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Mineralogy Section Report No. 87-91

MINERALOGICAL INVESTIGATION OF A GOLD-SILVER ORE FROM THE PROPERTY OF
NEWHAWK GOLD MINES LTD., MITCHELL-SULPHURETS AREA, NORTHERN BRITISH
COLUMBIA

by

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SUMMARY OF RESULTS

The gold occurs as native gold with an average Au:Ag ratio of 1:1 that is electrum. The silver occurs chiefly as pyrargyrite, silver-bearing tetrahedrite, polybasite, native silver and less common acanthite and stephanite. Associated ore minerals are major pyrite and sphalerite with minor galena and trace amounts of chalcopryrite and pyrrhotite. Most pyrite grains are poikiloblastic with fine grained inclusions of native gold, tetrahedrite, sphalerite, galena, chalcopryrite, pyrrhotite, rutile, apatite and other gangue minerals. Less common inclusions are pyrargyrite, polybasite, native silver, acanthite and stephanite.

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INTRODUCTION

As part of a new project on the lithogeochemistry and mineralogy of the Mitchell-Sulphurets District, Stewart area, Northern British Columbia, Mr. Ken Hicks, Newhawk Gold Mines Ltd. provided rock samples from the west zone underground of their property. The samples were received in May, 1987 and they represent a series of wall chip samples from two crosscuts in the west zone of an orebody that is located near Brucejack lake. The sample numbers, their location and gold/silver assays are listed in Table 1 and the Au and Ag assay data are plotted in Figures 1 and 2.

METHOD OF INVESTIGATION

The samples as received were quartered, with one quarter crushed for geochemical whole rock analyses (to be reported in a separate study by S.B Ballantyne) and another quarter crushed to pass -60 mesh (250 um) for heavy liquid separation using methylene iodide (sp. gr. 3.32) to aid in the identification of the ore minerals. Polished sections were made from all of the concentrates and these were examined under an ore microscope to identify the minerals and to study any intergrowths that are present in the crushed samples. Mineral compositions were obtained by electron-microprobe analyses of the polished sections. The float fraction of the heavy liquid separations were used for X-ray diffractometry to assist in the identification of the principal gangue minerals.

GENERAL DESCRIPTION OF THE SAMPLES

Most of the samples consist of a siliceous matrix with quartz, k-feldspar, albite and muscovite as the principal gangue minerals. Other associated gangue minerals are calcite, dolomite and barite which is a major component in some sink fractions, zircon and apatite. Rutile is the principal oxide mineral with rare hematite and magnetite as inclusions in pyrite. The elements of interest are gold and silver with the gold restricted entirely to native gold of electrum in composition, the silver occurs in the form of major pyrargyrite, silver-bearing tetrahedrite, polybasite, native silver and trace amounts of acanthite and stephanite. Minor silver also occurs with the electrum and within galena that is a minor sulphide. The principal sulphides are pyrite and sphalerite with minor to trace amounts of galena, chalcopyrite and rare pyrrotite

DETAILED DESCRIPTION OF ORE MINERALS

Pyrite is the chief sulphide mineral. It occurs mainly as poikiloblastic grains which contains inclusions of gangue minerals, particularly apatite, ore minerals of chalcopyrite, pyrrhotite, native gold (Figure 3A,B), tetrahedrite, galena, sphalerite and less frequently pyrargyrite, polybasite, acanthite and stephanite. From an examination of pyrite from all the samples, the inclusions of native gold and the silver minerals indicates that recovery of the pyrite is important and fine grinding is required to liberate the inclusions.

Sphalerite is the second most abundant sulphide, and it is fairly coarse since most grains in the -60 mesh fraction occur as liberated grains. The sphalerite is generally free of inclusions, but frequently it forms as an intergrowth with tetrahedrite, galena and polybasite or pyrargyrite. Native gold was rarely observed as an inclusion in sphalerite.

Chalcopyrite and pyrrhotite are present in all samples. Chalcopyrite occurs as tiny inclusions in pyrite and less frequently as inclusions in sphalerite and with tetrahedrite. Pyrrhotite was only observed as tiny inclusions in pyrite.

Galena is a minor constituent and in some samples from the 51+00S XC, it is a major constituent where it occurs as free liberated grains. It commonly occurs as inclusions in pyrite, associated with sphalerite and with tetrahedrite, pyrargyrite or polybasite. Microprobe analyses (Table 5) indicates that the mineral contains trace amounts of Ag, Sb, Bi and Se. The variation in the elements for several grains within the same polished section indicates that the trace elements may be due to minute inclusions and not as solid solution substitution in the galena. Further study using etching and the scanning electron microscope would be necessary on non-crushed samples to determine whether the variation is due to inclusions.

