MAR 19560004: PEACE RIVER

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SUMMARY REPORT

PEACE RIVER IRON DEPOSIT

for

PREMIER STEEL MILLS LIMITED

Edmonton, Alberta

by

D. B. McDougall
706 Seventh Street West
Calgary, Alberta

May, 1956

ENCLOSURES

1. A copy of the "Preliminary Report on Peace River Iron Ore".
2. A copy of "Geological Report, Clear Hills District".
3. Map A - Topography.
4. Map B.

This page was inserted by the Coal and Minerals Development Branch, to provide a reference that the enclosure's 1 through 4 mentioned in the assessment report could not be found and therefore not included in the digital copy.

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GENERAL

This report includes what is currently known of the Peace River Iron Deposit. Included is a copy of the "Preliminary Report on Peace River Iron Ore", a copy of a surface Geologic Report, metallurgical reports, a topographic map, recommendations for land acquisition together with all comments or other pertinent information. This summary report should be read after reading copies of the other two reports enclosed inasmuch as this report includes data and information subsequent to the other reports.

With the data in this report Premier Steel Mills Limited can devise a program that will logically follow from where the former Permit Holders in the area terminated their investigations.

Whether the deposit is economic depends upon whether an economical method can be developed to treat the iron.

METALLURGICAL INVESTIGATIONS

A. Department of Mines and Technical Surveys, Ottawa.

A 46 lb. sample of the deposit was obtained by splitting the cores obtained from the core drilling program and submitted to the Department of Mines in Ottawa. Copies of their reports are below. While discouraging, their tests, being limited by the smallness of the sample, were inconclusive and only served to eliminate orthodox approaches.

DEPARTMENT
OF
MINES AND TECHNICAL SURVEYS

Division of
Mineral Dressing
and
Process Metallurgy

552 Booth Street
Ottawa, Ontario
June 24, 1954

Mr. D. B. McDougall
Calgary, Alberta

Interim Report

Re: Your sample of Iron Ore Drill Cores from Peace River.

Dear Mr. McDougall:

Mineragraphic Examination of the Ore:

Examination of hand specimens showed them to be aggregates of numerous small brown globules or oolites, which average almost 0.5 mm. (-28+35 mesh) in diameter and are rather loosely consolidated in a ground mass of quartz and a dark brown to black mineral. Scattered throughout this material are a few small patches of soft, earthy, dull grey siderite. X-ray diffraction patterns of the other constituents identify both the oolites and the darker matrix to be goethite.

Examination of Polished Sections:

The globules or oolites of goethite are characteristic in appearance. While most show a concentric banded structure, some are composed of more or less homogeneous material. Many display no nuclei but others do have silica cores. The X-ray powder pattern of apparently clean oolites exhibits extra quartz lines. Although some cores are more or less round, others are quite angular in shape.

A photomicrograph will be included in the final report.

Acid Digested Ore:

A sample of ore (-10+14 mesh) was leached in hot hydrochloric acid and the residue remaining after this treatment was examined microscopically.

The residue contained soft, porous, grey sinter-like particles as the most abundant constituent. An X-ray powder pattern of some of these particles identifies them as illite (a clay mineral) and quartz. Quartz is present as irregular, clear, vitreous particles, dense grey to white grains, fine powdery masses and tiny dull light-coloured globules. The latter are thought to be the cores from oolites.

Analysis of the Head Sample:

Total iron (Fe)	-	34.26 per cent	
Acid soluble iron (Fe)	-	34.03 " "	
Iron as Fe_2O_3	-	48.62 " "	(calculated)
Silica (SiO_2)	-	23.88 " "	
Insoluble	-	25.80 " "	
Aluminium Oxide (Al_2O_3)	-	5.94 " "	
Magnesium Oxide (MgO)	-	1.17 " "	
Calcium Oxide (CaO)	-	1.75 " "	
Phosphorus (P)	-	0.62 " "	
Suphur (S)	-	Trace	
Manganese (Mn)	-	0.10 " "	
Molybdenite (MoS_2)	-	None detected	
Carbon dioxide (CO_2)	-	5.22 per cent	
Loss on ignition	-	12.00 " "	

A portion of the head sample was used for a qualitative spectrographic analysis.

