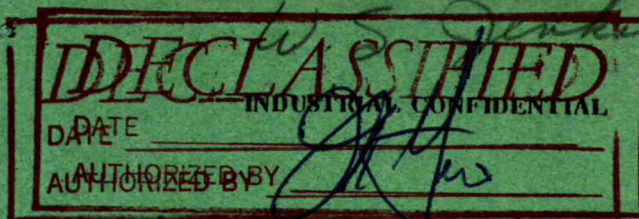


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CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

OTTAWA

MINES BRANCH INVESTIGATION REPORT IR 63-37

**INVESTIGATION OF IRON ORE FROM
LODESTONE MOUNTAIN AREA, B. C.,
SUBMITTED BY IMPERIAL METALS
AND POWER LIMITED, N. P. L.,
VANCOUVER, B. C.**

by

W. S. JENKINS

MINERAL PROCESSING DIVISION

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Mines Branch Investigation Report IR 63-37

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W. S. Jenkins*

- - -

SUMMARY

The investigation was made to determine the grade of concentrate and recovery of iron from ore represented by the shipment. The sample assayed 26.47% soluble iron and 1.66% titanium dioxide.

A -150 m concentrate assayed, iron 66.43%, TiO_2 2.32%. The recovery of iron was 83.8% at a ratio of concentration of 3.14:1. Cobbing at -20 m gave a concentrate assaying, iron 46.60%, TiO_2 2.63%. The recovery of iron was 95.5% at a ratio of concentration of 1.8:1. Regrinding the concentrate to -150 m and reconcentrating it, produced concentrate assaying, iron 66.54%, TiO_2 2.22%, sulphur 0.025%, SiO_2 1.44%. The recovery of iron was 83.8% in terms of original feed. The ratio of concentration was 3:1. Infrasing a -150 m concentrate showed that TiO_2 occurred in all fractions, from 2.58% in +58 microns to 1.87% in the -10 micron fraction.

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INTRODUCTION

Shipment

A shipment, consisting of 5 bags of lump ore, net weight 500 lb, was received at the Mineral Processing laboratories on November 7, 1962. It was submitted by Mr. C. W. Eppard, Managing Director, Imperial Metals and Power Ltd., N.P.L., 230 West Broadway, Vancouver 10, B. C.

Location of the Property

The property is located in the Lodestone Mountain area near Coalmont, 20 miles west of Princeton, B. C.

Description of the Property

From the Mineral Resources Division, Iron Ore Review 1960, page 102, under the name of Royal Canadian Ventures Limited, the following description is taken:

The property consists of 40 claims in the Lodestone Mountain Area. Veins and lenses of magnetite in ultrabasic rocks in zones from 3 to 30 feet in width occur in an 11 by 4 mile area. No reserve estimate has been made. The host rock contains from 4 to 10% iron while the magnetite-bearing zones grade up to 60% iron.

Purpose of the Investigation

The purpose of the investigation was to determine the grade of concentrate and recovery of iron to be expected from ore represented by the shipment.

SAMPLING AND ANALYSIS OF THE SHIPMENT

The shipment was crushed to $\frac{3}{4}$ inch and a head sample was obtained. Specimens were selected for a mineralogical examination by the Mineralogy Section of the Mineral Sciences Division, of the Mines Branch.

TABLE 1

Chemical Analysis* of the Head Sample

Total iron	28.09%
Bisulphate fusion (soluble) iron	26.47%
Titanium dioxide	1.66%
Phosphorus pentoxide	0.022%
Sulphur	0.067%
Silica	29.76%
Calcium oxide (CaO)	11.48%
Magnesium oxide MgO	10.95%

* From Internal Report MS-AC-62-1445

TABLE 2

Semi-Quantitative Spectrographic Analysis**
of the Head Sample

Major constituents	Fe, Mg, Ca, Si
Intermediate constituents	Al, Ti
Minor constituents	Mn, V, Cr, Cu, Ni
Trace constituents	Co

The elements were listed in order of decreasing abundance.