Native gold is the only source of gold and microprobe analyses (Table 4) indicates that its average composition is close to that of electrum with a fineness of 64.5 or an Au:Ag = 1:1. It was observed as coarse free grains (Figure 3c), as several hundred micrometre inclusions in quartz, as fracture filling in pyrite and frequently as less than 20 micrometre inclusions in pyrite (Figures 3a,b). The coarsest gold grains were observed in samples 43089 and 43090, 51+00S XC together with coarse native silver and in sample 43115, 50+50S XCE.

Silver Minerals

Tetrahedrite is widespread and it occurs in most of the samples. Electron-microprobe analyses (Table 3) indicates a range of silver contents from 5.6 to 36.0 wt.% Ag with a mean value of approximately 20 wt.% Ag. It occurs frequently as liberated grains in the -60 mesh fraction, as inclusions in pyrite, as intergrowths with galena, pyrargyrite and sphalerite and as rims on native silver. In samples of low silver assays, it is the principal silver mineral.

Pyrargyrite, polybasite and native silver are important silver minerals and for those samples with high silver assays, one or more of these minerals are responsible for the silver values. Sample 43090, 51+00S XC that assayed 290.54 oz/t Ag contains abundant coarse pyrargyrite and native silver (Figure 3d) whereas sample 43107, 50+50S XCE that assayed 21.79 oz/t Ag contains coarse polybasite as the principal silver mineral. Microprobe analyses of the silver sulphosalts are given in Table 3. Stephanite and acanthite are rare in the samples examined and are not a major source of silver.

Gangue Minerals

X-ray diffractometer analyses of the principal gangue minerals in the float fractions are listed in Table 6. Quartz is present in all samples and is therefore not listed in Table 6.

CONCLUSIONS

The principal gold mineral is electrum and the principal silver minerals are tetrahedrite, pyrargyrite, polybasite and native silver. Less common silver minerals are acanthite and stephanite. Trace amounts of silver occur with galena, but it is not a significant source of silver. Although electrum occurs as coarse grains, several inclusions were noted in pyrite together with tetrahedrite and galena. Pyrite and sphalerite are the chief sulphide minerals and sphalerite is generally free of inclusions.

DRIFT 51+00S XC

43086 0.0-2.0 0.005Au/0.58Ag

mostly pyrite with incl. pyrr, gal, cpy,rt, a few free sph.

43087 2.0-4.6 0.003Au/0.55Ag

essentially pyrite with trace incl. pyrr,gal,tetra. a couple sph grains.

43088 4.6-6.4 0.045Au/4.32Ag

mainly pyrite w/incl.gal, tetra, pyrr, tr. hem,mag, poly.

43089 6.4-8.1 0.195Au/8.49Ag

pyrite, sph, pyrargyrite, elect, gal, tetra, acant, cpy. some coarse elect and native silver with pyrarg, cpy.

43090 8.1-9.8 1.027Au/290.54Ag

abundant pyrargyrite, py, tetra, gal, sph, poly, coarse elect, silver. some elect in sph. gal and pyrarg show mutual boundaries. Elect and Ag usually intergrowth with poly, pyrarg.

43091 9.8-12.6 0.007Au/1.20Ag

poik. py, incl.pyrr,cpy,rt, trace sph, tetra, gal.

43092 12.6-14.6 0.011Au/1.78Ag

py with incl. gal, tetra. Trace hem,mag in py. Trace tetra, sph.

43093 14.6-15.0 0.310Au/24.15Ag

insufficient material

43094 15.0-15.9 0.277Au/3.99Ag

poik py, minor sph, some gal,tetra, small elect in py. tetra w/sph

43095 15.9-17.5 0.752Au/40.00Ag

py, sph,gal,tetra, coarse pyrargyrite, poly, acant, several elect in py fractures, coarse native Ag. se-poly

43096 17.5-18.9 0.060Au/5.73Ag

py, sph, minor tetra, gal,step.

43097 18.9-20.7 0.010Au/1.51Ag

poik py,minor sph, tr. gal, tetra. pyrr,cpy incl in py.

43098 20.7-22.7 0.015Au/4.27Ag

py w/cpy,pyrr; free sph some w/tetra, a few gal, tetra, tr. pyrarg.

43099 22.7-24.3 0.025Au/1.88Ag

mainly py w/incl pyrr,gal,sph,cpy, tr. sph.

43100 24.3-25.6 0.055Au/10.92Ag

mainly py, tetra, sph, gal, pyrarg, free tetra and w/sph,gal. some barite. Tr. step.

43101 25.6-27.0 0.018Au/1.03Ag
py w.incl. gal.tetra, pyrr, some free sph.

43102 27.0-29.0 0.030Au/0.68Ag
poik py w/pyrr,cpy,gal,tetra. some free sph, gal, tetra. 20um
elect in pyrite.coarse rt.

43103 29.0-31.3 0.005Au/1.45Ag
py, sph, tr. gal, tetra as incl. in sph, abut py.

