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MINERALOGICAL INVESTIGATION OF A LEAD-ZINC-COPPER ORE FROM BURNT BASIN MINES LTD., BRITISH COLUMBIA

by

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MINERAL SCIENCES DIVISION

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SUMMARY OF RESULTS

Samples of a lead-zinc-copper ore from Burnt Mines Limited, southern British Columbia, were investigated mineralogically. The lead, zinc, and copper contents are related directly to the presence of galena, sphalerite, and chalcopyrite, respectively. The lead concentrate appears to be contaminated with fine intergrowths of other sulphides with galena so will probably be difficult to beneficiate. Silver is present as acanthite and argentian pentlandite, both of which go with the copper concentrate.

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INTRODUCTION

Several samples of a lead-zinc-copper ore from an area approximately 40 miles west of Trail, southern British Columbia, were received from G. Mathieu of the Mineral Processing Division, on August 17, 1972. Mr. Mathieu indicated that 300 pounds of the ore had been submitted to the Mines Branch by Mr. S. Ruzicka of Burnt Basin Mines Limited, P.O. Box 1496, Grand Forks, British Columbia, for beneficiation tests. A mineralogical examination of the sample was requested. The samples received included several chip samples, a head sample, and samples of copper, zinc, and lead concentrates that were obtained during the beneficiation tests.

METHODS OF INVESTIGATION

Polished sections were prepared from the various types of sample submitted. These sections were studied using the reflecting microscope, and tentative mineral identifications were established. Several mineral species were analysed using the electron microprobe.

The head sample was screened into several size fractions between 20 and 200 mesh. The 150 to 200-mesh fraction was separated into float and sink subfractions using heavy liquids of specific gravities 2.96 and 3.30. The sink and float portions were prepared as polished sections.

Polished sections were prepared from an initial mill product, labelled Test #2, which included samples of the copper, zinc, and lead concentrates and flotation tails. A final set of polished sections was prepared for a mill product consisting of Test Runs 100 and 101 which included samples of the copper, zinc, and lead concentrates.

RESULTS OF INVESTIGATION

Characteristics of the Ore

The hand specimens examined consist of relatively fine-grained sulphide aggregates in a predominantly carbonate matrix which contains irregular inclusions of argillaceous material. The carbonate has been marbleized and tends to be coarser-grained than the sulphides, which range in grain size up to approximately 2 mm. The hand specimens include three distinct mineral assemblages; chalcopyrite-pyrrhotite, galena-sphalerite, and sphalerite. The chalcopyrite-pyrrhotite forms irregular, wispy intergrowths, whereas the galena and sphalerite form compact, granular aggregates.

Mineralogy

The following minerals were identified:

pyrite	FeS_2	niccolite	NiAs
pyrrhotite	$Fe_{1-x}S$	violarite	$(Ni,Fe)_3S_4$
mackinawite	$Fe_{1.06}S$	loellingite	$FeAs_2$
		cobaltite	(Co, Fe)AsS
galena	PbS	arsenopyrite	FeAsS
sphalerite	(Zn, Fe)S		
		magnetite	Fe_3O_4
chalcopyrite	$CuFeS_2$		
cubanite	$CuFe_2S_3$		
native silver	Ag		
argentian pentlandite	$(Fe,Ni,Ag)_9S_8$		
acanthite	Ag_2S		

Several of these minerals were analysed using the electron microprobe. The results obtained are as follows:

Mackinawite	Wt%
Fe	58.65
Ni	5.40
Cu	.51
S	35.84
Total	100.40

$(Fe,Ni,Cu)_{1.02}S_{1.00}$

Cobaltite	Wt%
Co	24.63
Ni	10.14
Fe	.54
As	47.99
S	17.47
Total	100.77

$(Co,Ni,Fe)_{1.11}As_{1.18}S_{1.00}$

Loellingite	Wt%
As	70.85
Fe	21.60
Ni	6.29
Co	.43
S	1.49
Total	100.66

$(Fe,Ni,Co)_{1.01}(As,S)_{2.00}$

Arsenopyrite	Wt%
As	48.59
Fe	29.35
Ni	2.84
Co	1.33
S	17.82
Total	99.93

$(Fe,Ni,Co)_{1.08}As_{1.17}S_{1.00}$

Niccolite	Wt%
Co	.97
Ni	40.86
Fe	.82
As	55.12
Total	97.77

$(Ni,Co,Fe)_{0.98}As_{1.00}$

Violarite	Wt%
Cu	3.25
Fe	47.26
Ni	6.39
S	40.09
Total	96.99

$(Fe,Ni,Cu)_{3.22}S_{4.00}$

Argentian Pentlandite	Wt%
Fe	36.99
Ni	17.42
Ag	12.78
S	31.48
Total	98.67

(Fe, Ni, [illegible])$_{8.77}$[illegible]$_{8.00}$

Lead Minerals:

Galena is the only lead mineral present and occurs as dense impregnations within the host rock. It is generally associated with abundant, strongly corroded carbonate gangue fragments.

