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MINERALOGICAL EXAMINATION OF MILL PRODUCTS OBTAINED FROM A SAMPLE FROM THE NORTH ZONE OF THE TEXAS GULF SULPHUR DEPOSIT, KIDD TOWNSHIP, ONTARIO

by

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MINERAL SCIENCES DIVISION

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SUMMARY OF RESULTS

Seven mill products prepared from a sample of the north zone of the Texas Gulf Sulphur deposit in Kidd Township, Ontario, were examined mineralogically. It was found that the mill products consist of either sphalerite or pyrite, and small quantities of the other minerals in the ore. The other minerals are chalcopyrite, covellite, digentite, galena, native silver, marcasite, pyrrhotite, tetrahedrite(?), arsenopyrite, bornite, wolframite and goethite. These minerals are present largely as free grains but a few contain inclusions of other minerals.

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INTRODUCTION

Seven mill products obtained from a sample of the north zone of the Texas Gulf Sulphur deposit in Kidd Township, Ontario, were received from A. Stemerowicz of the Mineral Processing Division on June 1, 1965. Mr. Stemerowicz requested that the mill products be studied to determine the mode of occurrence and grain size of the minerals, the main contaminant in the zinc concentrate, and the reason for the difference in the copper and lead contents in the May 12 and May 25 lead concentrates.

SAMPLES

The samples received from Mr. Stemerowicz and their Ag, Cu, Pb and Zn contents are given in Table 1.

TABLE 1

Results of Analysis of the Mill Products*

Samples	Ag Oz/Ton	Weight (Per Cent)			
		Cu	Pb	Zn	S
May 12 Lead concentrate	98.57	13.56	8.70	22.85	---
May 12 Lead rougher concentrate	35.76	5.80	2.80	11.87	---
May 12 Lead cleaner tails	30.72	5.20	2.54	11.07	---
May 20 Zinc concentrate	11.46	1.84	0.96	45.90	---
May 20 Zinc rougher tails	5.41	0.45	0.67	1.30	45.04
May 20 Pyrite concentrate	10.40	1.33	1.24	2.63	48.49
May 25 Lead concentrate	32.68	3.43	3.60	22.70	---

*Analytical results supplied by the Analytical Chemistry Subdivision, Mineral Sciences Division, Mines Branch.

METHOD OF INVESTIGATION

One polished section was prepared from each of the mill products and examined under the ore microscope. The minerals were identified by X-ray diffraction and microscopical methods.

RESULTS OF INVESTIGATION

May 12 Lead Concentrate (Figure 1)

This sample consists of sphalerite, pyrite, covellite, digenite, chalcopyrite, galena, native silver, marcasite, pyrrhotite, and a mineral tentatively identified as tetrahedrite. Sphalerite is the principal constituent

and is present largely as free grains. A few of the sphalerite grains contain inclusions of covellite, digenite and other minerals, and a few others are rimmed with covellite and digenite.