DRIFT 50+50S XCE

43104 0.0-2.0 0.085Au/0.66Ag
poik py, minor sph, trace tetra, gal, incl cpy,pyrr in pyrite,
some cpy in sph. gal and tetra mainly as free grains. 15x50 elect
in py.

43105 2.0-3.6 0.134Au/12.44Ag
poik py, trace free tetra, gal, sph.

43106 3.6-5.0 0.003Au/0.65Ag
poik py, few sph, a few incls in py.

43107 5.0-6.8 0.072Au/21.79Ag
poik py w/incls gal, pyrr, rare tetra,elect. sph sometimes
intergrown w/gal,tetra. gal freq.w/tetra,pyrarg. abundant poly,
micron elect w/gal in py. gal younger than sph.

43108 6.8-9.8 0.011Au/0.73Ag
poik py, some free gal,sph,pyrarg, incl pyrr,cpy,gal,sph in py. a
couple tetra. 5um elect in py. one coarse pyrarg.

43109 9.8-11.6 0.007Au/1.34Ag
poik py, some sph, a couple tetra, tr. gal., cpy, rt.

43110 11.6-13.6 0.004Au/0.81Ag
mainly py w/some incl.pyrr,cpy,gal,tetra. minor free sph.

43111 13.6-15.0 0.005Au/0.34Ag
mainly py,w/incl. pyrr,gal,rt,cpy. a few sph

43112 15.0-16.6 0.024Au/1.39Ag
poik and non poik py, some sph,tetra,gal, tr.pyrr and mag in py.

43113 21.5-22.0 0.022Au/1.36Ag
all py w/some incls pyrr,cpy,gal,sph,tetra. a couple sph

43114 22.0-23.5 0.052Au/5.29Ag
poik py, minor sph,tr. gal,tetra, incl. pyrr, gal, tetra
elect,cpy in py. 50um elect in gangue. several less than 15 um
elect in py.

43115 23.5-25.0 2.132Au/2.96Ag

poik py, minor sph,gal,tetra, rt. large elect 100x400 liberated and 50x200 in quartz.

43116 25.0-27.0 0.077Au/1.71Ag

poik py, minor sph, some gal, tetra,rt, tr.cpy,pyrr. 10um elect in pyrite.

43117 27.0-29.0 0.080Au/1.55Ag

poik py, minor sph,gal,tetra, several coarse tetra, elect. attached to gal and py, tetra enclosing sph. rt.

43118 29.0-31.0 0.082Au/1.10Ag

mainly py, incl pyrr, cpy, a few um elect. tr. gal. a couple free sph and tetra.

43119 31.0-33.0 0.030Au/2.45Ag

poik py, some gal,tetra, sph. rt. elect incl in py w/gal,w/cpy,w/tetra se-poly

43120 33.0-35.0 0.040Au/0.76Ag

poik py,w/numerous incl. gal,tetra,sph,pyrr,cpy. a few sph grains

43121 35.0-37.0 0.021Au/0.86Ag

poik py with incl. pyrr, some gal,tetra, a few free sph, gal,sph,tetra. one half sample is barite.

TABLE 1. SAMPLE DATA

WEST ZONE 51+00S XC

Sample No.	Sample Interval (m) (From East to West)	Fire Assay	
		Au oz/t	Ag oz/t
43086	0.0 - 2.0	0.005	0.58
43087	2.0 - 4.6	0.003	0.55
43088	4.6 - 6.4	0.045	4.32
43089	6.4 - 8.1	0.195	8.49
43090	8.1 - 9.8	1.027	290.54
43091	9.8 - 12.6	0.007	1.20
43092	12.6 - 14.6	0.011	1.78
43093	14.6 - 15.0	0.310	24.15
43094	15.0 - 15.9	0.277	3.99
43095	15.9 - 17.5	0.752	40.00
43096	17.5 - 18.9	0.060	5.73
43097	18.9 - 20.7	1.010	1.51
43098	20.7 - 22.7	0.015	4.27
43099	22.7 - 24.3	0.025	1.88
43100	24.3 - 25.6	0.055	10.92
43101	25.6 - 27.0	0.018	1.03
43102	27.0 - 29.0	0.030	0.68
43103	29.0 - 31.3	0.005	1.45

WEST ZONE 50+50S XCE

43104	0.0 - 2.0	0.085	0.66
43105	2.0 - 3.6	0.134	12.44
43106	3.6 - 5.0	0.003	0.65
43107	5.0 - 6.8	0.072	21.79
43108	6.8 - 9.8	0.011	0.73
43109	9.8 - 11.6	0.007	1.34
43110	11.6 - 13.6	0.004	0.81
43111	13.6 - 15.0	0.005	0.34
43112	15.0 - 16.6	0.024	1.39
43113	21.5 - 22.0	0.022	1.36
43114	22.0 - 23.5	0.052	5.29
43115	23.5 - 25.0	2.132	2.96
43116	25.0 - 27.0	0.077	1.71
43117	27.0 - 29.0	0.080	1.55
43118	29.0 - 31.0	0.082	1.10
43119	31.0 - 33.0	0.030	2.45
43120	33.0 - 35.0	0.040	0.76
43121	35.0 - 37.0	0.021	0.86

