Textures have been blurred owing to epizonal alteration coupled with shearing. The argillic material has been converted to sericite, and the shearing has given the sericite a crude foliation around detached chert fragments. The sericite is more randomly oriented within some domains that are partially cherty - these sometimes resemble vitric basalts. Small round quartz grains of uncertain origin are rarely embedded in sericite foliae.

Sulfides are fine grained and are evenly disseminated both in cherty and sericite-dominated domains. Pyrite is invariably present as curious spongy spherulites, rarely clustered. Stibnite grains are anhedral and they may attach to pyrite as a younger phase. Arsenopyrite crystals are invariably euhedral, floating in chert domains most commonly. The only other reflective phase found is sphalerite. It is rare, as fillings in curved extensional microcracks in chert domains.

CA-004

The rock is an argillic chertstone similar to CA-003. It is a complex bedded unit with cherty laminae that show cryptic fragmental structure. Some of the fragment domains are chert intimately admixed with argillic matter, and more clays once occurred in sinuous laminae interlayered with the chert-dominated ones.

Alteration has been accompanied by mild shearing. Cherty laminae are little affected; quartz in them still ranges from cryptocrystalline to amorphous, even though clays have re-formed as sericite. The chert patches now lie in a matrix of coarse granular quartz rimmed with sericite that is partly converted to curved phlogopite scales. This assemblage has begun to advance upon and replace some of the chert. Associated minerals (in the quartz) are calcite and barite.

The silicate gangue is host to euhedral and slender prisms of arsenopyrite and blebs and beads of pyrite. These two minerals show no paragenetic relationship and they are confined to unrecrystallized domains. The quartz-phlogopite assemblage is related to coarse granular realgar which is armored by botryoidal native arsenic against the gangue. Small irregular stibnite inclusions occur in the realgar and in the base of the arsenic coatings on it.

CA-005

The sample is a microbreccia composed of small and rounded fragments scattered widely in a sulfide matrix, mainly

CA-005 con't.

realgar. The majority of fragments consist of granular to prismatic quartz and coarse scaly phlogopite and they show no relict textures whatsoever. Far less common are fragments composed of cloudy and cryptocrystalline feldspars that appear to have been basic volcanic glass, and a few small fragments consist of euhedral calcite crystals.

Those fragments containing quartz enclose sulfide dust and small beads within the quartz, and their sulfide assemblage may differ from that of the matrix, as if brecciation were an interruption to the mineralizing process.

The realgar cementing fragments in this sample is host to occasional small round pyrite grains that are typically .02mm in size. Much smaller pyrite patches occur interstitially to silicates in the fragments as well. Stibnite is found as irregular grains within realgar and interstitially to silicates as well. It hosts irregular grains of cinnabar and is also cut by tendrils of cinnabar. In the latter event cinnabar is intimately intergrown with native gold as filaments so small they are not resolvable analytically (i.e. less than $\frac{1}{2}\mu$ in size). Larger gold grains (up to 20μ) are very rare and occur at the contacts of realgar and gangue. The rare mineral polhemusite was found as inclusions in stibnite and occurs in much the same manner as the late cinnabar.

The paragenesis, thus, is pyrite (first) - stibnite - cinnabar+gold - realgar - stibnite+cinnabar+polhemusite (last).

CA-006

The rock appears to be a sheared breccia, altered subsequently, and protolith textures in fragment domains are consequently obliterated. Most of the fragment domains are lenses of coarse scaly muscovite that are interwoven and intergrown with opaques. Other lenses consist of cryptocrystalline and cloudy orthoclase and these seem to be rocks which were fragmentals originally. Quartz occurs only occasionally in the interstices of the breccia and rarely as discontinuous veins filling extensional features. The calcite is interstitial to coarse grained stibnite as a gangue mineral in ill-defined veins that wander along the "foliation" induced by shearing.

Stibnite is abundant in this sample as massive, coarsely crystalline matrix to gangue minerals. It is host to small round pyrite grains that occur in vaguely defined stringers but pyrite of like habit occurs in the gangue as well. Stibnite hosts grains of cinnabar, sometimes in patches with an unknown sulfosalt of Pb-Ag close to $Pb_4(Ag,Hg)_2(Sb,As)_8S_{17}$ in composition. Stibnite may also be cut by threads of cinnabar which are intimately intergrown with unresolvable gold (less than $\frac{1}{2}\mu$).

CA-007

The original rock was a porphyry, or a porphyroblastic metamorphic, possibly an andesite, and it may have been effusive or hypabyssal. The outlines of squarish phenocrystals are still clearly visible but other textural data have been lost owing to intense epizonal alteration.

The "phenocrysts" are replaced <u>in situ</u> by a fine scaly paste of sericite. The matrix is replaced by a patchy mix of cryptocrystalline and cloudy orthoclase and very fine grained sericite. The distribution of these minerals and their coloring by colloidal debris defines cryptic textures.

The rock is cut by occasional younger shears and sericite is drawn into foliation in these. Cracked sulfide crystals in the vicinity may be healed by fibrous quartz whereas carbonates rimming some sulfide grains appear to be older.

Sharply euhedral arsenopyrite prisms are disseminated in the gangue. They lie in the plane of foliation but are randomly oriented within it. Pyrite is more rare and it is an older sulfide, occurring as round beads locked in both gangue and in arsenopyrite. No other reflective phases were found.

CA-010

The rock is a silicified breccia in which the majority of fragments seem to have been porphyritic rocks initially. Mild shearing accompanied the brecciation and was followed by intense epizonal silicification, so that textures are obliterated.

Shears are filled with lenses of shreddy, crudely foliated sericite, the foliation often diverted around larger fragments. The porphyries are replaced wholly by a jigsaw-puzzle mosaic of quartz grains. Finer quartz clouded with sericite replaces the matrix areas whereas feldspar phenocrystals are replaced by coarser, clearer quartz. Leucoxene is an accessory in the sericitic matrices of these fragments.

Pyrite is the dominant sulfide here and it occurs as curious hollow rings from 0.03 to 0.005mm in size that are disseminated throughout the fabric. Rarely are the central portions of the rings occupied by pyrite. Sphalerite occurs as larger (0.1mm) blotches in the gangue, spatially unassociated with pyrite. The cores of pyrite rings are sometimes occupied by ramdohrite (a Pb-Ag-Sb sulfide) or by Ag-rich tetrahedrite.

CA-011

The rock is a sheared breccia of uncertain origin. Some fragment domains display faint relic textures suggestive of porphyries, others show no recognizable features at all. Intense alteration preceding shearing has destroyed most of the original features.

Some fragments are dense cloudy chert, others are coarser

CA-011 con't.

grained quartz with sericite in the interstices or engulfed in the quartz. It is in some of these domains that rectangular patches of especially coarse quartz, free of inclusions, seems to represent former feldspar grains. Pockets of shreddy sericite have been drawn into tortuous foliae that wind around the fragments or are squeezed into extensional fractures. Most of the sulfide present occurs in these features and it appears to post-date the deformation. Some pyrite grains are mantled by curious fibrous quartz.

Pyrite is widely but sparingly disseminated both as small rounded anhedra and as larger (0.1mm) crude cubes. The smaller grains are also to be found as inclusions in sphalerite, which occurs as irregular crystalloblasts up to 0.2mm in size. In one instance a larger pyrite crystal is cut by tendrils of galena, and more commonly there is tetrahedrite within pyrite. It fills the irregular cores of rounded or ring-like pyrite grains of small size. Analysis of the tetrahedrite shows substantial Ag-Zn-Fe in substitution for its Cu, but little or no As.

