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Microscopical Examination of
Samples of Silver Ore and Mill
Products from Desert Silver Inc.,
Silver Peak, Nevada

THIS REPORT IS BASED ON METALLURGICAL RESULTS OBTAINED IN THE ORE DRESSING LABORATORY OF AMERICAN CYANAMID COMPANY ON A SAMPLE OF MATERIAL SUBMITTED BY THE SUBJECT COMPANY, AND ALL RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN APPLY ONLY TO THE TREATMENT OF MATERIAL CONFORMING TO THE SAMPLE SUBMITTED.

Introduction:

Several samples of silver ore and mill products were submitted for microscopical examination by Desert Silver Inc., Silver Peak, Nevada.

The samples were accepted for examination by our Mr. C. F. Bonnet. In a letter from Mr. Bonnet dated April 6, 1938, the samples were described as follows:

1. Ball Mill Heads. Composite sample from March 20, 1938 to March 31, 1938. Assay: Ag - 15.15 oz./ton, Au - 0.0325 oz./ton.
2. Mill Tailing (Dried filter cake). Composite sample from March 20, 1938 to March 31, 1938. Assay: Ag - 3.472 oz./ton, Au - 0.006 oz./ton.
3. Bralorne Type Jig Concentrate for March 23, 1938. Assay - Pb 23.8. Assay for Ag and Au not available.
4. Mill Tailing (Dried filter cake). Composite of 1 shift per day from March 22, 1938 to April 4, 1938. No assay available.

The combined weights of the two tailing samples were approximately 200 grams. We did not feel that this was sufficient material for both assays and microscopical examination so we requested a larger sample. A 5-lb. sample marked "1 Week Composite of Dried Tailings" was subsequently shipped by the subject company.

On June 6, Mr. Fred H. Gray, General Manager of the subject company, shipped us several specimen samples of the crude ore. These were

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labeled as follows:

1. 6318C - 600' level. 450' E.
Assay - Ag 18.2 oz./ton
Au 0.34 "
2. 6522C - 600' level. 375' E.
Assay - Ag 22.5 oz./ton
Au 0.26 "
3. 6548C - 600' level. 280' Dr W.
4. 6550C - 500' level - 605.650 + 15' E.
Assay - Ag 29.2 oz./ton
Au 0.02 "
5. 6551C - 500' level. 516 + 20' E.
H. W. Ore Body.
Assay - Ag 65.1 oz./ton
Au 0.02 "
6. 6552C - 500' level. 280' W Stope.
Assay - Ag 28.8 oz./ton
Au 0.02 "
7. 6553C - 500' level. 165' F W Stope
Shute #2.
Assay - Ag 28.6 oz./ton
Au 0.025 "
8. 6554C - 440' level. 730' Stope.
#4 M. W.
Assay - Ag 8.2 oz./ton
Au 0.01 "
9. 6555C - 600' level. 550' Stope.
Assay - Ag 17.6 oz./ton
Au 0.01 "
10. 6668C - 600' level. 280' W. Dr.
Assay - Ag 11.9 oz./ton
Au 0.09 "
11. 6671C - 500' level. 25 ' E 605'.
Assay - Ag 29.4 oz./ton
Au 0.05 "
12. 6682C - 600' level. 605' Stope.
Assay - Ag 21.0 oz./ton
Au 0.035 "

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All of the samples arrived at the Ore Dressing Laboratory in good condition.

Purpose of the Investigation:

The purpose of our investigation was as follows:

1. To determine the minerals and petrographic nature of the crude ore.
2. To determine the mineralogy of the ball mill head, the mill tailing, and the concentrate from the Bralorne Jig.
3. To determine the nature of the silver losses in the mill tailing.
4. To make an assayed screen analysis of the ball mill head and the mill tailing.
5. To make a fairly complete chemical analysis.

Crude Ore:

In order to simplify the petrographic description of the crude ore, the samples were divided into three general groups. The division was based on their textural and structural characteristics and the principal gangue minerals. The groups were as follows:

Group #1

A - 6548C 6-280PW
B - 6668C 6-280PW

Group #2

A - 6318C 6-450E
B - 6522C 6-375E

Group #3

A - 6550C 5-605-650
B - 6551C 5-516+70'E
C - 6552C 5-280W stage
D - 6553C 5-105FW stage
E - 6554C 4-730 stage
F - 6555C 6-550 stage
G - 6671C 5-25'E 605
H - 6682C 6-605 stage

Group #1 (6548C and 6668C)

Megascopical Examination

The rocks in this group were composed largely of massive, granular quartz and calcite which was milk-white to gray in color.

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Number 6548C was coarse-grained and number 6668C was fine-grained. Manganese oxides and veinlets of oxidized lead minerals were visible in number 6668C.

Microscopical Examination

Both of the rocks were composed essentially of quartz and calcite. The calcite grains in number 6548C ranged up to 5 millimeters in diameter. Those in number 6668C were, in general, considerably finer. The quartz was fine grained in both samples. Grains of about 100 microns were the maximum size observed.

Calcite appeared to be the earliest mineral. The calcite crystals were generally ragged in appearance and appeared to be partially replaced by quartz. In some cases the quartz penetrated along the cleavage of the calcite. A lamellar structure in the quartz and calcite was common. Figure 1, which is a photomicrograph of number 6548C, illustrates the partial replacement of calcite by quartz.

Drusy cavities and veinlets were not observed in number 6548C and were not abundant in 6668C. In the latter specimen the veins carried quartz and some late calcite such as is illustrated in Figure 2.

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Figure 1

Photomicrograph of a Thin-Section of
Sample Number 6548C
Crossed Nicols.

35X

The calcite is partially replaced by introduced quartz.

Ca - Calcite (Coarsely crystalline)
Qu - Quartz (Finely crystalline)