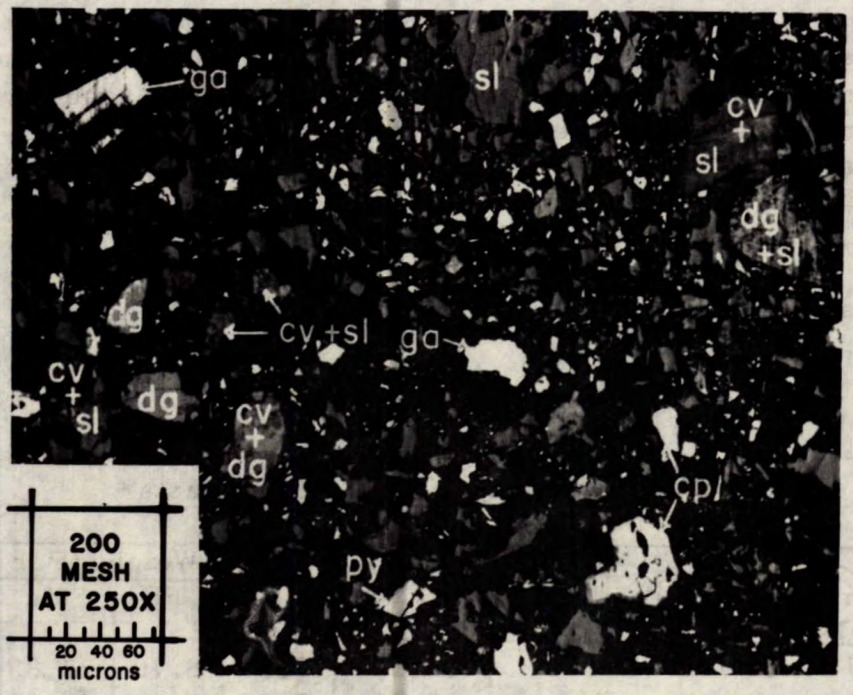

Figure 1. Photomicrograph of the May 12 lead concentrate, which consists predominantly of sphalerite (sl). A number of grains of sphalerite combined with covellite (cv) and digenite (dg) are also shown. The white grains represent pyrite (py), galena (ga) and chalcopyrite (cp).

Pyrite is also a major constituent in this sample; it is largely present as free grains but a number of the grains contain inclusions of the other minerals.

Covellite, digenite and chalcopyrite are the copper-bearing minerals found in the sample. Covellite and digenite are more abundant than chalcopyrite; they are present as free grains, as intergrowths with each other, as inclusions in sphalerite and pyrite, and as rims around sphalerite, chalcopyrite and pyrite. The chalcopyrite is present mainly as free grains and occasionally as remnants in covellite and digenite.

The galena found in the sample is present as free grains and occasionally as small inclusions in pyrite.

Twenty-eight grains of native silver were found in the polished section of the sample. Thirteen of these grains are free, fourteen are locked in pyrite, and one grain is locked in pyrrhotite.

The amount of marcasite, pyrrhotite, and tetrahedrite (?) present in the sample is very small. The pyrrhotite is present as inclusions in sphalerite and the marcasite is present as separate grains and locked particles in covellite. The mineral tentatively identified as tetrahedrite is present as free grains which are too small to identify by either X-ray diffraction or microscopical methods.

May 12 Lead Rougher Concentrate (Figure 2)

This sample is mineralogically similar to the May 12 lead concentrate but it contains more pyrite and less sphalerite, digenite, covellite and chalcopyrite. In addition, it contains a few free grains of arsenopyrite, occasional veinlets and inclusions of bornite in covellite,

Figure 2. Photomicrograph of the May 12 lead rougher concentrate. The principal minerals shown are pyrite (py) and sphalerite (sl), a few of which are labelled. One combined grain of native silver (Ag) and pyrite is shown. Several grains of digenite (dg) are present.

and pyrrhotite grains rimmed with chalcopyrite. Fourteen grains of native silver were found in one polished section of the sample. Only one of these grains is free; the remaining thirteen are present as locked grains in pyrite.

May 12 Lead Cleaner Tails (Figure 3)

This sample is mineralogically similar to the May 12 lead concentrate but it contains more pyrite and slightly less sphalerite, covellite, digenite and chalcopyrite.

Four grains of native silver were found in one polished section of the sample; of these, one grain is free and the remainder are locked in pyrite.