** Analysis by Spectrographic Laboratory SL-62-295
From Internal Report MS-AC-62-1086

MINERALOGICAL EXAMINATION

The following statements are extracted from the report "Mineralogical Investigation of an Iron Ore from the Lodestone Mountain Area in British Columbia." *

"The iron ore consists of magnetite in a serpentized pyroxene-rich rock. The magnetite contains minute blebs and lamellae of ilmenite and possibly spinel, and some of the gangue minerals contain needle-shaped inclusions of magnetite."

"The ilmenite occurs in magnetite as (a) irregular grains and (b) tiny grains and lamellae.--- The tiny grains and lamellae range from nearly sub-microscopic sizes to blebs that are up to 3 microns in diameter, and lamellae that range up to 3 microns in width and 50 microns in length."

"Some of the gangue minerals contain fine needle-like magnetite inclusions. These minerals, therefore, are somewhat magnetic."

SUMMARY OF TEST PROCEDURE

The ore was concentrated magnetically, at sizes ranging from $-\frac{3}{4}$ in. to -150 m. Cobber concentrates were made at $-\frac{3}{4}$ in., $-\frac{1}{4}$ in., and at -20 m. Ore at -20 m was cobbled by both wet and dry separators, and the -20 m concentrates were ground to -65, -100 and -150 mesh, and reconcentrated by a wet drum separator.

An infrasizer test was made on a -150 m concentrate and screen-sizing tests were made on the products of several tests.

SUMMARY OF RESULTS

The results of the tests are summarized in Table 3.

* Mines Branch Investigation Report IR 62-114, December 18, 1962.
By W. Petruk, Scientific Officer, Mineralogy Section, Mineral Sciences Division, Mines Branch, Department of Mines and Technical Surveys, Ottawa, Canada.

TABLE 3

Summary of Magnetic Concentration Tests

Test	Product Mag. Concs	Mesh	Weight % In orig feed	Analysis %			Distn % In orig feed		R/C
				Fe	TiO ₂	SiO ₂	Fe	TiO ₂	
1	Cobbing ore	$-\frac{3}{4}$ "	96.0	27.9	1.55	28.8	99.2	96.7	1.04:1
2	Cobber conc reground " " "	$-\frac{1}{4}$ " -20	71.3	35.9	2.05	22.68	95.6	88.0	1.4:1
			53.8	46.9	2.38	14.54	94.6	83.7	1.86:1
3	Conc from Ore " " "	$-\frac{1}{4}$ " -20	74.4	33.58	2.01	24.44	96.2	91.6	1.34:1
			55.4	44.62	2.30	16.52	95.0	83.2	1.81:1
4	Conc from Ore	-150	31.8	66.43	2.32	—	83.8	46.1	3.14:1
5	Wet cobbing Ore Conc reground	-20 -150	55.4	46.6	2.63	14.58	95.5	88.1	1.81:1
			33.4	66.54	2.22	1.44	83.8	47.8	3:1
6	Dry cobbing Ore Conc grd 15 min Conc grd 30 min	-20 -65 -100	51.5	47.12	2.46	—	92.6	80.6	1.94:1
			34.9	63.75	2.52	2.48	81.1	57.8	2.86:1
			33.5	66.35	2.51	1.46	84.4	50.1	3:1

R/C - ratio of concentration

DETAILS OF TESTS

Test 1 Magnetic Cobbing of $-\frac{3}{4}$ in. Ore

The test was made with ore crushed to pass a $\frac{3}{4}$ in. screen. The $-\frac{3}{4}$ in. ore was concentrated on a dry belt separator of pilot mill size.

The products were a concentrate and a tailing.

TABLE 4

Results of Magnetic Cobbing of $-\frac{3}{4}$ in. Ore

Product	Weight %	Analysis, % **			Distn, %		R/C
		Fe	TiO ₂	SiO ₂	Fe	TiO ₂	
Feed *	100.0	27.0	1.54		100.0	100.0	
Mag Conc	96.0	27.9	1.55	28.80	99.2	96.7	1.04:1
Tailing	4.0	5.48	1.25	---	0.8	3.3	

* Calculated

** From Internal Report MS-AC-62-1445

Test 2 Magnetic Concentration of $-\frac{3}{4}$ in. Cobber Concentrate crushed to $-\frac{1}{4}$ in. and to -20 m

Two portions of $-\frac{3}{4}$ in. cobber concentrate from Test 1 were crushed to $-\frac{1}{4}$ in. and to -20 m. The $-\frac{1}{4}$ in. feed was concentrated by a laboratory-size Ball-Norton dry belt separator. A concentrate and a tailing were produced.