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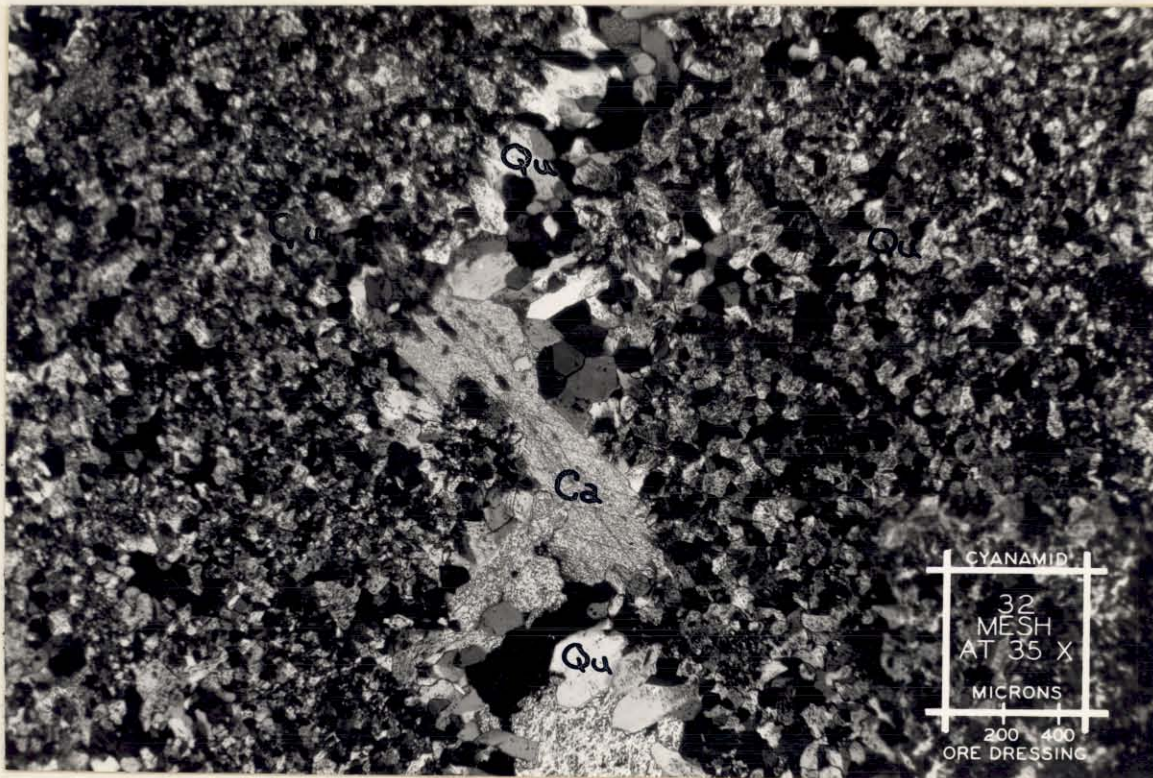


Figure 2. Photomicrograph of a Thin-Section of 35X
Sample Number 6668C.
Crossed Nicols.

Veinlet of quartz and late calcite cutting
an area of fine-grained quartz.

Qu - Quartz
Ca - Calcite

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Both rocks in this group were composed of fine-grained, milk-white quartz. A poorly developed, banded structure was characteristic. Drusy cavities were present, but not abundant. Manganese oxide and limonite were noted on both specimens.

Microscopical Examination

The quartz grains in both samples ranged up to 300 microns in size. It was generally dusty in appearance. This was particularly true of number 6318C. Drusy cavities in both samples were partially filled with quartz crystals. Lithic fragments of an extremely-fine grained quartz-sericite rock were observed in number 6522C. Figure 3, which is a photomicrograph of number 6318C, shows the occurrence of the dusty granular quartz and drusy cavities lined with quartz crystals.

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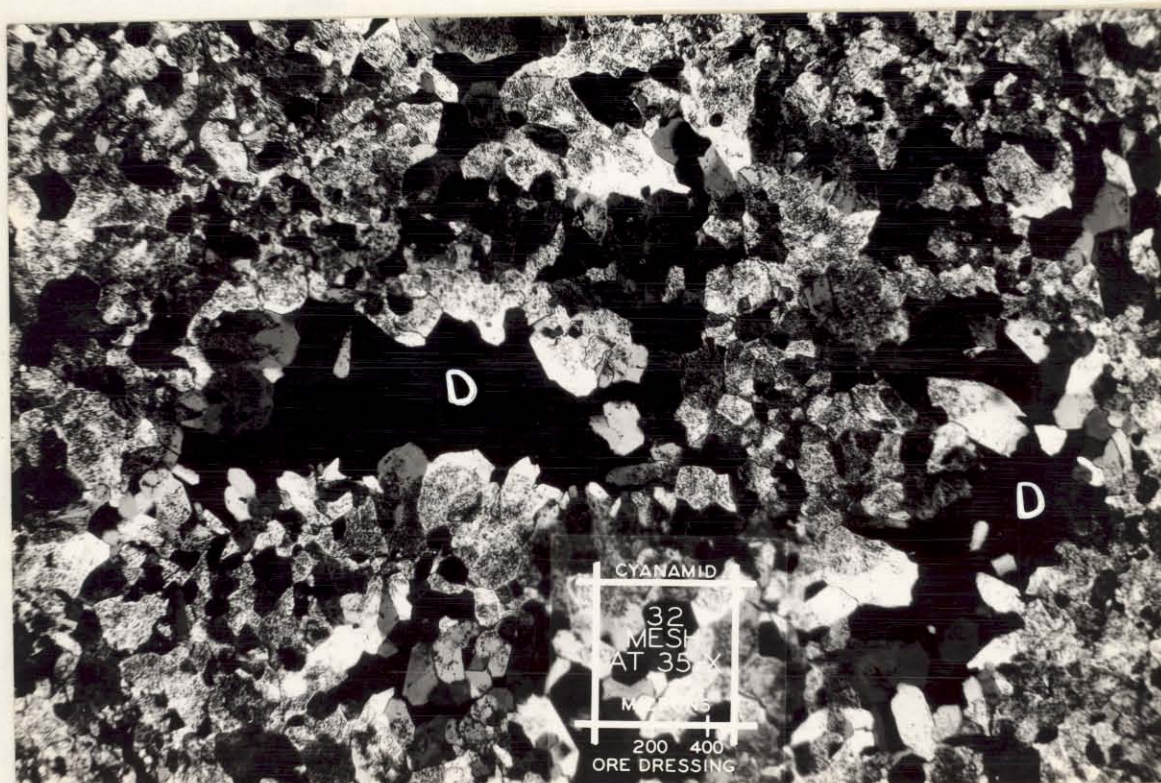


Figure 3

Photomicrograph of a Thin-Section of
Sample Number 6318C
Crossed Nicols

35X

Dusty, granular quartz grains are illustrated:
the drusy cavities (D) are lined with quartz
crystals.

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The specimens in this group were composed essentially of a gray quartz gangue. They were characterized by a well developed, banded structure, except for number 6554C, and numerous drusy cavities. Sulfides and their oxidation products were observed. Limonite and manganese oxides were characteristically well developed.

Microscopical Examination

Quartz was the principal gangue mineral. The banded structure was prominently developed in all of the section, except number 6554C. The individual bands were, in some cases, quite discontinuous and irregular in nature. The quartz, in the various bands, varied considerably in grain size, as is illustrated in Figure 4, which is a photomicrograph of number 6555C. A comb and flamboyant structure was, likewise, well developed in the quartz, as is illustrated in Figure 5 which is a photomicrograph taken of number 6550C. Drusy cavities, lined with quartz crystals were a common feature.