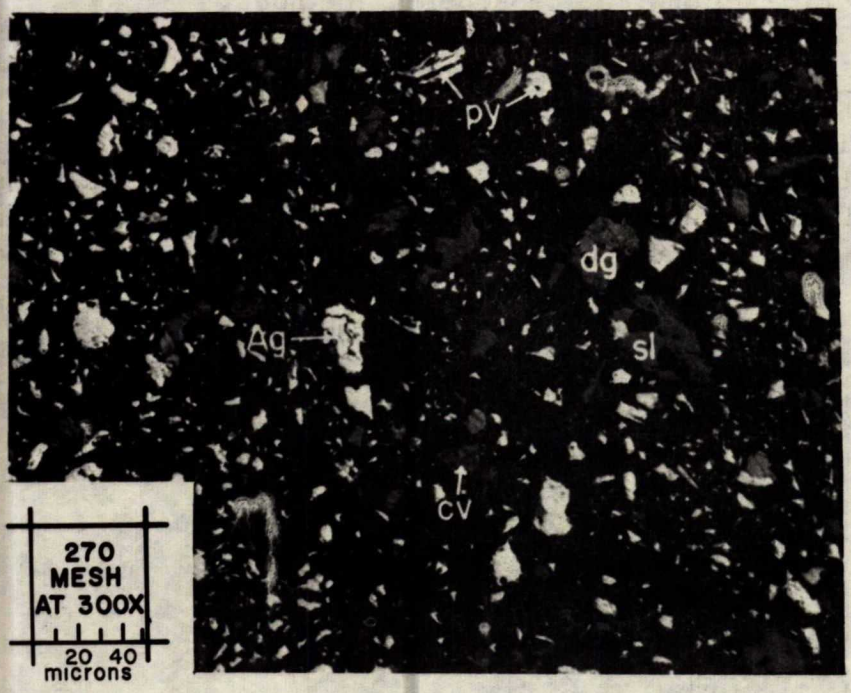

Figure 3. Photomicrograph of the May 12 lead cleaner tails. The white grains are mostly pyrite (py), a notable exception being the large combined grain of native silver (Ag) and pyrite near the centre of the photomicrograph. The dark grains are sphalerite (sl), covellite (cv) and digenite (dg).

May 20 Zinc Concentrate (Figure 4)

Sphalerite is the principal metallic mineral in this sample and pyrite the principal contaminant. The sphalerite is present mainly as free grains with occasional inclusions of pyrite and the other minerals. Pyrite is present as locked grains in sphalerite and as free grains. The locked grains range in size from 5 to 60 microns with an approximate average of 20 microns. Other minerals found in the sample are chalcopyrite, digenite, covellite, galena, pyrrhotite and marcasite.

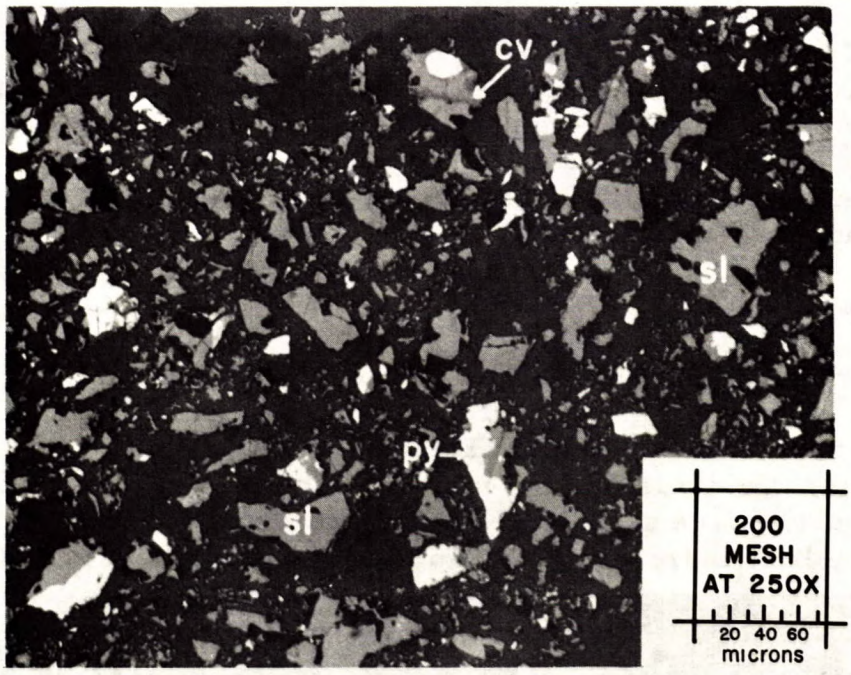

Figure 4. Photomicrograph of the May 20 zinc concentrate showing free grains of sphalerite (sl), a few free and locked grains of pyrite (py), and one grain of sphalerite veined with covellite (cv).

