GOVERNMENT OF
NEWFOUNDLAND AND LABRADOR

Department of Mines and Energy **Mineral Lands Division**

Registry File Nos: 774:4114.

Geological Survey No: LAB/1412

Confidential Until: 2004-06-14

Mineral Rights:
☑ Licence ☐ Extended Licence ☑ Impost ☐ Mining Lease ☐ Regional ☐ Other ________

Licence/Property	No. of Claims	Assessment Year	Date Issued	NTS Map
7782M	191	1st	00-12-01	23G/7,10e.
7783M	192	1st	00-12-01	23G/7,8,9,10.
7784M	207	1st	00-12-01	23G/8.
7785M	222	1st	00-12-01	23G/7.
7786M	256	1st	00-12-01	23G/7,8.
7787M	151	1st	00-12-01	23G/7.
7788M	194	1st	00-12-01	23G/7,8.
7789M	177	1st	00-12-01	23G/7.
7790M	212	1st	00-12-01	23G/7.
7791M	202	1st	00-12-01	23G/2,7,8.
7792M	255	1st	00-12-01	23G/2,7.

SL = ~~Sub~~licence (area in hectares) *Continued next page* ☑ Yes ☐ No

Number of Volumes: 5

Enclosures (indicate number of each):

CD-Roms:________ Disketts:________ Zip Disks:________ Tapes:________

Transparencies:________ Paper Maps:________ Microfiche:________ Other:________

Comments: Recd. 2001-06-14

Signed: [signature]

Date: 2006-08-24

Continued:

Registry File Nos: 774:4114; 772:28:06:18,19.	Geological Survey No: LAB/1412

Licence/Property	No. of Claims/ha.	Assessment Year	Date Issued	NTS Map
7793M	244	1st	00-12-01	23G/2,7.
7794M	95	1st	00-12-01	23G/2.
7795M	122	1st	00-12-01	23G/2.
7796M	249	1st	00-12-01	23G/2,7.
7797M	148	1st	00-12-01	23G/2.
7798M	238	1st	00-12-01	23G/2,3.
7799M	256	1st	00-12-01	23B/14; G/2,3
7800M	240	1st	00-12-01	23B/14.
7801M	182	1st	00-12-01	23B/14.
7802M	90	1st	00-12-01	23B/14,15.
7803M	89	1st	00-12-01	23B/14,15.
SL 24	2890.96	2000-2001	Impost	23B/14, 15.
SL 25	644.74	2000-2001	Impost	23B/14, 15.
SL 26	301.33	2000-2001	Impost	23B/14, 15.
SL 27	505.76	2000-2001	Impost	23B/14.
SL 28	158.68	2000-2001	Impost	23B/14.
SL 29	149.49	2000-2001	Impost	23B/14.
SL 30	797.75	2000-2001	Impost	23B/14.
SL 31	90.96	2000-2001	Impost	23B/14.
SL 32	1103.30	2000-2001	Impost	23B/14.
SL 33	36.82	2000-2001	Impost	23B/14.
SL 34	99.64	2000-2001	Impost	23B/14.
SL 35	115.71	2000-2001	Impost	23B/14.
SL 36	828.19	2000-2001	Impost	23B/14.
SL 37	1984.55	2000-2001	Impost	23G/2.
SL 38	1114.36	2000-2001	Impost	23G/2.

Continued:

Registry File Nos: 772:28:06:18,19.

Geological Survey No: LAB/1412

Licence/Property	No. of Claims	Assessment Year	Date Issued	NTS Map
SL 39	669.20	2000 – 2001	Impost	23G/2.
SL 40	1400.67	2000 – 2001	Impost	23G/2.
SL 41	936.30	2000 – 2001	Impost	23G/2.
SL 42	813.25	2000 – 2001	Impost	23G/7.

1 of 5

IOC Report
GL 10000
DocsOpen 46

Iron Ore Company of Canada

Resource Assessment Program

Summary report of partially sublicenced blocks to December, 2000.
Licences 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, and 42

16th December, 2000.

Submitted by: Roger Hulstein
Submitted to: Marcus Flis

Accepted:

Distribution: RAP Library, Labrador City
Grant Goddard, Montreal

Table of Contents

List of Figures

List of Tables

1.0 INTRODUCTION

All retrievable data was reviewed and summarized and the blocks ranked from high to low potential (= priority). Criteria used in ranking include: geological "space" for a sizeable (>200Mt) iron deposit, positive magnetic and gravity signature, synclinal structure, and favorable geology. The amount or quality of information does not result in an automatic high or low rank. All work recommendations are tentative and are made with the assumption that the target's priority may change following the results of the 2000 aeromagnetic survey or if other information becomes available. Quoted resources are taken from an IOC anonymous report. The method of calculation is not known other than all available information (i.e., drilling data, surface mapping, aeromagnetic anomalies) at the time was used.

With few exceptions the field mapping and sampling was completed by the late 1950's along with magnetic (dip needle) and gravity surveys. An aeromagnetic survey was flown in the early 1950's. A helicopter airborne survey was flown in 1972, limited ground magnetometer lines were done over most blocks in 1979 and some diamond drilling was done on the Canning block and on Block 26 in the late 1970's. The Newfoundland government produced a set of 1:100,000 scale geology maps over the area in the 1980's and various reports, dealing primarily with the geological structure from thesis work, in the 1990's. For the Duley # 1 (Polly Lake), block assessment reports from the 1950's and more detailed geophysics in the early 1970's (gravity, magnetics) augment the data set. The outcrop geology maps, 29 in number, at 1:12,000 scale, covering the heart of the project area, are the single most valuable data resource.

A total of 1405 drill holes have been drilled in reconnaissance exploration. Of these 442 are located on the 1:12,000 scale geology maps and about 280 holes were completed on or near the partially sublicensed blocks. Many of these holes, particularly the early ones, were designed to trace the iron formation units and not to test for tonnage or grade. Almost all of the holes drilled on the blocks are BX and AX core size. Core recoveries are variable depending on the ground conditions on each individual block and range from 0%-95%. A lot of the drill core information is very sketchy due to poor core recoveries and shallow depths.

Recommendations for future work range from relinquishing an individual property following analysis of the 2000 aeromagnetic survey to drilling. Future work is staged depending on how advanced the target or deposit is. Work recommendations escalate from ground field checks, detailed mapping and sampling, ground geophysical surveys (magnetics, gravity) and diamond drilling. Significant office work remains to be done prior to the 2001 field season including; integrating the results of the 2000 aeromagnetic survey, Landsat TM interpretation and the SRK structural/metamorphic study. In addition government assessment reports covering the blocks have been ordered and will require review along with aerial photographs of the area. All the above should be available and used in a GIS format for maximum exploration effectiveness.

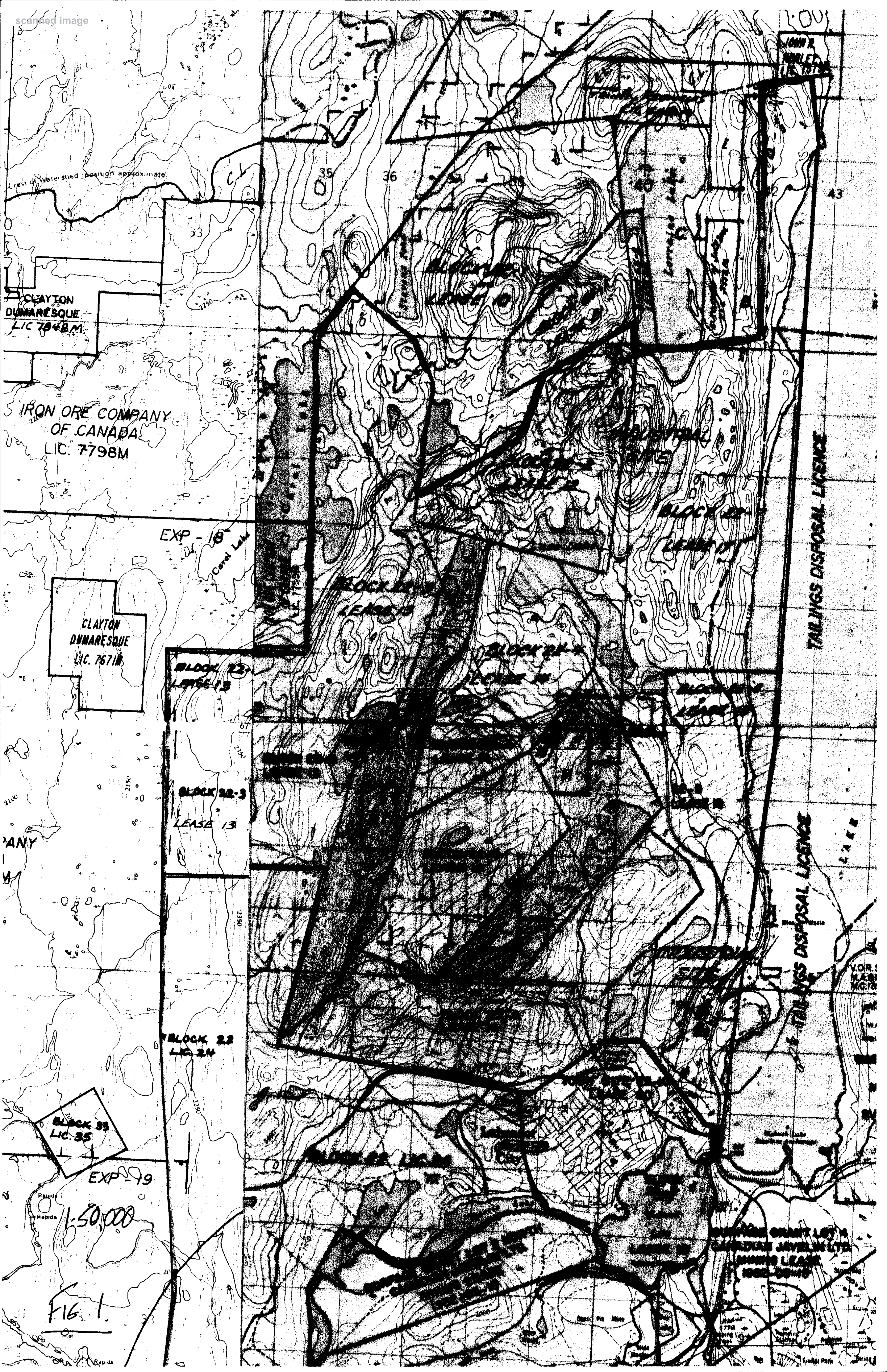
Crest of Watershed (position approximate)
CLAYTON DUMARESQUE
IRON ORE COMPANY OF CANADA
LIC. 7798M
EXP - 18
Carol Lake
CLAYTON DUMARESQUE
LIC. 7671M
BLOCK 22-3
LEASE 13
BLOCK 22
LIC. 24
BLOCK 33
LIC. 35
EXP - 19
1:50,000
TAILINGS DISPOSAL LICENCE
TAILINGS DISPOSAL LICENCE
Rapids

FIG. 1.

figure 1

page size with all blocks

Table 1. Land Status of Partially Sublicensed Blocks.

IRON ORE COMPANY OF CANADA
RESOURCE ASSESSMENT PROGRAM
Land Status Summary of Partially Sublicenced Blocks
December 13, 2000
By: R. Hulstein

Name Deposit and/or Location	IOC Block No.	License Number	Area Hectares	Expiry Date
Canning No.1	22	24	2890.39	July 9, 2002
Duley # 2	23	25	644.61	Feb. 03, 2004
Mills # 1	24	26	301.27	Feb. 03, 2004
Duley # 1 (Polly L.)	25	27	505.66	July 9, 2002
Block 26	26	28	158.65	July 9, 2002
Huguette # 2	27	29	149.46	July 9, 2002
Block 28	28	30	797.59	July 9, 2002
Sitting Bear # 2	29	31	90.94	July 9, 2002
Sudbury 1 & 2	30	32	1103.08	July 9, 2002
Huguette 1	31	33	36.81	July 9, 2002
Neal # 1	32	34	99.62	July 9, 2002
Block 33	33	35	115.69	July 9, 2002
Neal (Virot) Lake	34	36	828.03	July 9, 2002
D'Aigle Bay Zone	35	37	1984.16	July 9, 2002
Julienne 1 & 2	36	38	1114.14	July 9, 2002
Mugga Lake Zone	37	39	669.07	July 9, 2002
Shabogamo #1	38	40	1400.4	July 9, 2002
Shabogamo South Z.	41	41	936.11	July 9, 2002
Block 42	42	42	813.09	July 9, 2002

Table 2. Summary of Deposits – Partially Sublicensed Blocks

IRON ORE COMPANY OF CANADA - RESOURCE ASSESSMENT PROGRAM

Deposit - Block Summary
December 13, 2000
By: R. Hulstein

Name	Block No.	Priority Rank**	1970 est.* Tonnage (m)	1970 est. Grade Fe %	Number of deposits	Prospective Geology	Synclinal Structure	Outcrop	Deposit Host	Magnetic Anomaly	Gravity Anomaly	Drilled No. Holes	Drilled meters	Size Potential	Previous Recom.	Current Recom.	Notes
Canning No.1	22	1	35	27	1	yes	yes, large	minor	LIF,MIF,UIF	partial, over showing	n/a	27	409.04	yes	more work	Keep, more work	>500Mt.?, oxi?
Duley # 2	23	2	162	27	1	yes	yes	yes	LIF	strong high	yes	29	1492	yes?	n/a	Keep, more work	CIF, folded <200Mt?
Mills # 1	24	3	3	33	1	yes	partial, limb	yes	LIF	yes, smallish	n/a	13	387	no?	n/a	Keep, more work	v. small, CIF
Duley # 1 (Polly L.)	25	1	115+	38	1	Yes	yes, large	yes	CIF,MIF	yes	yes	32	906	yes	more work	Keep, more work	good potential, Mn?
Block 26	26	4	n/a	n/a	0	minor	no, fold limb	v. little	UIF	yes, linear high	n/a	3	415.75	no	drop	drop	tested
Huguette # 2	27	3	0.2	46	1	yes	maybe	v. little	IF	weak, small	n/a	none	none	no?	n/a	all but drop	limited size potential
Block 28	28	2	n/a	n/a	1	yes	no, fold limb	v. little	IF	yes, weak-mod. X 3	n/a	none	none	?	n/a	Keep, more work	drift covered
Sitting Bear # 2	29	3	4	26	1	limited	no, fold limb	abundant	UIF, MIF	weak, small	n/a	none	none	no?	n/a	all but drop	limited size potential
Sudbury 1 & 2	30	2	10	32	2	limited	yes	yes	IF	yes	n/a	none	none	no?	n/a	Keep, more work	limited size potential
Huguette 1	31	4	9	34	1	minor	yes	yes	IF	no	n/a	none	none	no	n/a	drop	no size potential
Neal # 1	32	4	15.8	36	1	minor	no, anticline	abundant	IF	linear high	n/a	none	none	no	n/a	drop	no size potential
Block 33	33	2	n/a	n/a	0	yes	yes?	v. little	UIF?,MIF?	yes, large	n/a	7	138.4	yes	n/a	Keep, more work	geophysical target
Neal (Virot) Lake	34	3	n/a	n/a	0	limited	yes	v. little	IF	yes, weak high	n/a	none	none	no?	no potential	all but drop	v. little info.
D'Aigle Bay Zone	35	1	280	33	3	yes	yes, & limb	yes	LIF, MIF	yes	n/a	52	732	yes	n/a	Keep, more work	has size potential
Julienne 1 & 2	36	1	396	32	2	yes	yes	abundant	LIF,MIF?	yes	yes	42	1109	yes	n/a	Keep, more work	supergene and oxide
Mugga Lake Zone	37	2	28.5	28	1	yes?	yes ?	yes	LIF,MIF?	weak, small	n/a	43	564.79	no?	n/a	Keep, more work	limited size potential
Shabogamo #1	38	2	45	24	1	yes	? Yes ?	yes	UIF?,MIF?	strong, large high	n/a	25	835.24	yes	n/a	Keep, more work	not much info, LIF
Shabogamo South Z.	41	2	5	30	0	yes	? Yes ?	little	UIF?	strong high	n/a	none	none	yes?	n/a	Keep, more work	not much info, UIF
Block 42	42	2	n/a	n/a	0	yes	? Yes ?	v. little	UIF?	mod size high	n/a	none	none	yes?	n/a	Keep, more work	not much info, UIF

* Tonnage and grade figures from an anonymous IOC 1970 report. Calculations are based on very little information and only serve to indicate what the geologic resource may be.

**Rank
1 High priority target, has most or all of the following characteristics: geological room for >200MT,MIF, mag signature, gravity anomaly, syncline structure
2 Moderate priority, has some of the above characteristics
3 Low priority target, has one or more of the above characteristics
4 To be dropped, is missing all or most of the above characteristics

Examples of Possible Target Size
200MT 100m depth X 200m X 2780m
500MT 100m depth X 555m X 2500m

2.0 Canning No. 1 (New Townsite), Block No. 22

License: 24

Priority: 1

Status: Partially sublicensed block

Expiry: July 9, 2002

Area: 296.5 hectares

Location:

NTS: 23B/14 Lac Virot & 23B/15 Flora Lake
IOC Map Sheet Numbers (1:12,000 scale): 257E-4, 257E-7, 256W-6, 256W-9

Conclusions and Recommendations

The Canning No. 1 deposit, is located in a northeast trending overturned syncline, and is a possible extension of the Wabush #4 deposit. It has an aerial extent of approximately 3,500m x 300m, although the exact dimensions have not been determined due to cover and mostly shallow drilling. The deposit may be extensively oxidized and consist of carbonate iron formation. There is an old magnetic anomaly over the original outcrop, but the remainder of the deposit is non-magnetic. Two other aeromagnetic anomalies are found over mapped iron formation to the northwest, but have not yet been followed up on.

Even though any deposit is likely weathered and oxidized, it's proximity to the plant, large untested areas of the Canning No 1 and untested aeromagnetic anomalies make this a priority 1 target. Drilling is required to determine the extents and grade of the deposit. Further exploration (mapping, ground geophysical surveys and drilling) will be conducted over the untested aeromagnetic anomalies in 2001.

Work History

Year	Work Done	Comments
1949	geological mapping	H.E. Neal, 1950
1953	geological mapping, sampling, dip needle survey	Crouse, R.A., 1954
1971	30 DDH – 651.66m, magnetic and gravity survey	G.Krueckl, 1971)
1972	airborne magnetic survey	
1979	6550m ground mag survey	Price, 1979

Geology

The map by Krueckl (1972) supersedes those portions of the 1:12000 scale geology maps that it covers. Both sets of maps are required when interpreting the geology of the block. The only showing of the Canning No. 1 deposit is found at the south end of the deposit.