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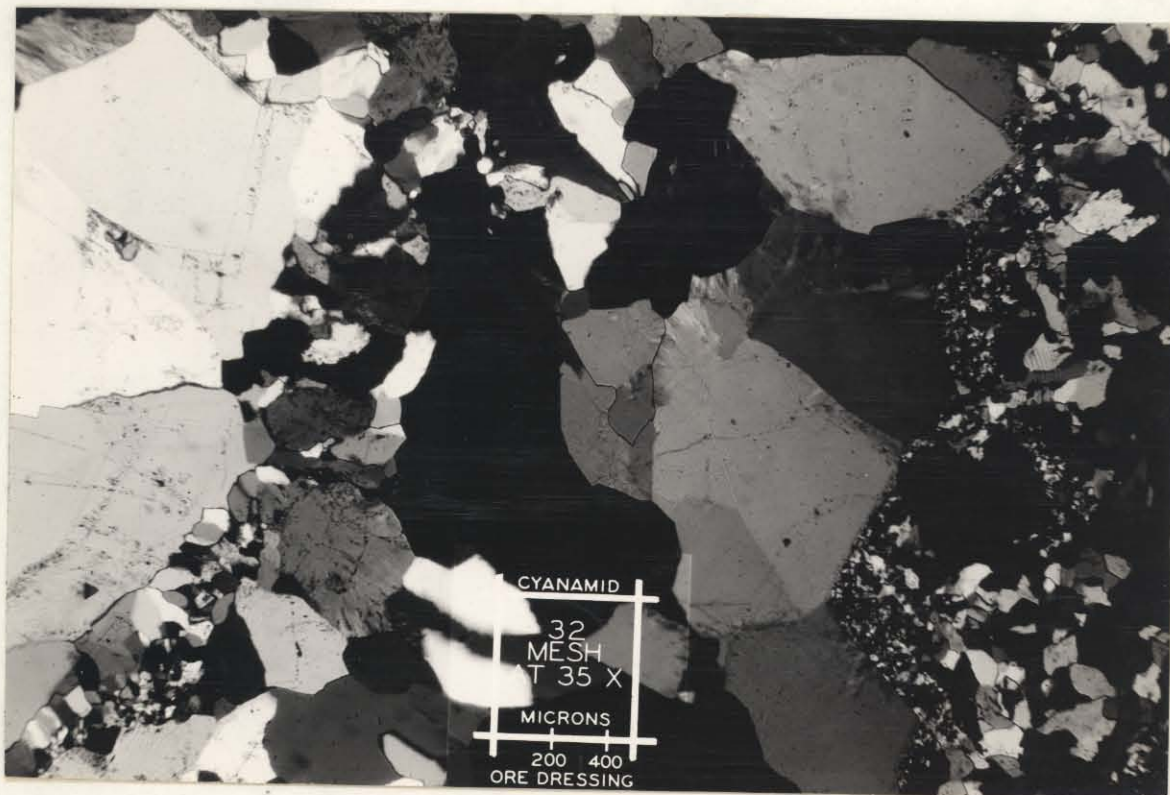


Figure 4

Photomicrograph of a Thin-Section of
Sample Number 6555C
Crossed Nicols

35X

Banded structure in quartz.

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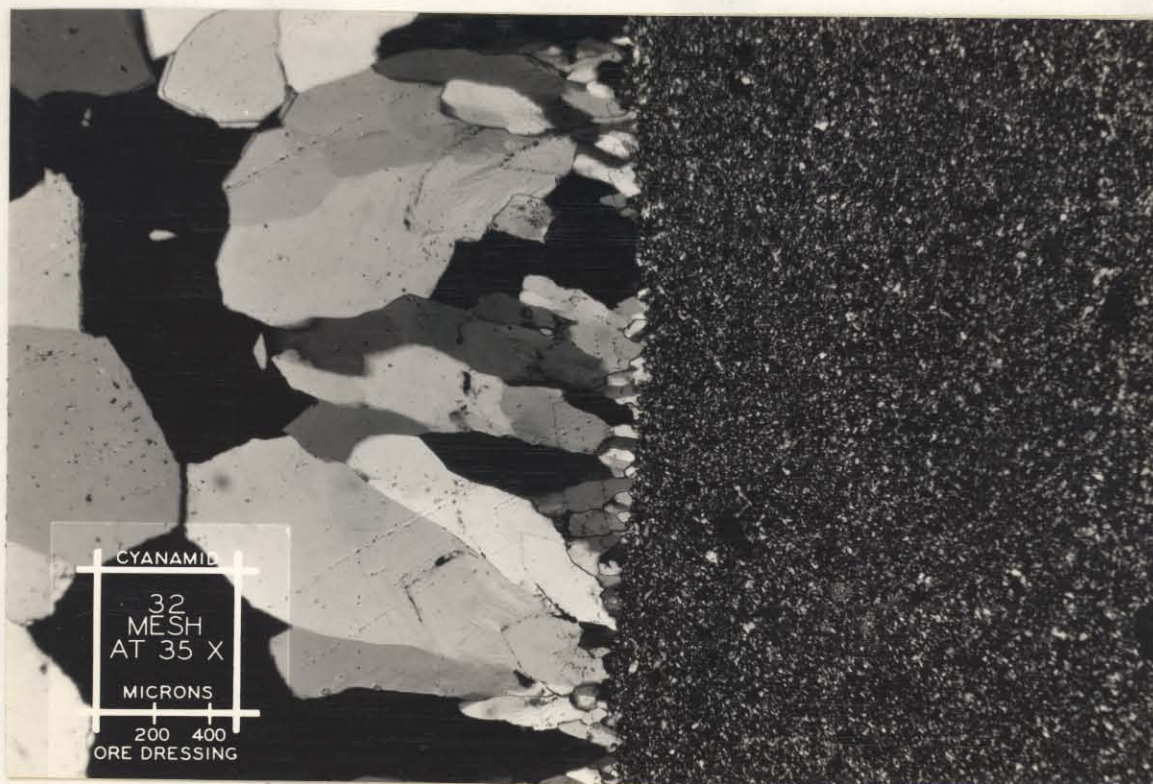


Figure 5. Photomicrograph of a Thin-Section of 35X
Sample Number 6550C.
Crossed Nicols.

Banded quartz illustrating coarse grains on the left, which are characterized by a comb and flamboyant structure, and a crypto-crystalline variety on the right.

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The sulfide mineral constituents identified were pyrite, galena, and sphalerite. Limonite, manganese oxides, and the oxidation products of galena were prominently developed.

The sulfides appeared to have been introduced simultaneously with the quartz. They did not occur in well-defined veinlets, but tended to be irregularly disseminated through the ore. Segregations, high in sulfides, were common. Samples number 6555C appeared to be particularly high in sulfide-content. Figure 6, which is a photomicrograph of a thin-section of number 6555C illustrates the occurrence of galena and quartz.

