019057

COLORADO SCHOOL OF MINES RESEARCH FOUNDATION, INC.

GOLDEN, COLORADO

MINERALOGY OF A CANADIAN HEMATITE ORE

Prepared for

Pacific Giant Steel Ores, Ltd.
P.O. Box 1039
Whitehorse, Yukon
Canada

Approved:

E.H. Crabtree
Director

William N. Baillie
Project Engineer

Fred L. Smith
Director of Research

Project No. 360102

14 March 1966

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INTRODUCTION

Purpose

The purpose of the project was:

1. to determine the essential chemical composition of the ore,
2. to determine ore-gangue grain relationships which may affect the beneficiation of the ore, and
3. to learn if there are any microscopic properties of the ore which would indicate its history of formation.

Two samples, a six-pound hand sample and a $-\frac{1}{4}$ inch composite sample, were submitted for this purpose.

Scope

To accomplish the foregoing, chemical analyses for Fe, Ti, SiO_2, P, S, Mn, CaO, MgO, and Al_2O_3 were run on the submitted samples. These were in addition to a semiquantitative spectrographic analysis on each sample.

The mineralogy of the material was determined through the combined methods of x-ray diffraction, optical petrography, and mineralography.

Some 1400+ measurements were made on quartz and hematite grains to provide liberation size data. In addition, a point count was made to determine degree of locking and relative abundance of the constituents.

Efforts to resolve the ore genesis were confined wholly to microscopic observations.

CONCLUSIONS

The essential mineralogy of the ore is hematite (± 90%) and quartz (± 8%). Goethite, limonite, pyrite, and barite are lesser constituents.

Hematite is the matrix of the ore, and the gangue minerals (quartz) can be 80% cleaned from it at a particle size of 74μ (200 Tyler mesh). Titanium is present in amounts less than 0.2% and should not be detrimental.

The ore appears to be one in which concentration has been accomplished by recrystallization of original constituents with no addition of material from outside sources. The porosity of the hematite is probably due to leaching of carbonate or silica, but this is not substantiated.

If any phase of the proposed beneficiation methods will utilize surface chemistry of the hematite, there may be problems with barite in that this mineral tends to coat parts of some hematite grains.

METHODS

The analytical work was described by the analysts as "routine", and unless this aspect of the work requires a more thorough description for a now unforeseen reason, no additional space will be devoted to it. The spectrographic analyses were performed with the emission spectrograph, and the results are semiquantitative; i.e., may be multiplied or divided by a factor of three.

In general, the hematite forms the matrix of the ore, and it will be necessary to grind to the size of the contained gangue grains to obtain monomineralic particles. For this reason the gangue minerals were measured when they were locked in hematite. Conversely, when the gangue minerals occurred as matrix it was necessary to measure the size of the hematite grains. Then, to determine what percentage of the hematite were locked in gangue matrices, a point count was made.

A petrographic point count is a technique designed to provide a random sampling, and therefore an accurate mineralogical composition, of material represented on a thin section. In practice this sampling is accomplished by using a specially adapted mechanical stage which moves the section in regular increments along a fixed pattern of traverse lines. Since the distribution of minerals in the section can be regarded as random, the samples themselves are effectively random, even though they are taken on a nonrandom grid.

RESULTS

Table 1 presents the analytical results obtained on the two samples. Table 2 is the spectrographic analysis. Tables 3 and 4 are grain size distributions of quartz in hematite and of hematite in quartz, respectively.

Table 5 contains the results of a petrographic point count performed on the composite ore. The classifications were chosen to permit the differentiation of free hematite from locked hematite in addition to strict mineralogy.

The minerals found in the material were hematite, pyrite, quartz, goethite, limonite, and barite. Hematite occurs both as large or small irregular masses and as minute euhedral crystals. It is primarily as "blue" hematite, but it is also present in lesser amounts as both earthy and specular varieties. Hematite generally forms the matrix of the rock although on a microscopic scale quartz locally may contain considerable hematite.

Quartz occurs primarily as anhedral irregular blebs within hematite (see Fig. 1); however, it also occurs in veinlets as sinuous discontinuous stringers containing euhedral plates of hematite.

Goethite (Figs. 2, 4, and 3 respectively) was noted in only two fragments during the study. In each case it occurred as crustiform masses with or without an anhedral pyrite core in hematite.

TABLE 1

Results of Selected Chemical Analyses
Performed on Two Hematite-Bearing Samples

Sample Number	Sample Description	Al_2O_3	CaO	Fe	MgO	Mn	P	S	SiO_2	Ti
1	hand sample	2.27	0.21	63.7	0.03	0.01	0.05	0.056	7.24	0.22
2	composite sample	0.31	0.30	62.4	0.02	0.01	0.06	0.131	8.43	0.14

TABLE 2

Order No. 360102

Sample: P 6012

COMPLETE QUALITATIVE SPECTROGRAPHIC ANALYSIS

Figures Are Percentage Estimates

	Antimony		Molybdenum
	Arsenic		Neodymium
0.01	Aluminum		Nickel
	Boron		Osmium
1	Barium		Palladium
	Beryllium		Phosphorus
	Bismuth		Potassium
0.5	Calcium		Praseodymium
	Columbium		Platinum oz per ton
	Cadmium		Radium
	Cerium		Rubidium
	Cobalt		Rhenium
0.001	Chromium		Rhodium
	Caesium		Ruthenium
0.01	Copper		Scandium
	Dysprosium	10	Silicon
	Erbium		Samarium
	Europium	0.001	Strontium
	Gallium		Silver oz per ton
	Gadolinium	0.01	Sodium
	Germanium		Tantalum
	Gold oz per ton		Tellurium
	Hafnium		Terbium
	Holmium		Thallium
	Indium		Thulium
major	Iron		Thorium
	Iridium	0.001	Tin
	Lanthanum	0.01	Titanium
0.01	Lead		Tungsten
	Lithium		Uranium
	Lutetium	0.001	Vanadium
0.01	Magnesium		Yttrium
0.01	Manganese		Ytterbium
	Mercury	0.01	Zinc
			Zirconium

TABLE 3

Grain Size Frequency Distribution of Quartz Grains Locked in Hematite

Screen or Micron Interval	A Number of Grains	B Weight Factor	(A)(B)	Weight Percent	Cumulative Weight Percent
- 28+ 35	3	50.00	150.00	28	28
- 35+ 48	4	25.00	100.00	18	46
- 48+ 65	4	12.50	50.00	9	55
- 65+100	6	6.25	37.50	7	62
-100+150	19	3.12	59.28	11	73
-150+200	28	1.56	43.68	8	81
-200+270	31	0.78	24.18	4	85
-270+400	36	0.39	14.04	3	88
-400(37μ)+26μ	174	0.19	33.06	6	94
-26 +18.4μ	229	0.09	20.61	4	98
-18.4+13μ	104	0.05	5.20	1	99
-13 + 9.2μ	167	0.02	3.34	1	100
- 9.2+ 6.5μ	69	0.01	0.69	--	--
- 6.5μ	126	0.0038	0.17	--	--

TABLE 4

Grain Size Frequency Distribution of Locked Hematite Grains

Screen Size or Micron Interval	A Number of Grains	B Weight Factor	(A)(B)	Weight Percent	Cumulative Weight Percent
-150+200	2	50.00	100.0	15.1	15.1
-200+270	0	25.00	0.0	0.0	15.1
-270+400	1	12.50	12.5	1.9	17.0
-400+26μ	21	6.25	131.25	19.8	36.8
- 26+18.4	46	3.12	143.52	21.7	58.5
-18.4+13	30	1.56	46.80	7.1	65.6
- 13+ 9.2	239	0.78	186.42	28.2	93.8
-9.2+ 6.5	89	0.39	34.71	5.2	99.0
-6.5	35	0.19	6.65	1.0	100.0
			661.85	100.0	

TABLE 5

Results of Petrographic Modal Analysis of Composite Sample

Constituent	Number of Points	Volume Percent
Hematite	533	94.5
Hematite locked in gangue	7	1.2
Quartz	21	3.7
Barite(?)	3	0.4
	567	99.8

Ontario Research Foundation

43 QUEEN'S PARK CRESCENT EAST TORONTO 5, CANADA

TELEPHONE 924-6201

Petrographic Analysis

O.R.F. No. 0-66308 (Bear River Ore)

In a hand specimen the massive ore has a high specific gravity and is obviously fragmental, consisting of coarse fragments up to 5 mm long, slightly porous and quite inhomogeneous.

I The Thin Section Shows:

Hematite
Quartz and Jasper
Sericite and some coarser muscovite
magnetite
Leucoxene

The material consists of angular to subrounded detrital fragments of:

(1) Jaspilite or jasperized fine grained recrystallized chert.

(2) Hematite free or relatively hematite free recrystallized chert.

(3) Sericitic ferruginous slate or argillite which consists of about 70% mica 25% quartz and minor hematite.

(4) Massive dense hematite in a matrix of fine grained quartz and hematite.

There are a few patches of leucoxene, probably after ilmenite.

The material is an accumulation of detrital fragments which have suffered very short transportation. The nature of the material suggests derivation from a fairly normal series of iron formations, ferruginous cherts and ferruginous slates or greywackes.

The degree of metamorphism is very low as there are no signs of iron silicates being formed from reaction between hematite and quartz, furthermore the amount of recrystallisation of the quartz is slight. The material is mainly hematite with little magnetite.

II The Ore Slab
Showing banding in the hand specimen contains:

Quartz
Hematite and Magnetite
Sericite and white mica
Cummingtonite - Grunerite
Hedenbergite

The rock consists of patches and ill defined bands mainly of quartz and hematite. The quartz grains are in a mosaic looking like recrystallized chert and vary in coarseness all the way up to 75 or 100 microns. These are commonly in patches up to 1 mm in diameter.

The hematite is also in a mosaic of grains and clusters or patches grains like the quartz.

There are patches (altered sedimentary fragments) of much finer grained quartz, still cryptocrystalline, containing a dusting of hematite. There are patches of partly recrystallized greywacke or argillite consisting of quartz and sericite with minor amounts of fine dusty hematite (these and the cherty patches look jasper red by reflected light).

The iron silicates cummingtonite - grunerite are present in small amount (less than 1%) occur as small clusters of radiating flakes disseminated through the rock and show no preference for patches or undifferentiated quartz-hematite matrix. The iron rich pyroxene hadenbergite is present as ill formed patches mainly in the finer grained quartz hematite mixture.

All of the silicates with the exception of quartz are present in insignificant amounts.

III <u>General</u>

There seems to be little to indicate a relationship between the materials in the two samples. The banded material seems to be a fairly normal iron formation, moderately metamorphosed to the extent of recrystallizing the chert to granular quartz and the primary iron oxide to hematite but insufficient to derive much magnetite. Some iron silicates have developed, probably at the locus of some alumina rich alkali rich detrital grain in the original sediment.

The coarse granular ore seems to have developed from some pre-existing ferruginous sediment by weathering and transportation of the fragments, and there seems to have been very little recrystallization subsequent to deposition.

Because the material contains a very small magnetic fraction there is possibly some magnetite or maghemite present. This was looked for but could not be seen in the polished section. It is possibly therefore either too fine grained or intergrown with the hematite. No magnetite is present in the coarser hematite masses. The amount of magnetite must be very small as the gross magnetic properties of the massive ore are negligible.

F. Everard, P.Eng.,
Assistant Director,
Department of
Engineering and Metallurgy.
Ontario Research Foundation

FE/gb

April 29, 1966

T S L

ASSAYERS
CHEMISTS
GEOCHEMISTS

Laboratories Limited

325 HOWE STREET - VANCOUVER 1, B.C.
TELEPHONE 684-1374

CERTIFICATE OF ANALYSIS

SAMPLE(S) FROM PACIFIC GIANT STEEL ORES LTD.,

REPORT NO. V - 22

3 SAMPLE(S) OF pulp

	Phosphorus (P)	Sulphur (S)	Titanium (Ti)
BR - I - 1	0.078%	0.037%	0.11%
BR - I - 2	0.078%	0.020%	0.08%
Concentrate	0.039%	0.045%	0.07%

DATE February 18, 1966

SIGNED [signature]
Provincial Assayer.

Department of Mines and Technical Surveys
Ministère des Mines et des Relevés techniques
MINERAL PROCESSING DIVISION

Mines Branch
Direction des mines

File Number
N. a rappeler

40 Lydia Street,
Ottawa 1, Ontario,
March 11, 1966.

Pacific Giant Steel Ores Ltd.,
P.O. Box 1039,
Whitehorse, Yukon.

Dear Mr. Jellinek:

With reference to your letter of February 26 regarding results of additional beneficiation tests on the iron ore from your Bear River, Yukon property we have completed tests treating the ore with a Jones high intensity wet magnetic separator and by flotation. Our investigation is now completed and we are preparing a formal report which we will forward to you when completed.

The following are results from these tests.

Jones magnetic separator tests on ore ground to minus 250 mesh. Separator was operated at 15 amps and the middling returned.

Product	Wt %	Analysis % Sol Fe	Analysis % SiO_2	Recovery % Sol Fe
1st Magnetic conc	79.9	67.7	2.5	86.1
2nd Magnetic conc	4.6	62.1	9.0	4.6
2nd Middling	2.6	30.5	49.1	1.3
1st Non-Mag. tailing	10.2	41.3	35.4	6.7
2nd Non-Mag. tailing	2.7	31.1	48.4	1.3
Feed	100.0	62.6*	8.6*	100.0

*Calculated

Silica flotation tests on ore ground to minus 150 mesh.

Product	Wt %	Analysis % Sol Fe	SiO$_2$	Recovery % Sol Fe
Iron product	82.1	67.0	2.5	87.6
Middling	7.7	62.8	8.4	7.7
Silica float	10.2	28.7	56.0	4.7
Feed	100.0	62.8*	8.4*	100.0

*Calculated

Yours very truly,

G. W. Riley
Ferrous & Less Common Minerals Section

GWR:rlm

C. EMERSON NOBLE
CHEMICAL ENGINEER
DIRECTOR INDUSTRIAL LABORATORIES
PROVINCIAL ANALYST

EDMONTON, ALBERTA
CANADA

May 26, 1966

Report of Analysis

SAMPLE OF	Iron Ore
SUBMITTED BY	Pacific Giant Steel Ores Limited, Box 1039, Whitehorse, Yukon
LABORATORY NUMBER	66 - 5576, 77 & 78

	Mines Branch Test 13 Gravity Concentrate	Mines Branch Test 26 Magnetic Concentrate	Mines Branch Test 228 B Flotation Concentra
Iron (soluble)	63.32 %	64.72 %	66.69 %
Silica	2.17 %	2.22 %	2.22 %
Phosphorous	0.02 %	0.01 %	0.06 %
Sulfur	0.17 %	0.21 %	0.12 %
Titanium	trace	trace	trace
Manganese	nil	nil	nil
Calcium Oxide	0.29 %	0.29 %	0.28 %
Magnesium Oxide	0.10 %	0.11 %	0.10 %
Alumina	2.93 %	2.65 %	1.39 %

The test for "Iron (soluble)" was done on a sample which was dissolved overnight in dilute Hydrochloric Acid. If this was not the procedure required, please advise.

O.K.

C. Emerson Noble
Director
Industrial Laboratories
Per:

CEN:pm

C. EMERSON NOBLE
CHEMICAL ENGINEER
DIRECTOR INDUSTRIAL LABORATORIES
PROVINCIAL ANALYST

EDMONTON, ALBERTA
CANADA

July 13, 1966

Report of Analysis

SAMPLE OF Iron Ores (3)

SUBMITTED BY Pacific Giant Steel Ores Ltd., Box 1039, Whitehorse

LABORATORY NUMBER 66-5576-8

As requested the alumina content of the following ores has been checked. Originally the alumina was determined by an indirect method. By direct method (cupferron) the values are as follows:

	Alumina
Test #13	0.40%
Test #26	0.56%
Test #228B	0.35%

K. Strausz
Kathleen Strausz

Assistant Provincial Analyst

KS:kjw

Department of Mines and Technical Surveys
Ministère des Mines et des Relevés techniques

Mines Branch
Direction des mines

File Number
N° à rappeler

MINERAL PROCESSING DIVISION

40 Lydia Street,
Ottawa 1, Ontario.
22 March 1966.

Pacific Giant Steel Ores Ltd.,
P. O. Box 1039,
Whitehorse, Yukon.

Attention: Mr. A. Jellinek, Managing Director

Dear Mr. Jellinek:

In reply to your letter of March 18 we are pleased to enclose a copy of Report No. SL 64-198 showing the results of a semi-quantitative spectrographic analysis on a head sample of your Bear River ore.

We are now arranging for semi-quantitative spectrographic analyses on the magnetic and flotation iron concentrates and we will forward the results to you when they are available. The chemical analyses of these iron concentrates would take some time and we suggest that the analyses be made by a commercial firm as was done previously with the gravity concentrates.

Regarding the test programme for pelletising and subsequent preparation of prereduced pellets and sponge iron this work is carried out by the Extraction Metallurgy division of the Mines Branch and information concerning this stage of the test programme should be addressed directly to Dr. K. W. Downes, Chief, Extraction Metallurgy Division, 300 LeBreton Street, Ottawa.

Yours truly,

G. W. Riley,
Ferrous and Less Common Minerals Section.

GWR/le

Samples Head Sample

Submitted by G.W. Riley, M.P.D.

SPECTROGRAPHIC LABORATORY

MINES BRANCH, OTTAWA, CANADA

SEMI-QUANTITATIVE SPECTROGRAPHIC ANALYSIS

Report No. SL 64-198

Plate No. 456

Date Dec. 10 19 64

Sgd. J. F. Palombo

Description of Samples	Si	Mn	Mg	Cr	Fe	Al	V	Ca	Mo	Cu	Ti	Ni	Co
	ELEMENTS—Per cent												
S553	PC	0.04	0.2	0.03	PC	0.2	0.04	0.26	0.04	0.04	0.01	0.12	0.06

Department of Mines and Technical Surveys
Ministère des Mines et des Relevés techniques
CANADA

Mines Branch
Direction des mines

File Number
N° à rappeler

MINERAL PROCESSING DIVISION

40 Lydia Street,
Ottawa 1, Ontario.
4 April, 1966.

Mr. A. Jellinek,
Managing Director,
Pacific Giant Steel Ores Ltd.,
P. O. Box 1039,
Whitehorse, Yukon.

Dear Mr. Jellinek:

Further to our letter of the 22nd March we are pleased to attach a copy of Report No. SL 66-040 showing the results of semi-quantitative spectrographic analysis on the gravity, magnetic and flotation iron concentrates.

Yours truly,

G. W. Riley,
Ferrous and Less Common Minerals Section.

GWR/le
Encl.

Samples: Fe Concentrate Test 13, Pacific Giant Steel

Submitted by: G.W. Riley, Fuels

SPECTROGRAPHIC LABORATORY
MINES BRANCH, OTTAWA, CANADA

SEMI-QUANTITATIVE SPECTROGRAPHIC ANALYSIS

Report No. SL: 66-040

Plate No.: 582

Date: Mar. 28 1966

Sgd: P. E. Pottenes

Description of Samples	Mn	Al	Mg	Pb	Si	Fe	V	Cu	Ti
	ELEMENTS—Per cent								
S-106 Test #13 Gravity conc	0.02	0.05	0.04	0.02	1.2	PC	0.005	0.01	0.06
S-107 Test #26 Magnetic Conc.	0.02	0.04	0.03	0.01	0.65	PC	0.005	0.005	0.07
S-108 Test #228B Flotation conc.	0.02	0.04	0.02	ND	1.2	PC	0.005	0.01	0.06

Department of Mines and Technical Surveys
Ministère des Mines et des Relevés techniques

CANADA

Mines Branch
Direction des mines

File Number
N° à rappeler

Mineral Processing
Division

40 Lydia Street,
Ottawa 1, Ontario,
May 3rd, 1965.

Mr. Leverman,
Pacific Giant Steel Ores Ltd.,
P.O. Box 1039,
Whitehorse, Yukon.

Dear Mr. Leverman:

Further to our telegram of March 12th, 1965, in which we gave results of a preliminary beneficiation test on the sample of high grade ore submitted, we have now completed and calculated the results of additional tests.

Gravity concentration tests using a shaking table were made on samples crushed both to minus 28 mesh and minus 65 mesh. Results of the tests showed that the minus 28 mesh material produced table concentrates averaging 64.1% Fe and 5.98% SiO_2 with an 85.5% Fe recovery. The sample crushed to minus 65 mesh produced table concentrates averaging 67.36% Fe and 2.32% SiO_2 with a 69.9% iron recovery. The middling and tailing from this test were passed through a Jones high intensity wet magnetic separator after grinding to minus 100 mesh. The concentrate from the magnetic separator together with that from the table gave a combined concentrate averaging 66.39% Fe and 3.38% SiO_2 with overall iron recovery of 91.4%.

We are continuing our investigations and will keep you informed of our progress as results become available.

Yours truly,

G. W. Riley

G.W. Riley,
for L.E. Djingheuzian,
Chief of Division.