Zinc Minerals:

Sphalerite is the only zinc mineral present and occurs as massive, granular aggregates in a weakly calcareous matrix. Small veinlets and patches of coarser-grained sphalerite, with grains up to 2 mm in diameter, are dispersed through a finer-grained sphalerite matrix. The sphalerite occurs as two varieties, a light and a dark, with the coarser material appearing to have the lighter colour. This suggests a variation in iron content of the sphalerite.

Copper Minerals:

Chalcopyrite, the major copper mineral, is relatively fine-grained and is closely intergrown with pyrrhotite (Figure 1).

Cubanite, a second copper mineral, occurs in trace amounts as bladed intergrowths in chalcopyrite (Figure 2).

Silver Minerals:

Acanthite and argentian pentlandite are the two major silver minerals. Both are closely associated with chalcopyrite with which they form relatively complex intergrowths (Figure 3, Figure 4, respectively).

Several grains of native silver were tentatively identified but could not be confirmed because of their small size. They occur with the other silver minerals, but in trace amounts.

Miscellaneous Minerals:

These occur in minor to trace amounts in the samples studied.

Pyrite occurs as discrete grains and/or granular aggregates.

Pyrrhotite is closely associated with chalcopyrite and forms complex intergrowths with it.

Mackinawite occurs only with chalcopyrite and forms highly irregular, spindle-like inclusions.

Arsenopyrite occurs as discrete euhedral to subhedral grains within the main assemblage.

Cobaltite, loellingite, violarite, and niccolite generally occur together as irregular, granular aggregates. The violarite appears to be secondary and occurs along fractures and grain boundaries of the argentian pentlandite.

Mill Products

In the screened head sample, the maximum amount of liberated chalcopyrite and sphalerite occurs in the 150 to 200-mesh fraction.

In the mill product sample labelled Test #2, both the copper and zinc concentrates appeared relatively clean with less than 10% contamination by middlings of sphalerite with chalcopyrite in the copper concentrate and by middlings of chalcopyrite with sphalerite in the zinc concentrate. However, the lead concentrate is highly contaminated by both sphalerite and chalcopyrite middling products. The pyrite content of the lead concentrate is far higher than that of either the copper or zinc concentrates and it forms fine-grained intergrowths with the galena.

In the mill product sample labelled Tests #100 and #101, the copper and zinc concentrates were more than 90% pure and relatively free of middling products. However, the lead concentrate remained highly contaminated by middling products of sphalerite, chalcopyrite, and pyrite.

CONCLUSIONS

Copper and zinc concentrates can be obtained from the respective chalcopyrite and sphalerite contents of the ore through standard beneficiation procedures.

The lead concentrate is highly contaminated by copper and zinc, due to a high percentage of middling products. The galena-bearing portion of the ore will require finer grinding prior to flotation.

The silver minerals, which include argentian pentlandite and acanthite, are recovered in the copper concentrate, thus explaining the silver values reported. The galena is not argentiferous, which suggests that those silver values obtained in the lead concentrate are related to middling products containing minor amounts of the two silver minerals identified.