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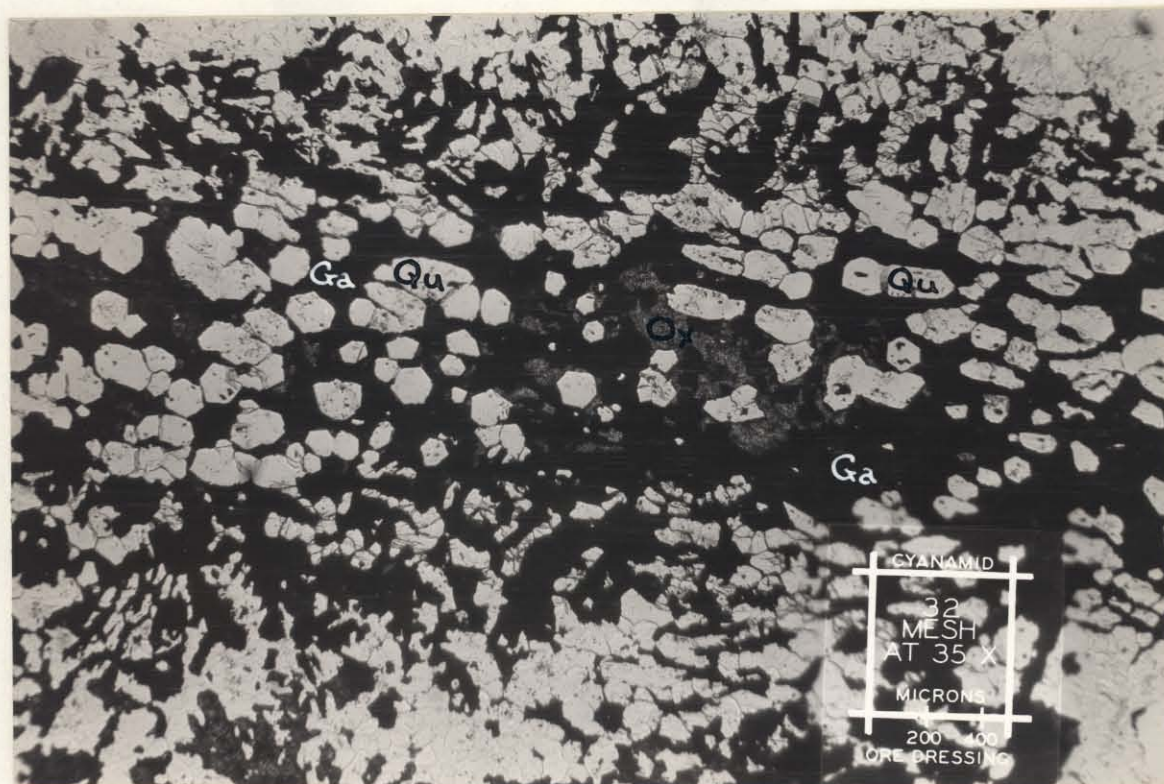


Figure 6

Photomicrograph of a Thin-Section of
Sample Number 6555C
Plain Light

35X

Intergrowth of quartz and galena.

Qu - Quartz (White)

Galena (Black)

Ox - Oxide Lead Minerals (Dark Gray)

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Much of the galena was oxidized and particles of unoxidized galena were frequently minutely disseminated through the oxidation products. This feature is illustrated in Figure 7, which is a photomicrograph of a polished surface of number 6555C.

Sample number 6571C contained considerable malachite. An occurrence of malachite, associated with oxide lead minerals, is illustrated in Figure 8.

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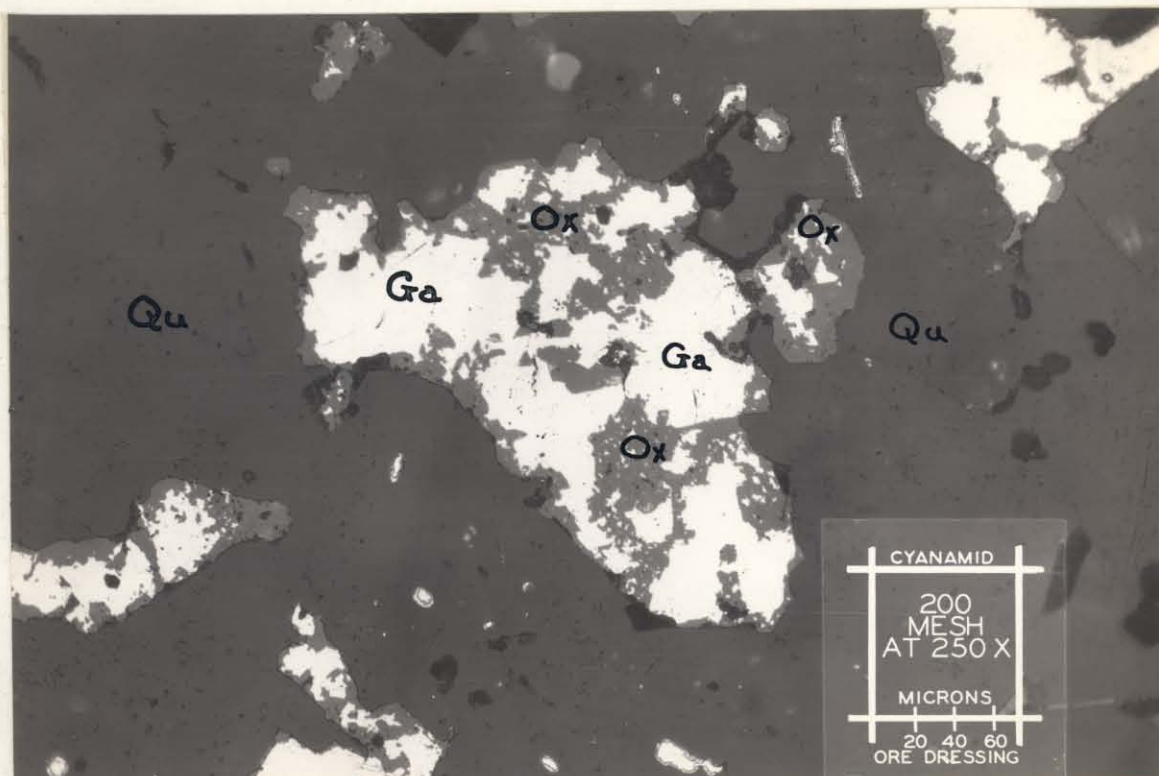


Figure 7 Photomicrograph of a Polished Surface of Sample Number 6555C 250X

Partially oxidized galena. Some of the galena occurs as minute particles in the oxide lead minerals.

- Ga - Galena (White)
- Ox - Oxide Lead Minerals (Medium gray)
- Qu - Quartz (Dark gray)

