WELCOME NORTH MINES LTD. (N.P.L.)
Suite 8, 1161 Melville St., Vancouver, B.C. V6E 2X7 Telephone (604) 687-1658

EXPLORATION REPORT

DELTA IRON DEPOSIT

DELTA 1-48 MINERAL CLAIMS, DAWSON MINING DISTRICT

DAWN 1-48 MINERAL CLAIMS, DAWSON MINING DISTRICT

N.T.S. 117-A

Latitude: 68°30'N

Longitude: 136°30'W

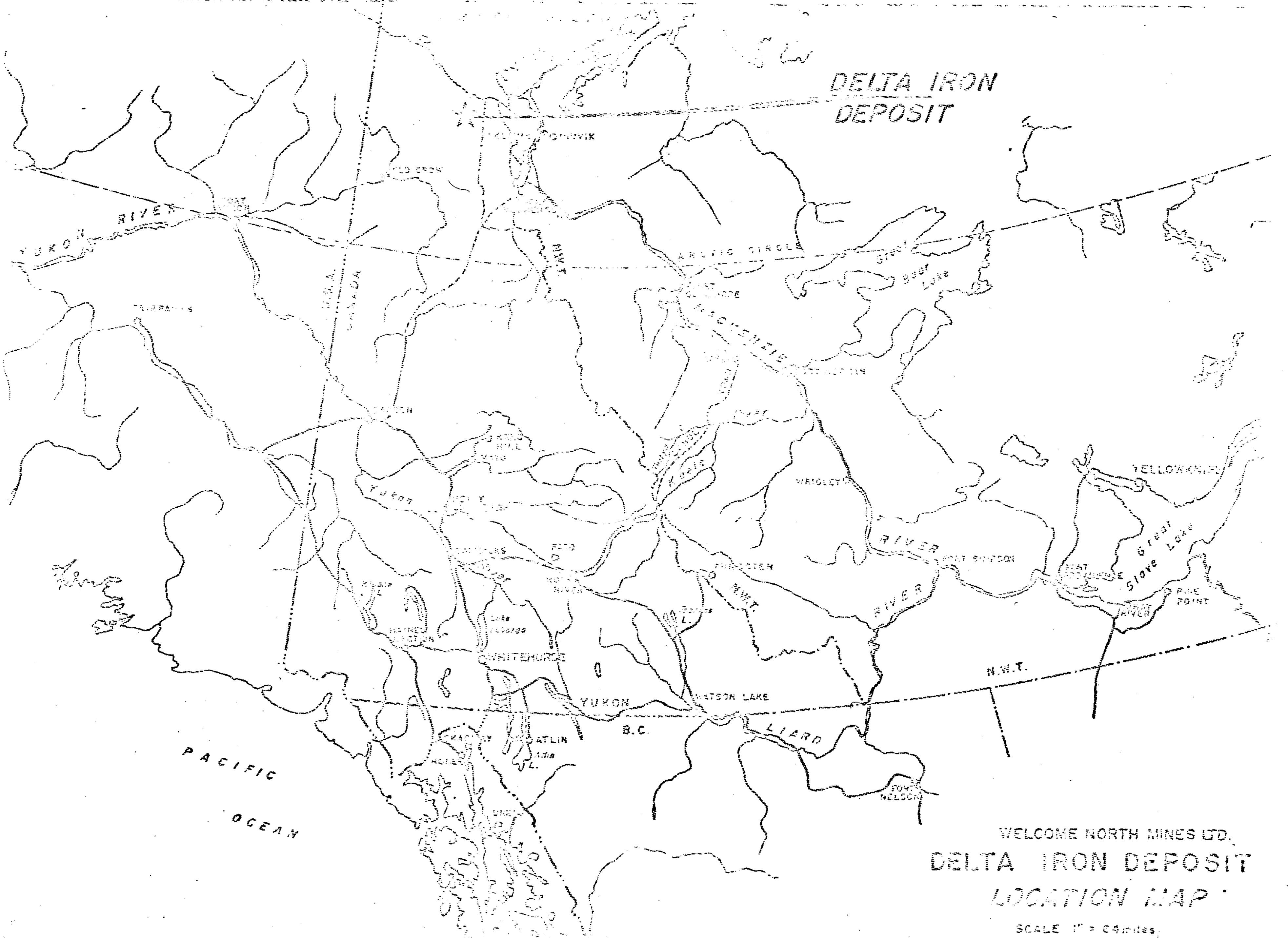
Period Covered: April 1 to December 31, 1974

by

John S. Brock

April 2, 1975.

12,100



WELCOME NORTH MINES LTD.
DELTA IRON DEPOSIT
LOCATION MAP
SCALE 1" = 64 miles.

CLAIMS LIST

CLAIM NAMES	GRANT NUMBERS	RECORDING DATE
DELTA 1-48 inclusive	Y82503-Y82550	May 30th, 1974
DAWN 1-48 inclusive	Y82551-Y82598	May 30th, 1974

SUMMARY

Welcome North was attracted to the Mount Davies Gilbert ironstone deposits after reference was made to their location by F.G. Young in the Geological Survey of Canada Report of Activities (Paper 72-1A). Further personal communication with Young led to Welcome North staking selected areas of known ironstone sections in April, 1974.

A letter of agreement, outlining the principal terms of a joint venture on the properties and surrounding area was entered into on June 27th, 1974, between Welcome North Mines Ltd. and Bethlehem Copper Corporation Ltd.

Field work by the G.S.C. has shown the ironstone formations to be extensive, about 24 miles long, 6 miles wide and from 50 to 150 feet thick. Indications are that the deposit consists of several tens of billions of tons of iron ore, grading from 35% to 40% Fe. Attention must be paid also to high P_2O_5 assays obtained by the G.S.C., with a view to commercial phosphate production.

Not to be overlooked in the area are the possibilities of associated mineralization, such as sedimentary bedded copper deposits. In this regard, no work has been done. The region also has a history of placer gold production, and the possibility of colloidal gold deposits should not be overlooked.

In view of the fact that a large tonnage of iron exists within 36 miles of a proposed deepwater sea port at Shingle Point, and that the Mackenzie Delta natural gas reserves offer an energy source for refining of the iron, further evaluation and exploration is recommended.

The first phase of such an evaluation consisted of a detailed examination made by H.E. Neil, a geological consultant and expert on iron deposits. His findings, appended to this report, indicate that further work is warranted.

LOCATION AND ACCESS

The Delta iron deposit is located 80 miles west of Inuvik, the main transportation and supply point for the area. Fort McPherson, on the Dempster Highway, is 88 miles to the southeast.

The Shingle Point Dewline airstrip is 32 miles northwest of the property. The Shingle Point deepwater seaport (proposed by the Federal Government) is located 36 miles northwest of the deposit.

Present access is via daily scheduled airline service, P.W.A. or Jet Air, to Inuvik, and from that point by charter air service to the property. Lakes suitable for float-equipped aircraft are within the area of the claims.

GEOLOGY AND MINERAL OCCURRENCES

The area, as described by F.G. Young[1], consists mainly of Cretaceous rocks. Bedded ironstone and shale has been found within an Aptian-Albian flysch division (late Early Cretaceous). The bedded ironstone and shale member has measured thicknesses of 2,800 feet to 700 feet. Richer ironstone beds of net thickness of up to 150 feet are found in the Cache Creek, Fish Creek and Rapid Creek areas. The bedded ironstone has been traced for at least 6 miles across strike to the northeast. Young and his associates[2] with the G.S.C. suggest that the ironstone beds thicken as they dip gently to the northeast.

[1] G.S.C. Paper 72-1A, Report of Activities, April-October, 1971.

[2] Personal Communication.

CHEMICAL AND MINERAL ANALYSES OF BEDDED IRONSTONE

Total Chemical Analyses	Sample 108-YA-1	Sample 108-YA-4
% SiO_2	15.00	9.60
% Al_2O_3	4.53	4.73
% TiO_2	0.17	0.17
% Fe_2O_3*	38.61	34.12
% MnO	5.72	4.52
% Na_2O	0.18	2.26
% K_2O	0.37	0.60
% CaO	3.31	5.99
% MgO	2.87	2.56
% BaO	0.00	0.04
% P_2O_5	7.85	20.00
% L.O.I	21.08	14.75
% TOTAL	99.69	99.54

Mineral Analysis		
% Apatite	5.94	10.75
% Kaolin	8.14	6.88
% Pyrite	0.06	2.12
% Siderite	55.95	31.06
% Quartz	11.28	6.46
% Non-crystalline components	18.64	42.73

* Total % iron reported as % Fe_2O_3

Chemical and Mineral Analyses of Bedded Ironstone, Random Samples, 240 feet apart, Fish River Section.

Ironstone sections have been measured at the following locations by the Geological Survey:

CACHE CREEK	50 feet thick
FISH RIVER	150 feet thick
WEST FISH RIVER	Ironstone noted
DAVIES GILBERT (RAPID CREEK)	110 feet thick

A strike length of 18 miles exists, from Cache Creek to the Mount Davies Gilbert section. Regionally defined dimensions of the deposit are 26 miles by about 8 miles.

MINERALOGY

Siderite, sodalite and scorzolite have been identified by the G.S.C. Mineralogical studies are in progress with Queen's University and Dr. McLeod of the G.S.C. in Ottawa, the results of which should be available within a few months.

Welcome North stakers collected random samples from talus slopes on the Fish River (site D1-D4, Mac Claims) during the course of staking the Mac and Delta mineral claims. Assays from these specimens are presented in Table I. Snow conditions limited adequate prospecting of the area. It has been noted that the samples submitted for assay were not similar in character to "high grade" ironstone specimens collected by the G.S.C.

A further investigation of the properties was made during the month of June by G. Penikis, an independent prospector, who has been evaluating the area for commercial deposits of lazulite. Penikis submitted a variety of selected ironstone samples from the Dawn Group. These specimens have not been assayed, but do contain more visible siderite than those previously collected from the Delta and Mac claims.

ENERGY SOURCES

In view of the possibilities for commercial iron production from the Delta deposit, local energy sources to be considered are:

1) Prudhoe Bay-Delta Natural Gas Line

The proposed pipe line route has been surveyed and crosses the central area of the deposit.

2) Coal

a) Moose Channel Coal Mine
Mined up to 1939, located 18 miles north of the deposit, 20 ft. seams of Bituminous coal.

b) Welcome North Coal Occurrence
Located 23 miles west of deposit (Lignite ?).

c) Bonnet Coal Occurrence
Located 35 miles southwest of deposit (Lignite ?).

Little is known of the nature and extent of coal occurrences in this area.

CLIMATE - SUBARCTIC CLIMATIC REGION
CONTINUOUS PERMAFROST

Mean annual minimum temperature	-50 degrees F.
Mean annual maximum temperature	+80 degrees F.
Mean January daily temperature	-20 degrees F.
Mean July daily temperature	+50 degrees F.
Mean annual precipitation	7 inches
Mean annual snowfall	40 inches
Mean date first snow cover (1 inch)	October 7th
Mean date last snow cover (1 inch)	May 20th
Ice Cover - mild summer Beaufort Sea	Less than 20%
Ice Cover - severe summer Beaufort Sea	40% - 70%
Vegetation	Alpine Tundra

EXPLORATION RESULTS

During the month of July, geological consultant, H.E. Neal visited the Delta area in the company of prospectors A. Kulan and G. Penikis. The object of this examination was to map and sample selected areas of ironstone facies with a view to determining recommendations for further land acquisition and a subsequent exploration program.

The results of this program are appended to this report.

Respectfully submitted,

John. S. Brock
Vice-President Exploration

April 2, 1975.

TABLE I

ASSAY TABLE - SPECIMENS - DELTA AND MAC CLAIMS

SAMPLE LOCATIONS ON MAP

"DELTA IRON DEPOSIT CLAIMS"

Sample Number	Description
0601	Bulk sample, site D1 - float, black Mn stained shale, remnant pyrite (limonite) conglomeritic texture - concretionary ?
0602	Bulk sample, site D2 - float similar to D1 - more limonite.
0603	Bulk sample, site D3 - float, brown-grey shale, minor Mn stain, minor scorzalite, minor visible siderite.
0604	Bulk sample, site D4 - light grey non-descript, competent shale, pebbly texture, visible blebs siderite.
0605	Misc. bulk sample from site D1-D4 (selected lowest s.g.)
0606	Misc. sample from sites D1-D4 (selected highest s.g.)
0607	Misc. sample from sites D1-D4 (selected highest Mn stain)
0608	Selected sample - scorzalite (?).

Spectrographic Analysis

Sample Numbers

	0601	0602	0603	0604	0605	0606	0607	0608
Au	Tr	Tr	Tr	Tr				
Ag	Tr	Tr	Tr	Tr				
Mn	2.56	3.03	1.13	1.21			4.13	
P_2O_5	5.51	5.07	4.27	5.21				
Fe	21.87	23.85	18.85	16.88	13.03	33.67	24.52	major
Al	5.+	5.+	5.+	5.+				6.+
Ba	0.03	0.03	0.01	0.2				N.D.
Mg	2.+	2.+	2.+	2.+				5.+
Na	0.2	0.2	0.1	0.1				0.1
Sr	0.01	0.01	0.01	0.01				0.001
Ti	0.2	0.1	0.2	0.2				0.3
V	0.01	0.01	0.01	0.01				0.01

GENERAL TESTING LABORATORIES

DIVISION SUPERINTENDENCE COMPANY (CANADA) LTD.

1001 EAST PENDER ST., VANCOUVER, B.C., CANADA, V6A 1W2

PHONE (604) 254-1647 TELEX 04-507514 CABLE SUPERVISE

SUPERVISE

TO:

WELCOME NORTH MINES LTD.
#8 - 1161 Melville St.
Vancouver, B.C.
Attn: Mr. J. Brock

CERTIFICATE OF ASSAY

No.: 7405-1551 DATE: May 21st/74

We hereby certify that the following are the results of assays on: ORE

MARKED	GOLD OZ/ST GR/MT	SILVER OZ/ST GR/MT	IRON (Fe)%	MANGANESE (Mn)%	xxxxxxxxx	xxxxxxxxx	xxxxxxxxx	xxxxxxxxx
0601 - V D1			21.87	---				
0602 D2			23.85	---				
0603 D3			18.85	---				
0604 D4			16.88	---				
0605			13.03	---	Knobby shale			
0606			33.67	---	heavier [illegible]			
0607			24.52	4.13	Delta [illegible] slag Mn stained shale			

LW/pm

NOTE: REJECTS RETAINED ONE MONTH. PULPS RETAINED THREE MONTHS. ON REQUEST PULPS AND REJECTS WILL BE STORED FOR A MAXIMUM OF ONE YEAR.