CA-012

The rock is a breccia, the protolith now uncertain. Its textures have been modified by intense epizonal alteration that largely preceded but also followed brecciation.

Most fragments consist of coarse, strained quartz crystals that are slab-like anhedra, packed in parallel, with very fine grained sericite in the interstices. The sericite is not at all foliated and it seems to have replaced an earlier aluminosilicate. The orientation of the fragments is random in a matrix of directionless, cherty-textured quartz, again with sericite in the interstices. Dust-like sulfides color matrix grain boundaries but are absent in the fragments. Calcite is a minor matrix accessory.

Pyrite is evenly disseminated as minute grains 5μ to 0.02mm in size. The larger grains are found in the sericite that is interstitial to the quartz gangue. The only other reflective phase found is galena which occurs as tiny (1-5μ) beads in the cores of larger pyrite grains and rarely as larger patches filling microcracks in the quartz.

CA-013

The nature of the protolith is uncertain though an equigranular hypabyssal intrusive of intermediate composition is a possibility. Textures have been virtually destroyed by very intense epizonal alteration.

The rock is replaced about equally by quartz and sericite. Quartz grains are crudely prismatic, interlocking in random orientation. Very fine grained sericite packs interstitial

CA-013 con't.

space and often is concentrated within crudely rectangular domains. It also replaces an earlier foliated mineral that was squeezed through the fabric prior to alteration. Sulfides tend to follow these foliae but the coarsest grains lie within areas where quartz growth is strongest.

Sulfides are abundant and coarse grained in this sample, including pyrite as crude cubes and clusters of them to 1mm in size or more. Pyrite is an early sulfide, and so, too, is arsenopyrite which occurs rarely as sharply euhedral prisms isolated within the gangue. Other sulfides tend to cluster around or envelop pyrite and they include sphalerite, tetrahedrite, and galena in paragenetic succession. Sphalerite hosts irregular exsolution patches of chalcopyrite and is rimmed or corroded by tetrahedrite, a mineral of composition like that found in Ca-012. Galena then coats and veins both tetrahedrite and sphalerite.

CA-014

The nature of the protolith is uncertain though a sediment, metamorphosed to an aluminosilicate assemblage seems possible. The last event, intense epizonal alteration, has blurred earlier textures and destroyed the prograde mineralogy.

The rock now consists of quartz and sericite. Quartz grains tend to be concentrated in lenses and bands suggestive of bedding, their grain size and texture varying from one domain to another. Fine grained sericite packs the interstitial spaces. In places it seems to replace a former prismatic mineral; in other cases it has replaced foliated silicates that follow the bedding structure. Fine grained sulfides tend to be lodged in sericite that has replaced certain foliae.

Pyrite is sparingly present as small (0.01 - 0.02mm) crudely cubic grains that are disseminated in the foliation in vague stringers, and the grains are almost invariably embedded in the sericite, not the quartz. The only other reflective phase found is galena which is present as micron-size beads floating as inclusions within a few pyrite crystals.

CA-015

The rock now consists almost solely of sericite and there is little evidence of protolith owing to the intense alteration event that produced the sericite.

The sericite occurs in patches of slender rectangular outline, sometimes in parallel, sometimes in random orientation. Equally fine grained but disorgenized sericite packs the interstitial spaces. The rectangular patches are clearly pseudomorphs - the host crystals could have been plagioclase or an aluminosilicate. Small quartz crystalloblasts are rare in the interstices. Dust-like sulfide grains cloud the disorganized

(interstitial) sericite. They are absent in occasional cross-cutting bands of sericite that are packed into the young fractures. Analysis of this sericite shows a higher Si content than that comprising the bulk of the rock.

Pyrite is the only sulfide found in this sample and it is thickly dispersed as minute (2-10μ) grains that are hollow rings of irregular oval outline. Analysis of sericite within the rings shows a notably high Ti content in comparison with the sericite outside in the general matrix.

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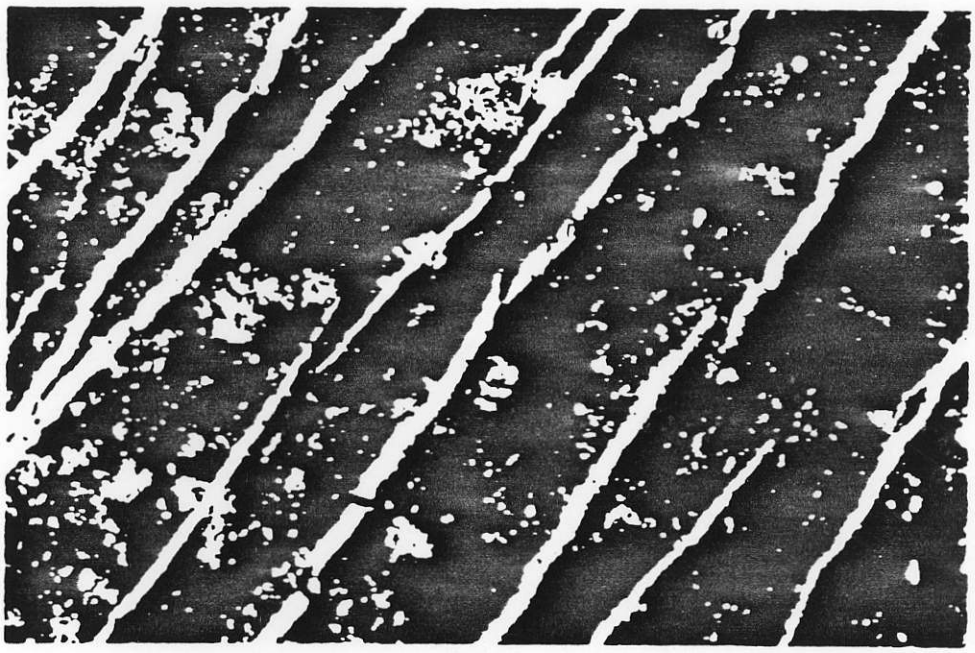
XES GEOCHEMICAL ANALYSIS

pulp	sample #	Fe	Cu	Zn	Hg	As	Tl	Pb	Mo	Mn	Ag	Sb	Ba		
	CA-001	5.78%	86	<10	97	2.08%	6	45	27	436	33	352	0.14%		
	CA-002	0.36%	75	96	144	1.37%	<5	38	15	265	24	0.30%	24		
	CA-003	2.19%	84	154	71	0.23%	35	11	27	<50	64	0.15%	0.10%		
	CA-004	0.96%	90	108	68	3.48%	61	<5	39	<50	15	585	0.16%		
	CA-005	0.98%	197	474	403	38.6%	<5	64	26	388	<2	0.45%	624		
	CA-006	0.28%	17	0.14%	892	0.12%	<5	220	23	0.11%	29	32.1%	55		
	CA-007	1.31%	27	<10	<10	0.86%	20	12	55	<50	22	96	0.14%		
	CA-010	1.09%	26	0.13%	<10	552	17	246	<2	<50	173	588	459		
	CA-011	0.84%	97	13	<10	195	28	59	<2	<50	131	170	464		
	CA-012	0.43%	37	22	<10	59	31	214	<2	<50	5	23	219		
	CA-013	1.08%	0.13%	0.48%	34	274	68	0.13%	16	<50	850	670	259		
	CA-014	0.39%	28	<10	<10	31	7	65	<2	<50	2	13	369		
	CA-015	1.83%	140	<10	33	198	21	28	<2	<50	18	71	406		