The elements present in the order of decreasing abundance were reported as follows:

1. Major Constituent, Fe.
2. Minor " Si.
3. Strong trace, P, Na.
4. Trace, Mn, Mg, Pb, Al, V, Ni, Zn, As.
5. Faint trace, B, Cr, Ca, Cu, Ag, Ti, Co, Sn, Mo.

The investigative tests include magnetic roasting followed by magnetic separation, and gravity concentration of raw ore on the Wilfley table. The ore was crushed to various sizes for both magnetic and gravity tests.

Test #1 - Magnetic Concentration:

Analysis of Magnetic Concentrate -

Fe	-	55.0 per cent
Insoluble	-	10.3 " "
SiO_2	-	8.58 " "
CaO	-	2.14 " "
Recovery of iron,		16.76 " "
Ratio of Concentration,		8.58:1

Analysis of Non-magnetic Tailing -
Fe - 36.05 per cent
Insoluble - 32.0 " "
Iron in Tailing, - 83.24 " "
Calculated analysis of the feed, Fe, 38.26 per cent, Insoluble, 29.47 per cent.

Test #2 - Magnetic Concentration:
Magnetic Concentrate -
Fe - 50.2 per cent
Insoluble - 15.6 " "
SiO_2 - 13.0 " "
Recovery of iron, 50.2 " "
Ratio of concentration, 2.58:1

Non-magnetic Tailing -
Fe - 31.46 per cent
Insoluble - 38.17 " "
Iron in tailing - 49.8 " "

Calculated analysis of the feed, Fe 38.71 per cent, insoluble 29.43 per cent.

Gravity concentration made with sized feed of fractions from minus 48 to minus 200 mesh indicated some separation of iron from gangue at the size -100+150 mesh.

The analysis of the table products was reported as follows:

Product	Analysis, per cent		
	Fe	SiO_2	Insol.
Feed (calculated)	32.46	24.93	29.14
Conc -48+65 mesh	33.55	24.7	29.5
" -65+100 "	36.05	18.7	22.9
" -100+150 "	41.70	7.47	9.90
" -150+200 "	40.20	8.90	11.9
" -200 "	40.0	8.09	11.5
Middling +200 "	31.05	28.8	32.6
Tailing +200 "	30.52	22.28	27.87
Middling -200 "	34.8	19.3	22.6
Tailing -200 "	32.8	22.32	26.17

The results of magnetizing roasting and magnetic separation, so far obtained, are not very satisfactory as to grade and recovery of iron.

However, these results indicate that a magnetizing roast, followed by magnetic separation offer the best method of concentrating the ore.

The results of magnetic concentration of several tests show that the amount of magnetic material formed during the roasting period varies considerably.

The reducing agent used in these tests was charcoal, ground to minus 20 mesh, and mixed with the ore. The amount of charcoal was varied from 2 to 3 per cent of the weight of the feed.

It is proposed to use city gas as a reducing agent which should indicate the results to be expected if natural gas, available near your deposit, could be used.

As nearly all of the ore has been used up in the tests, it will be necessary for you to ship us about 100 pounds of ore as soon as possible to enable us to complete the investigation.

The results of tests underway will be forwarded to you as interim reports and the final report will be issued when the investigation has been completed.

Yours very truly,

W. S. Jenkins,
for R.J.Traill
Chief of Division.

DEPARTMENT
OF
MINES AND TECHNICAL SURVEYS

Division of
Mineral Dressing
and
Process Metallurgy

552 Booth Street
Ottawa Ontario
August 6, 1954

Mr. D. B. McDougall
Calgary, Alberta

Interim Report No.2 - Re: Your sample of Iron Ore Drill Cores from Peace River.