The block is underlain predominantly by the Sokoman and Wishart Fms and lesser schists and gneisses of the Attikamagen Fm. Minor bodies of Shabogamo Gabbro have also been mapped on the block.

During drilling in 1971 for the proposed townsite, iron formation was intersected and was interpreted to be the northeast extension of the previously mapped Canning No. 1 deposit. Intersections consist of various units of quartz-specularite, quartz-carbonate and quartz-grunerite indicating possible lower, middle and upper iron formation. The 1971 program of 30, mostly very short (<25m long), diamond drill holes totaling 651m tested the Canning No.1 deposit and area. Core recovery was very poor, commonly less than 50% for the very short drillholes, all but one being <24m in length. According to Krueckl (1971), the Canning deposit has a low magnetite content which he thought explained why it has a subdued magnetic response compared to the deposits of iron formation in the area. The moderate to intense weathering and oxidization, noted throughout the drill core, has probably destroyed the primary magnetite.

Structure

The Canning No. 1 deposit, extending for over 3600m, lies in a northeast trending syncline that is overturned to the west. The deposit is though to be contiguous with the Wabush No. 4 deposit to the north. Alternatively, the Canning deposit is terminated to the northeast by a northwest trending overturned anticline separating it from the Wabush No.4 deposit which terminates against the same anticline.

Mineralization

The showing mapped at the southwest end of the Canning No. 1 deposit is the only known exposure of the deposit. It marks the southern end of the synclinal deposit from which it trends at least 3600m northeast (Krueckl, 1971). The overall estimated length of the deposit is estimated at 3600m and the width is about 300-500m.

Zodrow (1965) estimated a probable tonnage of 35Mt grading 27% Fe but this was prior to the 1971 drilling when the deposit limits were extended. In a memo by C. Broemling (Park Investigation – correspondence) an estimate of 750Mt was given for deposits in the area. Broemling thought these deposits contain an average of about 3% magnetite based on the magnetic model he was using. Of the 27 shallow drill holes (<38.4m) reported by Krueckl (1971), 12 intersected moderately to intensely weathered and leached quartz-specularite and lesser magnetite iron formation. These holes averaged 36.5% Fe, 4.1% magnetite and 3.5% manganese. Core recoveries averaged about 20% indicating very friable and or very weathered oxidized material. Two of the deeper holes, returned core recoveries between 10% - 90% and intersected moderately to intensely weathered and oxidized middle and lower iron formation. The best section from these holes contained 37.27% Fe over 77.72m (hole Y1367C).

Geophysics

On the 1972 aeromagnetic survey the southwest showing of the Canning No. 1 deposit is represented by an off-scale anomaly while the remainder of the iron formation in the syncline is not represented by any sort of anomaly. Given the continuity of mineralization indicated by drilling this discontinuity is problematic and needs to be resolved. Krueckl (1972) attributed the low magnetic response noted in the ground magnetic survey to a lack of magnetite. Apparently gravity profiles were also completed over the deposit, which are currently unavailable, but did indicate the deposit to be flat lying and shallow (Krueckl, 1972).

To the northwest of the Canning No. 1 deposit are two northeast trending off-scale aeromagnetic anomalies that lie over mapped Sokoman Fm. No additional information or samples are available for these areas.

In 1979 Price (1979) carried out 7 lines of ground magnetic survey totaling 6550m in length. In his discussion on the results he thought the most interesting readings were obtained from the westernmost aeromagnetic anomaly located at Tup Lake.

The 1972 airborne electromagnetic maps show a general northeast trend. The Canning No 1 deposit is highlighted as a weak high.

References:

Anon., 1970. Ore Potential within the Wabush Sub-lease. Development File C210-35?

Broemling, C., 1971. Park Investigation – correspondence file, filed with Canning No.1.

Krueckl, 1971. Geological Investigation of the Proposed New Townsite, IOCC, technical Services Division. CB020, GL5600.

Price., J., 1979. Details of Results of Impost Work on Block 22 (magnetic survey – profiles). (From block files)

Zudrow, E.L., 1965. Summary of Ore Deposits (Memo)

Sanders Geophysics, 1972. Aeromagnetic maps, 1":1000' scale. Flat File, Drawer 17 &18.

3.0 Duley No. 2 (Long lake), Block No. 23

License: 25

Priority: 2

Status: Partially sublicensed block

Area: 644.61 hectares

Expiry Date: Feb. 03, 2004

Location:

NTS: 23B/14 Lac Virot & 23B/15 Flora Lake
IOC Map Sheet No. (1:12,000 scale): 257E-4, 257E-1, 256W-6, 256W-3

Conclusions and Recommendations

The Duley No. 2 showing outcrops on the shore of Duley Lake and is the presumed extension of the Canadian Javelin deposit (mined by Wabush Mines). The deposit dimensions are about 1,800 x 350m within a larger northerly trending positive magnetic anomaly that extends over 4,000 x 750m. It is thought to lie in a syncline overturned to the west and consist primarily of carbonate iron formation (the lower member of the Sokoman Fm). A previous 1492m diamond drill program tested the Duley No. 2 deposit and an aeromagnetic anomaly located to the south with 3 wide spaced fences. The deposit was tested to a maximum depth of 133.5m and has an estimated size of 147.9Mt grading 27% Fe. The best hole returned a grade of 31.85% Fe over 111.3m and ended in mineralization. Where the aeromagnetic anomaly was tested by shallow holes (<42m deep) the results returned low (<30%) Fe grades.

The Duley Lake area is in a recreational area, which may pose future development problems. Diamond drilling is recommended to test for higher-grade material. If drilling yields similar grade material to what was previously reported (about 30% Fe) the ground should be dropped.

Work History

Year	Work Done	Comments
1949	1":1/2 mile geological mapping, sampling	H.E. Neal
1951	airborne magnetic survey	
1953	1:12,000 geological mapping, sampling, dip needle survey	Crouse, R.A., 1954
1957	29 DDH, 1492m. magnetic and gravity survey	
1959	single gravity profile	
1972	airborne magnetic survey	

1980	ground magnetic and gravity survey over Duley Lake	No ref. material, two maps only

Geology

The block is underlain predominantly by the Sokoman and Wishart Fms and lesser schists and gneisses of the Attikamagen Fm, although the later are not exposed. Rock exposure is very limited on the block. Most drill holes intersected quartzites or banded specular hematite, magnetite and quartz-carbonate. This is interpreted to be rocks of the lower member of the Sokoman Fm.

A previous 1492m diamond drill program totaling 29 holes tested the Duley No. 2 deposit and the linear aeromagnetic anomaly that extends south of the deposit.

Structure

The current deposit model shows the deposit lying in a north trending overturned syncline that can be traced for over 3600m. Steep (?) faults in the southeast side of the block juxtapose Attikamagen Fm against the Wishart and Sokoman Fms.

Mineralization

The Duley No. 2 deposit is considered to be an extension of the Canadian Javelin deposit (mined by Wabush Mines). The probable grade and tonnage given by Anon. (1970) is 162Mt grading 27% Fe. Mathieson (1957) noted that it was highly irregular in width along its length and averaged about 600m wide and had an average grade of 26.7% Fe. The zone is composed of specularite with some magnetite, with much brown carbonate throughout with associated amphiboles and minor disseminated sulphides (Mathieson ,1957).

Ore tests carried out in 1958 by IOCC, Ore Testing and Research (Caron, 1958) on drill core samples (1957 drilling) indicated that the quartz magnetite carbonate rocks do not respond to gravity separation. The presence of grunerite and other silicates made tabling impractical although it was noted that magnetic concentration was more efficient than gravity separation as the deposit contained a high percentage of magnetite.

Geophysics

The Duley No. 2 deposit is a prominent to 'off-scale' aeromagnetic anomaly, which terminates to the north at about the middle of Duley Lake. The deposit is thought to be the southwest extension of the Canadian Javalin deposit located on the east side of the lake. The drilling to date has confirmed the coincident presence of magnetite iron formation below positive aeromagnetic and electromagnetic anomalies. The lack of a magnetic anomaly to the north may indicate a mineralogical change from magnetite to hematite mineralization.

A profile of a gravity line, with no accompanying plan map, over the Duley No. 2 shows a moderate gravity anomaly (Anon., 1959).

Results of a ground magnetic and gravity survey carried out in 1980 over the north side of Duley Lake are poorly documented. However the maps show a weak gravity high located to the south of a weak magnetic high

References:

Anon. 1959. Maps and sections on preliminary gravity and magnetic profiles 1959, Scott Bay, Goethite Bay, Duley #2. IOC Vault, DA025 GP0390.

Anon., 1970. Ore Potential within the Wabush Sub-lease. Development File C210-35?

Anon., 1980. Ground gravity and magnetic maps of Duley Lake – Block 23. From block files folder

Anon., 1950. Ore Test on Duley No. 2 Deposit. The Dept. of Mines and Resources Ottawa. IOC Vault, DD006 MT0060

Caron, J.C. 1958. Results of Beneficiation Tests on Duley Area, 1957 Drill Core Samples. The Iron Ore Company of Canada, Ore Testing and Research Laboratory, Report No. 3. IOC Vault, DD015 MT0140

Sanders Geophysics, 1972. Aeromagnetic maps, 1":1000' scale. Flat File, Drawer 17 &18.

Zudrow, E.L., 1965. Summary of Ore Deposits (Memo). From block files folder.

4.0 Mills #1, (Mills Lake #1, Kelly – Clavin showing), Block No. 24

License No: 26

Priority: 3

Status: Partially sublicensed block

Expiry: Feb. 3, 2004

Area: 301.27 hectares

Location

NTS: 23B/14 Lac Virot, 23B/15 Flora Lake
IOC Map Sheet Numbers (1:12,000 scale): 257E-1, 247E-4, 256W-3, 246W-6

Conclusions and Recommendations

Mills #1 appears to be in an overturned north-northwest trending syncline with at least a portion of the east limb cut off by a fault. Only two holes tested the iron formation and one of these had poor core recovery. Units intersected are generally described as carbonate iron formation. Most of the old aeromagnetic anomaly remains untested. The deposit size appears to be approximately 1,440 x 180m, based on the old airborne magnetic data. It is a second order target which will need to be upgraded by the new aeromagnetic data if it is to be kept.

Work History

Year	Work Done	Reference
1933	geological mapping	J.E. Gill, M. Bannerman and C. Tolman
1949	geological mapping	H.E. Neal
1953	geological mapping, sampling	Crouse, R.A., 1954
1957	diamond drilling, 8 holes	Mathieson, 1957
1961	mapping – limestone exploration.	McIntosh, 1961
1972	airborne EM & magnetometer survey	
1979	magnetometer survey	J.Price

Geology

Outcrop is present and most abundant on the west limb of the iron formation. From west to east, across the NW trending iron formation, the units consist of marble – crystalline limestone, a thin band of quartzite (Wishart Fm), amphibole-carbonate iron formation (presumed lower iron formation?) which is in fault contact with mica schist. Two of the eight shallow (<48.77m) drill holes on block 24 tested and ended in mineralized iron formation. One of these holes was apparently in carbonate iron formation and the other intersected abundant limonite. The remainder intersected micaceous schists, carbonate iron formation, marble or were lost in overburden.

The possibility exists in the area for limestone deposits. A limestone occurrence at Squaw Lake, located off the block, had a SiO_2 content of 2.62%.

Structure

The iron formation trends northwest, dips moderately east and is most likely a syncline overturned to the west. The iron formation unit is truncated by a NNW trending fault to the east.

Mineralization

Crouse (1954) estimated mineralized (friable magnetite – specularite beneficiating 'ore') averages approximately 32% Fe over a minimum distance of 487m and width of 106m. The body strikes NW and dips 55 degrees east. Estimated at 37,000 tons per vertical foot (Mathieson (1957) estimated (p.21) a maximum width of 609m and length of 3000m, composed of specularite with varying amounts of magnetite at a grade of 32.1% Fe. Anon. (1970) estimated a probable tonnage of 3Mt at 33% Fe.

Geophysics

Associated with a strong aeromagnetic high (approximately 1440m x 180m at >10000Nt). Results from the 1972 electromagnetic survey over the block show a weak northwesterly trending high approximately coincident with the magnetic high.

Price (1979) carried out 4 lines of ground magnetic survey totaling 3500m. He concluded that oxide facies of iron formation does occur on Block 24 but that there was no indication the iron formation is unusually enriched in magnetite.

References:

Crouse, R.A., 1954. Mills Lake – Dispute Lake Area; Development File GL1400

Mathieson, R.D., 1957. Iron Ore Company of Canada, Wabush Project 1957, Duley Lake – Mills Exploration Drilling; Development File DR 1100

McIntosh, J., 1961. Chemical Analysis of the Dolomitic Limestone – Mills Lake Area; Development File GL 6210

McIntosh, J., 1961. Geological Investigation and Sampling of the Dolomitic Limestone Deposits, West of Mills Lake, Newfoundland and Labrador. Development File GL 6210

Anon., 1970. Ore Potential within the Wabush Sub-lease. Development File C210-35?

5.0 Duley #1 (including Polly Lake), Block No. 25

License: Lease 27

Priority: 1

Status: Partially sublicensed block

Expiry: July 9, 2002

Area: 505.66 hectares

Location:

NTS: 23B/14 Lac Virot
IOC Map Sheet Numbers (1:12,000 scale): 257E-4 and 257E-1
Lislois and No. 2856 Townships, Saguenay County, Quebec

Conclusions and Recommendations

The Duley #1 deposit is located in an overturned syncline on the nose of an overturned anticline trending and plunging to the northeast. Possible structural thickening and grade enhancement may have occurred. Drilling has partially tested the east and northeast areas of the deposit and the limbs of the anticline but not the nose fold area. A 1,200 x 1,800m aeromagnetic anomaly partially defines the area. 1970 grade and tonnage calculations indicate 115.5Mt at 38% Fe. Duley #1 is an attractive target as it is hosted in middle member of the Sokoman Fm. There is room for it to host >200Mt of iron ore. Large portions of the sizeable old aeromagnetic anomaly are virtually untested by drilling. The block covers only the Newfoundland side of a target zone that straddles the Quebec boarder. Access to the area is good, as it is less than 2.5km to the Fermont – Labrador City Road.

Additional mapping, deposit modeling, ground geophysics and drill testing will be done and acquisition of ground in Quebec considered.

Work History

Year	Work Type	Amount/Comments
1949	geological mapping	H.E. Neal
1953	geological mapping, sampling	Crouse, R.A., 1954
1953	Dip needle survey	map 0031-P-1
1956, 1957	Claims staked in Quebec	Holannah Mines
1957	mapping, dip needle survey	Sofanio, Hollannah Mines
1957	mapping, diamond drilling, 20 holes	Mathieson, 1957

1958	diamond drilling, 12 holes (HH holes) Polly Lake	R. Jury, 1958, Holannah Mines
1958 (to 1971)	Quebec ground withdrawn from staking	IOC requests Quebec land to be opened in 1971
1971	IOC stakes 30 claims in Quebec	
1972	airborne magnetometer survey, claims and area remapped.	
1973	mapping, magnetic & gravity survey	C.G. Hamilton, 1973
1974	gridding, ground mag and gravity survey	
1979	magnetometer survey	J.Price

Geology

Two geological maps are present in the files. One set consists of maps 257E-4 & 257E-1 (1958 vintage) while the other is Figure 6 from Hamilton (1975) which supersedes the earlier maps. Hamilton's (1975) map shows the "HH" series of 12 diamond drill holes (totaling 537.97m) consisting of small diameter (AX) holes less than 53m in length.

From north to south across the fold the rocks consist of Wishart Fm quartzite, the core of the anticline, amphibole carbonate iron formation (lower iron formation), mica schist (Attikamagen Fm) and quartz–magnetite-specularite gneisses and schists (middle iron formation) and quartz-grunerite gneisses and schists (lower or upper iron formation). Shabogamo gabbro intrudes the above units. The Duley #1 deposit and iron formation in the limbs are part of the middle member of the Sokoman Fm, the same unit that hosts the deposits being mined in the Wabush Lake-Mount Wright area. The western limb is a thin unit and likely to be uneconomic, the eastern limb is interpreted to be a doubly plunging syncline with the potential for a significant thickness of iron formation.

Structure

The Duley 1# iron formation lies in an overturned syncline at the nose of a NE trending overturned anticline that plunges at an unknown dip to the northeast. Iron formation in the anticline limbs are found underlying Polly Lake (SE fold limb and a doubling plunging syncline) and near the Quebec – Labrador border (thin NW fold limb). Mathieson (1957) reports that faulting complicates the geological picture.

Mineralization

Crouse (1954) described the mineralization discovered by H.E. Neal in 1949 on the ridge which forms the height of land as of beneficiating 'ore'. Mathieson (1957) described the zone as 4267m long, 1829m wide over which drill holes (not including HH holes on Quebec side) intersected specularite – magnetite schist averaging 34.3% Fe. Anon. (1970) calculated a "probable" tonnage of 115.5Mt tons grading 38% iron based on surface mapping and the minimal drilling.

Geophysics

Associated with a very strong (off scale) aeromagnetic high (1972 survey) over an area 1200m x 1800m. Five magnetometer and gravity profiles, totaling 4,876m, completed in 1973 on the south-east side of the target (north of Polly Lake) show coincident positive magnetic and gravity anomalies over the iron formation as mapped in the east fold limb.

Maps of the 1972 airborne electromagnetic survey show a northerly trend approximately coincident with the airborne magnetic anomalies.

In 1975 five lines totaling 4,267m were established for control and were used for gravity with stations spaced 30.48m. Interpretation of the survey results indicated that the two zones of oxide iron formation in the area of Polly Lake were more extensive than initially interpreted and that the bands are limbs of a doubly plunging syncline.

Price (1979) carried out 2 lines of ground magnetic survey totaling 1780m and concluded that there were excellent indications of strongly magnetic strata on the block and recommended more work.

References:

Anon., 1970. Ore Potential within the Wabush Sub-lease. Development File C210-35?

Anon., 1973. 1973 Polly Lake (Duley#1) Gravity notes, computations.

Crouse, R.A., 1954. Mills Lake – Dispute Lake Area; Development File GL1400

Hamilton, C.G., 1972. Polly lake Claim Group Quebec. GL3400

Hamilton, C.G., 1973. Polly Lake Claim Group. GL1400

Hamilton, C.G., 1975. Polly Lake Claim Group. 1975 Report. GL1400

Jury, R., 1958. Report on the Kissing Lake Iron Showing. GL1400

Mathieson, R.D., 1957. Iron Ore Company of Canada, Wabush Project 1957, Duley Lake – Mills Exploration Drilling; Development File DR 1100

Tuffy, F., 1958. Kissing Lake Claim Group, Diamond Drilling Program 1958.