ACKNOWLEDGEMENTS

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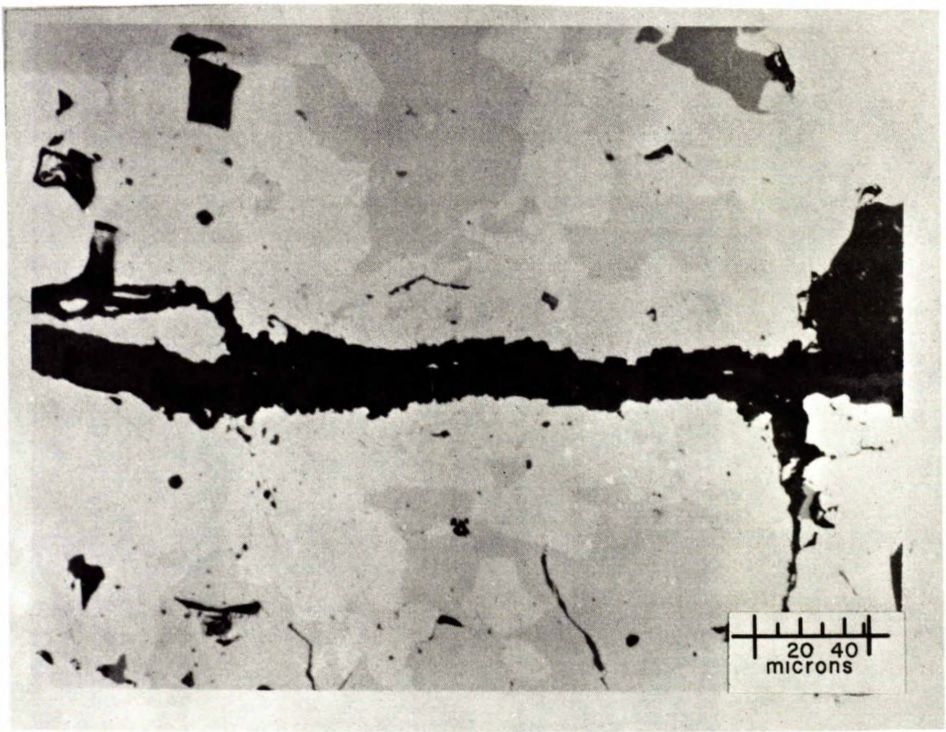

Figure 1. - Photomicrograph of chalcopyrite grains (light grey) intergrown with pyrrhotite (darker grey) and cut by a band of gangue (black).

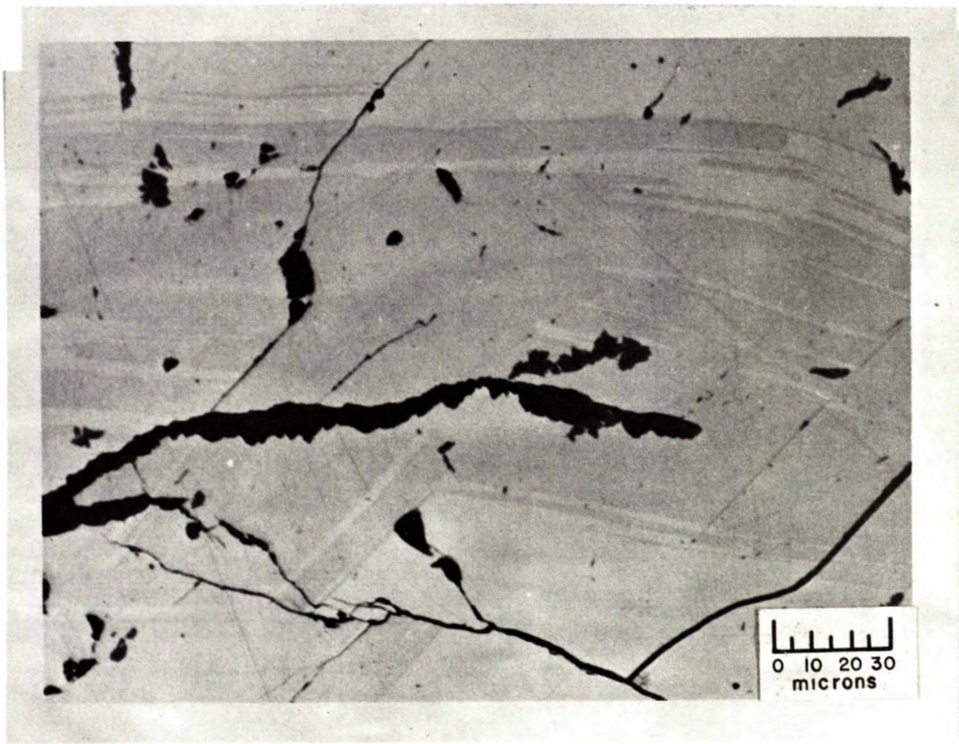

Figure 2. - Photomicrograph (crossed nicols) of cubanite laths (dark grey) in chalcopyrite. The black areas represent pits.