GWR:em

CN Telecommunications

send this message subject to the terms on back
dépêche à expédier aux conditions énoncées au verso

to / à: G.R.E. Leverman, Secretary Treasurer, Pacific Giant Steel Ores Ltd.

street and number / numéro, rue: P.O. Box 1039, Whitehorse, Y.T.

care of or apt. number / aux soins de ou: app. numéro

time and date received / heure et date de réception: 9:15 am, Mar. 13/65

place / endroit

PRELIMINARY GRAVITY TEST AT MINUS 65 MESH PRODUCED CONCENTRATE ASSAYING 66 PERCENT IRON, FOUR PERCENT SILICA, AT RECOVERY OF 77 PERCENT OF THE IRON IN THE HIGH GRADE SAMPLE SUBMITTED. ADDITIONAL TEST MADE AT MINUS 28 MESH BUT AWAITING ASSAYS.

L.E. DJINGHEUZIAN, CHIEF, MINERAL PROCESSING
DIVISION, MINES BRANCH, DEPARTMENT OF MINES
AND TECHNICAL SURVEYS, OTTAWA, ONTARIO

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address and telephone / adresse, téléphone

COPY

6101b

C. EMERSON NOBLE
CHEMICAL ENGINEER
DIRECTOR INDUSTRIAL LABORATORIES
PROVINCIAL ANALYST

EDMONTON, ALBERTA
CANADA

April 28, 1965

Report of Analysis

SAMPLE OF	Iron Ore (Ottawa sample) Bear River hematite iron ore concentrate by Mines Branch, Ottawa
SUBMITTED BY	Pacific Giant Steel Ores Limited, Box 1039, Whitehorse, Yukon
LABORATORY NUMBER	65 - 4162

Iron (Fe)	--	65.88 %
Silica	--	4.37 %
Phosphorous (P)	--	0.03 %
Sulphur (S)	--	trace
Titanium	--	trace
Manganese	--	faint trace
Calcium Oxide	--	0.08 %

C. Emerson Noble
Director
Industrial Laboratories

CEN:pm

C. EMERSON NOBLE
CHEMICAL ENGINEER
DIRECTOR INDUSTRIAL LABORATORIES
PROVINCIAL ANALYST

EDMONTON, ALBERTA
CANADA

April 7, 1965

Report of Analysis

SAMPLE OF Iron Ore (original sample) Raw hematite iron ore, Bear River

SUBMITTED BY Pacific Giant Steel Ores Limited, P.O. Box 1039, Whitehorse, Yukon

LABORATORY NUMBER 65 - 3484

Iron (Fe)	--	57.78 %
Silica	--	8.51 %
Phosphorous (P)	--	0.11 %
Sulphur (S)	--	0.05 %
Titanium	--	trace
Manganese	--	trace
Calcium Oxide	--	0.37 %

Ottawa sample not received to date.

C. Emerson Noble
Director
Industrial Laboratories

CEN:pm

Department of Mines and Technical Surveys
Ministère des Mines et des Relevés techniques

Mines Branch
Direction des mines

File Number
N° à rappeler

Extraction Metallurgy
Division

552 Booth St.,
Ottawa, Ont.,
July 5, 1966.

Pacific Giant Steel Ores Ltd.,
P.O. Box 1039,
Whitehorse, Yukon.

Attention: Mr. A. Jellinek,
Managing Director

Subject: Pelletizing Bear River
Hematite Iron Ore

Dear Mr. Jellinek:

The pelletizing tests outlined in our letter to you dated April 25, 1966 have been completed.

Mr. G. Riley, of the Mineral Processing Division, mixed together the small quantities of concentrate that he had obtained from various concentration tests on Bear River Hematite and produced a composite sample weighing about 20 lbs. This composite sample was then divided into four equal samples and each sample was ground to a different degree of fineness in a small ball mill.

Each of the four samples were then blended with 3/4% bentonite and pelletized in laboratory equipment to form green pellets containing about 9% water. The strengths of the resulting pellets were determined, on the green pellets, on pellets that were dried in an oven at 110°C and on pellets that were fired in a muffle furnace at 1300°C. The results of these tests are tabulated below.

.../2

Results of grinding and pelletizing tests
Bear River Hematite

Test No.	Grind expressed as		Compressive Strength for 1/2" pellet (lbs)		
	% -325M	Specific Surface Area cm^2/gm	Green	Dry	Fired
1	58.0	884	0.8	1.3	143
2	71.8	1014	2.1	10.7	428
3	81.5	1230	2.6	13.9	498
4	89.3	1293	3.2	15.0	576

The results of these tests indicate the normal trend where the pellet strength increases as the concentrate is ground finer. The final selection of the grind required will depend on the design of the pellet plant particularly with respect to pellet handling facilities.

We hope that these results are of some assistance to you.

Yours very truly,

G.E. Viens

for K.W. Downes,
Chief of Division.

ERIEZ MAGNETICS

Central Test Laboratory
REPORT OF TEST

Date: December 10/65 Engineering Request: 8175

Test Made For: Pacific Giant Steel Ores Limited

Address Whitehorse, Yukon

City State

Problem:

To remove impurities from hematite iron ore by using high intensity wet separation.

Discussion and Conclusions:

A 25-lb sample of large chunks of hematite iron ore was received for testing on our high intensity wet separator. The sample was processed through our crushing equipment and screened to three fractions (-35 +100, -100 +200, -200) so that we could determine which particle size it would be necessary to crush to achieve complete liberation of hematite.

Prior to processing through our HIW separator, the three samples were processed through our HCB separator at a low voltage to scalp off the highly magnetic particles, such as iron of abrasion. These were packaged as samples and will be returned.

The three samples were processed through the HIW separator at density of 25% solids.

Microscopic examination of the cleaned material indicated a small amount of composite grains were present in the -35 +100 and -100 +200 size fractions. A trace of free silica grains was present in the cleaned materials from each of the three tests. This indicates a very good separation was achieved with a good hematite concentrate.

Analysis of the tested samples will determine the liberation size of the ore, or the most practical size range.

Recommendations:

The customer requested that we pelletize the concentrate, which we are unable to do because of lack of equipment.

With regard to making sponge iron from the concentrate by reduction, we think it would be practical. For further information, we suggest you contact the Dravo Engineering Co, Toronto, Canada, or the Ontario Research Foundation. These organizations are equipped to conduct such tests.

... 2

TEST PROCEDURE

Recommendations:

Our proposal for the plant flow sheet is still the same, that is, primary concentration by the Humphrey Spiral with a final clean-up concentration on the HIW separator. The high concentrate can then be pelletized or directly reduced into sponge or powdered iron.

J W SULESKI
Laboratory Technician
jw

Test #1 — 2265 gm (-35 +100)

HCB mag scalpings 14.2 gm

HIW @ 230V

Mags	Nonmag	Loss
2009.7 gm	111.2 gm	144.1 gm
88.7%	4.9%	6.36%

Test #2 — 1205 gm (-100 +200)

HCB mag scalpings 32.8 gm

HIW @ 230V

Mags	Nonmags	Loss
1066.8 gm	112.9 gm	25.3 gm
88.5%	9.4%	2.1%

Test #3 — 2265 gm (-200)

HCB mag scalpings 33 gm

HIW @ 230V

Mags	Nonmags	Loss
1365.9 gm	867.5 gm	31.6 gm
60.3%	38.4%	1.3%

ERIEZ MAGNETICS
ERIE, PENNSYLVANIA U. S. A.

Ontario Research Foundation

43 QUEEN'S PARK CRESCENT EAST TORONTO 5, CANADA

TELEPHONE 924-6201

February 24, 1966.

Ore Dressing Division,
50 Taber Road,
Rexdale, Ontario.

Mr. A. Jellinek,
Managing Director,
Pacific Giant Steel Ores Ltd.,
P.O. Box 1039,
WHITEHORSE, Yukon.

Dear Mr. Jellinek:

The following Chemical Analyses were done on your Bear River hematite ore as arranged by Mr. J. S. Gatt, of Eries Canada:

PERCENT

Sample	Total Fe	SiO_2	P	S	TiO_2	Mn	CaO	MgO	Al_2O_3
Raw Ore	63.5	8.22	0.10	0.07	.03	.02	.22	.13	.28
Mag.Fraction Conc.Test 1 Magnetics -35 +100	62.2	8.65	.06	.13	.06	.02	.25	.36	.10
Mag.Fraction Conc.Test 2 Magnetics -100 +200	64.8	7.10	.06	.11	.07	.02	.26	.22	.13
Mag. Fraction Conc. Test 3 Magnetics -200 M	66.3	3.48	.04	.08	.07	.02	.22	.23	.08
Non-Mag. Fraction -35 +100 M	45.5								
Non- Mag. Fraction -100 +200 M	44.3								
Non - Mag. Fraction -200 M	52.2								

SEMI-QUANTITATIVE ANALYSIS

Bear River Hematite Ore
and
Concentrate

Sample Code

I Raw Ore

Concentration Tests 1-2-3 Eries
Magnetics, Lump Ore

II -35 +100 M

Magnetic fraction - Concentration
Test 1, Eries Magnetics

III -100 +200 M

Magnetic fraction - Concentration
Test 2, Eries Magnetics

IV -200 M

Magnetic Fraction - Concentration
Test 3, Eries Magnetics

FE/gb

March 9, 1966.

Chemical Analyses

		% Acid Soluble Iron
I	Raw Ore	63.1
II	-35 +100 M Magnetics	62.1
III	-100 +200 M Magnetics	64.7
IV	-200 M Magnetics	66.3

F. Everard

F. Everard, P.Eng.,
Assistant Director,
Department of
Engineering and Metallurgy.

FE/gb

March 9, 1966.

Ontario Research Foundation

43 QUEEN'S PARK CRESCENT EAST TORONTO 5, CANADA

TELEPHONE 924-6201

March 23, 1966.

Ore Dressing Division,
50 Taber Road,
Rexdale, Ontario.

Mr. A. Jellinek,
Managing Director,
Pacific Giant Steel Ores Ltd,
P.O. Box 1039,
WHITEHORSE, Yukon.

Dear Mr. Jellinek:

I am sorry for the delay in not sending you the assays. Here are the missing analyses:

Sample	% Acid Soluble Iron
-35 +100 mesh non-magnetics	45.5
-100 +200 mesh non-magnetics	44.1
-200 mesh non-magnetics	52.1

Yours very truly,

F. Everard, P.Eng.,
Assistant Director,
Department of
Engineering and Metallurgy.

FE/gb

SEMI-QUANTITATIVE SPECTROGRAPHIC ANALYSIS

	RAW ORE		RAW ORE
Antimony	ND	Phosphorus	ND
Arsenic	ND	Platinum	ND
Barium	.1%	Rhenium	X
Beryllium (BeO)	ND	Rhodium	ND
Bismuth	ND	Rubidium	X
Boron	ND	Ruthenium	ND
Cadmium	ND	Silver	.0001%
Cerium (CeO_2)	ND	Strontium	ND
Caesium	X	Tantalum (Ta_2O_5)	ND
Chromium	.005%	Tellurium	ND
Cobalt	.005%	Thallium	ND
Columbium (Cb_2O_5)	ND	Thorium (ThO_2)	ND
Copper	.02%	Tin	ND
Gallium	ND	Titanium	.05%
Germanium	ND	Tungsten	ND
Gold	ND	Uranium (U_3O_8)	ND
Hafnium	ND	Vanadium	<.01%
Indium	ND	Yttrium (Y_2O_3)	ND
Iridium	ND	Zinc	ND
Lanthanum (La_2O_3)	ND	Zirconium (ZrO_2)	ND
Lead	.002%	ROCK FORMING METALS	
Lithium (Li_2O)	ND	Aluminum (Al_2O_3)	.2%
Manganese	.005%	Calcium (CaO)	.5%
Mercury	ND	Iron (Fe)	Balance
Molybdenum	.005%	Magnesium (MgO)	.05%
Neodymium (Nd_2O_3)	ND	Silica (SiO_2)	5-10%
Nickel	.005%	Sodium (Na_2O)	.1%
Palladium	ND	Potassium (K_2O)	.5-1%

Figures are approximate:

CODE

H - High	10 - 100% approx.	TL	- Trace Low	.05 - .5% approx.
MH - Medium High	5 - 50% approx.	T	- Trace	.01 - .1% approx.
M - Medium	1 - 10% approx.	FT	- Faint Trace	approx. less than .01%
LM - Low Medium	.5 - 5% approx.	PT	- Possible Trace	Presence not certain

ND - Not detected. Elements looked for but not found

X - Not looked for

SEMI-QUANTITATIVE SPECTROGRAPHIC ANALYSIS

	-35 +100 M		-35 +100 M
Antimony	ND	Phosphorus	ND
Arsenic	ND	Platinum	ND
Barium	.1%	Rhenium	X
Beryllium (BeO)	ND	Rhodium	ND
Bismuth	ND	Rubidium	X
Boron	ND	Ruthenium	ND
Cadmium	ND	Silver	.0001%
Cerium (CeO_2)	ND	Strontium	ND
Caesium	X	Tantalum (Ta_2O_5)	ND
Chromium	.005%	Tellurium	ND
Cobalt	.005%	Thallium	ND
Columbium (Cb_2O_5)	ND	Thorium (ThO_2)	ND
Copper	.02%	Tin	ND
Gallium	ND	Titanium	.05%
Germanium	ND	Tungsten	ND
Gold	ND	Uranium (U_3O_8)	ND
Hafnium	ND	Vanadium	<.01%
Indium	ND	Yttrium (Y_2O_3)	ND
Iridium	ND	Zinc	ND
Lanthanum (La_2O_3)	ND	Zirconium (ZrO_2)	ND
Lead	.002%	ROCK FORMING METALS	
Lithium (Li_2O)	ND	Aluminum (Al_2O_3)	.1%
Manganese	.005%	Calcium (CaO)	.2%
Mercury	ND	Iron (Fe)	Balance
Molybdenum	.005%	Magnesium (MgO)	.05%
Neodymium (Nd_2O_3)	ND	Silica (SiO_2)	5-10%
Nickel	.005%	Sodium (Na_2O)	.1%
Palladium	ND	Potassium (K_2O)	.5-1%

Figures are approximate:

C O D E

H -	High	10 - 100% approx.	TL	- Trace Low	.05 - .5% approx.
MH -	Medium High	5 - 50% approx.	T	- Trace	.01 - .1% approx.
M -	Medium	1 - 10% approx.	FT	- Faint Trace	approx. less than .01%
LM -	Low Medium	.5 - 5% approx.	PT	- Possible Trace	Presence not certain

ND - Not detected. Elements looked for but not found

X - Not looked for

SEMI-QUANTITATIVE SPECTROGRAPHIC ANALYSIS

	-100 +200 M		-100 +200 M
Antimony	ND	Phosphorus	ND
Arsenic	ND	Platinum	ND
Barium	.1%	Rhenium	X
Beryllium (BeO)	ND	Rhodium	ND
Bismuth	ND	Rubidium	X
Boron	ND	Ruthenium	ND
Cadmium	ND	Silver	.0001%
Cerium (CeO_2)	ND	Strontium	ND
Caesium	X	Tantalum (Ta_2O_5)	ND
Chromium	.005%	Tellurium	ND
Cobalt	.005%	Thallium	ND
Columbium (Cb_2O_5)	ND	Thorium (ThO_2)	ND
Copper	.001%	Tin	ND
Gallium	ND	Titanium	.05%
Germanium	ND	Tungsten	ND
Gold	ND	Uranium (U_3O_8)	ND
Hafnium	ND	Vanadium	<.01%
Indium	ND	Yttrium (Y_2O_3)	ND
Iridium	ND	Zinc	ND
Lanthanum (La_2O_3)	ND	Zirconium (ZrO_2)	ND
Lead	.002%	ROCK FORMING METALS	
Lithium (Li_2O)	ND	Aluminum (Al_2O_3)	.05%
Manganese	.005%	Calcium (CaO)	.1%
Mercury	ND	Iron (Fe)	Balance
Molybdenum	.005%	Magnesium (MgO)	.05%
Neodymium (Nd_2O_3)	ND	Silica (SiO_2)	5%
Nickel	.001%	Sodium (Na_2O)	.1%
Palladium	ND	Potassium (K_2O)	.5-1%

Figures are approximate:

C O D E

H -	High	10 - 100% approx.	TL -	Trace Low	.05 - .5% approx.
MH -	Medium High	5 - 50% approx.	T -	Trace	.01 - .1% approx.
M -	Medium	1 - 10% approx.	FT -	Faint Trace	approx. less than .01%
LM -	Low Medium	.5 - 5% approx.	PT -	Possible Trace	Presence not certain

ND - Not detected. Elements looked for but not found

X - Not looked for

SEMI-QUANTITATIVE SPECTROGRAPHIC ANALYSIS

	-200M		-200 M
Antimony	ND	Phosphorus	ND
Arsenic	ND	Platinum	ND
Barium	.1%	Rhenium	X
Beryllium (BeO)	ND	Rhodium	ND
Bismuth	ND	Rubidium	X
Boron	ND	Ruthenium	ND
Cadmium	ND	Silver	.0001%
Cerium (CeO_2)	ND	Strontium	ND
Caesium	X	Tantalum (Ta_2O_5)	ND
Chromium	.005%	Tellurium	ND
Cobalt	.005%	Thallium	ND
Columbium (Cb_2O_5)	ND	Thorium (ThO_2)	ND
Copper	.001%	Tin	ND
Gallium	ND	Titanium	.05%
Germanium	ND	Tungsten	ND
Gold	ND	Uranium (U_3O_8)	ND
Hafnium	ND	Vanadium	<.01%
Indium	ND	Yttrium (Y_2O_3)	ND
Iridium	ND	Zinc	ND
Lanthanum (La_2O_3)	ND	Zirconium (ZrO_2)	ND
Lead	.002%	ROCK FORMING METALS	
Lithium (Li_2O)	ND	Aluminum (Al_2O_3)	.05%
Manganese	.005%	Calcium (CaO)	.1%
Mercury	ND	Iron (Fe)	Balance
Molybdenum	.005%	Magnesium (MgO)	.05%
Neodymium (Nd_2O_3)	ND	Silica (SiO_2)	5%
Nickel	.001%	Sodium (Na_2O)	.1%
Palladium	ND	Potassium (K_2O)	.5-1%

Figures are approximate:

CODE

H - High	10 - 100% approx.	TL - Trace Low	.05 - .5% approx.		
MH - Medium High	5 - 50% approx.	T - Trace	.01 - .1% approx.		
M - Medium	1 - 10% approx.	FT - Faint Trace	approx. less than .01%		
LM - Low Medium	.5 - 5% approx.	PT - Possible Trace	Presence not certain		

ND - Not detected. Elements looked for but not found

X - Not looked for

Executive Office
[redacted] 1455 Woodroffe Avenue
OTTAWA 5, ONT.

Area Code 613
Telephone 224-2173

FERRO-MAGNETICS LTD.

(NO PERSONAL LIABILITY)

21 March 1966

Mr. A. Jellinek
Managing Director
Pacific Giant Steel Ores
P.O.Box 1039
Whitehorse, Yukon.

Dear Mr. Jellinek:

Enclosed please find a proposal for a test programme which we have prepared for your Hematite Ore.

The results of the preliminary tests conducted on same show that a test programme is fully guaranteed to yield a product which can be used for steel making. It will also result in obtaining the necessary data for a commercial operation.

We hope that the said proposal will meet your requirements, and look forward to being of service.

Yours sincerely

FERRO-MAGNETICS LTD.

G.W. Reschke

G.W. Reschke
Metallurgist

R:b

Executive Office
108 David Drive
OTTAWA 5, ONT.

Area Code 613
Telephone 224-2173

FERRO-MAGNETICS LTD.

(NO PERSONAL LIABILITY)

18 March 1966

Mr. A. Jellinek
Managing Director
Pacific Giant Steel Ores Ltd.
P. O. Box 1039
Whitehorse, Yukon

Dear MR. Jellinek:

By Parcel Post we are sending to you today the products of separation of five preliminary tests conducted on your Hematite material, which we have recorded as sample No. 63.

The following table shows the weight distribution and assays for SiO_2 on the magnetic fractions.

Hematite (Sample No. 63)

TEST NO.	PRODUCTS	PRODUCT NO.	% WT.	% SiO_2
1 Intensity: 5 A Wash water: None Pulse: None	Magnetics Washings Non-magnetics	63-1 63-2 63-3	[illegible].5 5.1 35.3 100.0	3.3
2 Intensity: 10 A Wash water: None Pulse: None	Magnetics Washings Non-Magnetic	63-4 63-5 63-6	[illegible].2 [illegible].8 12.0 100.0	4.6
3 Intensity: 15 A Wash water: None Pulse: None	Magnetics Washings Non-magnetics	63-7 63-8 63-9	90.2 2.0 7.8 100.0	[illegible].0

Hematite (Sample No. 63)

TEST NO.	PRODUCTS	PRODUCT NO.	% WT.	% SiO_2
4 Intensity: 10A Wash water: Med. Pulse: Medium	Magnetics Washings Non-magnetics	63-10 63-11 63-12	72.4 16.5 11.1 100.0	4.3
5 Intensity: 10A Wash water: Heavy Pulse: Heavy	Magnetics Washings Non-magnetics	63-13 63-14 63-15	62.6 26.5 10.9 100.0	3.4

The tests shown above were run on material ground to -48 mesh.