[signature]

SUPERVISE

[illegible] SUPERINTENDENCE COMPANY (CANADA) LTD
1001 EAST PENDER STREET, VANCOUVER 6, B.C., CANADA
PHONE (604) 254-1647 TELEX 04-507514 CABLE SUPERVISE

TO:

WELCOME NORTH MINES LTD.
#3 - 1161 Melville St.
Vancouver, B.C.
Attn: Mr. J. Brock

SEMI QUANTITATIVE SPECTROGRAPHIC ANALYSES CERTIFICATE

No. 7405-1551 DATE: May 22nd/74

We hereby certify that the following are the results of spectrographic analyses made on: ORE

		1	2	3	4	5
Aluminum	Al	5.	5.	5.	5.	(Assay required)
Antimony	Sb	ND	ND	ND	ND	
Arsenic	As	ND	ND	ND	ND	
Barium	Ba	0.2	0.01	0.03	0.03	
Beryllium	Be	ND	ND	ND	ND	
Bismuth	Bi	ND	ND	ND	ND	
Boron	B	ND	ND	ND	ND	
Cadmium	Cd	ND	ND	ND	ND	
Calcium	Ca	3.	2.	3.	3.	
Chromium	Cr	0.003	0.001	0.001	0.003	
Cobalt	Co	0.001	0.001	0.003	0.003	
Copper	Cu	0.007	0.001	0.001	0.01	
Gallium	Ga	ND	ND	ND	ND	
Gold	Au	TRACE	TRACE	TRACE	TRACE	
on	Fe	MAJOR	MAJOR	MAJOR	MAJOR	
Lead	Pb	ND	ND	ND	ND	
Magnesium	Mg	2.	2.	2.	2.	
Manganese	Mn	*	*	*	*	
Molybdenum	Mo	ND	ND	ND	ND	
Niobium	Nb	ND	ND	ND	ND	
Nickel ND	Ni	ND	ND	ND	ND	
Potassium	K	ND	ND	ND	ND	
Silicon	Si	MAJOR	MAJOR	MAJOR	MAJOR	
Silver	Ag	TRACE	TRACE	TRACE	TRACE	
Sodium	Na	0.1	0.1	0.2	0.2	
Strontium	Sr	0.01	0.01	0.01	0.01	
Tantalum	Ta	ND	ND	ND	ND	
Thorium	Th	ND	ND	ND	ND	
Tin	Sn	ND	ND	ND	ND	
Titanium	Ti	0.2	0.2	0.1	0.2	
Tungsten	W	ND	ND	ND	ND	
Uranium	U	ND	ND	ND	ND	
Vanadium	V	0.01	0.01	0.01	0.01	
Zinc	Zn	ND	ND	ND	ND	
Phosphorus	P	*	*	*	*	(0.2 - 1%)

P_2O_5

LW/pm

SAMPLE No.		DESCRIPTION:
1	0604	V
2	0603	V
3	0602	V
4	0601	V
5		

All results expressed as percentages

MATRIX — Major constituent
MAJOR — Above normal spectrographic range
TRACE — Detected but minor amounts
N.D. — Not detected
☆ — Suggest assay

NOTES: Rejects retained one month.
Pulps retained three months.
On request pulps and rejects will be stored for a maximum of one year.

L. Wong - Provincial Assayer
SIGNATURE AND TITLE

Analytical and Consulting Chemists, Bulk Cargo Specialists, Surveyors, Inspectors, Samplers, Weighers

DIVISION SUPERINTENDENCE COMPANY (CANADA) LTD.
1001 EAST PENDER ST., VANCOUVER, B.C., CANADA, V6A 1W2
PHONE (604) 254-1647 TELEX 04-507514 CABLE SUPERVISE

SUPERVISE

TO:
WELCOME NORTH MINES
#3 - 1161 Melville Street
Vancouver, B.C.

CERTIFICATE OF ASSAY

No.: 7405-2451/A DATE: May 29th/74

We hereby certify that the following are the results of assays on: ORE

MARKED	GOLD OZ/ST	SILVER OZ/ST	MANGANESE (Mn)%	PHOSPHORUS PENTOXIDE (P_2O_5)%				
ADDITIONAL WORK DONE ON LAB. NO. 7405-1551								
0601 V	Trace	Trace	2.56	5.51				
0602 V	Trace	Trace	3.03	5.07				
0603 V	Trace	Trace	1.13	4.27				
0604 V	Trace	Trace	1.21	5.21				

LW/pm

PROVINCIAL ASSAYER

Analytical and Consulting Chemists, Bulk Cargo Specialists, Surveyors, Inspectors, Samplers, Weighers

DIVISION SUPERINTENDENCE COMPANY (CANADA) LTD
1001 EAST PENDER STREET. VANCOUVER 6. B C.. CANADA
PHONE (604) 254-1647 TELEX 04-507514 CABLE SUPERVISE

TO:

WELCOME NORTH MINES
#8 - 1161 Melville St.
Vancouver, B.C.
Attn: Mr. J. Brock

SEMI QUANTITATIVE SPECTROGRAPHIC ANALYSES CERTIFICATE

No.: 7405-2703 DATE: June 4th/74

We hereby certify that the following are the results of spectrographic analyses made on: ORE

		1	2	3	4	5
Aluminum	Al	6.				
Antimony	Sb	ND				
Arsenic	As	ND				
Barium	Ba	ND				
Beryllium	Be	ND				
Bismuth	Bi	ND				
Boron	B	ND				
Cadmium	Cd	ND				
Calcium	Ca	1.				
Chromium	Cr	0.01				
Cobalt	Co	ND				
Copper	Cu	0.001				
Gallium	Ga					
Gold	Au	trace				
Iron	Fe	major				
Lead	Pb	ND				
Magnesium	Mg	5.				
Manganese	Mn	*				
Molybdenum	Mo	ND				
Niobium	Nb	ND				
Nickel	Ni	ND				
Potassium	K	ND				
Silicon	Si	matrix				
Silver	Ag	trace				
Sodium	Na	0.1				
Strontium	Sr	0.001				
Tantalum	Ta	ND				
Thorium	Th	ND				
Tin	Sn	ND				
Titanium	Ti	0.3				
Tungsten	W	ND				
Uranium	U	ND				
Vanadium	V	0.01				
Zinc	Zn	ND				
Phosphorus	P	*				

LW/pm

SAMPLE No.	DESCRIPTION:
1	
2	
3	
4	
5	

All results expressed as percentages

MATRIX — Major constituent
MAJOR — Above normal spectrographic range
TRACE — Detected but minor amounts
N.D. — Not detected
☆ — Suggest assay

Della Fe.

NOTES: Rejects retained one month.
Pulps retained three months.
On request pulps and rejects will be stored for a maximum of one year.

L. WONG - Provincial Assayer
SIGNATURE AND TITLE

PRELIMINARY EVALUATION

DELTA IRON DEPOSITS

MOUNT DAVIES GILBERT AREA

YUKON TERRITORY

CANADA

By

H.E. NEAL P.Eng.
CONSULTING ENGINEER

H.E. NEAL & ASSOCIATES LTD.
TORONTO, CANADA.

OCTOBER, 1974

TABLE OF CONTENTS

1.0 SUMMARY AND CONCLUSIONS

1) The Delta Iron Deposits form a unique occurrence of fine-grained Quartz Siderite. The grade of the Rapid Creek section is 16.7% T Fe based on 5 samples; the Fish River section grades 20.5% T Fe based on 16 samples.

2) The Quartz Siderite is characterized by high alumina (4.7 to 12.9 % Al_2O_3), high phosphorous (1.15 to 3.87% P) and manganese in the range of 2% Mn in the Fish River section and an average of .72% Mn in the Rapid Creek area.

3) The tonnage of the Quartz Siderite is very extensive, estimated in the hundreds of millions of tons although the lateral extent is not known. The Rapid Creek section was measured to have a true thickness of 1,450 feet and a vertical section of 598 feet occurs in one ridge at Fish River.

4) The Delta Iron Deposits can only be considered as a potential iron source in view of their proximity to natural gas, oil and coal reserves. Insufficient testwork has been conducted to determine whether these energy sources can produce recoverable iron, phosphorous or aluminum products.

The Delta Deposits are located 80 miles west of Inuvik, N.W.T., Canada and 15 miles south west of the western edge of the Mackenzie Delta.

5) This report is based on a 4½ day visit to two areas of the Delta Deposit during which time 21 samples were collected (5 at Rapid Creek; 16 at Fish River).

6) Preliminary Metallurgical testwork has given inconclusive results based on an expenditure of $2,500. The Quartz Siderite was considered to be too fine grained for physical concentration and testwork was confined to magnetizing roasting and metallization tests at the Ontario Research Foundation. All metallurgical testwork was confined to a thick-bedded Quartz Siderite sample RC-5 from Rapid Creek, due to the restricted budget and numerous variables to be tested. Only iron recovery was considered during this testwork.

7) Magnetizing roasting tests to convert the siderite to magnetite failed to reach optimum conditions with over reduction occurring in all the tests to produce non-magnetic Wustite (Fe O). The best Davis Tube concentrate at -325 mesh contained 40.9% T Fe with a Weight Recovery of 20.8% and an Iron Recovery of 37.6%. Finer grinding might have produced a higher grade concentrate at a lower recovery.

8) Two Direct Reduction tests were made to convert the Siderite to metallic iron using hydrogen as a reductant. The best product contained 66.7% T Fe at a Weight Recovery of 24.2% and an Iron Recovery of 72.5%. The phosphous in the metallized product was 4.75% P compared to 2.76% P in the crude sample of RC-5 An intermediate step to remove phosphorous ahead of the final steel product in an electric furnace would be required.

9) Direct Reduction offers the greatest promise for the recovery of the iron in the Delta Deposits although much more work will be required to obtain the optimum test conditions. Composites of other samples will require testing to determine any variation in the response to metallization.

10) Mineralogical examination showed that the siderite is very fine grained in the order of 1 to 5 micron size. The silica occurs as angular quartz fragments in the 10 to 20 micron size range. Apatite was observed in only 2 of the 4 samples analysed with X-Ray diffraction. The present mineralogical study is very preliminary since the alumina, manganese and phosphorous-bearing minerals have not been identified. Minor chlorite and mica were observed but they do not appear to be abundant enough to satisfy the chemical analyses.

11) The extraction of saleable products from the Delta Iron Deposits will require long term research and field programs.

12) Section 11 contains a brief background of the theory and commercial practices of Magnetizing Roasting and Metallization.

2.0 RECOMMENDATIONS

1) Field work should be restricted to mapping the extent of the iron-bearing sedimentary horizon.

2) Various sections of the deposit should be sampled after the field mapping. Sampling should be conducted on several cross sections with a drill using a tricone bit with recovery of the cuttings by compressed air. The Concore drill is considered to be a good machine for penetration of the soft and hard bedded sediments and for the recovery of representative samples. Some chip sampling of exposures in the Fish River area might be possible but the drill samples should be more representative.

3) Further mineralogical and metallurgical testing of the remaining samples are recommended to determine variations in response since all the testwork has been conducted on Sample RC-5. The biggest unknown at the present time is a method of recovery of the iron. Testwork should be confined largely to Direct Reduction. A budget of up to $50,000 may be necessary to test various aspects of direct reduction. The distribution of phosphorous, alumina and mangenese in the products requires detailed studies.

4) The assistance of the Federal Government and/or a large company in the energy resource field should be solicited for a metallurgical test program.

3.0 INTRODUCTION

This report contains the results of field observations made during a 4½ day visit to two areas of Quartz Siderite sediments in the Delta Iron Deposits. Also included are chemical analyses of 21 samples, preliminary metallurgical results and a brief background on Roasting and Direct Reduction. The metallurgical test program was limited to an expenditure of $2,500. Recommendations for future investigations are outlined.

Attention was drawn to the Mount Davies Gilbert area from report of ironstone deposits by F.G. Young of the Geological Survey of Canada in the Report of Activities, Paper 72-1A. Two grab samples taken by Dr. Young in the Fish River area gave a Total Iron content of 27.0% and 23.8% with high Phosphorous and Manganese.

The field program began on July 31, 1974 with departure from Inuvik by jet helicopter to the Big Bend on the Fish River. On August 2, 1974 the party was moved to the Rapid Creek area for observation of another exposure of iron-bearing sediments indicated by F.G. Young. Two days were spent in the Rapid Creek area locating the iron occurrences and sampling a wide exposure in the valley of Crystal Creek which runs into Rapid Creek.

The field visit was made with the able guidance and assistance of Mr. A. Kulan and Mr. G. Penikis, prospectors who had visited the area during previous staking trips. Their help is gratefully acknowledged in assisting to collect and pack the 21 samples to the temporary camps during the short visits.

Two areas were selected for examination based on sample sites of F.G. Young during his seven-week reconnaissance of the area in 1971. The helicopter was used for preliminary scouting of the two sites, but time did not permit landings at other sites in order to outline the extent of the iron deposits. The helicopter returned to Inuvik after each of the camp moves and did not stay with the party until the August 4th return to Inuvik.

4.0 TERMS OF REFERENCE

We were requested by Bethlehem Copper Corporation, on behalf of a joint venture with Welcome North Mines Limited, to visit the Delta Iron Deposit and prepare a report on the nature of the deposits and recommendations regarding future work.

The property visit was intended to be for 2 to 3 days in order to obtain an overall impression without regard to mapping or complete sampling. Two areas were selected by Welcome North Mines Limited as the most promising sites based on their conservations with F.G. Young.

No overall evaluation of these sites with respect to other iron occurrences was intended nor were these available to outline the extent of the iron deposits. Verification of the claims was outside of the terms of reference.

After the visit to the property, a meeting was held on August 6, 1974 with Mr. R. Anderson, Bethlehem Copper Corporation and Mr. J. Brock, Welcome North Mines Limited. Authorization was granted for an expenditure of $2,500 for preliminary metallurgical testwork, in addition to the cost of the chemical analyses. It was also agreed that the 21 samples be analysed for TFe, Silica, Alumina, Phosphorous, Manganese and Loss On Ignition.

5.0 PROPERTY LOCATION

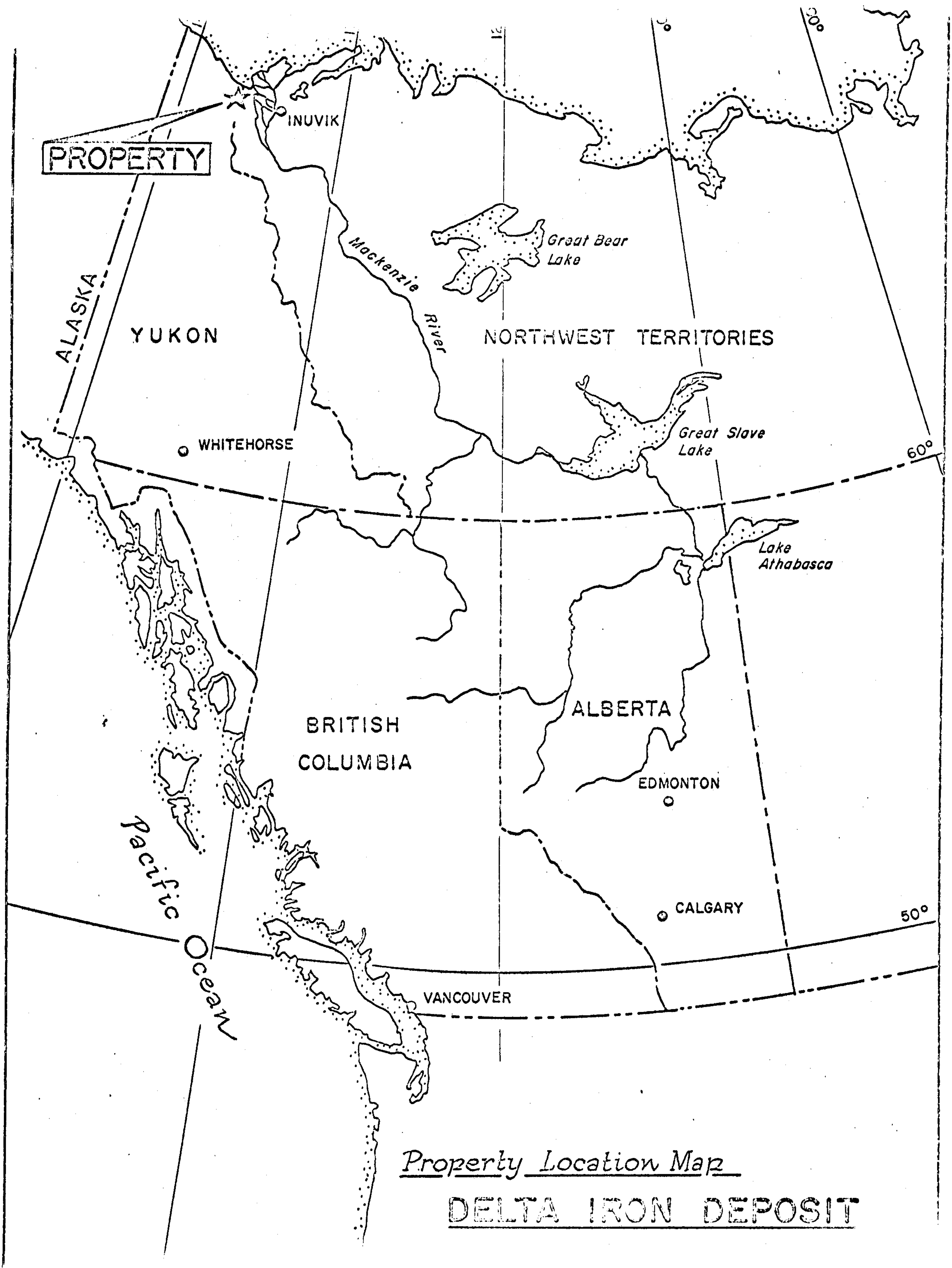
The Delta Iron Deposits are located in the Mount Davies Gilbert area, Yukon Territory forming the northern part of the Richardson Mountains. This area lies in the centre of the eastern half of the Blow River sheet at a scale of 1:250,000 published by the Energy, Mines and Resources Department, Ottawa. The geographical co-ordinates of the centre of this area are: 68° 30' N Latitude

136° 30' W Longitude.