6.0 Block 26 (aeromagnetic anomaly), Block No. 26

License: 28

Priority: 4

Status: Partially sublicensed block

Expiry: July 9, 2002

Area: 158.65 hectares

Location:

NTS: 23B/14 Lac Virot
IOC Map Sheet Numbers (1:12,000 scale): 257E-4

Conclusions and Recommendations

Three diamond drill holes tested a northeast trending, off-scale aeromagnetic anomaly for a small tonnage, magnetite rich deposit. The block is underlain by the middle and upper members of the Sokoman Fm. intruded by Shabogamo gabbros on the west limb of an overturned syncline. The best result was 20.7% Fe over 94.5m, including a 12.2m section that returned 35.7%. Various combinations of quartz-grunerite-carbonate-actinolite-amphibole schist (upper iron formation) host the magnetite mineralization. As the diamond drill holes tested the flanks of the aeromagnetic anomaly after a ground follow-up survey it can be considered to have been adequately drill tested. Unless the 2000 airborne survey data generates a new target/model this block can be considered tested and the ground relinquished.

Work History

Year	Work Done	Comments
1949	geological mapping, thought to have been covered by Neal.	H.E. Neal, 1949
1953	geological mapping, sampling	Crouse, R.A., 1954
1972	airborne magnetic survey	
1978	3840m magnetic survey	J.Price (not located, Nov 00)
1979	diamond drilling, 3 holes, 415.75m	Price, 1979

Geology

Only rare outcroppings of amphibole iron formation (upper iron formation) and gabbro has been found on the block (Anon., 1970). Based on these sparse outcrops and the three 1979 drillholes the block appears to be underlain by units of the middle and upper member of the Sokoman Fm intruded by gabbro of the Shabogamo intrusive. Drilling intersected units of quartz-carbonate-magnetite and quartz-grunerite-magnetite, having true widths of about 5-8m, are bounded by thick layers of quartz-grunerite schist. Sills of Shabogamo gabbro intrude the iron formation. Following the drilling Price (1979) recommended no further work on this block as, "The chance of locating an iron ore body on this block is minimal."

Structure

Units of gabbro and amphibolite trend northeast and dip steeply to the southeast. The block covers the west side (west limb) of an overturned syncline. No structural thickening is indicated in either the mapping or the geophysics.

Mineralization

No iron formation is exposed on surface. The drill holes intersected narrow bands of 10%-20% wt. magnetite in a silicate rich facies of iron formation (quartz-carbonate–magnetite and quartz-grunerite–magnetite) presumed to be an upper member of the Sokoman Fm. The best results, from DDH hole Y1404C, was 20.72% Fe over 94.5m. This included a 12.19m section that returned 35.70%. Various combinations of quartz-grunerite-carbonate-actinolite-amphibole schist (upper iron formation) host the magnetite mineralization.

Geophysics

Associated with a strong off-scale aeromagnetic high (approximately 300m x 3000m >15,000 nT, vertical gradient). In 1978 the anomaly was covered with 6 ground magnetometer traverses of which 5 lines recorded anomalous readings. The anomaly appears to follow known lithological units as mapped regionally. As the magnetic anomaly was not explained by the smallish amount of magnetite intersected the anomaly was thought, by Muwais (1979), to be possibly due to remnant magnetism. Alternatively the pyrrhotite noted in the drill core (Price, 1979) might help explain the anomaly.

References:

Anon., 1970. Ore Potential Within the Wabush Sub-lease. Development File C210-35?

Muwais, W., 1979. L.M.&E. Memo dated 1980-02-11.

Price, J., 1978. Magnetometer Survey – 12600'. (Not located as of Nov22, 00)

Price., J. 1979. Details of Results of Impost Work on Block 26. From block files

7.0 Huguette No. 2, Block No. 27

License: 29

Priority: 3

Status: Partially sublicensed block

Area: 149.46 hectares

Expiry Date: July 09, 2002

Location:

NTS: 23B/14 Lac Virot
IOC Map Sheet Numbers (1:12,000 scale): 257E-4

Conclusions and Recommendations

Huguette No. 2 outcrops near Huguette Lake. It is a small but high grade (45.9% Fe) showing approximately 450 x 60m in area. The target has not been diamond drilled. It has a positive magnetic response that trends to the northeast, approximately parallel to the mapped geology. The anomaly offset, together with northwest trending foliation at right angles to the mapped units, suggests a fold closure.

This prospect is too small to be of interest to IOC. Unless the 2000 aeromagnetic survey indicates a significant increase in potential size, the ground will be relinquished.

Work History

Year	Work Done	Comments
1951	airborne magnetic survey	
1953	1:12,000 geological mapping, sampling,	Anon., 1970
1957	1:12,000 geological mapping, sampling	Mathieson, 1957
1972	airborne magnetic survey	
1979	ground magnetic survey	Price, J. 1970

Geology

The block is underlain predominantly by the Sokoman Fm. Outcrops were mapped as quartz-magnetite-specularite, magnetite-amphibole iron formation and amphibole-carbonate iron formation. Schists and gneisses Rocks of the Menihek are exposed on the south side of the block. Rock exposure is very limited on the block. The current deposit model shows the deposit lying in a northeast trending body of iron formation.

Surface mapping shows the Huguette No. 2 zone to be approximately 450m by 60m in area. The target has not been drilled.

Structure

As mapped on the 1:12,000 scale geology maps the Huguette No. 2 deposit lies within on a northeast trending band of Sokoman Fm. The local foliation and banding within the deposit trends northwest and dips moderately to the north. There is an obvious problem reconciling the local foliation within the northeast trend of the iron formation. Local folds or alternative geological interpretations can explain this problem. One interpretation is that the showing lies within a northeast plunging anticline as defined by the Menihek Fm.

Mineralization

Mathieson (1957) reported that scattered outcrops of "specularite magnetite and magnetite specularite" analyzed 45.9% Fe.

Geophysics

Other than the 1951 and 1972 airborne surveys two lines of ground magnetometer were run across the Huguette No. 2 deposit in 1979 (Price, 1979). Price reported that only small bodies of weakly magnetic iron formation can be expected on this block.

The 1972 airborne magnetic map shows a moderate to strong positive anomaly over the known deposit showings and continuing to the northeast. The magnetic anomaly terminates to the southwest. The implication is that if any further mineralization is to be found in the area it would be to the northeast.

References:

Anon., 1970. Ore Potential Within the Wabush Sub-lease. Development File C210-35?

Mathieson, R.D., 1957. Iron Ore Company of Canada, Wabush Project 1957, Duley Lake – Mills Exploration Drilling; Development File DR 1100

Price., J. 1979. Details of Results of Impost Work on Block 27. Block Files from accordion file folder

Sanders Geophysics, 1972. Aeromagnetic maps, 1":1000' scale. Flat File, Drawer 17 & 18.

8.0 Block 28, Block No. 28

License: 30

Priority: 2

Status: Partially sublicensed block

Area: 797.59 hectares

Expiry Date: July 09, 2002

Location:

NTS: 23B/14 Lac Virot
IOC Map Sheet Numbers (1:12,000 scale): 257E-1, 257E-2, 257E-4, 257E-5

Conclusions and Recommendations

Block 28 covers three aeromagnetic anomalies identified in 1972. One anomaly at the south end of Huguette Lake corresponds to a small (approximately 457 x 45 m) zone of iron formation estimated to average 25% to 30% Fe. No drilling has been done. There is only sparse outcrop. The prominent aeromagnetic anomaly in the southeast corner is over interpreted Sokoman Iron formation. The lack of magnetic response elsewhere on the block is due to schist and gneiss units of the Attikamagen and Ashuanipi Fms.

The target is currently too small to be of interest to IOC. However, it can be expanded if the northeast trending aeromagnetic anomaly is included. If the 2000 aeromagnetic survey suggests a significant increase in target size, more work is warranted. Otherwise, the licence may be relinquished.

Work History

Year	Work Done	Comments
1951	airborne magnetic survey .	
1953	1:12,000 geological mapping, sampling,	Anon., 1970
1972	airborne magnetic survey	
1979	ground magnetic survey	Price, J. 1970

Geology

The Sokoman Fm and schists and gneisses of the Attikamagen Fm underlie the block. Rock exposure is limited to the south margin of the block. Quartz-grunerite, magnetite-amphibole iron formation, presumably of the upper iron formation, has been mapped to the east and south of the block. The target has not been drilled.

Structure

As mapped on the 1:12,000 scale geology maps the aeromagnetic anomalies lie within a northeast trending band of Sokoman Fm.

Mineralization

Other than the report of iron formation located on the south end of Huguette Lake by Anon. (1957), no mineralization has been reported. The reported mineralization consists of a small (approximately 457m x 45m) zone of iron formation that assayed up to 45.9% Fe but is estimated to average 25% to 30% Fe (Anon. 1970). This is not shown as an outcrop on the 1:12,000 scale geology maps.

Geophysics

Other than the 1951 and 1972 airborne surveys one line of ground magnetometer was run across the north side of the block 1979 (Price, 1979). A 400m wide positive anomaly was returned from the south end of the line and a narrow 80-160m peak in the central portion of the line. Price reported that only small bodies of weakly magnetic iron formation could be expected on this block.

The 1972 airborne magnetic map shows a moderate to strong northeast trending positive anomaly over the southeast corner of the block.

References:

Anon., 1970. Ore Potential Within the Wabush Sub-lease. Development File C210-35?

Price., J. 1979. Details of Results of Impost Work on Block 27. Block Files from accordion file folder

Sanders Geophysics, 1972. Aeromagnetic maps, 1":1000' scale. Flat File, Drawer 17 & 18.

9.0 Sitting Bear No. 2, Block No. 29

License: 31

Priority: 3

Status: Partially sublicensed block

Area: 90.94 hectares

Expiry Date: July 09, 2002

Location:

NTS: 23B/14 Lac Virot
IOC Map Sheet Numbers (1:12,000 scale): 257E-2, 257E-5

Conclusions and Recommendations

Block 29 covers a small positive aeromagnetic anomaly that is a reflection of a narrow iron formation hosting the Sitting Bear #2 deposit. No drilling or ground geophysics has been done. There is no evidence of a thicker or tectonically thickened unit that might host an economic deposit (>200Mt). Unless the 2000 aeromagnetic survey and a final field examination in 2001 indicates a higher potential for more size potential the block will be relinquished.

Work History

Year	Work Done	Comments
1950	geological mapping, 1"-1/2mile	Neal, 1950
1950?	airborne magnetic survey?	
1953	1:12,000 geological mapping, sampling,	Jackson, 1962
1955	1:12,000 geological mapping, sampling,	Jackson, 1962
1972	airborne magnetic survey	

Geology

The block is underlain by the northwest trending units of the Sokoman Fm, mostly upper iron formation member, bounded by schists and gneisses of the Attikamagen Fm(?) in apparent conformable contact. The area is cut by numerous faults. Rock exposure is generally very good (+20%). There has been no drilling carried out on the block

Structure

As mapped on the 1:12,000 scale geology maps the potentially economic iron formation lies within a northwest trending band of Sokoman Fm bounded by schist and gneiss units of the Attikamagen Fm. The banding within the Sitting Bear No. 2 deposit and its host rocks dip shallowly to moderately south. From the mapping (Jackson 1962) there is no evidence of a significant fold structure where one might find economic tonnages of iron formation.

Mineralization

Two samples collected in 1953 averaged 26.2% Fe and 11.7% magnetic iron (Anon. 1970). Based on the outcrop and random surface sampling Anon. (1970) estimated a tonnage of 4.05 million tonnes grading 26% Fe.

Geophysics

Other than the 1951 and 1972 airborne surveys no geophysics has been carried out on this block. The 1972 total field magnetic map displays a high-low pair, trending northwest, over the block. Line spacing is too wide spaced to accurately reflect the thin folded units of magnetic iron formation. The electromagnetics follow the general trend of the geology and aeromagnetics.

References:

Anon., 1970. Ore Potential Within the Wabush Sub-lease. Development File C210-35?

Jackson, G.D. 1962. The Geology of The Neal (Virot) Lake Area, West of Wabush Lake, Labrador, With Special Reference to Iron Deposits, Ph.D. Thesis, File GL4600.

Sanders Geophysics, 1972. Aeromagnetic maps, 1":1000' scale. Flat File, Drawer 17 & 18.

10.0 Sudbury 1 and 2, Block No. 30

License: 32

Priority: 2

Status: Partially sublicensed block

Area: 1103.08 hectares

Expiry Date: July 09, 2002

Location:

NTS: 23B/14 Lac Virot
IOC Map Sheet Numbers (1:12,000 scale): 257E-5

Conclusions and Recommendations

Block 30 covers a 1,000 x 7,000m overturned synclinal unit of Sokoman Fm. that hosts the Sudbury No. 1 (1.7Mt at 33% Fe) and the Sudbury No. 2 deposit (7.5Mt at 32% Fe). Coincident with the iron formation, and on strike with the known deposits, are intense positive, unexplained aeromagnetic anomalies. No drilling has been done in this area. Although the indicated tonnage is small there is potential for greater tonnages and similar or better grades. Refined targeting can be done following the 2000 airborne magnetic survey.

Work History

Year	Work Done	Comments
1950	geological mapping, 1"-1/2mile	Neal, 1949
1951	airborne magnetic survey	
1953	1:12,000 geological mapping, sampling,	Jackson, 1962
1955	1:12,000 geological mapping, sampling,	Jackson, 1962
1972	airborne magnetic survey	Sanders geophysics
1979	Ground magnetic survey	J.Price

Geology

The block covers a 1000m wide by 7000m long synclinal and overturned section of the Sokoman Fm that has been refolded about an approximate east-west plane so that it resembles an arch (Jackson, 1962). Schists and gneisses of the Attikamagen Fm are in apparent conformable contact. Rock exposure is very good (+15%) in the vicinity of the Sudbury No. 2 occurrence and moderate in about the Sudbury No. 1 occurrence. Although exposures or mapping is lacking, both occurrences are presumed to be connected by buried iron formation. There has been no drilling and only one small ground magnetometer profile carried out on the block.

Given the 1km by 7km surface dimensions of the Sokoman and that the contacts with Attikamagen Fm are inferred there is room for a moderate sized iron formation deposit.

Structure

As mapped on the 1:12,000 scale geology maps the potentially economic iron formation lies within an 'arched' band of Sokoman Fm bounded by schist and gneiss units of the Attikamagen Fm. Foliations generally dip moderately to steeply towards the center of the arch and which is thought to be a refolded overturned syncline (Jackson, 1962). The fold arch is folded about a northeast plane. No major faults have been mapped or interpreted on the block.

Mineralization

Two samples reported by Jackson (1962) from the Sudbury No. 1 averaged 36.7% Fe and 11.7% magnetic iron (Anon. 1970). Based on the outcrop and random surface sampling Anon. (1970) estimated a tonnage of 1.85Mt grading 33% for the Sudbury No. 1 and 8.3Mt grading 32% for the Sudbury No. 2 deposit.

Occurrence	No. of Samples	Fe%	Mn%	SiO_2%	Reference:
Sudbury No.1	2	36.7	0.32	46.2	Jackson, 1962
Sudbury No. 2	17	31.7	1.09	51.7	Jackson, 1962

Geophysics

Other than the 1951 and 1972 airborne surveys and one (820m) ground magnetometer profile no geophysics has been carried out on this block. The 1972 total field magnetic map displays a magnetic high, including two off-scale anomalies that approximates the mapped folded (arched) Sokoman Fm. Each off-scale anomaly is about 250m x 2000m and does not cover known mineralization.

References:

Anon., 1970. Ore Potential Within the Wabush Sub-lease. Development File C210-35?

Jackson, G.D. 1962. The Geology of The Neal (Virot) Lake Area, West of Wabush Lake, Labrador, With Special Reference to Iron Deposits, Ph.D. Thesis, File GL4600.

Price., J., 1979. Details of Results of Impost Work on Block 22 (magnetic survey – profiles). Flat File, Drawer 17 & 18.

Sanders Geophysics, 1972. Aeromagnetic maps, 1":1000' scale. Flat File, Drawer 17 & 18.

11.0 Huguette 1, Block No. 31

License: 33

Priority: 4

Status: Partially sublicensed block

Area: 36.81 hectares

Expiry Date: July 09, 2002

Location:

NTS: 23B/14 Lac Virot
IOC Map Sheet Numbers (1:12,000 scale): 257E-4

Conclusions and Recommendations

Block 31 covers a 200 x 600m overturned synclinal unit of Sokoman Fm, rimmed by Wishart Fm. (quartzite). The resource consists of 8.9Mt at 34% Fe. No aeromagnetic anomalies are associated with this resource and no drilling or ground geophysics has been done. The potential for more tonnage is very limited.

No further work is recommended on this block unless the 2000 airborne magnetic survey delivers a wholly unexpected result.

Work History

Year	Work Done	Comments
1950	geological mapping, 1"-1/2mile	Neal, 1949
1951	airborne magnetic survey	
1953	1:12,000 geological mapping, sampling,	Jackson, 1962
1955	1:12,000 geological mapping, sampling,	Jackson, 1962
1972	airborne magnetic survey	Sanders geophysics
1979	Rock Sampling	J. Price

Geology

The block covers an overturned synclinal pocket, approximate 200m wide by 600m in area, of scattered outcrops of steeply dipping Sokoman Fm, rimmed by Wishart Fm that in turn is surrounded by Attikamagen Fm. The syncline trends to the north-northeast). Rock exposure is good (+15%) in the area underlain by the Sokoman Fm but practically nonexistent in the surrounding Attikamagen Fm. There has been no drilling and no ground geophysics carried out on the block.

Structure

As mapped on the 1:12,000 scale geology maps the potentially economic iron formation lies within a synclinal pocket of Sokoman Fm rimmed by Wishart quartzite and in turn bounded by schist and gneiss units of the Attikamagen Fm. Foliations generally dip moderately to steeply and outline the overturned syncline. The northeast trending overturned fold axis has been refolded about a later northwest trending fold plane. No major faults have been mapped or interpreted on the block.

Mineralization

Samples collected by Jackson (1962) and Price (1979) are reported below. Price (1979) noted that the iron formation had a high magnetite content, which may have been a result of surface enrichment. Based on the outcrop and random surface sampling Anon. (1970) estimated a tonnage of 8.9Mt grading 34%.