TABLE 2. MICROPROBE ANALYSES OF TETRAHEDRITE

WEST ZONE 51+00S XC

Sample No.	Cu	Ag	Fe	Zn	Sb	As	S
43089	16.5	30.0	3.4	3.3	21.3	3.8	22.4
	21.0	23.6	1.2	5.8	21.6	4.1	23.4
	14.3	36.0	4.8	1.0	14.3	6.6	20.1
43090	24.4	19.0	1.1	6.0	23.3	3.1	23.9
	26.4	16.8	1.8	5.1	21.4	4.6	24.4
43091	24.7	18.3	1.3	5.8	24.0	2.8	23.9
43092	22.7	20.2	1.3	5.7	24.0	2.8	23.3
43094	23.8	19.2	1.3	5.4	25.2	1.9	23.6
43095	19.9	23.8	1.0	5.5	24.3	2.0	22.5
	21.8	20.7	1.0	5.8	24.4	2.2	23.1
43098	34.2	6.7	2.0	5.2	20.2	6.7	25.4
	33.7	7.3	1.2	6.2	20.4	6.4	25.1
	33.1	7.9	1.6	5.7	20.8	6.0	25.1
43100	23.6	19.8	1.8	4.7	25.2	1.2	23.1
	24.1	19.2	1.2	5.6	23.6	2.5	24.0
	25.5	18.6	2.7	4.0	18.9	5.8	24.3
	22.8	20.3	0.9	6.1	24.5	1.8	23.3
43102	25.6	17.1	2.5	4.1	22.4	4.2	24.1

WEST ZONE 50+50S XCE

43104	32.9	8.3	1.1	6.0	16.4	8.4	25.6
	37.0	5.6	2.3	5.6	8.1	14.5	27.3*
43107	25.6	17.7	1.3	5.8	21.0	4.6	23.9
	25.8	17.8	1.7	5.1	21.1	4.5	24.4
	25.2	17.8	0.9	6.7	21.9	3.4	24.5
	28.4	13.7	1.9	4.9	21.2	4.5	24.5
43108	24.8	18.4	1.1	5.9	24.4	2.1	23.8
43114	25.9	17.8	2.2	4.6	19.6	5.4	24.6
	28.8	13.0	1.1	6.0	22.7	3.7	24.5
	26.8	16.3	2.4	4.3	20.2	5.2	24.6

(cont.)

43115	29.8	12.0	2.1	4.7	20.3	5.4	24.8
	28.5	13.0	1.9	4.7	24.5	2.4	24.2
43116	25.5	17.2	1.2	5.9	24.5	2.1	24.0
	26.9	16.2	2.3	4.4	21.4	4.5	24.4
	29.2	12.6	1.3	5.7	23.4	3.1	24.6
43117	30.4	10.1	2.2	4.4	26.1	1.7	24.5
	31.7	9.2	2.4	4.4	24.2	3.0	25.0
	29.5	11.1	2.2	4.6	26.2	1.2	24.2
	33.6	6.9	1.9	5.2	22.8	4.1	25.4
43119	26.5	14.8	2.3	4.7	24.6	1.9	24.0
	31.7	10.0	4.1	4.4	16.5	8.6	25.7
43121	24.5	18.2	1.4	5.8	23.7	2.2	23.9

* Tennantite

TABLE 3. MICROPROBE ANALYSES OF SILVER SULPHOSALTS

WEST ZONE 51+00S XC							
Sample No.	Cu	Ag	Sb	As	S	Se	Mineral
43089	-	62.5	14.2	2.9	14.9	-	Pyrargyrite
	-	60.3	19.2	2.7	18.5	-	"
	-	60.6	18.3	3.2	18.4	-	"
	-	61.0	18.4	3.2	18.7	-	"
	-	61.8	18.1	3.2	17.5	-	"
	-	86.4	-	-	12.6	-	Acanthite
43090	-	60.4	19.8	2.3	18.5	-	Pyrargyrite
	-	60.0	19.4	2.4	18.6	-	Pyrargyrite
	-	63.0	17.9	2.6	17.5	-	Pyrargyrite
	3.6	70.6	6.6	2.8	16.0	-	Polybasite
43095	-	59.5	21.1	1.2	18.0	-	Pyrargyrite
	2.8	74.0	6.8	1.3	13.0	-	Polybasite
	2.3	70.9	8.1	1.3	14.1	2.2	Polybasite
	3.1	68.3	9.0	2.0	17.2	1.3	Polybasite
	-	84.2	-	-	15.7	-	Acanthite
43100	-	58.4	23.8	1.1	16.3	-	Pyrargyrite
	-	65.4	16.5	0.5	16.3	-	Stephanite
WEST ZONE 50+50S XCE							
43107	2.9	72.1	5.4	3.1	15.9	-	Polybasite
43108	-	61.9	19.6	1.8	18.3	-	Pyrargyrite
43119	3.9	71.0	6.1	2.4	14.2	2.2	Polybasite
	1.5	72.1	5.0	2.6	20.0	1.2	Polybasite