Four blocks of claims have been staked in two groups about 8 miles apart straddling Rapid Creek and Fish River. The easternmost block extends into the Northwest Territories, District of Mackenzie. The accompanying Property Location Maps at a scale of 1 inch to 189 miles and the Claims Location Maps at a scale of 1:250,000 (1 inch = 4 miles) illustrate the property location.

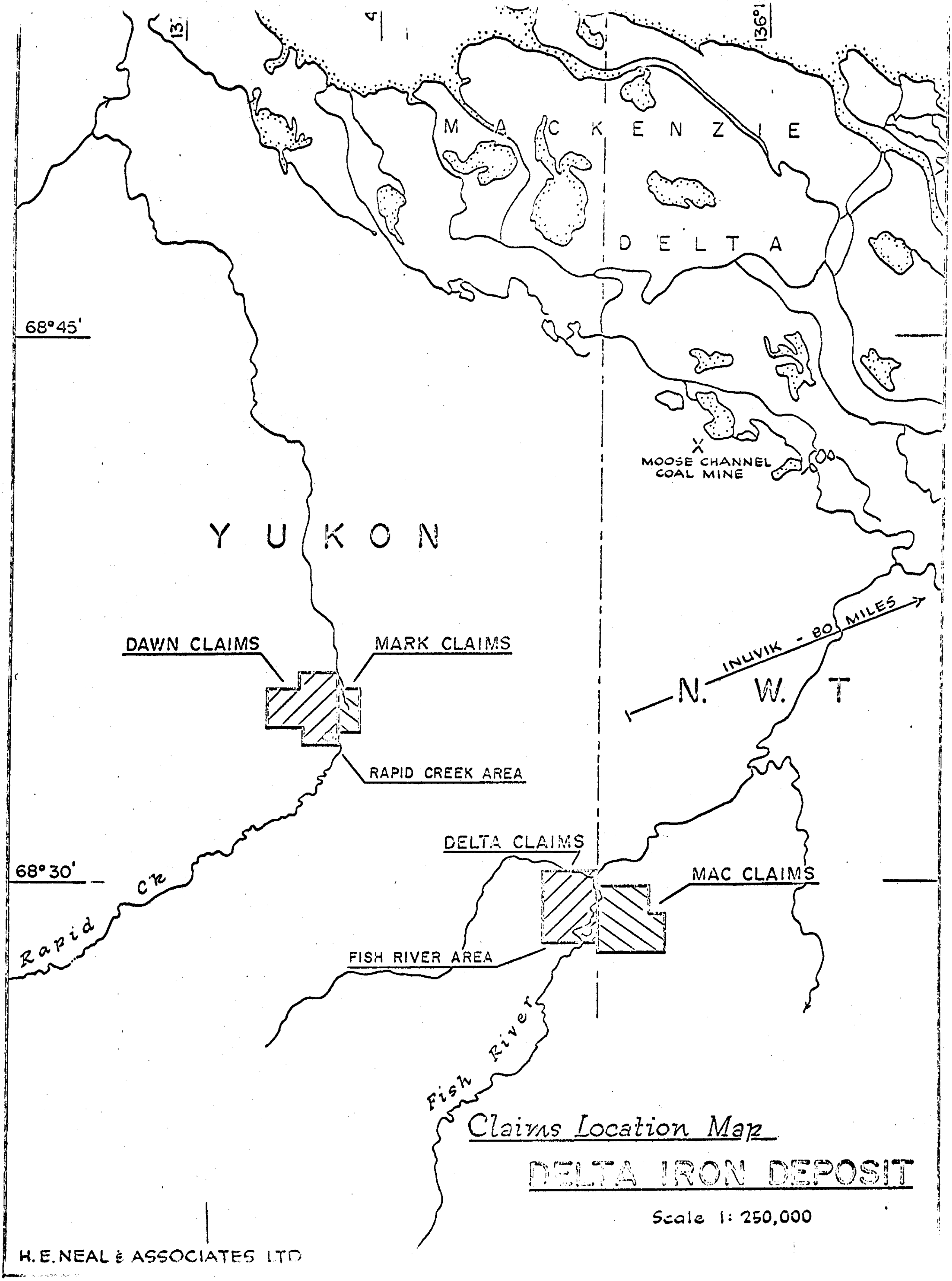
The claim groups are 15 to 20 miles southwest of the western edge of the Mackenzie Delta and 10 to 15 miles southwest of the reported coal occurrences at Moose Channel. Inuvik, N.W.T. is 80 miles east of the centre of the property.

Daily air service is provided to Inuvik with Pacific Western Airlines to Edmonton and Jet Air to Whitehorse with Canadian Pacific Airlines connections to Vancouver. The Shingle Point airport is 20 to 28 miles northwest of the two claim groups.



Property Location Map

DELTA IRON DEPOSIT


13
4
136°
M A C K E N Z I E
D E L T A
68°45'
MOOSE CHANNEL
COAL MINE
Y U K O N
DAWN CLAIMS
MARK CLAIMS
INUVIK - 80 MILES
N. W. T
RAPID CREEK AREA
DELTA CLAIMS
68°30'
MAC CLAIMS
Rapid Ck
FISH RIVER AREA
Fish River
Claims Location Map
DELTA IRON DEPOSIT
Scale 1: 250,000
H. E. NEAL & ASSOCIATES LTD

The recently discovered natural gas deposits are located in the Beaufort Sea and the Mackenzie Delta area. The Prudhoe Bay pipe line branch to connect with the Delta pipeline is projected to be within 10 miles of the claim groups.

6.0 GEOLOGY

6.1 Geological Setting

The Mount Davies Gilbert area is underlain by rocks of Cretaceous age and occurs within the Arctic tundra. The stratigraphy of this area was studied by Dr. F.G. Young in 1971 and he briefly outlined his field results in the Geological Survey of Canada Paper 72-1, Reports of Activities for April-October 1971.

Young described the siderite-bearing sediments as part of the bedded ironstone and shale member in the Aptian-Albian Flysch Sequence of late Early Cretaceous. The bedded ironstone and shale member is reported to exceed 2800 feet in thickness in the Perkis River area (immediately west of Rapid Creek) and decreases eastward to about 700 feet in the Fish River - Cache Creek area. The distance between the Rapid Creek and Cache Creek occurrences is 13 miles although the full extent of the iron-bearing sediments is not described. Young's maps were not reviewed by the author since they have not been published. Depositional and structural features complicate the distribution of the iron bearing sediments and therefore the outline of the Delta Iron Deposits is not presently known.

6.2 Description of the Quartz Siderite Formation

These iron-bearing sediments may be described as Quartz Siderite, an ironstone or a Siderite Shale. The term Quartz Siderite is used here based on preliminary thin-section and X-Ray Diffraction analyses which show that the rocks consist essentially of quartz and siderite with only minor chlorite, mica detected. These sediments are an unique occurrence in Canada and they can not be related to other known iron deposits in this country. The non-oolitic nature of this very fine -grained siderite and shale is in contrast to the flat-lying oolitic sandstone of Late Cretaceos in the Clear Hills of the Peace River area, Alberta. Here the iron occurs in beds 5 to 30 feet thick consisting chiefly of goethite, siderite and hydrous silicates in a sandstone with descrete sand grains at an average grade of 32 to 35% Fe. The Delta Deposit also differs from the oolitic Clinton type of iron deposits found at Wabana, Newfoundland and in the eastern United States. Here the iron is chiefly present as hematite, chamosite and siderite in deep red to purple coloured beds.

The Delta iron-bearing sediments most closely resemble the "black band" and massive non-oolitic beds described by Dr. G.A. Gross, Geological Survey of Canada in his description of Canadian iron occurrences. This type consists of lenticular beds of siderite, sideritic mudstones, siderite-hematite or massive hematite and goethite. Bedding is poorly developed in most of these occurrences in contrast to the thick and thin bedded character of the Delta deposits. Typically members of the "black band" have an iron content of less than 25% Fe, high manganese (up to 15%) with high phosphorous. Examples of "black band" sediments occur in Europe in the black band clay ironstones associated with the coal beds in the Lahn and Dill River valleys of Germany and the siderite-hematite beds near Vares, Yugoslavia.

The Delta siderite deposits are a completely different type of occurrence to the Algoma-type siderite in Michipicoten, Ontario. Here the siderite forms massive and lenticular beds in a banded chert closely associated with pyrite-pyrrhotite beds and various volcanic rocks.

6.3 Geology of the Rapid Creek-Fish River Areas

Rapid Creek Area

Rapid Creek flows through a broad valley measuring 1,000 to 2,500 feet wide bordered by 100 foot scarps cut in either sediments or overburden. The surface above the valleys is gently rolling grass - covered tundra. The highest point in the area is Mount Davies Gilbert which has an elevation of 2,693 feet. The elevation in the Rapid Creek area is between 500 and 1,000 feet.

Bedded siderite shale occurs along the east side of Rapid Creek, north of the junction with Crystal Creek (See Sketch of Rapid Creek Area 1" = 2,640 feet). This outcrop shows slickensides and deformation with steep easterly dips. Two prominent exposures of flat-lying Quartz Siderite form a 200 foot high cliff face opposite the junction of Crystal Creek with Rapid Creek (Photographs 7 and 8).

Crystal Creek forms a deep V-shaped valley with cliff faces rising up to 400-600 feet where the stream has cut through the sediments exposing an excellent cross section over half a mile wide.

In Crystal Creek gray and red shales overlie the Quartz Siderite (called ironstone by F.G. Young) which is exposed across a horizontal width of 1,950 feet (See Sample Plan). The Quartz Siderite consists of interbedded hard thick bedded and platy thin-bedded bands weathering to a grayish brown colour with minor gun-metal blue weathering. The thin-bedded Quartz Siderite frequently forms a fissile slate with decreasing iron content. The overall proportion of thick and thin bedded Quartz Siderite is about equal. Finely disseminated Marcasite is frequently present giving a rusty weathered surface. Quartz and other complex minerals of unknown identity occur as well as crystallized linings of vugs and fractures in the siderite beds.

The Quartz Siderite dips at an average of 55° to the east with a north-south strike. The footwall of the Quartz Siderite is underlain by a shale-mudstone member of unknown thickness. The lateral extent of the Quartz Siderite is not known since it normally only occurs in Creek valleys. Mapping and sampling in the Crystal Creek valley required all the available time.

<u>Fish River Area</u>

Observations and sampling were centred around the Big Bend section of the Fish River. (See Sketch of Fish River Area at a scale of 1" = 2,640 ft.)

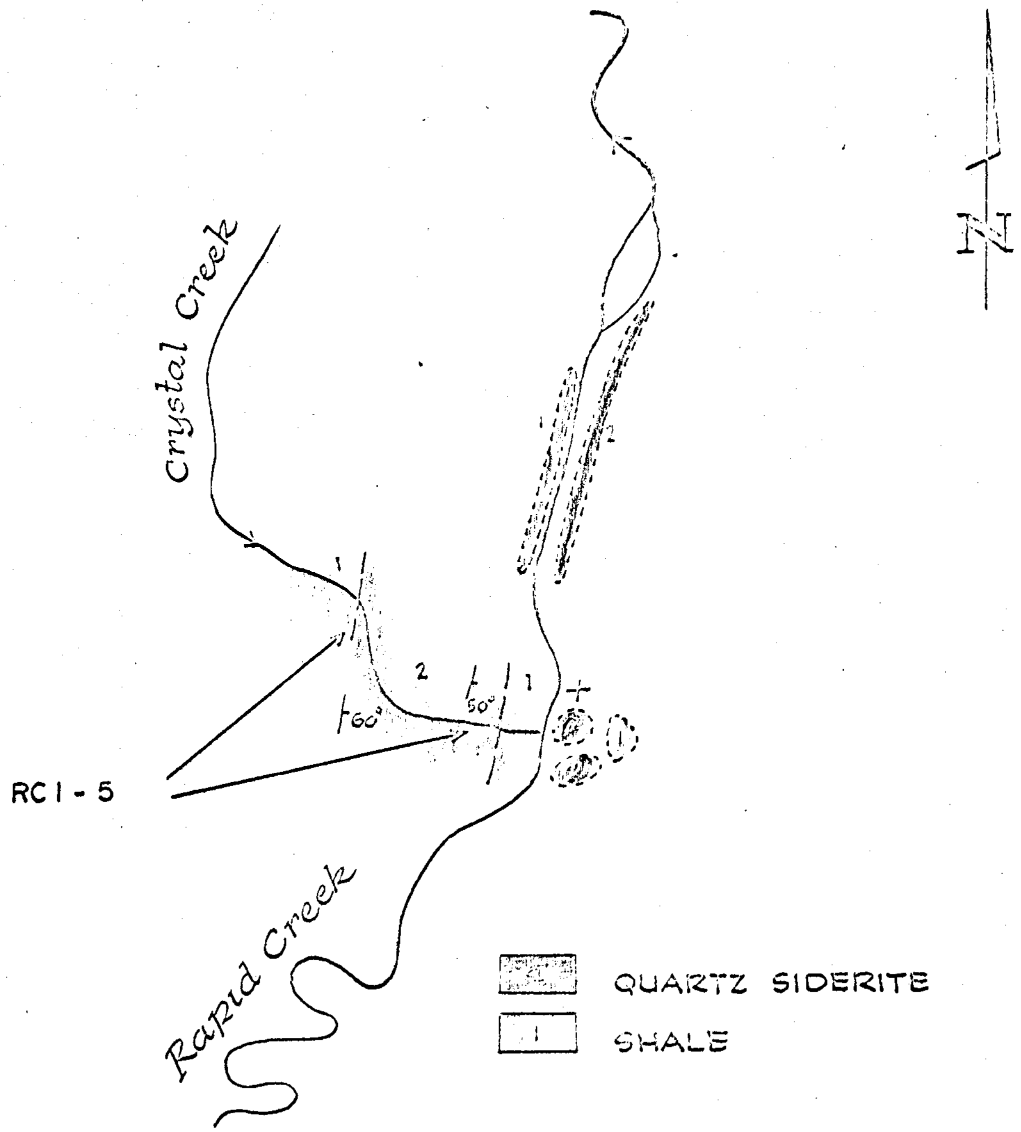
At the Big Bend an extensive exposure of mudstone with a conformable contact with the overlying Quartz Siderite is present along the bank of the river (see Photograph 1). The beds in this area dips 20° to the east. Steep angle faults occur within the Quartz Siderite and have offset the formation dropping the east side down with respect to the west side (See Photograph 1). The accompanying sketch shows the distribution of the Quartz Siderite and Shale in the immediate vicinity of Big Bend. The structural geology is quite complicated in this area where faulting extends south along the Fish River. Several blocks of Quartz Siderite are cut by faults as evidenced by slickensides and crumpling of the beds. These fault blocks have left several resistant flat-lying and folded ridges of Quartz Siderite east of the Fish River, Photographs 2 and 6.

