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REPORT ON POTENTIAL IRON ORE TONNAGE AND MAGNETIC SURVEY

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REPORT ON

MAGNETOMETER SURVEYS

A N D

POTENTIAL IRON ORE TONNAGE

DUNCAN RANGE IRON MINES LIMITED

Southwestern Ungava District
Quebec

April 17
1958

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Duncan Range Iron Mines Limited,
Suite 415,
18 Toronto Street,
TORONTO, Ontario.

Gentlemen:

It is the primary purpose of this report to describe the results of an extensive ground magnetometer survey carried out in February and March, 1958, on your Mineral Exploration License (Mining Concession) in the Ungava District, Quebec. For details regarding previous exploration, sampling, metallurgical testing and airborne magnetometer survey, the reader is referred to a report by the writer, dated September, 1957; and printed in the Company Prospectus. From the ground magnetometer surveys, and very limited surface geological observations, it is inferred that a potential of 4,009,000 tons per vertical foot of magnetite iron ore occurs within the boundaries of the Mineral Concession of Duncan Range Iron Mines Limited. Preliminary assaying and concentration tests have yielded highly satisfactory results. An average profit potential, subject to more detailed investigation, of about $4.00 per ton of concentrate is provisionally indicated.

PROPERTY

The property of Duncan Range Iron Mines is held under a Mineral Exploration License, Number 335, granted to the Company by the Quebec Department of Mines,

August 22, 1957. This Mineral Exploration License, loosely called a "Mining Concession", covers an area of 85.5 square miles, and is centred at Latitude 53° 32', Longitude 77° 44'. The M. E. L. is 17.5 miles long in a N. E.-S. W. direction, and averages about 5 miles wide.

LOCATION AND ACCESS

The property is in the southwestern section of the Ungava District of Northern Quebec. It covers the eastern end of Duncan Lake, a body of water some 17 miles long and 3 miles wide. The centre of the M. E. L. is 52 miles east of James Bay, at a point on the shore that is 22 miles south of Fort George. Fort George, at the mouth of the mile-wide Fort George River, is the nearest settlement in the area. Great Whale River, on the shore of Hudson Bay, where a major Radar installation and Airport for large planes are located, is 110 miles north of the property.

Duncan Lake is 360 air miles north of the float plane air base at Senneterre, Quebec. This is a small town on the main northern line of the Canadian National Railway, 350 miles northwest of Montreal, Quebec. Chibougamau is 300 miles southeast of the property. The Northern terminus of the Ontario Northland Railway at Moosonee, Ontario, at the south end of James Bay, is 180 miles by water from Fort George.

The M. E. L. lies on a low peneplain extending eastward for 60 miles inland from James Bay. The terrain is mostly muskeg covered and flat, except for a few low, rocky hills. Unconsolidated glacial deposits are widespread, with numerous eskers of sand and gravel. Duncan Lake is 475 feet above sea level.

PROPERTY GEOLOGY

Little is known of the geology or structure of the iron deposits and their environment. Observations of a few outcrops, an airborne magnetometer survey, and the ground magnetometer surveys indicate that two main bands of iron formation occur. The bands are roughly parallel with a northeast strike, and about 1 mile apart. The north band is indicated for a length of 14.5 miles, except for a short section north of Desaulniers Lake. The south band extends for some 9 miles. There may be a gap in the continuity for a length of 1 mile southeast of Maloney Lake. The structure of the two bands becomes complicated a mile west of Desaulniers Lake. The north and south bands may form a southwest plunging syncline with the nose at this location. It is possible that the nose of another syncline also occurs at this location; but it plunges northeast. The two structures close in this area because of cross-folding or faulting. The south limb of the northeast syncline appears to be dragfolded towards the

southwest just south of the western end of Desaulniers Lake. Such a structural interpretation at the present stage of information is largely hypothetical, and subject to confirmation or change when geological mapping provides bedding strikes, dips, and top direction determinations.