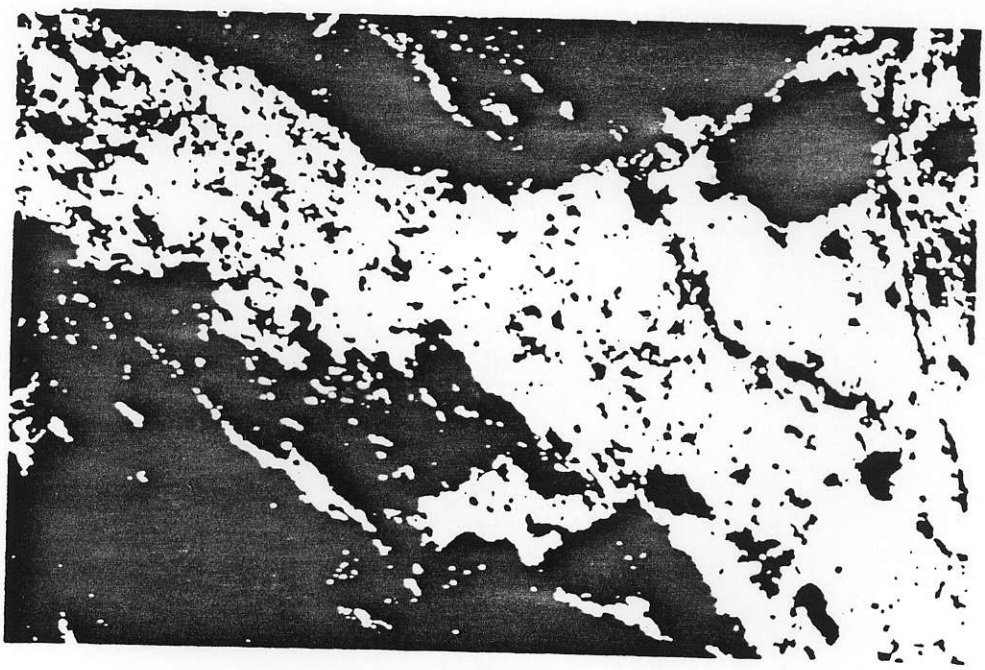
values in ppm unless % is specified

TS 1



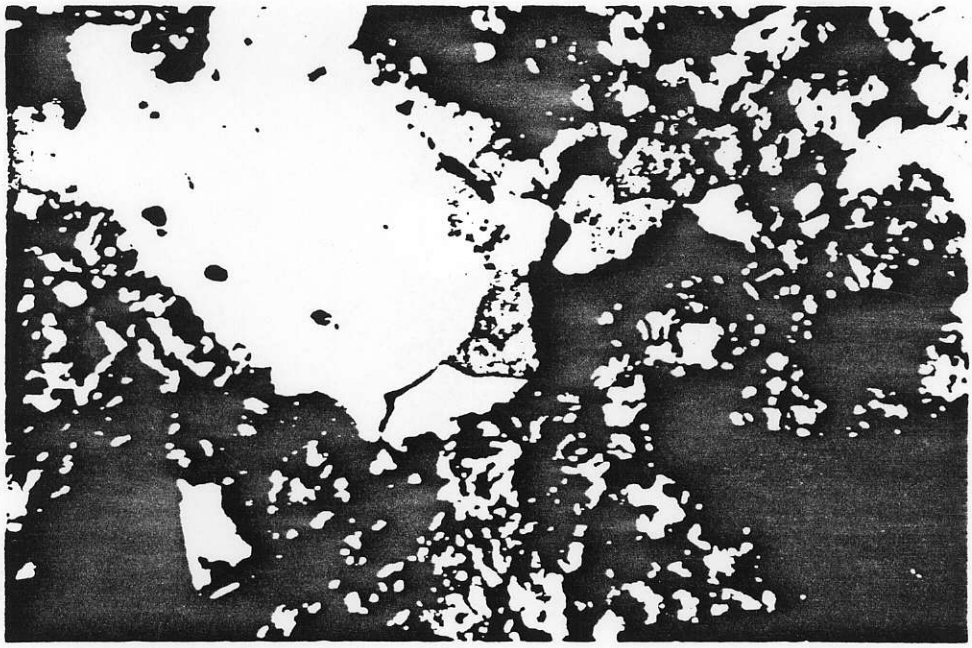
Sample CA-002 at 35X, Plane Polarized Light. Brown chert with numerous small fragments oriented about E-W. Black prisms of arsenopyrite lie in the chert. Numerous calcite veinlets in parallel cut obliquely across bedding. The length of a photograph at 35X represents 4mm.

TS 2



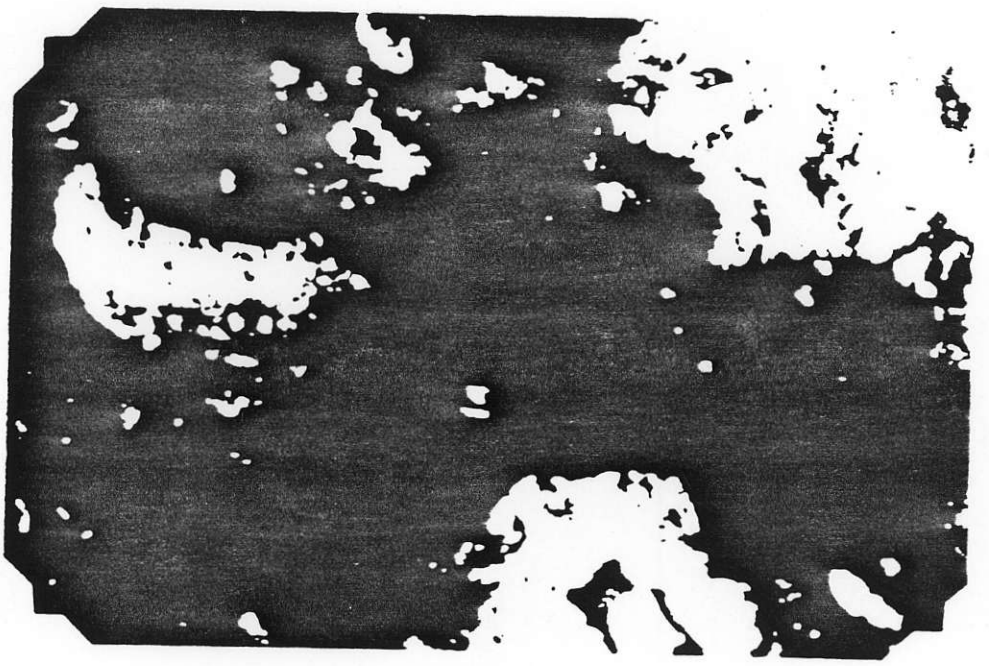
Sample CA-003 at 100X, Crossed Nicols. The dark areas are cherty laminae, cut and detached in a folia of sericite. The photograph represents a length of 1.5mm at 100X.