Dear Mr. McDougall:

In our letter dated June 24th, the results of several tests were given and additional tests have been completed in which charcoal and city gas as reducing agents have been used.

The amount of charcoal used was varied from 2 to 4 per cent. The increased amounts of charcoal above 2 per cent did not result in any appreciable increase in recovery of iron.

Two flotation tests were made.

Reducing with Gas

Tests Nos. 1, 2, 3.

Samples of ore crushed to pass 20, 48 and 65 mesh were placed in a retort which was heated to 1100°F. City gas passed through the retort and the excess was burned at the outlet.

The reduced ore was magnetically concentrated.

The 20 mesh roasted ore was ground in a ball mill prior to magnetic concentration.

Magnetic Concentration

Test No.1 - Minus 20 Mesh Ore

Product	Weight, Per Cent	Analysis, Per Cent		Distribution, Per Cent		Ratio of Concentration
		Fe	Insol.	Fe	Insol.	
Feed*	100.0	40.38	34.93	100.0	100.0	
Mag.Conc.	11.5	58.50	14.59	16.6	4.8	8.7:1
Tailing	88.5	38.03	37.56	83.4	95.2	

Loss in weight by roasting 27.2%

Test No. 2 - Minus 48 Mesh Ore

Product	Weight, per cent	Analysis, per cent		Distribution, per cent		Ratio of Concentration
		Fe	Insol.	Fe	Insol.	
Feed*	100.0	41.17	32.76	100.0	100.0	
Mag.Conc.	32.5	52.10	19.02	41.2	18.9	3.1:1
Tailing	67.5	35.9	39.39	58.8	81.1	

Loss in weight by roasting 23.7%

Test No. 3 - Minus 65 Mesh Ore

Feed*	100.0	30.36	33.23	100.0	100.0	
Mag.Conc.	15.6	58.0	15.6	29.8	7.3	6.4:1
Tailing	84.4	25.25	36.49	70.2	92.7	

*Calculated Loss in weight by roasting 24.6%

A microscopic examination of concentrate showed that the individual particles were all quite black; lighter coloured particles appeared to be obscured by black coloured fines (dust). Gangue particles were not easily distinguished.

A portion of the concentrates were acid leached and the residues were white with occasional small black grains.

Much gangue was seen as fine white particles and also as grains of clear glassy quartz. The quartz grains did not appear to have any inclusions of iron. The quartz may have been brought into the concentrate by being trapped among magnetic particles or else the fine layer of magnetic oxide adhered to the surface causing the particle to report in the concentrate. Acid leaching would remove the iron from the surface of the particle.

The fineness of most of the gangue makes its separation from the iron minerals very difficult.

Examination of the reground roasted ore indicated that part of the iron present appeared unreduced, which indicated that the interior of the particle may not be magnetic.

Test No. 4 - Roasting in air prior to reducing roast

A sample of minus 20 mesh ore was roasted at 600°F. in an open dish. The roasted ore became red, the colour of hematite. This material was placed in the retort for a reducing roast at 1100°F. After grinding the reduced ore, it was magnetically concentrated.

Test No. 4 - Minus 20 Mesh Ore

Product	Weight, per cent	Analysis, per cent		Distribution, per cent		Ratio of Concentration
		Fe	Insol.	Fe	Insol.	
Feed*	100.0	41.17	33.20	100.0	100.0	
Mag.Conc.	30.4	53.0	18.32	39.2	16.8	3.3:1
Tailing	69.6	36.0	39.71	60.8	83.2	

*Calculated Loss in weight by roasting 28.3%

Test No. 5 - (1) Grinding Ore in a ball mill,
(2) Roasting in air,
(3) Reducing roast with city gas.

A sample of the ore was ground in a ball mill to 85 per cent minus 200 mesh, filtered and dried.

The ground ore was roasted in air in an open dish at 600°F. followed by a reducing roast with city gas. The roasted ore was magnetically concentrated.

A sample of the non-magnetic tailing was given a second reducing roast to find out if more magnetic iron could be obtained from it.