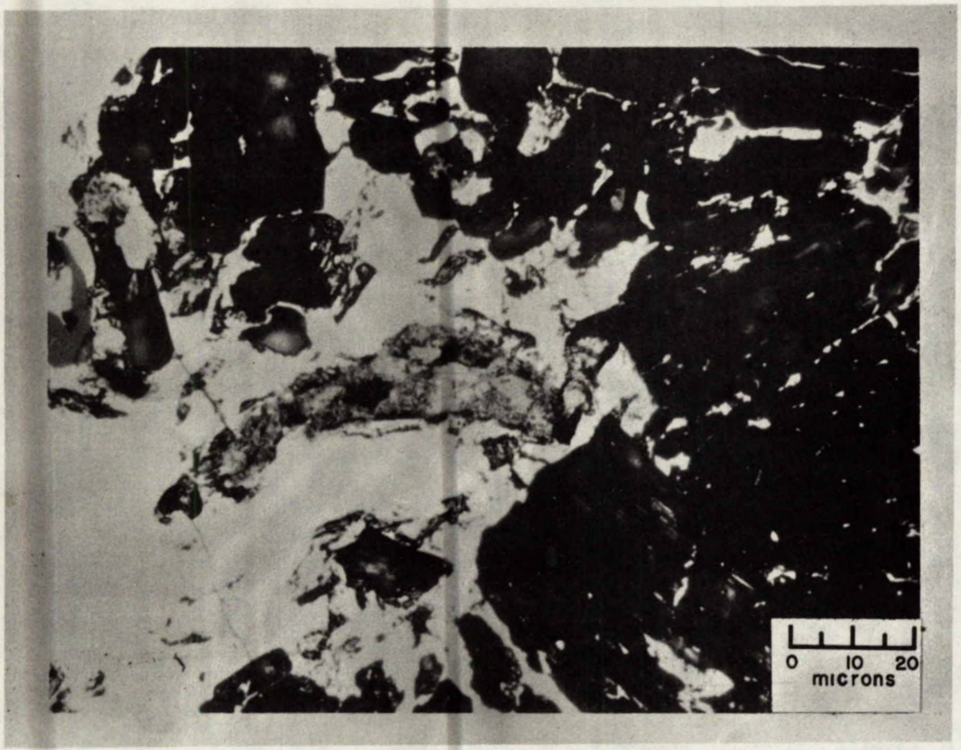

Figure 3. - Photomicrograph showing an irregular, highly pitted patch of acanthite (dark grey) in a chalcopyrite matrix (light grey). Black areas represent gangue.

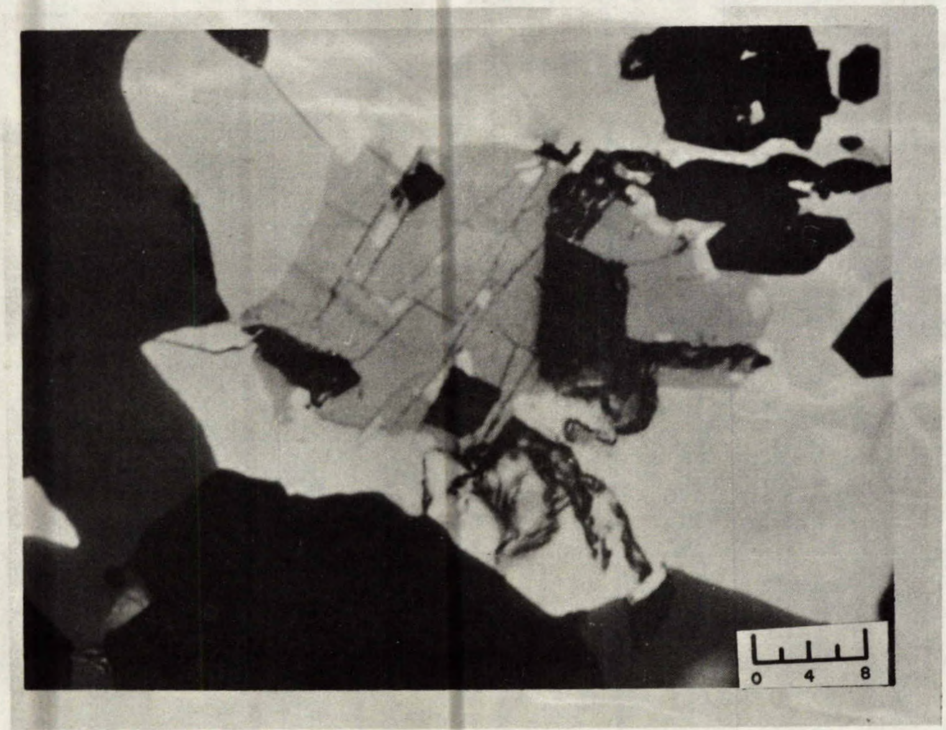

Figure 4. - Photomicrograph showing argentian pentlandite (med. grey) (note 2 distinct cleavage directions) in a chalcopyrite matrix. Dark grey represent sphalerite and black areas, pits.

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