Occurrence	No. of Samples	Fe%	Mn%	SiO_2%	Reference:
Huguette No.1	3	38.7			Price, 1979
Huguette No.1	11	35.9	0.89	45.5	Jackson, 1962

Geophysics

Other than the 1951 and 1972 airborne no geophysics has been carried out on this block. The 1972 total field magnetic map displays no magnetic high(s) over or near the Huguette occurrence in spite of the fact that significant magnetite was reported from the deposit.

References:

Anon., 1970. Ore Potential Within the Wabush Sub-lease. Development File C210-35?

Jackson, G.D. 1962. The Geology of The Neal (Virot) Lake Area, West of Wabush Lake, Labrador, With Special Reference to Iron Deposits, Ph.D. Thesis, File GL4600.

Sanders Geophysics, 1972. Aeromagnetic maps, 1":1000' scale. Flat File, Drawer 17 &18

12.0 Neal 1, Block No. 32

License: 34

Priority: 4

Status: Partially sublicensed block

Area: 99.62 hectares

Expiry Date: July 09, 2002

Location:

NTS: 23B/14 Lac Virot
IOC Map Sheet Numbers (1:12,000 scale): 257E-7

Conclusions and Recommendations

Block 32 covers a 200 x 900m overturned anticline unit of Sokoman Fm rimmed by Wishart Fm. The resource consists of 15.8Mt at 36% Fe. The block covers a positive aeromagnetic anomaly, coincident with mapped iron formation. No drilling or ground geophysics has been done. Given the small surface dimensions, the anticlinal structure of the Sokoman Fm and good outcrop, there is little room to increase the resource.

Final field checking is recommended following delivery of the new aeromagnetic data to confirm the interpretation. If the interpretation holds, relinquishment of the ground will be recommended.

Work History

Year	Work Done	Comments
1951	airborne magnetic survey	
1953	1:12,000 geological mapping, sampling,	Jackson, 1962
1972	airborne magnetic survey	Sanders geophysics

Geology

The block covers a northeast trending anticline of Sokoman Fm surrounded by Menihek Fm and Shabogamo Gabbro on a basement of Ashuanipi Fm. As mapped on the 1:12,000 scale maps the Sokoman is approximately 200m wide by 900m in area, defined by scattered outcrops of moderately south dipping Sokoman Fm, rimmed by Wishart Fm to the southwest. Scattered outcrops of Sokoman Fm are found outside the main area showing area. Rock exposure is good (+20%) in the area underlain by the Sokoman Fm and moderate in the surrounding Menihek and Ashuanipi Fms. There has been no drilling and no ground geophysics carried out on the block.

Structure

As shown on the 1:12,000 scale geology maps the iron formation lies within an anticline of Sokoman Fm. Foliations generally dip moderately to the south and outline the overturned anticline. No major faults have been mapped or interpreted on the block.

Mineralization

Samples collected by Jackson (1962) are reported below. Based on the outcrop and random surface sampling Anon. (1970) estimated a tonnage of 15.84 million tons grading 36%.

Occurrence	No. of Samples	Fe%	Mn%	SiO_2%	Reference:
Neal No.1	5	36.9	0.85	36.5	Jackson, 1962

Geophysics

The positive aeromagnetic response over the block indicates that the iron formation may extend slightly further to the northeast and southwest from what is currently mapped. There is no electromagnetic anomaly (1972 data) over the block.

Other than the 1951 and 1972 airborne no geophysics has been carried out on this block.

References:

Anon., 1970. Ore Potential Within the Wabush Sub-lease. Development File C210-35?

Jackson, G.D. 1962. The Geology of The Neal (Virot) Lake Area, West of Wabush Lake, Labrador, With Special Reference to Iron Deposits, Ph.D. Thesis, File GL4600.

Sanders Geophysics, 1972. Aeromagnetic maps, 1":1000' scale. Flat File, Drawer 18

13.0 Block 33, Block No. 33

License: 35

Priority: 2

Status: Partially sublicensed block

Area: 115.69 hectares

Expiry Date: July 09, 2002

Location:

NTS: 23B/14 Lac Virot
IOC Map Sheet Numbers (1:12,000 scale): 257E-7

Conclusions and Recommendations

Block 33 covers northeast trending units of the Sokoman and Shabogamo Fm. Outcrop is restricted to the southwest property margin. One hole in a fence of shallow holes intersected quartz-magnetite-grunerite schist (likely LIF) that assayed 17.1% Fe over 7.6m.The block partially covers a high intensity aeromagnetic anomaly that is 300-600m wide and extends for over 4,000 Very little drilling and no ground geophysics or sampling have been done on this block. The outcrop is too sparse to rule out the presence of the prospective middle iron formation (MIF). Given the dimensions of the magnetic anomaly, the minor amount of drilling and minimal outcrop the area has potential to host iron formation deposits of potentially economic size.

A field visit will locate potential outcrop in the area of the magnetic anomaly and follow-up any anomalies derived from the 2000 aeromagnetic survey. The target is primarily a geophysical one and ground geophysical surveys and/or drilling will be required to test the anomaly(s).

Work History

Year	Work Done	Comments
1951	airborne magnetic survey	
1953	1:12,000 geological mapping, sampling,	Jackson, 1962
1972	airborne magnetic survey	Sanders geophysics

Geology

The block covers Sokoman Fm intruded by northeast trending units of the Shabogamo Intrusive. As shown on the 1:12,000 scale maps quartz-magnetite-specularite gneiss or schist of the Sokoman outcrops along the Ironstone River, which forms the property's southwest boundary. Outcrops of quartz-grunerite gneiss or schist (upper iron formation member?) also outcrops along the river and around the block. A northwest trending fence of drillholes crosses the northeast corner of the property.

Of the seven holes, on or immediately adjacent to the block, all but two intersected gabbro, commonly altered, of the Shabogamo Fm. Of the two other holes, one intersected quartz-grunerite schist and the other quartz-magnetite-grunerite schist. Quartz-magnetite-specularite as mapped in outcrop along the Ironstone River was not intersected by the drillholes.

A fence of shallow holes south of the block intersected altered gabbro, Shabogamo Fm, where the holes managed to penetrate the overburden.

Structure

As shown on the 1:12,000 scale geology maps the Sokoman Fm trends northeast and the foliation dips moderately, to the southeast (?), in the drillcore. No major faults have been mapped or interpreted on the block.

Mineralization

No samples have been recorded other than those collected from the one mineralized (quartz-magnetite-grunerite schist) drillhole which returned 17.14% Fe over 7.62m. No samples have been collected from the quartz-magnetite-specularite outcrops located along the river suggesting lean quartz-magnetite-specularite of the LIF which would be consistent with the carbonate-amphibole-grunerite schist located elsewhere.

Geophysics

The 1972 positive off-scale (>65,000 nT) aeromagnetic anomaly is underlain by both the Sokoman and Shabogamo Fms and cannot be resolved further. The anomaly extends well off the block and extends further to the northeast and southwest from what is now covered by the block. The dimensions of the anomaly are approximately 350m – 600m wide and 4000m in length. The off-scale anomaly does cover the single mineralized drill hole and the quartz-magnetite-specularite outcrops along the river.

The 1972 electromagnetic survey shows a northwest trending discontinuity on the northeast side of the block and a weak northeast trending, kidney shaped high across the north side of the block.

Other than the 1951 and 1972 airborne surveys no geophysics has been carried out on this block.

References:

Anon., 1970. Ore Potential Within the Wabush Sub-lease. Development File C210-35?

Jackson, G.D. 1962. The Geology of The Neal (Virot) Lake Area, West of Wabush Lake, Labrador, With Special Reference to Iron Deposits, Ph.D. Thesis, File GL4600.

Sanders Geophysics, 1972. Aeromagnetic maps, 1":1000' scale. Flat File, Drawer 18

14.0 Neal (Virot) Lake, Block No. 34

License: 36

Priority: 3

Status: Partially sublicensed block

Area: 828.03 hectares

Expiry Date: July 09, 2002

Location:

NTS: 23B/14 Lac Virot
IOC Map Sheet Numbers (1:12,000 scale): 257E-8

Conclusions and Recommendations

Block 34 covers northeast trending units of the Sokoman Fm surrounded by Ashuanipi Complex rocks. No commercial grade iron formation has been found on this block. Outcrop is restricted to the southwest property margin. The block covers two (approx. 450 x 1,000 m), airborne magnetic anomalies that overlie mapped Sokoman Fm. Sparse outcrops of quartz-grunerite schist (or gneiss) and amphibole-carbonate iron formation (LIF?) coincides with the aeromagnetic anomalies. No drilling and minor ground magnetometry have been done on this block.

The sparse outcrop and weak magnetic response does not allow the block to be easily assessed. There doesn't appear to be sufficient volume in which to host a significant deposit. The 2000 aeromagnetic survey interpretation and field mapping will need to be completed before a decision is made to support drilling or relinquishment.

Work History

Year	Work Done	Comments
1953	1:12,000 geological mapping, sampling,	Jackson, 1962
1955	1:12,000 geological mapping, sampling,	Jackson, 1962
1972	airborne magnetic survey	Sanders geophysics
1979	Ground magnetic survey	J.Price

Geology

The block covers northeast trending units of Sokoman Fm surrounded by rocks of the Ashuanipi complex. Where exposed the Sokoman Fm consists of quartz-grunerite gneisses and schists and amphibole-carbonate iron formation (upper iron formation member?). As mapped on the 1:12,000 scale maps outcrop is only found on the southwest boundary. The block has not been drill tested.

Structure

As shown on the 1:12,000 scale geology maps the Sokoman Fm trends northeast and the foliation, on the southern portion of the block, dips moderately to the south. The government geology map shows the northern Sokoman Group iron formation being thrust over the Ashuanipi basement complex.

Mineralization

Price (1979) collected three rock samples in 1979 from the southwest side of the property. The best sample returned a high of 9.75% Fe_2O_3. No other mineralization has been reported on the block.

Geophysics

The 1972 aeromagnetic map shows two small weak to moderate strength, one to two line (800m line spacing) anomalies which coincide with the mapped Sokoman Fm. The airborne electromagnetic map of the area is featureless. Price (1979) carried out 4 separate lines, totaling 2570m, of ground magnetometer survey over the best airborne magnetic anomaly located in the southwest corner of the block. Results show essentially featureless profiles indicating that there is no underlying magnetic iron formation.

References:

Anon., 1970. Ore Potential Within the Wabush Sub-lease. Development File C210-35?

Jackson, G.D. 1962. The Geology of The Neal (Virot) Lake Area, West of Wabush Lake, Labrador, With Special Reference to Iron Deposits, Ph.D. Thesis, File GL4600.

Sanders Geophysics, 1972. Aeromagnetic maps, 1":1000' scale. Flat File, Drawer 17 & 18

15.0 D'Aigle Bay Zone, Block No. 35

License: 37

Priority: 1

Status: Partially sublicensed block

Area: 1984.16 hectares

Expiry Date: July 09, 2002

Location:

NTS: 23G/2 Wabush Lake
IOC Map Sheet Numbers (1:12,000 scale): 306W-6, 316W-3

Conclusions and Recommendations

The Sokoman Fm forms a shallow south dipping overturned isoclinal fold limb and is bounded to the east by the Wishart and Attikamagen Fm and to the west is underlain by the overturned Menihek Fm. Contacts between the Fms may be thrust faults. There are three known deposits of iron formation; D'Aigle Bay Zone No. 1, Zone No. 2 South, and No. 2 North, containing a 'probable' tonnage of 280Mt at 33% Fe. Scattered outcrop is found throughout most of the block. Aeromagnetic anomalies highlight the known deposits and indicates additional mineralization may be found. Fifty-two AX and/or BX size holes totaling 732m for an average length of 14.1m tested the block. Most of the 25 mineralized holes ended in mineralization, including nine in possible MIF. In 1979 four lines of magnetometer survey totaling 4,520m were completed over the No. 2 North deposit indicating a sizable deposit but not overly rich in magnetite.

The known iron formation needs to be drill tested for grade and tonnage potential. As the maximum thickness of the iron formation would be found along the east contact with the Wishart Fm, drilling should be concentrated there. A gravity survey in conjunction with a ground magnetic survey may be considered to evaluate the ground further.

Work History

Year	Work Done	Comments
1950	1":1/2 mile, geological mapping, sampling,	
1953	1":1000feet, geological mapping, sampling,	
1958	mapping, sampling, dip needle, drilling	52 DDH
1972	airborne magnetic survey	Sanders geophysics
1979	Ground magnetic survey	J.Price

Geology

This is a large size block over a 12km long by 1.2km wide (average) northeast trending section of the Sokoman Fm. The Sokoman is on the east dipping overturned limb of a syncline bounded to the southeast by the Wishart Fm or in fault contact with the Attikamagen Fm. To the northwest the Sokoman Fm is covered by the Menihek Fm or overlies the Ashuanipi complex. The presumed middle iron formation (MIF), outcrops of quartz-magnetite-specularite, are found between the Wishart and Menihek. The Sokoman hosts three iron formation deposits labeled, from south to north, D'Aigle Bay Zone No. 1, D'Aigle Bay, Zone No. 2 South and D'Aigle Bay Zone No. 2 North.

As mapped on the 1:12,000 scale maps scattered outcrop is found throughout the block. The block has been drill tested by 52 AX and/or BX holes totaling 732m for an average length of 14.07m, short holes indeed.

Structure

As shown on the 1:12,000 scale geology maps the Sokoman Fm, on the east dipping overturned limb of syncline, trends north (at north end of the block) to northeast and the foliation dips shallowly towards the south and southeast. Foliations noted in the drill core varied on average between horizontal and 25 degrees. The east side of the central portion of the block abuts a northeast trending fault. The outcrop distribution and the measured foliation suggest a shallow southeast dipping sheet of iron formation. The maximum thickness of the iron formation would be reached at the eastern contact with the Wishart Fm. How thick the actual formation is unknown due to the shallow drilling. James and van Gool (1997) show the Sokoman as being sandwiched between two northwest directed thrust faults. Based on the 1972 aeromagnetic survey and 1:12,000 scale geology maps shallowly plunging anticlines and synclines are suggested.

Mineralization

Geological mapping and sampling indicates that the surface dimensions of the three zones are as tabled below:

Zone Name	Dimensions m
D'Aigle Bay Zone No. 1	2 limbs, ea. 250m x 1000m
D'Aigle Bay Zone No. 2 South	100-300 x 1500m
D'Aigle Bay Zone No. 2 North	300m x 1000m

A total of 25 of the drill holes intersected mineralized iron formation and almost all of these holes were ended in iron formation. The intersections commonly consisted of quartz-specularite-magnetite +/- carbonate iron formation (lower and middle iron formation members). Nine holes (Y334C, 335, 485, 488, 498, 500, 504, 507 and Y523C) mostly located towards the middle of the Sokoman Fm exposures intersected quartz-magnetite-specularite, possibly part of the middle iron formation. Based on the mapping, random surface sampling and short drill holes, Anon. (1970), presumably combining all three deposits assigned a tonnage of about 280 million tons grading 33% iron.

Geophysics

The 1972 aeromagnetic map shows a strong high (but not off-scale) over the mapped iron formation deposits. It also indicates that the D'Aigle Bay No.1 and D'Aigle Bay No. 2 South are continuous but that the D'Aigle Bay No. 2 North is a separate deposit across a lithologic or tectonic boundary. Based on the southern magnetic high potential exists for more iron formation outside the known mapped outcrops or drill intersections.

In 1979 Price (1979) carried out 4 separate lines of magnetometer survey totaling 4520m over the D'Aigle Bay No. 2 North deposit. Two lines, running north south on the block boundary lines, approximately parallel to the deposit, showed the presence of magnetic iron formation on the west side of the block and nothing on the east side. The lines that crossed the deposit returned strong positive anomalies although Price (1979) concluded that the presence of magnetite was not sufficient to justify mining magnetite by itself.

Results from the 1972 airborne electromagnetic survey show a strong anomaly over the D'Aigle Bay No.1, D'Aigle Bay No. 2 South and the aeromagnetic anomaly. The D'Aigle Bay No. 2 North is indicated by a weaker EM anomaly.

References:

Anon., 1970. Ore Potential Within the Wabush Sub-lease. Development File C210-35?

Sanders Geophysics, 1972. Aeromagnetic maps, 1": 1000' scale. Flat File, Drawer 18

Price., J., 1979. Details of Results of Impost Work on Block 35 (magnetic survey – profiles). From Block file folder

James, D.T. and van Gool, J., 1997. Geology of the Archean Ashuanipi Complex and Paleoproterozic Knob Lake Group, western Labrador (parts of NTS map areas 23G/2, G/3, 23B/14. Newfoundland Department of Mines and Energy, Geological Survey, Map 97-04, scale 1:100,000.

16.0 Julienne 1 and 2, Block No. 36

License: 38

Priority: 1

Status: Partially sublicensed block

Area: 1114.14 hectares

Expiry Date: July 09, 2002

Location:

NTS: 23G/2 Wabush Lake
IOC Map Sheet Numbers (1:12,000 scale): 316W-2

Conclusions and Recommendations

A moderately south to southwest dipping overturned, isoclinally folded, syncline of Sokoman Fm trends northwest to west. The Wishart and Attikamagen Fms bound the Sokoman Fm to the south. Remnants of Menihek Fm, preserved in syncline cores, and anticlines of Wishart Fm, are found to the north within folded Sokoman Fm. Thrust faults slice and repeat the folded sequence. Of the two known deposits, Julienne No. 1 and Julienne No. 2, No. 2, associated with a prominent aeromagnetic high (approximately 2,100 x 600 m), is the more significant. It has a size of 306Mt at 32% Fe, compared to about 90Mt at 33% Fe in the No. 1 deposit. Drill testing in the past was hampered by poor core recoveries. The best intersection (36.8% Fe over 23.2 m) was from No. 2.

As the Julienne 1 deposit is in a shallow dipping overturned syncline, closely bounded by the Wishart Fm and/or thrust faults, the tonnage potential is likely limited. However, the hard blue magnetite (supergene) mineralization does outcrop on surface and the overall extents of the deposit is poorly constrained, particularly to the east. Given the variable magnetic nature of the iron formation of Julienne No. 2 and the nonmagnetic nature of Julienne No. 1, a gravity survey in conjunction with a ground magnetic survey and mapping will be carried out prior to drilling.