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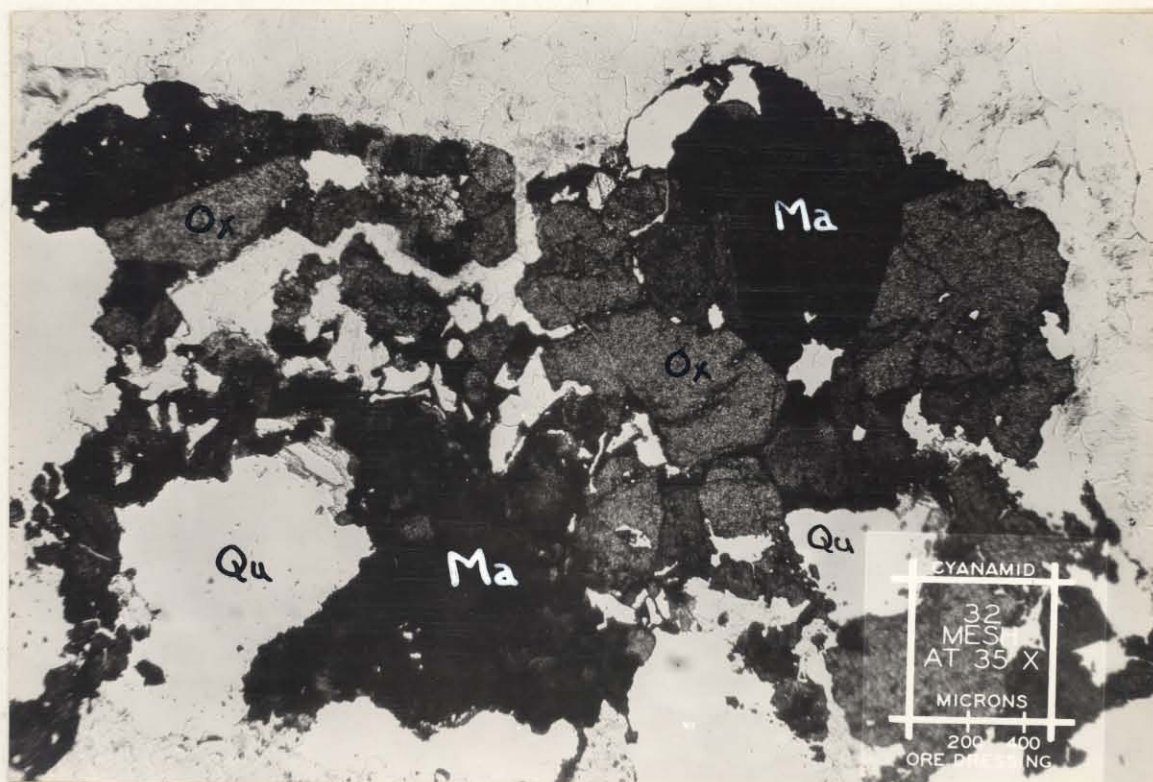


Figure 8

Photomicrograph of a Thin-Section of
Sample Number 6571C.
Plain Light.

35X

Malachite and the oxide lead minerals occurring
in quartz.

Ma - Malachite (Black)
Ox - Oxide Lead Minerals (Gray)
Qu - Quartz (White)

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Ball Mill Head

Preparation of the Material

The sample, as received, was thoroughly mixed on a rolling cloth and a representative 800-gram sample was removed for a screen analysis. The sized fractions were assayed for gold, silver, and lead.

Another portion of the sample was panned on the Haultain super-panner and a panner concentrate was obtained.

A representative portion of the head sample and the panner concentrate was briquetted separately in Bakelite. The briquets were ground to a plane cross-section and then polished on the Graton-Vanderwilt polishing machine. The opaque minerals were identified in the polished briquets and the transparent minerals were studied in transmitted light in the sample, as received.

Assays

The assays of the ball mill head sample are shown in Table I. Those furnished by our Mr. Bonnet are given in Column 1 and the assays calculated from our assayed screen analysis are given in Column 2.

Table I

Assays of Ball Mill Head

	<u>1</u>	<u>2</u>
Au oz./ton	0.0325	0.024
Ag "	15.15	15.84
Pb %	--	0.55

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Assayed Screen Analysis

The assayed screen analysis of the ball mill head sample is found in Table II.

Table II

Assayed Screen Analysis of Ball Mill Head

Mesh	% Wt.	Assays			% Distribution		
		Au Oz./ton	Ag Oz./ton	% Pb	Au	Ag	Pb
+100	6.06	0.030	13.44	0.21	7.59	5.14	2.28
+150	6.70	0.020	13.62	0.13	5.60	5.76	1.56
+200	9.43	0.020	13.08	0.27	7.88	7.78	4.57
+325	11.27	0.020	12.12	0.28	9.42	8.62	5.66
-325	66.54	0.025	17.31	0.72	69.51	72.70	55.93
	100.00	0.024	15.84	0.55	100.00	100.00	100.00

The minus 325 mesh fraction was high in both silver and lead. It assayed 17.31 oz. Ag/ton and 0.72 % Pb and carried 72.70 % of the silver and 55.93 % of the lead.

Mineralogy

The following mineral constituents were identified in the ball mill head sample:

argentite	chalcopyrite	magnetite
native silver	native copper	hematite
cerargyrite	chalcocite	limonite
galena	covellite	psilomelane
wulfenite $PbMoO_4$	malachite CO_3	pyrolusite
pyromorphite	sphalerite	quartz
cerussite	smithsonite $ZnCO_3$	calcite
anglesite $SrSO_4$	pyrite	barite

$Pb_5Cl(PbO_4)_3$

The sulfide minerals were all present in minor quantities and their oxidation products were abundant.

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Concentrate from the Bralorne Type Jig

Preparation of the Material

A representative portion of the sample was assayed for gold, silver, total lead, non-sulfide lead, molybdenum, manganese, tungsten, vanadium, chromium, arsenic, phosphate, total sulfur, and sulfate sulfur.

A portion of the sample was briquetted in Bakelite and polished for study in reflected light. A thin-section was prepared from another portion of the sample for study in transmitted light.

Assays

The assays of the jig concentrate are found in Table III.

Table III

Assays of the Jig Concentrate

	<u>%</u>
Pb (Total)	22.36
Pb (Non-Sulfide)	3.01
Mo	4.00
Mn	6.05
As	0.07
P ₂ O ₅	1.20
S (Total)	0.85
S (Sulfate)	0.29
W	Nil
V	Nil
Cr	Nil
Au oz./ton	0.20
Ag "	267.48

From the sulfur assay it was obvious that only a small amount of the total lead could be present as galena. The lead extracted by the method ordinarily employed for non-sulfide lead was probably that which occurred in the form of cerussite and anglesite. It seemed probable

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that the lead not accounted for by the sulfur assay and the non-sulfide lead assay was present as non-sulfide lead minerals which were refractory to the non-sulfide lead assay method.

Mineralogy

The following mineral constituents were identified in the concentrate from the Bralorne Jig:

argentite	anglesite	magnetite
native silver	chalcopyrite	limonite
cerargyrite	native copper	hematite
galena	chalcocite	psilomelane
wulfenite	covellite	pyrolusite
pyromorphite	sphalerite	quartz
cerussite	pyrite	barite

The silver minerals present were argentite, native silver and cerargyrite.

Grains of galena were selected under the binocular microscope and tested for silver by microchemical methods. A positive test was obtained.

The non-sulfide lead minerals were derived, by oxidation, from the galena. In many instances galena was observed as unoxidized remnants in the non-sulfide lead minerals, as is illustrated in Figure 9.