May 20 Zinc Rougher Tails (Figure 5)

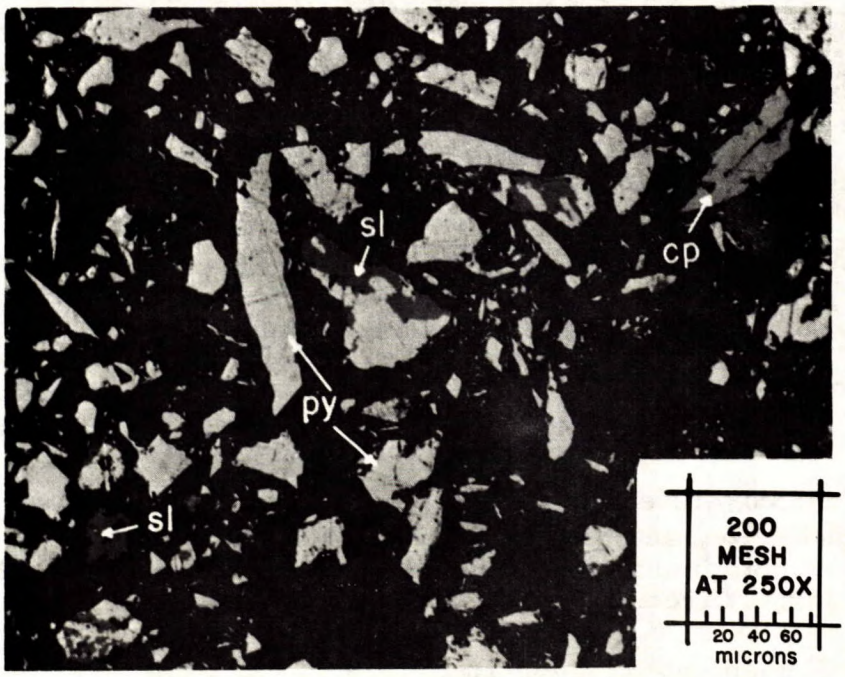

Figure 5. Photomicrograph of the May 20 zinc rougher tails showing pyrite (py) with a few locked and free grains of sphalerite (sl) and one free grain of chalcopyrite (cp).

The grains in this sample are coarser than those in the other six samples. Pyrite is the principal metallic mineral and accounts for more than 90 per cent of the sample. The remaining minerals in the sample are sphalerite, chalcopyrite, covellite, digenite, galena, pyrrhotite, marcasite and goethite. These minerals are present both as free grains and locked grains in pyrite.

May 20 Pyrite Concentrate (Figure 6)

Pyrite is the principal constituent and sphalerite is the main contaminant. The pyrite is present predominantly as free grains with a small number of grains containing inclusions of sphalerite, pyrrhotite and galena. The sphalerite is present mainly as locked particles in pyrite with a lesser amount as free grains. The other minerals in the sample are digenite, covellite, marcasite, wolframite, tetrahedrite (?) and bornite.