TS 3



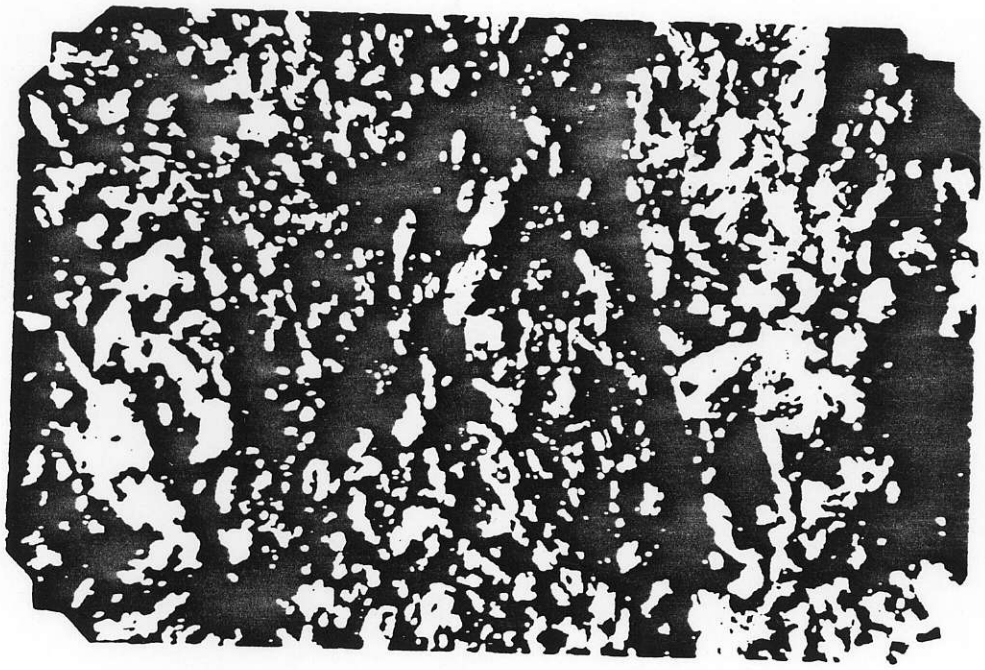
Sample CA-004 at 35X, Crossed Nicols. A patch of granular quartz (white, yellow) mantled by scaly phlogopite. Dark areas are unrecrystallized chertstone.

TS 4



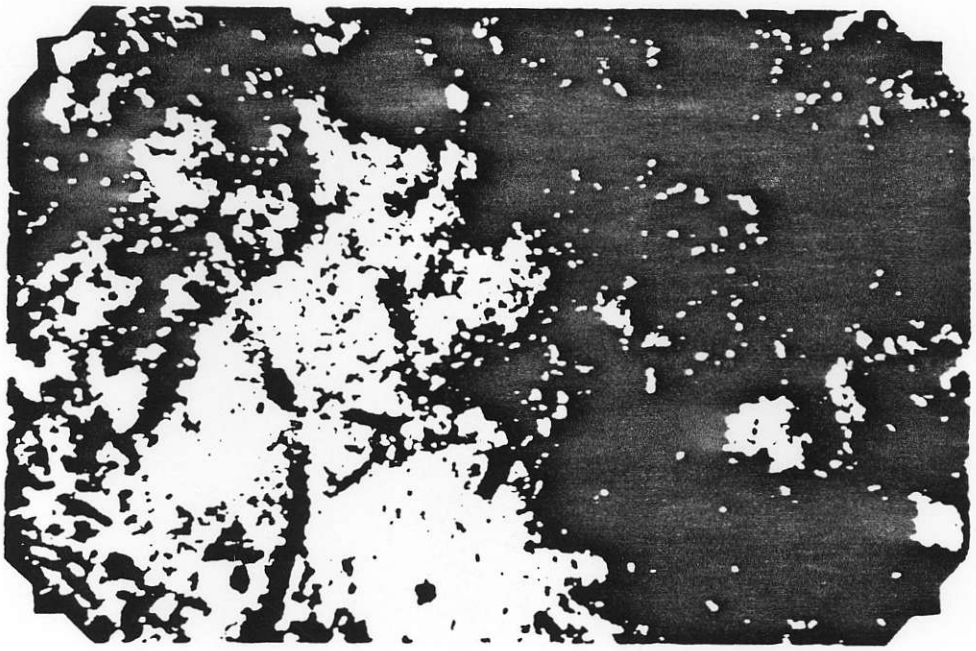
Sample CA-005 at 100X, Crossed Nicols. Dark reddish is the realgar matrix. Two patches of quartz-phlogopite are visible and another one (top) is mainly granular quartz.

TS 5



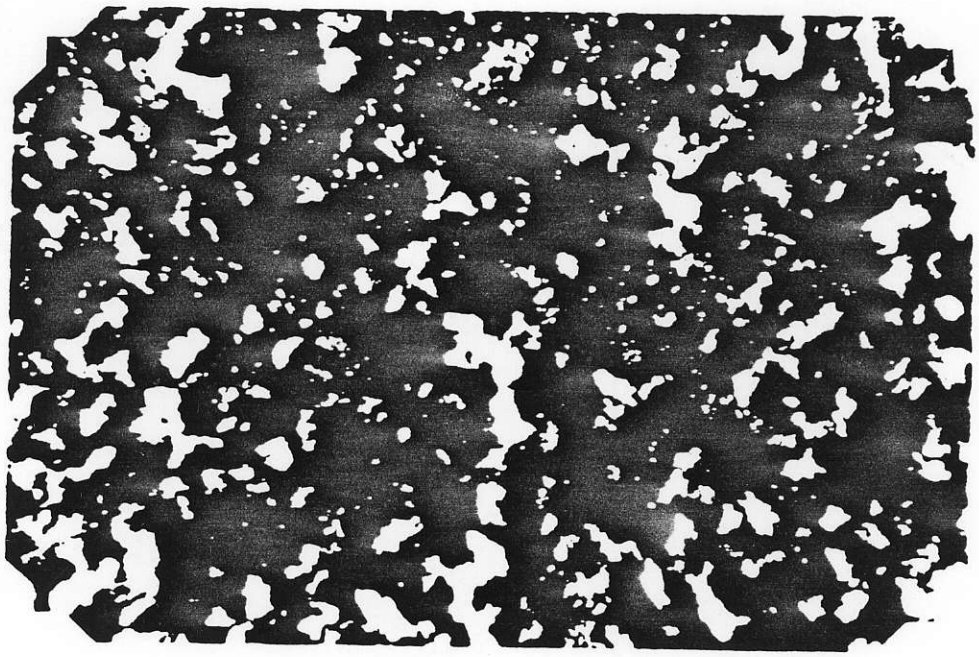
Sample CA-006 at 35X, Crossed Nicols. All colored areas are patches of muscovite scales and the black is sulfide between the muscovite patches and filling fractures.