The -20 m feed was concentrated by a laboratory-size Crockett wet belt separator which produced a concentrate and a tailing. The concentrate was reprocessed; the tailing was designated as a middling.

TABLE 5

Results of Magnetic Concentration of $-\frac{3}{4}$ in Cobber Concentrate
crushed to $-\frac{1}{4}$ in.

Product	Weight %		Analysis % ^{***}		Distn, %				R/C
	In test	In orig feed	Fe	TiO ₂	In test		In orig feed		
					Fe	TiO ₂	Fe	TiO ₂	
Feed ^{**}	100.0	96.0	27.68	1.67	100.0	100.0	99.2	96.7	1.40:1
Mag conc	74.3	71.3	35.90	2.05	96.4	91.0	95.6	88.0	
Tailing	25.7	24.7	3.88	0.59	3.6	9.0	3.6	8.7	

* Calculated

SiO₂ in mag conc 22.68%

** From Internal Report MS-AC-62-1445

TABLE 6

Results of Magnetic Concentration of $-\frac{3}{4}$ in Cobber Concentrate
crushed to -20 m

Product	Weight %		Analysis % ^{***}		Distn, %				R/C
	In test	In orig feed	Fe	TiO ₂	In test		In orig feed		
					Fe	TiO ₂	Fe	TiO ₂	
Feed ^{**}	100.0	96.0	27.59	1.54	100.0	100.0	99.2	96.7	1.86:1
Mag conc	56.1	53.8	46.90	2.38	95.4	86.6	94.6	83.7	
Midds	2.6	2.5	4.28	0.81	0.4	1.4	0.4	1.3	
Tailing	41.3	39.7	2.83	0.45	4.2	12.0	4.2	11.7	

* Calculated

SiO₂ in mag conc 14.54%

** From Internal Report MS-AC-62-1445

Test 3 Magnetic Concentration of Ore crushed to $-\frac{1}{4}$ in. and to -20 m

Two samples of ore were crushed to $-\frac{1}{4}$ in. and to -20 m. The $-\frac{1}{4}$ in. feed was concentrated by the Ball-Norton separator which produced a concentrate and a tailing.

The -20 m feed was concentrated by a Crockett separator which produced a concentrate and a tailing. The concentrate was reprocessed and the tailing was designated as a middling.

TABLE 7

Results of Magnetic Concentration of $-\frac{1}{4}$ in. Ore

Product	Weight %	Analysis, % **		Distn, %		R/C
		Fe	TiO ₂	Fe	TiO ₂	
Feed*	100.0	26.0	1.63	100.0	100.0	
Mag conc	74.4	33.58	2.01	96.2	91.6	1.34:1
Tailing	25.6	3.89	0.54	3.8	8.4	

* Calculated

** From Internal Report MS-AC-62-1445.

TABLE 8

Results of Magnetic Concentration of -20 m Ore

Product	Weight %	Analysis, % **		Distn, %		R/C
		Fe	TiO ₂	Fe	TiO ₂	
Feed*	100.0	26.0	1.53	100.0	100.0	
Mag conc	55.4	44.62	2.30	95.0	83.2	1.81:1
Midds	2.8	4.98	0.66	0.5	1.2	
Tailing	41.8	2.79	0.57	4.5	15.6	

* Calculated

** From Internal Report MS-AC-62-1445

Additional Analyses of Concentrates

	$-\frac{1}{4}$ in. conc.	-20 m conc.
P ₂ O ₅	0.020 %	0.004 %
S	0.006 %	0.009 %
SiO ₂	24.44 %	16.52 %

Test 4 Magnetic Concentration of -150 m Ore and Infrasizer Test
on the Magnetic Concentrate

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

The concentrate was screened on 200 m and the -200 m portion was infrasized by the Haultain Infrasizer. Each fraction was analysed for iron and titanium dioxide.