Results:

Product	Weight per cent		Analysis per cent		Distribution of iron, per cent		Ratio of Concentration
	In test	In orig. feed	Fe	Insol.	In Test	In orig. feed	
Feed*	100.0	--	40.05	--	100.0	--	
Mag.Conc.	26.8	--	49.20	18.9	32.9	--	3.7:1
Tailing	73.2	--	36.7	--	67.1	--	

Loss in weight by roasting 28.3%

Re-roast of Tailing

Feed*	100.0	73.2	36.0		100.0	67.1	
Mag.Conc.	4.85	3.6	52.0	16.0	7.0	4.7	20.6:1
Tailing	95.15	69.6	35.2		93.0	62.4	

Loss in weight by roasting, 3.1%

Combined Conc.*	--	30.4	49.53	18.5	--	37.6	3.3:1

*Calculated

Test No. 6 - Magnetic Concentration of Reground Magnetic Concentrate

(1) Roasting in air of minus $\frac{1}{4}$ inch ore,
Loss in weight by roasting, 15.3%.
(2) Grinding to minus 65 mesh,
(3) Reducing roast with charcoal (4%),

(4) Magnetic concentration at minus 65 mesh,
(5) Magnetic concentration of samples of magnetic concentrate (from 4) ground to minus 100, 150 and 200 mesh.

Results of Magnetic Concentration of Roasted Product at minus 65 mesh

Product	Weight, per cent		Analysis, per cent		Distribution, per cent				Ratio of Concentration
					In test		In orig. feed		
	In test	In orig. feed	Fe	Insol.	Fe	Insol.	Fe	Insol.	
Feed*	100.0	--	38.73	28.40	100.0	100.0	--	--	
Conc.	24.9	--	49.40	15.1	31.7	13.2	--	--	4.0:1
Tailing	75.1	--	35.20	32.8	68.3	86.8	--	--	

Loss in weight by roasting, 7.6%

Magnetic Concentration of Concentrate at Minus 100 Mesh

Feed*	100.0	24.9	48.58	15.54	100.0	100.0	31.7	13.2	
Conc.	76.	18.9	51.90	12.05	81.2	58.9	25.7	7.8	1.3:1
Tailing	24.	5.9	38.05	26.60	18.8	41.1	6.0	5.4	

Magnetic Concentration of Concentrate at Minus 150 Mesh

Feed*	100.0	24.9	49.54	15.06	100.0	100.0	31.7	13.2	
Conc.	57.	14.2	55.45	9.0	63.8	34.1	20.2	4.5	1.75:1
Tailing	43.	10.7	41.70	23.1	36.2	65.9	11.5	8.7	

Magnetic Concentration of Concentrate at Minus 200 Mesh

Feed*	100.0	24.9	49.54	14.91	100.0	100.0	31.7	13.2	
Conc.	48.	11.9	56.25	8.15	54.5	26.2	17.3	3.5	
Tailing	52.	12.9	43.35	21.15	45.5	73.8	14.4	9.7	

*Calculated

The tests shown above indicate the recoveries and grades of concentrates to be expected from ore represented by the shipment, by the method of a reducing roast followed by magnetic concentration.

The tests included air roasting followed by magnetic or reducing roasts with both charcoal and gas used as reducing agents on ore samples crushed to varying sizes.

Two flotation tests did not show satisfactory results, but if a larger supply of ore becomes available more flotation tests will be tried.

The gangue minerals are extremely fine and will prove difficult to separate from the iron minerals by magnetic concentration. More tests will have to be made to determine the maximum amount of magnetic iron that can be obtained and the highest grade of concentrate that can be expected by this process.

The supply of ore, 46 lb., has been all used up in the test work to date.