TABLE 4. MICROPROBE ANALYSES OF NATIVE GOLD & NATIVE SILVER

WEST ZONE 51+00S XC

Sample No.	Au	Ag	Hg	Sb	Fineness	
43089	64.1	34.4	-	-	65.1	
	64.9	34.0	-	-	65.6	
	60.4	37.9	-	-	61.4	
	64.7	33.5	-	-	65.9	
	-	99.8	-	-	-	
43090	57.8	41.3	-	-	59.0	
	61.9	36.9	-	-	62.7	
	57.5	41.7	-	-	58.6	
	61.5	37.1	-	-	62.4	
	-	98.7	-	0.4	-	
	-	99.8	-	-	-	
43095	59.2	38.6	-	-	60.5	
	-	96.6	-	0.9	-	
43102	59.9	38.5	-	-	60.9	
WEST ZONE 50+50S XCE						
43104	70.5	28.1	-	-	71.5	
43107	26.9	70.5	5.7	-	-	in galena
	57.6	41.0	-	-	58.4	in sph
43114	61.7	36.9	-	-	62.6	in qtz
	60.9	36.4	0.7	-	62.6	in qtz
	67.9	30.2	-	-	69.2	10um in py
	62.8	34.6	-	-	64.5	10um in py
43115	63.7	34.8	-	-	64.7	in qtz
	63.8	34.3	-	-	65.0	in qtz
	64.1	34.8	-	-	64.8	in qtz
	63.3	34.7	-	-	64.6	20um in py
43116	59.3	38.4	-	-	60.7	10um in py
43117	66.3	32.6	-	-	67.0	
43119	51.2	48.0	-	-	52.1	10um w/cpy in py

TABLE 5. MICROPROBE ANALYSES OF GALENA

WEST ZONE 51+00S XC				
Sample No.	Ag	Sb	Bi	Se
43089	0.067	0.113	0.132	0.108
43090	0.050	0.091	-	0.035
43094	0.035	0.073	0.169	0.191
43095	-	0.051	0.125	0.151
43098	0.039	0.073	0.093	0.123
43100	0.058	0.081	0.107	0.324

WEST ZONE 50+50S XCE				
43107	0.051	0.070	-	0.060
43116	-	-	0.169	0.188

TABLE 6. X-RAY DIFFRACTION ANALYSES OF -60 MESH FLOAT FRACTIONS

WEST ZONE 51+00S XC						
Sample No.	Muscovite	Albite	Kfeldspar	Calcite	Dolomite	Pyrite
43086	tr	tr		tr	tr	
43087	min	tr		tr	tr	
43088	min	tr		tr		
43089	min	tr	tr			tr
43090	tr	tr				
43091	tr		min			
43092	tr		tr			tr
43094	tr		min	tr		
43095	min		min			
43096	tr	tr	tr	tr		tr
43097	min		min			tr
43098	min		min			tr
43099	tr		min			tr
43100	tr		tr	tr	tr	
43101	min					
43102	tr		tr			
43103	min					
WEST ZONE 50+50S XCE						
43104	min	tr		tr		
43105	min					
43106	tr	tr				
43107	min	tr				
43108	min	tr				tr
43109	min					

43110	min			tr
43111	min			tr
43112	min		tr	tr
43113	min		tr	tr
43114	tr		min	
43115	tr		min	
43116	tr		min	
43117	tr		min	tr
43118	min		min	tr
43119	tr		min	
43120	min		tr	tr
43121	min	tr		tr

Note. Quartz is a major component in all samples. tr = trace; min = minor.