Work History

Year	Work Done	Comments
1950	1":1/2 mile, geological mapping, sampling,	
1953	1:12,000 geological mapping, sampling, drilling	9 DDH, Julienne No.1
1958	sampling, mapping, dip needle survey, drilling	12 DDH Julienne No.2
1959	gravity, magnetometer survey drilling	
1972	airborne magnetic survey	Sanders geophysics
1979	Ground magnetic survey	J.Price

Geology

This is a large size block over an approximately 8.7km long by 1.2km wide (average) northwest trending section of the Sokoman Fm. The Sokoman is on the southwest dipping overturned limb of a syncline bounded to the southwest by the Wishart Fm. Thrust faults according to the mapping by James and van Gool (1997) form some of the formation contacts and slice and repeat the units. Minor remnants of the Menihek Fm mapped on the northeast boundary of the block mark the central portion of the syncline and the presumed area of maximum thickness for the preserved Sokoman Fm. The Sokoman hosts two iron formation deposits named the Julienne No. 1 in the west and the Julienne No. 2 in the southeast.

As mapped on the 1:12,000 scale maps scattered outcrop is found on the central portion of the Julienne No. 1 and No. 2 deposits. The block has been drill tested by 42 AX and/or BX size holes totaling 1109m for an average length of 26.4m. Drill core recoveries, as shown on the attached sheet, are very poor ranging from 0%-10% core recovered to 60%-80%.

Middle iron formation member of the Sokoman Fm is indicated in some of the better drill hole intersections that do not contain appreciable carbonate or secondary mineralization.

Structure

As shown on the 1:12,000 scale geology maps the Sokoman Fm, on the southwest dipping overturned limb of a syncline, trends west (at the northwest end of the block) to northwest and the foliation dips shallowly towards the south and southwest. Foliations noted in the drill core varied on average between 10 and 45 degrees. The outcrop distribution and the measured foliation suggest at the Julienne No. 1 & 2 a significant thickness of iron formation may be preserved in the overturned syncline. A thinner thickness of iron formation is suspected at the Julienne No. 1 as the outcrop pattern of the Wishart and Sokoman Fms and the shallow dips indicate less iron formation has been preserved form erosion. The maximum thickness of the iron formation should be reached at the eastern contact with the Wishart Fm. Indeed this is the area of the best drill hole (DDH-Y605C) which intersected 36.82% iron over 23.16m and ended in iron formation. How thick the actual formation is unknown due to the shallow drilling. Some of the mapped unit contacts are northeasterly directed, southwest dipping, thrust faults according to the mapping by James and van Gool (1997).

Mineralization

Geological mapping, drilling and sampling indicates that the surface dimensions of the zones are as tabled below:

Zone Name	Dimensions m
Julienne No. 1	2200m x 300m
Julienne No. 2 (NW portion)	2100m x 200m
Julienne No. 2 (SE portion)	2400m x 600m

Based on the mapping, random surface sampling and short drill holes, Anon. (1970), assigned a tonnage of about 90 million tons grading 33% iron to the Julienne No. 1 deposit and 306 million tons grading 32% iron to the Julienne No. 2 deposit.

Mineralization of the Julienne No.1 deposit consists of banded hard blue (supergene) hematite in a gangue of friable quartzite. Iron grades in some sections ran as high as 40% - 50%. Goethite and iron oxides were reported in the drill holes but not their percentages. Some of the core is presumed to be very oxidized and friable as only results for sludge samples are reported. All of the 9 drill holes on the deposit ended in iron formation.

Julienne No.2 deposit mineralization consists mostly of quartz-carbonate iron formation, quartz-specularite +/- magnetite schist and gneiss with variable amounts of goethite and iron oxides in a gangue of friable quartzite or quartz-carbonate. Eleven holes intersected quartz-specularite+/-magnetite and may indicate middle iron formation (MIF).

Drill core recovery averaged about 33% indicating oxidized and friable rock. A total of 21 drill holes, out of 33 drilled on the deposit reported iron assays. One hole (Y604C) reported 11% Mn over 4.87m. Almost all of the mineralized holes ended in iron formation. An additional six holes intersected quartz-carbonate iron formation but were not assayed.

Geophysics

The 1972 aeromagnetic map shows a strong high (off-scale) magnetic anomaly, measuring approximately 2100m by 600m, over the southern portion of the Julian No. 2 deposit. Magnetite was only reported from the Julienne No. 2 mineralization. The Julienne No.1 and the northern portion of the Julienne No.2 showed no anomaly (Julienne No. 1) or a very weak magnetic anomaly. Diamond drilling tested the central and southeast edge of the Julienne No. 2 deposit. The best drill hole (DDH-Y605C; 36.82% Fe over 23.16m) was from the central portion of the Julienne No. 2.

IN 1959 a gravity and magnetic survey line was run over the central portion of the Julienne No. 2 deposit (Anon. 1959). A profile of the results shows a coincident anomaly over 600m wide. Therefore, excellent potential exists for significant thickness of iron formation within and near the Julienne No. 2 (southern portion) magnetic anomaly.

In 1979 Price (1979) carried out 6 separate lines of magnetometer survey totaling 7660m over the Julienne No. 2 deposit. The two lines that crossed the aeromagnetic anomaly over the southern portion of the Julienne No. 2 returned weakly anomalous values, as did the line along the eastern edge of the block. The other lines returned background to low values.

Electromagnetic results from the 1972 airborne survey show a weak to moderate anomaly over the southern portion of the Julienne No. 2 deposit approximately coincident with the off-scale (>65,000nT) aeromagnetic anomaly. There is no EM response over the Julienne No. 1 deposit.

References:

Almond, P., 1953. Sampling Julienne, North Wabush Lakes. IOC Vault, AB022 EN6100.

Anon. 1959. Maps and sections on preliminary gravity and magnetic profiles 1959, Scott Bay, Goethite Bay, Duley #2. IOC Vault, DA025 GP0390.

Anon., 1970. Ore Potential Within the Wabush Sub-lease. Development File C210-35?

Erickson, S.E., 1954. Ore Tests – Julienne 1. IOC Vault, DD011 MT0100.

Sanders Geophysics, 1972. Aeromagnetic maps, 1":1000' scale. Flat File, Drawer 17 & 18.

Price., J., 1979. Details of Results of Impost Work on Block 36 (magnetic survey – profiles). From block files

James, D.T. and van Gool, J., 1997. Geology of the Archean Ashuanipi Complex and Paleoproterozic Knob Lake Group, western Labrador (parts of NTS map areas 23G/2, G/3, 23B/14. Newfoundland Department of Mines and Energy, Geological Survey, Map 97-04, scale 1:100,000.

17.0 Mugga Lake Zone, Block No. 37

License: 39

Priority: 2

Status: Partially sublicensed block

Area: 669.07 hectares

Expiry Date: July 09, 2002

Location:

NTS: 23G/2 Wabush Lake
IOC Map Sheet Numbers (1:12,000 scale): 316W-2, 316W-5

Conclusions and Recommendations

Block 37 covers an east-west trending, south dipping, overturned syncline of Sokoman Fm. The Wishart and Ashuanipi Fms bound the Sokoman Fm to the south and northwest respectively. Thrust faults bound the Sokoman Fm and form the lithological contacts. This section of the Sokoman is presumed to part of the same folded and thrust faulted sequence that hosts the Julienne Deposit No. 1 to the south. Although past drill testing was hampered by poor core recoveries almost all holes intersected carbonate iron formation (LIF). Significant goethite is reported in the quartz-carbonate iron formation from the periphery of the Mugga Lake Zone. Based on the mapping, surface sampling and short drill holes a size of 28.5Mt at 28% Fe has been assigned to Mugga Lake Zone.

Although the tonnage potential of this deposit is limited the extent of the deposit is poorly constrained, except to the south and northwest. Given the possible variably magnetic nature of the iron formation, a programme of geological mapping and ground geophysics will be undertaken prior to drilling.

Work History

Year	Work Done	Comments
1950	1":1/2 mile, geological mapping, sampling,	
1951	airborne magnetic survey	
1956	1:12,000 geological mapping, sampling, drilling	
1958	sampling, mapping, dip needle survey, drilling	25 DDH, 564.79m
1959	gravity, magnetometer survey drilling	
1972	airborne magnetic survey	Sanders geophysics
1979	Ground magnetic survey	J.Price

Geology

The block covers an overturned syncline of the Sokoman Fm hosting the east-west trending Mugga Lake Zone. The southern extent of the Mugga Lake Zone is constrained by Wishart Fm intersected in drilling on the south side of the block. Altered gabbro of the Shabogamo Fm and gneissic rocks of the Ashuanipi complex bound the Sokoman to the west and northwest.

As mapped on the 1:12,000 scale maps scattered outcrop of quartz-specularite schists is found on the central portion of the Mugga Lake Zone deposit. Two holes (Y550C and Y552C) on the deposit intersected possible middle iron formation. The block has been drill tested by 43 AX and/or BX size holes totaling 564.79m for an average length of 13.13m. Drill core recoveries, as shown on the attached sheet, are variable ranging from 0%-100% and averaging about 50%.

Structure

As shown on the 1:12,000 scale geology maps the Mugga Lake Zone lies within an overturned syncline of the Sokoman Fm. Foliations mapped on surface dip gently to moderately south and those noted in the drill core varied, on average, between 10 and 40 degrees. As mapped by James and van Gool (1997), the Sokoman Fm is bounded by south dipping, northerly directed, thrust faults.

Mineralization

Geological mapping, drilling and sampling indicates that the surface dimensions of the zones are as tabled below:

Zone Name	Dimensions m
Mugga Lake Zone	1560m x 350m

The Sokoman Fm, composed mostly of quartz-carbonate iron formation is variably mineralized with primary magnetite, specular hematite and secondary goethite. Based on the mapping, random surface sampling and short drill holes, Anon. (1970), assigned a tonnage of about 28.5 million tons grading 28% iron to the Mugga Lake Zone.

Mugga Lake Zone mineralization consists of banded magnetite-carbonate-quartzite, disseminated magnetite and goethite, presumably of the lower iron formation (LIF). Most of the 7 mineralized holes that define the deposit end in (LIF) mineralization. Two holes intersected possible middle iron formation (MIF). The rock in drill core was also reported to be leached.

One mineralized drill hole Y570C occurs by itself to the southwest of the deposit.

Geophysics

The 1972 aeromagnetic map shows a strong positive (but not off-scale) magnetic anomaly, trending north over the eastern edge of the block. This anomaly partially covers the Mugga Lake Zone but trends north versus the east-west geological trend.

In 1959 (Anon. 1959) a gravity and magnetic line was run almost due north of Goethite Bay starting just to the northeast of the Mugga Lake Zone which was not covered. A profile of the results shows no anomaly.

In 1979 Price (1979) carried out 3 separate lines of magnetometer survey totaling 3900m over the Mugga Lake Zone deposit. The two lines that crossed the aeromagnetic anomaly over the southern portion of the Mugga Lake Zone returned moderately anomalous values, as did the line along the deposit axis.

Electromagnetic results from the 1972 airborne survey show a weak to moderate anomaly over the eastern end of the block and is approximately coincident with the aeromagnetic anomaly. There is no obvious EM response directly associated with the Mugga Lake Zone deposit.

References:

Anon. 1959. Maps and sections on preliminary gravity and magnetic profiles 1959, Scott Bay, Goethite Bay, Duley #2. IOC Vault, DA025 GP0390.

Anon., 1970. Ore Potential Within the Wabush Sub-lease. Development File C210-35?

James, D.T. and van Gool, J., 1997. Geology of the Archean Ashuanipi Complex and Paleoproterozic Knob Lake Group, western Labrador (parts of NTS map areas 23G/2, G/3, 23B/14. Newfoundland Department of Mines and Energy, Geological Survey, Map 97-04, scale 1:100,000.

Sanders Geophysics, 1972. Aeromagnetic maps, 1":1000' scale. Flat File, Drawer 18

Price., J., 1979. Details of Results of Impost Work on Block 36 (magnetic survey – profiles). From block file folder.

18.0 Shabogamo No. 1, Block No. 38

License: 40

Priority: 2

Status: Partially sublicensed block

Area: 1400.40 hectares

Expiry Date: July 09, 2002

Location:
NTS: 23G/2 Wabush Lake
IOC Map Sheet Numbers (1:12,000 scale): 316W-1

Conclusions and Recommendations

Block 38 covers a north-south trending, east dipping, overturned syncline of Sokoman Fm. A northeast trending body of Menihek Fm cores the syncline and small bodies of Shabogamo gabbro intrude the Sokoman Fm. The Sokoman Fm may be thrust over the Menihek Fm, suggesting possible stratigraphic loss. Most of the sparse outcrop and several of the drill holes are mapped as magnetite – amphibole iron formation, presumed upper iron formation (UIF). The block has been drill tested by 25 AX and/or BX size holes totaling 835.2m for an average length of 33.4. Nine holes failed to penetrate the overburden. The best intersection returned 29.5% iron over 50m. A resource of 45Mt at 24% Fe has been assigned to the deposit. However, it has not been closed off by drilling. The old aeromagnetic map shows an intense positive magnetic anomaly, approximately 2,000 x 2,000m, trending north over the eastern edge of the block. This anomaly is partially coincident with the weak to moderate electromagnetic anomaly that covers the Shabogamo No. 1 deposit and mapped magnetite – amphibole iron formation. Large areas of the aeromagnetic anomaly are drift covered and includes the area tested by the nine drill holes that failed to penetrate the overburden.

Given the possible variably magnetic nature of the iron formation, a gravity survey in conjunction with a ground magnetic survey will be considered to evaluate the ground further. The known iron formations, and untested portions of the aeromagnetic anomaly, need to be drill tested.

Work History

Year	Work Done	Comments
1950	1":1/2 mile, geological mapping, sampling,	
1951	airborne magnetic survey	
1953	diamond drilling	15 holes
1956	1:12,000 geological mapping, sampling	
1958	sampling, mapping, dip needle survey, drilling	10 DDH

1972	airborne magnetic survey	Sanders Geophysics
1979	Ground magnetic survey	J.Price

Geology

The block covers an overturned syncline of the Sokoman Fm hosting the Shabogamo No. 1 deposit and a northeast trending body of Menihek Fm. Small, <500m size, bodies of Shabogamo gabbro are also found on the block. Most of the Sokoman consists of magnetite – amphibole iron formation, presumably of the lower iron formation (LIF).

As mapped on the 1:12,000 scale maps only very scattered outcrop is found on the block and over the Shabogamo No. 1 deposit. The block has been drill tested by 25 AX and/or BX size holes totaling 835.24m for an average length of 33.4m. Drill core recoveries, as shown on the attached sheet, are quite good overall and average about 77%, although 9 holes failed to penetrate the overburden. Two holes, Y170C and Y171C intersected possible middle iron formation (MIF).

Structure

As shown on the 1:12,000 scale geology maps the Shabogamo No. 1 deposit lies in an overturned north-south trending syncline of the Sokoman Fm. Foliations mapped on surface dip gently to moderately east and those noted in the drill core that dipped no more than 50 degrees. The deposit lies on the nose of a regional structural turn in the trend of the fold belt, from east-west to north-south. Maps by James and van Gool (1997), shows the Sokoman Fm being thrust to the west over the Menihek Fm.

Mineralization

Geological mapping, drilling and sampling indicates that the surface dimensions of the zone, including a gabbro body, as tabled below:

Zone Name	**Dimensions m**
Shabogamo No. 1	1400m 350m

The Sokoman Fm, composed mostly of quartz-carbonate-amphibole iron formation and schist (LIF?) is variably mineralized with primary magnetite, specular hematite. Based on the mapping, random surface sampling and short drill holes, Anon. (1970), assigned a tonnage of about 45 million tons grading 24% iron to the Shabogamo No. 1 deposit.

Geophysics

The 1972 aeromagnetic map shows a strong positive (off-scale) magnetic anomaly, approximately 2km by 2km, trending north over the eastern edge of the block. This anomaly partially covers the Shabogamo No. 1 deposit and extends to Shabogamo Lake over Sokoman Fm, mapped for the most part as magnetite – amphibole iron formation, presumed lower iron formation (LIF). Large areas of the aeromagnetic anomaly are drift covered and includes the area tested by the nine drill holes that failed to penetrate the overburden.

In 1979 Price (1979) carried out 2 separate lines of magnetometer survey totaling 3295m over the drilled area of the Shabogamo No. 1 deposit. One line was interpreted to cross a band of oxide facies iron formation, with a maximum thickness of 60m, bounded by gabbro. The other line was assumed to be sub-parallel to the strike of some weakly magnetic body.

References:

Anon., 1970. Ore Potential Within the Wabush Sub-lease. Development File C210-35?

James, D.T. and van Gool, J., 1997. Geology of the Archean Ashuanipi Complex and Paleoproterozic Knob Lake Group, western Labrador (parts of NTS map areas 23G/2, G/3, 23B/14. Newfoundland Department of Mines and Energy, Geological Survey, Map 97-04, scale 1:100,000.

Sanders Geophysics, 1972. Aeromagnetic maps, 1":1000' scale. Flat File, Drawer 18

Price., J., 1979. Details of Results of Impost Work on Block 36 (magnetic survey – profiles). From block files.

19.0 Shabogamo South Zone, Block No. 41

License: 41

Priority: 2

Status: Partially sublicensed block

Area: 936.11 hectares

Expiry Date: July 09, 2002

Location:

NTS: 23G/2 Wabush Lake
IOC Map Sheet Numbers (1:12,000 scale): 316W-4

Conclusions and Recommendations

The block is largely covered by overburden underlain by a series of north trending anticline - synclines of the Sokoman Fm, amphibole-carbonate (UIF?), cored by Menihek Fm. Alternatively, the Sokoman may be thrust over the Menihek. Outcrop is restricted to the centre of the block where the Shabogamo South deposit outcrops. The block has not been drill tested. Two surface samples averaged 30% Fe, 0.007% P, 2.14% Mn and 51.15% SiO_2. Two lines of magnetometer data over the deposit indicate thin (20m-30m) bands of moderately magnetic rocks. The 1972 aeromagnetic map shows an intense positive magnetic anomaly over the southeast corner of the block and the Shabogamo South deposit, approximately 1,000m wide trending north to northeast. Information in this area is limited. Although a significant aeromagnetic anomaly is found over the deposit, the ground magnetic survey indicates that the magnetic bands are thin. Limited potential is indicated as the deposit is restricted to the UIF.

Additional geologic mapping, geophysical surveying, and drilling are required to progress this target. One or two wildcat holes, early in the season, will provide the necessary encouragement to continue with follow-up exploration.

Work History

Year	Work Done	Comments
1950, 1952	1":1/2 mile, geological mapping, sampling,	
1951	airborne magnetic survey	
1956	1:12,000 geological mapping, sampling, dip needle survey	
1972	airborne magnetic survey	Sanders Geophysics
1979	Ground magnetic survey	J.Price

Geology

The block covers a largely overburdened area underlain by a series of north trending anticline - synclines of the Sokoman Fm cored by Menihek Fm. Where mapped the Sokoman consists largely of amphibole-carbonate (Upper Iron Formation?).