Yours very truly,

W. S. Jenkins,
for R. J. Traill,
Chief of Division.

B. Other Agencies With Processes for Similar Deposits.

(i) Correspondence was carried on with a Mr. Anderson who claimed he had a process for treating low grade ores. This consisted briefly of grinding to 35 mesh, reducing with Natural gas, then passing over a magnetic separator. He claimed success with this process in Japan using beach sands which only contained 20 - 25% iron. He submitted a Pictorial Flowsheet and photographs of his equipment which were subsequently returned. It is suggested Premier Steel Mills contact Mr. Anderson and study his method. His address is

H.G.S.Anderson & Sons
1321 Boston Avenue
Muskogee, Oklahoma, U.S.A.

(ii) Sweden has been experimenting with an iron extraction process using natural gas. No further information is currently available.

(iii) The Kaiser organization has acquired an European steel making process, "The Brassert Oxygen Process". This method is apparently used successfully in treating low-grade ore in Europe. A plant using this process is supposed to be constructed somewhere in Ontario.

(iv) Dr. William Armstrong of the University of British Columbia has suggested the "Krupp-Renn" process

which is successful in treating ores not too dissimilar to the one in the Peace River District.

TOPOGRAPHY - General

The topographic work on former Permits No. 2 and No. 4 was done by Blanchett, Trorey & Associates and their letters explaining methods and degree of accuracy are copied below. The remainder of the work including Permit No. 1 was done under the supervision of Seismic Ventures Limited using a simple stereoscope. As good elevation data was available from geophysical work carried out by Phillips Petroleum, the accuracy of this is well within 50 feet. The location of the old Permits may be seen on the surface geologic map.

COMPILATION OF TOPOGRAPHIC MMS.
OF PARTS OF PERMITS 4 and 2

One hundred foot vertical interval, topographic compilation has been made over a gross area of some 88,000 acres as shown on the Blanchet, Trorey & Associates Ltd. map dated 1 November 1954.

The area is covered by Dominion Government photography at nominal scale of 3333 feet to one inch.

Larger scale Alberta Government photography of 1949-50 covers a part of the area. Being of later date, this photography shows certain seismic roads, survey data of which are available.

These roads were transferred, by detail, from the newer photography to the Federal 3333 serving to control the compilation.

The work was started at the south of the area, line 5700 set up in the Multiplex projector at 1500 feet to one inch, scaled at several points to base line detail, and levelled to the seismic data. The 100 foot vertical interval topographic compilation was then taken off.

Work was carried North to the North edge of line 5703, in a similar manner.

It was of course necessary to carry the bridges well beyond the limits actually mapped - particularly in the North.

The 1500 foot to one inch Multiplex manuscript was then photographically reduced to one inch and retraced.

At the North limit of the mapping, because of distance from reliable control, topography shown should be considered to be of the nature of form lines with, however, accurate delineation of shape.

In the Central and Southern parts of the area, the topography is of good reconnaissance standard.

Lyle G. Trorey, P.Eng.
Consulting Engineer
25 November 1954

RECONNAISSANCE
TOPOGRAPHIC MAPPING
PERMIT NO. 2

The work was carried out on the Multiplex projector, from Alberta Government six inch photography of nominal contact scale of 3333 ft/in.

In the North central part of the subject area, where the topography is shown by broken lines, the flight is at a distance from suitable vertical control. As well, film distortion is present in such magnitude as to result in pass point discrepancies approaching a contour interval. For these reasons this part of the work is of low order.

The remainder of the area in which the form lines are shown broken is probably reliable to plus or minus one hundred feet, but the film distortion mentioned above prevents lateral tie. Accordingly, there are not data definitely to state that the reliability is one hundred feet here.

The Southern portion is controlled from elevations to the East of the permit area, the flight altimetric data, the drainage pattern, and that part of the 2500 contour (as shown on the eight mile) which appeared to be reliable. It is of good reconnaissance standard, estimated mean contour reliability plus or minus fifty to seventy-five feet.

The Northern portion is well controlled, and of standard half interval accuracy.

Throughout, shape is accurate, and mean relative accuracy of the interval may be expected to be of the order of plus or minus twenty feet - except in the area of film distortion.

Calgary, Alberta
7 January 1955

Lyle G. Trorey, P.Eng.