South and east of the Big Bend the Quartz Siderite dips gently eastward and appears to be overlain by light gray shales (Photograph 3). Flat lying Quartz Siderite are visible north and south of Big Bend but the extent is not known.

The thick-bedded Quartz Siderite in this area weathers to a bright gun-metal blue colour (Photograph 6). A thin-bedded slaty variety of Quartz Siderite is interbedded with the thick bedded bands. The chemical analyses of the thick and thin beds appear to be similar in the Fish River section.

Irregular rusty weathered shaly lenses occur throughout this section. These lenses vary in thickness from 18 inches to 5 feet averaging about 2 feet. (Photograph 5).

A distinctive feature of the Quartz Siderite in this area is the presence of an irregularily distributed white coating of a soft secondary mineral which has not been identified (Photographs 1, 2, 5 and 6). This chalky white to bluish gray coating forms a skin-like covering on the rock surface. Chiefly it occurs as a non-crystalline film but locally fine white feathery acicular crystals form zeolite-like clusters.



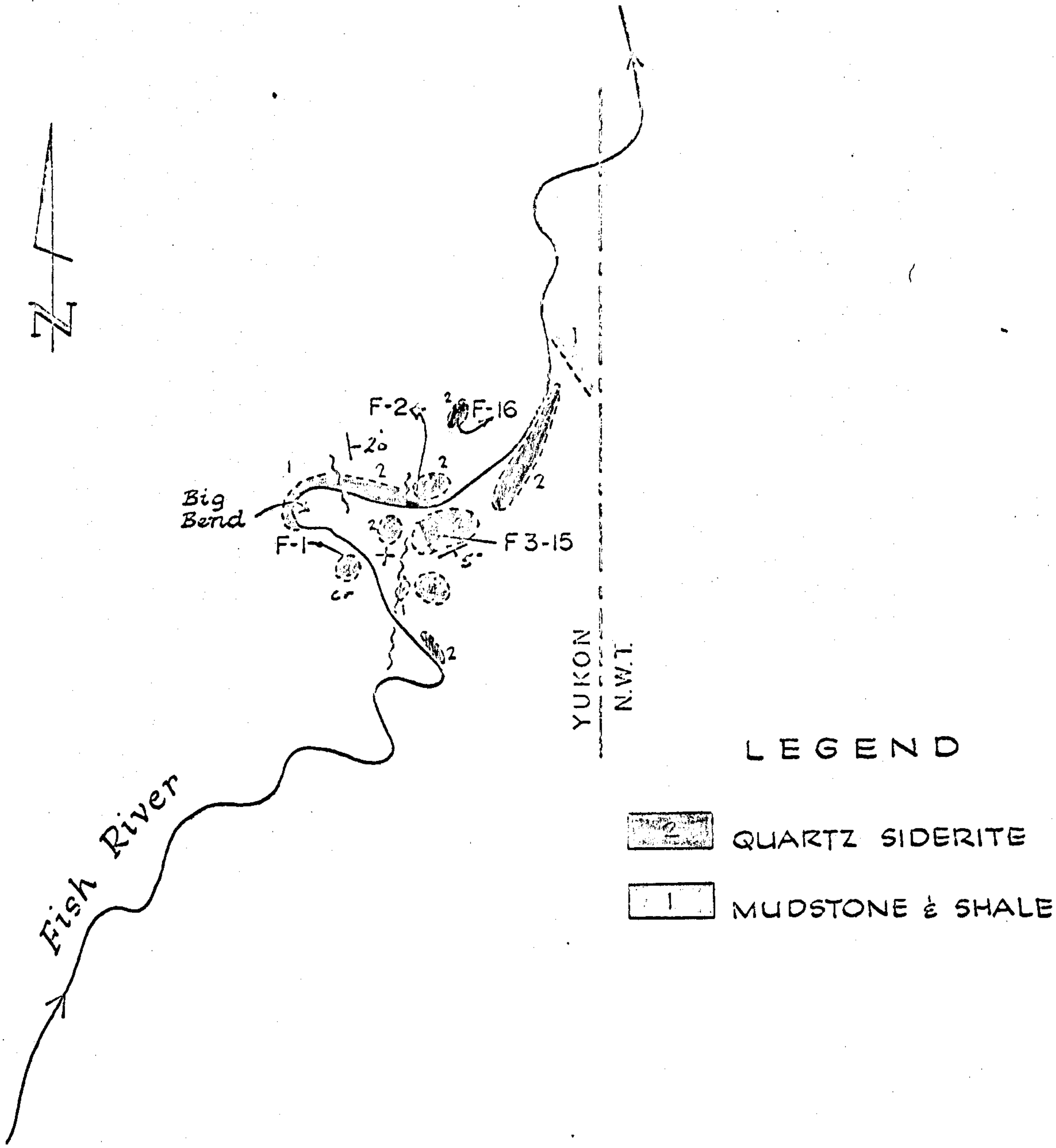
Sketch of

RAPID CREEK AREA

DELTA IRON DEPOSIT

Scale: 1in to 2640 ft

H.E. NEAL & ASSOCIATES LTD



Sketch of

FISH RIVER AREA

DELTA IRON DEPOSIT

Scale: 1 in to 2640 ft

7.0 MINERALOGY

7.1 Highlights of Observations

Examination of 4 samples showed that the chief minerals are quartz and siderite which have very fine grained texture. The quartz occurs as angular grains measuring 10 to 20 microns in diameter (25 microns = 500 Mesh). The siderite occurs as very fine grains in the order of 1 to 5 microns.

7.2 Procedure

A very preliminary mineralogical examination was made of the texture and mineralogical association as a guide to the metallurgical test program rather than an identification of the numerous complex minerals.

The Mineral Research Branch of the Ministry of Natural Resources of Ontario was requested by the Ontario Research Foundation to conduct this examination. They normally co-operate in order to give faster service than that provided by the Universities. The full report by the Mineral Research Branch is Included in the Appendix.

7.3 Samples

Thin Section Examination - crude rock samples.

RC-1 - thick bedded	Rapid Creek
RC-3 - thin bedded	Rapid Creek
F-11 - thick bedded	Fish River

7.3 Samples (continued)

X-Ray Diffraction

Crude Samples - RC-1, RC-3, RC-5, F-11.

RC-5 was selected for all the metallurgical testwork.

Magnetic Roast Samples - RC-5		Test 5	roast product
		Test 2	roast product
Metallization Sample	-	Test 3	+ 325 Mesh metallic beads and - 325 Mesh product

7.4 Results

Petrology - The chief constituents are quartz and siderite with minor mica and chlorite. The quartz occurs as small angular fragments measuring 10 to 20 microns in diameter disseminated through the siderite. The siderite is finer grained than the quartz and in the order of 1 to 5 microns in size as determined under a high power petrographic microscope. An unidentified zeolite-like mineral appeared to be davity fillings.

The absence of apatite in the thin sections was rathersurprising since it normally is easily identified and the percentage of phosphorous is unusally high. X-Ray diffraction identified small amounts of apatite in two of the four samples. The phosphorous is suspected to be present in unidentified complex phosphates requiring detailed study.

The thin bedded slaty sample RC-3 showed banding between siderite-rich layers and siderite-poor layers with considerable clastic quartz and minor mica.

7.4 Results (continued)

X-Ray Diffraction - Four crude samples were analysed with all showing the major constituents as quartz and siderite. Chlorite was present in three of the four samples; apatite in two of the four samples and mica appearing only in sample RC-3.

Other silicates and phosphates were expected to account for the high alumina and phosphorous analyses but they were not identified. The relation of the chemical analyses and the mineralogy was not resolved in this brief study.

The X-Ray diffraction analyses of roasted products confirmed the presence of Wustite (FeO) which is non-magnetic and the product of over-reduction past the magnetite stage. Fayalite, an iron silicate was also present as an unrecoverable iron-bearing product. Magnetic roast product of Test 2 showed that metallic iron was formed during the prolonged roasting with hydrogen.

7.5 Other Mineralogical Studies

It is reported that Dr. Young submitted several small samples to the Geological Survey of Canada for chemical and mineralogical analyses. Mr. R. MacLeod, mineralogist at the Geological Survey advised us that no chemical analyses have been received and that the petrographic work has not been started.

It is understood that mineralogical studies are being presently conducted at Queen's University although results are not available.

The 72-1 Report of Activities of the Geological Survey includes chemical and mineral analyses of two grab samples of unknown location. These analyses vary greatly from the analyses of the 21 samples taken in August 1974. The largest differences are in the iron, alumina and silica content. The analyses of these two samples are reproduced from the report of the G.S.C. The reporting of the Total Iron as Fe_2O_3 (Hematite) is very misleading since it gives a false sense of proportion and occurrence. The % Fe_2O_3 should be multiplied by 0.7 to determine the % Fe present.

CHEMICAL AND MINERAL ANALYSES OF BEDDED IRONSTONE

Conducted For The Geological Survey of Canada

Total Chemical Analyses	Sample 108-YA-1	Sample 108-YA-4
% SiO_2	15.00	9.60
% Al_2O_3	4.53	4.73
% TiO_2	0.17	0.17
% Fe_2O_3 *	38.61	34.12
% T Fe (calculated)	27.03	23.8
% MnO	5.72	4.52
% Na_2O	0.18	2.26
% K_2O	0.37	0.60
% CaO	3.31	5.99
% MgO	2.87	2.56
% BaO	0.00	0.04
% P_2O_5	7.85	20.00
% L.O.I.	21.08	14.75
% TOTAL	99.69	99.54
Mineral Analysis		
% Apatite	5.94	10.75
% Kaolin	8.14	6.88
% Pyrite	0.06	2.12
% Siderite	55.95	31.06
% Quartz	11.28	6.46
% Non-crystalline components	18.64	42.73

* Total % iron reported as % Fe_2O_3.

8.0 SAMPLING

8.1 Sampling Procedure

The extensive steep exposures of Quartz Siderite in both the Fish River and Rapid River areas presented a difficult sampling problem during a reconnaisance visit.

8.1.1 Fish River Area

The sample site selected immediately east of the Big Bend offered the best continuous exposure in this area (See Sketch of Fish River Area). The ridge has a slope of 35° rising from the Fish River for a measured distance of 1,050 feet to the peak, equivalent to a vertical height of 598 feet. Continuous rock is exposed for 580 feet along the slope from 290 to 870 feet. The bottom section was covered with talus and the upper section contained overburden.

The distance along the slope was measured with a cloth tape and the angle of the slope was determined by a Brunton compass. See sample Cross Section 1" = 100 ft.

Due to the limitation of time and the steepness of the slope, the sample lengths were measured along the slope with 50 foot sections marked (except F-14 at 30 feet). The dip of the beds was horizontal to 5° south and for the purpose of calculating the true sample thickness the beds were taken as horizontal.

Each sample weighed from 7 to 15 pounds. The samples were taken by breaking 1 to 2 inch pieces from each band across the beds with a geological hammer. Samples were taken continuously along the 580 feet of exposure. Regular 50 foot sample lengths were selected due to the variable Proportion of thick and thin bedded material (See Cross Section of Fish River Sampling). Other sites were inaccessible or discontinuous (Photographs 1, 2, 3, 6).

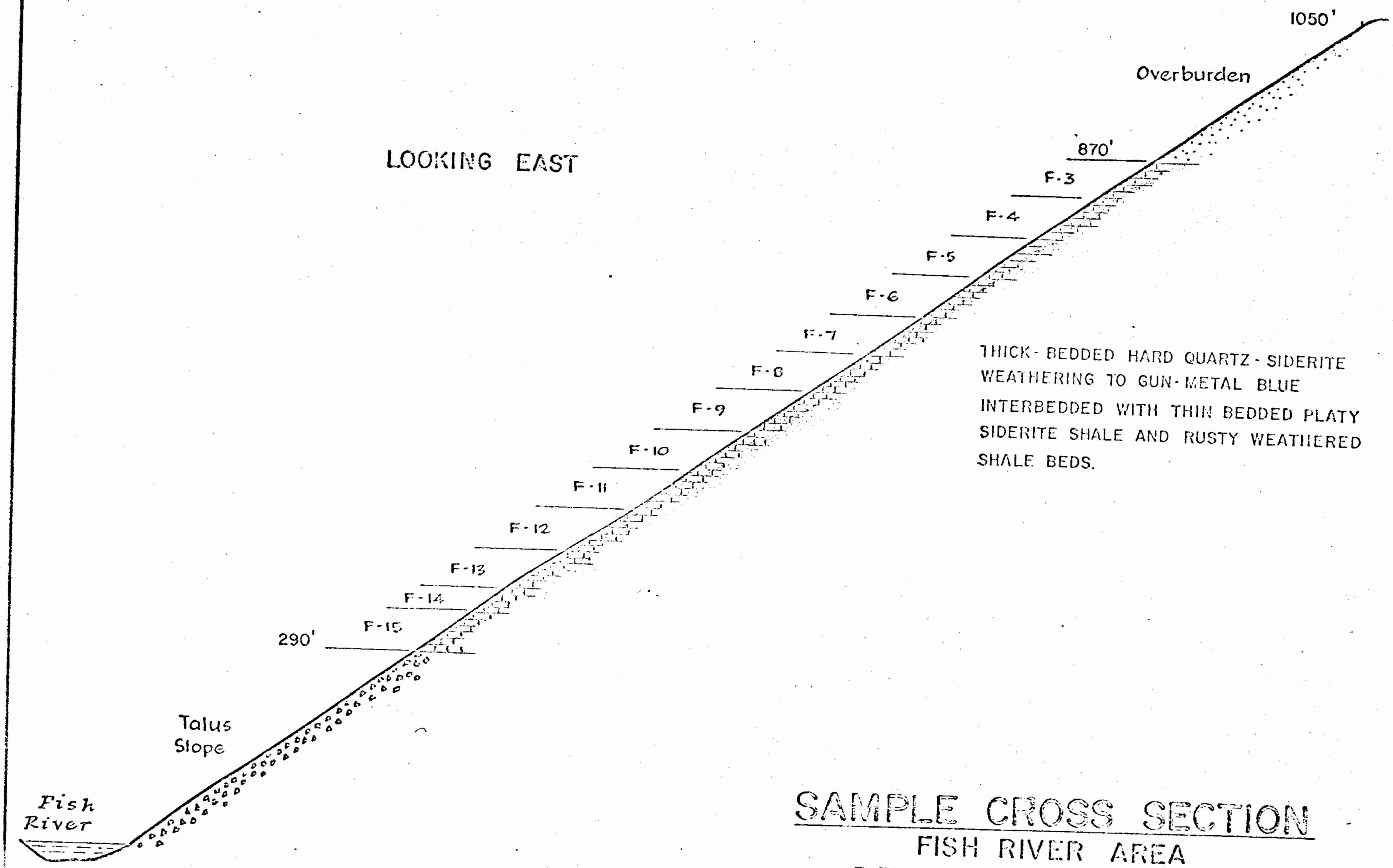
8.1.2 Rapid Creek Area

The best continuous exposure of the Quartz Siderite occurs along Crystal Creek which flows eastward into Rapid Creek. See Sample Plan Rapid Creek at a scale of 1" = 200 feet. Sampling of two flat lying ridges of Quartz Siderite, east of Rapid Creek (Photographs 7 and 8) would have provided less continuous rock exposure.