As mapped on the 1:12,000 scale maps only rare and scattered outcrop is found on the block and most of it is restricted to the center of the block where the Shabogamo South deposit outcrops. The block has not been drill tested.

Structure

As shown on the 1:12,000 scale geology maps the Shabogamo South deposit lies in an overturned north-south trending syncline of the Sokoman Fm. Foliations mapped on surface dip gently to moderately east. James and van Gool (1997) show the Shabogamo Fm being thrust to the north, over the Menihek Fm.

Mineralization

Geological mapping and sampling defines the surface dimensions of the zone, as tabled below:

Zone Name	**Dimensions m**
Shabogamo South	500m 200m

The Sokoman Fm, composed mostly of quartz-carbonate-amphibole iron formation and schist is variably mineralized with primary magnetite, specular hematite. Based on the mapping and random surface sampling, Anon. (1970), assigned a tonnage of about 5 million tonnes grading 30% iron to the Shabogamo South deposit. Two surface samples averaged 30% Fe, 0.007% P, 2.14% Mn and 51.15% SiO_2.

Geophysics

The 1972 aeromagnetic map shows a strong positive (<65,000 nT) magnetic anomaly over the southeast corner of the block approximately 1km wide trending north to northeast. The Shabogamo South deposit lies on the northwest side of this anomaly. Large areas of the aeromagnetic anomaly are drift covered and includes the possible southern extension of the deposit indicated by the aeromagnetic anomaly. The electromagnetic anomaly is approximately coincident with the magnetic anomaly.

In 1979 Price (1979) carried out 2 separate lines of magnetometer survey totaling 2380m over the area of the Shabogamo South deposit. The profiles were interpreted to indicate thin (20m-30m) bands of moderately magnetic rocks.

References:

Anon., 1970. Ore Potential Within the Wabush Sub-lease. Development File C210-35?

James, D.T. and van Gool, J., 1997. Geology of the Archean Ashuanipi Complex and Paleoproterozic Knob Lake Group, western Labrador (parts of NTS map areas 23G/2, G/3, 23B/14. Newfoundland Department of Mines and Energy, Geological Survey, Map 97-04, scale 1:100,000.

Sanders Geophysics, 1972. Aeromagnetic maps, 1":1000' scale. Flat File, Drawer 17 & 18.

Price., J., 1979. Details of Results of Impost Work on Block 36 (magnetic survey – profiles). From block file folder.

20.0 Block 42, Block No. 42

License: 42

Priority: 2

Status: Partially sublicensed block

Area: 813.09 hectares

Expiry Date: July 09, 2002

Location:

NTS: 23G/7 Wabush Lake
IOC Map Sheet Numbers (1:12,000 scale): 316W-4, 316W-7

Conclusions and Recommendations

No outcrop has been mapped on this block, nor has it been drill tested. The area is underlain by a series of north trending anticline - synclines of the Sokoman Fm in contact with the Ashuanipi Complex to the northwest. The Sokoman may be thrust to the north, over the Ashuanipi Complex, raising the possibility of stratigraphic loss. Outcrop located near the block consists largely of amphibole-carbonate (UIF?) of the Sokoman Fm. Two surface samples from the Shabogamo North Zone deposit averaged 29% Fe, 0.012% P, 0.21% Mn and 52.7% SiO_2. The 1972 aeromagnetic map shows an intense positive magnetic anomaly, approximately 800m wide, trending northerly, over the eastern side of the block. The Shabogamo North Zone deposit is covered by a 1,000 x 150m weak-moderate high. Weak airborne electromagnetic anomalies follow the same approximate trend as the aeromagnetic anomaly. A 4,560m ground magnetometer survey over the area of the aeromagnetic anomaly on the eastern side of the block suggested that no magnetite rich deposits are present. A notation on the 316W-7 geology map noted that highs on dip needle surveys suggested uneconomic narrow bands of magnetite –specularite schist.

Information on this block is limited. Although a significant aeromagnetic anomaly is found over the eastern side of the block, the limited ground magnetic survey indicates that the magnetic bands are thin. The aeromagnetic anomaly over the Shabogamo North Zone indicates it is narrow (<100m wide) and less than 1,000m long. Because of the overburden, the results of the 2000 aeromagnetic survey are required to fully assess the prospect.

Work History

Year	Work Done	Comments
1950, 1952	1":1/2 mile, geological mapping, sampling,	
1951	airborne magnetic survey	
1956	1:12,000 geological mapping, dip needle survey	
1972	airborne magnetic survey	Sanders Geophysics
1979	Ground magnetic survey	J.Price

Geology

The block covers an overburdened area underlain by a series of north trending anticline - synclines of the Sokoman Fm in contact with the Ashuanipi complex to the northwest. Very little outcrop has been mapped on the block. Where mapped the Sokoman consists largely of amphibole-carbonate (Upper Iron Formation?). The block has not been drill tested.

Structure

As shown on the 1:12,000 scale geology maps the block and nearby Shabogamo North deposit lie within a series of overturned north-south trending syncline – synclines of the Sokoman Fm. Foliations mapped at the Shabogamo North deposit dip gently to the south and east. The nature of the Ashuanipi – Sokoman contact is unknown.

Mineralization

Geological mapping and sampling defines the surface dimensions of the Shabogamo North Zone, as tabled below:

Zone Name	Dimensions m
Shabogamo North	1000m 100m

The Sokoman Fm, composed mostly of quartz-carbonate-amphibole iron formation and schist is variably mineralized with primary magnetite, specular hematite. No tonnage or grade has been assigned to either the Shabogamo North deposit or Block 42. Two surface samples averaged 28.95% Fe, 0.012% P, 0.21% Mn and 52.65% SiO_2.

Geophysics

The 1972 aeromagnetic map shows a strong positive (<64,000 nT) magnetic anomaly over the east side of the block approximately 0.8km wide trending northerly. The Shabogamo North Zone deposit is covered by a 1000m by 150m weak narrow high.

Weak electromagnetic anomalies follow the same approximate trend as the aeromagnetic anomaly.

In 1979 Price (1979) carried out 5 separate lines of magnetometer survey totaling 4560m over the area of the aeromagnetic anomaly on the east side of the block. According to Price (1979) no magnetite rich deposits were indicated.

References:

Anon., 1970. Ore Potential Within the Wabush Sub-lease. Development File C210-35?

James, D.T. and van Gool, J., 1997. Geology of the Archean Ashuanipi Complex and Paleoproterozic Knob Lake Group, western Labrador (parts of NTS map areas 23G/2, G/3, 23B/14. Newfoundland Department of Mines and Energy, Geological Survey, Map 97-04, scale 1:100,000.

Sanders Geophysics, 1972. Aeromagnetic maps, 1":1000' scale. Flat File, Drawer 18

Price., J., 1979. Details of Results of Impost Work on Block 36 (magnetic survey – profiles). From accordion file folder

MANAGEMENT PROPOSAL

RESOURCE ASSESSMENT PROGRAM OF WABUSH IRON FORMATION FOR IRON ORE COMPANY OF CANADA

Watts, Griffis and McOuat Limited ("WGM") was requested by **Iron Ore Company of Canada** ("IOC") to prepare a Management Proposal (the "Proposal") to conduct a resource assessment program of the Wabush Iron Formation in Labrador, within economic reach of the Carol Project of IOC. This Proposal is based on initial discussions with Mr. Robert Didur, Superintendent Mine Technical Services, and the technical "Kick-off Meeting" held at the Sheraton Hotel at the Toronto International Airport on September 25, 2000. Present at the meeting were:

WGM:	Michael Kociumbas (Geologist - Project Manager) Dave Beggs (Geomatics Specialist) Ross D. Lawrence (Vice-Chairman)
PGW:	Stephen Reford (Vice President) Greg Lipton (EarthScan Ltd.) Jim Misener (PGW President)
IOC:	Rob Didur (Superintendent Technical Services) Tim Leriche (Senior Geologist) Rick Casmey (Materials Management) Grant Goddard (Vice President)

Due to time constraints, and the uncertainty of the amount and format of the existing data, WGM has necessarily only outlined what is considered to be the most important aspects of this program and the method to achieve these goals. The Proposal can be expanded or modified at the request of IOC.

IOC has requested that WGM act as project managers (agents) for IOC, to coordinate and facilitate the compilation and processing of all acquired data from the various contractors. WGM is pleased to work with **Paterson, Grant and Watson Limited** ("PGW") and **EarthScan Ltd.** ("EarthScan") as the selected geophysical and remote sensing contractors for this project. All companies are prepared to start work immediately on this job and are willing to commit their resources for the long term. Appendix C contains the detailed proposals submitted by PGW and EarthScan that were used to complete this unified proposal. Appendix D contains a memo from PGW summarizing the quotes received from the geophysical contractors and PGW's recommendations.

WGM is project manager based on its experience with iron ore projects in this region, managing and conducting numerous field programs in northern climates and our expertise in GIS. WGM will work closely with IOC staff and PGW/EarthScan in order to ensure that the criteria outlined by IOC (geographical, geological and economic) are used to define potential targets. All of the collected and processed information will be fully integrated into IOC's database of choice to facilitate future regional and site specific exploration planning.

A summary of the budget for the Resource Assessment Program listing the main tasks and divided into years 2000 and 2001 is on the following page.

IOC RESOURCE ASSESSMENT PROGRAM BUDGET SUMMARY

Phase			Cost
YEAR 2000			
Phase I	WGM	Data Collection/Compilation/Digitization and Initialization of GIS	$ 225,000
	PGW	Data Collection/Processing/Digitization Geophysics/Remote Sensing	61,400
	Contractor	Aeromagnetic Survey & Luce Survey (100 m line spacing)	230,000
	IOC	Stake Open Ground	350,000
	10% Contingency		86,600
TOTAL FOR 2000			**$ 953,000**
YEAR 2001			
Phase I Con't	WGM	Data Collection/Compilation/Digitization and Initialization of GIS	$ 150,000
	PGW	Data Collection/Processing/Digitization Geophysics/Remote Sensing	61,400
	Contractor	Aeromagnetic Survey & Luce Survey (100 m line spacing)	98,000
	Total Phase 1 (con't)		**$ 309,000**
Phase II	WGM	Target Selection	**$ 70,000**
Phase III	WGM	Exploration Programs	230,000
	Contractor	Drilling Allowance (10,000 m)	1,000,000
	Contractor	Geophysical Follow-up Surveys	85,000
	PGW	Geophysical/Remote Sensing Follow-up	22,000
	Total Phase III		**$1,337,000**
Phase IV	WGM	Resource/Reserve Estimation/Reporting	**$ 130,000**
	10% Contingency		184,600
TOTAL FOR 2001			**$2,031,000**
TOTAL RESOURCE ASSESSMENT PROGRAM TO END OF 2001			**$2,984,000**

1. SCOPE OF WORK

WGM will be responsible for the management of the project, including the overall planning, data collection, implementation of a Geographic Information System ("GIS"), target identification and follow-up ground investigation of the selected areas. PGW/EarthScan will be primarily responsible for the collection and processing of old and new geophysical and remote sensing surveys and data and will work with WGM on the integration and interpretation of the data for target identification. WGM has contracted Strategex Ltd. to review on behalf of WGM any bidding and surveying criteria and costs made by PGW and the contracted geophysical company conducting the surveys. PGW will also provide digitizing services for certain aspects of the project, as required.

If IOC requires WGM to perform resource/reserve estimates on any of the more advanced deposits, following the field investigation and exploration, WGM is prepared to complete this work under the supervision of IOC.

WGM, PGW and EarthScan will provide the technical and support personnel, prepare budgets and provide project accounting for all aspects of this project.

WGM envisions this assessment program to include the following major tasks:

1. Plan and budget the overall program, with consultation with all parties involved.

2. Review of available historical data, such as IOC's company/internal files, assessment files held by the government agencies, WGM's company and personal files, and any other appropriate sources.

3. Initiate and complete historical data collection from reports and compiled maps and drill logs. This will involve the compilation of all data into a fully integrated database/GIS. Any historical data that is not presently in digital format, will be digitally captured (scanned and digitized) by WGM and PGW/EarthScan and, if required, enhanced or processed.

4. A fixed wing aeromagnetic survey will be completed by a selected geophysical contractor. WGM, in conjunction with PGW/EarthScan, will incorporate all new data or completed surveys into the GIS. Conversion of data to a common map projection, tieing into a common digital topographic base map and utilizing scales appropriate for detailed geological mapping and target identification (1:20,000 or finer) is essential.

5. As set out by IOC, target identification and selection will be carried out using, but not limited to, the following criteria: a) geographical; b) geological/structural; c) mineralogical/chemical; d) grade and economic parameters; e) targets that would represent the best opportunity to develop additional resources and/or reserves; and f) distance from the Carol project.

6. Planning of systematic phased exploration program(s) for ground mapping and sampling of primary target selection(s). WGM will prepare requests for diamond drilling proposals and field camp set-up, including access road construction (if required) to qualified companies. WGM would analyze these bids and select the most suitable contractor.

7. Conduct field program(s) under the supervision of IOC. All previous exploration work (topographical, geological, drilling, etc.) would be integrated with any new data collected by the field program. PGW will be responsible for contracting, collecting and processing any follow-up ground or airborne detailed geophysical surveys, under the supervision of WGM. WGM would log and sample all drill cores and ship half core samples for analytical and metallurgical testing. All logging will be done in accordance with industry professional standards and will follow IOC's lithological definitions and guidelines, where possible.

8. As part of the field program, WGM would build a database, plot drillhole data, complete a geological interpretation and prepare work reports on a monthly basis, or as required, in order to keep IOC fully informed. A resource/reserve estimate and pit design could be done by WGM and a final technical report would be completed. All data would be supplied to IOC in a format that can be imported into the Vulcan software system in use at the mines. A report of the field program for assessment purposes, would also be completed if required.

2. PERSONNEL

WGM agrees to provide Mr. H.E. "Buzz" Neal as Project Supervisor, Mr. M. Kociumbas as Project Manager (he will also provide geological/reporting support) and Mr. D. Beggs as Geomatics Specialist. Mr. Neal and Mr. Kociumbas have worked together on numerous projects and are currently involved with two iron ore companies providing technical assistance and geological reviews.

Mr. Neal has over 40 years in the mineral industry and has particular expertise in all aspects of the exploration and development of iron ore deposits. Over this time, Mr. Neal has supervised, evaluated and completed resource and reserve estimates for more than 25 iron ore properties throughout the world. He is familiar with the geology of the Labrador Trough with special knowledge of the Carol Lake-Wabush Lake area.

Mr. Kociumbas has over 15 years experience in the minerals industry, and is WGM's resident expert in resource estimation. He has considerable experience with Gemcom software and has assisted clients with its implementation. Recently, Mr. Kociumbas was the project manager for a large diamond drill program and resource estimate for Quebec Cartier Mining Company.

Mr. Beggs is an expert in GIS, satellite imagery/remote sensing and relational databases. Over the last 20 years, he has overseen, implemented and trained numerous clients on various systems around the world. He is an expert at data capture and integration.

The above team members will be supplemented and supported by other WGM staff and associates, such as I. Allen and L. Scaife, to provide additional database and GIS support, and R. Risto and A. Nishio, both with iron ore experience, for data review and compilation and field programs.

The main personnel supplied by PWG for this proposal are Stephen Reford and Jim Misener, and by EarthScan, Greg Lipton. The resumes for the main personnel for this project are attached as Appendix B.

Depending on the length of the programs, additional personnel will be available on an as required basis to ensure uninterrupted work during rotations due to field breaks and to assist other personnel in the office.

After data review, compilation/indexing and initial digitization of a selected data set, WGM will be in a better position to more accurately estimate the schedule and budget for the complete digital capture of all pertinent data and set-up of the GIS. An order of magnitude budget for digitizing is included in this proposal until all of the available data can be evaluated.

3. WORK SCHEDULE

The following is a brief explanation of each phase, which incorporates one or more tasks (other details from the Scope section). The initial phases are heavily dependent on the availability, amount and format of the data. The subsequent phases are based on the results of the data compilation and some major assumptions regarding these results.

The time line is only estimated until the end of 2001. Any future estimation is not considered to be accurate. It must be emphasized that the enclosed budget/schedule prepared as part of the proposal are best estimates only. After consultations with IOC, and assessment of the data format, availability and any follow-up results, the actual time and cost of performing the services may exceed or be less than the estimated costs. WGM will make every effort to insure that the work is conducted according to the approved programs and budgets and to maintain expenditures at or below the approved budget. A reporting procedure will be established in accordance with IOC guidelines.

<u>Phase I</u> Data Collection/Compilation/Digitization and Initialization of GIS.

The main activities will be to complete a new aeromagnetic survey (products will be total magnetic field, vertical gradient, horizontal gradient and digital elevation model) over the area of interest, review and compile existing information in digital format, advise on enhancements to the data, and build a GIS to store and display the required information in a geo-referenced manner. If required, WGM will also make recommendations on the type of system to be installed at the mine and could train IOC staff in its use.

The main tasks to complete the airborne magnetic survey and collect the remote sensing data are:

- Finalize the survey boundaries using available geophysical and geological information and select a geophysical contractor based on received bids. The final contract will incorporate stringent technical specifications to guarantee a high quality product.

- On-site technical supervision of the magnetic survey to ensure the contractor meets or exceeds survey specifications and is therefore able to receive rapid responses to questions and allows for immediate follow-up of target areas if desired. A detailed survey could be conducted over the Luce deposit at the same time, providing an excellent geophysical signature which could be useful in subsequent target selection.

- Compilation of past GSC data and digitization of Sander Geophysics surveys. This data is useful for regional control and for information over deposits that have been mined since 1972. The Sander data will help to determine what EM anomalies are present and if a new helicopter-borne survey may be applicable in any follow-up work.

- Collection and processing of remote sensing data. This data will include Landsat 7 Thematic Mapper and panchromatic digital data, Radarsat Fine Mode digital data and digital elevation data. Fine Mode is recommended due to the importance of structural mapping of the target horizons.

- Geophysical data processing, modelling and interpretation. Using stratigraphic/geological interpretation and remote sensing data, and recognizing that complex structure will most likely play an important role in target definition, the data will be modelled accordingly. PGW will complete an initial geological interpretation and WGM will refine and finalize this interpretation. A physical property study of samples from the Luce deposit will contribute to the modelling procedures.

- Preparation of all digital data into a GIS-ready format.

Creation of the GIS database will include the following:

- Design thematic layers, quality control and data standards and entity relationships for the GIS database. Define software and hardware requirements.