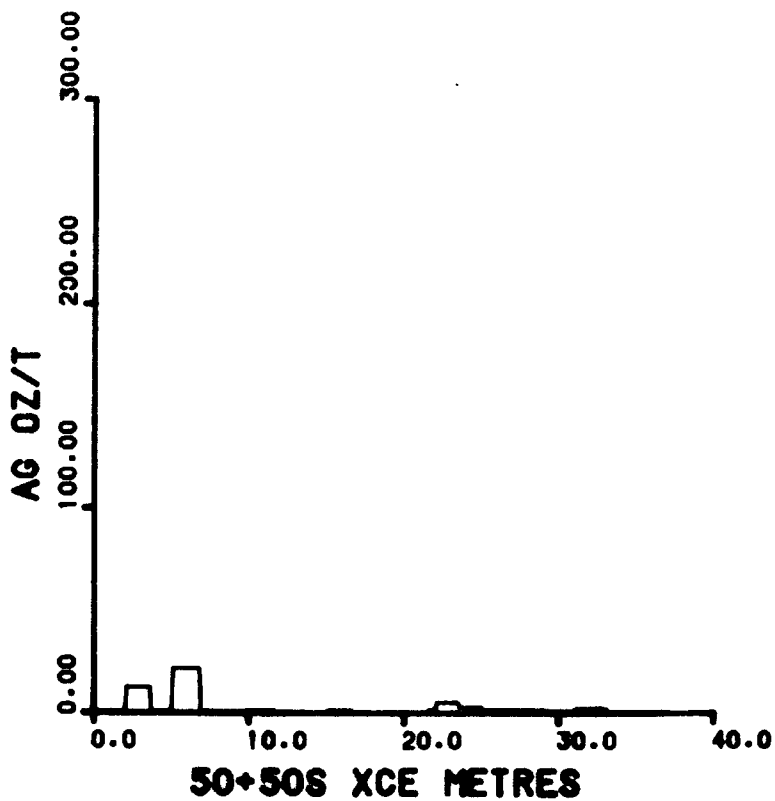
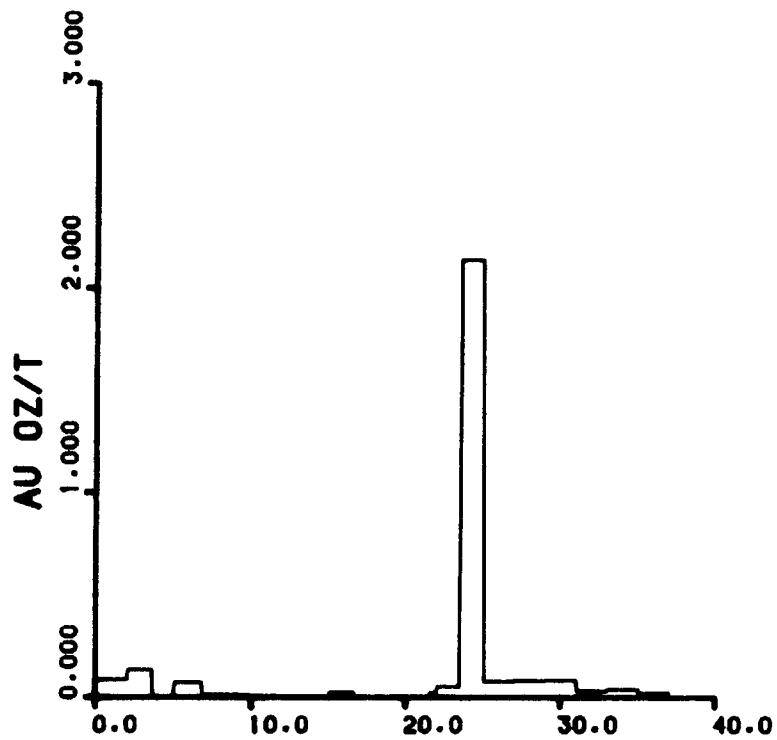