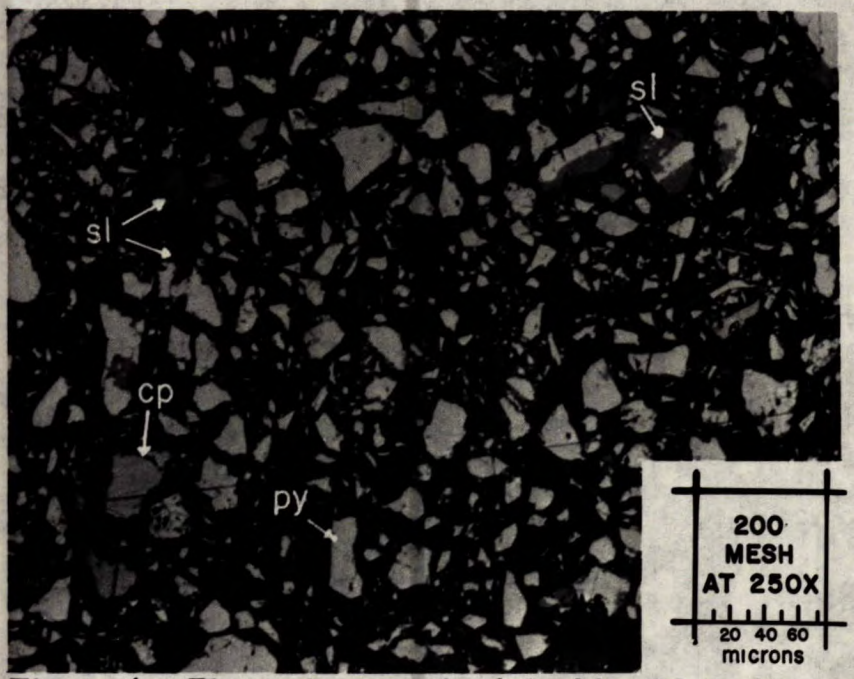

Figure 6. Photomicrograph of the May 20 pyrite concentrate showing pyrite (py) with a few locked and free grains of sphalerite (sl) and one grain of chalcopyrite (cp).

The digenite and covellite are present as free grains, as inclusions and veinlets in sphalerite, and as partial rims around sphalerite. Bornite was found only as minute inclusions in digenite; the remaining minerals in the sample were largely free.

May 25 Lead Concentrate (Figure 7)

Sphalerite and pyrite are the principal minerals in this sample, with the sphalerite predominating. The other minerals in the sample are: chalcopyrite, covellite, digenite, galena, native silver, marcasite,

arsenopyrite, pyrrhotite, bornite and tetrahedrite (?) - the chalcopyrite being more abundant than the covellite and digenite. Most of the grains are free, but covellite and digenite sometimes are found as thin rims around the sphalerite and chalcopyrite. Twenty-six grains of native silver were found in one polished section of the sample. Eighteen of these grains are

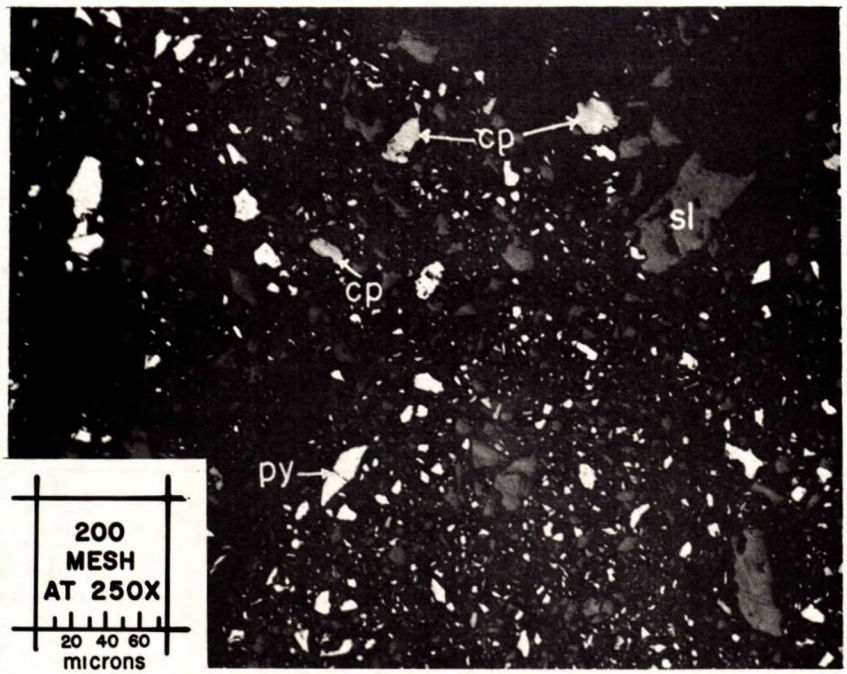

Figure 7. Photomicrograph of the May 25 lead concentrate showing sphalerite (sl), pyrite (py), and a few free grains of chalcopyrite (cp).

free, three grains are present as inclusions in pyrite, two grains as inclusions in sphalerite, and two grains are locked with pyrite and one with pyrrhotite. Bornite is present as minute inclusions in digenite; the remaining minerals are present mainly as free grains.