- Production of base maps. Select map projection, datum and topographic base map(s) for the project. All data will be converted to a common map projection (likely UTM) and tied into the topographic base map. The base maps could range from 1:50,000 to 1:5,000 and be derived from government NTS 1:50,000 digital maps, IOC proprietary detailed topographic maps and/or IKONOS detailed satellite imagery.

- Make an inventory of all historical data and create an index database showing geographic coverage of various surveys. The geographic outline of each survey will be linked to metadata defining survey parameters and descriptions. A more accurate budget and schedule could be completed at this stage.

- Create a database containing scanned images of all historical data. All maps will be geo-referenced and tied in to a common topographic base map. Selection of appropriate historical data from the image database (see above) for compiling and digitizing in vector format.

- New geophysical and remote sensing data will be collected, digitized and processed by the PGW/EarthScan. All other data will be digitized by WGM. Incorporation into the GIS of all image maps from new geophysical surveys and remote sensing studies.

- The GSC aeromagnetic data and past geological mapping indicate that a good portion of the proposed survey area is underlain by iron formation. As part of Phase I, and before the survey is flown, WGM and PGW recommend that IOC stake the available ground within the survey area to prevent any other individuals or companies from picking up open ground in the area of interest.

    Estimated Start Date - October / November 2000
    Estimated Time - 3 to 5 months

It is expected that Phase I will roll into Phase II.

<u>Phase II</u> **Target Selection.**

Using predetermined criteria and all compiled geological and geophysical data, WGM, PGW/EarthScan and IOC will select targets for further follow-up field investigation. In order to ensure complete and seamless transfer of knowledge of the possible targets, this will be carried out by the same personnel that conducted the data collection.

Mining licences that are set to expire within the next two years would be the focus of the target selection. However, WGM would take a regional approach during the data review and would also recommend other areas for further investigation or acquisition. WGM would produce a report (detail depending on IOC's documentation requirements) summarizing our data review, compilation and rational for the target selection(s).

Estimated Time - 1 to 2 months

<u>Phase III</u> **Exploration Programs and Reports.**

WGM will select the appropriate contractors (camp, surveyors, drilling companies, laboratory, etc.) from submitted bids and will manage and staff the exploration programs over the available field season. The personnel, time frame and costs of the programs are entirely dependent on the number and size of the identified targets.

High spatial resolution remote sensing data ("IKONOS") may be acquired during this phase, as a follow-up to the initial Landsat images collected. IKONOS is good for detailed work, as it has a resolution of up to 1 m, versus 30 m for standard Landsat imagery.

WGM would be responsible for locating all new drillholes, logging, assaying and reporting of results. These will be conducted following protocols and criteria set out by IOC.

It is WGM's experience that most field programs of substance, ie., camp establishment, ground geophysics, surveying, surface mapping/sampling and follow-up drilling will last the duration of a field season, which in the case of the Wabush area would be approximately 3 to 4 months for field exploration and 4 to 5 months for drilling. Depending on the total number of metres drilled and the number of drills, it is estimated that from one to three geologists and a couple of assistants would be required. Estimated drilling costs in this area are about $100/m and up to 100 m per day could be completed per drill (two shifts). It is possible that the drilling program could continue in the winter after freeze-up at an additional cost.

Estimated Start Date - May / June 2001
Estimated Time - 3 to 4 months

Phase IV **Resource/Reserve Estimation/Reporting.**

If required by IOC, WGM could integrate the acquired data and complete a block model resource estimate and Whittle pit design(s). WGM could also prepare a report for the applicable government organizations for assessment purposes.

As all of the available data will be input into the database during the previous tasks in a suitable/compatible format, completing a resource estimate and pit design would be the logical final step. Depending on the complexity and number of deposits, WGM has found that from 6 to 8 weeks is required for geological interpretation and modelling, grade interpolation and preliminary pit design.

Estimated Start Date - October / November 2001
Estimated time - 2 to 3 months

4. RESPONSIBILITIES OF WGM

A list of WGM's responsibilities are as follows:

1. WGM will be appointed as project manager and will act as IOC's agent in carrying out the program. The terms and conditions for this assignment will be outlined in a detailed contract and will include an approved program, budget and schedule. Some of the items to be included in the contract are outlined below.

2. WGM shall perform the Services as an independent contractor in accordance with industry professional standards, the terms of this Proposal and applicable laws and regulations. WGM's liability arising out of or in connection with the Services shall be limited solely to WGM's failure to perform its Services with that degree of skill and judgement which is normally exercised by recognised professional engineering firms performing services of a similar nature. Said deficiencies must be reported in writing to WGM within a reasonable time, not to exceed thirty (30) days after discovery thereof, and in no event later than one year from the date of completion of the Services hereunder.

3. WGM's total liability to IOC arising out of or in connection with this Proposal, from any and all causes, shall not exceed the total compensation received by WGM hereunder.

4. Except as otherwise provided, WGM's liability to IOC for any reason in connection with the performance of the Services shall terminate upon completion of the Services.

5. Under no circumstances shall WGM be liable to IOC for any consequential or incidental damages.

5. FORCE MAJEURE

Neither party hereto shall be considered in default in the performance of its obligations hereunder to the extent that the performance of any obligation is prevented or delayed by any cause, existing or future, which is beyond the reasonable control of the affected party.

6. COMPENSATION AND PAYMENT

IOC will pay WGM and PGW for the performance for the Services as follows.

Fees

WGM will charge fees for its personnel for each employee classification for time engaged by WGM personnel contracted for this project. The fee schedule will remain in force through 2001.

Long-term rates will be applied to WGM personnel if the contract is extended past December 2000 and will be charged at a monthly rate.

PGW and EarthScan cost estimates are prepared by estimating the time required for each staff level, and adding applicable expenses (map plotting, shipping, travel). The cost estimates can be considered as a fixed quotation that will change only if the scope of work changes, in agreement with IOC.

Disbursements

IOC would reimburse WGM and PGW for all disbursements incurred in the performance of project work, including but not limited to:

- Airfare, travel expenses, room and board, local transportation and associated costs, including any team meetings in Labrador;
- The cost of local personnel engaged by WGM and PGW and their room and board expenses;
- The cost of all contracts, services, materials and supplies used in performance of the program;
- Costs of all long distance communications including telephone, facsimile, e-mail, satellite phone, etc.;
- Costs of computer services, including printing/plotting and transmission; and
- Cost for reproduction of drawings, digital products, reports and other data.

A monthly surcharge during the field exploration phases may be applicable (approximately $3,000/month) to cover the cost of accounting and payment of all invoices by third parties and fees and disbursements by WGM. WGM prefers to work on a cash call basis for all long-term field projects. PGW is charging a project management fee of $1,000/month for the duration of the project.

7. PAYMENTS

1. IOC shall pay to WGM a retainer of $25,000 to cover fees and disbursements during the planning and initial set-up of the project. This amount will be divided between WGM and PGW. The retainer will be credited to the last invoice. WGM and PGW will prepare monthly invoices covering actual fees and disbursements, to be paid by IOC within thirty (30) days of receipt of said invoice.

2. For field exploration programs, on or about the fifteenth (15th) day of each calendar month, WGM will prepare and submit to IOC a cash call covering all projected fees and disbursements which will be incurred by WGM during the month. IOC shall pay the amount of each cash call to WGM within 5 days after receipt of the cash call, such payment to cover WGM's estimated expenses for the month.

3. For cash calls, as soon as practicable after the last day of each calendar month, WGM will prepare and submit to IOC an invoice covering actual fees and disbursements incurred during the month by WGM. If the actual invoiced amount is less than the previous cash call, the difference will be credited to the next cash call. If the actual invoiced amount is greater than the cash call, the difference will be added to the cash call invoice for the next month. The final invoice on completion of the work will reconcile the balance of the advance payment, if any, with the previous cash call invoice and the final actual costs incurred by WGM.

4. All payments shall be made in Canadian Dollars.

5. All payments will be made by wire transfer to WGM at the address below, with a copy of the transfer documentation to be sent to Kenneth Hawrelak, Chief Financial Officer at WGM's Toronto office:

   Bank of Montreal
   Head Office
   First Canadian Place
   Toronto, ON
   Account No.: 1306 949 Transit No.: 0002

8. BUDGET

The budget outlined in Appendix A is based on normally quoted rates. GST is not included. The budget will be revised, if necessary, once the contract is awarded and WGM has had an opportunity to review the data and digitize a selected data set. For long-term projects, weekly or monthly personnel rates may be negotiable.

WGM and PGW will be responsible for paying all disbursements for contracts and services provided by third parties and direct disbursements in the performance of the work. Books and accounts of all personnel charges and disbursements will be maintained in accordance with generally accepted accounting principles and practices.

Monthly statements will be provided to include actual expenditures and budgetary status. In the event that total expenditures may exceed the approved budget, IOC shall have the option to modify the work program or approve an increase in the budget. IOC would be responsible for the necessary permits for access and diamond drilling (and moving between holes) on any properties.

Should this proposal meet with your approval, we request that you sign below and return a copy to us at your convenience.

Yours sincerely,

WATTS, GRIFFIS AND McOUAT LIMITED

Per: Michael Kociumbas
Project Manager

MWK/ls

Agreed to this ________ day of October, 2000

IRON ORE COMPANY OF CANADA

____

Per: Robert Didur
Superintendent Mine Technical Services

APPENDIX A

BUDGET FOR
2000 AND 2001 WABUSH ASSESSMENT PROGRAM

WATTS, GRIFFIS AND McOUAT LIMITED
BUDGET FOR
PHASE I - 2000 WABUSH RESOURCE ASSESSMENT PROGRAM
Data Collection/Compilation/Digitization and Initialization of GIS

Personnel	Level	Cost/Hour	Total *
H.E. Neal – Project Supervisor	F+	$185	$20,000
M. Kociumbas – Project Manager	E-1	$122	$35,000
D. Beggs – Geomatics Specialist	D	$108	$45,000
L. Scaife or A. Nishio – Geologist	C	$90	$20,000
R. Risto – Geologist	D	$108	$50,000
I. Allen – GIS Training Specialist	D	$108	$5,000
Technicians		$30	$30,000
Digital / Hard Copy Purchases			$10,000
Report Prep. / Drafting			$10,000
Total			**$225,000**

* Based on 3 months and hourly rates

PATERSON, GRANT & WATSON LIMITED
BUDGET FOR
PHASE I - 2000 WABUSH RESOURCE ASSESSMENT PROGRAM
Data Collection/Processing/Digitization

Cost Centre	Company	Total
Survey Tender and Contracting	PGW	$4,100
Contracted Aeromagnetic Survey *	To be selected	$230,000
Survey Q.A/Q.C. **	PGW	$24,200
Data Purchases – Geophysics	PGW	$800
Data Purchases – Remote Sensing	EarthScan	$10,500
Data Processing – Geophysics	PGW	$10,700
Data Processing – Remote Sensing	EarthScan	$3,100
Physical Property Analysis	PGW	$5,000
Project Management	PGW	$3,000
Total		**$291,400**

* Based on 100m line spacing totalling 30,000 line km (over 2,800 km^2), 70% of the cost of the survey is applied to 2000

** Total is pro-rated from original budget, based on larger survey area (includes airfare and accommodations) - See Appendix D

WGM to end of 2000	**$225,000**
PGW/EarthScan	**61,400**
Aeromagnetic Survey	**230,000**
IOC Map Staking Costs *	**350,000**
+10% Contingency	**86,600**
TOTAL FOR REMAINDER OF 2000	**$953,000**

* Based on $60/claim up-front map staking cost of available ground in survey area (assumed 1,500 km^2 – after subtracting ground under licence/lease and areas outside of a reasonable distance to the Carol plant)

WATTS, GRIFFIS AND McOUAT LIMITED
BUDGET FOR
PHASE I CON'T - 2001 WABUSH RESOURCE ASSESSMENT PROGRAM
Data Collection/Compilation/Digitization and Initialization of GIS

Personnel	Level	Cost/Hour	Total *
H.E. Neal – Project Supervisor	F+	$185	$15,000
M. Kociumbas – Project Manager	E-1	$122	$25,000
D. Beggs – Geomatics Specialist	D	$108	$30,000
L. Scaife or A. Nishio – Geologist	C	$90	$15,000
R. Risto – Geologist	D	$108	$30,000
I. Allen – GIS Training Specialist	D	$108	$10,000
Technicians		$30	$15,000
Report Prep. / Draftng			$10,000
Total			**$150,000**

* Based on 2 months and hourly rates

PATERSON, GRANT & WATSON LIMITED
BUDGET FOR
PHASE I CON'T - 2001 WABUSH RESOURCE ASSESSMENT PROGRAM
Data Collection/Processing/Digitization

Cost Centre	Company	Total **
Survey Q.A/Q.C.	PGW	$1,100
Contracted Aeromagnetic Survey *	To be selected	$98,000
Modelling – Geophysics	PGW	$8,000
Interpretation – Geophysics **	PGW	$30,600
Interpretation – Remote Sensing	EarthScan	$4,700
Products to Client ***	PGW	$15,000
Project Management	PGW	$2,000
Total		**$159,400**

* Based on 100m line spacing totalling 30,000 line km (over 2,800 km^2), 30% of the cost of the survey is applied to 2000
** Total is pro-rated from original budget, based on larger survey area (see Appendix D)
*** Based on 2 sets of 1:10,000 scale maps

WATTS, GRIFFIS AND McOUAT LIMITED
BUDGET FOR
PHASE II - 2001 WABUSH RESOURCE ASSESSMENT PROGRAM
Target Selection

Personnel	Level	Cost/Hour	Total *
H.E. Neal - Project Supervisor	F+	$185	$15,000
M. Kociumbas – Project Manager	E-1	$122	$20,000
D. Beggs – Geomatics Specialist	D	$108	$15,000
R. Risto – Geologist	D	$108	$15,000
Report Prep./ Drafting			$5,000
Total			**$70,000**

* Based on 2 months and hourly rates

WATTS, GRIFFIS AND McOUAT LIMITED
BUDGET FOR
PHASE III - 2001 WABUSH RESOURCE ASSESSMENT PROGRAM
Exploration and Drilling Programs

Personnel	Level	Cost/Hour	Total *
H.E. Neal - Project Supervisor	F+	$185	$25,000
M. Kociumbas – Project Manager	E-1	$122	$40,000
D. Beggs – Geomatics Specialist	D	$108	$15,000
L. Scaife or A. Nishio – Geologist	C	$90	$50,000
R. Risto – Geologist	D	$108	$70,000
Field Assistants/Technicians		$15	$30,000
Diamond Drilling Allowance **			$1,000,000
Total			**$1,230,000**

* Based on 4 months and hourly rates
** Based on 10,000 m of drilling @ $100/m

PATERSON, GRANT & WATSON LIMITED
BUDGET FOR
PHASE III - 2001 WABUSH RESOURCE ASSESSMENT PROGRAM
Geophysical Follow-up Surveys During Exploration Programs

Cost Centre	Total
Helicopter-borne Magnetic and EM surveys (poss. Radiometrics) over Luce deposit + 2 or 3 other targets (1,000 line km)	$70,000
Gravity surveys over Luce + 2 or 3 other targets	$15,000
Q.A./Q.C., interpretation and management of above surveys	$12,000
IKONOS imagery purchase, processing and interpretation (25-30 km^2)	$10,000
Total	**$107,000**

WATTS, GRIFFIS AND McOUAT LIMITED
BUDGET FOR
PHASE IV - 2001 WABUSH RESOURCE ASSESSMENT PROGRAM
Resource/Reserve Estimation

Personnel	Level	Cost/Hour	Total *
H.E. Neal - Project Supervisor	F+	$185	$25,000
M. Kociumbas – Project Manager	E-1	$122	$40,000
A. Nishio – Geologist	C	$90	$15,000
R. Risto – Geologist	D	$108	$25,000
P. McCrae – Engineer	E-1	$122	$15,000
Report Prep. / Drafting			$10,000
Total			**$130,000**

* Based on 3 months and hourly rates

WGM for 2001	**$580,000**
PGW/EarthScan	**83,400**
Aeromagnetic Survey	**98,000**
Diamond Drilling	**1,000,000**
Geophysical Follow-up	**85,000**
+10% Contingency	**184,600**
TOTAL FOR 2001	**$2,031,000**

TOTAL FOR PHASES I TO IV:	**WGM**	**$805,000**
(to end of 2001)	**PGW/EarthScan**	**144,800**
	IOC Map Staking Costs	**350,000**
	Aeromagnetic Survey	**328,000**
	Diamond Drilling	**1,000,000**
	Follow-up Geophysics	**85,000**
	10% Contingency	**271,000**
	GRAND TOTAL	**$2,984,000**

APPENDIX B

RESUMES OF KEY PERSONNEL FOR IOC ASSESSMENT PROGRAM

H.E. "BUZZ" NEAL, P.Eng
Senior Geological Associate
Watts, Griffis and McOuat Limited

With over 40 years in the mineral industry, Buzz Neal has particular expertise in all aspects related to the exploration and development of iron ore deposits including economic geology, reserve estimation, grade control, flowsheet design, marketing and mineral dressing investigations on laboratory and pilot plant scale. Mr. Neal has also carried out projects on gold, base metal and industrial mineral deposits, conducting geological surveys, drilling, feasibility studies and economic evaluations. He is a specialist in the supervision and management of iron ore exploration programs.

EDUCATION

M.A. (Economic Geology) - University of Toronto, Canada (1949)
Post Graduate Studies - McGill University, Canada (1950-1951)

PROFESSIONAL EXPERIENCE

Geological Associate to Watts, Griffis and McOuat (since 1990)

- Assignments carried out by Mr. Neal include: review of the geology, grade and reserves of Canada's largest iron mine as part of a reserve audit and evaluation of the mining company; preparation of a marketing study of world iron ores; study of major Canadian iron deposits including a ranking of Canadian producers and undeveloped deposits. Recently he was project manager for a $2.5 million diamond drilling program and reserve estimate for an iron deposit held by Quebec Cartier Mining Company in Quebec. In 1995, 1997, and 1999 Mr. Neal managed an audit of the Mont-Wright operations with particular emphasis on ore reserves, mining and product quality.

H.E. Neal & Associates (1962-1990)

- Mr. Neal managed and supervised many geological exploration programs whose scope of work include detailed mining, geological mapping and drilling in Ontario, Quebec and the Northwest Territories. Property valuations and ore reserve calculations were completed for over 25 iron projects throughout the world, as well as precious and base metal properties.

- Mr. Neal has a broad knowledge of the international iron industry including the specifications for many types of iron ore as they apply to blast furnace, direct reduction and electric furnace operation.