TS 6



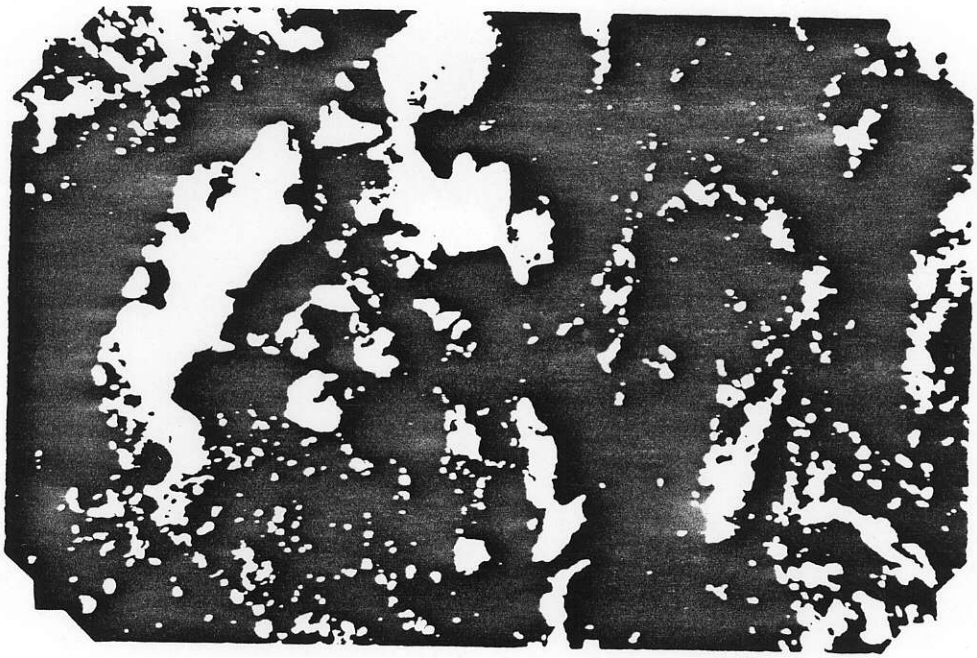
Sample CA-007 at 35X, Crossed Nicols. Several light colored squarish patches of sericite pseudomorphous after plagioclase or an aluminosilicate. Darker area to left is orthoclase-sericite. The black prisms are arsenopyrite.

TS 7



Sample CA-010 at 35X, Crossed Nicols. A general view showing the small interlocking quartz grains, their boundaries clouded with very fine grained sericite.

TS 8



Sample CA-011 at 35X, Crossed Nicols. A patch of coarse quartz (right center) rimmed with sulfide (black). To the left are deformed quartz domains interlayered with quartz-sericite matrix.

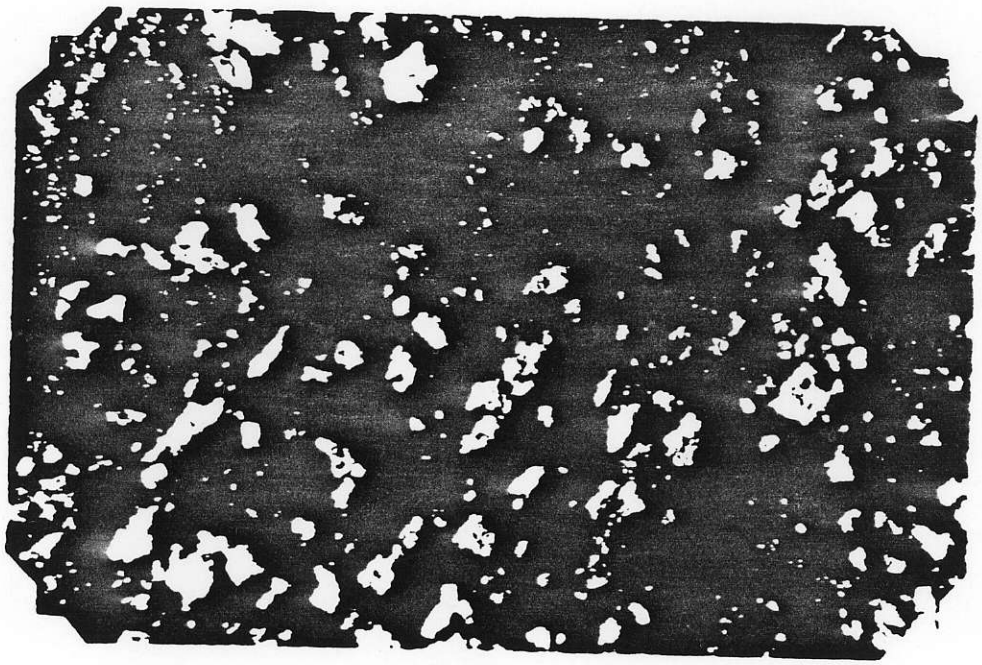
TS 9

Sample CA-012 at 35X, Crossed Nicols. One of the fragments composed of quartz laminated in parallel with a paste of very fine grained sericite in the interstices.

TS 10

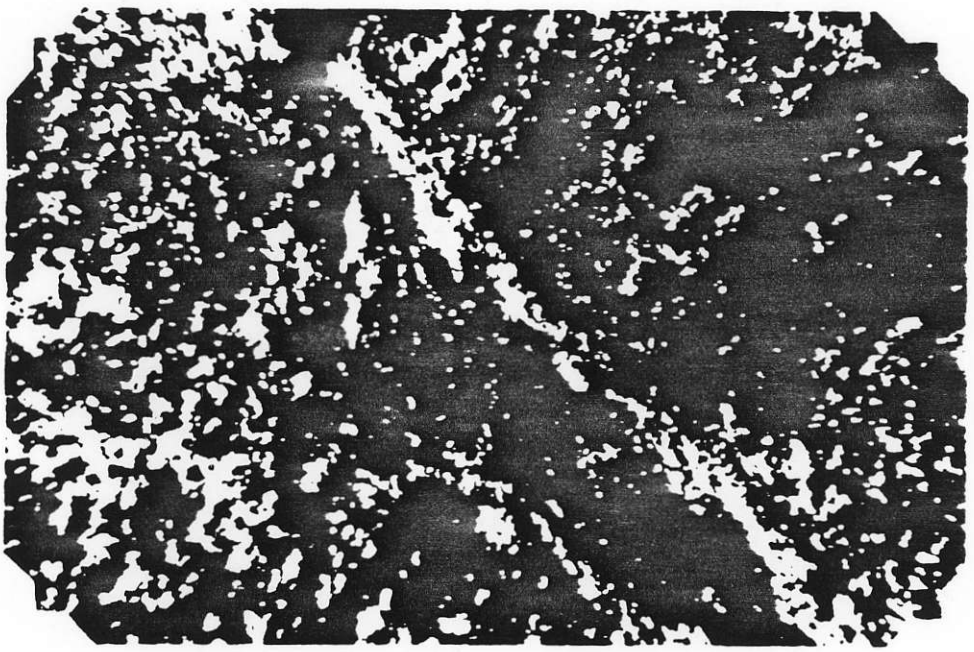
Sample CA-013 at 35X, Crossed Nicols. A general view of interlocking quartz grains and very fine grained interstitial sericite. The black grains are sulfides.

TS 11



Sample CA-014 at 35X, Crossed Nicols. Quartz grains (yellow or white) and abundant and very fine grained sericite which sometimes is visible as vaguely rectangular patches.