The Crystal Creek valley was chained from the Shale-Quartz Siderite footwall contact to the Shale hanging wall and to Rapid Creek. The irregular path of the Creek was charted by a Brunton compass with horizontal distances measured by a nylon measuring chain. The locations of the 5 samples taken are shown on the sample plan. The Quartz Siderite has a horizontal span of 1,950 feet. The true thickness of the Quartz Siderite was calculated to be 1,640 feet; 1,400 feet at 60° and 550 feet at 50° average dip.

A complete sampling of this section was not possible due to the time and number of sample bags available since the amount of exposure was greater than anticipated.

The continuous exposure along the creek bed was mapped to show the major contacts and rock types. The slopes along the valley varied from 60° to 30° forming rock cuts which are 400 to 600 feet deep (Photograph 11). Five sample sites were selected to be typical of the various types of thick-bedded and thin-bedded Quartz Siderite. Continuous chip samples were taken across each bed with a geological hammer for a horizontal distance of 25 feet. This length was selected arbitrarily to provide about 10 pounds of sample.

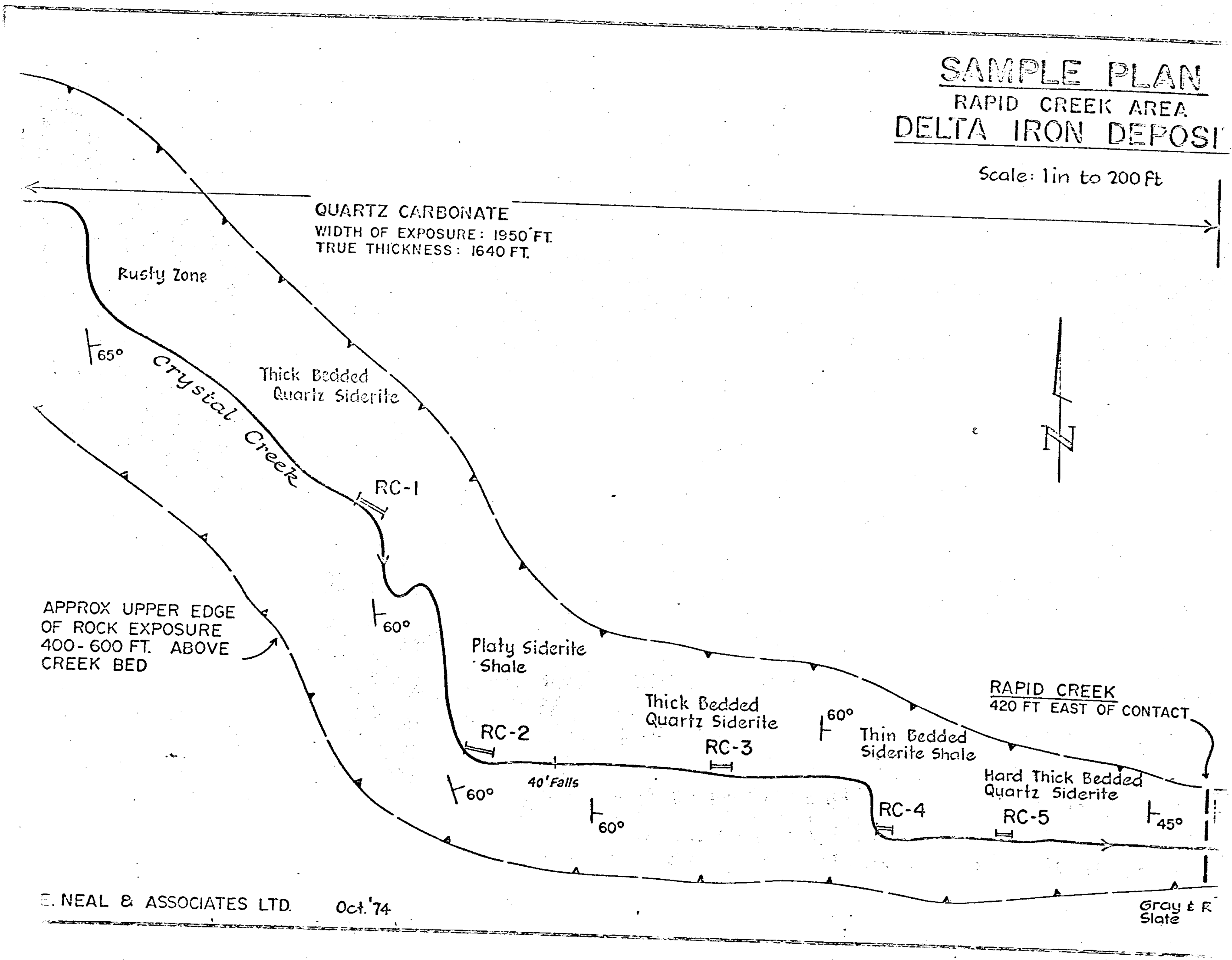


SAMPLE CROSS SECTION
FISH RIVER AREA
DELTA IRON DEPOSIT

Scale: 1in to 100 Ft

H. E. NEAL & ASSOCIATES LTD.

Oct.


SAMPLE PLAN
RAPID CREEK AREA
DELTA IRON DEPOSI
Scale: 1in to 200 ft
QUARTZ CARBONATE
WIDTH OF EXPOSURE: 1950 FT.
TRUE THICKNESS: 1640 FT.
Rusty Zone
65°
Crystal Creek
Thick Bedded Quartz Siderite
RC-1
N
APPROX UPPER EDGE OF ROCK EXPOSURE 400-600 FT. ABOVE CREEK BED
60°
Platy Siderite Shale
RC-2
60°
40' Falls
60°
Thick Bedded Quartz Siderite
RC-3
60°
Thin Bedded Siderite Shale
RAPID CREEK
420 FT EAST OF CONTACT
Hard Thick Bedded Quartz Siderite
RC-4
RC-5
45°
Gray & R Slate
E. NEAL & ASSOCIATES LTD.
Oct.'74

8.2

DESCRIPTION OF FIELD SAMPLES

Sample No.	Length Feet	True Thickness Feet	Description
			FISH RIVER AREA
F-1	Grab	-	Thick bedded Quartz Siderite with 25% thin bedded Siderite Shale - weathered to gun-metal blue colour. - representative of exposure south of Big Bend.
F-2	Vertical Sample	32.5	Strike 60° Dip 15° S. Rusty brown weathering inter-bedded hard Quartz Siderite and thin bedded fissile Siderite Slate. Hard Quartz Siderite beds vary from ½ inch to 6 inches thick forming about 50% of this exposure.

See Sample Cross Section - Fish River

Sample No.	Length Feet	True Thickness Feet	Description
F-3	50 ft. along 35° slope (F3-F15)	27.5	Chiefly gun-metal blue weathering thick-bedded Quartz Siderite with 10% thin slaty material. Dip flat to 5° South.
F-4	"	"	Gun-metal blue weathering thick-bedded Quartz Siderite with 20% thin slaty Siderite.
F-5	"	"	80% thick-bedded Quartz Siderite and 20% thin-bedded Quartz Siderite/
F-6	"	"	75% thin-bedded platy Quartz Siderite with 25% thick bedded variety, white secondary coating. Two 5 foot rusty weathered slaty bands occur with this sample; rusty appearance due to weathered disseminated Pyrite-Marcasite.

DESCRIPTION OF FIELD SAMPLES (continued)

Sample No.	Length Feet	True Thickness Feet	Description
F-7	50 ft. along 35° slope (F3-F15)	27.5	50% thin-bedded, 50% thick-bedded Quartz Siderite.
F-8	"	"	70% thin-bedded, 30% thick-bedded Quartz Siderite with white coating over most of this sample. A 2-ft. and a 3-ft. rusty shaly bands occur in this sample.
F-9	"	"	85% thick-bedded, 15% thin-bedded Quartz Siderite containing 5 rusty slaty bands in this sample varying from 18 inches to 2 feet in thickness.
F-10	"	"	Medium to thin-bedded Quartz Siderite with majority of beds measuring 3/8" to 3/- thick; brownish grey weathered surface with sample containing two 2 foot rusty slate bands.
F-11	"	"	90% gun-metal blue weathering thick-bedded and 10% thin fissile slaty beds. Whit secondary coating covered most of this sample. Dip 5° South.
F-12	"	"	50% thick-bedded, 50% thin-bedded Quartz Siderite with hard bands up to 1 inch thick; minor interbedded rusty bands.
F-13	"	"	90% Thick-bedded, 10% thin-bedded fissile Quartz Siderite; strong jointing.
F-14	30 feet along 35° slope	17.1	Similar to F-13 with gun-metal blue weathering.

DESCRIPTION OF FIELD SAMPLES (continued)

Sample No.	Length Feet	True Thickness Feet	Description
F-15	59 feet along 35° slope	27.5	Chiefly thin bedded with 20% hard bands up to 3/4 inch thick; gun-metal blue weathering.
F-16	Grab across 50 feet		Rusty thin bedded slaty Quartz Siderite with prominent gray colour on the fresh surface.
			Part of large outcrop 500 feet above Fish River 1-2 miles east of big bend. Sample taken by A. Kulan
F-17	Grab		White secondary coating consisting of fine acicular white crystals of unknown indentity for Spectrographic analysis.

DESCRIPTION OF FIELD SAMPLES (continued)

Sample No.	Length Feet	True Thickness Feet	Description
			RAPID CREEK AREA Sampled Along Crystal Creek See Rapid Creek Sample Plan
RC-1	25	21.8	Thick-bedded light brownish gray weathering Quartz Siderite with 10% thin fissile slaty material. Dip 60° East; contains minor disseminated Marcasite.
RC-2	25	22.5	Thin-bedded slaty Quartz Siderite with 20% as thicker beds up to 1 inch thick; some fissile appear to be low in iron; finely disseminated Marcasite. Dip 65° East.
RC-3	25	21.8	Thick-bedded grayish brown weathering Quartz Siderite with beds varying from 2" to 6" thick accompanied by 10-15% thin fissile slaty Quartz Siderite. Dip 60° East.
RC-4	25	20.5	Thin-bedded fissile slaty Quartz Siderite with 5-10% thick bedded bands up to 3/4 inch thick; dark grey to brownish gray weathering; fine light gray nodules of unknown material occur in the slaty bands; the nodules are about 10 Mesh in size (1/20 inch) Dip 55° East.
RC-5	25	19.2	Light gray weathering with minor gun-metal blue coloured thick bedded Quartz Siderite; minor associated blue crystalline mineral (lazulite?) and a light green unknown mineral; Dip 50° East. This section appeared to have the highest Siderite content of the section along Crystal Creek.

9.0 CHEMICAL ANALYSES

The following table contains the Chemical Analyses as reported by the Ontario Research Foundation.

The Appendix also contains a report of a semiquantitative spectrographic analysis of sample F-17. This is a sample of the soft white secondary mineral forming an irregular coating on the Quartz Siderite.

The chief components are:	10-5%	S, Al
	5 - 1.0	Fe, Si, Mr
	1.0 - 0.1	K, P, Sn, Ca

This might suggest a secondary sulphate mineral although its identity is unknown.

CHEMICAL ANALYSES

OF SAMPLES AS

REPORTED BY ONTARIO RESEARCH FOUNDATION

Sample	% T.Fe	% SiO_2	% Al_2O_3	% Mn	% P	% L.O.I.
RAPID CREEK AREA						
RC-1	12.4	39.3	7.3	0.12	3.87	9.3
2	13.1	46.4	8.6	0.13	1.98	8.3
3	17.3	35.9	9.2	0.56	3.00	8.8
4	18.5	36.0	8.6	0.85	2.92	9.9
5	22.2	26.0	7.0	2.0	3.19	14.3
FISH CREEK AREA						
F-1	19.5	28.4	8.7	3.4	2.61	12.0
2	12.9	42.2	12.9	3.5	1.58	9.8
3	25.0	15.8	4.7	2.2	2.30	20.0
4	24.7	16.1	5.7	1.7	2.94	19.8
5	22.5	25.2	7.7	2.2	2.76	13.8
6	20.3	30.8	8.9	2.0	1.94	15.2
7	22.6	24.3	6.6	1.2	3.24	15.3
8	20.0	31.8	9.1	1.9	1.91	13.6
9	23.4	24.7	7.2	2.3	2.15	16.9
10	22.8	28.3	8.3	1.7	1.95	15.6
11	24.6	22.6	5.9	3.4	2.47	17.2
12	19.3	34.7	8.8	1.9	1.15	13.8
13	18.1	33.7	8.0	2.9	1.64	13.6
14	16.8	39.2	10.3	1.5	1.45	11.2
15	16.5	37.0	9.5	2.0	1.45	12.7
16	19.7	38.8	7.6	0.71	2.47	14.4

10.0 METALLURGICAL TEST RESULTS

The testwork was conducted by the Ontario Research Foundation which is the most experienced Canadian commercial laboratory for pyrometallurgical treatment of iron ores. The accompanying report entitled "Metallurgical Investigation Of Delta Iron Ore Sample RC-5" contains the detailed test results of 8 roasting and 2 metallization tests conducted under the supervision of H.E. Neal. This report is included in the Appendix along with the Chemical Analyses and Heavy Liquid test results. The above testwork can only be considered very preliminary and limited in scope by an authorized expenditure of $2,500.

10.1 Summary of Results - Roasting and Metallization

1) Mineralogical examination showed that the Siderite and Quartz in the Delta samples were very fine grained and that physical separation appeared less promising than pyrometallurgical treatment for the first attempts at beneficiation.

2) Ten tests were conducted to convert the Siderite and the other iron-bearing minerals into Magnetite or Metallic Iron in order to raise the concentrate grade by magnetic separation. It was assumed that complete melting of a rock with 15-25% Total Iron would be impractical, especially with the high phosphorous content.

3) The 10 tests consisted of the following:

   a) 3 - Magnetizing Roasting tests where Carbon Monoxide and Hydrogen were used as reducing agents to convert the Siderite to Magnetite.

10.1 Summary of Results (continu...)

3) b) 2 - Metallization tests (Direct Reduction) where Hydrogen was used as a reductant at temperatures in the range of 1850 - 2050° F in order to reduce the Siderite to Metallic Iron.

c) 5 Oxidizing Roasting tests where the conversion of Siderite to Magnetite was attempted in a deficiency of air.

4) Magnetizing Roasting tests failed to produce a high-grade product and recovered only slightly more than the 35% of the Total Iron present in the sample.

The best result was test 5:

	% Wt	% T Fe	% T Fe Distribution
-325 Mesh D.T. Conc.	20.8	40.9	37.6
-325 Mesh D.T. Tailing	64.2	22.0	62.4
Roasted Calcine	85.0	26.6	100.0

In test 2 using Hydrogen the reduction appeared to be carried too far with a weight loss in the roasted product of 26% compared to the normal 15%. X-Ray Diffraction showed metallic Iron in this roasted product.