Test Nos. 1 to 3 were conducted at 5, 10, 15 amps in order to find the effect of intensity on recovery.

Test Nos. 4 and 5 were conducted to see the effect of wash water and pulse on the grade of the concentrate, when using an intensity of 10 amps.

The results of these preliminary tests show that a good separation of the hematite can be made. A test programme to investigate thoroughly the variables involved in wet magnetic separation is necessary to reach the conditions under which the best metallurgy will be obtained.

We are now preparing a proposal for a test programme, and will be sent to you for your consideration.

Yours sincerely,

FERRO-MAGNETICS LTD.

J.G. Reschke

J.G. Reschke
Metallurgist

R:V

COLORADO SCHOOL OF MINES RESEARCH FOUNDATION, INC.

GOLDEN, COLORADO 80402

18 May 1966

360501

Mr. A. Jellinek
Pacific Giant Steel Ores Ltd.
P.O. Box 1039
Whitehorse, Yukon

Dear Mr. Jellinek:

Chemical assays of 5 sets of test samples conducted by Ferro-Magnetics Ltd. are as follows:

Test	Sample No.	Fe(soluble) %	SiO_2 %	P %	S %	Ti %
1	63-1 Magnetic	66.3	2.50	0.027	0.113	0.046
2	63-4 "	65.6	3.77	0.035	0.129	0.051
3	63-7 "	65.1	3.85	0.039	0.132	0.055
4	63-10 "	66.4	2.67	0.035	0.140	0.049
5	63-13 "	66.7	2.48	0.031	0.118	0.051
1	63-2 Washings	57.9				
2	63-5 "	52.0				
3	63-8 "	41.7				
4	63-11 "	60.8				
5	63-14 "	61.6				
1	63-3 Nonmag.	56.7				
2	63-6 "	43.8				
3	63-9 "	37.5				
4	63-12 "	42.4				
5	63-15 "	43.6				

Under separate shipment I am airmailing you small vials containing each of the above samples. We are also saving all samples remaining from the assay work and will return to you. The additional copies of the report and the color photographs and explanation of the hand specimen are being finished.

Very truly yours,

James K. Trimble

James K. Trimble
Assistant Manager
Mining Division

/lsj

Executive Office
[illegible] 1455 Woodroffe Avenue
OTTAWA 5, ONT.

Area Code 613
Telephone 724-2173

FERRO-MAGNETICS LTD.

(NO PERSONAL LIABILITY)

21 March 1966

PROPOSED TEST PROGRAMME FOR PACIFIC GIANT STEEL ORES

FOR THE EVALUATION OF A HEMATITE ORE

BY TREATMENT WITH THE JONES MAGNETIC SEPARATOR

The suggested procedure is greatly influenced by our past experience in the treatment of hematite ores by the use of the Jones Magnetic Separator and by the results of the preliminary tests previously conducted. An order for testing the variables has thus been compiled. These are listed in order of evaluation. The approximate number of tests and products are shown with each variable. These numbers will vary according to the effect of the variable on the overall scheme. Furthermore, a number of tests must be allowed around the critical settings of each variable.

1. <u>Grind</u>: It is important to determine degree of liberation, in order to improve grade and recovery. Five tests will be conducted at -35, -48, -65, -100, -200 mesh.

   Total Tests: 5

   Total Products: 15

2. <u>Per Cent Solids</u>: This is an important factor as generally it is desirable to operate at as high a per cent solids figure as possible. Tests will be conducted between a range of 5 per cent to 45 per cent solids.

   Total Tests: 9

   Total Products: 27

3. <u>Feed Rate</u>: To determine the optimum amount of material passing through the plates in every cycle.

   Total Tests: 10

   Total Products: 30

4. **Intensity:** Tests at several intensities. Usually low intensities are required to produce a separation. However, the finer the particle size the higher the intensity needed for separation.

Total Tests: 7

Total Products: 21

5. **Plates:** Tests will be conducted using chromed plates. Try the mild steel salient pole plates and high extraction plates. Two tests on each.

Total Tests: 6

Total Products: 18

6. **Wash Water:** Tests will be run from zero to heavy wash.

Total Tests: 8

Total Products: 24

7. **Pulse:** Tests will be run from 0 to heavy pulse.

Total Tests: 8

Total Products: 24

8. **Correlation:** From study of the test data a few tests will be necessary to combine the optimum conditions for each variable. Allow ten tests for this.

Total Tests: 10

Total Products: 30

TABULATION OF WORK INVOLVED

VARIABLE	NUMBER OF TESTS	NUMBER OF PRODUCTS
Grinding	5	15
Per cent solids	9	27
Feed rate	10	30
Intensity	7	21
Plates	6	18
Wash water	8	24
Pulse	8	24
Correlation	10	30
Totals	63	189

RESULT OF TEST PROGRAMME:

Such test work as outlined will:

a) result in the best separation possible being obtained on the lab/pilot plant unit.

b) indicate degree of separation obtainable on commercial machine.

c) determine settings for the commercial unit.

COST:

A charge of two thousand dollars ($2,000.00) will be made for the complete programme (excluding assays).

CHEMICAL ASSAYS:

Although 189 products are contemplated it will not be necessary to assay all of these. Considerable information can be obtained from the per cent weight removals and visual examination. It is estimated that the number of assays required will be as follows:

Element or Compound	No. of Assays
Fe	129
SiO_2	5
P	5
S	5
CaO	5
Al_2O_3	5
TiO_2	5
Mn	5

Our laboratory has facilities to perform such chemical assays. If undertaken by ourselves, there will be a charge of $552.00 (five hundred and fifty two dollars)

Alternative ways are:

a) To return the products of separation to yourselves for evaluation.
b) To have a custom laboratory do the work.

However, a considerable saving in time will result in the case of our laboratory undertaking the said assay work.

TIME SCHEDULE:

Estimated completion time of test programme from receipt of order is three months.

REPORT:

A report on the investigation will be delivered approximately one month after the termination of test programme.

This report will include:

a) Evaluation of results
b) Recommended machine for commercial operation
c) Flow sheet.

TERMS OF PAYMENT:

One third after 2 months
One third after 3 months
Balance on delivery of report

MATERIAL NEEDED:

About 100 lbs. of material will be needed for such an evaluation. This should be sent to our Ottawa address.

FERRO-MAGNETICS LTD.

G.W. Reschke
Metallurgist

DATE Oct 17th 1965
FILE NO 2530-15

ASSAY CERTIFICATE

WHITEHORSE ASSAY OFFICE

P.O. BOX 346, WHITEHORSE, YUKON

RECEIVED FROM Mr. A. Jellinek, Pacific Giant Steel Ores Ltd.,

SAMPLE NO	GOLD OZ. PER TON	SILVER OZ. PER TON	Iron	Silica (SiO2)		Insol.		
B.P.I. 1			63.4	5.92		I.04		
2			66.0	3.72		.24		
3			62.5	6.24		.60		
4			55.6	7.40		8.52		
5			57.0	7.12		7.72		
6			65.5	2.88		.28		
7			62.5	6.68		.52		
8			63.2	6.44		.76		
9			16.5	43.96		21.8		
10			44.8	19.66		12.14		
11			37.8	33.8		3.20		
12			27.6	43.1		6.14		
13			48.8	17.76		6.16		

ASSAYER [illegible signature]

Bear River iron ore
samples from trenches
and heavy outcrop zones

DATE Oct 6th I966

FILE NO. 3354-3

ASSAY CERTIFICATE

WHITEHORSE ASSAY OFFICE

P.O. BOX 346. WHITEHORSE, YUKON

RECEIVED FROM Pacific Giant Steel Ores Ltd.,

SAMPLE NO.	GOLD OZ. PER TON	SILVER OZ PER TON	Soluable Iron	Nickel	Copper	Silica	(SiO_2)	
Br-A			54.5	Trace	Trace	8.58		
-B			6I.6	Trace	Trace	5.36		
-C			6I.3	Trace	Trace	4.58		

Notes: Copper on all samples less than .005 %

Nickel on all samples less than .0I %

Raw hematite iron ore samples
Bear River property, Yukon

ASSAYER Geo Spalding

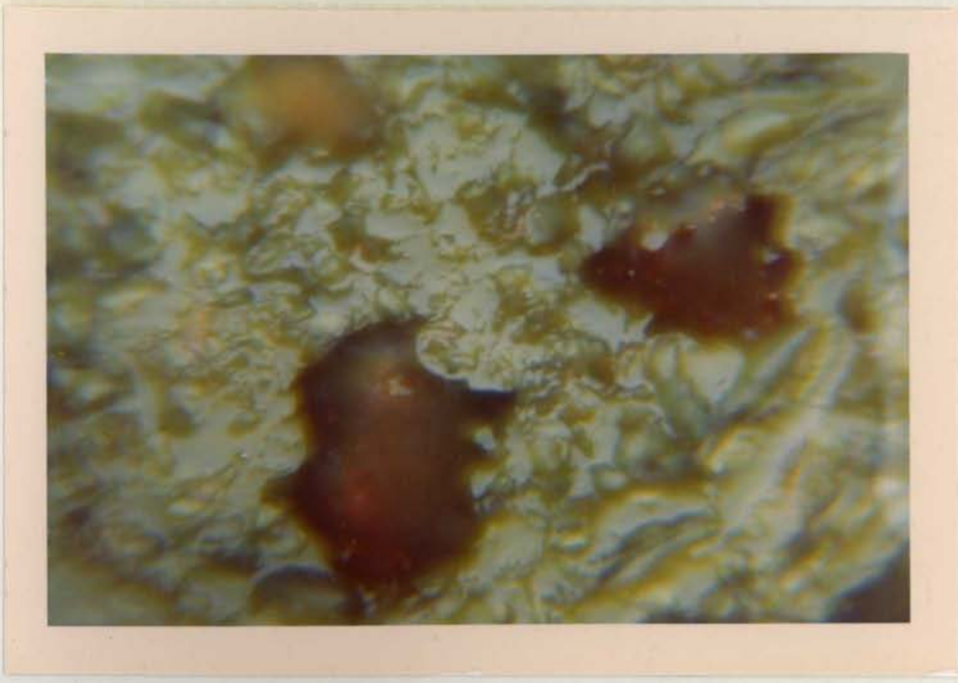
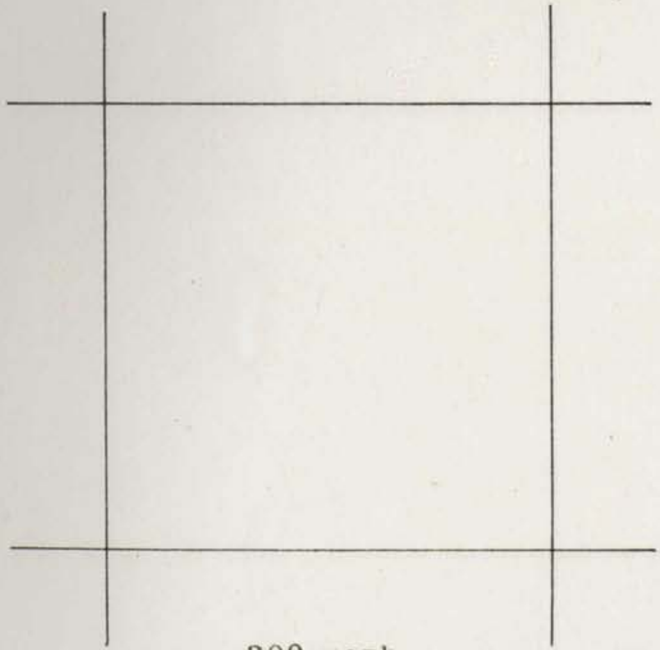


FIGURE 1

Photomicrograph illustrating the porous surface of the hematite and the relationship of quartz grains to the hematite.



200 mesh

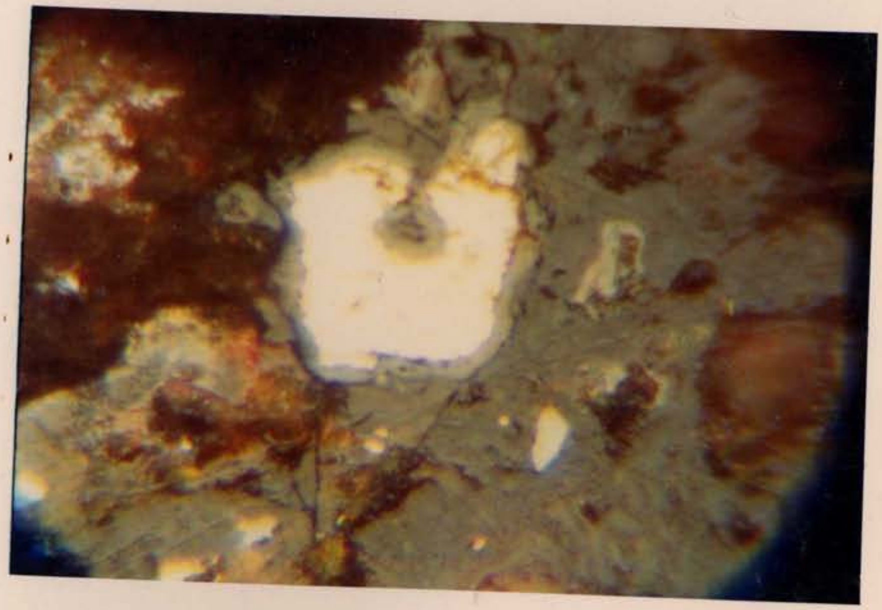
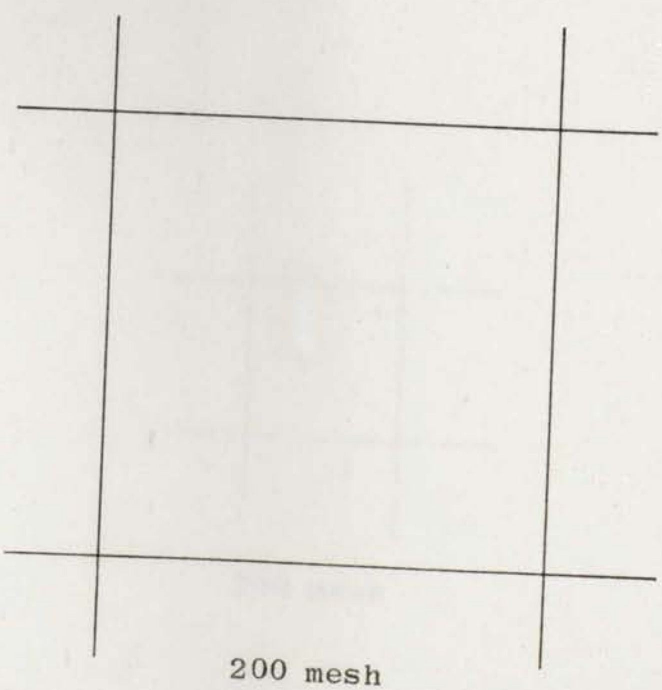


FIGURE 2

Pyrite (cream yellow) surrounded by a rim of goethite. The host mineral is hematite. The goethite appears to be hydrothermally emplaced.



200 mesh

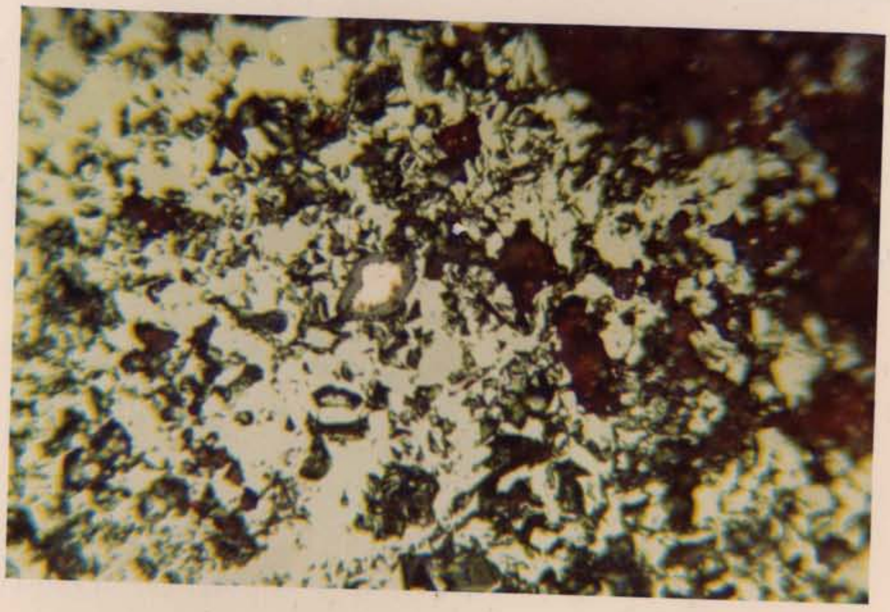
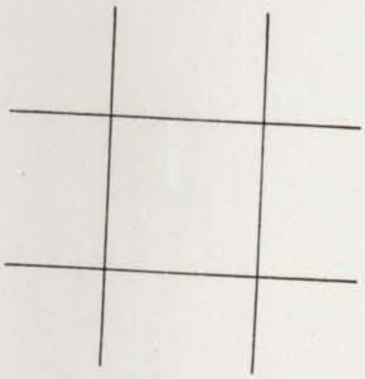


FIGURE 3

A small pyrite core (cream yellow) surrounded by a rim of goethite is shown in this photomicrograph. The light grey-green host mineral of the pyrite and goethite is hematite.



200 mesh

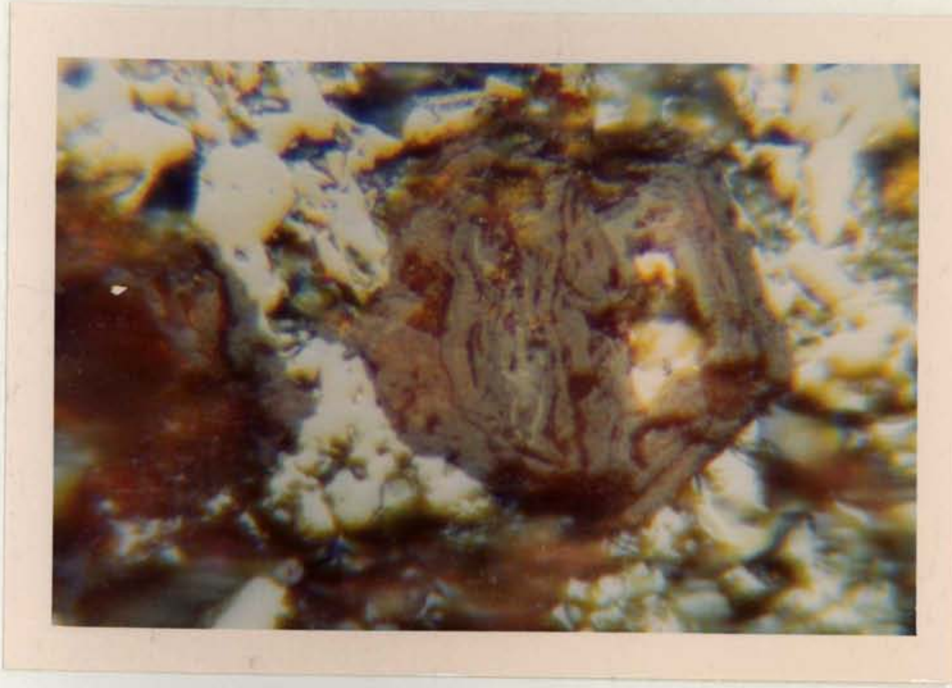
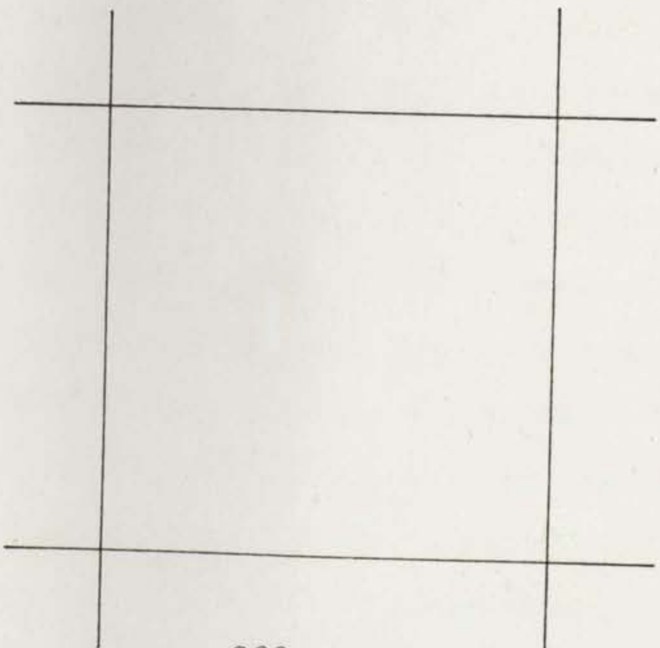


FIGURE 4

Photomicrograph illustrating a pyrite core in a goethite pseudomorph after pyrite.