Granitic rocks appear to form part of a sill extending northeast along the southern margin of the iron formation from Espirit Lake to Maloney Lake. Granite or syenite has been observed interlayered with the iron body at the southwest end of Desaulniers Lake.

Chloritic "greenstone" cut by quartz veinlets and mineralized with pyrite occurs immediately north of the large iron ore deposit north of Desaulniers Lake. Chalcopyrite has been noted with pyrite, a short distance northeast of this Lake.

Geological Survey of Canada, Map No. 23-1957, published at a scale of 1 inch to 8 miles, in March 1958, shows the geology of a large area along the east coast of Southern Hudson Bay and Northern James Bay, between the East Main River on the south and the Little Whale River on the north. This reconnaissance mapping shows a belt of volcanic and sedimentary rocks extending northeast and east for 30 miles from Duncan Lake. Iron formation is noted within the band. The rocks are the oldest of the Early Precambrian (Archean) group, and are surrounded by Early

Precambrian granitic intrusives. A few miles to the east, on line of strike, an area 25 miles long, of Late Precambrian (Proterozoic) sedimentary formations, is mapped.

IRON FORMATION

Nature and Distribution -

The iron deposits on the M. E. L. of Duncan Range Iron Mines are a typical example of Early Precambrian, sedimentary, iron formation. They consist of alternate silica-rich and magnetite-rich layers, compressed into a relatively fine-grained rock with a distinct thinly-bedded or banded structure. An outcrop area of the north iron band, at a location near the western end of Maloney Lake is described by J. C. Honsberger, Mining Engineer and Geologist, as follows:-

> "Here a width of about 200 feet of fine-grained magnetite was observed and was traced about 1,000 feet in length. The ore consists of fine-grained banded magnetite with tiny bands of white silica intercalated. The silica bands range in thickness from one-sixteenth of an inch down to a knife edge. No hematite is known to occur in the deposits. Several quartz veinlets up to one foot in width were observed intruding the ore parallel to the banding. Locally, dykelets of

schistose granitic or syenitic material up to 6 inches wide and paralleling the structure were also observed. In all, however, over the observed width of about 200 feet of iron ore there was a maximum of 5 per cent of included rock material (quartz veins and syenitic dykelets)."

The iron ore exposed on Almond Island, 2 miles to the southwest, is similar to the above outcrops. Part of the band outcrops across 360 feet. The strike is N. 45° E., and the dip 80° northwest. Figure 1 shows the writer and J. C. Honsberger standing on the iron formation on top of Magnetite Hill on Almond Island, in early March, 1958.

Figure 1 - W. N. Ingham and J. C. Honsberger holding slabs of iron ore on Magnetite Hill, Almond Island, Duncan Lake, March, 1958.

The ore zone south of Desaulniers Lake strikes N. 65° E. and dips steeply south. It is more coarse-grained than the few observed exposures of the north band of iron. Bands of intrusive granite occur within the main width of iron formation. Minor crenulations of the bedding, seen in Figure 2, are diagnostic of drag-folding, which is further indicated by the extension to the southwest of the main band. This ore zone was sampled at intervals across 400 feet of the north portion during the March 1958 visit of the writer to the property. Figure 3 is an aerial view of the west end of Desaulniers Lake on which the "I" ore zone and the east end of the "F" are plotted.

Only one exposure of the iron ore north of Desaulniers Lake could be located, due to the snow-covered terrain in March. This outcrop is at the extreme north edge of the magnetically-indicated northern limit of the iron zone. The ore is definitely quite coarse-grained, and the white silica-black iron banding is definitely more pronounced than seen in any of the other zones examined.