Figure 1. Silver and Gold Assay Data, 50+50S XCE

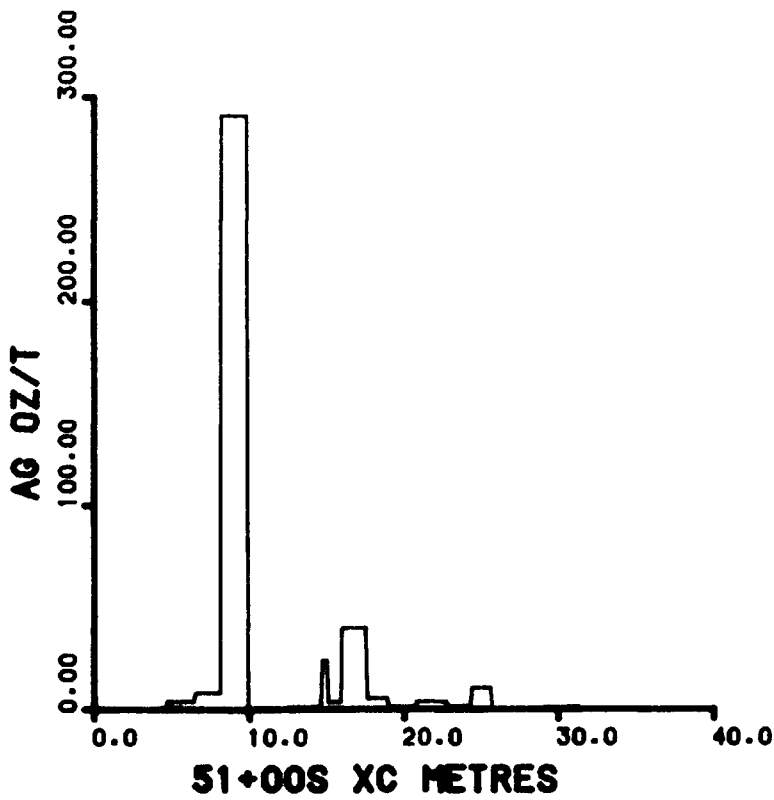
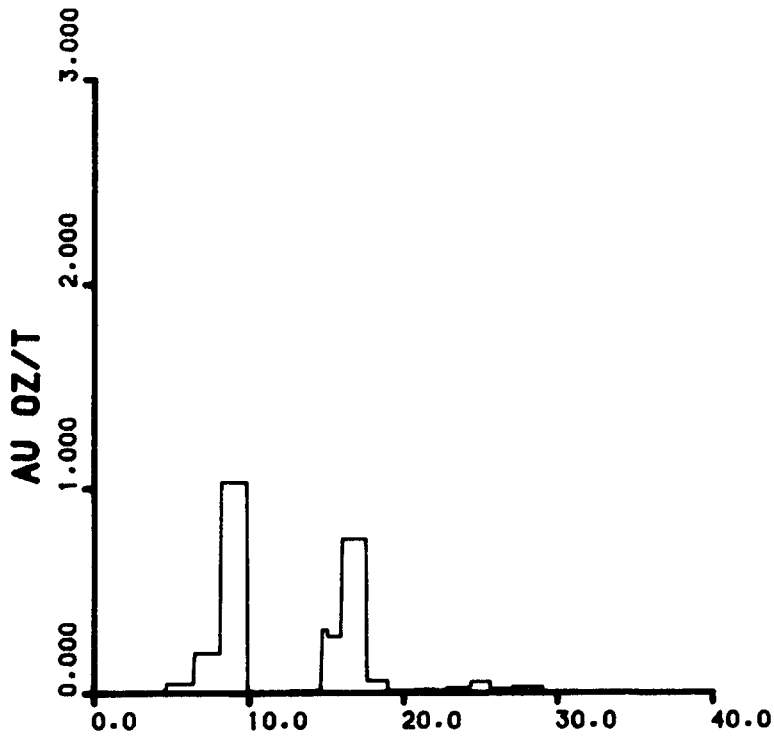


Figure 2. Silver and Gold Assay Data, 51+00S XC

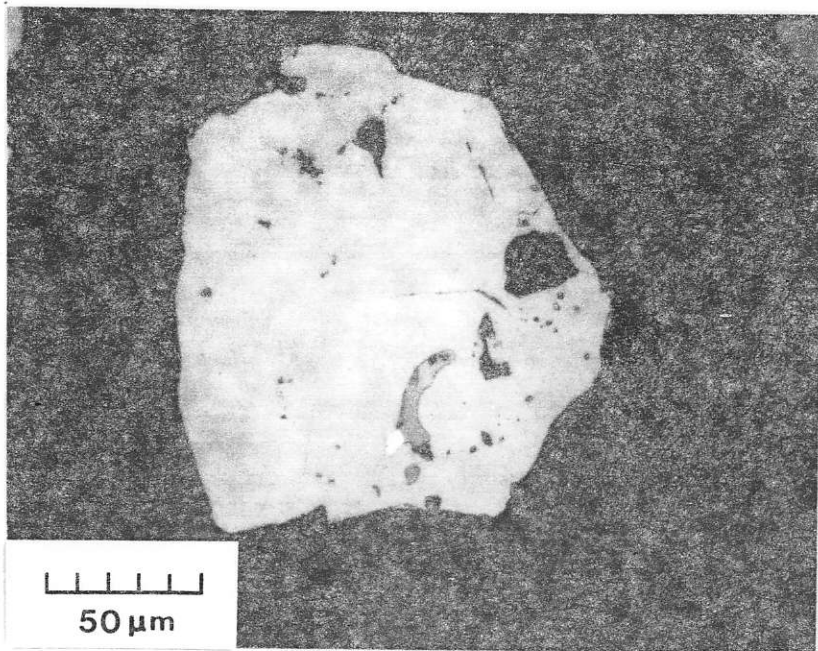
Captions for Figure 3.

a/ Photomicrograph of electrum inclusion in pyrite.