TS 12

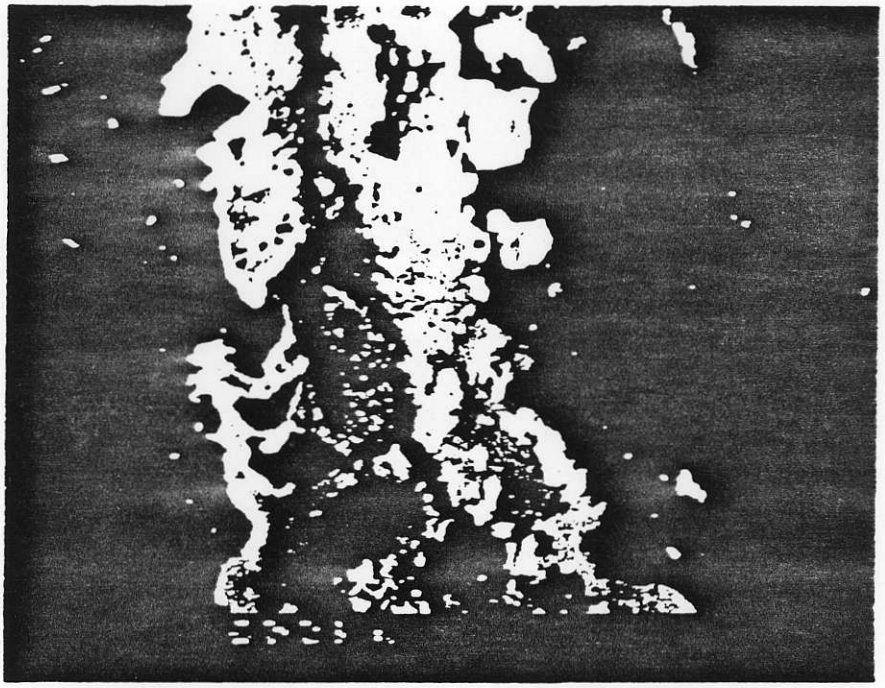


Sample CA-015 at 35X, Crossed Nicols. Fine grained sericite with (black) clouds of tiny sulfide grains. They are absent in the sericite-packed seams cutting diagonally cross the photo. It is this younger sericite which is more silica - rich than elsewhere.

Photo 001

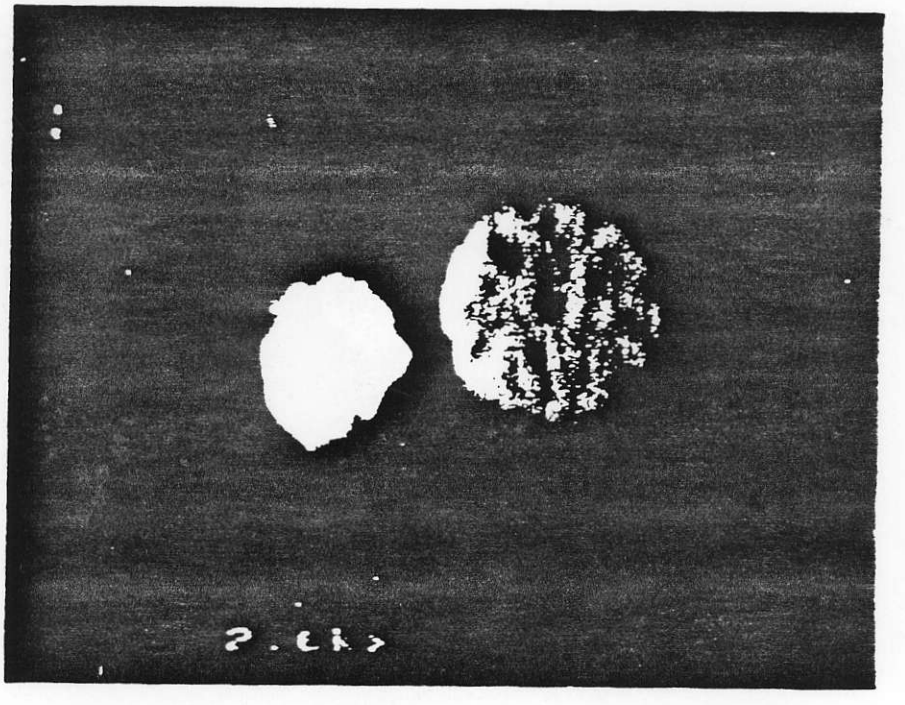
Sample CA-001 at 270X, BSE image. Field width is 500μ. The white prisms and rhombic sections are arsenopyrite. Also visible are small (and greyer) spherules of pyrite (e.g. SE corner).

Photo 002



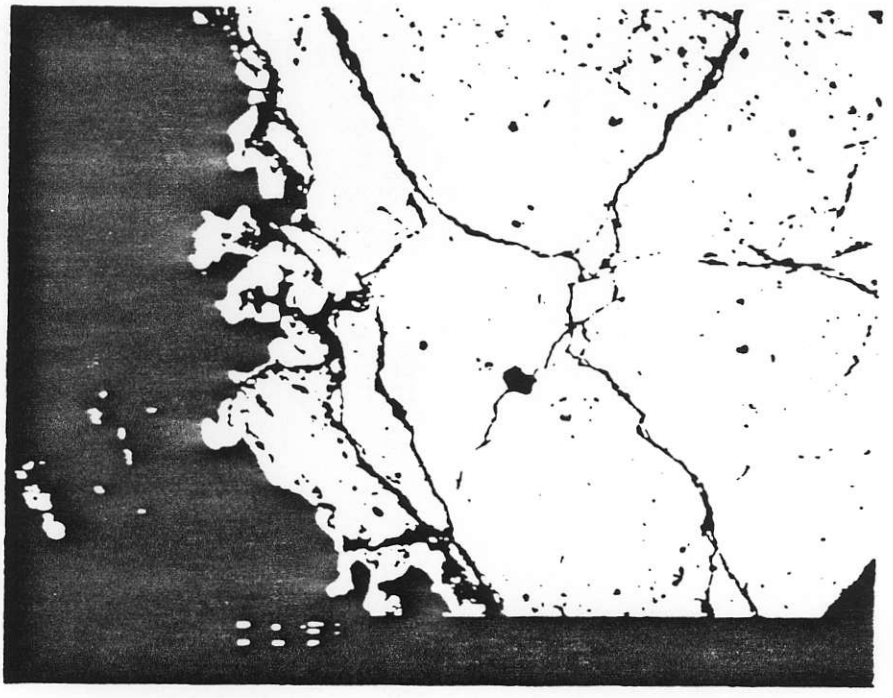
Sample CA-002 at 53X, BSE image. The field width is 0.2mm. Black is quartz gangue cut by a complex vein with native arsenic rims on realgar (duller grey interior masses). Embedded in the realgar are stibnite grains (same shade of grey as native arsenic) hosting tiny (white) cinnabar inclusions.

Photo 003



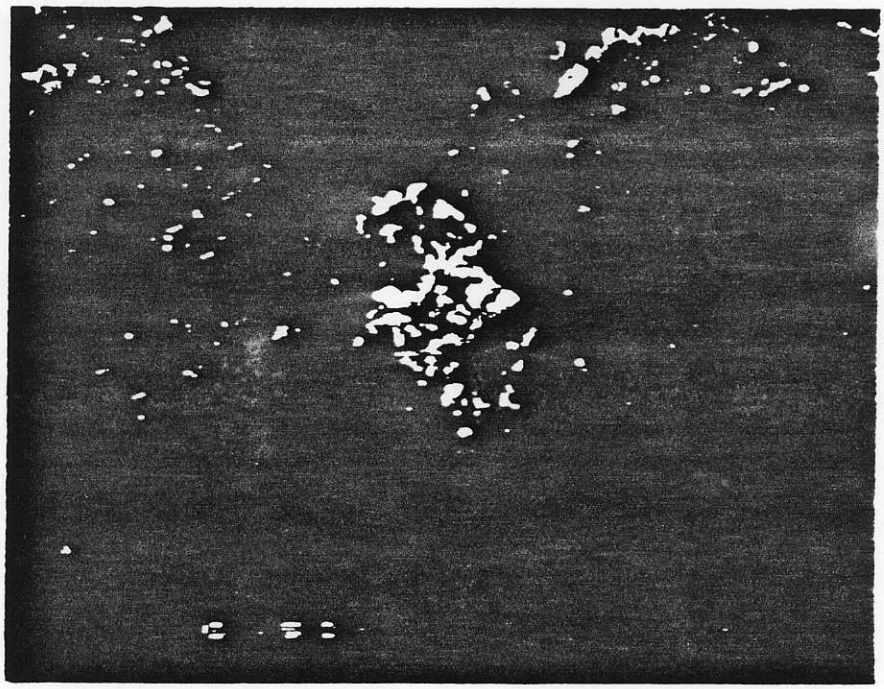
Sample CA-003 at 2600X, BSE image; field width is 40μ. The black is gangue, and the white patch is stibnite to the left of a spherule of pyrite. Such grains are disseminated very widely, (plus equally small euhedral arsenopyrite prisms).

