

O T T A W A      June 22nd, 1942.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1250.

Plotation Tests on Scheelite Ore from  
the Leitch Gold Mines Limited,  
Bardmore, Ontario.

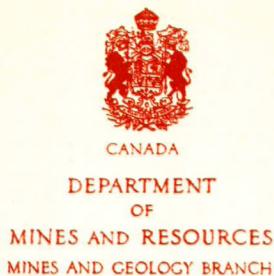
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BUREAU OF MINES  
DIVISION OF METALLIC MINERALS  
ORE DRESSING AND  
METALLURGICAL LABORATORIES



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Investigation No. 1250.

Flotation Tests on Scheelite Ore from  
the Leitch Gold Mines Limited,  
Beardmore, Ontario.

Shipment:

A shipment of 6,206 pounds of hand-sorted scheelite ore was received on March 31st, 1942, from Leitch Gold Mines Limited, Beardmore, Ontario.

Purpose of Tests:

The test work was done at the request of Mr. A. D. Dickson, manager of Leitch Gold Mines Limited. The ore was treated by flotation to obtain data on grade and recovery to be expected from the low-grade scheelite ore.

The flow-sheet and reagents used for the tests on the sample of scheelite ore from Little Long Lac were used on this sample. This flow-sheet is shown on Page 4.

Sampling and Analysis:

The entire lot of ore was crushed to minus 8 mesh and sampled by standard methods. Analysis of the head sample gave the following results:

Gold	=	2.15 oz./ton.
W <sub>3</sub> O <sub>8</sub>	=	2.19 per cent
Phosphorus	=	0.029 "
Sulphur	=	0.38 "

General Discussion:

In these tests the flow-sheet that was developed by the United States Vanadium Corporation at their Pine Creek (California) plant was used. This company, in conjunction with the Procter and Gamble Company, have developed a new reagent, "Orso," that is a specific for scheelite. It is their work that is mainly responsible for the success of these tests.

The reagent "Orso" replaces sodium oleate in the flotation of scheelite. It is less expensive to use and gives more consistent results. It was found necessary to make a 1 per cent solution of the "Orso," a stronger solution having a tendency to form a jelly. Step addition of the "Orso" was found to be beneficial as it allowed a higher grade concentrate to be made, while the addition of the

(General Discussion, cont'd) -

reagent in the scavenging circuit improved recovery.

The hardness of the water has an effect on the flotation of scheelite as well as on the amount of reagent required. The hardness in the city water was neutralized by the addition of a small amount of soda ash; more or less of this reagent may be required at the mine.

Sodium silicate is fed to the ball-mill circuit primarily to act as a disperser. It is also used, along with the soda ash, as a pH regulator.

Emulsol X-1 is a wetting agent and is used in the scheelite circuit. The reagent also has a modifying action on the froth and its use in this respect is very critical. The use of small amounts will give a cleaner concentrate but a small excess will cause a decrease in recovery of the scheelite.

No particular attention was paid to the flotation of the sulphides, as it was considered that information already available would be more than ample to cover this. Cleaning followed by recleaning is considered necessary to reduce the amount of scheelite remaining in the sulphide concentrate.