200 mesh

Limonite is rare and is limited to areas adjacent to fractures in the rock. Barite is completely confined to vein occurrences, and occurs in well crystallized swarms of grains within the fractures. Only two minute grains of pyrite (see Figs. 2 & 3) were noted, and each of these was less than 30μ in diameter.

DISCUSSION

Megascopically the rock is a heavy, dense, red-tinted gray, banded rock with a few randomly oriented, thin, light-colored veinlets. The bands range from 0.1 mm to 20 mm in width and may be either continuous or discontinuous.

Microscopically the banding is not obvious. Irregular discontinuous stringers of quartz are present, but no distinct bands are evident.

The chemical analyses are for the most part self-explanatory; however, a few observations seem justified. Most of the iron can be assigned to hematite, and, if done, results in a chemically derived hematite content of $\pm$ 87%. This is eight percent less than the petrographically-derived figure of 94.5% (Table 5) and is best explained by variation in degree of representativeness. Because the samples for chemical analyses were derived according to a rigid sample reduction scheme, they are undoubtedly more valid than the results obtained by the petrographic examination of ten thin sections. This same explanation must be extended to the apparent discrepancy between the seven to eight percent SiO_2 reported by chemical analysis and the four percent obtained by petrography.

The disparity between the two Al_2O_3 contents reported in the hand sample (2.27) and in the composite sample (0.31) allows two conclusions: 1. the hand sample contains more than the composite, or 2. one or both analyses are in error. No feldspar was found in the samples, and this tends to support the tenet that perhaps the 2.27 percent Al_2O_3 in the hand sample may be error.

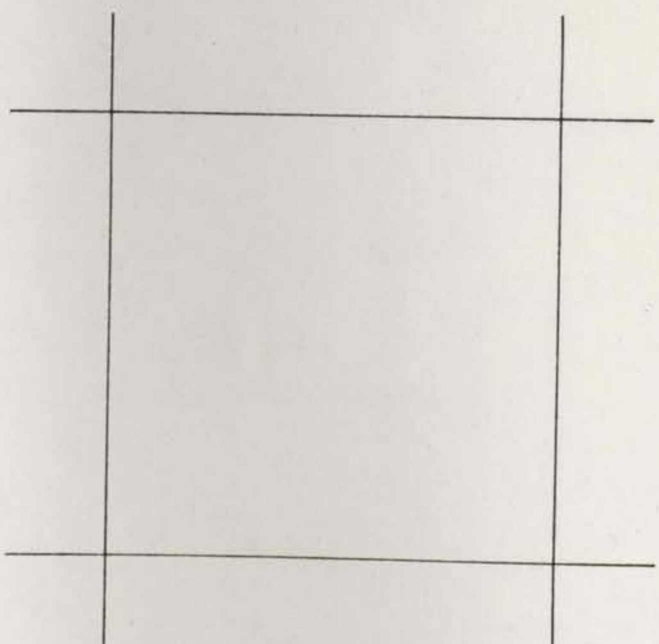
Examination of Tables 3 and 4 reveals that quartz locked in hematite will be 90% liberated at 400 mesh whereas the hematite locked in quartz won't be 90% liberated until a particle size of $\pm 10\mu$ is reached. However, reference to Table 5 reveals that hematite occurring in the latter form constitutes only 1.2% of the total hematite in the sample, and therefore probably does not merit beneficiation considerations.

The ore genesis of the deposit is not wholly discernible in microscopic studies. The hematite is very difficult to polish, and on examination, is very porous (Fig. 5). Some authors, namely Gross (Metamorphism of Iron Formations and its Bearing on Their Beneficiation, Can. Min. & Met. Bull, v. 54, no. 585, 1961, p. 30-37) ascribe this to leaching of previously existing carbonates and/or silicates. If this is the case here it is speculation to say so because no carbonate vestiges remain.

"Ghosts" (Figs. 6 & 7); i.e., outlines of pre-existing grains visible in quartz masses suggest mechanical deformation which tended to segregate like mineral grains followed by chemical migration of silica and iron (recrystallization). In other words, the banded appearance of the rock is due to regional metamorphism of a predominately iron-silica rock that has caused first mechanical failure of the constituents, segregation of like mineral grains, and finally, an additional

FIGURE 5

Photomicrograph of a hematite surface which exhibits a less porous surface than is normally present.



200 mesh

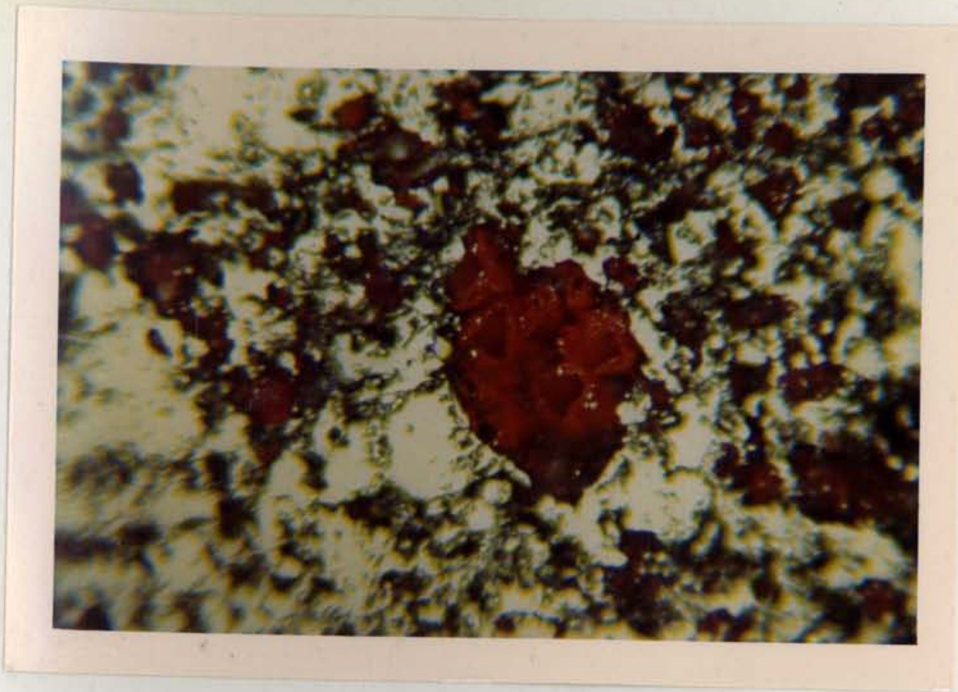
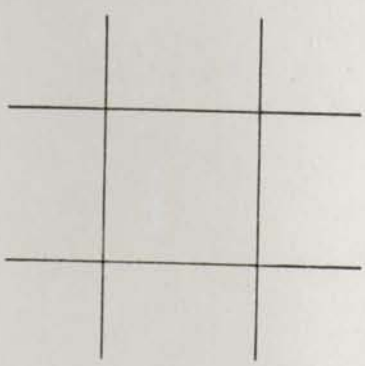


FIGURE 6

An iron stained quartz grain showing "ghosts" of several mineral grains included within the quartz.



200 mesh

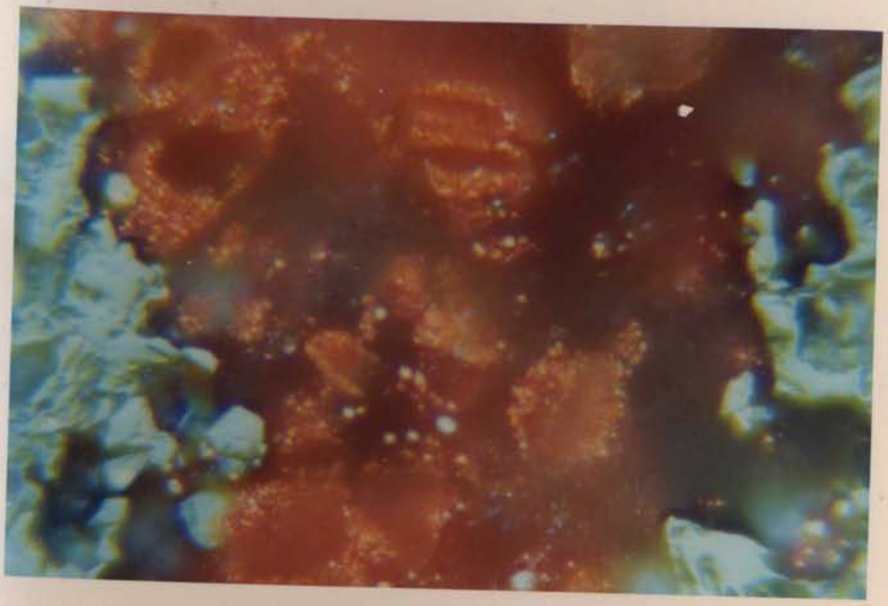
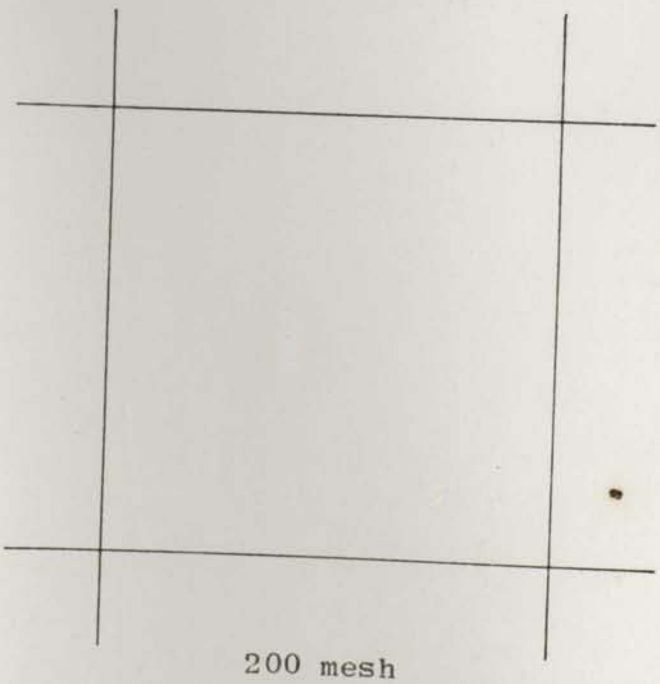


FIGURE 7

A swarm of hematite "ghosts" within a large quartz grain.



200 mesh

concentration by recrystallization of the constituents. If there was introduction of iron from without the formation there is no textural relationship to support it. The presence of euhedral plates of hematite extending into quartz stringers (Fig. 8) indicates simultaneous formation of both the quartz filling and the hematite under nondeformative conditions, but under considerable static pressure.

The minute barite-filled veinlets of course represent deposition under or at near surface conditions of pressure and temperature.

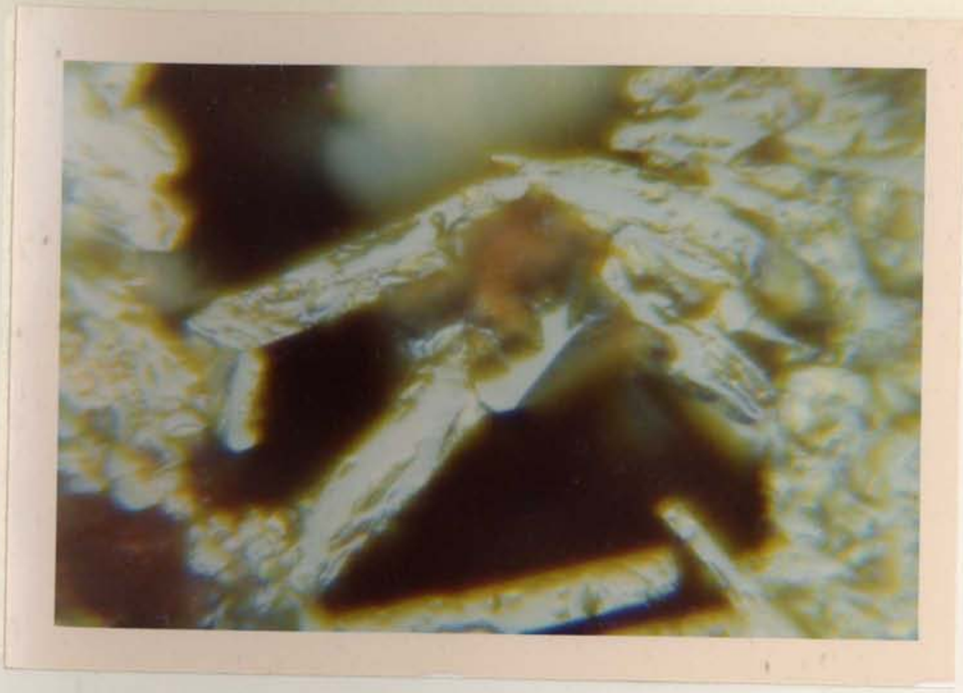
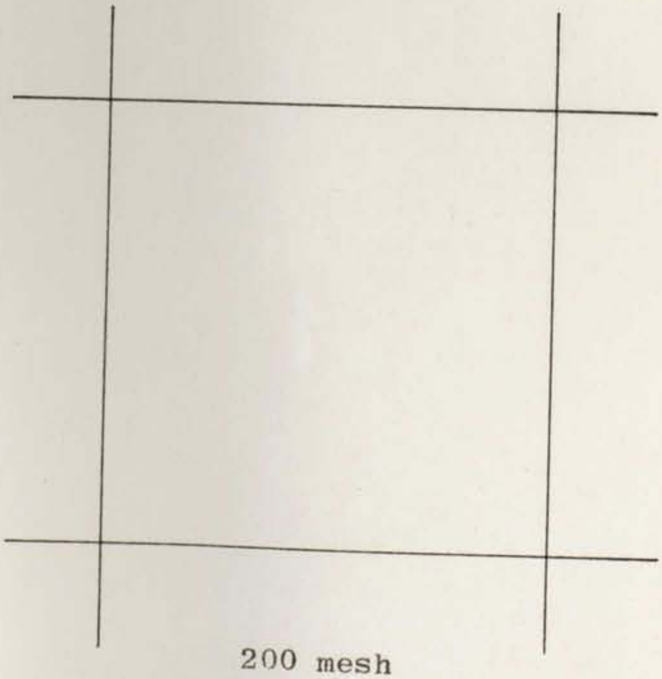
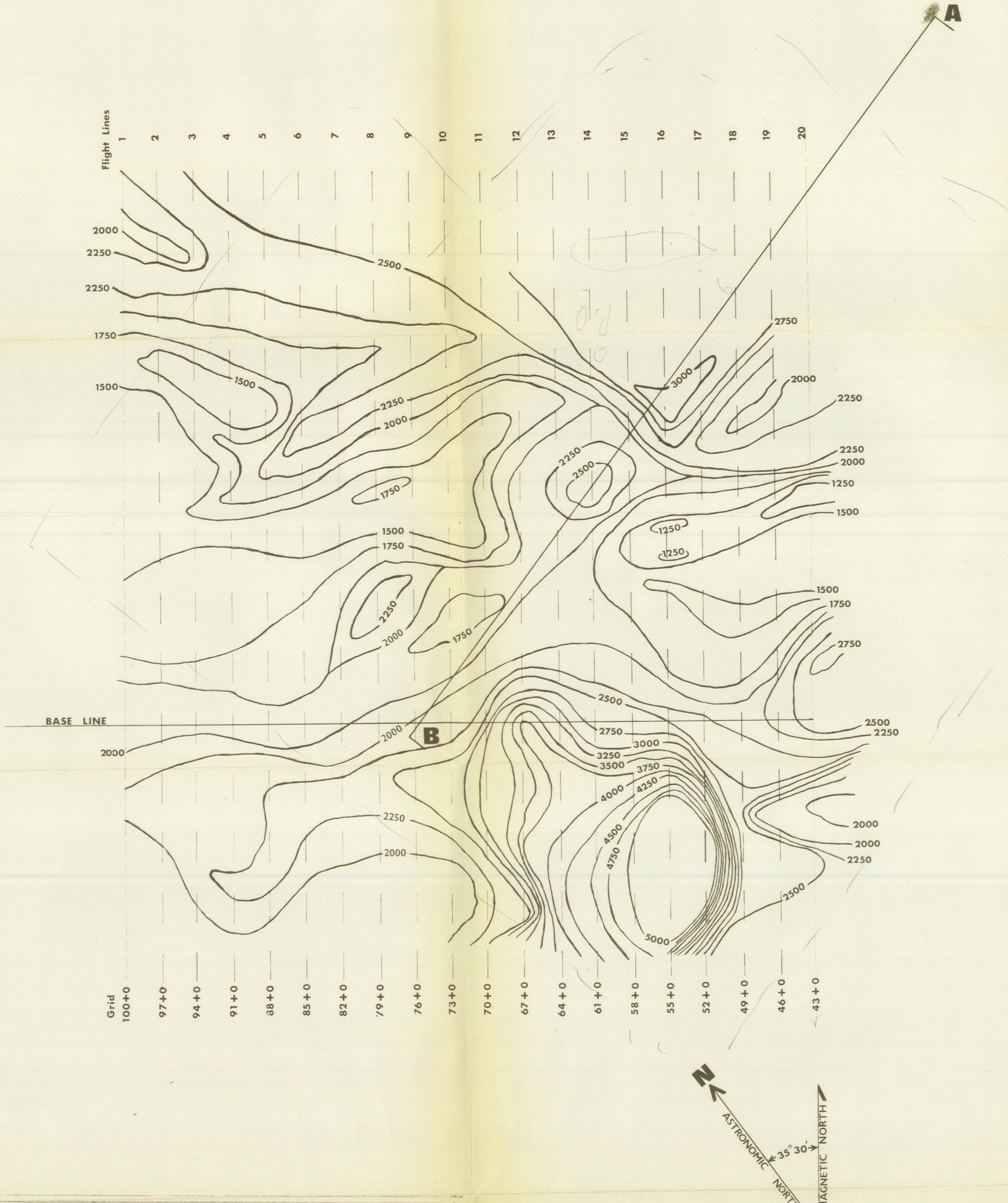


FIGURE 8

Hematite needles (well crystallized hematite) in a quartz veinlet indicating, perhaps, that the opening occurred before the quartz filling.



200 mesh



019057

AIRBORNE GEOMAGNETIC SURVEY

BEAR RIVER IRON ORE DEPOSIT

MAYO MINING DISTRICT

YUKON TERRITORY

CANADA

SCALE : 1 : 6000
(1 inch : 500 feet)

Latitude 64°- 50′ Longitude 134°- 15′

Scale reduced from original map annexed to report of H. H. Cohen Engineering Ltd. entitled "Report on the Airborne Geophysical Survey" of October 12, 1965.
Scale : 1 : 3600 (1 inch : 300 feet)

Reduced-scale map prepared by

PACIFIC GIANT STEEL ORES LTD. JUNE 1, 1966

NOTES

Contour Interval	:	250 Gammas
Instrument used	:	Modified Fluxgate Magnetometer
Aircraft used	:	Hiller 12E Helicopter
Air speed	:	60 Miles Per Hour
Height flown above ground	:	500 Feet

SPECIAL NOTE: Line A B coincides with the location line between GIANT STEEL 1 & 2, GIANT STEEL 3 & 4, GIANT STEEL 5 & 6, GS 7 & 8, GS 9 & 10.

CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

OTTAWA

MINES BRANCH INVESTIGATION REPORT IR 66-35

BENEFICIATION TESTS ON AN IRON ORE FROM THE BEAR RIVER PROPERTY OF PACIFIC GIANT STEEL ORES LTD., WHITEHORSE, YUKON TERRITORY

by

G.W. RILEY AND A. PAGE

MINERAL PROCESSING DIVISION

NOTE: THIS REPORT RELATES ESSENTIALLY TO THE SAMPLES AS RECEIVED. THE REPORT AND ANY CORRESPONDENCE CONNECTED THEREWITH SHALL NOT BE USED IN FULL OR IN PART AS PUBLICITY OR ADVERTISING MATTER.

COPY NO. 6

MARCH 29, 1966

Industrial Confidential

Mines Branch Investigation Report IR 66-35

BENEFICIATION TESTS ON AN IRON ORE FROM THE BEAR RIVER PROPERTY OF PACIFIC GIANT STEEL ORES LTD., WHITEHORSE, YUKON TERRITORY

by

G.W. Riley* and A. Page**

- - - -

SUMMARY OF RESULTS

Analysis of a head sample showed the ore to contain 62.9% Sol Fe, 8.4% SiO_2, and 0.06% P. Mineralogical examination indicated that the ore is composed of coarse and fine grained hematite with quartz filling the interstitial spaces between the grains of hematite.

Results of gravity separation, high intensity wet magnetic separation, flotation, and gravity combined with flotation or high intensity wet magnetic separation of the gravity tailing are summarized below:

	Conc. Analysis %		Recovery %
	Sol Fe	SiO_2	Sol Fe
Gravity separation	67.0	2.8	78.7
High intensity wet mag. sep	67.2	2.9	90.7
Silica flotation	66.6	3.0	95.3
Comb. gravity & flotation	67.2	2.4	94.5
Comb. gravity & mag sep	66.8	3.4	94.4

*Technical Officer and **Technician, Mineral Processing Division, Mines Branch, Department of Mines and Technical Surveys, Ottawa, Canada.