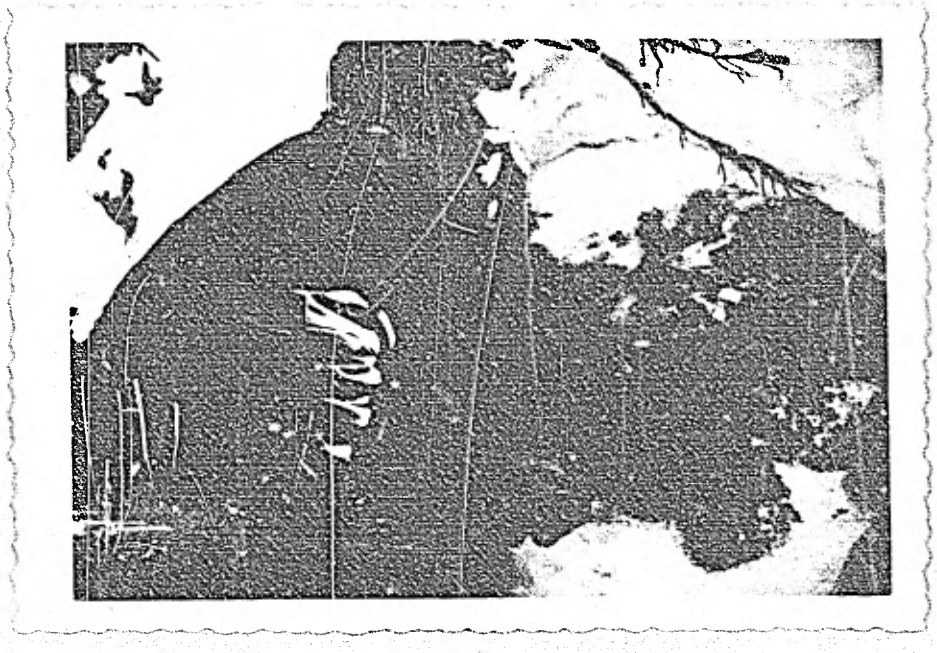

Figure 2. - Outcrop of the "I" ore zone at the south side of Desaulniers Lake, showing crenulated bands of white silica in the dark magnetite groundmass.

The ten ore zones indicated by previous ground and airborne magnetometer surveys, can be grouped into six main ore bodies. Following the original designations, these are:-

(1): A - B - C.

(2): D - E.

(3): F.

(4): G.

(5): H.

(6): I - J.

Figure 3. - Aerial view of the western end of Desaulniers Lake showing the "I" iron ore body and the eastern end of the "F" ore body. Note the flat, only sparsely tree-covered nature of the terrain.

Grade and Concentration Tests -

A chip sample of the "A" iron zone taken across 360 feet by J. C. Honsberger, Mining Engineer, and L. B. Almond, Geologist, assayed as follows:

Iron	Fe.....	31.95%
Silica	SiO_2.....	45.20%
Sulphur	S.....	0.50%
Phosphorous	P.....	0.11%
Manganese	Mn.....	0.20%
Titanium	Ti.....	0.10%

Among the individual 10-foot chip samples collected by Honsberger and Almond across this 360 feet, the highest iron was 38% and the lowest 22%. At this location the magnetic data indicates the iron formation is 1,400 feet wide, but lack of exposure prevented sampling the full width.

A 45-pound sample of pieces of ore taken at various intervals, where outcrop could be found, across 400 feet of the northern part of the "I" iron zone, assayed 34.12% iron, very small amounts of phosphorous and sulphur, and only traces of manganese and titanium. Here the iron formation has a magnetically-indicated width of 1,600 feet, so that again full width could not be sampled because of shallow overburden cover.

A grab sample of 11 pounds,from an exposure at the north edge of the "G" iron zone, was found to assay 34.60% iron.

Concentration tests have been carried out on three of the main iron ore bodies. These are the "A", the "I", and the "G".