TABLE 9

Results of Magnetic Concentration of -150 m Ore

Product	Weight %	Analysis, % **		Distn, %		R/C
		Fe	TiO ₂	Fe	TiO ₂	
Feed*	100.0	25.22	1.60	100.0	100.0	
Mag conc*	31.8	66.43	2.32	83.8	46.1	3.14:1
Midds	1.8	57.18	2.33	4.1	2.6	
Tailing	66.4	4.61	1.24	12.1	51.3	

* Calculated

** From Internal Report MS-AC-62-1445

TABLE 10

Results of Infrasing the -150 m Concentrate

Product	Weight %		Analysis % ^{***}		Distn %			
	In test	In orig feed	Fe	TiO ₂	In test		In orig feed	
					Fe	TiO ₂	Fe	TiO ₂
Feed [*]	100.0	31.80	66.43	2.32	100.0	100.0	83.8	46.1
+200 mesh	10.5	3.35	62.11	2.73	9.9	12.4	8.3	5.7
+56 microns	29.7	9.44	66.55	2.58	29.7	33.0	24.9	15.2
+40 "	16.6	5.29	66.29	2.34	16.6	16.8	13.9	7.7
+28 "	13.3	4.23	67.43	2.22	13.5	12.7	11.3	5.9
+20 "	10.7	3.41	68.15	2.04	11.0	9.4	9.2	4.3
+14 "	7.1	2.23	68.05	2.00	7.2	6.0	6.1	2.8
+10 "	3.9	1.25	67.43	1.83	4.0	3.1	3.3	1.4
-10 "	8.2	2.60	66.13	1.87	8.1	6.6	6.8	3.1

* Calculated

** From Internal Report MS-AC-63-148

Test 5 Wet Magnetic Cobbing of -20 m Ore
Reconcentration of Cobber Concentrate at -150 m

A portion of -20 m ore was concentrated by the Crockett separator which produced a concentrate and tailing. The concentrate was repassed and the products were a concentrate and tailing. The two tailings were combined for analysis. A portion of the cleaned concentrate was analysed and the remainder was stage ground to -150 m. The -150 m concentrate was repassed on the Jeffrey-Steffensen wet drum separator which produced a concentrate, a middling and a tailing.

TABLE 11

Results of Wet Magnetic Cobbing of -20 m Ore

Product	Weight %	Analysis % ***		Distn %		R/C
		Fe	TiO ₂	Fe	TiO ₂	
Feed*	100.0	27.0	1.65	100.0	100.0	
Mag conc	55.4	46.6	2.63	95.5	88.1	1.81:1
Tailing	44.6	2.69	0.44	4.5	11.9	

* Calculated

Additional analyses of mag conc SiO₂ - 14.58%

*** From Internal Report MS-AC-63-203

TABLE 12

Results of Magnetic Concentration of Cobber Concentrate
ground to -150 m

Product	Weight %		Analysis % ***		Distn %				R/C
	In test	In orig feed	Fe	TiO ₂	In test		In orig feed		
					Fe	TiO ₂	Fe	TiO ₂	
Feed*	100.0	55.4	45.81	2.47	100.0	100.0	95.5	88.1	
Mag conc	60.4	33.4	66.54	2.22	87.7	54.2	83.8	47.8	3:1
Midds	3.8	2.1	59.68	2.81	4.9	4.3	4.7	3.8	
Tailing	35.8	19.9	9.38	2.86	7.4	41.5	7.0	36.5	

* Calculated

Additional analyses of mag conc, S - 0.025%
SiO₂ - 1.44%

*** From Internal Report MS-AC-63-203

A semi-quantitative spectrographic analysis^{***} was made on the -150 m concentrate.

The elements reported in order to decreasing abundance were:

Major constituents - Fe
 Intermediate constituents - Ti, Al
 Minor constituents - Si, Mg, V, Mn
 Trace constituents - Ca, Co, Ni, Cr, Cu, Ag

*** From Internal Report MS-AC-63-16, SL-63-010

Test 6 Dry Magnetic Cobbing of -20 m Ore,
Reconcentration of ground Cobber Concentrate

A sample of -20 m ore was concentrated by a Ball-Norton dry belt separator, which produced a concentrate and a tailing.