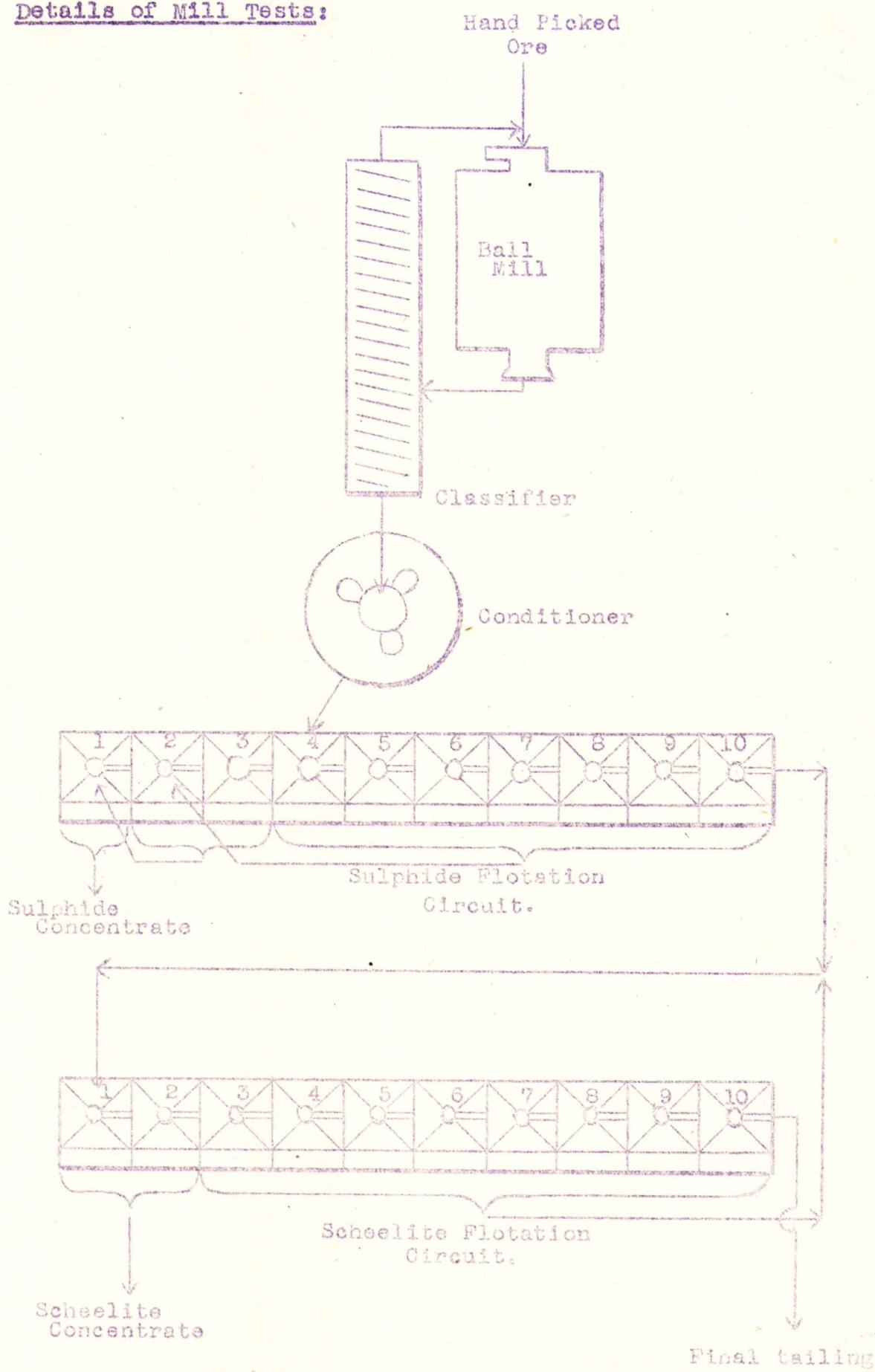
The tailings from the scheelite circuit could be treated further, if desired, for the removal of the remaining gold.

As it was the intention of Leitch Gold Mines Limited to mill their ores at the mill of the Little Long Lac Gold Mines Limited, the tests were run paralleling those made for Little Long Lac.

The head analysis of the ore was somewhat high and a lower grade (15 per cent WO<sub>3</sub>) is to be expected from a head of 1 per cent WO<sub>3</sub>.

FLOW-SHEET.

Details of Mill Tests:



(Details of Mill Tests, cont'd) -

The foregoing flow-sheet is that used for Tests Nos. 1 to 3 inclusive. In Test No. 4, the last eight cells of the scheelite circuit were used as a rougher, the tailings going to waste, and the concentrate being cleaned in the first two cells. The first two cells gave a finished concentrate and the tailings went to the rougher circuit.

Mill Test No. 1.

Feed rate - 300 pounds per hour.

Per cent solids: Sulphide flotation = 33  
Scheelite flotation = 29

Time of run = 6 hours.

Reagent Consumption:

<u>Grinding:</u>	<u>Lb./ton</u>
Soda ash	= 0.27
Sodium silicate	= 1.33
Potassium amyl xanthate	= 0.12
Reagent 208	= 0.18

Conditioner:

Potassium amyl xanthate	= 0.05
Cresylic acid	= 0.29

Scheelite flotation:

Emulsol X-1	= 0.09
Orso	= 0.09
Scavenger feed: Cresylic acid	= 0.12
Scavenger Cell No. 4: Orso	= 0.07
" " 6: Orso	= 0.06

Screen Analysis of Classifier Overflow.

<u>Screen size</u>	<u>Weight, per cent</u>
+ 65	: 2.0
- 65+100	: 5.4
-100+150	: 13.3
-150+200	: 13.4
-200	: 65.9

(Continued on next page)

(Mill Test No. 1, cont'd) -

Product	Assays:				
	Gold, oz./ton	W <sub>O</sub> <sub>3</sub>	P	S	
Flotation feed	1.50	2.46	0.05	0.23	
Pyrite concentrate	76.34	0.27			
Pyrite flotation tailing	0.14	2.50		0.06	
Scheelite concentrate	0.20	27.78		0.13	
Scheelite scavenger concen.		11.35			
Final tailing	0.135	0.22		0.06	

Product	Recoveries:			
	Weight recovery, per cent	Au	Recoveries, per cent	Ratio of concen- tration
Flotation feed	100.0	100.0	100.0	:
Pyrite concentrate	1.8	90.9	0.2	55.87:1.
Pyrite flotation tailing	98.2	9.1	99.8	:
Scheelite concentrate	8.1	1.1	91.7	12.32:1.
Final tailing	90.1	8.0	8.1	:

In this, as well as successive runs, there was a considerable tie-up of gold in the grinding circuit. This would not apply in continuous operation.