5) Ideal roasting conditions were not achieved. The samples responded rapidly to reduction roasting and it is felt that the times were too long causing over reduction. In spite of a lower %CO in test 5 that the reduction was extended to produce non-magnetic wustite. The presence of Wustite was confirmed by X-Ray Diffraction of the

10.1 Summary of Results (continued)

-325 mesh feed to the Davis Tube from Test 5 (See Mineral Study Report in Appendix). Fayalite(Fe_2SiO_4) was the second most abundant mineral which helped produce a low-grade concentrate.

6) Metallization Tests were inconclusive although Test 3 produced metallic beads containing 80.2% Total Iron and 77.6% Metallic Iron using Hydrogen at 2050° F.

Test Result:

	% Wt	% T Fe	% P	% T Fe Distribution
+325 M Metallic Beads	9.3	80.2	8.25	33.5
-325 M D.T. Conc.	14.9	58.3	2.53	39.0
Total Recoverable Metallics	24.2	66.7	4.75	72.5
D.T. Tailings	50.7	12.1		27.5
Metallized Product	74.9	29.7		100.0

This test showed that the metallized product at -325 mesh would produce a concentrate with only 58.3% T Fe although X-Ray Diffraction analysis showed that only Metallic Iron and Quartz were Present. At -500 mesh test 4 Davis Tube concentrate contained 50.0% T Fe although it was 65.6% metallized.

7) Oxidizing Roasting tests failed to convert an appreciable amount of the iron to Magnetite which at -325 mesh in Test 8 produced a Davis Tube concentrate containing 37.7% T Fe at 39.7% T Fe Recovery. Conditions tested converted the majority of the iron to Hematite.

10.1 Summary of Results (continued)

8) No Manganese or Phosphorous analyses were made since the magnetic concentrate were low in Iron compared to the normal 80-90% T Fe in a metallized product or 66-69% in a magnetic roast product.

10.2 Summary of Heavy Liquid Results

1) Sink-float tests conducted at a specific gravity of 2.96 were made on two samples from each of the Rapid Creek area (RC-2, RC-3 and the Fish River area (F-3, F-11).

The purpose of these tests was to determine whether low-grade slaty bands could be rejected at a coarse size. Except for RC-2 which is a thin-bedded slaty variety, there was little or no upgrading by rejection of barren beds. The T Fe losses in the tailings were high.

The results are summarized as follows (for -¼ inch feed size)

		Head	2.96 Sink		
		% T Fe	% Wt	% T Fe	% T Fe Dist
RC-2	Slaty variety	14.2	31.0	25.5	55.5
RC-3	Thick bedded	17.6	33.3	25.2	47.7
F -3	Thick bedded	25.2	77.3	25.8	79.2
F -11	Thick bedded	25.0	75.6	26.5	80.2

10.2 Summary of Heavy Liquid Results (continued)

1) (continued)

The Rapid Creek samples showed a greater rejection of low-grade tailings from the slaty beds; the Fish River samples were more uniform and thick bedded with even less upgrading in the sink product.

The Phosphorous content in all cases increased in the sink product compared to the crude sample. Phosphorous rejection in the float product was in the range of 15.8% to 39.6% with the greater rejection in the Rapid Creek samples.

11.0 MAGNETIZING ROASTING AND DIRECT REDUCTION THEORY AND COMMERCIAL PROCESSES

11.1 Oxidizing Roasting - Siderite in theory can be converted to a magnetic product under closely controlled temperature and gas conditions. An oxidizing roast is made in a deficiency of the theoretical amount of oxygen at 700 - 800° C (1300 - 1470° F). With insufficient oxygen, the siderite is converted to magnetite; but over roasting with oxygen will produce hematite.

The following equations illustrate the chemical reactions.

Oxidizing Roast TO Magnetite: $3\ Fe\ CO_3 + \frac{1}{2}\ O_2 \longrightarrow Fe_3\ O_4 + 3\ CO_2$
Oxygen Deficiency

Oxidizing Roast TO Hematite: $4\ Fe\ CO_3 + O_2 \longrightarrow 2\ Fe_2\ O_3 + 4\ CO_2$

11.2 Reduction Roasting - Siderite is heated and calcined to Hematite in air then reduced in carbon monoxide or hydrogen will have the following reactions:

Calcining to Hematite: $4\ Fe\ CO_3 + O_2 \longrightarrow 2\ Fe_2\ O_3 + 4\ CO_2$

Reduction to Magnetite: $3\ Fe_2\ O_3 + CO \longrightarrow 2\ Fe_3\ O_4 + CO_2$

or $3\ Fe_2\ O_3 + H_2 \longrightarrow 2\ Fe_3\ O_4 + H_2O$

Further reduction of the magnetite will form non-magnetic Wustite (Fe O) which can not be recovered magnetically.

$$Fe_3\ O_4 + CO \longrightarrow 3\ Fe\ O + CO_2$$

11.2 (continued)

Experimental work at the U.S. Bureau of Mines has shown that magnetite can be produced by heating hematite with scrap iron in a carbon dioxide and water atmosphere in the temperature range of 700 - 1000° C with the following net result:

$$Fe + 4\ Fe_2O_3 \rightarrow 3\ Fe_3O_4$$

11.3 Direct Reduction - This is also called solid state reduction to metallic iron without passing through a liquid phase of iron. The resulting metallized product is called sponge iron which will reoxidize if stored in a wet uncovered area. Sponge iron has been successfully used in electric furnace smelting as an alternative to scrap. Sidbec, the Quebec Government steel plant is expanding their electric melt shop to consume one million tons per year of sponge iron produced in their Midrex furnaces using chiefly pellets and minor amount of sized lump ore. The use of sponge iron in electric smelting has been widely accepted in many countries as an alternative to scrap which has widely fluctuating prices, and a build-up of undesireable trace elements.

The direct reduction processes are based on either gaseous or solid carbon reductants.

Gaseous Reductants - The following equation represents the reduction of hematite to metallic iron; the reaction is exothermic:

$$Fe_2O_3 + 3\ CO \rightarrow 2\ Fe + 3\ CO_2 + Heat$$

11.3 (continued)

Hematite and hydrogen can also produce metallic iron with an endothermic reaction:

or $$Fe_2 O_3 + H_2 + Heat \longrightarrow 2 Fe + 3 H_2O$$

Hydrogen is a more effective reductant for the usual operating temperatures over 800° C. The cost of pure hydrogen is normally too high except for special powder iron applications. The accompanying Equilibrium Diagram illustrates the gas composition - temperature relationships required to produce magnetite, wustite and iron.

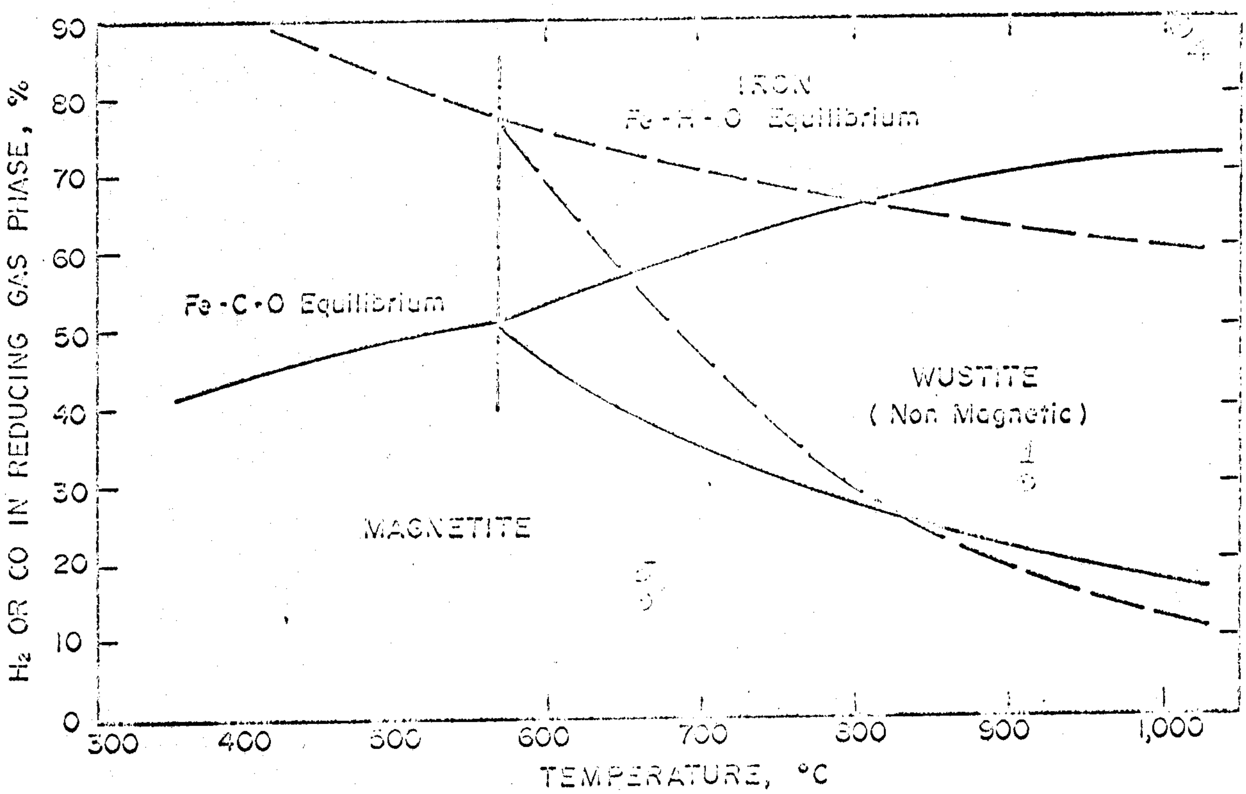
Reducing Gas Production

Reducing gas containing carbon monoxide or hydrogen can be produced from a variety of sources.

a) Natural Gas - Desulphurized natural gas and steam are mixed, preheated and processed in the presence of a nickel catalyst according to the following equation using methane as the chief constituent.

$$CH_4 + H_2 O + Heat \longrightarrow CO_2 + H_2$$

The reformed gas after cooling contains approximately 74% hydrogen and 13% carbon monoxide and the balance as carbon dioxide and methane. Other hydrocarbons such as naptha and petroleum are also suitable for reforming. Reformed gas is used in the Hyl (Mexico) and Midrex direct reduction processes.



GAS COMPOSITIONS IN EQUILIBRIUM WITH IRON & IRON OXIDES

11.3 (continued)

b) Direct Injection of Fuel Oil - By using fuel oil in a deficiency of theoretical oxygen for combustion, a reducing atmosphere is produced containing chiefly carbon monoxide as the reductant.

c) Solid Carbon Reaction - Either of two reactions may occur in the reduction of hematite with carbon as non-coking coal in most cases.

$$Fe_2O_3 + 3\ C + Heat \longrightarrow 2\ Fe + 3\ CO$$

or

$$Fe_2O_3 + 1.5\ C + Heat \longrightarrow 2\ Fe + 1.5\ CO_2$$

The latter reaction is preferred for kiln processes using solid carbon reductant since it requires less carbon to produce iron and carbon dioxide. This goal can not be fully realized since an equalibrium limit fixes the amount of CO_2 which may exist in a CO_2 - CO mixture in the presence of heated carbon and iron oxides. The gaseous products from direct reduction can therefore contain both CO_2 and CO in varying amounts.

11.4 Commercial Processes

11.4.1 Reduction Roasting - Several pilot plant and semi-commercial plants have been operated in Minnesota for the treatment of low-grade oxidized taconite. Some of these have included work by M.A. Hanna at the

11.4.1 (continued)

Butler plant 1934-1938; M.A. Hanna roasting pilot plant with a Lurgi kiln 1958 - 1960; U.S. Steel and W.S. Moore Company. Flotation appears to have superseded roasting as a method of concentration of the semi-taconites.

In France, IRSID (French Iron Ore Steel Research Institute) have studied the treatment of the low-grade Lorraine ores containing limonite, siderite, clays and chlorites. A 250 ton per day pilot plant started operation in 1965 using a fluid bed type of reactor with fuel oil burners. No actual commercial plant for roasting is known to be operating except for the Bethlehem Steel Manganese Pelletizing plant in Brazil.

11.4.2. Direct Reduction

Several hundred direct reduction schemes have been suggested since 1869 when Siemans made sponge iron in a rotating cylindrical furnace with coal and iron ore. The following direct reduction processes have attracted the greatest interest in recent years.

a) Gaseous Reducing Processes

1) Midrex - continuous vertical shaft furnace process which uses reformed natural gas. Feed to the furnace is primarily oxide pellets with sized natural high-grade ores used in lesser amounts. Six Midrex plants are in production - 3 in U.S.A., 1 in Canada,

11.4.2 (continued)

1 in Germany and 1 in Japan). Silica in the furnace feed is normally limited to 2 to 3%. Other similar processes include the Wiberg, Purofer and Novafer which have been much less popular than the Midrex which has a proven record of successful operation.

2) HyL - This process is a static bed batch type using a gaseous reductant. Four plants are in commercial operation in Mexico using high-grade lump ore and one is located in Brazil. Reformed natural gas is used as the reductant. The latest plant at Puebla, Mexico operates with 66% Fe oxide pellets to produce sponge iron with 87% metallization.

3) Armco Shaft Furnace - This process is similar to the Midrex plant except the oxide pellets or sized ore are charged intermittently. The reducing gas is produced from reformed natural gas which was developed to use partial oxidation or stove reforming although the initial operation uses steam reforming. This plant, located at Houston, Texas, has a daily capacity of 1000 tons.

4) Orinoco or High Iron Briquette Process - developed by U.S. Steel Corporation in Venezuela. A fluidized bed is used with finely crushed high-grade ore and a gaseous reductant. The

11.4.2 (continued)

metallized fines are briquetted at an annual rate of 1 million tons. The Esso-Fior process is similar.

b) Solid Reductants

1) SL/RN Process - (Stelco, Lurgi - Republic - National Lead) This process has had a long history of development and pooling of many developments and modifications. The process consists of using a rotary kiln which is fed with high-grade iron pellets, dolomite and coal. The coal provides the reductant and the supplemental heat. Mantle burners are supplied with air and gas to maintain the required temperature and atmosphere along the length of the kiln. The dolomite absorbs the sulphur from the coal. The metallized product is recovered magnetically with the non-magnetic char being recirculated. A 300,000 ton per year plant is currently under construction for Stelco at the Griffith Mine in Northern Ontario. Another SL/RN plant is producing sponge iron from beach sands in New Zealand.

2) Krup Renn Process - This is the only process developed for the treatment of low-grade oolitic Saltzzitter ores in Germany. Fine low-grade ore or concentrates are fed into a brick-lined rotary kiln along with low-grade coal as the reductant and heat source. The process is a continuous reduction at higher

11.4.2 (continued)

temperatures than the SL/RN kiln whereby a pasty slag and metallic iron nodules or luppen are formed up to 1½ inches in size. The slag and luppen are separated magnetically after cooling. This process was used for many years in Germany during World War II and into the early 1960's. Most or all of the plants are now shut down due to the high energy consumption, high maintenance costs and poor removal of phosphorous and sulphur. The import of high-grade foreign ores which are sintered in Germany have made the Krup-Renn process non-competitive.

H.E. Neal P.Eng.

October 25, 1974

APPENDIX 2

1. Ontario Research Foundation - Letter of Mr. Biskupski with Chemical Analyses, Heavy Liquid Results and Spectrographic Analysis of Sample F-17.

