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CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

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MINES BRANCH INVESTIGATION REPORT IR 62-113

INVESTIGATION OF IRON ORES FROM FRONTENAC AND LEEDS COUNTIES, SUBMITTED BY W. H. STRONG, PERTH, ONTARIO

by

W. S. JENKINS

MINERAL PROCESSING DIVISION

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SUMMARY OF RESULTS

Four samples of ore were received for investigation and were designated as Black Lake, Bob's Lake, Aaron's Lake and Troy Lake. The iron content of the samples was 44.75%, 40.81%, 63.19% and 33.18% respectively.

Recoveries on Bob's Lake ore were as follows: -10m, -35m, -65m concentrates assayed Fe, 58.5%, 65.24% and 68.36% respectively. The recoveries of iron were 95.9%, 93.2% and 92.8% respectively. The ratios of concentration were 1.5:1, and 1.74:1 respectively.

Concentrate from -20m Bob's Lake ore assayed Fe 58.7%; recovery of iron was 95.9%; ratio of concentration was 1.50:1. This -20m concentrate, ground to -150m and reconcentrated, assayed: Fe 69.82%, TiO_2 0.24%, P_2O_5 0.002%, S 0.010%, Cu 0.003%, Cr_2O_3 $<$0.001%, V_2O_5 0.02% and SiO_2 0.72%. The recovery of iron was 89.1% at a ratio of concentration of 2:1 in this test.

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INTRODUCTION

Shipment

On July 16, 1962, Mr. W.H. Strong, Perth, Ontario, delivered four samples of iron ore, of total weight 301 lb, to the Mineral Processing Division laboratories.

Location of Properties

In his covering letter, Mr. Strong stated that the samples were taken from four properties which were designated as Black Lake, Bob's Lake and Aaron's Lake, all in Bedford township, Frontenac County, and Troy Lake in South Crosby township, Leeds county.

Purpose of the Investigation

The investigation was to determine the amounts of iron and titanium in the four samples and magnetic concentration tests on each head sample by the Davis tube separator. The main investigation was to be made on the Bob's Lake sample to ascertain the grades and recoveries of iron and the amounts of titanium dioxide in the concentrates from various grinds.

Description of the Bob's Lake Property

In his letter dated August 14, 1962, Mr. Strong described the Bob's Lake property. An area of about two square miles has been surveyed by a magnetometer survey and pits and trenches have been dug. Two anomalies have been surveyed. One is about one mile long by one-half mile wide and the other is somewhat smaller. The anomalies are estimated to contain about 50 million tons of iron ore.

SAMPLING AND ANALYSIS OF SHIPMENT

A head sample was cut from each of the four samples of ore and analysed for soluble iron, titanium dioxide, phosphorus pentoxide and sulphur.

TABLE 1

Analyses* of the Head Samples

Sample	Weight lb	Sol Fe %	TiO_2 %	P_2O_5 %	S %
Black Lake	75	44.75	0.56	$\leq$0.02	0.69
Bob's Lake	41	40.81	0.37	$\leq$0.01	0.072
Aaron's Lake	74	63.19	0.88	$\leq$0.02	0.28
Troy Lake	116	33.18	7.31	3.12	0.84

*Internal Report MS-AC-62-862

TABLE 2

Semi-Quantitative Spectrographic Analysis* of the Head Samples

Constituents in order of decreasing abundance

Sample	Black Lake	Bob's Lake	Aaron's Lake	Troy Lake
Major constituents	Fe,	Fe,	Fe,	Fe,
Intermediate constituents	Si, Mg, Ca,	Si, Mg, Ca,	Al, Si, Mg, Ca, Ti, Zn, Mn,	Si, Ti, Al, Mg,
Minor constituents	Al, Ti, Mn, Zn,	Al, Na, Ti,	V, Ni,	Ca, Ba, Zn, Mn,
Trace constituents	Cu, Zr, Ni, V, Co, Ba, Na, Cr, B, Ag,	Mn, V, Cu, Ni, Co, Ba, Zn, Cr, Zr,	Cu, Co, Ba, Cr, Zr, Ag,	V, Cu, Ni, Co, Cr, Zr,

*Internal Report MS-AC-62-884, SL 62-183 by Miss E.M. Kranck and Dr. A.H. Gillieson, Head, Spectrographic Laboratory, Mineral Sciences Division.

MINERALOGICAL EXAMINATION

No mineralogical examination was made on any of the four samples of the shipment.