#### Conclusions to Test No. 1:

This ore is amenable to concentration by the use of "Orso" even at the low grind shown here. The run was quite steady and no difficulty should be experienced in the handling of this ore. An increase in the "Orso" should be followed by an increase in recovery and a decrease in the grade.

#### Mill Test No. 2.

The flow-sheet used in this test was the same as in Test No. 1. The only difference in the tests was that the "Orso" was increased in an attempt to improve recovery.

(Continued on next page)

(Mill Test No. 2, cont'd) -

Feed rate - 300 pounds per hour.

Per cent solids:

Sulphide flotation feed	=	33
Scheelite	"	= 28

Time of run - 6 hours.

Screen Analysis of Classifier Overflow.

Screen size	:	Weight, per cent
+ 65		2.3
- 65+100		6.2
-100+150		17.9
-150+200		13.2
-200		60.4

Reagent Consumption:

Lb./ton

Grinding:

Soda ash	=	0.27
Sodium silicate	=	1.33
Potassium amyl xanthate	=	0.12
Reagent 208	=	0.18

Conditioner:

Potassium amyl xanthate	=	0.05
Cresylic acid	=	0.31

Scheelite flotation:

Emulsol X-1	=	0.12
Orso	=	0.18
Scavenger feed: Cresylic acid	=	0.16
Scavenger Cell No. 4: Orso	=	0.05
" " " 6: Orso	=	0.05

Assays:

Product	:	Gold, oz./ton	:	Per cent WO <sub>3</sub>	:	P	:	S
Flotation feed	:	0.97	:	1.70	:	:	:	0.40
Sulphide concentrate	:	112.32	:	0.31	:	:	:	
Sulphide flotation tailing	:	0.16	:	1.71	:	0.034	:	0.08
Scheelite concentrate	:	0.25	:	19.78	:	0.25	:	0.13
Scheelite scavenger concentrate	:		:	10.51	:		:	
Final tailing	:	0.15	:	0.06	:	0.01	:	0.06

(Continued on next page)

(Mill Test No. 2, cont'd) -

Product	Recoveries:			Ratio of concen- tration
	:Weight	:Recoveries,	:per cent	
	:recovery, :per cent	:Au	:W <sub>o</sub> 3	
Flotation feed	:	100.0	:	100.0
Sulphide concentrate	:	0.7	:	85.6
Scheelite concentrate	:	8.3	:	2.1
Final tailing	:	91.0	:	14.3
	:	:	:	96.7
	:	:	:	3.2
	:	:	:	:

Conclusions to Test No. 2:

There appeared to be a distinct improvement in the recovery obtained by increasing the "Orso". This was also accompanied by a drop in the grade of the concentrate obtained. This drop in grade may be due, to some extent at least, in the drop in the grade of the scheelite in the head.

Mill Test No. 3.

In this test a finer grind was used and an addition of Emulsol X-1 to the scavenger circuit was used. The flow-sheet used was similar to that used in the previous tests.

Rate of feed = 300 pounds per hour.

Per cent solids:

Sulphide flotation feed = 35  
Scheelite " " = 31

Time of run: 6 hours.

Reagent Consumption:

Lb./ton

Grinding Circuit:

Sodium carbonate	=	0.36
Sodium silicate	=	1.29
Potassium amyl xanthate	=	0.12
Reagent 208	=	0.18

(Continued on next page)

(Mill Test No. 3, cont'd) -

(Reagent Consumption, cont'd) -

<u>Conditioner Tank:</u>	<u>Lb./ton</u>
Potassium amyl xanthate	= 0.05
Cresylic acid	= 0.27

Scheelite Flotation:

Emulsol X-1	=	0.09
Orso	=	0.13
Scavenger feed - Cresylic acid	=	0.12
Scavenger circuit, 2nd cell: Orso	=	0.05
" " , 4th cell: Orso	=	0.05
" " , 5th cell: Emulsol X-1	=	0.05

Screen Analysis of Classifier Overflow.

<u>Screen size</u>	<u>:</u>	<u>Weight, per cent</u>
+100	:	0.9
-100+150	:	6.5
-150+200	:	13.4
-200	:	79.2

Analysis of Products.