INTRODUCTION

Pacific Giant Steel Ores Ltd. has an iron ore deposit on the Bear river located about 100 miles northeast of Mayo, Yukon Territory, at latitude 64° 50' and longitude 134° 15'.

The deposit consists of massive hematite which occurs in several outcrops, and lower grade ore which is hematite dispersed through the host rock.

The sample of massive hematite received for this investigation was said to be of the kind occurring in the outcrops.

Shipment

A shipment of 200 lb. of iron ore was received on Nov. 26, 1964. The shipment was submitted by Mr. G.R.E. Leverman, Secretary-Treasurer, Pacific Giant Steel Ores Ltd., P.O. Box 1039, Whitehorse, Yukon Territory.

Purpose of Investigation

The investigation was to carry out preliminary beneficiation tests to determine the concentration characteristics of the ore.

Mr. Leverman, in his letter of March 29, 1965, asked that high-intensity magnetic separation tests be made along with other methods of treatment.

Sampling and Analysis

The sample of lump ore was crushed to ½ in. and after picking out several pieces as specimens for mineralogical examination the remainder of the sample was crushed to minus 10 mesh and split into 2,000 gram samples. One of these samples was used as a head sample for mineralogical examination, semi-quantitative spectrographic analysis, and chemical analysis, and the remaining samples were used for the investigation.

Chemical analysis of the head sample gave the following results:

Table 1

Chemical Analysis of the Head Sample		
Fe	-	62.9%
SiO_2	-	8.4%
P	-	0.06%

A semi-quantitative spectrographic analysis of the head sample gave the following results.

Table 2

Spectrographic Analysis of the Head Sample *

Elements	%
Ca	0.26
Mg,Al	0.20
Ni	0.12
Co	0.06
Mn,V,Mo,Cu	0.04
Cr	0.03
Ti	0.01

Mineralogical Examination**

The ½ in. pieces of ore are composed of massive hematite. The hematite in some of the chips is very fine grained (see Figure 1), while in others the grains are comparatively coarse (see Figure 2). The interstitial spaces between the grains in both types are filled with quartz.

The head sample contains hematite, quartz, and trace amounts of pyrrhotite, apatite, calcite, feldspar, a clay material, sericite, chlorite, and hornblende.

* From Internal Report SL 64-198
** From Internal Report MS 64-120 W. Petruk

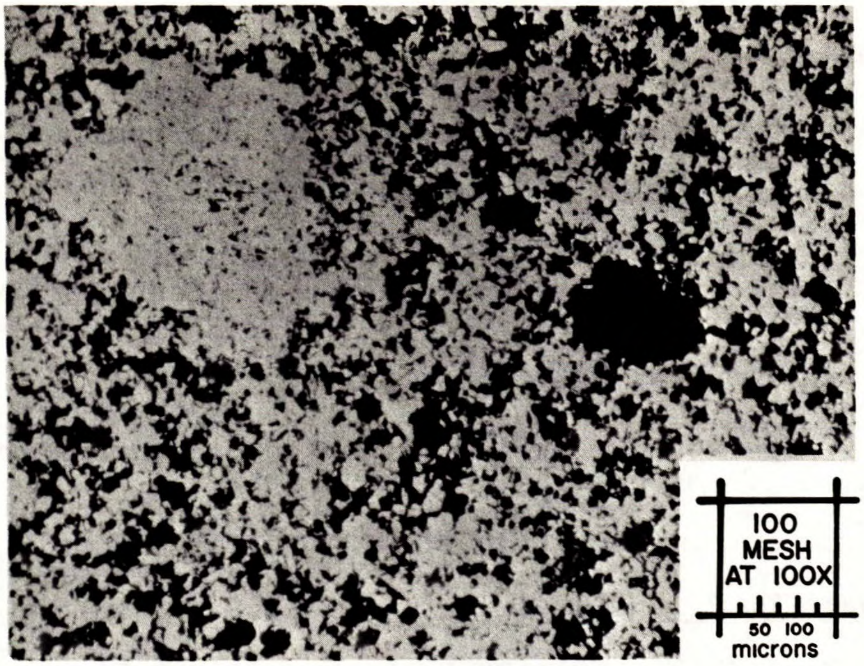


Figure 1 - Photomicrograph of a polished section showing the massive fine textured hematite (white), and interstitial quartz (grey). The black areas represent pits.

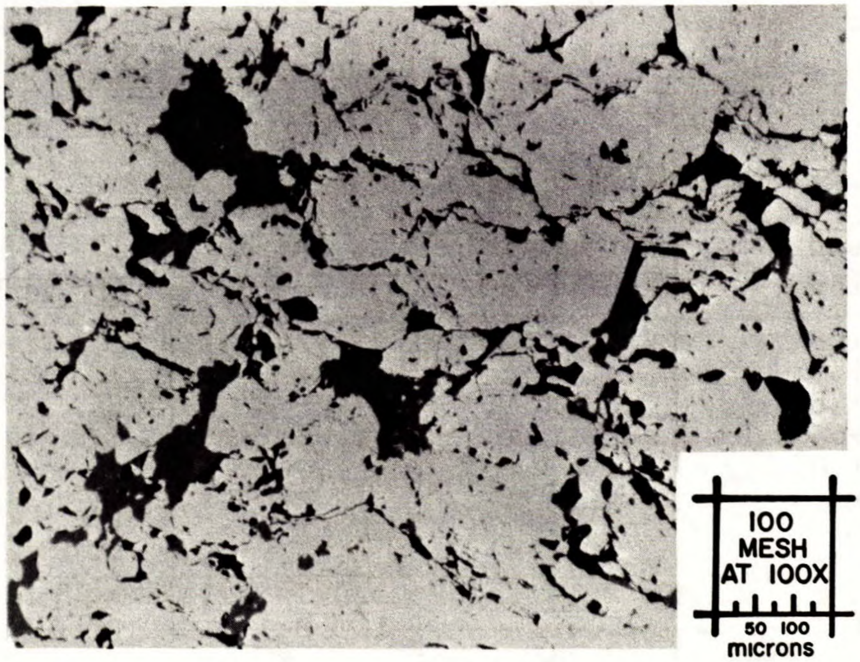


Figure 2 - Photomicrograph of a polished section showing the massive coarse textured hematite (white), and interstitial quartz (grey).

Outline of Investigation Procedures

Four different methods were used to beneficiate the ore:

1 - Gravity separation using a Deister shaking table.

2 - Magnetic separation using a Jones high intensity wet magnetic separator.

3 - Flotation in which the silica was floated.

4 - Gravity separation combined with magnetic separation or flotation of the gravity tailing.

DETAILS OF INVESTIGATION

Tabling Tests 1, 2, and 3

Two thousand gram samples were ground to -28 mesh, -35 mesh, and -65 mesh and passed over a laboratory concentrating table with the middling returned to give a final concentrate and tailing. Results of screen tests of the ground ore are shown in Table 3 and the tabling tests in Table 4.

Table 3

Results of Screen Tests

Mesh Tyler	Weight %		
	-28 mesh	-35 mesh	-65 mesh
+28	-	-	-
- 28+35	18.6	-	-
- 35+48	13.3	16.6	-
- 48+65	10.0	14.6	-
- 65+100	9.5	11.7	12.4
-100+150	10.3	13.0	22.6
-150+200	6.2	7.1	10.9
-200+325	9.4	10.3	15.0
-325	22.7	26.7	39.1
Total	100.0	100.0	100.0

Table 4

Results of Tabling Tests

Test 1. - 28 mesh

Product	Weight % Original ore	Analysis % SolFe	SiO_2	Distribution % Sol Fe
Table conc	75.2	65.2	5.6	77.9
Table tailing	24.8	56.2	16.8	22.1
Feed (calcd)	100.0	63.0	8.3	100.0

Test 2. - 35 mesh

Product	Weight % Original ore	Analysis % SolFe	SiO_2	Distribution % Sol Fe
Table conc	75.2	65.7	4.7	78.5
Table tailing	24.8	54.4	19.4	21.5
Feed (calcd)	100.0	62.9	8.3	100.0

Test 3. - 65 mesh

Product	Weight % Original ore	Analysis % SolFe	SiO_2	Distribution % Sol Fe
Table conc	73.7	67.0	2.8	78.7
Table tailing	26.3	50.9	23.2	21.3
Feed (calcd)	100.0	62.8	8.2	100.0

Test 4. Magnetic Separation of Tailing from Test 3

The tailing from Test 3 was passed through the Jones high intensity separator at 10.0 amp to produce a magnetic iron concentrate.

The results are shown in Table 5.

Table 5

Results of Jones Magnetic Separator Test 4

Product	Weight % Original ore	Analysis % SolFe	SiO_2	Distribution % Sol Fe
Mag conc	16.2	61.7	8.8	16.2
Middling	5.6	32.3	47.5	2.9
Non Mag tailing	4.5	29.7	50.2	2.2
Feed (calcd)	26.3	49.9	24.1	21.3

The combined table concentrate and Jones magnetic concentrate give a weight recovery of 89.9% of the original feed and contain 66.1% Sol Fe and 3.9% SiO_2 with 94.9% Sol Fe recovery.

Tests 5 and 6

A sample of ore was ground to minus 65 mesh and passed over a laboratory table to produce a high grade concentrate. The tailing was then ground to minus 150 mesh and split into several fractions for magnetic separation and silica flotation tests.

A sample of the minus 150 mesh table tailing was treated in a Jones magnetic separator at 10.0 amp. The results are shown in Table 6.

Table 6

Results of Tabling and Magnetic Separation Test 5

Products	Weight % Original ore	Analysis % Sol Fe	Analysis % SiO_2	Distribution % Sol Fe
Tabling				
Table conc	61.8	67.8	2.0	66.5
Table tailing	38.2	55.2*	18.2*	33.5
Feed	100.0	63.0*	8.2*	100.0
Magnetic Separation				
Mag conc	27.3	64.4	6.6	27.9
Middling	5.7	32.9	47.1	2.9
Non mag tailing	5.2	31.9	47.1	2.7
Table tailing	38.2	55.2*	18.2*	33.5
Table conc	61.8	67.8	2.0	66.5
Mag conc	27.3	64.4	6.6	27.9
Comb conc	89.1	66.8*	3.4*	94.4

* Calculated

A sample of the minus 150 mesh table tailing was treated by flotation. The pulp was made alkaline with NaOH and conditioned for 5 minutes at pH 10.0 with 4 lb. of Amioca starch per ton and 0.64 lb. of dodecylamine hydrochloride per ton. After conditioning for 5 min, 0.05 lb. of methyl isobutyl carbinol per ton was added and silica was floated for 5 min. The results of the test are shown in Table 7.

Table 7

Results of Tabling and Flotation Test 6

Product	Weight % Original ore	Analysis % Sol Fe	Analysis % SiO_2	Distribution % Sol Fe
Tabling				
Table conc	61.8	67.8	2.0	66.8
Table tailing	38.2	54.6*	19.1*	33.2
Feed	100.0	62.8*	8.2*	100.0
Flotation				
SiO_2 float	11.7	29.6	55.0	5.5
Fe conc	26.5	65.7	3.2	27.7
	38.2	54.6*	19.1*	33.2
Table conc	61.8	67.8	2.0	66.8
Flotation Fe conc	26.5	65.7	3.2	27.7
Comb Fe conc	88.3	67.2*	2.4*	94.5

* Calculated

High Intensity Wet Magnetic Separation Tests

Jones wet magnetic separator tests were made at 10.0 amps with ore stage-ground to minus 100 mesh, minus 150 mesh, and minus 250 mesh. A test was also made at 15.0 amps on ore ground to minus 250 mesh the middlings were repassed to increase the overall Sol Fe recovery. The results of the tests are shown in Table 8.

Table 8

Results of Jones Magnetic Separator Tests

Test 7. Minus 100 mesh, 10.0 amp

Product	Weight % Original ore	Analysis % Sol Fe	Analysis % SiO_2	Distribution % Sol Fe
Mag conc	77.7	67.1	2.9	82.8
Middling	14.1	52.7	21.3	11.8
Non mag tailing	8.2	41.1	34.4	5.4
Feed (calcd)	100.0	62.9	8.1	100.0

Test 8. Minus 150 mesh, 10.0 amp

Product	Weight % Original ore	Analysis % Sol Fe	Analysis % SiO_2	Distribution % Sol Fe
Mag conc	69.1	67.5	2.1	74.5
Middling	18.1	55.9	17.5	16.1
Non mag tailing	12.8	45.9	30.0	9.4
Feed (calcd)	100.0	62.6	8.5	100.0

Test 9. Minus 250 mesh, 10.0 amp

Product	Weight % Original ore	Analysis % Sol Fe	Analysis % SiO_2	Distribution % Sol Fe
1st Mag conc	76.0	67.9	2.1	82.0
2nd Mag conc	6.8	64.1	7.3	6.9
2nd Middling	2.6	33.9	45.9	1.4
1st Non mag tailing	11.0	43.5	33.3	7.6
2nd Non mag tailing	3.6	37.1	40.1	2.1
Feed (calcd)	100.0	63.0	8.4	100.0
Comb 1st and 2nd mag conc	82.8	67.6	2.5	88.9

Test 10. Minus 250 mesh, 15.0 amp

Product	Weight % Original ore	Analysis % Sol Fe	Analysis % SiO_2	Distribution % Sol Fe
1st Mag conc	79.9	67.5	2.5	86.1
2nd Mag conc	4.6	62.1	9.0	4.6
2nd Middling	2.6	30.5	49.1	1.3
1st Non mag tailing	10.2	41.3	35.4	6.7
2nd Non mag tailing	2.7	31.1	48.4	1.3
Feed (calcd)	100.0	62.6	8.6	100.0
Comb 1st and 2nd mag conc	84.5	67.2	2.9	90.7

Silica Flotation. Test 11

A sample of ore was ground to minus 150 mesh and a number of silica flotation tests were made. The best results were obtained when the pulp was conditioned for 5 min. with 4 lb. of Amioca per ton at pH 10.0; 2.5 lb. of Armeen L-11 per ton was then added, and, after 2 minutes conditioning, silica was floated for 8 min. The silica rougher float was cleaned without reagent additions to produce a silica cleaner float and a middling. The results of the test are shown in Table 9.

Table 9

Test 11, Silica Flotation of Minus 150 Mesh Ore

Product	Weight % Original ore	Analysis %		Distribution %
		Sol Fe	SiO_2	
SiO_2 cleaner float	10.2	28.7	56.0	4.7
Middling	7.7	62.8	8.4	7.7
Fe product	82.1	67.0	2.5	87.6
Feed (calcd)	100.0	62.8	8.4	100.0

The combined Fe product and middling would give a product containing 66.6% Sol Fe and 3.0% SiO_2 with a Sol Fe recovery of 95.3%.

CONCLUSIONS

The results show that the sample of high grade massive hematite ore can be upgraded by either gravity separation, high intensity wet magnetic separation, or flotation.

Gravity concentration of the ore ground to minus 65 mesh produced an iron concentrate containing 2.8% SiO_2, 67.0% Sol Fe, with a Sol Fe recovery of 78.7%

High intensity wet magnetic concentration of the ore ground to 250 mesh produced a concentrate which contained 2.9% SiO_2, 67.2% Sol Fe, with a Sol Fe recovery of 90.7%.

Flotation of the ore ground to 150 mesh and the silica floated produced an iron concentrate which contained 3.0% SiO_2 66.6% Sol Fe with 95.3% Sol Fe recovery. Reagent costs would be high so the feasibility of flotation would depend on further testing.

Gravity separation combined with flotation of the gravity tailing after it was ground to minus 150 mesh produced a combined concentrate containing 2.4% SiO_2, 67.2% Sol Fe with a Sol Fe recovery of 94.5%. Gravity separation combined with high intensity wet magnetic concentration of the gravity tailing after grinding to minus 150 mesh produced a combined concentrate containing 3.4% SiO_2, 66.8% Sol Fe with a 94.4% Sol Fe recovery.

All methods investigated produced acceptable grades of iron concentrates. The best overall results were obtained by the combination gravity plus flotation test with flotation the best of the individual methods tested although cost would be high.

ACKNOWLEDGEMENTS

The writers wish to acknowledge the contribution to this investigation by the following members of the staff of the Mineral Sciences Division: W. Petruk who carried out the mineralogical examination, D.P. Palombo for the spectrographic analysis, L. McCorriston, J. Hale, E. MacEachern, and E. Mark for the chemical analysis. Acknowledgement is also made to J. Banks, senior technician who carried out the tabling and magnetic separation tests.

019057

Ontario Research Foundation

Department of Engineering and Metallurgy

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Progress Report No. 1
Investigation No. O-66308

Pelletizing and Reduction
of Concentrates

Pacific Giant Steel Ores Ltd
Whitehorse, Yukon

F. EVERARD

May 27th, 1966

ONTARIO RESEARCH FOUNDATION

Department of Engineering and Metallurgy

Progress Report No. 1

Investigation No. 0-66308

Pelletizing and Reduction of Concentrates

Pacific Giant Steel Ores Limited

Introduction

An additional 80 pounds of Pacific Giant Steel Ores Limited mixed grain iron ore which contained about 9:1 hematite to magnetite, was sent to the Ore Dressing Division of the Ontario Research Foundation. The following tests were requested:

1. Petrographic examination of the ore and diamond cut pieces
2. Concentration tests to furnish pellet feed
3. Green pellet tests
4. Fired pellet tests
5. Reduction test
6. Tumble Index test

Summary of Results

The petrographic examination of the raw ore has already been forwarded. Concentration tests were a duplicate of the original tests done by Eriez magnetics. Concentrate grade was 67.3% total iron at approximately 84% -200 mesh.

Physical characteristics of the green and dried pellets were good. The compressive strength of the fired pellet was average but the hot strength was slightly below average. Decrepitation was low on the Tumble Index test and the reduced pellet assayed 87.4% total iron.

As the reduction test was on a single batch of fired pellets, we suggest more reduction tests to establish the effect of variables.

Details of Test Results

(1) Concentration Tests

Approximately 80 pounds of raw ore were ground for wet high intensity concentration on an Eriez Magnetic Separator. The ore was not only ground to achieve liberation but also for making pellets. The screen analyses of the concentrate was as follows:

+200 mesh	16.6%
-200 +325M	21.0%
-325M	62.4%

For further particulars on the wet magnetic separation, we suggest you contact Eriez Magnetics. The chemical analyses of the concentrate was 67.3% total iron.

(2) Pelletizing Tests

The concentrate was balled in a batch pelletizer using 0.75% by weight of Western bentonite as a binder. The moisture content of the green pellets was 8.4%.

(3) Pellet Physical Tests

(a) Green Pellet - Drop Test

An average of 7.4 drops from a 12" height was obtained for the green pellets. This is considered satisfactory.

(b) Green Pellet - Compression Test

The green pellets averaged 2.8 pounds under compression loading before breaking. This rating, as compared to other pellets, is acceptable.

(c) Dried Pellets - Drop Test

All green pellets were oven dried for 16 hours. The dried pellets averaged 3.0 drops from a 12" height and are rated as acceptable.

(d) Dried Pellets - Compression Test

The dried pellets averaged 10.0 pounds under compression before breaking. This is very satisfactory.

(4) Fired Pellets

A batch of dried pellets was fired on a 3 hour cycle; a firing temperature of 2350°F was maintained for 1 hour. The compressive strength of the fired pellets averaged 650 pounds with a low of 550 pounds and a high of 820 pounds. This is average for a good iron ore pellet. A hot strength test of the pellets indicated a strength of 100 lbs. at 1600°F in a $3CO_2$:1CO atmosphere. This is a marginal rating for this test.

(5) Reduction Test

A small batch of pellets was fired for 1 hour at 2350°F in a closed Inconel box. The temperature was kept constant and a flow of natural gas was run through the pellets. Approximately 40 cubic feet per hour of natural gas was used for 90 minutes. At this temperature the natural gas was partially cracked and some carbon deposition occurred. Due to the size of the bed (6" x 12") it was not possible to obtain an even flow of natural gas through all the pellets, therefore the degree of reduction was not the same for all areas. The pellets best exposed to the gas flow were almost completely reduced. An average grade of 87.4% total iron was obtained for the reduced pellets.

(6) Tumble Index Test

A modified tumble index machine using the Dravo method gave a Dravo Tumble Index of 96.8%. This represents 3.2% fines produced by tumbling action and is marginal for pellets.

Recommendations

(1) Due to marginal results on the tumble index and hot strength tests, a further lot of pellets should be made on a larger scale, i.e. 100-200 lbs. by use of a pelletizing cone. In doing so it would be advisable to increase specific surface by aiming for a grind of + 70% -325 mesh and to raise the firing temperature to 2400°F using two stage firing due to the high hematite content. Hot strength should be rated by the Linder test which is now

widely accepted, and further tumble tests run by the Dravo method.

(2) A thorough study of the semi-reduction of pellets with natural gas is required. This should establish a) the method of reduction, b) relationship of residence time for 70-80% reduction to temperature and flow rates, c) fuel efficiency, d) carbon pick up by the pellets and e) general cost figures.