H. U. Ross, Professor of Metallurgy at the University of Toronto, and Consulting Metallurgist, has prepared a report dated June 13, 1957, on Iron Ore Concentration Tests on ore from the deposits at Duncan Lake, which now are held under a Quebec Mineral Exploration License by Duncan Range Iron Mines Limited. The test material used by Ross consisted of 5 pounds of material from the "A" iron body assaying 32.76% iron, which amount of sample can be regarded as only very roughly indicative of all the potential ore. His work resulted in the conclusion that by fine grinding all the ore to minus 200-mesh, and proper adjustment of the magnetic intensity of the magnetic separators, a concentrate can be produced containing 64.06% iron and 9.83% silica with an iron recovery of 90.7%. It is stated that "This result may be considered highly satisfactory." The ratio of concentration is 2.195 tons of ore needed to produce 1 ton of concentrate.

In a report dated November 28, 1957, Ross summarizes the results of a concentration test on a 5-pound sample

from the "I" ore body as follows:

Grade of Ore	34.41% Iron, 46.64% Silica
Grade of Concentrate	68.80% Iron, 3.28% Silica, 0.024% Phosphorus
Ratio of Concentration	2.083 to 1
Percentage Iron Recovery	94.8%
Magnetic Iron Assay	33.02%

These results may be considered to be extremely good. The grade of the concentrate is such as to make it a product of premium quality highly acceptable to the Iron and Steel Industry of North America.

Metallurgical testing by Ross of the 11-pound sample collected in March, 1958, by the writer from the north edge of the "G" ore body, gave excellent results. Two tests were made on the sample. One test showed that the ore can be concentrated to a product containing 58.03% iron and 10.42% silica after grinding to only 65-mesh. The other test showed that the same ore, at 200-mesh grinding, yielded a concentrate containing 66.41% iron and 4.46% silica. Iron recovered in the concentrates averaged 71.7%. This is not high, becuase of 10.49% non-magnetic iron in the sample, which is in the form of shiny specks of specular hematite. Assay of the concentrate gave negligible amounts of phosphorous, sulphur, manganese and titanium.

MAGNETOMETER SURVEYS

General Information -

A ground magnetometer survey of the No. 1 (A-B-C), and No. 2 (D-E), ore zones was carried out by J. C.

Honsberger in 1953. This work outlined the northern band of iron ore for a length of 7 miles. The present magnetometer survey work continued from the above survey, following the north iron formation eastward through ore bodies 3(F), and 4(G), for a length of 7.5 miles. The present survey also delineated the south band of iron formation for a length of 9 miles eastward from ore body 5(H) to ore body 6(I-J), except for a gap of 1.5 miles between H and F.

The results of the 1953 and the 1958 surveys are gathered together on five map-sheets accompanying this report. One map-sheet is a general plan of the entire Mineral Exploration License area at a scale of 1 inch to one-quarter mile. It shows the general geology and the distribution of the six main iron ore bodies. The four other map-sheets, drawn at a scale of 1 inch = 400 feet, give the details of the magnetic values and concise information as to the size and shape of the iron zones. The western map-sheet shows the No. 1 ore body. The west-central map-sheet shows the No. 2, and the No. 5 ore bodies. The east-central map-sheet shows the No. 3 and No. 6 ore bodies. The eastern map-sheet shows the No. 4 ore body.

Lines were spaced at 660-foot intervals, and readings were taken at 100-foot intervals. A series of base lines were set up, with a transit forming the control for each of the three 1958 survey blocks. The blocks are tied together and tied to

the 1953 survey. A check magnetic measurement taken during the present survey at the base control station of the 1953 survey indicates that the former set of magnetic values are all only 191 gammas higher. Electromagnetic profiles were carried out on Line 2-E., Block F-I-J, and on Line 0, Block G. Three conducting zones found on Line 0, Block G, north of the main iron ore body, may indicate sulphide mineralization or narrow bands of lean iron formation. The E. M. survey work amounted to 2.51 miles. The magnetometer surveyed lines add up to a total of 84.63 miles. In addition, 15.7 miles of base lines and tie lines were established. The surveys were performed by the four experienced operators shown in Figure 4. Work was under the technical direction of Dr. S. S. Szetu, Geologist and Geophysicist for Geo-Technical Development Company, Dr. W. N. Ingham, independent Consulting Geologist, and J. C. Honsberger, Mining Engineer and Geologist, Vice-President Duncan Range Iron Mines Limited. These individuals are shown in Figure 5, at the base camp at Desaulniers Lake.