SUMMARY OF TEST PROCEDURE AND RESULTS

The head sample of each ore was magnetically concentrated by Davis tube at a grind finer than 200 m.

The Bob's Lake ore was magnetically concentrated at grinds of -10, -20, -35, -65, -150 and -200 m. Some of the -20 m concentrates were ground to -150 m and reconcentrated.

The ilmenite in the non-magnetic tailing was not concentrated.

Table 3 shows the results obtained by magnetic concentration at different grinds.

TABLE 3

Grades and Recoveries of Magnetic Concentrates

Test No.	Ore	Mesh of grind	Weight %	Analysis %					Recovery %		R/C
				Fe	TiO_2	P_2O_5	S	SiO_2	Fe	TiO_2	
1	Black Lake	-200	64.0	62.5	0.91	0.01	0.45	2.14	93.1	64.5	1.56:1
2	Bob's Lake	"	56.8	64.4	0.48	<0.01	0.033	1.52	95.4	67.7	1.76:1
3	Aaron's Lake	"	86.4	70.40	0.23	0.007	0.16	0.24	98.6	24.2	1.2:1
4	Troy Lake	"	38.4	59.6	0.71	0.07	0.14	1.96	76.9	3.7	2.6:1
5	Bob's Lake	-10	66.3	58.57	0.39	0.007	0.014	8.58	95.9	96.3	1.5:1
6	"	-35	56.1	65.24	0.40	0.030	0.022	3.84	93.2	75.7	1.78:1
7	"	-65	57.3	68.36	0.38	<0.01	0.024	1.74	92.8	68.6	1.74:1
8	"	-20	69.88	56.08	0.40	-	0.02	6.88	96.6	89.0	1.4:1
9	"	Regrind -150	53.54	70.12	0.39	<0.01	0.018	0.86	91.6	60.7	1.87:1
10	"	-20	66.6	58.27	0.35	0.017	0.012	8.90	96.5	95.9	1.50:1
10	"	Regrind -150	49.2	69.82	0.24	0.002	0.010	0.72	89.1	43.4	2:1
11	"	-150	48.	69.29	0.29	0.01	0.01	0.72	85.9	-	2.1:1

Tests 1 to 4 were by Davis Tube.
Tests 5 to 11 were by laboratory dry and/or wet magnetic separators.

DETAILS OF TESTS

Tests 1-4 Magnetic Concentration of the Four Head Samples

A 25 g sample of -200 m ore from each head sample was concentrated by a Davis tube separator which produced a concentrate and a tailing from each sample.

TABLE 4

Results of Magnetic Concentration of the Four Head Samples

Product	Weight, %	Analysis, %** Sol Fe	TiO_2	P_2O_5	S	SiO_2	Distn, % Fe	TiO_2	R/C
Test 1 Black Lake Ore -200 m									
Feed*	100.0	43.0	0.90	-	-	-	100.0	100.0	
Mag conc	64.0	62.5	0.91	0.01	0.45	2.14	93.1	64.5	1.56:1
Tailing	36.0	8.26	0.89	-	-	-	6.9	35.5	
Test 2 Bob's Lake Ore -200 m									
Feed*	100.0	38.4	0.40				100.0	100.0	
Mag conc	56.8	64.4	0.48	<0.01	0.033	1.52	95.4	67.7	1.76:1
Tailing	43.2	4.10	0.30	-	-	-	4.6	32.3	
Test 3 Aaron's Lake Ore -200 m									
Feed*	100.0	61.68	0.82				100.0	100.0	
Mag conc	86.4	70.40	0.23	0.007	0.16	0.24	98.6	24.2	1.2:1
Tailing	13.6	6.28	4.58	-	-	-	1.4	75.8	
Test 4 Troy Lake Ore -200 m									
Feed*	100.0	29.8	7.36				100.0	100.0	
Mag conc	38.4	59.6	0.71	0.07	0.14	1.96	76.9	3.7	2.6:1
Tailing	61.6	11.16	11.50	-	-	-	23.1	96.3	

*Calculated
**Internal Report MS-AC-62-942, J023
R/C = ratio of concentration

Test 5 Magnetic Concentration of -10 m Bob's Lake Ore

A sample of the ore was ground to -10 m and concentrated on a Ball-Norton dry belt separator. The products were a concentrate and a tailing.