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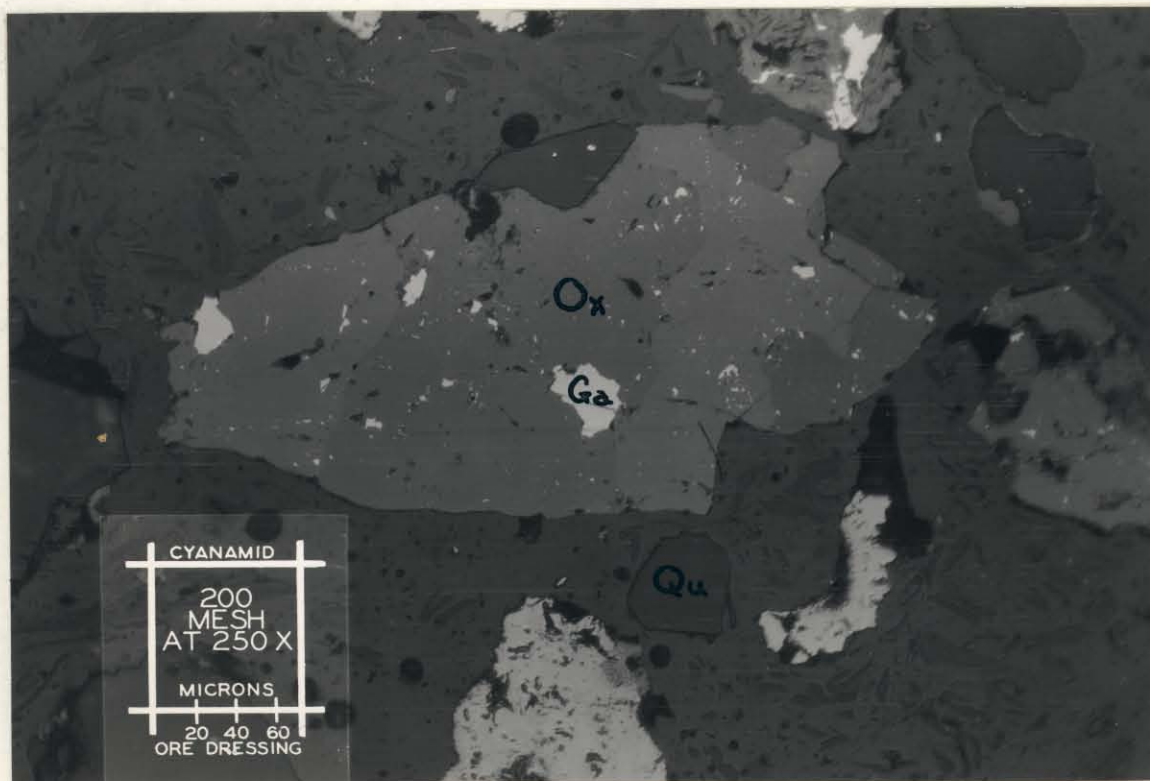


Figure 9 Photomicrograph of a Polished Surface of 250X
the Jig Concentrate.

Galena disseminated through a grain of oxide lead.

- Ga - Galena (White)
- Ox - Oxide lead (Medium gray)
- Qu - Quartz (Dark gray)

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It was believed, therefore, that the non-sulfide lead minerals would likewise carry silver. Accordingly, grains were selected under the binocular microscope and tested for silver. A positive reaction was obtained.

Other possible silver-bearing minerals were the manganese oxides, psilomelane and pyrolusite. Several grains of these minerals were selected and tested for silver. A negative result was obtained. —

It was concluded that, in addition to the silver carried by the argentite, cerargyrite and native silver, values were also carried by the galena and its oxidation products, wulfenite, pyromorphite, cerussite, and anglesite.

200 milligrams of partially oxidized galena and 200 milligrams of wulfenite were selected, under the binocular microscope from the plus 40 mesh size fraction. These two samples were assayed for silver. The results are given in Table IV.

Table IV

Assays of Plus 40 Mesh Partially
Oxidized Galena and Wulfenite

	Ag Oz./ton
Partially Oxidized Galena	65.5
Wulfenite	17.0

The lead-bearing minerals were galena, wulfenite, pyromorphite, cerussite and anglesite.

Manganese oxides frequently carry several elements in addition to those which are usually given in the empirical formula. In order to determine if the manganese minerals carried lead, six grams were selected under

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the binocular microscope. Each was tested separately for lead by micro-chemical methods. A positive test was obtained on each grain.

Several grains of the manganese minerals were then selected for assay from the plus 40 mesh size fraction. They were assayed for lead, manganese and insoluble material. The results are given in Table V.

Table V

Assay of the Plus 40 Mesh
Pyrolusite and Psilomelane

	<u>%</u>
Pb	16.4
Mn	19.5
Insoluble Material	5.4

It was observed that some of the manganese minerals carried non-sulfide lead minerals, as illustrated in Figure 10.

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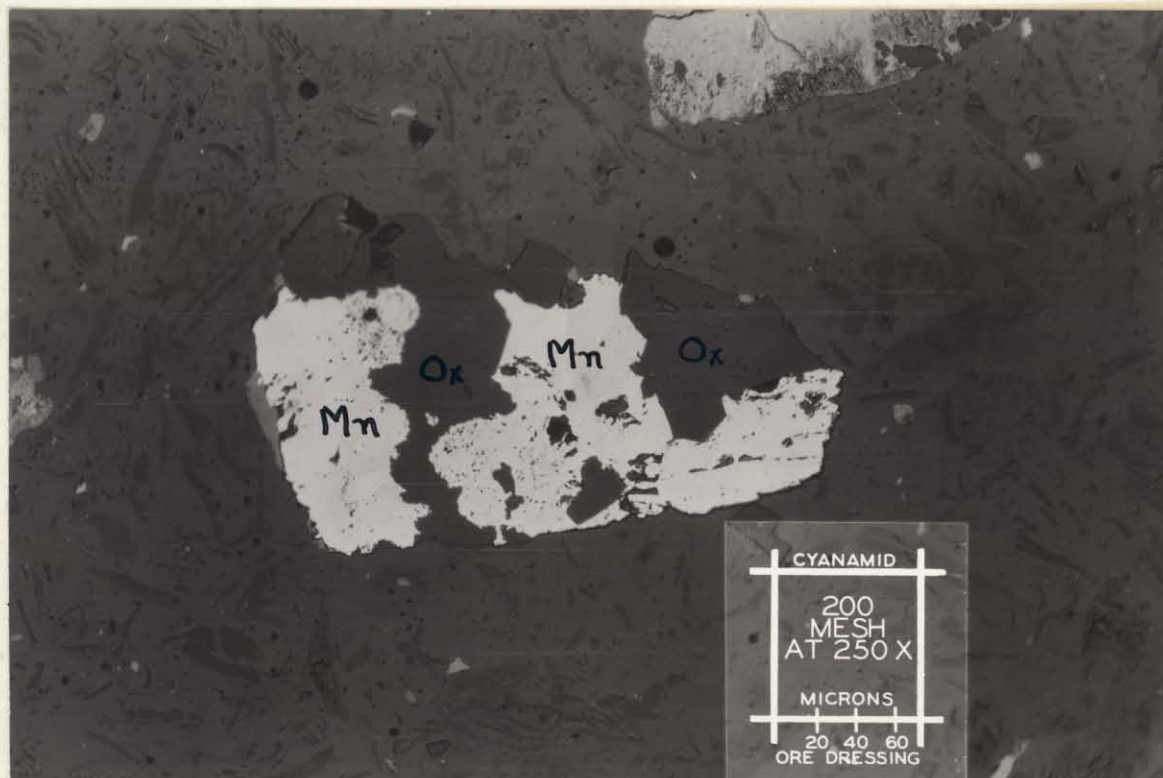


Figure 10

Photomicrograph of a Polished Surface
of the Jig Concentrate

250X

Manganese oxide locked with a lead oxide
mineral.