2. Ontario Research Foundation - Metallurgical Investigation of Delta Iron Ore Sample RC-5.

3. Mineral Research Branch - Mineral Study
   Ministry of Natural Resources,
   Ontario.

ONTARIO RESEARCH FOUNDATION

SHERIDAN PARK, MISSISSAUGA, ONTARIO, CANADA. L5K 1B3 PHONE (416) 822-4111 OR 279-9771 * TWX 610-492-2624

October 15, 1974.

Mr. H. E. Neal, P.Eng.,
Consulting Metallurgist,
H. E. Neal & Associates Ltd.,
124 Roxborough Drive,
Toronto, Ontario.

Dear Sir:

Re: Investigation No. MP-74331

The attached tables list the results of chemical analysis and sink-float tests on samples of siderite. The results were submitted previously in an informal way.

The sink-float tests were conducted at a size of minus 1/4 inch. The absence of fines allowed the omission of the sink-float tests at minus 100 mesh. Also included is the result of spectrographic analysis of sample F-17

Yours very truly,

J. Biskupski,
Senior Technician,
Department of Metallurgy.

WEIGHTS AND RESULTS OF ANALYSES

Sample	Wt. g.	% T.Fe	% SiO_2	% Al_2O_3	% Mn	% P	% L.O.I.
RC-1	5900	12.4	39.3	7.5	0.12	3.87	9.3
2	6800	13.1	46.4	8.6	0.13	1.98	8.3
3	7900	17.3	35.9	9.2	0.56	3.00	8.8
4	5600	18.5	36.0	8.6	0.85	2.92	9.9
5	5900	22.2	26.0	7.0	2.0	3.19	14.3
F-1	1900	19.5	28.4	8.7	3.4	2.61	12.0
2	14600	12.9	42.2	12.9	3.5	1.58	9.8
3	3700	25.0	15.8	4.7	2.2	2.30	20.0
4	3400	24.7	16.1	5.7	1.7	2.94	19.8
5	3400	22.5	25.2	7.7	2.2	2.76	13.8
6	3200	20.3	30.8	8.9	2.0	1.94	15.2
7	3400	22.6	24.3	6.6	1.2	3.24	15.3
8	3900	20.0	31.8	9.1	1.9	1.91	13.6
9	3600	23.4	24.7	7.2	2.3	2.15	16.9
10	4000	22.8	28.3	8.3	1.7	1.95	15.6
11	3800	24.6	22.6	5.9	3.4	2.47	17.2
12	6500	19.3	34.7	8.8	1.9	1.15	13.8
13	3100	18.1	33.7	8.0	2.9	1.64	13.6
14	3400	16.8	39.2	10.3	1.5	1.45	11.2
15	3900	16.5	37.0	9.5	2.0	1.45	12.7
16	1400	19.7	38.8	7.6	0.71	2.47	14.4

SINK-FL[illegible] TESTS

at. 2.96 S.G.

Sample	Product	Wt. %	% T.Fe	% Dist.	% P	% Dist.
RC-2	Sink	31.0	25.5	55.5	4.35	60.4
	Float	69.0	9.2	44.5	1.28	39.6
	Head	100.0	14.2	100.0	2.20	100.0
RC-3	Sink	33.3	25.2	47.7	6.40	70.8
	Float	66.7	13.8	52.3	1.32	29.2
	Head	100.0	17.6	100.0	3.00	100.0
F-3	Sink	77.3	25.8	79.2	2.93	84.2
	Float	22.6	23.2	20.8	1.89	15.8
	Head	100.0	25.2	100.0	2.69	100.0
F-11	Sink	75.6	26.5	80.2	2.35	78.3
	Float	24.4	20.3	19.8	2.02	21.7
	Head	100.0	25.0	100.0	2.27	100.0

SEMIQUANTITATIVE SPECTROGRAPHIC ANALYSIS - SAMPLE F-17

Appr. %	Elements
10 - 5%	S, Al
5 - 1%	Fe, Si, Mn
1 - 0.1%	K, P, Sn, Ca
$<0.1\%$	Ti, Ni, Co, Cu, As, Cd, Y, Sr

ONTARIO RESEARCH FOUNDATION

SHERIDAN PARK, MISSISSAUGA, ONTARIO, CANADA, L5K 1B3
PHONE (416) 822-4111 OR 279-9771 * TWX 610-492-2524

Report of Investigation
No. MP-74331

Metallurgical Investigation of Delta Iron Ore Sample RC-5

H. E. Neal & Associates Ltd.
Toronto, Ontario

J. MELNBARDIS

October 4, 1974

TABLE OF CONTENTS

Report of Investigation

No. MP-74331

Metallurgical Investigation of

Delta Iron Ore Sample RC-5

H. E. Neal & Associates Ltd.

1. INTRODUCTION

The results of chemical analyses and other testwork including some heavy liquid sink-float tests on Delta iron ore samples RC1 to 5 and F1 - 16 have been reported earlier.

This report describes the results of some preliminary tests carried out to investigate the amenability of iron values in sample RC-5 to magnetizing roasting and direct metallization.

As authorized by Mr. H. E. Neal the test work involved the following:

(1) Magnetizing roasting in reducing atmospheres using carbon dioxide-monoxide gases in the ratio of 2.3 to 1 and hydrogen, both at a temperature of 1675°F. Also using a carbon dioxide-monoxide gas ratio of 5.6 to 1 at a lower temperature of 1400°F.

(2) Metallizing tests using hydrogen as reductant at temperatures of 2050°F and 1850°F.

(3) Some exploratory oxidizing roasts with limited access of air at 1300°F.

2. TEST PROCEDURES AND RESULTS

Except for the initial test 1, all other tests were conducted on feed material ground to minus 48 mesh. Either a 100 or 50 gram lot of test feed was charged in a stationary bed over the gas inlet grid of a 2" x 3" stainless steel container and held at temperature in a globar muffle furnace.

In Test 1 the charge was 1000 grams of minus 10 mesh feed placed in a revolving stainless steel cylinder.

The conditions and results of 10 individual batch tests are shown in Tables I to IV. The following is a review of the conditions and results obtained with each individual test or series of tests.

2.1 Magnetizing Roasting

Tests 1, 2 and 5 were intended as magnetizing roasts under reducing conditions in CO_2-CO and hydrogen atmospheres. Since from test to test changes were made in more than one condition, the individual results are not directly comparable, but all show a low degree of magnetizing - low iron grade and recovery of magnetic concentrate. Magnetic concentration was by Davis tube testing product ground to minus 325 mesh.

In Test 1 using a CO_2-CO ratio of 2.3 to 1 at 1675°F for 2 hours practically no magnetic iron was produced while in tests using a CO_2-CO ratio of 5.6 to 1 at 1400°F for 2 hours the Davis tube magnetic iron recovery was 37.6% of total iron at 40.9% grade. A similar result was obtained in Test 2 using hydrogen atmosphere at 1675°F for 2 hours.

Both the magnetic and non-magnetic fractions of all test products assayed high in ferrous iron. Therefore these results are consistent with the indication that most of the iron in the ore may occur as the iron carbonate [illegible]. The mineral decomposes in the temperature range from 950° - 1050°F. If the loss of ignition of 15% of the feed weight as determined earlier on the head sample is assumed to be all due to carbon dioxide evolving from decomposition of siderite, then by calculation the mineral would account for over 70% of the total iron in the ore. Since the conversion of siderite to magnetite would require some addition of oxygen, it follows that under reducing conditions most of the iron should remain in ferrous form.

2.2 Oxidizing Roasting

Tests 6 to 10 were conducted on an exploratory basis to test the effect of limited access of air conditions at 1300°F, but they proved very difficult to control and yielded no better results than were obtained under reducing conditions.

Whenever excess air was admitted the charge was readily oxidized to hematite as evidenced by the reddish appearance of the product and the low ferrous iron assay shown for Tests 6 and 7 in Table IV. Some magnetic iron was produced but the concentrate was invariably low grade. In Test 10 the air input was controlled to avoid excess. Still the product outer layers were reddish while the centre was black. The results of the Davis tube test and assay conducted on the black portion of the product indicated it to be only partly magnetized.

All products were tested at minus 325 mesh.

2.3 Metallizing

Metallizing Test 3 was carried out in hydrogen atmosphere held at a temperature of 2050°F for 2 hours.

The product appeared as a single chunk of fused and brittle material. Upon breaking and crushing the product yielded 5 metallic beads each weighing about 1 gram and some other smaller plus 325 mesh chips were separated by hand magnet. These coarse metallics were treated as a separate product, while the rest was ground to minus 325 mesh for magnetic separation in the Davis tube. The results as shown in Table III indicate 72.5% total iron recovery in the magnetic concentrate at 66.7% grade, including metallic iron assay of 61.7%. The test product assayed 29.7% total and 21.9% metallic iron indicating 73.7% metallization.

In Test 4 the feed material was first roasted in excess air flow at 1850°F for 1 hour, then held in a hydrogen atmosphere at 1850°F for an additional 3 hours. The product weight after the air roast was 86.0% while the final product weight was 76.3% of the original feed.

In comparison with Test 3 this product appeared less uniform and less solid. It was rather raw and crumbling around the corners of the bed while fused and hollow at the center. No large metallics were noted. The Davis tube test was conducted on minus 500 mesh, but all iron grades and recoveries were considerably lower than those obtained under Test 3 conditions.

Samples of Test 3 products were submitted to the Ontario Department of Natural Resources for mineralogical examination. The results of this examination will be reported separately by that Department.

3. CONCLUSIONS

If the weight loss on ignition is CO_2, calculation shows that 73% of the total iron in the RC-5 feed is in the form of siderite. The results of metallizing tests indicate metallization up to 72.5% of the total iron which would indicate virtually complete metallization of the siderite. Fe grades of the magnetic fractions are all low due to very fine quartz inclusions (minus 20 micron as a rule). This fine quartz is present in the feed and its presence in the metallic iron product may be due either (1) to the original fine grained nature of the feed, (2) to fusion during metallization, or (3) to both the above reasons.

The oxidizing roast results indicate that the magnetic concentrate contained iron mainly in the form of magnetite whereas reducing roasts produced mainly ferrous iron. Concentrate grades were low due to fine quartz inclusions.

P. D. R. Maltby, P.Eng.
Assistant Director,
Department of Metallurgy.

J. Melnbardis,
Senior Technologist,
Department of Metallurgy.

JM:jc

TABLE I

ROAST AND METALLIZING TEST CONDITIONS

Test No.	Gas Flow Atmosphere	Temp. °F	Time min.	Weight (g.) Charge	Weight (g.) Product
1	CO_2-CO ratio 2.3	1675	120	1000	848
2	Hydrogen	1675	120	100	74.0
3	Hydrogen	2050	120	100	74.9
4	Air only	1850	60	100	86.0
	then Hydrogen	1850	180	86.0	76.3
5	CO_2-CO ratio 5.6	1400	120	100	85.0
6	Charge open to air	1300	60	100	86.8
7	Charge open to air	1300	10	50	44.2
8	Limited access air	1300	30	50	42.5
9	Nitrogen	1300	30	50	-
	then limited, but excess air	1300	12		43.15
10	As No. 9 except less air - 3.0 ft.^{3}/hr.	1300	3	50	42.9

TABLE II

MAGNETIC ROASTING RESULTS

Test No.	Product	Weight %	Assay T.Fe %	Assay Fe^{++} %	Dist. % T.Fe
1	D.T. Magnetic Conc.	0.8	41.0	32.5	1.4
	D.T. Tailings (calc.)	84.0	27.0	22.7	98.6
	Roasted Product	84.8	27.1	22.8	100.0
2	D.T. Magnetic Conc.	17.2	46.9	42.7	35.9
	D.T. Tailings (calc.)	56.8	25.4	18.9	64.1
	Roasted Product	74.0	30.4	24.4	100.0
5	D.T. Magnetic Conc.	20.8	40.9	19.4	37.6
	D.T. Tailings (calc.)	64.2	22.0	15.2	62.4
	Roasted Product	85.0	26.6	16.2	100.0

TABLE III

METALLIZING RESULTS

Test No.	Product	Weight %	Assay T.Fe %	Assay Met. Fe %	Assay Fe^{++} %	Dist. % T.Fe
3	+325 M. Magnetic Product	9.3	80.2	77.6	80.2	
	-325 M. D.T. Magnetic Conc.	14.9	58.3	51.8	58.3	
	Total Magnetics Fraction	24.2	66.7	61.7	66.7	72.5
	D.T. Tailings (calc.)	50.7	12.1	2.9	9.0	27.5
	Metallization Product	74.9	29.7	21.9	27.5	100.0
	% Metallized					73.7
4	D.T. Magnetic Conc.	27.6	50.0	44.9	44.2	61.5
	D.T. Tailings (Calc.)	48.7	17.7	4.8	14.6	38.5
	Metallization Product	76.3	29.4	19.3	25.3	100.0
	% Metallized					65.6

TABLE IV

OXIDIZING ROAST RESULTS

Test No.		Weight %	Assay T.Fe %	Assay Fe^{++} %	Dist. % T.Fe
6	D.T. Magnetic Concentrate	7.8	40.6	3.0	14.0
	D.T. Tailings	79.0	24.5	2.8	86.0
	Roasted Product	86.8	25.9	2.9	100.0
7	D.T. Magnetic Concentrate	23.4	35.5	4.0	37.4
	D.T. Tailings	65.0	21.4	-	62.6
	Roasted Product	88.4	25.1	-	100.0
8	D.T. Magnetic Concentrate	23.4	37.7	11.3	39.7
	D.T. Tailings	61.6	21.8	-	60.3
	Roasted Product	85.0	26.1	-	100.0
9	Roasted Product	86.3	25.7	-	-
10	Roasted Product	85.8	25.9	-	-
	D.T. Magnetic Conc. (testing black appearing product only)	17.3	42.2	15.6	-

Ontario

LABORATORY REPORT
MINISTRY OF NATURAL RESOURCES
MINERAL RESEARCH BRANCH
77 GRENVILLE STREET, 11TH FLOOR
TORONTO 181, ONTARIO
TELEPHONE: 965-1307

REPORT NUMBER C 17335

DATE Oct. 11, 1974

ISSUED TO: Ontario Research Foundation, Sheridan Park, Mississauga, Ontario Att: Mr. P. Maltby

MINERAL STUDY

In attempting to obtain an iron ore concentrate from an iron carbonate-rich rock, difficulties were encountered in the treatment process. As a result, this laboratory was asked to investigate some of the treated products and to compare them with the original head samples.

X-ray diffraction was employed for most of our study with subordinate petrographic work where applicable.

The Head Samples:

All samples are characterized by extreme fineness of grain and by the presence of quartz and siderite. The quartz occurs as small angular clasts 10 to 20 microns in diameter disseminated through the carbonate. The siderite is much finer - of the order of 1 to 5 microns in size.

Although all samples are fine-grained, they display textural variations.

RC-1: - consists of angular aggregates of quartz and siderite surrounded by considerable gangue material that appear to fill cavities. The gangue minerals were not positively identified but are believed to be zeolites.

RC3: - shows fine distinct banding consisting of siderite-rich and siderite-poor layers with considerable clastic fine-grained quartz and minor mica.

F-11:- The sample is massive, and appears to be composed chiefly of siderite with disseminated grains of quartz.

X-ray diffraction of 4 head samples showed:

RC-1 - Quartz.....A*
Siderite...A
Apatite....C

continued....

DIRECTOR

Fees Received

MS

RC-3 - Quartz......A
Siderite.....A
Chlorite....C
Mica........C

RC-5 - Quartz......B
Siderite.....A
Chlorite....C

F-11 - Siderite.....A
Quartz......C
Apatite.....D
Chlorite....D

*The designations A, B, C, and D, following the mineral name serve to show the relative amounts of each component; A being the most abundant and D the least.