TABLE 5

Results of Magnetic Concentration of -10 m Bob's Lake Ore

Product	Weight, %	Analysis, %**		Distn, %		R/C
		Fe	TiO_2	Fe	TiO_2	
Feed*	100.0	40.48	0.27	100.0	100.0	
Mag conc	66.3	58.57	0.39	95.9	96.3	1.5:1
Tailing	33.7	4.98	0.03	4.1	3.7	

*Calculated
**From Internal Report MS-AC-62-1223

Additional analyses of the concentrate:

P_2O_5	0.007%
S	0.014%
SiO_2	8.58%
Insol	16.04%

Test 6 Magnetic Concentration of -35 m Bob's Lake Ore

A sample of the ore was ground to -35 m and concentrated on a Jeffrey-Steffensen wet drum separator. The products were a concentrate, a middling and a tailing.

TABLE 6

Results of Magnetic Concentration of -35 m Bob's Lake Ore

Product	Weight, %	Analysis, %**		Distn, %		R/C
		Fe	TiO_2	Fe	TiO_2	
Feed*	100.0	39.23	0.30	100.0	100.0	
Mag conc	56.1	65.24	0.40	93.2	75.7	1.75:1
Midds	2.3	36.62	0.44	2.2	3.4	
Tailing	41.6	4.34	0.15	4.6	20.9	

*Calculated
**From Internal Report MS-AC-62-1223

Additional analyses of the conc and midds,

	conc	midd
P_2O_5	0.030%	-
S	0.022%	-
SiO_2	3.84%	24.32%
Insol	7.26%	-

Test 7 Magnetic Concentratration of -65 m Bob's Lake Ore

A 1000 g sample of -65 m ore was concentrated by a Jeffrey-Steffensen separator. The products of the test were a concentrate, a middling and a tailing.

TABLE 7

Results of Magnetic Concentration of -65 m Bob's Lake Ore

Product	Weight, %	Analysis, %**					Distn, %		R/C
		Fe	TiO_2	P_2O_5	S	SiO_2	Fe	TiO_2	
Feed*	100.0	42.21	0.32				100.0	100.0	
Mag conc	57.3	68.36	0.38	0.01	0.024	1.74	92.8	68.6	1.74:1
Midds	1.9	50.78	0.32	-	-	-	2.3	1.9	
Tailing	40.8	5.02	0.23	-	-	-	4.9	29.5	

*Calculated
**Internal Report MS-AC-62-1017 and 1054

TABLE 8

Screen Analysis on -65 m Concentrate

Mesh	Wt %
+100	21.8
+150	24.8
+200	16.8
+325	14.0
-325	22.6
	100.0
-200	36.6

Test 8 Magnetic Concentration of -20 m Bob's Lake Ore

A 2000 g sample of ore ground to -20 m was magnetically concentrated by a Crockett wet separator. The concentrate was repassed. The products of the test were a concentrate, a middling and a tailing.

TABLE 9

Results of Magnetic Concentration of -20 m Bob's Lake Ore

Product	Weight, %	Analysis, %**			Distn, %		R/C
		Fe	TiO_2	SiO_2	Fe	TiO_2	
Feed*	100.00	40.58	0.31		100.0	100.0	
Mag conc	69.88	56.08	0.40	6.88	96.6	89.0	1.4:1
Midd	0.96	27.90	0.56	-	0.7	1.7	
Tailing	29.16	3.86	0.10	-	2.7	9.3	

*Calculated
**From Internal Report MS-AC-62-1017

Test 9 Magnetic Concentration of -20 m Bob's Lake Concentrate reground to -150 m

A portion of -20 m concentrate from Test 8 was stage ground in a ball mill to -150 m and concentrated by a Jeffrey-Steffensen separator. The products were a concentrate, a middling and a tailing.

TABLE 10

Results of Magnetic Concentration of -20 m Bob's Lake Concentrate Reground to -150 m

Product	Weight %		Analysis %**			Distn %				R/C
						In test		In orig feed		
	In test	In orig feed	Fe	TiO_2	SiO_2	Fe	TiO_2	Fe	TiO_2	
Feed*	100.0	69.88	56.08	0.44		100.0	100.0	96.6	89.0	
Mag conc	76.6	53.54	70.12	0.39	0.86	94.9	68.2	91.6	60.7	1.87:1
Midds	2.6	1.79	63.60	0.48	-	2.9	2.8	2.8	2.5	
Tailing	20.8	14.55	6.18	0.61	-	2.2	29.0	2.2	25.8	