Photo 004



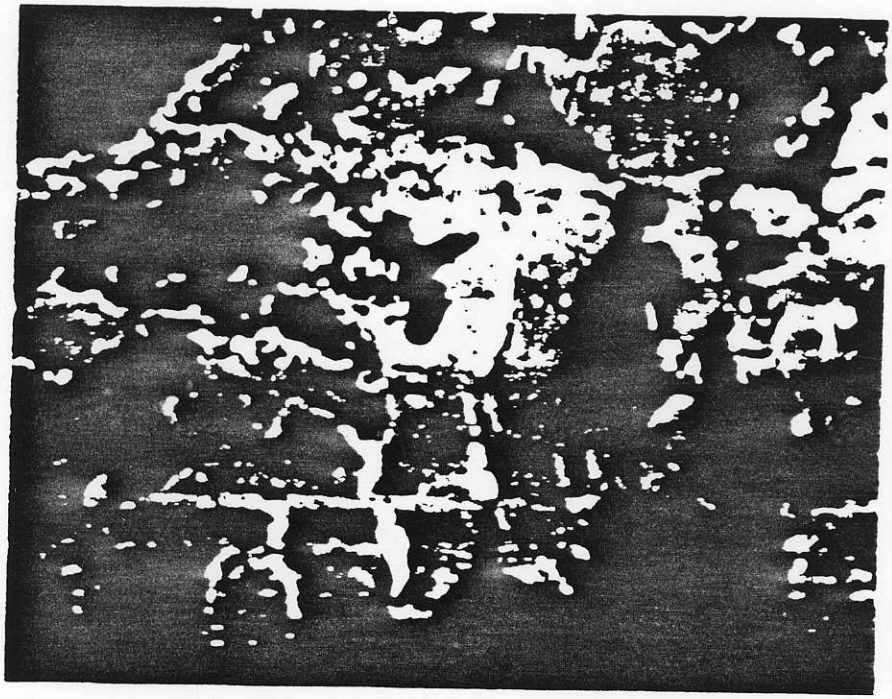
Sample CA-004 at 16X, BSE image. Black is quartz and the large grey mass is realgar rimmed with native arsenic at the left. Small (bright, nearly white) stibnite inclusions are just visible in the realgar.

Photo 005



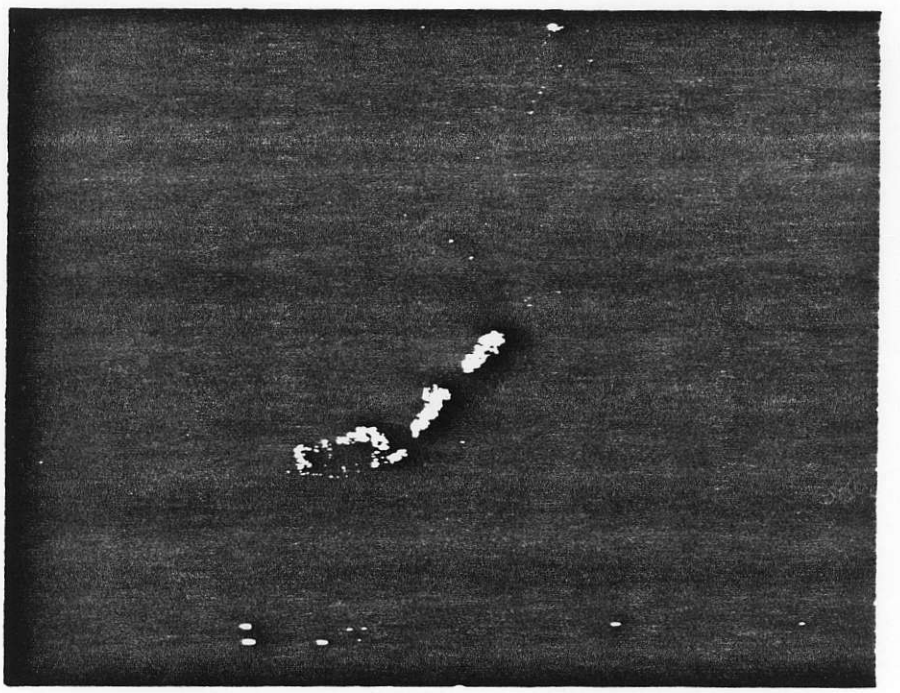
Sample CA-005 at 500X, BSE image. The black is gangue, dark grey is realgar. In the center is an irregular patch of (late) stibnite (grey) with a 4μ white grain of cinnabar enclosed.

Photo 006



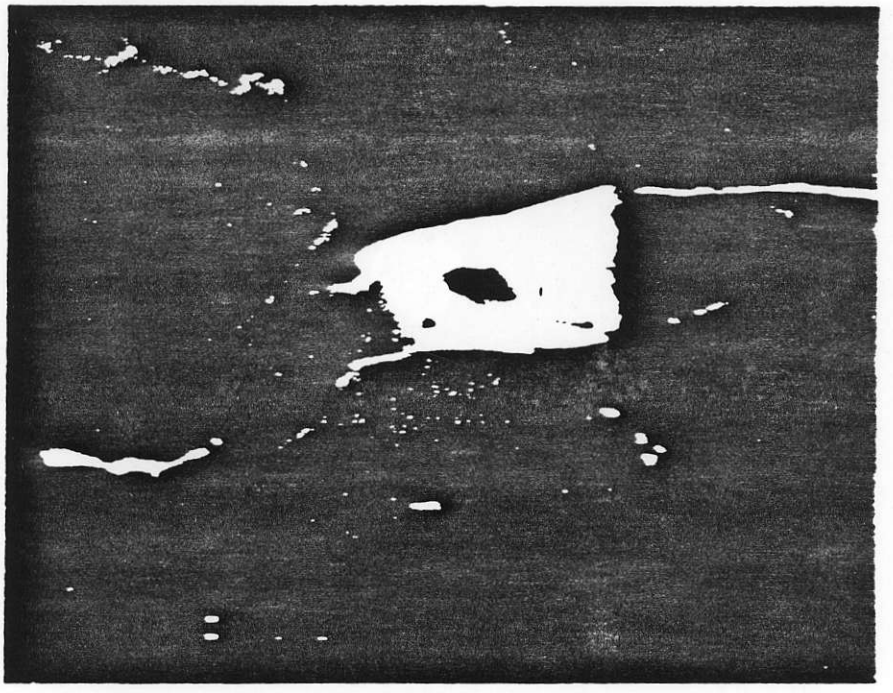
Sample CA-005 at 750X, BSE image. The black is realgar, the grey irregular mass is corroded stibnite which is cut by (white) threads of cinnabar intimately intergrown with gold.