Grain Sizes of the Minerals in the Samples

The grain sizes of the principal constituents, as well as of the native silver in the samples, vary from a minimum size of about 2 microns to the maximum sizes given in Table 2.

Table 2 shows that only two of the products, the May 20 zinc rougher tails and May 20 pyrite concentrates contain particles larger than 100 microns. Certain consistent grain size relationships are also evident: galena and silver are generally finer grained than the other minerals, whereas sphalerite, pyrite and covellite are coarser grained. Chalcopyrite and digenite occupy intermediate positions.

TABLE 2

Maximum Grain Size of the Principal Metallic Minerals in the Mill Products

(Microns)

Minerals	May 12 Lead Conc.	May 12 Lead Rougher Conc.	May 12 Lead Cleaner Tails	May 20 Zinc Conc.	May 20 Zinc Rougher Tails	May 20 Pyrite Conc.	May 25 Lead Conc.
Sphalerite	100	65	60	80	95	80	100
Pyrite	70	50	55	65	200	200	65
Native Silver	52	40	20	24	--	--	34
Galena	64	30	30	25	50	50	40
Chalcopyrite	50	60	40	65	65	110	65
Digenite	60	75	40	30	115	160	40
Covellite	65	55	50	70	175	200	55

SUMMARY AND CONCLUSIONS

A summary of the minerals present in the mill products is given in Table 3.

The mill products were found to have the following features:

1. Most of the grains are free but some contain inclusions of the other minerals.

2. Some of the sphalerite and chalcopyrite grains are bordered with covellite and digenite, and occasionally the sphalerite grains contain veinlets of covellite and digenite.

3. The grains in two of the mill products vary from 2 to 200 microns in size whereas the grains in other samples are smaller than 100 microns.

4. Native silver is present mainly as free grains but some is present as locked grains in pyrite and as inclusions in sphalerite and pyrrhotite.

5. The main contaminant in the May 20 zinc concentrate is pyrite; the main contaminant in the May 20 pyrite concentrate is sphalerite. The principal contaminants of the lead concentrates of May 12 and May 25 are sphalerite, pyrite, covellite, digenite and chalcopyrite.

TABLE 3

Minerals Present in the Mill Products

Sample	Principal Constituents	Other Constituents
May 12 lead concentrate	sphalerite	pyrite, covellite digenite, chalcopyrite, galena, native silver, marcasite, pyrrhotite and tetrahedrite(?).
May 12 lead rougher concentrate	sphalerite and pyrite	covellite, digenite, chalcopyrite, galena, native silver, marcasite, pyrrhotite, tetrahedrite(?), arsenopyrite and bornite.
May 12 lead cleaner tails	sphalerite and pyrite	covellite, digenite, chalcopyrite, galena, native silver, marcasite, pyrrhotite and tetrahedrite(?).
May 20 zinc concentrate	sphalerite	pyrite, chalcopyrite, digenite, covellite, galena, pyrrhotite and marcasite.
May 20 zinc rougher tails	pyrite	sphalerite, chalcopyrite, covellite, digenite, galena, pyrrhotite, marcasite and goethite.
May 20 pyrite concentrate	pyrite	sphalerite, pyrrhotite, galena, digenite, covellite, marcasite, wolframite, tetrahedrite(?) and bornite.
May 25 lead concentrate	sphalerite and pyrite	chalcopyrite, covellite, digenite, galena, native silver, marcasite, arsenopyrite, pyrrhotite, bornite and tetrahedrite.

6. The higher copper content of the May 12 lead concentrate than that of the May 25 lead concentrate is accounted for by the presence of more numerous and coarser grains of digenite, covellite and chalcopyrite (see Figures 1 and 7). It is also noted that the May 12 lead concentrate contains more grains of covellite and digenite than chalcopyrite, while the reverse is true of the May 25 lead concentrate.

7. The reason for the difference in the lead content of the May 12 and May 25 lead concentrates is not readily apparent. Although there appears to be a slightly larger number of grains of galena in the first concentrate than the second, no difference in the mode of occurrence of the galena in the two mill products was found.