Mn - Manganese Oxide (White)
Ox - Lead Oxide (Gray)

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Grains of this nature were not as common as those which were apparently free of the non-sulfide lead minerals. It is possible that some of the lead reported in the manganese assay was present as included particles of wulfenite, pyromorphite, cerussite and anglesite. Some of it was probably present as an integral part of the manganese minerals.

A calculation was made to determine the approximate distribution of the lead values in the different lead-bearing minerals. In the calculation, the non-sulfide lead was assumed to represent the anglesite and cerussite. The anglesite percentage was based on the sulfate present. The remainder was calculated as cerussite. The amount of lead required in the wulfenite and pyromorphite was calculated from the molybdenum and phosphate assays respectively. The percentage of lead, as galena, could only be estimated roughly because some of the sulfur in the assay occurred in other sulfides. As has been pointed out, some of the lead reported in the manganese assay was probably also included with the other lead-bearing minerals, but some probably was an essential part of the manganese minerals. The results of the calculation are shown in Table VI.

Table VI

Approximate Distribution of the Lead
in the Lead-Bearing Minerals

	<u>%</u>
Anglesite	1.88
Cerussite	1.13
Wulfenite	8.64
Pyromorphite	5.64
Galena (estimated)	1.25
Manganese minerals	5.00
Total Lead	23.54
Total lead by assay	22.36

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The copper minerals, chalcopyrite, native copper, chalcocite, and covellite, were all present in minor amounts.

Sphalerite was a minor constituent.

Limonite was the most abundant iron-bearing mineral. Pyrite, magnetite, and hematite were all present in relatively minor amounts.

Psilomelane and pyrolusite were both present in appreciable quantities. They were generally closely associated with limonite.

An appreciable amount of quartz was present. Barite was a minor constituent.

Mill Tailing

Preparation of the Material

The sample was thoroughly mixed on a rolling cloth and a representative portion was removed and assayed for gold, silver and lead. A 1500-gram portion was removed for screen analysis and the sized products were assayed for gold, silver and lead.

A representative portion of the sample, as received, was briquetted in Bakelite. A panner concentrate was examined in transmitted light prior to briquetting for examination in reflected light.

Assays

The assays of the mill tailing are given in Table VII.

Table VII

Assays of Mill Tailing

Au Oz./ton	0.007
Ag "	3.09
Pb %	0.55

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Assayed Screen Analysis

The assayed screen analysis of the mill tailing is given in Table VIII.

Table VIII

Assayed Screen Analysis of the Mill Tailing

Mesh	% Wt.	Assays			% Distribution		
		Au Oz./ton	Ag Oz./ton	% Pb	Au	Ag	Pb
+ 65	6.87	0.008	3.19	0.08	8.40	6.92	0.99
+100	16.81	0.008	3.13	0.13	20.63	16.63	3.95
+150	13.75	0.008	2.98	0.21	16.82	12.95	5.23
+200	13.80	0.008	2.88	0.33	16.88	12.56	8.24
+325	10.63	0.005	2.68	0.51	8.12	9.00	9.81
-325	38.14	0.005	3.48	1.04	29.15	41.94	71.78
	100.00	0.007	3.16	0.55	100.00	100.00	100.00

The minus 325 mesh fraction was high in both silver and lead. It assayed 3.48 oz./ton silver and 1.04 % lead and carried 41.94 % of the silver and 71.78 % of the lead.

Mineralogy

The following mineral constituents were identified in the mill tailing:

argentite	chalcopyrite	limonite
native silver	sphalerite	psilomelane
galena	smithsonite	pyrolusite
wulfenite	pyrite	quartz
pyromorphite	magnetite	calcite
cerussite	hematite	barite
anglesite		

No free silver minerals were identified. Native silver and argentite were observed as minute inclusions in pyrite and limonite. An occurrence of native silver in pyrite is illustrated in Figure 11.

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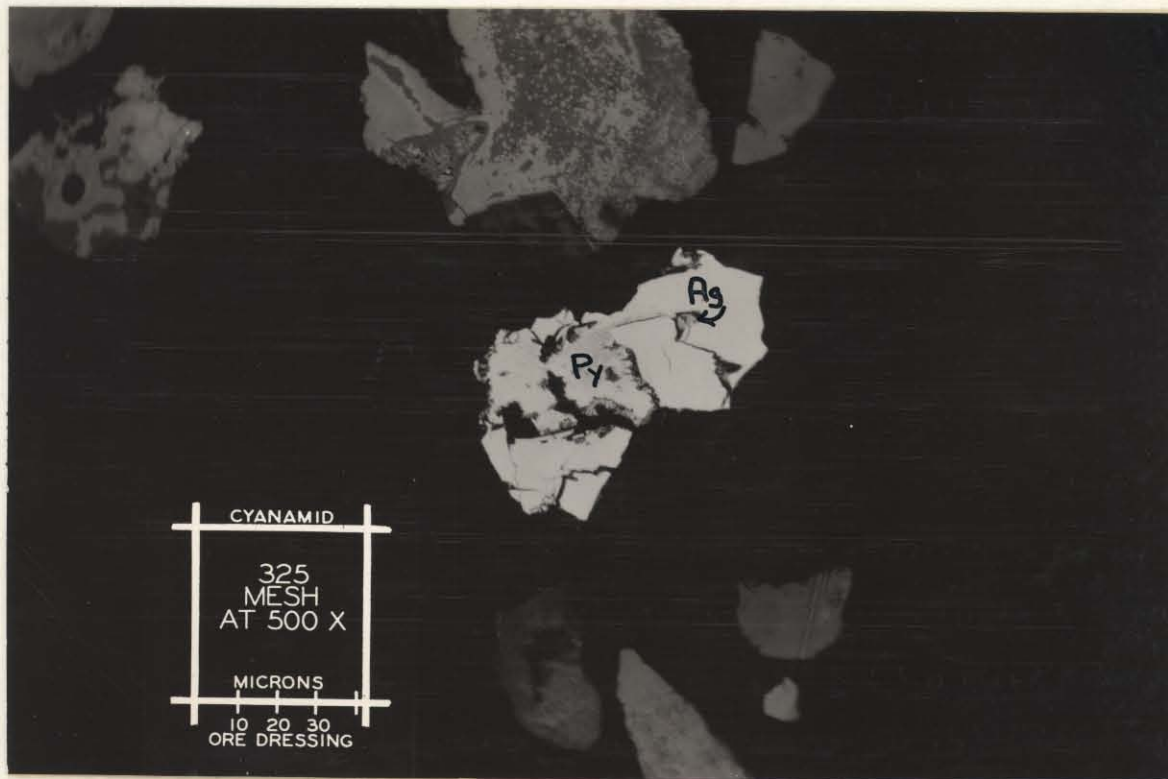


Figure 11 Photomicrograph of a Polished Surface of the 500X
Panner Concentrate from the Mill Tailing

Native silver encased in pyrite.