Test Work by:

J. Biskupski

Reference:

O.D.S. Notebook #31

F. Everard

F. Everard, P.Eng.,
Assistant Director,
Department of Engineering
and Metallurgy.

p.p. R.H.

FE:rh

019057

Ontario Research Foundation

Department of Engineering and Metallurgy

43 QUEEN'S PARK CRESCENT EAST TORONTO 5, CANADA

TELEPHONE 924-6201

Investigation No. 0-66308

<u>Progress Report No. 3</u>

Pellet Tests

Pacific Giant Steel Ores Ltd.
Whitehorse, Yukon

F. EVERARD

July 26th, 1966.

ONTARIO RESEARCH FOUNDATION

Department of Engineering and Metallurgy

Investigation No. 0-66308

Progress Report No. 3 - Pellet Tests

Pacific Giant Steel Ores Ltd.
White Horse, Yukon.

Introduction:

As recommended from previous results obtained on physical properties of pellets, additional regrinding of the iron ore concentrates and pellet flux addition was done to improve the physical characteristics of the pellets.

Conclusions:

With the finer grinding of concentrates, compression strength of the green and dry pellets improved even though the fired strength remained about the same. There was a huge improvement, however, in the Dravo Tumble Index of the fired pellets; it being decreased from over 3.0% to 0.68%.

Fluxing the pellets with 5% limestone and 0.75% bentonite remarkably increased the compression strength of the fired pellets to 1265 pounds. The Dravo Tumble Index was also greatly improved to a low 0.32% loss of fines at -28 mesh.

The reduced pellets assayed 76.4% iron.

Recommendations:

Better and more complete reduction of the fired pellets should be done using natural gas. Methods for reducing with natural gas should be evaluated.

Procedure and Results:

In order to improve the physical characteristics of the pellets, the concentrate from magnetic separation was reground to approximately 85% -325 mesh.

Size Structure of Reground Concentrate

+200 mesh	nil
+325 mesh	15.6
-325 mesh	84.4

Chemical Analyses of Concentrate

Total Iron	= 66.5%
SiO_2	= 3.24%
CaO	= 0.02%
$MgO + Al_2O_3$	= 0.20%

Table I

Physical Properties of Pellets containing 0.75% Bentonite

Moisture -	8.1%	
Green Strength -	12" Drops:	+10
	Compression:	3.45 lbs.
Dry Strength -	12" Drops:	2.9
	Compression:	12.87 lbs.
Fired Strength -	1 hour at 2350°F	
	Compression:	684 lbs.
Dravo Tumble Index	-28 mesh = 0.68%	

Table II

Self Fluxing Pellets

For self fluxing pellets, 5% limestone was added to the pellet mix with 0.75% bentonite as a binder.

Moisture -	8.3%	
Green Strength -	12" drops:	+10
	Compression:	3.58 lbs.
Dry Strength -	12" drops:	2.0
	Compression:	9.75 lbs.
*Fired Strength -	Compression:	1265 lbs.
Dravo Tumble Index -	-28 mesh fines = 0.32%	

* 1 hour at 2350°F.

Reduction Tests:

For the reduction tests a 7" x 7" cylindrical container was cast from a high temperature refractory. A ceramic grating was inserted in the bottom of the cylinder to allow for free gas flow.

Two pounds of fired pellets were heated to 2250°F. After temperature was reached, natural gas at the rate of 0.3 cuft/min/pound was passed through the pellets. The natural gas was cracked in an Inconel tube leading to the reduction pot. The test had to be terminated after 40 minutes, as the Inconel would not stand the highly reducing atmosphere. The pellets were then cooled in a nitrogen atmosphere but some slight re-oxidation occurred. Examination of the pellets showed that cracking and reduction was not complete. Most of the pellets had a shell of metallic iron on the surface but the cores showed non-reduced hematite. Chemical analyses of the reduced pellets was 76.4% iron.

For more complete reduction, a longer time will be required. A slightly lower reduction temperature seems advisable and separate furnace or ceramic tube section to crack the natural gas should be used for any further reduction tests.

F. Everard, P.Eng.,
[illegible]
Department of Engineering
and Metallurgy.

References:

Test-work by J. Biskupski
O.D.S. Book #31

FE:rh

21037

Ontario Research Foundation

Department of Engineering and Metallurgy

43 QUEEN'S PARK CRESCENT EAST TORONTO 5, CANADA

TELEPHONE 924-6201

Report of
Investigation 0-66308

Mineralogical Report on
Yukon Iron Ore

Pacific Giant Steel Ores Ltd.,
Whitehorse, Yukon, N.W.T.

F. EVERARD

August 5th, 1966

YUKON IRON ORE

The following is a series of photographs made from a slab of iron ore and from a thin-section and a polished section of the same material. They illustrate the texture of the material and the relationships of the minerals comprising it.

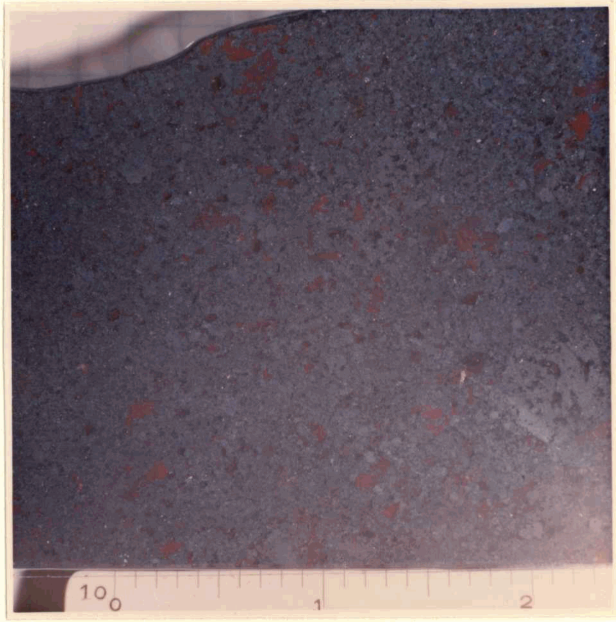
The fragmental nature of the minerals, especially of the hematite, is apparent. The hematite shows best in the polished section where, because of its high reflectability, it stands out from all the rest of the minerals. It can be seen that there is a uniformity in the size of the grains and that they are preserving their original clastic shape.

There is no development of a new metamorphic texture nor have any metamorphic minerals been produced. There is no sign in the thin section of the jasper undergoing considerable recrystallization as it still preserves its strong red reflectability in the thin section and there are no signs of the highly coloured, usually bright green, iron silicates which would be produced.

Some grains of clear quartz (white in transmitted light and grey in the polished section) may be originally detrital quartz or may be chert recrystallized to quartz. They do have a detrital look (in the polished section - photograph lower left and upper left, and grey) and seem to be angular grains. At the upper left of the polished section photograph there is a sharp boundary between one of these grains and a jasper grain (grey, speckled with white hematite).

F. Everard, P.Eng.,
Assistant Director,
Department of
Engineering and Metallurgy.

August 5th, 1966.
FE:rh



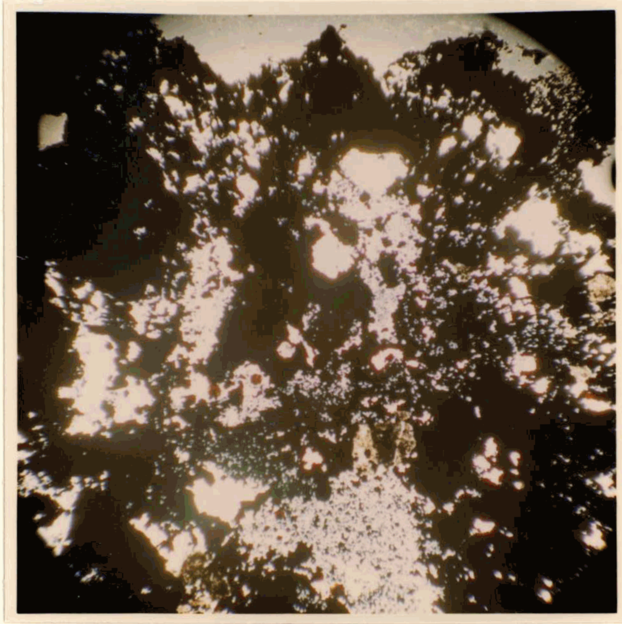
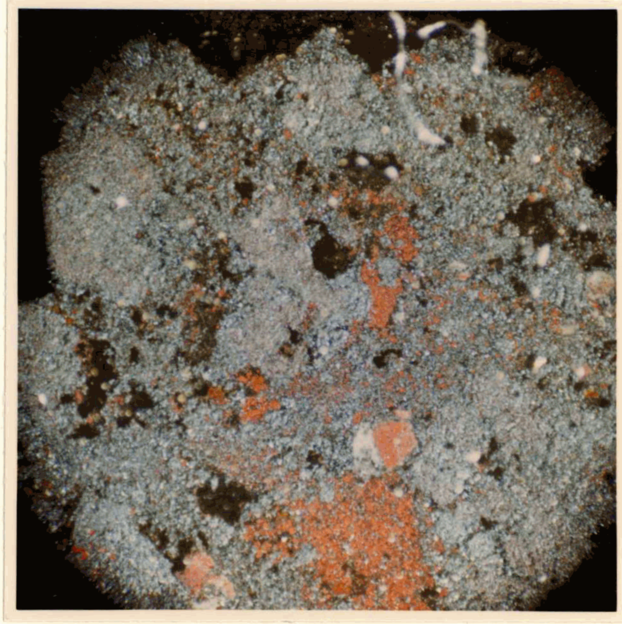
Slab of Iron Ore, natural size

Red: - - - Jasper or jaspilite fragments

Blue-grey: Massive hard hematite

Black: - - Voids

(Surface of the slab is rough ground and was photographed through a thin film of water behind glass).

Photomicrographs of thin-section. 40X. Both pictures are of the same field and of the same magnification.

Left: by transmitted light

Right: by reflected light

Transmitted light (left)

Black .... massive hematite

Red .... thin edges of massive hematite

White .... voids

(White with .... jasper (large area near bottom)
(speckled appearance

Yellow .... mica or sericite (some hematite inclusions)

White area midway between centre and left edge is quartz.

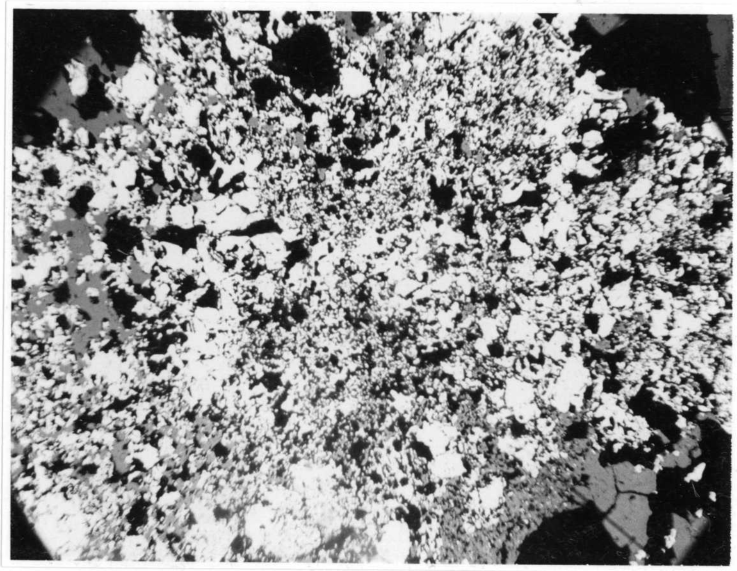
Reflected light (right)

Blue-grey .... hematite (speckled appearance due to the grinding of the thin section)

Red .... jasper or jaspilite

Black .... voids

Dark grey .... quartz



Photomicrograph of polished section
About 40X

White .... hematite
Grey .... silicate gangue
Black .... voids

(The grey areas bottom right and at top left are of jasper or partly re-crystallized jasper to quartz carrying disseminated hematite).

Ontario Research Foundation

43 QUEEN'S PARK CRESCENT EAST TORONTO 5, CANADA

TELEPHONE 924-6201

Petrographic Analysis

O.R.F. No. 0-66308 (Bear River Ore)

In a hand specimen the massive ore has a high specific gravity and is obviously fragmental, consisting of coarse fragments up to 5 mm long, slightly porous and quite inhomogeneous.

I The Thin Section Shows:

Hematite
Quartz and Jasper
Sericite and some coarser muscovite
magnetite
Lemcoxene

The material consists of angular to subrounded detrital fragments of:

(1) Jaspilite or jasperized fine grained recrystallized chert.

(2) Hematite free or relatively hematite free recrystallized chert.

(3) Sericitic ferruginous slate or argillite which consists of about 70% mica 25% quartz and minor hematite.

(4) Massive dense hematite in a matrix of fine grained quartz and hematite.

There are a few patches of lemcoxene, probably after ilmenite.

The material is an accumulation of detrital fragments which have suffered very short transportation. The nature of the material suggests derivation from a fairly normal series of iron formations, ferruginous cherts and ferruginous slates or greywackes.

The degree of metamorphism is very low as there are no signs of iron silicates being formed from reaction between hematite and quartz, furthermore the amount of recrystallisation of the quartz is slight. The material is mainly hematite with little magnetite.

II The Ore Slab
Showing banding in the hand specimen contains:

Quartz
Hematite and Magnetite
Sericite and white mica
Cummingtonite - Grunerite
Hedenbergite

The rock consists of patches and ill defined bands mainly of quartz and hematite. The quartz grains are in a mosaic looking like recrystallized chert and vary in coarseness all the way up to 75 or 100 microns. These are commonly in patches up to 1 mm in diameter.

The hematite is also in a mosaic of grains and clusters or patches grains like the quartz.

There are patches (altered sedimentary fragments) of much finer grained quartz, still cryptocrystalline, containing a dusting of hematite. There are patches of partly recrystallized greywacke or argillite consisting of quartz and sericite with minor amounts of fine dusty hematite (these and the cherty patches look jasper red by reflected light).

The iron silicates cummingtonite - grunerite are present in small amount (less than 1%) occur as small clusters of radiating flakes disseminated through the rock and show no preference for patches or undifferentiated quartz-hematite matrix. The iron rich pyroxene hadenbergite is present as ill forred patches mainly in the finer grained quartz hematite mixture.

All of the silicates with the exception of quartz are present in insignificant amounts.

III General

There seems to be little to indicate a relationship between the materials in the two samples. The banded material seems to be a fairly normal iron formation, moderately metamorphosed to the extent of recrystallizing the chert to granular quartz and the primary iron oxide to hematite but insufficient to derive much magnetite. Some iron silicates have developed, probably at the locus of some alumina rich alkali rich detrital grain in the original sediment.

The coarse granular ore seems to have developed from some pre-existing ferruginous sediment by weathering and transportation of the fragments, and there seems to have been very little recrystallization subsequent to deposition.

Because the material contains a very small magnetic fraction there is possibly some magnetite or maghemite present. This was looked for but could not be seen in the polished section. It is possibly therefore either too fine grained or intergrown with the hematite. No magnetite is present in the coarser hematite masses. The amount of magnetite must be very small as the gross magnetic properties of the massive ore are negligible.

F. Everard, P.Eng.,
Assistant Director,
Department of
Engineering and Metallurgy.
Ontario Research Foundation

FE/gb

April 29, 1966

T S L

ASSAYERS
CHEMISTS
GEOCHEMISTS

Laboratories Limited

325 HOWE STREET - VANCOUVER 1, B.C.
TELEPHONE 684-1374

CERTIFICATE OF ANALYSIS

SAMPLE(S) FROM PACIFIC GIANT STEEL ORES LTD.,

REPORT NO. V - 22

3 SAMPLE(S) OF pulp

	Phosphorus (P)	Sulphur (S)	Titanium (Ti)
BR - I - 1	0.078%	0.037%	0.11%
BR - I - 2	0.078%	0.020%	0.08%
Concentrate	0.039%	0.045%	0.07%

DATE February 18, 1966

SIGNED [signature]
Provincial Assayer.

Department of Mines and Technical Surveys
Ministère des Mines et des Relevés techniques
MINERAL PROCESSING DIVISION

Mines Branch
Direction des mines

File Number
N° d rapport

40 Lydia Street,
Ottawa 1, Ontario,
March 11, 1966.

Pacific Giant Steel Ores Ltd.,
P.O. Box 1039,
Whitehorse, Yukon.

Dear Mr. Jellinek:

With reference to your letter of February 26 regarding results of additional beneficiation tests on the iron ore from your Bear River, Yukon property we have completed tests treating the ore with a Jones high intensity wet magnetic separator and by flotation. Our investigation is now completed and we are preparing a formal report which we will forward to you when completed.

The following are results from these tests.

Jones magnetic separator tests on ore ground to minus 250 mesh. Separator was operated at 15 amps and the middling returned.

Product	Wt %	Analysis % Sol Fe	Analysis % SiO_2	Recovery % Sol Fe
1st Magnetic conc	79.9	67.7	2.5	86.1
2nd Magnetic conc	4.6	62.1	9.0	4.6
2nd Middling	2.6	30.5	49.1	1.3
1st Non-Mag. tailing	10.2	41.3	35.4	6.7
2nd Non-Mag. tailing	2.7	31.1	48.4	1.3
Feed	100.0	62.6*	8.6*	100.0

*Calculated

Silica flotation tests on ore ground to minus 150 mesh.

Product	Wt %	Analysis % Sol Fe	SiO_2	Recovery % Sol Fe
Iron product	82.1	67.0	2.5	87.6
Middling	7.7	62.8	8.4	7.7
Silica float	10.2	28.7	56.0	4.7
Feed	100.0	62.8*	8.4*	100.0

*Calculated

Yours very truly,

G. W. Riley
Ferrous & Less Common Minerals Section

GWR:rlm

C. EMERSON NOBLE
CHEMICAL ENGINEER
DIRECTOR INDUSTRIAL LABORATORIES
PROVINCIAL ANALYST

EDMONTON, ALBERTA
CANADA

May 26, 1966

Report of Analysis

SAMPLE OF Iron Ore

SUBMITTED BY Pacific Giant Steel Ores Limited, Box 1039, Whitehorse, Yukon

LABORATORY NUMBER 66 - 5576, 77 & 78

	Mines Branch Test 13 Gravity Concentrate	Mines Branch Test 26 Magnetic Concentrate	Mines Branch Test 228 B Flotation Concentr
Iron (soluble)	63.32 %	64.72 %	66.69 %
Silica	2.17 %	2.22 %	2.22 %
Phosphorous	0.02 %	0.01 %	0.06 %
Sulfur	0.17 %	0.21 %	0.12 %
Titanium	trace	trace	trace
Manganese	nil	nil	nil
Calcium Oxide	0.29 %	0.29 %	0.28 %
Magnesium Oxide	0.10 %	0.11 %	0.10 %
Alumina	2.93 %	2.65 %	1.39 %

The test for "Iron (soluble)" was done on a sample which was dissolved overnight in dilute Hydrochloric Acid. If this was not the procedure required, please advise.

O.K.

C. Emerson Noble
Director
Industrial Laboratories
Per:

CEN:pm

C. EMERSON NOBLE
CHEMICAL ENGINEER
DIRECTOR INDUSTRIAL LABORATORIES
PROVINCIAL ANALYST

EDMONTON, ALBERTA
CANADA

July 13, 1966

Report of Analysis

SAMPLE OF Iron Ores (3)

SUBMITTED BY Pacific Giant Steel Ores Ltd., Box 1039, Whitehorse

LABORATORY NUMBER 66-5576-8

As requested the alumina content of the following ores has been checked. Originally the alumina was determined by an indirect method. By direct method (cupferron) the values are as follows:

	Alumina
Test #13	0.40%
Test #26	0.56%
Test #228B	0.35%

K. Strausz
Kathleen Strausz

Assistant Provincial Analyst

KS:kjw

Department of Mines and Technical Surveys
Ministère des Mines et des Relevés techniques

CANADA

Mines Branch
Direction des mines

File Number
Nº à rappeler

MINERAL PROCESSING DIVISION

40 Lydia Street,
Ottawa 1, Ontario.
22 March 1966.

Pacific Giant Steel Ores Ltd.,
P. O. Box 1039,
Whitehorse, Yukon.

Attention: Mr. A. Jellinek, Managing Director

Dear Mr. Jellinek:

In reply to your letter of March 18 we are pleased to enclose a copy of Report No. SL 64-198 showing the results of a semi-quantitative spectrographic analysis on a head sample of your Bear River ore.

We are now arranging for semi-quantitative spectrographic analyses on the magnetic and flotation iron concentrates and we will forward the results to you when they are available. The chemical analyses of these iron concentrates would take some time and we suggest that the analyses be made by a commercial firm as was done previously with the gravity concentrates.

Regarding the test programme for pelletising and subsequent preparation of prereduced pellets and sponge iron this work is carried out by the Extraction Metallurgy division of the Mines Branch and information concerning this stage of the test programme should be addressed directly to Dr. K. W. Downes, Chief, Extraction Metallurgy Division, 300 LeBreton Street, Ottawa.