Figure 4. - Magnetometer Operators, Duncan Range Iron Mines Survey, March, 1958. M. Noack, Sur. Eng., S. S. Szetu, Ph.D., J. W. Tiefenthaler, and A. Szenasi, Geoph. Eng.

Figure 5. - Technical Supervision, Duncan Range Iron Mines Survey, March, 1958. S.S.Szetu, Ph.D., J.C.Honsberger, P.Eng., and W.. N. Ingham, Ph. D..

Interpretation -

The surveys have provided well-defined outlines of the various highly-magnetic ore bodies lying along the two bands of quartz-magnetite iron formation. In the case of the 1953 survey, shown on the maps of No. 1 and No. 2 ore bodies, the maximum reading the instrument could register was 23,000 gammas, and where this value is plotted the magnetic intensity is 23,000 gammas or higher. In the case of the 1958 survey, shown on the maps of No. 3, No. 4, No. 5 and No. 6 ore bodies, the instruments used were calibrated to read up to 30,000 gammas, and where this value is plotted, the magnetic intensity is 30,000 gammas or higher. In both cases, had compensating magnet systems been employed in the instruments, readings would rise up to 50 or 60,000 gammas.

Magnetic readings of 23,000 gammas or higher are interpreted to represent iron ore containing at least 32% iron, in the No. 1-No. 2 ore area; and readings of 25,000 gammas or higher are assumed to be caused by this grade of ore in the No. 3, No. 4, No. 5, and No. 6 ore areas. Actual assay values from the various ore bodies over which such magnetic readings occur range up to 38% iron. It is probable that all magnetic readings over 20,000 gammas are caused by ore-grade iron-rich rock. However, in measuring the areal extent of the ore bodies, 23,000 gammas is used as the cut-off for the No. 1 and No. 2 ore bodies, and

25,000 is used for the No. 3 to No. 6 inclusive. On this basis, the following tabulation has been compiled:

Ore Body	Length Feet	Maximum Width	Average Width	Sp. Gr. Factor	Short Tons Per Vertical Foot	
No. 1	18,000	1,350	600	9.2	1,174,000	A-B-C
No. 1 Area	4,900	200	100	9.2	53,200	D-E
No. 2	12,000	300	175	9.2	228,200	D-E
No. 3	14,500	1,050	500	9.2	788,000	F
No. 3 Area	2,000	100	50	9.2	10,900	
No. 4	6,200	1,450	900	9.2	606,500	I-J
No. 4 Area	5,200	200	100	9.2	56,500	
No. 5	13,500	300	150	9.2	230,900	H
No. 6	8,800	2,200	900	9.2	860,800	G
TOTAL POTENTIAL TONS PER VERTICAL FOOT					4,009,000	

The above total of 4,009,000 tons per vertical foot, as previously stated, includes only iron ore areas with a magnetic intensity of over 23,000 gammas. The arithmetical average width of the six main ore bodies is 530 feet. If open pit mining is carried out to only this average depth, the tonnage obtainable is 2,124,770,000. In ore bodies such as No. 6, which

has a maximum indicated width of 2,200 feet, open-pit mining could be reasonably done to a depth of at least 1,000 feet. It is also quite probable, that zones with a magnetic intensity of over 15,000 gammas, which are extensions of the length and width of the 6 main deposits, may prove to be sufficiently rich in iron to constitute lower grade, but still concentrateable ore. If this is the case, then the ore potential is increased to three or four billion tons.