*Calculated
** Internal Report MS-AC-62-1017

Additional analyses on mag conc: S - 0.018%, P_2O_5 <0.01%

TABLE 11

Screen Analysis on -150 m Concentrate

Mesh	Wt %
+200	9.2
+325	27.4
-325	63.4
	100.0
-200	90.8

Test 10 Magnetic Concentration of -20 m Bob's Lake Ore Magnetic Concentrate, reground to -150 m and reconcentrated

A sample of -20 m ore was concentrated by a Crockett wet separator. The concentrate was repassed on the Crockett and the products of the test were a concentrate and a tailing.

The concentrate was stage ground in a ball mill to -150 m and reconcentrated on a Jeffrey-Steffensen separator. The products were a concentrate, a middling and a tailing.

TABLE 12

Results of Magnetic Concentration of -20 m Bob's Lake Ore

Product	Weight, %	Analysis, %**		Distn, %		R/C
		Fe	TiO_2	Fe	TiO_2	
Feed*	100.0	40.26	0.24	100.0	100.0	
Mag conc	66.6	58.27	0.35	96.5	95.9	1.50:1
Tailing	33.4	4.29	0.03	3.5	4.1	

*Calculated
**From Internal Report MS-AC-62-1223

Additional Analyses of conc

P_2O_5	0.017%
S	0.012%
SiO_2	8.90%
Insol	16.68%

TABLE 13

Results of Magnetic Concentration of -20 m Bob's Lake Concentrate Reground to -150 m

Product	Weight, %		Analysis %**		Distn, %				R/C
					In Test		In orig feed		
	In test	In orig feed	Fe	TiO_2	Fe	TiO_2	Fe	TiO_2	
Feed*	100.0	66.6	55.83	0.39	100.0	100.0	96.5	95.9	
Mag conc	73.9	49.2	69.82	0.24	92.4	45.2	89.1	43.4	2:1
Midds	2.4	1.6	65.94	0.53	2.9	3.5	2.8	3.3	
Tailing	23.7	15.8	11.17	0.85	4.7	51.3	4.6	49.2	
Combined conc & midd	76.3	50.8	69.70	0.25	95.3	48.7	91.9	46.7	2:1

*Calculated
**From Internal Report MS-AC-62-1256

Additional analyses of conc,

P_2O_5	0.002%
S	0.010%
SiO_2	0.72%
Cu	0.003%
Cr_2O_3	<0.001%
V_2O_5	0.02%
Mn	0.07%

Test 11 Magnetic Concentration of -150 m Bob's Lake Ore

A sample of -20 m ore was stage ground to -150 m and concentrated by the Jeffrey-Steffensen separator. The products were a concentrate, a middling and a tailing.

TABLE 14

Results of Magnetic Concentration of -150 m Bob's Lake Ore

Product	Weight %	Analysis, %**			Distn, %	R/C
		Fe	TiO_2	SiO_2	Fe	
Feed*	100.0	38.88			100.0	
Mag conc	48.2	69.29	0.29	0.72	85.9	2.1:1
Midd	3.2	64.15	-	-	5.2	
Tailing	48.6	7.09	-	-	8.9	
Combined conc & midd*	51.4	68.97	-	-	91.1	1.94:1

*Calculated
**From Internal Report MS-AC-62-1269

Additional Analysis of conc

P_2O_5 - 0.010%
S - 0.010%

CONCLUSIONS

The Bob's Lake ore concentrates produced by grinding and direct magnetic concentration all contained about 0.4% TiO_2. A two stage process of cobbing at 20 mesh, followed by a regrind of the concentrate to -150 m and reconcentration, reduced the TiO_2 content to 0.24% which may be acceptable although higher than standard blast furnace feed.

Acceptable iron and silica content in a concentrate was obtained at 35 m with 65.24% Fe, 3.84% SiO_2 and 0.40% TiO_2. Finer grinding produced concentrates with up to 70% Fe and about 0.72% SiO_2. Overall recovery of iron would vary with grade but would be about 90% with a 2 to 1 ratio of concentration.

Cobbing at 10 or 20 m gave about 96% recovery but the silica content would be too high without regrinding and reconcentration.

The shipment of 41 lb, consisting of several large fragments of rock, could not be considered to be a representative sample of the ore which was said to cover two square miles and consists of at least two anomalies.

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WSJ/Jg