Yours truly,

G. W. Riley,
Ferrous and Less Common Minerals Section.

GWR/le

Samples: Head Sample

Submitted by: G.W. Riley, M.P.D.

SPECTROGRAPHIC LABORATORY
MINES BRANCH, OTTAWA, CANADA

SEMI-QUANTITATIVE SPECTROGRAPHIC ANALYSIS

Report No. SL 64-198

Plate No. 456

Date Dec. 10 19 64

Sgd. D. P. Palombo

Description of Samples	Si	Mn	Mg	Cr	Fe	Al	V	Ca	Mo	Cu	Ti	Ni	Co
S553	PC	0.04	0.2	0.03	PC	0.2	0.04	0.26	0.04	0.04	0.01	0.12	0.06

ELEMENTS—Per cent

CANADA

Nº à rappeler

MINERAL PROCESSING DIVISION

40 Lydia Street,
Ottawa 1, Ontario.
4 April, 1966.

Mr. A. Jellinek,
Managing Director,
Pacific Giant Steel Ores Ltd.,
P. O. Box 1039,
Whitehorse, Yukon.

Dear Mr. Jellinek:

Further to our letter of the 22nd March we are pleased to attach a copy of Report No. SL 66-040 showing the results of semi-quantitative spectrographic analysis on the gravity, magnetic and flotation iron concentrates.

Yours truly,

G. W. Riley,
Ferrous and Less Common Minerals Section.

GWR/le
Encl.

Samples: Fe Concentrate Test 13
Pacific Giant Steel

Submitted by: G.W. Riley,
Fuels

SPECTROGRAPHIC LABORATORY
MINES BRANCH, OTTAWA, CANADA

SEMI-QUANTITATIVE SPECTROGRAPHIC ANALYSIS

Report No. SL. 66-040
Plate No. 582
Date: Mar. 28 1966
Sgd. [illegible]

Description of Samples	Elements—Per cent								
	Mn	Al	Mg	Pb	Si	Fe	V	Cu	Ti
S-106 Test #13 Gravity conc	0.02	0.05	0.04	0.02	1.2	PC	0.005	0.01	0.06
S-107 Test #26 Magnetic Conc.	0.02	0.04	0.03	0.01	0.65	PC	0.005	0.005	0.07
S-108 Test #228B Flotation conc.	0.02	0.04	0.02	ND	1.2	PC	0.005	0.01	0.06

Department of Mines and Technical Surveys
Ministère des Mines et des Relevés techniques

Mines Branch
Direction des mines

File Number
Nº à rappeler

Mineral Processing
Division

40 Lydia Street,
Ottawa 1, Ontario,
May 3rd, 1965.

Mr. Leverman,
Pacific Giant Steel Ores Ltd.,
P.O. Box 1039,
Whitehorse, Yukon.

Dear Mr. Leverman:

Further to our telegram of March 12th, 1965, in which we gave results of a preliminary beneficiation test on the sample of high grade ore submitted, we have now completed and calculated the results of additional tests.

Gravity concentration tests using a shaking table were made on samples crushed both to minus 28 mesh and minus 65 mesh. Results of the tests showed that the minus 28 mesh material produced table concentrates averaging 64.1% Fe and 5.98% SiO_2 with an 85.5% Fe recovery. The sample crushed to minus 65 mesh produced table concentrates averaging 67.36% Fe and 2.32% SiO_2 with a 69.9% iron recovery. The middling and tailing from this test were passed through a Jones high intensity wet magnetic separator after grinding to minus 100 mesh. The concentrate from the magnetic separator together with that from the table gave a combined concentrate averaging 66.39% Fe and 3.38% SiO_2 with overall iron recovery of 91.4%.

We are continuing our investigations and will keep you informed of our progress as results become available.

Yours truly,

G.W. Riley

G.W. Riley,
for L.E. Djingheuzian,
Chief of Division.

GWR:em

CN Telecommunications

send this message subject to the terms on back
dépêche à expédier aux conditions énoncées au verso

to / à: G.R.E. Leverman, Secretary Treasurer, Pacific Giant Steel Ores Ltd.

street and number / numéro, rue: P.O. Box 1039, Whitehorse, Y.T.

care of or apt. number / aux soins de ou: app. numéro

time and date received / heure et date de réception: 9:15 am, Mar. 13/65

place / endroit

PRELIMINARY GRAVITY TEST AT MINUS 65 MESH PRODUCED CONCENTRATE ASSAYING 66 PERCENT IRON, FOUR PERCENT SILICA, AT RECOVERY OF 77 PERCENT OF THE IRON IN THE HIGH GRADE SAMPLE SUBMITTED. ADDITIONAL TEST MADE AT MINUS 28 MESH BUT AWAITING ASSAYS.

L.E. DJINGHEUZIAN, CHIEF, MINERAL PROCESSING
DIVISION, MINES BRANCH, DEPARTMENT OF MINES
AND TECHNICAL SURVEYS, OTTAWA, ONTARIO

check / mots	full rate / plein tarif	day letter / lettre de jour	night letter / lettre de nuit	tolls / coût

charge account no. / numéro du compte — cash number / numéro de caisse

sender's name for reference only / nom de l'expéditeur pour référence seulement

address and telephone / adresse, téléphone

COPY

6101b

C. EMERSON NOBLE
CHEMICAL ENGINEER
DIRECTOR INDUSTRIAL LABORATORIES
PROVINCIAL ANALYST

EDMONTON, ALBERTA
CANADA

April 28, 1965

Report of Analysis

SAMPLE OF Iron Ore (Ottawa sample) Bear River hematite iron ore concentrate by Mines Branch, Ottawa

SUBMITTED BY Pacific Giant Steel Ores Limited, Box 1039, Whitehorse, Yukon

LABORATORY NUMBER 65 - 4162

Iron (Fe)	--	65.88 %
Silica	--	4.37 %
Phosphorous (P)	--	0.03 %
Sulphur (S)	--	trace
Titanium	--	trace
Manganese	--	faint trace
Calcium Oxide	--	0.08 %

C. Emerson Noble
Director
Industrial Laboratories

CEN:pm

C. EMERSON NOBLE
CHEMICAL ENGINEER
DIRECTOR INDUSTRIAL LABORATORIES
PROVINCIAL ANALYST

UNIVERSITY OF ALBERTA
QUAECUMQUE VERA

EDMONTON, ALBERTA
CANADA

April 7, 1965

Report of Analysis

SAMPLE OF Iron Ore (original sample) Raw hematite iron ore, Bear River

SUBMITTED BY Pacific Giant Steel Ores Limited, P.O. Box 1039, Whitehorse, Yukon

LABORATORY NUMBER 65 - 3484

Iron (Fe)	--	57.78 %
Silica	--	8.51 %
Phosphorous (P)	--	0.11 %
Sulphur (S)	--	0.05 %
Titanium	--	trace
Manganese	--	trace
Calcium Oxide	--	0.37 %

Ottawa sample not received to date.

C. Emerson Noble
Director
Industrial Laboratories

CEN:pm

Department of Mines and Technical Surveys
Ministère des Mines et des Relevés techniques

Mines Branch
Direction des mines

File Number
No à rappeler

Extraction Metallurgy
Division

552 Booth St.,
Ottawa, Ont.,
July 5, 1966.

Pacific Giant Steel Ores Ltd.,
P.O. Box 1039,
Whitehorse, Yukon.

Attention: Mr. A. Jellinek,
Managing Director

Subject: Pelletizing Bear River
Hematite Iron Ore

Dear Mr. Jellinek:

The pelletizing tests outlined in our letter to you dated April 25, 1966 have been completed.

Mr. G. Riley, of the Mineral Processing Division, mixed together the small quantities of concentrate that he had obtained from various concentration tests on Bear River Hematite and produced a composite sample weighing about 20 lbs. This composite sample was then divided into four equal samples and each sample was ground to a different degree of fineness in a small ball mill.

Each of the four samples were then blended with 3/4% bentonite and pelletized in laboratory equipment to form green pellets containing about 9% water. The strengths of the resulting pellets were determined, on the green pellets, on pellets that were dried in an oven at 110°C and on pellets that were fired in a muffle furnace at 1300°C. The results of these tests are tabulated below.

.../2

Results of grinding and pelletizing tests
Bear River Hematite

Test No.	Grind expressed as		Compressive Strength for 1/2" pellet (lbs)		
	% -325M	Specific Surface Area cm^2/gm	Green	Dry	Fired
1	58.0	884	0.8	1.3	143
2	71.8	1014	2.1	10.7	428
3	81.5	1230	2.6	13.9	498
4	89.3	1293	3.2	15.0	576

The results of these tests indicate the normal trend where the pellet strength increases as the concentrate is ground finer. The final selection of the grind required will depend on the design of the pellet plant particularly with respect to pellet handling facilities.

We hope that these results are of some assistance to you.

Yours very truly,

G.E. Viens

for K.W. Downes,
Chief of Division.

ERIEZ MAGNETICS

Central Test Laboratory
REPORT OF TEST

Date: December 10/65 Engineering Request: 8175

Test Made For: Pacific Giant Steel Ores Limited

Address Whitehorse, Yukon

City State

Problem:

To remove impurities from hematite iron ore by using high intensity wet separation.

Discussion and Conclusions:

A 25-lb sample of large chunks of hematite iron ore was received for testing on our high intensity wet separator. The sample was processed through our crushing equipment and screened to three fractions (-35 +100, -100 +200, -200) so that we could determine which particle size it would be necessary to crush to achieve complete liberation of hematite.

Prior to processing through our HIW separator, the three samples were processed through our HCB separator at a low voltage to scalp off the highly magnetic particles, such as iron of abrasion. These were packaged as samples and will be returned.

The three samples were processed through the HIW separator at density of 25% solids.

Microscopic examination of the cleaned material indicated a small amount of composite grains were present in the -35 +100 and -100 +200 size fractions. A trace of free silica grains was present in the cleaned materials from each of the three tests. This indicates a very good separation was achieved with a good hematite concentrate.

Analysis of the tested samples will determine the liberation size of the ore, or the most practical size range.

Recommendations:

The customer requested that we pelletize the concentrate, which we are unable to do because of lack of equipment.

With regard to making sponge iron from the concentrate by reduction, we think it would be practical. For further information, we suggest you contact the Dravo Engineering Co, Toronto, Canada, or the Ontario Research Foundation. These organizations are equipped to conduct such tests.

... 2

TEST PROCEDURE

Recommendations:

Our proposal for the plant flow sheet is still the same, that is, primary concentration by the Humphrey Spiral with a final clean-up concentration on the HIW separator. The high concentrate can then be pelletized or directly reduced into sponge or powdered iron.

J W SULESKI
Laboratory Technician
jw

Test #1

2265 gm (-35 +100)

HCB mag scalpings 14.2 gm

HIW @ 230V

Mags	Nonmag	Loss
2009.7 gm	111.2 gm	144.1 gm
88.7%	4.9%	6.36%

Test #2

1205 gm (-100 +200)

HCB mag scalpings 32.8 gm

HIW @ 230V

Mags	Nonmags	Loss
1066.8 gm	112.9 gm	25.3 gm
88.5%	9.4%	2.1%

Test #3

2265 gm (-200)

HCB mag scalpings 33 gm

HIW @ 230V

Mags	Nonmags	Loss
1365.9 gm	867.5 gm	31.6 gm
60.3%	38.4%	1.3%

Ontario Research Foundation

43 QUEEN'S PARK CRESCENT EAST TORONTO 5, CANADA

TELEPHONE 924-6201

February 24, 1966.

Ore Dressing Division,
50 Taber Road,
Rexdale, Ontario.

Mr. A. Jellinek,
Managing Director,
Pacific Giant Steel Ores Ltd.,
P.O. Box 1039,
WHITEHORSE, Yukon.

Dear Mr. Jellinek:

The following Chemical Analyses were done on your Bear River hematite ore as arranged by Mr. J. S. Gatt, of Eriez Canada:

PERCENT

Sample	Total Fe	SiO_2	P	S	TiO_2	Mn	CaO	MgO	Al_2O_3
Raw Ore	63.5	8.22	0.10	0.07	.03	.02	.22	.13	.28
Mag.Fraction Conc.Test 1 Magnetics -35 +100	62.2	8.65	.06	.13	.06	.02	.25	.36	.10
Mag.Fraction Conc.Test 2 Magnetics -100 +200	64.8	7.10	.06	.11	.07	.02	.26	.22	.13
Mag. Fraction Conc. Test 3 Magnetics -200 M	66.3	3.48	.04	.08	.07	.02	.22	.23	.08
Non-Mag. Fraction -35 +100 M	45.5								
Non- Mag. Fraction -100 +200 M	44.3								
Non - Mag. Fraction -200 M	52.2								

SEMI-QUANTITATIVE ANALYSIS

Bear River Hematite Ore
and
Concentrate

Sample Code

I Raw Ore

Concentration Tests 1-2-3 Eriez Magnetics, Lump Ore

II -35 +100 M

Magnetic fraction - Concentration Test 1, Eriez Magnetics

III -100 +200 M

Magnetic fraction - Concentration Test 2, Eriez Magnetics

IV -200 M

Magnetic Fraction - Concentration Test 3, Eriez Magnetics

FE/gb

March 9, 1966.

Chemical Analyses

		% Acid Soluble Iron
I	Raw Ore	63.1
II	-35 +100 M Magnetics	62.1
III	-100 +200 M Magnetics	64.7
IV	-200 M Magnetics	66.3

F. Everard

F. Everard, P.Eng.,
Assistant Director,
Department of
Engineering and Metallurgy.

FE/gb

March 9, 1966.

Ontario Research Foundation

43 QUEEN'S PARK CRESCENT EAST TORONTO 5, CANADA

TELEPHONE 924-6201

March 23, 1966.

Ore Dressing Division,
50 Taber Road,
Rexdale, Ontario.

Mr. A. Jellinek,
Managing Director,
Pacific Giant Steel Ores Ltd,
P.O. Box 1039,
WHITEHORSE, Yukon.

Dear Mr. Jellinek:

I am sorry for the delay in not sending you the assays. Here are the missing analyses:

Sample	% Acid Soluble Iron
-35 +100 mesh non-magnetics	45.5
-100 +200 mesh non-magnetics	44.1
-200 mesh non-magnetics	52.1

Yours very truly,

F. Everard, P.Eng.,
Assistant Director,
Department of
Engineering and Metallurgy.

FE/gb

SEMI-QUANTITATIVE SPECTROGRAPHIC ANALYSIS

	RAW ORE		RAW ORE
Antimony	ND	Phosphorus	ND
Arsenic	ND	Platinum	ND
Barium	.1%	Rhenium	X
Beryllium (BeO)	ND	Rhodium	ND
Bismuth	ND	Rubidium	X
Boron	ND	Ruthenium	ND
Cadmium	ND	Silver	.0001%
Cerium (CeO_2)	ND	Strontium	ND
Caesium	X	Tantalum (Ta_2O_5)	ND
Chromium	.005%	Tellurium	ND
Cobalt	.005%	Thallium	ND
Columbium (Cb_2O_5)	ND	Thorium (ThO_2)	ND
Copper	.02%	Tin	ND
Gallium	ND	Titanium	.05%
Germanium	ND	Tungsten	ND
Gold	ND	Uranium (U_3O_8)	ND
Hafnium	ND	Vanadium	<.01%
Indium	ND	Yttrium (Y_2O_3)	ND
Iridium	ND	Zinc	ND
Lanthanum (La_2O_3)	ND	Zirconium (ZrO_2)	ND
Lead	.002%	ROCK FORMING METALS	
Lithium (Li_2O)	ND	Aluminum (Al_2O_3)	.2%
Manganese	.005%	Calcium (CaO)	.5%
Mercury	ND	Iron (Fe)	Balance
Molybdenum	.005%	Magnesium (MgO)	.05%
Neodymium (Nd_2O_3)	ND	Silica (SiO_2)	5-10%
Nickel	.005%	Sodium (Na_2O)	.1%
Palladium	ND	Potassium (K_2O)	.5-1%

Figures are approximate:

C O D E

H - High	10 - 100% approx.	TL - Trace Low	.05 - .5% approx.
MH - Medium High	5 - 50% approx.	T - Trace	.01 - .1% approx.
M - Medium	1 - 10% approx.	FT - Faint Trace	approx. less than .01%
LM - Low Medium	.5 - 5% approx.	PT - Possible Trace	Presence not certain

ND - Not detected. Elements looked for but not found

X - Not looked for

SEMI-QUANTITATIVE SPECTROGRAPHIC ANALYSIS

	-35 +100 M		-35 +100 M
Antimony	ND	Phosphorus	ND
Arsenic	ND	Platinum	ND
Barium	.1%	Rhenium	X
Beryllium (BeO)	ND	Rhodium	ND
Bismuth	ND	Rubidium	X
Boron	ND	Ruthenium	ND
Cadmium	ND	Silver	.0001%
Cerium (CeO_2)	ND	Strontium	ND
Caesium	X	Tantalum (Ta_2O_5)	ND
Chromium	.005%	Tellurium	ND
Cobalt	.005%	Thallium	ND
Columbium (Cb_2O_5)	ND	Thorium (ThO_2)	ND
Copper	.02%	Tin	ND
Gallium	ND	Titanium	.05%
Germanium	ND	Tungsten	ND
Gold	ND	Uranium (U_3O_8)	ND
Hafnium	ND	Vanadium	<.01%
Indium	ND	Yttrium (Y_2O_3)	ND
Iridium	ND	Zinc	ND
Lanthanum (La_2O_3)	ND	Zirconium (ZrO_2)	ND
Lead	.002%	ROCK FORMING METALS	
Lithium (Li_2O)	ND	Aluminum (Al_2O_3)	.1%
Manganese	.005%	Calcium (CaO)	.2%
Mercury	ND	Iron (Fe)	Balance
Molybdenum	.005%	Magnesium (MgO)	.05%
Neodymium (Nd_2O_3)	ND	Silica (SiO_2)	5-10%
Nickel	.005%	Sodium (Na_2O)	.1%
Palladium	ND	Potassium (K_2O)	.5-1%

Figures are approximate:

CODE

H -	High	10 - 100% approx.	TL	- Trace Low	.05 - .5% approx.
MH -	Medium High	5 - 50% approx.	T	- Trace	.01 - .1% approx.
M -	Medium	1 - 10% approx.	FT	- Faint Trace	approx. less than .01%
LM -	Low Medium	.5 - 5% approx.	PT	- Possible Trace	Presence not certain

ND - Not detected. Elements looked for but not found

X - Not looked for

SEMI-QUANTITATIVE SPECTROGRAPHIC ANALYSIS

	-100 +200 M		-100 +200 M
Antimony	ND	Phosphorus	ND
Arsenic	ND	Platinum	ND
Barium	.1%	Rhenium	X
Beryllium (BeO)	ND	Rhodium	ND
Bismuth	ND	Rubidium	X
Boron	ND	Ruthenium	ND
Cadmium	ND	Silver	.0001%
Cerium (CeO_2)	ND	Strontium	ND
Caesium	X	Tantalum (Ta_2O_5)	ND
Chromium	.005%	Tellurium	ND
Cobalt	.005%	Thallium	ND
Columbium (Cb_2O_5)	ND	Thorium (ThO_2)	ND
Copper	.001%	Tin	ND
Gallium	ND	Titanium	.05%
Germanium	ND	Tungsten	ND
Gold	ND	Uranium (U_3O_8)	ND
Hafnium	ND	Vanadium	<.01%
Indium	ND	Yttrium (Y_2O_3)	ND
Iridium	ND	Zinc	ND
Lanthanum (La_2O_3)	ND	Zirconium (ZrO_2)	ND
Lead	.002%	ROCK FORMING METALS	
Lithium (Li_2O)	ND	Aluminum (Al_2O_3)	.05%
Manganese	.005%	Calcium (CaO)	.1%
Mercury	ND	Iron (Fe)	Balance
Molybdenum	.005%	Magnesium (MgO)	.05%
Neodymium (Nd_2O_3)	ND	Silica (SiO_2)	5%
Nickel	.001%	Sodium (Na_2O)	.1%
Palladium	ND	Potassium (K_2O)	.5-1%

Figures are approximate:

C O D E

H -	High	10 - 100% approx.	TL -	Trace Low	.05 - .5% approx.
MH -	Medium High	5 - 50% approx.	T -	Trace	.01 - .1% approx.
M -	Medium	1 - 10% approx.	FT -	Faint Trace	approx. less than .01%
LM -	Low Medium	.5 - 5% approx.	PT -	Possible Trace	Presence not certain

ND - Not detected. Elements looked for but not found

X - Not looked for

SEMI-QUANTITATIVE SPECTROGRAPHIC ANALYSIS

	-200M		-200 M
Antimony	ND	Phosphorus	ND
Arsenic	ND	Platinum	ND
Barium	.1%	Rhenium	X
Beryllium (BeO)	ND	Rhodium	ND
Bismuth	ND	Rubidium	X
Boron	ND	Ruthenium	ND
Cadmium	ND	Silver	.0001%
Cerium (CeO_2)	ND	Strontium	ND
Caesium	X	Tantalum (Ta_2O_5)	ND
Chromium	.005%	Tellurium	ND
Cobalt	.005%	Thallium	ND
Columbium (Cb_2O_5)	ND	Thorium (ThO_2)	ND
Copper	.001%	Tin	ND
Gallium	ND	Titanium	.05%
Germanium	ND	Tungsten	ND
Gold	ND	Uranium (U_3O_8)	ND
Hafnium	ND	Vanadium	<.01%
Indium	ND	Yttrium (Y_2O_3)	ND
Iridium	ND	Zinc	ND
Lanthanum (La_2O_3)	ND	Zirconium (ZrO_2)	ND
Lead	.002%	ROCK FORMING METALS	
Lithium (Li_2O)	ND	Aluminum (Al_2O_3)	.05%
Manganese	.005%	Calcium (CaO)	.1%
Mercury	ND	Iron (Fe)	Balance
Molybdenum	.005%	Magnesium (MgO)	.05%
Neodymium (Nd_2O_3)	ND	Silica (SiO_2)	5%
Nickel	.001%	Sodium (Na_2O)	.1%
Palladium	ND	Potassium (K_2O)	.5-1%

Figures are approximate:

C O D E

H -	High	10 - 100% approx.	TL -	Trace Low	.05 - .5% approx.
MH -	Medium High	5 - 50% approx.	T -	Trace	.01 - .1% approx.
M -	Medium	1 - 10% approx.	FT -	Faint Trace	approx. less than .01%
LM -	Low Medium	.5 - 5% approx.	PT -	Possible Trace	Presence not certain

ND - Not detected. Elements looked for but not found

X - Not looked for

Executive Office
1455 Woodroffe Avenue
OTTAWA 5, ONT.