Ag - Native silver
Py - Pyrite

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Grains of galena were selected under the binocular microscope and tested for silver by microchemical methods. A positive reaction was obtained.

Grains of the non-sulfide lead minerals were selected under the binocular microscope and tested for silver. A positive reaction was obtained.

Panner Test

A portion of the cyanide tail was panned on the Haultain super-panner in an attempt to reduce the silver content of the product. After the panning was completed an attempt was made to reduce further the silver content by removing the minerals that were above 2.90 in specific gravity. This separation was made with a liquid with a specific gravity of 2.90. The results of the panner test and the heavy-liquid separation are given in Table IX.

Table IX

Panner Test and Heavy-Liquid
Separation of Mill Tailing

<u>Panner Product</u>	<u>% Wt.</u>	<u>Ag Oz./ton</u>	<u>% Dist.</u>
Panner Concentrate	1.21	19.782	7.79
Heavy Liquid Concentrate	3.09	26.10	26.23
Sand Tailing	67.17	1.39	30.44
Slime	28.53	3.83	35.54
	100.00	3.07	100.00

The panner concentrate assayed 19.782 oz. Ag/ton and carried 7.79 % of the silver. The heavy-liquid concentrate assayed 26.10 oz. Ag/ton and carried 26.23 % of the silver. The sand tailing assayed 1.39 oz. Ag/ton and carried 30.44 % of the silver.

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Summary:

1. Crude Ore

- a. The crude ore consisted chiefly of banded quartz veins, generally characterized by crustification, comb structures, and drusy cavities.
- b. Calcite appeared to be the earliest gangue mineral. The calcite was partially replaced by introduced quartz. Some calcite accompanied the introduction of the quartz.
- c. The mineralization sequence of the primary base metal sulfides was probably pyrite, sphalerite, chalcopyrite, and galena.
- d. Oxidation of the primary base metal sulfides resulted in the production of limonite, smithsonite, malachite, secondary copper sulfides and a number of non-sulfide lead minerals. The manganese oxides were probably derived from original rhodochrosite gangue.
- e. The primary silver minerals possibly were complex sulfo- salts and argentiferous galena. Oxidation produced argentite, native silver, and cerargyrite from the primary sulfo- salts. The oxidation of the galena resulted in the formation of non-sulfide lead minerals which still carried silver values.
- f. The vein formation and mineralization was of the epithermal type, formed at a comparatively shallow depth.

2. Ball Mill Head

- a. The following minerals, which were identified in the ball mill head sample, were as follows: argentite, native silver, cerargyrite, galena, wulfenite, pyromorphite, cerussite, anglesite, chalcopyrite, native copper, chalcocite, covellite, malachite, sphalerite, smithsonite, pyrite, magnetite, hematite, limonite, psilomelane, pyrolusite, quartz, calcite, and barite.
- b. The product assayed 0.024 oz. Au/ton, 15.84 oz. Ag/ton and 0.55 % Pb.

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3. Concentrate from the Bralorne Type Jig

- a. The following minerals were identified in the concentrate from the Bralorne Jig: argentite, native silver, cerargyrite, galena, wulfenite, pyromorphite, cerussite, anglesite, chalcopryrite, native copper, chalcocite, covellite, sphalerite, pyrite, magnetite, limonite, hematite, psilomelane, pyrolusite, quartz and barite.
- b. The concentrate assayed 0.20 oz. Au/ton, 267.48 oz. Ag/ton, and 22.36 % Pb.
- c. The silver minerals present were argentite, native silver, and cerargyrite. Other silver-bearing minerals were galena, wulfenite, pyromorphite, cerussite and anglesite.

4. Mill Tailing

- a. The following minerals were identified in the mill tailing: argentite, native silver, galena, wulfenite, pyromorphite, cerussite, anglesite, chalcopryrite, sphalerite, smithsonite, pyrite, magnetite, hematite, limonite, psilomelane, pyrolusite, quartz, calcite, and barite.
- b. All of the observed native silver and argentite occurred as grains disseminated in pyrite and limonite. The galena and non-sulfide lead minerals carried silver values.
- c. The product assayed 0.007 oz. Au/ton, 3.09 oz. Ag/ton, and 0.55 % Pb.
- d. 7.79 % of the silver was panned from the product in a concentrate which assayed 19.782 oz. Ag/ton. 26.23 % of the silver was extracted from the panmer tailing by a liquid with a specific gravity of 2.90. The product assayed 26.10 oz. Ag/ton. The sand tailing assayed 1.39 oz. Ag/ton and carried 30.44 % of the silver. The slimes assayed 3.83 oz. Ag/ton and carried 35.54 % of the silver.

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A microscopical examination made on samples of crude ore, ball mill feed, jig concentrate and cyanidation residue submitted by Desert Silver Incorporated has shown the presence of a wide variety of secondary silver-bearing minerals. The general mineralization of the ore indicated that the deposit was epithermal, having been formed at comparatively shallow depth. It is probable that the silver originally occurred as sulfo-salts and in intimate association with galena. Oxidation resulted in the formation of argentite, cerargyrite, native silver and argentiferous lead oxides. The non-sulfide lead minerals, as well as the remaining galena, contained silver so finely disseminated that detection was possible only by chemical means. Silver so intimately dispersed through a host mineral would be refractory to cyanidation. This occurrence of silver explains the concentration of both lead and silver in the slime size of the cyanidation residue as the host minerals, galena, and the oxide lead minerals are all susceptible to oversliming during grinding. The ability of the Bralorne-type jig to recover the non-sulfide lead minerals and associated silver is particularly interesting.

Pan-concentration of the cyanidation residue recovered only 7.79 % of the silver. The only silver found in the pan concentrate was attached to pyrite. Argentiferous galena and non-sulfide lead minerals were also recovered in the pan concentrate. A heavy-liquid separation produced a concentrate containing 26.23 % of the silver in the cyanidation residue. This silver was largely associated with limonite.

This examination has shown the refractory silver to be present as argentiferous galena, argentiferous or non-sulfide lead minerals, and associated with pyrite or limonite. Finer grinding could be expected to

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release some of the silver associated with pyrite and limonite. Concentration and smelting of the argentiferous lead minerals would appear necessary before an appreciable increase in silver recovery can be obtained. The slime-size of a major portion of the silver not now recovered indicates that recovery by means of flotation would be more feasible than gravity concentration but effective flotation is likely to be difficult because an appreciable portion of the remaining lead minerals are non-sulfide.

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