MAP DISCUSSION

Map A

This map is self explanatory and shows the topographic work that has been done to date. While control is not completely satisfactory, it is sufficient for present purposes. A more detailed and more extensive topographic map would be necessary only if a satisfactory metallurgical process is worked out.

Map B

This map has all pertinent information including location of wells where the iron deposit has been encountered, its thickness where known from core drilling, contour elevations on the top of the iron bed, a 15 foot isopach line of the iron formation, and topography.

The area shaded in red outlines the approximate area of maximum interest (that is, where the deposit may be present 15 and more feet thick and under a maximum of 200 feet of overburden).

This area as may be seen is determined by limiting the area westward by the 15 foot isopach line, to the north

and east by the elevations of the land surface compared to the expected elevation of the top of the iron formation and eliminating the areas whose elevations are 200 feet above the expected elevation of the iron deposit.

It should be pointed out that this shaded area is a very rough approximation. There is a scarcity of detail information and what information there is has been freely extrapolated. Another unknown factor is the amount of glacial erosion and deposition in any locale.

Furthermore, the deposit probably extends much further south and north than shown by the work done to date but such extensions would have to be outlined by additional core drilling.

MISCELLANEOUS

1. The bed of oolitic iron undoubtedly extends over a much greater area than has been so far outlined. Mr. M. B. B. Crockford, geologist with J. S. Sproule and Associates, 901 - 8th Avenue West, Calgary, has reported an occurrence to me. He used this bed as a marker while doing surface mapping along the banks of the Peace River. He reports it varied in thickness from 2 to 8 feet, was a continuous horizon and was present on outcrop from Section 22, Township 81, Range 6, to Section 15, Township 80, Range 4, West of the 6th Meridian. It occurred at an elevation of about 1700 feet above sea level. This reported occurrence is 60 miles from the area of core

drilling. That this is the same continuous horizon as the "Peace River Iron Deposit" is not proven.

2. Correspondence with Mr. G. Walker, Traffic Assistant, Northern Alberta Railways Company, Edmonton, disclosed the only published rate now in effect on Crude Iron Ore from Hines Creek, Alberta to Edmonton is the 10th class rate of 65¢ per 100 pounds subject to minimum carload weight of 50,000 lbs. per car in accordance with Canadian Freight Classification No. 19.

A much more satisfactory rate could no doubt be negotiated depending on volume tonnage, etc.

RECOMMENDATIONS

1. An iron prospecting permit should be taken out covering the red-shaded area on Map B which outlines the area of current maximum interest. Protective acreage might be taken out around this area and further north and south where a further extrapolation of data and the ground elevations are favorable to anticipate the presence of the iron formation.

2. The major investigation to be carried out is one of developing a satisfactory process for treating this deposit. For this reason a large bulk sample should be obtained from the outcrop area in Section 1, Township 91, Range 5, West of the 6th Meridian. All possible help should be asked for from the various government agencies and all process used for treating similar ores (especially

in Europe) should be closely investigated.

3. A surface geological party should closely investigate the possibility of other outcrops occurring in the area; in particular along the east flank of the hills in Township 90, Range 4, and further south where an extrapolation of data and the ground elevations indicates the iron formation may be present.

4. If an economical metallurgical process is developed, a detailed core drill program and topographic mapping program will be required to outline the area of minimum overburden and maximum thickness of iron.

CONCLUSIONS

If an economical process for treating the Peace River Iron Deposit can be developed, other factors are favorable for the development of a profitable iron mine.

[redacted]

D. B. McDougall, BSc., P.E.

#19560004

SCALE 0 1 2 3 MILES

IRON PROSPECTING PERMIT No. 10

CANCELLED OCTOBER 3, 1957

PREMIER STEEL MILLS LTD.,

P. O. BOX 348,
EDMONTON, ALBERTA.

DATE OF ISSUE – JULY 13, 1956.
AREA – 40,000 ACRES.
NO LEASES SELECTED