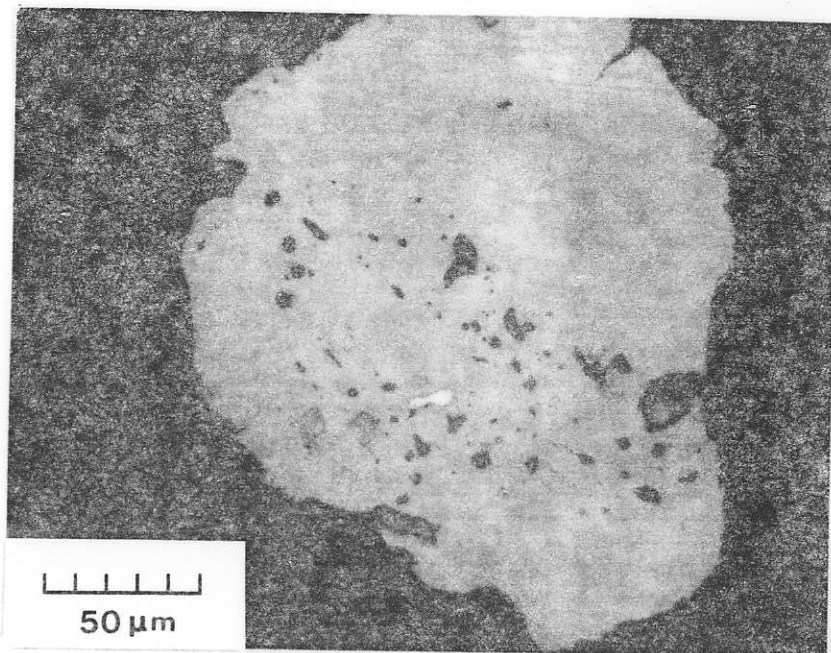
b/ Photomicrograph of electrum inclusion in poikiloblastic pyrite.

c/ Photomicrograph of coarse electrum. Sample 43090.

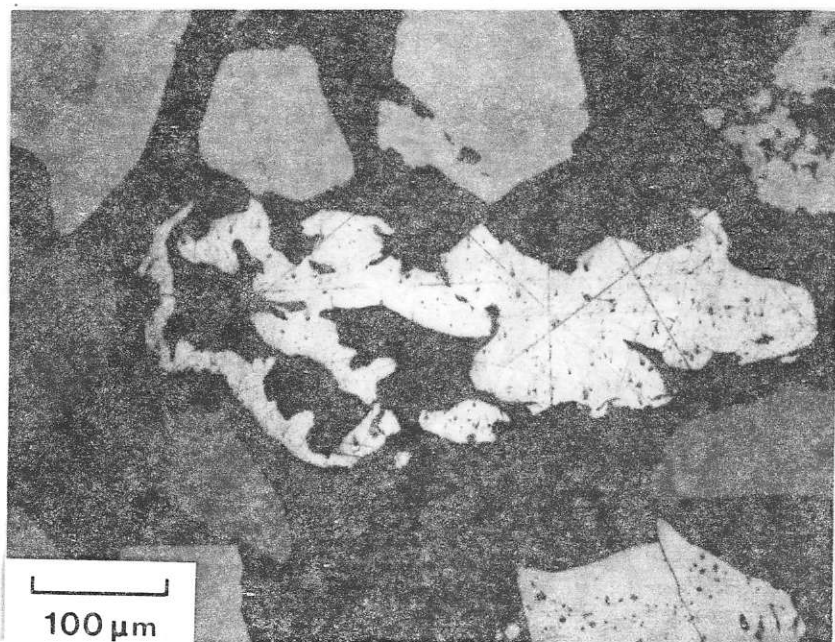
d/ Photomicrograph of coarse native silver rimmed with pyrargyrite. Sample 43090.



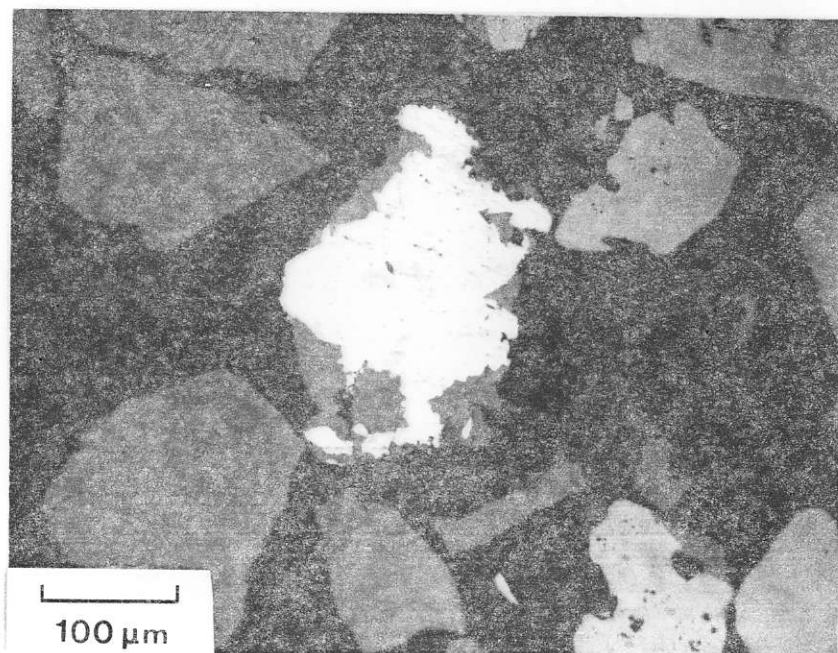
a



b



c



d