<u>Product</u>	<u>:</u>	<u>Gold,</u>	<u>Per cent</u>		
	<u>oz./ton</u>	<u>W<sub>O</sub>3</u>	<u>P</u>	<u>S</u>	
Flotation feed	:	1.40	2.35	0.037	0.35
Sulphide concentrate	:	61.32	0.54		
Sulphide flotation tailing	:	0.08	2.39	0.021	0.05
Scheelite concentrate	:	0.20	30.91	0.23	0.12
Scheelite scavenger concentrate	:		6.27		
Final tailing	:	0.07	0.24	0.01	0.04

Recoveries.

<u>Product</u>	<u>:</u>	<u>Weight</u>	<u>Recoveries,</u>	<u>Ratio of</u>
	<u>recovery,</u>	<u>per cent</u>	<u>Au</u>	<u>concen-</u>
Flotation feed	:	100.0	100.0	100.0 :
Sulphide concentrate	:	2.2	94.5	0.5 : 46.30:1.
Scheelite concentrate	:	6.9	0.9	90.2 : 14.58:1.
Final tailing	:	90.9	4.6	9.3 :

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(Mill Test No. 3, cont'd) -

Conclusions to Test No. 3:

In this test the finer grind allowed a slightly higher grade of concentrate to be made with a good recovery of the scheelite. The addition of Emulsol X-1 to the 5th cell of the scavenger circuit does not appear to be of any benefit. An increase in the "Orso" to 0.20 pound per ton to the head of the scheelite circuit would most likely have increased recovery at very little loss in grade.

Mill Test No. 4.

In this test the sulphide flotation tailing was sent to a rougher circuit of eight cells and the rougher concentrate cleaned in two cells. The rougher tailings were discarded and the cleaner tailings were sent to the head of the rougher circuit.

Feed rate - 300 pounds per hour.

Per cent solids:

Sulphide flotation feed	=	34
Scheelite	"	= 29

Reagent Consumption:

Grinding:	Lb./ton
Sodium carbonate	= 0.31
Sodium silicate	= 1.53
Potassium amyl xanthate	= 0.12
Reagent 208	= 0.18

Conditioner:

Potassium amyl xanthate	= 0.05
Cresylic acid	= 0.27

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(Mill Test No. 4, cont'd) -

(Reagent Consumption, cont'd) -

Scheelite Flotation:	Lb./ton
Emulsol X-1	= 0.09
Orso	= 0.13
Scavenger feed: Cresylic acid	= 0.12
Scavenger circuit, Cell No. 4: Orso	= 0.05
" " " No. 6: "	= 0.05

Screen Analysis of Classifier Overflow.

Screen size	Weight, per cent
+100	0.1
-100+150	4.6
-150+200	10.9
-200	84.4

Analysis of Products.

Product	Gold,		Per cent	
	oz./ton	W <sub>O</sub> <sub>3</sub>	S	
Flotation feed	: 1.42	: 2.15	:	0.39
Sulphide concentrate	: 116.82	: 0.37	:	
Sulphide flotation tailing	: 0.125	: 2.17	:	0.07
Scheelite rougher concentrate	:	: 25.02	:	
Scheelite cleaner "	: 0.20	: 31.56	:	0.18
" " tailing	:	: 7.90	:	
Final tailing	: 0.12	: 0.20	:	0.06

Recoveries:

Product	Weight, :		Recoveries	Ratio of
	per	cent	per cent	concen-
Flotation feed	: 100.0	: 100.0	: 100.0	:
Sulphide concentrate	: 1.1	: 91.3	: 0.2	: 90.09:1.
Scheelite cleaner concentrate	: 6.2	: 0.9	: 91.2	: 16.1:1.
" rougher tailing	: 92.7	: 7.8	: 8.6	:

Conclusions to Test No. 4:

This circuit was used to see whether a higher grade concentrate could be made by cleaning a rougher concentrate. Although there was a slight improvement in grade this could be because of the slightly finer grind. This circuit does not

(Conclusions to Test No. 4, cont'd) -

appear to contain any advantage over the circuit used in the previous tests.

Summary and Recommendations:

No difficulty should be found in obtaining a grade of concentrate suitable for chemical treatment from this ore. A high recovery of the scheelite was readily obtained at high grade for this type of work.

It is recommended that the quantity of Emulsol X-1 be kept below 0.10 pound per ton and that if the ore grades over 2 per cent  $WO_3$  the "Orso" used at the head of the circuit be 0.20 to 0.25 pound per ton of original feed.

Test No. 3 gave the best results, but an increase in the "Orso" from 0.13 to 0.20 pounds per ton would be beneficial.

A grind of 70 to 75 per cent minus 200 mesh appears to be ample for this ore.

The use of a rougher circuit followed by one cleaning of the rougher concentrates did not offer any advantages over the standard circuit as given in the flow-sheet.

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