Two portions of Ball-Norton concentrate were reground, one for 15 minutes and the other for 30 minutes. Reconcentration was made on the Jeffrey-Steffensen wet drum separator. Screen tests were made on the products of the tests.

TABLE 13

Results of Dry Magnetic Cobbing of -20 m Ore

Product	Weight %	Analysis % ^{***}		Distn %		R/C
		Fe	TiO ₂	Fe	TiO ₂	
Feed*	100.0	26.22	1.57	100.0	100.0	
Mag conc	51.5	47.12	2.46	92.6	80.6	1.94:1
Tailing	48.5	4.00	0.63	7.4	19.4	

* Calculated

** From Internal Report MS-AC-63-203

TABLE 14

Results of Magnetic Concentration of Cobber Concentrate
ground 15 min

Product	Weight %		Analysis % ^{***}			Distn %				R/C
	In test	In orig feed	Fe	TiO ₂	SiO ₂	In test		In orig feed		
						Fe	TiO ₂	Fe	TiO ₂	
Feed [*]	100.0	51.5	49.39	2.38		100.0	100.0	92.6	80.6	2.86:1
Mag conc	67.8	34.9	63.75	2.52	2.48	87.5	71.7	81.1	57.8	
Midds	3.1	1.6	47.77	2.94	---	3.0	3.8	2.8	3.1	
Tailing	29.1	15.0	16.10	2.01	---	9.5	24.5	8.7	19.7	

* Calculated

TABLE 15

Results of Magnetic Concentration of Cobber Concentrate
ground 30 min

Product	Weight %		Analysis % ^{***}			Distn %				R/C
	In test	In orig feed	Fe	TiO ₂	SiO ₂	In test		In orig feed		
						Fe	TiO ₂	Fe	TiO ₂	
Feed [*]	100.0	51.5	47.32	2.63		100.0	100.0	92.6	80.6	3:1
Mag conc	65.0	33.5	66.35	2.51	1.46	91.1	62.1	84.4	50.1	
Midds	2.8	1.4	55.98	3.23	---	3.3	3.5	3.1	2.8	
Tailing	32.2	16.6	8.16	2.81	---	5.6	34.4	5.1	27.7	

* Calculated

*** From Internal Report MS-AC-63-203

TABLE 16

Screen Tests on the Products

Weight %

Mesh	Ball-Norton Concentration			Jeffrey-Steffensen Concentration			
	Feed	Conc	Tailing	15 min Grind		30 min Grind	
				Conc	Tailing	Conc	Tailing
+20	0.4	0.6	0.2				
+28	9.7	13.4	5.4				
+35	19.4	24.8	18.0				
+48	12.4	13.2	11.8	0.3			
+65	10.8	11.2	11.0	1.0	1.0	0.2	
+100	10.5	9.0	10.5	7.4	5.6	0.7	
+150	8.0	6.4	8.4	21.0	12.4	5.0	6.0
+200	5.8	1.4	6.7	21.6	13.6	15.2	11.2
-200	23.0	20.0	28.0	--	--	--	--
	100.0	100.0	100.0	--	--	--	--
+325	--	--	--	20.0	15.6	27.2	22.2
-325	--	--	--	28.7	51.8	51.7	60.6
	--	--	--	100.0	100.0	100.0	100.0
-200 m	--	--	--	48.7	67.4	78.9	82.8

CONCLUSIONS

The ore represented by the shipment is amenable to magnetic concentration. The concentrates from grinds of -65 to -150 m assayed from 63.75% Fe to 66.54% and the TiO_2 content was from 2.52% to 2.22%.

The mode of occurrence of the TiO_2 in the ore makes its removal by ore dressing methods impossible. It is expected that concentrates recovered from ore represented by this shipment would contain at least 2% TiO_2 . It will be necessary to determine if a market for this type of concentrate exists or if a suitable smelting procedure can be used to exploit the deposit.

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