Treated Concentrates:

Four samples of the treated quartz-siderite ore were x-rayed to determine what products were present. The following data were obtained.

RC5R - Wustite (FeO)........A
Fayalite (Fe_2SiO_4)...B
Quartz...............A

MR2 DTF -325 Mesh - Metallic Iron
Quartz

MT3 (+325 Mesh) - Metallic Iron

MT3 (-325 Mesh) - Metallic Iron
Quartz

The x-ray peaks obtained in the latter two samples (MT3) were broad, flat and diffuse, indicative of incomplete crystallization. Note also that there is less gangue in the +325 mesh fraction. Considerable glass was observed in the -325 mesh fraction under the microscope. In contrast to the MT3 samples, the quartz and iron peaks in the MR2 sample are sharp and well defined, indicative of a wholly crystalline state.

Conclusion:

1) The difficulty in obtaining a high iron concentrate arises from the intimate association of fine-grained quartz and other silicates with siderate.

continued....,

2) The thin section work and the results of x-ray diffraction on the head samples indicated that quartz and siderate were the principal minerals in the ore.

The analyses supplied with the samples show a significance amount of alumina and phosphorus. Our mineral work does not agree with these results. No apatite (the expected phosphorus bearing mineral) was noted in two of the four samples and none of the samples contained enough alumina bearing minerals to explain the amounts in the analyses.

cc: Mr.H.E.Neal, P.Eng.
H.E.Neal & Associates Ltd.

FEES RECEIVED.

.......................(D.A.Moddle,P.Eng.)

APPENDIX I

CLAIMS SUMMARY

N.T.S. 117-A

DAWSON MINING DISTRICT, YUKON TERRITORY

CLAIMS	GRANT NUMBERS	RECORDING DATE	NO. OF CLAIMS
DELTA 1-48 incl.	Y82503-Y82550	May 30, 1974	48
DAWN 1-48 incl.	Y82551-Y82598	May 30, 1974	48
	TOTAL CLAIMS, YUKON		96

MACKENZIE MINING DISTRICT, NORTHWEST TERRITORIES

MAC 1-50	A56537-A56586	May 29, 1974	50
	TOTAL CLAIMS, N.W.T.		50

APPLICATIONS FOR CERTIFICATES OF WORK

In accordance with the provisions of the Yukon Quartz Mining Act and the Canada Mining Regulations, we, the owners of mineral claims listed below, hereby apply for the following Certificates of Work as per Appendix III of this report, "Statement of Costs", attached hereto:

TOTAL REPRESENTATION WORK YUKON TERRITORY	$12,100.00
TOTAL REPRESENTATION WORK - NORTHWEST TERRITORIES	$ 5,300.00
	$17,400.00

DISTRIBUTION OF REPRESENTATION WORK

YUKON

DELTA 1-10	Y82503-Y82512			
DELTA 17-26	Y82519-Y82528			
DELTA 28	Y82530			
DELTA 30	Y82532			
DELTA 32-48	Y82534-Y82550			
	39 claims - 1 year each	$3,900.00		
DELTA 11-16	Y82513-Y82518			
DELTA 27,29,31	Y82529, Y82531, Y82533			
	9 claims - 2 years each	$1,800.00		$5,700.00

YUKON

DAWN 9-16	Y82559-Y82566		
DAWN 25-48	Y82575-Y82598		
	32 claims - 1 year each	$3,200.00	
DAWN 1- 8	Y82551-Y82558		
DAWN 17-24	Y82567-Y82574		
	16 claims - 2 years each	$3,200.00	$6,400.00

NORTHWEST TERRITORIES

MAC	1- 2	A56537-A56538		
MAC	4	A56540		
MAC	6	A56542		
MAC	8-50	A56544-A56586		
		47 claims - 1 year each	$4,700.00	
MAC	3,5,7	A56539, A56541, A56543		
		3 claims - 2 years each	$ 600.00	$5,300.00

APPENDIX II

DELTA/DAWN/MAC CLAIMS

PERSONNEL & DATES WORKED - 1974

A. Kulan Ross River, Y.T.	Prospector $1200/month	April 1-10, 25-30 July 29 to Aug. 6
G. Penikis Ross River, Y.T.	Prospector (No charge made)	April 1-10, 25-30 July 29 to Aug. 6
J.S. Brock 3029 Procter Ave. West Vancouver, B.C.	Field Supervisor $71/day	April 1-7 May 1 July 29
Arthur John Ross River, Y.T.	Prospector $1100/month	April 1-10, 25-30
Robert Etzel Ross River, Y.T.	Prospector $1100/month	April 1-10, 25-30
Esau Dick Ross River, Y.T.	Prospector $800/month	April 1-10, 25-30
Pete Risby Ross River, Y.T.	Prospector $1200/month	April 1-30 inclusive

APPENDIX III

DELTA/DAWN/MAC CLAIMS

STATEMENT OF COSTS - 1974 FIELD SEASON

Following is a distribution of total costs incurred on behalf of the Delta Iron Project in carrying out exploration work on the DELTA, DAWN AND MAC claims during the 1974 field season. These costs can be invoice supported or in the case of internal costs documented.

Salaries & Wages	$ 3,158.75	
Consulting Fees	10,601.57	
Assays & Analyses	249.00	
Miscellaneous Expenses	862.83	
Freight & Transportation	2,532.32	$17,404.47

ALLOCATION OF COSTS - YUKON TERRITORY

DAWSON MINING DISTRICT

DELTA 1 to 10	Y82503 to Y82512		
DELTA 17 to 26	Y82519 to Y82528		
DELTA 28 & 30	Y82530 & Y82532		
DELTA 32 to 48	Y82534 to Y82550		
39 claims @ 1 year each		$ 3,900.00	
DELTA 11 to 16	Y82513 to Y82518		
DELTA 27,29,31	Y82529, Y82531, Y82533		
9 claims @ 2 years each		$ 1,800.00	$ 5,700.00
DAWN 9 to 16	Y82559 to Y82566		
DAWN 25 to 48	Y82575 to Y82598		
32 claims @ 1 year each		$ 3,200.00	
DAWN 1 to 8	Y82551 to Y82558		
DAWN 17 to 24	Y82567 to Y82574		
16 claims @ 2 years each		$ 3,200.00	$ 6,400.00

ALLOCATION OF COSTS - NORTHWEST TERRITORIES

MACKENZIE MINING DISTRICT

MAC 1,2,4,6, 8 to 50		A56537, A56538, A56540, A56542, A56544 to A56586		
	47 claims @ 1 year each		$ 4,700.00	
MAC 3,5,7		A56539, A56541, A56543		
	3 claims @ 2 years each		600.00	$5,300.00

WELCOME NORTH MINES LTD. (N.P.L.)
Suite 8, 1161 Melville St., Vancouver, B.C. V6E 2X7 Telephone (604) 687-1658

APPENDIX IV

AFFIDAVIT SUPPORTING SUMMARY OF COSTS

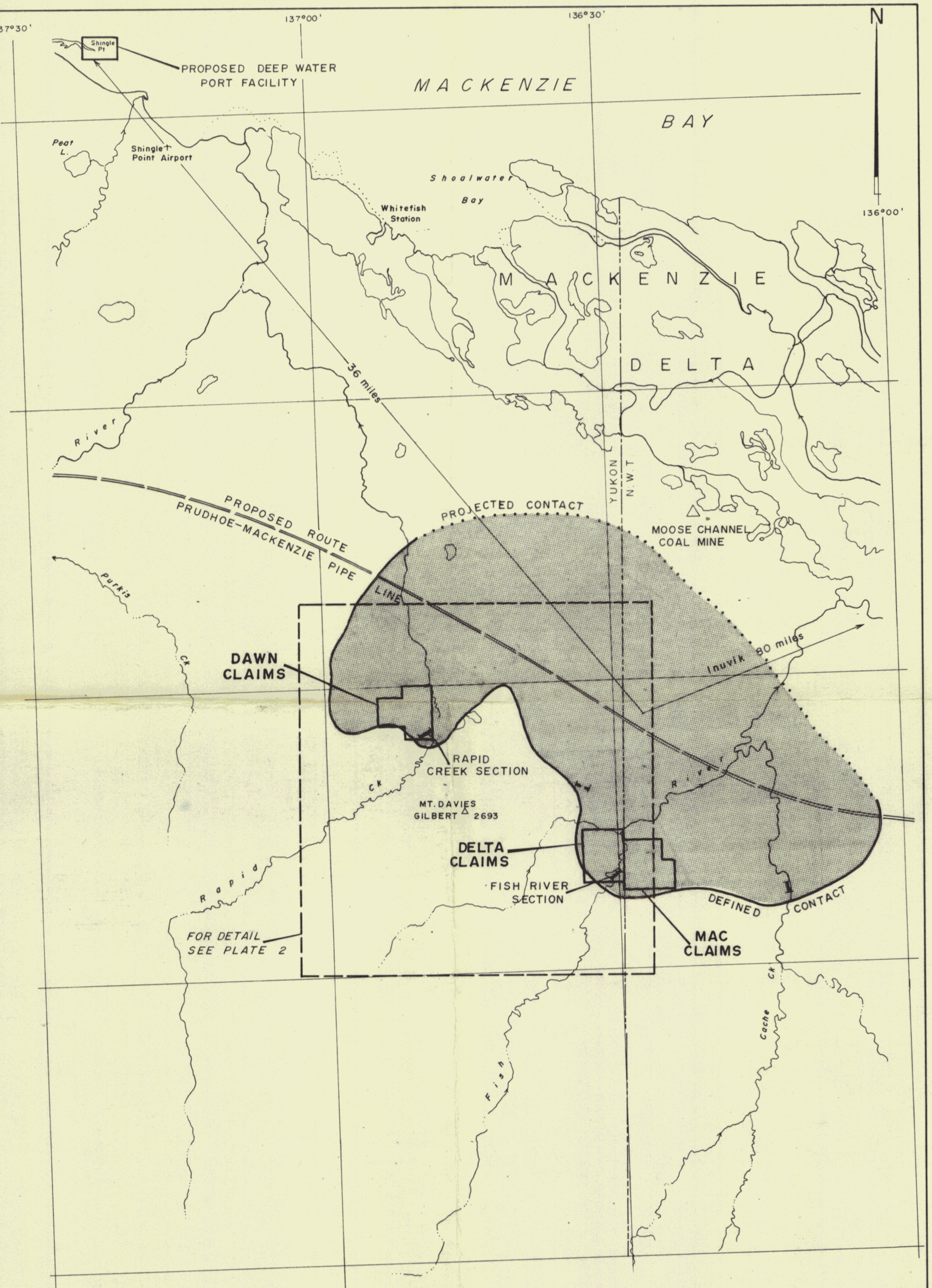
I, John S. Brock, Vice-President, Welcome North Mines Ltd. (N.P.L.), of Vancouver, British Columbia, do hereby state that, to the best of my knowledge and belief, the Statement of Costs presented in this report (EXPLORATION REPORT, DELTA IRON DEPOSIT, MAC, DELTA, DAWN MINERAL CLAIMS) is both true and correct.

John S. Brock

May 7/75

Date

Notary Public in and for the
Province of British Columbia.



DELTA IRON DEPOSIT

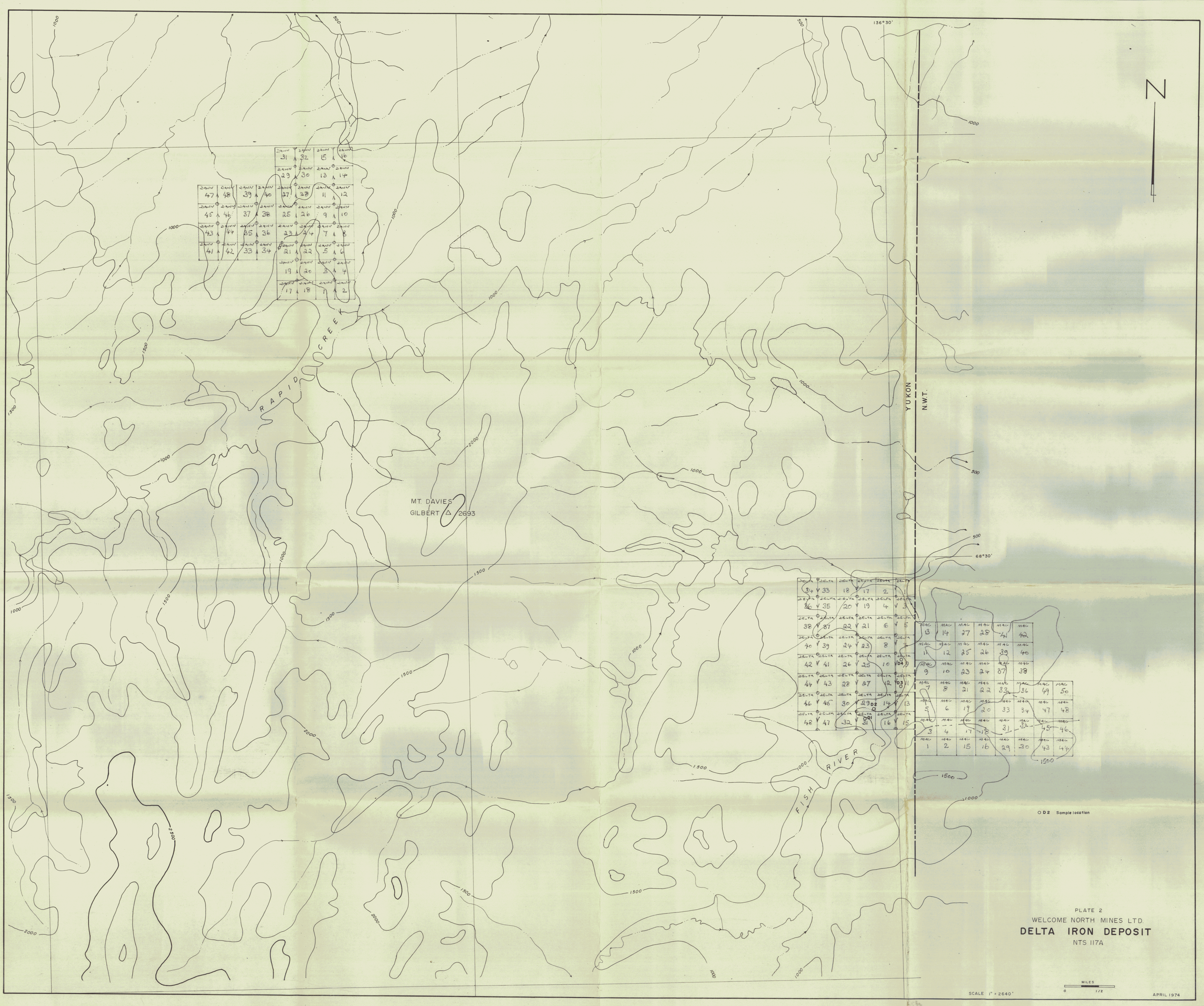
PLATE I

WELCOME NORTH MINES LTD.

DELTA IRON DEPOSIT

NTS 117A

SCALE 1: 250,000 APRIL 1974


N
136°30'
68°30'
YUKON
N.W.T.
RAPID CREEK
FISH RIVER
MT. DAVIES GILBERT △ 2693
DAWN
DELTA
MAG
D1
D2
D3
D4
O D2 Sample location
PLATE 2
WELCOME NORTH MINES LTD.
DELTA IRON DEPOSIT
NTS 117A
SCALE 1" = 2640'
MILES
0 1/2
APRIL 1974