Cost Analysis -

It is beyond the scope of this report to calculate the cost of transportation facilities, power, concentrating-pelletizing plant and preparation of the ore deposits for production. However, based on open-pit mining of 10,000,000 tons of ore to yield about 5,000,000 tons of concentrate annually, J. C. Honsberger estimates the following costs:-

	Per Long Ton Concentrate
Open Pit Mining	1.40
Concentrating	1.46
Agglomeration (Pelletizing)	1.37
Rail Haul to Fort George	0.70
Stockpiling and loading at Fort George	0.20
General - Head Office, Water, Repairs	0.40
Ocean Freight - Fort George, Baltimore (3,100 miles)	4.50
Total cost of shiprail at Baltimore	10.03
Amortization based on a capital cost of $100,000,000.00 to be paid back in 20 years	1.00
Total Cost	$11.03

CONCLUSIONS AND RECOMMENDATIONS

1. The ground magnetometer surveys have indicated six main iron ore deposits with an aggregate potential tonnage per vertical foot of 4,009,000, on the Quebec Mineral Exploration License held by Duncan Range Iron Mines Limited.

2. The magnetic results have been substantiated by examination of a few outcrops of four of the six main ore bodies, and by preliminary sampling of three of the ore bodies.

3. The tonnage estimates stated are provisional, remaining to be definitely established by a program of geological mapping and diamond drilling. However, since all the ore bodies appear to have nearly vertical dips, it is reasonable to assume that their depth extensions will be persistent. Because of the nearly vertical dips, the magnetic values obtained represent nearly the true width of each deposit.

4. The grade and the grain size of each deposit may vary, and this points to the need for detailed examination of all exposures, and systematic sampling of full widths wherever possible.

5. A small amount of diamond drilling is warranted at the present time, but only to obtain material for sampling and concentration tests at places where no surface exposures exist.

6. Pelletized magnetite iron ore, grading about 65% iron and containing less than 10% silica, is worth at least $15.00 per gross ton at lower Great Lakes Ports. If the quoted $11.03 cost estimate to produce and deliver a ton of such an iron ore concentrate from the Duncan Range Deposits is correct, then the profit potential is $4.00 per ton of concentrate.

7. Evidently, should the limited amount of exploration yet to be done on the deposits definitely prove the present inferred potential of at least a billion tons of concentrate, net operating profit from 5,000,000 tons of concentrate might be $20,000,000.00 per year.

Submitted by,

W. N. Ingham

W. N. Ingham, Ph. D.,
Consulting Geologist.

WNI:rap

Toronto, Ontario,

April 17, 1958.

Phone: HI. 7-7417

1617 Bayview Ave.
Toronto, Ontario

W. N. INGHAM, Ph.D.
Consulting Geologist

CERTIFICATE

1. I am Walter Norman Ingham, with office at 24 Wellington Street West, Toronto, and office and residence at 1617 Bayview Avenue, Willowdale, Ontario.

2. I graduated with the degree of B. A. in Geology from McMaster University, in 1938; I have the degree M. A. in Geology from the University of Toronto, in 1941; and I received the degree Ph. D. in Eccnomic Geology from the University of Toronto, in 1944.

3. I am a member of the Canadian Institute of Mining and Metallurgy since 1947; and a Charter Fellow of the Geological Association of Canada.

4. I hold no interest in the property of Duncan Range Iron Mines Limited.

5. I hold no shares of Duncan Range Iron Mines Limited, but I may purchase shares at a later date.

6. The information in this report is based mainly on magnetometer surveys carried out in 1953 by J. C. Honsberger, and in February-March, 1958, under the direction of the writer. Five of the personnel of six that performed the field work are university graduates. Certain data has been copied from the writer's previous report dated September 11, 1957, on this Mineral Exploration License of Duncan Range Iron Mines Limited. General geological information has been taken from the Geological Survey of Canada, Map No. 23-1957. The writer obtained considerable knowledge of the type of iron deposits described from mapping and property examinations in Northwest Quebec during 16 years while employed by the Quebec Department of Mines.

W. N. Ingham

W. N. Ingham, Ph. D.,
Consulting Geologist.

Toronto, Ontario,

April 17, 1958.