Area Code 613
Telephone 224-2173

FERRO-MAGNETICS LTD.

(NO PERSONAL LIABILITY)

21 March 1966

Mr. A. Jellinek
Managing Director
Pacific Giant Steel Ores
P.O.Box 1039
Whitehorse, Yukon.

Dear Mr. Jellinek:

Enclosed please find a proposal for a test programme which we have prepared for your Hematite Ore.

The results of the preliminary tests conducted on same show that a test programme is fully guaranteed to yield a product which can be used for steel making. It will also result in obtaining the necessary data for a commercial operation.

We hope that the said proposal will meet your requirements, and look forward to being of service.

Yours sincerely

FERRO-MAGNETICS LTD.

G.W. Reschke

G.W. Reschke
Metallurgist

R:B

Executive Office
108 David Drive
OTTAWA 5, ONT.

Area Code 613
Telephone 224-2173

FERRO-MAGNETICS LTD.

(NO PERSONAL LIABILITY)

15 March 1966

Mr. Aa Jellinek
Managing Director
Pacific Giant Steel Ores Ltd.
P. O. Box 1039
Whitehorse, Yukon

Dear MR. Jellinek:

By Parcel Post we are sending to you today the products of separation of five preliminary tests conducted on your Hematite material, which we have recorded as sample No. 63.

The following table shows the weight distribution and assays for SiO_2 on the magnetic fractions.

<u>Hematite (Sample No. 63)</u>

TEST NO.	PRODUCTS	PRODUCT NO.	% WT.	% SiO_2
1 Intensity: 5 A Wash water: None Pulse: None	Magnetics Washings Non-magnetics	63-1 63-2 63-3	59.6 5.1 35.3 100.0	3.3
2 Intensity: 10 A Wash water: None Pulse: None	Magnetics Washings Non-Magnetic	63-4 63-5 63-6	85.2 2.8 12.0 100.0	4.6
3 Intensity: 15 A Wash water: None Pulse: None	Magnetics Washings Non-magnetics	63-7 63-8 63-9	90.2 2.0 7.8 100.0	5.9

Hematite (Sample No. 63)

TEST NO.	PRODUCTS	PRODUCT NO.	% WT.	% SiO_2
4 Intensity: 10A Wash water: Med. Pulse: Medium	Magnetics Washings Non-magnetics	63-10 63-11 63-12	72.4 16.5 11.1 100.0	4.3
5 Intensity: 10A Wash water: Heavy Pulse: Heavy	Magnetics Washings Non-magnetics	63-13 63-14 63-15	62.6 26.5 10.9 100.0	3.4

The tests shown above were run on material ground to -48 mesh.

Test Nos. 1 to 3 were conducted at 5, 10, 15 amps in order to find the effect of intensity on recovery.

Test Nos. 4 and 5 were conducted to see the effect of wash water and pulse on the grade of the concentrate, when using an intensity of 10 amps.

The results of these preliminary tests show that a good separation of the hematite can be made. A test programme to investigate thoroughly the variables involved in wet magnetic separation is necessary to reach the conditions under which the best metallurgy will be obtained.

We are now preparing a proposal for a test programme, and will be sent to you for your consideration.

Yours sincerely,

FERRO-MAGNETICS LTD.

J.G. Reschke

J.G. Reschke
Metallurgist

R:V

COLORADO SCHOOL OF MINES RESEARCH FOUNDATION, INC.

GOLDEN, COLORADO 80402

18 May 1966

360501

Mr. A. Jellinek
Pacific Giant Steel Ores Ltd.
P.O. Box 1039
Whitehorse, Yukon

Dear Mr. Jellinek:

Chemical assays of 5 sets of test samples conducted by Ferro-Magnetics Ltd. are as follows:

Test	Sample No.	Fe(soluble) %	SiO_2 %	P %	S %	Ti %
1	63-1 Magnetic	66.3	2.50	0.027	0.113	0.046
2	63-4 "	65.6	3.77	0.035	0.129	0.051
3	63-7 "	65.1	3.85	0.039	0.132	0.055
4	63-10 "	66.4	2.67	0.035	0.140	0.049
5	63-13 "	66.7	2.48	0.031	0.118	0.051
1	63-2 Washings	57.9				
2	63-5 "	52.0				
3	63-8 "	41.7				
4	63-11 "	60.8				
5	63-14 "	61.6				
1	63-3 Nonmag.	56.7				
2	63-6 "	43.8				
3	63-9 "	37.5				
4	63-12 "	42.4				
5	63-15 "	43.6				

Under separate shipment I am airmailing you small vials containing each of the above samples. We are also saving all samples remaining from the assay work and will return to you. The additional copies of the report and the color photographs and explanation of the hand specimen are being finished.

Very truly yours,

James K. Trimble
James K. Trimble
Assistant Manager
Mining Division

/lsj

Executive Office
1455 Woodroffe Avenue
OTTAWA 5, ONT.

Area Code 613
Telephone 224-217

FERRO-MAGNETICS LTD.

(NO PERSONAL LIABILITY)

21 March 1966

PROPOSED TEST PROGRAMME FOR PACIFIC GIANT STEEL ORES
FOR THE EVALUATION OF A HEMATITE ORE
BY TREATMENT WITH THE JONES MAGNETIC SEPARATOR

The suggested procedure is greatly influenced by our past experience in the treatment of hematite ores by the use of the Jones Magnetic Separator and by the results of the preliminary tests previously conducted. An order for testing the variables has thus been compiled. These are listed in order of evaluation. The approximate number of tests and products are shown with each variable. These numbers will vary according to the effect of the variable on the overall scheme. Furthermore, a number of tests must be allowed around the critical settings of each variable.

1. <u>Grind:</u> It is important to determine degree of liberation, in order to improve grade and recovery. Five tests will be conducted at -35, -48, -65, -100, -200 mesh.

   Total Tests: 5

   Total Products: 15

2. <u>Per Cent Solids:</u> This is an important factor as generally it is desirable to operate at as high a per cent solids figure as possible. Tests will be conducted between a range of 5 per cent to 45 per cent solids.

   Total Tests: 9

   Total Products: 27

3. <u>Feed Rate:</u> To determine the optimum amount of material passing through the plates in every cycle.

   Total Tests: 10

   Total Products: 30

4. Intensity: Tests at several intensities. Usually low intensities are required to produce a separation. However, the finer the particle size the higher the intensity needed for separation.

Total Tests: 7

Total Products: 21

5. Plates: Tests will be conducted using chromed plates. Try the mild steel salient pole plates and high extraction plates. Two tests on each.

Total Tests: 6

Total Products: 18

6. Wash Water: Tests will be run from zero to heavy wash.

Total Tests: 8

Total Products: 24

7. Pulse: Tests will be run from 0 to heavy pulse.

Total Tests: 8

Total Products: 24

8. Correlation: From study of the test data a few tests will be necessary to combine the optimum conditions for each variable. Allow ten tests for this.

Total Tests: 10

Total Products: 30

TABULATION OF WORK INVOLVED

VARIABLE	NUMBER OF TESTS	NUMBER OF PRODUCTS
Grinding	5	15
Per cent solids	9	27
Feed rate	10	30
Intensity	7	21
Plates	6	18
Wash water	8	24
Pulse	8	24
Correlation	10	30
Totals	63	189

RESULT OF TEST PROGRAMME:

Such test work as outlined will:

a) result in the best separation possible being obtained on the lab/pilot plant unit.

b) indicate degree of separation obtainable on commercial machine.

c) determine settings for the commercial unit.

COST:

A charge of two thousand dollars ($2,000.00) will be made for the complete programme (excluding assays).

CHEMICAL ASSAYS:

Although 189 products are contemplated it will not be necessary to assay all of these. Considerable information can be obtained from the per cent weight removals and visual examination. It is estimated that the number of assays required will be as follows:

Element or Compound	No. of Assays
Fe	129
SiO_2	5
P	5
S	5
CaO	5
Al_2O_3	5
TiO_2	5
Mn	5

Our laboratory has facilities to perform such chemical assays. If undertaken by ourselves, there will be a charge of $552.00 (five hundred and fifty two dollars)

Alternative ways are:

a) To return the products of separation to yourselves for evaluation.
b) To have a custom laboratory do the work.

However, a considerable saving in time will result in the case of our laboratory undertaking the said assay work.

TIME SCHEDULE:

Estimated completion time of test programme from receipt of order is three months.

REPORT:

A report on the investigation will be delivered approximately one month after the termination of test programme.

This report will include:

a) Evaluation of results
b) Recommended machine for commercial operation
c) Flow sheet.

TERMS OF PAYMENT:

One third after 2 months
One third after 3 months
Balance on delivery of report

MATERIAL NEEDED:

About 100 lbs. of material will be needed for such an evaluation. This should be sent to our Ottawa address.

FERRO-MAGNETICS LTD.

G.W. Reschke
Metallurgist

DATE Oct 17th 1965

FILE NO 2550-15

ASSAY CERTIFICATE

WHITEHORSE ASSAY OFFICE

P.O. BOX 346, WHITEHORSE, YUKON

RECEIVED FROM Mr. A. Jellinek, Pacific Giant Steel Ores Ltd.

SAMPLE NO.	GOLD Oz. Per Ton	SILVER Oz. Per Ton	Iron	Silica (SiO2)		Insol.		
B.P.I. 1			63.4	5.92		I.04		
2			66.0	3.72		.24		
3			62.5	6.24		.60		
4			55.6	7.40		8.52		
5			57.0	7.I2		7.72		
6			65.5	2.88		.28		
7			62.5	6.68		.52		
8			63.2	6.44		.76		
9			I6.5	43.96		2I.8		
I0			44.8	I9.66		I2.I4		
II			37.8	33.8		3.20		
I2			27.6	43.I		6.I4		
I3			46.8	I7.76		6.I6		

ASSAYER

Bear River iron ore
samples from trenches
and heavy outcrop zones

ASSAY CERTIFICATE

DATE Oct 6th 1966

FILE NO. 3354-3

WHITEHORSE ASSAY OFFICE

P.O. BOX 346. WHITEHORSE, YUKON

RECEIVED FROM Pacific Giant Steel Ores Ltd.,

SAMPLE NO.	GOLD Oz. Per Ton	SILVER Oz Per Ton	Soluable Iron	Nickel	Copper	Silica	(SiO_2)	
Br-A			54.5	Trace	Trace	8.58		
-B			6I.6	Trace	Trace	5.36		
-C			6I.3	Trace	Trace	4.58		

Notes: Copper on all samples less than .005 %

Nickel on all samples less than .0I %

Raw hematite iron ore samples
Bear River property, Yukon

ASSAYER Geo Spalding

A REPORT

ON

<u>PACIFIC GIANT STEEL ORES LTD.</u>

WHITEHORSE, YUKON TERRITORY

June 14, 1967

Introduction

Pacific Giant Steel Ores Ltd. is incorporated under the Companies Act of the Province of British Columbia and is registered as an Extra-Territorial Company in the Yukon Territory. It is the only active exploration company with both its executive and field offices located in the Yukon. The Company operates in Canada's northwest, including northern British Columbia and the Yukon Territory. Its major project, the Bear River Iron Ore - Railroad Project, is within the Yukon Territory. The Company has the status of a public company in the Yukon Territory, where all of its operations are presently being carried on.

Company Policy

The operating policy of Pacific Giant Steel is to develop exploration projects to the stage where large financing is required for their further physical development. At this stage, the Company seeks an outside capital source with whom to complete the development of a project. Therefore, when a participating financial partner is acquired, the partner need not devote its staff to the administration of the project as Pacific Giant Steel is organized to carry through all phases of the project. Full use is made of recognized consultants, research organizations and such government assistance as is readily available.

Offices and Facilities

The executive and field offices of the Company are located in an office building owned by the Company and located at 205 Main Street, Whitehorse, Yukon. The offices are equipped to efficiently handle administration, compilation of reports, preparation of maps, and research. The Company maintains a library of technical publications and operates a research compilation system, which is yet in its early stages of development, and which will form a major section within the Company when it is fully developed.

Management

There are nine vacancies on the Board of Directors of the Company. Three vacancies were left unfilled by the last annual meeting to allow for further appointments. The management of the Company is as follows:

.../2

Gerry R.E. Leverman, President and Director

Mr. Leverman is one of the original organizers of Pacific Giant Steel and has an extensive knowledge of mining and exploration in the Yukon, as well as having had a broad background in engineering and administration, being formerly employed by the Royal Canadian Airforce. He has lived in the Yukon approximately 15 years during which time he has helped to shape several important projects. He is now active full time in the development of the Bear River iron ore project. Mr. Leverman is a resident of Whitehorse, Yukon.

Art Jellinek, Managing Director

Mr. Jellinek is a prospector and a geologist, and is one of the original discoverers of the Bear River iron ore property. He has been active in mining and exploration in the Yukon for 10 years and was responsible for organizing the Yukon Chamber of Mines, of which he is a past president. The Chamber is the voice of the Northwestern mining industry. Since the discovery of the Bear River iron ore deposit in 1960, Mr. Jellinek has devoted all of his time to its development and was one of the original organizers of the Company. Mr. Jellinek has developed close liaison with most officials and individuals involved in mining and exploration. He is a resident of Whitehorse, Yukon.

Rolf Bailey, Treasurer and Director

Mr. Bailey has been a resident of the Yukon for 26 years and has been active in the community as a whole. He owns and manages Rolf Bailey Agency, Customs Brokers and Insurance Agents. Mr Bailey's wide financial experience is an asset to the Company. Mr. Bailey is a resident of Whitehorse, Yukon.

G. Elizabeth Trainor (Mrs.), Secretary to the Board and Director

Mrs. Trainor is an active businesswoman in the Yukon Territory and retains business interests in British Columbia. Wife of the Territorial Magistrate, Mrs. Trainor is very active in the community affairs of the Yukon through her association with numerous civic organizations. Mrs. Trainor is a resident of Whitehorse, Yukon.

.../3

Larry A. Patnode, Director

Mr. Patnode is a mining executive who is associated with several active exploration companies and was one of the original organizers of Pacific Giant Steel. He has resided in the Yukon for some 15 years and is well acquainted with mining and exploration in the Yukon.

Mr. Patnode is a resident of Whitehorse, Yukon.

Egon Krueger, Director, Senior Financing, North America

Mr. Krueger is the Company's representative for senior financing in North America and devotes his full time to conducting negotiations with major financial firms and with mining and oil companies in the United States and Canada. He has participated in arranging financing for several exploration projects in Northern British Columbia and in the Yukon for over 10 years. Mr. Krueger is a resident of Whitehorse, Yukon.

Kurt Grundmann, Manager, Senior Financing, Europe

Mr. Grundmann represents the Company in Europe on senior financing. He has done an excellent job of acquainting European senior financial groups with the industrial opportunities in the Yukon. He has extensive knowledge of the Yukon Territory, acquired as a businessman and as a director of music of the Whitehorse High School. Through his teaching experience, he has developed acquaintance with civic leaders in the Territory. Mr. Grundmann is a resident of Whitehorse, Yukon.

Daryl Hepple, Assistant to Management

Mr. Hepple is Assistant to the Management and has developed a sound background in both field and office work with the Company. His work includes assistance with report compilations, production of maps, and assistance with office and field administration. He is personally acquainted with most of the companies engaged in the business of servicing the mining and exploration industry in the Territory and is thus of considerable aid in the Company's field programs. He has also had experience in business and commerce. Mr. Hepple is a resident of Whitehorse, Yukon.

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Dave H. Robertson, Manager of Technical Communications

Mr. Robertson conducts the Company's research from technical publications, compiles reports and conducts various administrative duties. After graduation from College Militaire Royal de St. Jean, where he studied engineering, he rose to the position of a Staff Officer with the Canadian Army. He has also owned and managed a general contracting firm and was partner in the local daily newspaper. Mr. Robertson is a resident of Whitehorse, Yukon.

Noreen Osborne (Mrs.), Secretary and Bookkeeper

Mrs. Osborne is the Company's secretary and bookkeeper. Her duties also include searching technical papers and journals for current information for the Company's technical research files. She has previously been associated with a large investment firm in Vancouver and has considerable experience in work related to the mineral industry. Mrs. Osborne is a resident of Whitehorse, Yukon.

Solicitors for the Company

Nielsen and Hudson, Barristers and Solicitors

Solicitor for the Company in the Yukon is the firm of Nielsen and Hudson, Barristers and Solicitors, of Whitehorse. Mr. Ralph E. Hudson is the Company's attorney in the Yukon. Mr. Eric Nielsen, senior partner of the firm, is the Member of Parliament for the Yukon.

Shulman, Worrall, Tupper, Jonsson, Laxton and Mulholland, Barristers and Solicitors

Solicitor for the Company in British Columbia is the law firm of Shulman, Worrall and associates. Mr. William J. Worrall is the attorney for the Company in British Columbia. Mr. Shulman, senior member of the firm, is well known in British Columbia as one of the foremost organizers of mining corporations and has been instrumantal in bringing several mines into production, such as the largest molybdenum mine in British Columbia, Endako Mines.

Auditors for the Company

Collins & Collins, Chartered Accountants, is the firm auditing the Company's books and records. The firm is widely known in Canada and has

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offices in a number of cities, including Whitehorse. Associate firms include Collins and Hames (Calgary, Alberta), W.D. Love and Company (Winnipeg, Manitoba), Eddis and Associates (Toronto, Ontario) and Anderson and Valiquette (Montreal, Quebec).

Technical Consultants for the Company

The Company's consultant for the Bear River iron ore project is the Colorado School of Mines Research Foundation, Inc., of Golden, Colorado. The firm presently has a Senior Project Engineer on the property who is supervising the initial drilling program.

In addition, the Company has utilized a number of research organizations to conduct various studies, such as milling, metallurgy and transportation. Among these have been the Ontario Research Foundation, The Mines Branch in Ottawa, LeTourneau-Westinghouse Company, and others.

Private consulting engineers, such as Cohen Engineering Ltd., have also been employed from time to time.

Shareholders of the Company

The Company has aimed for the longer-term investors rather than the shorter-term speculators as shareholders. All working personnel of the Company are shareholders, and the incentive of the working group is greater than is found in many organizations. Shareholders of the Company include senior government officials, prominent local businessmen and firms, professional men, prospectors, long-term investors, publishers, mining executives, and a general cross-section of people in various trades, businesses and professions. Most of the shareholders reside in, or formerly resided in, the Yukon.

Research Facilities

The Company is developing an extensive research department that will collect, compile and maintain up-to-date the most recent technological advances in the field of mining exploration and development. Planned for the department is an extension of the Company's existing research file system, which already incorporates a wide selection of pertinent information. The present department relates particularly to iron ore geology, mining and milling, and to iron and steel making.

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Most trade journals are received by the Company and information in them is either extracted or catalogued into a reference file. Publications, books and company brochures are also retained in a selective library system.

The purpose of the research department is to provide the Company with current information on most phases of mining and exploration with which to be able efficiently and accurately to assess the potential of any project the Company may wish to consider for development. This system will permit Pacific Giant Steel to retain a leading position in mining development in Northwestern Canada.

General

The Company maintains liaison by personal contact with other firms and individuals in the mining industry, and with pertinent government departments. As a member of the mineral industry, the Company has strived to be a good corporate citizen.

The Company's management, as well as a number of its shareholders, have devoted considerable time and effort to matters commonly affecting the mineral industry through a number of organizations such as the Yukon Chamber of Mines. Many of the members of the Company are actively involved in community public affairs that serve the interests of the Territory as a whole.