Photo 007



Sample CA-006 at 1500X, BSE image. The dull grey is stibnite with an irregular patch (slightly lighter grey, to the NE) of an unknown Pb-Ag-Sb sulfosalt). The lightest colored grains near the center are cinnabar.

Photo 008

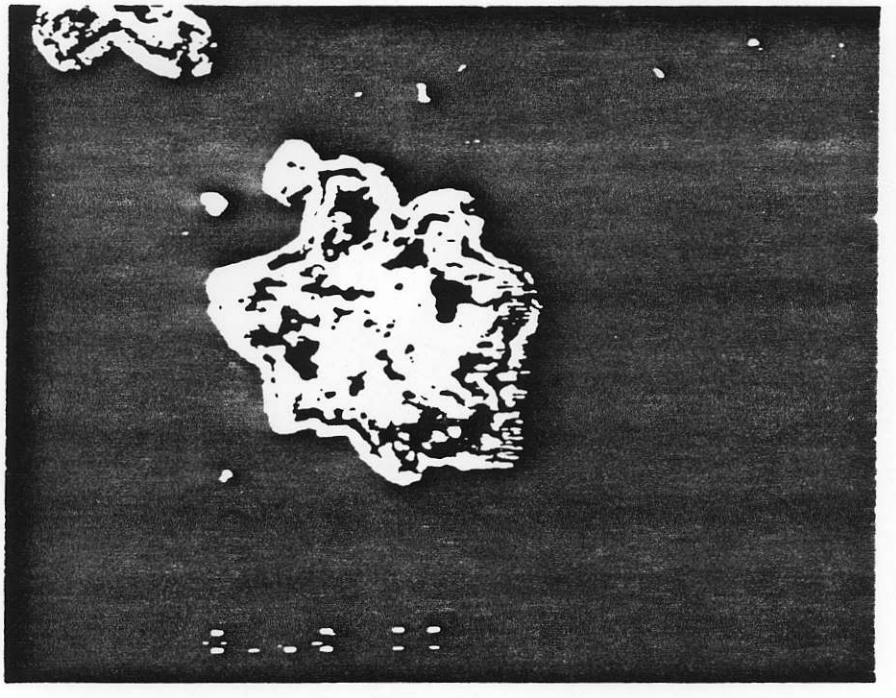


Sample CA-006 at 730X, BSE image. Black is gangue and grey is stibnite. A white cinnabar grain in the center is linked to hairline threads of cinnabar intermixed inextricably with gold, but no gold was found in the larger patch of cinnabar.

Photo 009

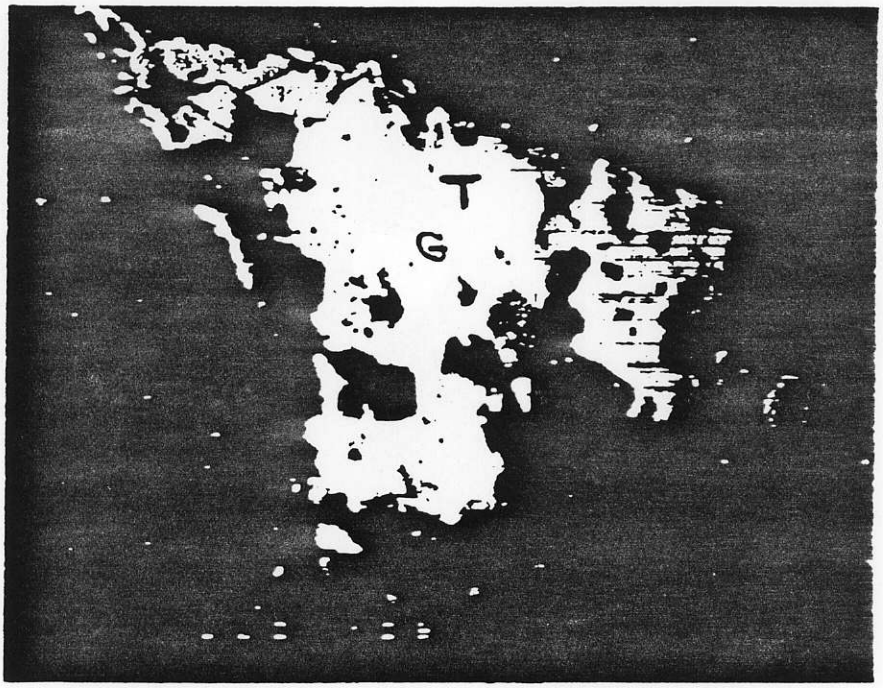
Sample CA-007 at 73X, BSE image. A general view showing the (dark grey) sericite gangue and (white) arsenopyrite prisms floating within it. The photo is electronically flawed (horizontal streaks).

Photo 010



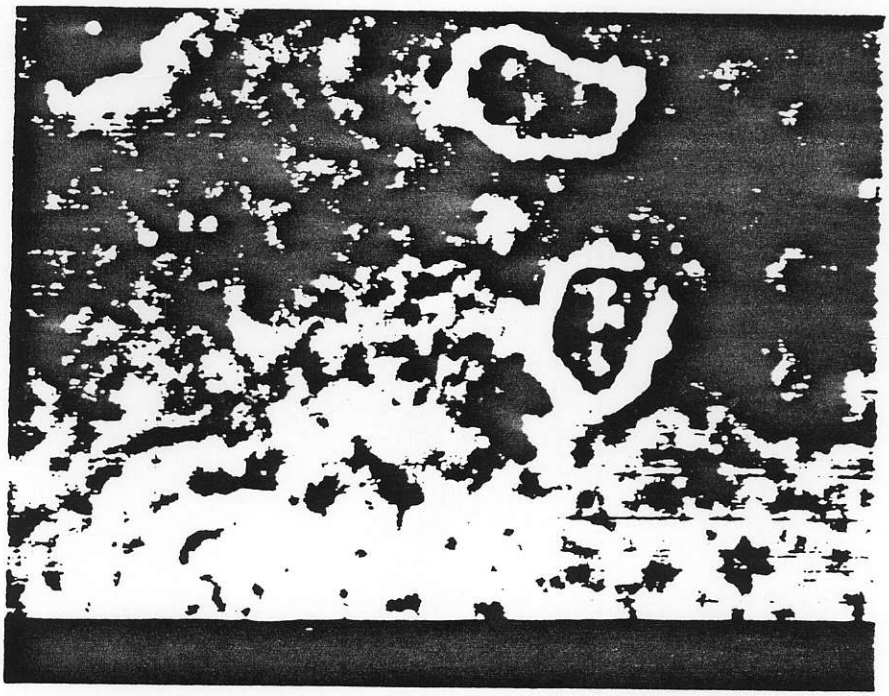
Sample CA-010 at 500X, BSE image, showing black gangue hosting ring-like pyrite (grey). The interior of the grain is filled with more pyrite and (white) ramdohrite. Tetrahedrite may occur in similar fashion in other grains of pyrite.

Photo 011



Sample CA-013 BSE image at 150X. Dull grey is gangue hosting an irregular patch of sulfides. The dullest grey (e.g. isolated grain at right edge) is pyrite (P). Some occurs in the large irregular patch of tetrahedrite (T) with sphalerite (S) and galena (G).

Photo 012



Sample CA-015 at 1770X, BSE image showing the (white) pyrite rings floating in sericite matrix.