- Mr. Neal's major iron ore projects include: market and quality evaluation studies; reports on Brazilian and Canadian iron ore deposits; an up-grading study for a major Venezuelan producer; prefeasibility study of an iron deposit in Spain; the management of diamond drilling and metallurgical evaluation of a magnetic deposit in the New Quebec-Ungava area for Armco Inc.; studies on flotation and pelletzing of earthy ore for Iron Ore Company of Canada; property evaluation and supervision of drilling and mineral processing for Quebec Cobalt and Exploration; flowsheet development, testwork and design of a 700,000 tpy beneficiating and pellet plant in Morocco; testwork, design and start-up of Wesfrob mine, producing 1 million tpy iron concentrate; grade control and evaluation for Algoma Steel; a feasibility report on the Adams mine; and a feasibility report for a 5 million tpy mill and pellet plant for Labrador Mining & Exploration Co.

- Mr. Neal has carried out many feasibility studies for massive and disseminated magnetite ores and hard and earthy hematite ores. Other commodity experience includes studies with copper, copper-molybdenum, tungsten, nickel, fluorite and several industrial minerals. Work carried out included geological interpretation, ores reserve calculation, mineral dressing design, flowsheets, and plant layouts.

Iron Ore Company of Canada (1950-1962)

- As Director of Research (1955-1962), Mr. Neal was responsible for laboratory and pilot plant programs for the beneficiation of the Carol Lake specularite ores and the Knob Lake earthy hematite-geothite ores. Other duties included research on pelletizing a wide variety of ores, development of grindability tests, cargo stability testwork, feasibility and economic evaluation of various processes.

- As Supervisor of Exploration and Development (1950-1955), Mr. Neal completed evaluations of earthy iron ores of Knob Lake area and specularite iron ores in New Quebec-Labrador.

Labrador Mining and Exploration Company (1948-1950)

- Mr. Neal served as Staff Geologist, carrying out mapping, sampling, and geological compilation in the Wabush and Knob lake areas. He was the first geologist to map and recognize the potential of the specularite deposit, some of which are now being mined by Iron Ore Company of Canada in the Wabush Lake area.

PROFESSIONAL AFFILIATIONS

Member, Professional Engineers Ontario
Member, Prospectors and Developers Association of Canada
Past Member, Iron and Steel Institute in England
Past Member, Canadian Advisory Committee - International Standards for Iron ores

MICHAEL W. KOCIUMBAS
Geologist
Watts, Griffis and McOuat Limited

Michael Kociumbas is an economic geologist with experience in exploration for precious and base metals and iron ore. He has participated in due diligence, valuations and feasibility studies of base metal, gold, iron ore, industrial minerals and gemstone deposits in North and South America, Europe, Africa, Asia, the South Pacific and the Middle East. Mr. Kociumbas specializes in computer-aided 3-D modelling and ore reserve estimations and assisting clients with the implementation of Gemcom software.

EDUCATION

B.Sc. (Honours Geology) - University of Waterloo, Canada (1985)

PROFESSIONAL EXPERIENCE

Watts, Griffis and McOuat Limited (since 1985)

- In North America, Mr. Kociumbas has completed such assignments as: management and implementation of a large definition drilling program (+18,000 m) and subsequent geological interpretation and resource estimation for Quebec Cartier Mining of an iron ore deposit in Labrador; 3-D kimberlite pipe modelling and assistance with the development of delineation and bulk sampling drilling programs for Monopros; diamond drilling in the Coronation Gulf area, Northwest Territories; diamond drilling, geological mapping and geophysical surveys around the Birch and Kirkland Lake areas in northern Ontario; sonic drilling of tailings in Nevada; and, reverse circulation drilling and surface and underground sampling in Baja California, Mexico. He has also helped numerous clients with the set-up and maintenance of the Gemcom software system on a project specific basis and has provided on-going technical supervision and advice regarding the more advanced features of the system.

- Since 1995 Mr. Kociumbas has completed a biannual audit of the Mont-Wright ore reserves for QCM. Mr. Kociumbas was also recently involved in a review of iron ore operations in Southern Brazil, with particular emphasis on the geological interpretation and resource and reserve estimation and categorization procedures.

- Mr. Kociumbas has participated in underground and open pit resource/reserve estimations/mine plan evaluations for several precious metals and base metals deposits. The estimations have been both manual and computer-aided (Gemcom software system) ranging from tropical to desert environments. Notable examples include the Golden Giant mine at Hemlo, Ontario; the Cannon mine in Washington; Echo Bay's and Hecla's acquisitions in the U.S.A.; and numerous open pit/underground deposits throughout Canada, USA, Africa, Indonesia and Latin America.

- Recently, Mr. Kociumbas has been involved with conducting and management of a variety of domestic and overseas exploration programs. All the programs included delineation and infill drilling programs, metallurgical sample collection, and 3-D geological modelling of the deposit with subsequent grade estimation by block modelling. Other recent experience includes: sonic drilling of tailings, placer evaluation and abandoned adit sampling of a gold project in Ghana; base metal reserve estimation in Saudi Arabia; surface/alluvial sampling and project evaluation in Brazil; a detailed mineral review of Zambia (including database design, coordination and management); an emerald property evaluation in Zambia; a mineral sands valuation in Australia; and numerous 3-D solids and surface models and resource/reserve estimations for a variety of clients around the world, but predominantly in West Africa and the CIS countries.

- Mr. Kociumbas has prepared "bankable" valuations and evaluations for industry mergers and acquisitions, and listings on the Toronto and Vancouver Stock Exchanges. Commodities examined were precious and base metals and diamonds/gemstones.

Earlier Experience (University work terms, 1982 - 1984)

- As Geological Assistant with the Ontario Geological Survey (1984), Mr. Kociumbas carried out geological correction, interpretation and transference of previously studied areas, and was also involved in research and compilation of the Grenville province map.

- Mr. Kociumbas served as Assistant Geologist with Harbinson Mining and Oil Limited (1983) where he conducted reconnaissance and detailed geological, geochemical and geophysical surveys for gold mineralization in the Mishibishu Lake area of northern Ontario.

- Mr. Kociumbas worked for Anaconda Exploration Canada Limited as an Assistant Geologist in 1982, and completed geological mapping, geochemical and geophysical surveys in the Lochalsh area, northern Ontario.

- At Noranda Mines Limited (1982), Mr. Kociumbas was a Mine Trainee assisting with the installation and repair of underground ventilation, air and water piping in the Geco Mine Manitouwadge, northern Ontario. He also gained experience with longhole drilling, blasting, scaling and tramming of Pb-Cu-Zn ore.

PROFESSIONAL AFFILIATIONS

Member, Canadian Institute of Mining and Metallurgy
Member, Prospectors and Developers Association of Canada
Associate, Geological Association of Canada

LANGUAGES

French (fair)

DAVID G. BEGGS
Senior Geomatics Associate
Watts, Griffis and McOuat Limited

Dave Beggs is a geologist with varied experience in geographic information systems (GIS), remote sensing, and relational databases. He has designed, implemented and compiled GIS databases for mineral exploration and government projects in Canada and internationally. He has experience with developing countries, their needs and technologies, and the training of personnel to use new technologies. In recent years, he has worked extensively with RadarSAT and LandSAT TM satellite imagery for mineral exploration. His earlier experience includes GIS software development, digital cartography and publishing technology.

EDUCATION

B.Sc. (Honours Geology)—University of Toronto, 1972
M.Sc. (Geology)—University of Toronto, 1975

PROFESSIONAL EXPERIENCE

Watts, Griffis and McOuat Limited (since 1996)

- As Senior Geomatics Associate, Dave Beggs is responsible for remote sensing and GIS projects at WGM. During much of 1996-1998, he processed and interpreted RadarSAT and LandSAT TM imagery for mineral exploration projects in Mongolia, Africa, Saudi Arabia, Indonesia, Philippines and Solomon Islands. He also compiled geological, geochemical and geophysical data into exploration databases on GIS and integrated these with the satellite imagery. As part of a World Bank project in Africa, he designed and implemented a digital map atlas on CD-ROM.

PDM Information Technology Inc. (since 1981)

- As a consultant, Dave Beggs undertakes GIS and remote sensing projects. These projects have included processing and interpretation of satellite imagery (RadarSAT, LandSAT TM, MK-4), design and compilation of GIS databases, management of digital publishing and cartographic projects and writing project reports and proposals.

- In projects for Falconbridge Ltd. during 1995-1997, Dave processed and interpreted LandSAT, RadarSAT and MK-4 imagery for projects in Russia, Canada, the Philippines and Greenland. He worked with company exploration geologists to implement GIS databases of exploration data on laptop computers. He also compiled geological and other data into GIS databases during these projects.

- In 1994-95, Dave managed a project to define a regional geoscience data management system for the Southern African Development Community (SADC). Existing data in the 10 participating countries was documented and databases for mineral occurrences, bibliography, and mineral titles were designed. He organized and led a workshop in Lusaka to review and finalize the specifications.

- In 1993, Dave carried out a United Nations project to establish a national geoscience databank for the Mongolian Geological Survey. Hardware and software was installed and the GIS databases were designed and implemented in cooperation with Mongolian staff, who were trained in Mongolia and Canada.

- During 1992-95, Dave and his staff undertook several projects for the Ontario Ministry of Northern Development and Mines to complete a GIS bibliographic index database of approximately 12,000 geological publications from 1890 to the present. The projects included (i) database design and prototype maps, (ii) compilation of all published maps and production of high-quality index maps, (iii) verification and updating of descriptive index for all publications and production of a catalog of publications, (iv) preparation of a geographic index for all reports and maps and (v) conversion of all data to the Ministry's ERLIS system.

- In 1991-93, as part of a larger project carried out by Watts, Griffis, and McOuat, Dave and his staff prepared digital geological and mineral occurrence maps of Saudi Arabia. AutoCAD maps of geology and mineral occurrence data were input to a GIS database from which high-resolution negatives for 4 maps were output; the maps were offset-printed in full colour.

- In 1990, Dave carried out an analysis of services related to mining lands tenure for the Mineral Development and Lands Branch, Ontario Ministry of Northern Development and Mines. The study reviewed services and procedures related to mining claim maps and made recommendations for implementing digital technology for claim maps.

- Projects for the Ontario Geological Survey in the 1980's included digital cartography and scientific editing of approximately 25 reports and accompanying maps of carbonatite complexes in Ontario. Other projects developed prototype digital maps and databases for various types of geoscience data.

- In the mid 1980's, Dave and his staff at PDM developed GIS software (TM/CARTO) to run within AutoCAD. At that time, no low-cost GIS were available. The software was used for the above mentioned digital cartographic projects up to the early 1990's.

Ontario Ministry of Natural Resources (1973-1981)

- As a review geologist with the Ontario Geological Survey, Dave Beggs was responsible for scientific editing and publication management of geoscience reports and maps. He was responsible for introducing digital publishing techniques at the Survey and for writing proposals and tender documents for digital publishing systems.

PROFESSIONAL AFFILIATIONS

Geological Association of Canada
Member, Canadian Institute of Geomatics
Member, Prospectors and Developers Association of Canada

IAIN A. ALLEN

Senior Associate GIS Specialist
WATTS, GRIFFIS AND MCOUAT LIMITED

Founder and president of a GIS consulting firm specializing in the mineral exploration industry. Seventeen years experience in mineral exploration including 10 years as a field geologist and seven years applying ArcView GIS to mineral exploration. GIS experience includes development and teaching of ArcView courses; creation of an ArcView-based data management system; application of GIS analysis techniques to geologic data.

EDUCATION

B.Sc., Honours Geology - University of Toronto (1983)

PROFESSIONAL EXPERIENCE

Geoscience Information Services (1999 - present)

- As Founder and President, Mr. Allen developed and taught mineral exploration-specific ArcView GIS course to Inco, Barrick Gold, AngloGold and Cominco.
- Developed ArcView-based Data Management application currently being used by Inco and Barrick Gold.
- Integrated geological, geophysical, geochemical, remote sensing and topographic data into ArcView GIS for Platinum Group Metals Ltd.
- Catalogued and evaluated backlog of historic exploration data for BHP Minerals.
- Created monthly ArcView e-newsletter that has more than 500 subscribers worldwide.
- Accepted by ESRI into the ArcView 8.1 beta testing program.

BHP Minerals International, Denver, CO (1996 - 1999)

- As Senior Project Geologist, Mr. Allen created a user-friendly Arcview-based data storage, management and retrieval system, giving all geoscientists easy access to all data for analysis and dramatically reducing the incidence of lost or unknown data.

- Initiated GIS analysis of depth to bedrock in Arizona and Mexico to better target BHP's porphyry copper exploration program.

- Explored relationship between porphyry copper deposits and Laramide intrusive rocks using GIS analysis tools.

- Proposed and organized first global BHP GIS meeting, resulting in greater collaboration and reduced duplication of effort.

- Provided local and global technical support for Arcview and related software.

- Updated previously-developed GIS course to match software upgrades, continued to provide group and individual training.

BHP Minerals Canada Ltd., Toronto (1988 - 1996)

- As Project Geologist, he promoted and managed implementation of PC-based GIS in eight North American offices.

- Developed and taught geologic Arcview GIS course, adopted company-wide, enabling faster, more comprehensive analysis of geologic data leading to better exploration decisions.

- Developed new GIS applications and techniques which were documented and distributed throughout the company.

- Provided GIS technical support for all North American offices.

- As Project Geologist, Mr. Allen was responsible for introduction, use and support of AutoCAD and Techbase software applications in the Toronto office. He also maintained and improved computer-based field note system.

- During 1988 to 1990, Mr. Allen was the Geologist responsible for Northwestern Ontario exploration including research, property acquisition, submission evaluation, option agreements, planning and execution of exploration programs. He designed and implemented use of Lotus 123-based field note system.

Sulpetro, Sherritt Gordon, BHP Minerals, Placer Development (1983 – 1988)

- As Contract Field Geologist, he completed mapping, drilling, claim staking, geophysical surveys and related activities, primarily in northwestern Ontario and northeastern Quebec.

LAURA J. SCAIFE
Geologist
Watts, Griffis and McOuat Limited

Laura Scaife is a geologist with a background in project coordination, international development and an extensive knowledge of computer system design and implementation, and software. She has experience with technical assistance programs and exploration programs in developing countries and has assisted with proposal preparation and project management. Ms. Scaife has expertise in designing database and information retrieval systems including GIS systems, utilizing MapInfo, ArcView, GEMCOM mining software, AutoCad, desktop publishing programs and spreadsheet and database management applications.

EDUCATION

B.Sc. (Honours Geology) - University of Waterloo, Canada (1985)

PROFESSIONAL EXPERIENCE

Watts, Griffis and McOuat Limited (since 1989)

- Ms. Scaife completed a study of the known magnesite deposits in Ontario and a report of its findings for Magnola Metallurgy Inc. She reviewed any reports, files, records and claim maps made public from the MNDM offices and also reviewed WGM's extensive collection of data available from past investigations of magnesite including the previous Canadian Magnesite Mines Limited ("CMML") deposit. Ms. Scaife prioritized the magnesite occurrences and completed a report on the geological setting, grade and tonnage, sampling analysis, testwork, product quality and potential of the identified occurrences.

- Ms. Scaife as a team member preparing a mineral exploration program in Saudi Arabia was responsible for compiling and evaluating data in order to plan an effective exploration program as the basis for target selection, exploration planning as well as for technical support for an investment prospectus. Ms. Scaife digitized regional geologic maps to prepare unified geologic maps of the license and immediate surrounding area and prepared a set of index maps showing the location and scale of geologic mapping, geochemical and geophysical surveys. The compilation of the data was in digital format using Autocad Map and MapInfo desktop mapping software and the data then written to CD-ROM for ease of storage.

- Ms. Scaife was a field geologist for a regional helicopter support exploration program in the Solomon Islands and was also in charge of establishing a data management GIS program. Ms. Scaife participated in all aspects of the reconnaissance exploration program including planning and implementing field programs, carrying out geochemical sampling programs, prospecting and supervising and training local personnel in geological field techniques. Ms. Scaife was also responsible for the compilation of geoscience data, the maintenance of the geochemical databases and training of the ArcView computer program.

- Ms. Scaife participated in the computerization of historic and exploration data, for the Getty Copper project in central British Columbia including the preparation of plans and sections. This database was utilized to produce an updated reserve estimate and block model resource estimate with the Gemcom software system. She also was responsible for 3-D solid modelling of oxide and sulphide zones, contouring of geochemical data, digitizing assay data for resource grade and tonnage calculations and the preparation of sample location and claim maps using Geomodel, PcExplor and Autocad. Ms. Scaife organized company presentations and prepared company slide shows, news releases, brochures and advertisements.

- Ms. Scaife completed a review of thirteen properties in Ontario and Quebec. She was responsible for reviewing property ownership agreements, property and regional geology, property history and claim status. She conducted literature research and data compilation and worked closely with the Mine Recorders office, performing client claim and lease searches.

- Ms. Scaife established a library archive of the Natural Resource project data in Saná Yemen for the Yemen Technology Centre facility which allowed for preservation of and access to the project data and involved the reorganization and cataloguing of the collection of publications, reports, maps and tape archive and field tape data. Associated databases were created for the catalogued data.

- Ms. Scaife was responsible for computer CAD training for the drafting department of the Minerals Exploration Board of Yemen. The objective of the training program was to prepare the department for digitizing topographic and geology maps of Yemen.

- As Data and Systems Manager for the multi-million dollar Saudi Review Project, Ms. Scaife was responsible for the implementation and management of all project computer systems. She implemented and administrated the Library Control System and accompanying database, which tracked over 4,000 technical volumes, and oversaw the installation of the Project's LAN system. Ms. Scaife also managed the desktop publishing of Project documentation.

- Ms. Scaife coordinated and organized visits by international delegates of clients, including preparation and management of seminars for a commission of Saudi Arabian businessmen and senior government officials in Toronto and Vancouver. She also organized an institutional investors panel discussion on strategic investments and the mining industry.

- Ms. Scaife also participated in an evaluation of the exploration and discovery potential of the Leaf Rapids area for the Leaf Rapids, Manitoba Town council. She was responsible for the research, review and compilation of geologic data and defining the extent of geologic mapping in relation to distribution of assessment work.

MCS Microtec (1988 - 1989)

- Ms. Scaife held the position of Software Trainer and Support Specialist at MCS where she provided corporate computer training on both PC and MacIntosh systems. Following training, she assisted users through long-term software and hardware support.

Multiview Geoservices

- Ms. Scaife was involved with field surveys in the Ecuador Andes that implemented seismic refraction to determine the depth to the water table and bedrock. She also assisted with the acquisition and compilation of data and participated in a DC-resistivity sounding survey to determine the vertical-electrical profile of the subsurface geologic conditions.

Technos Inc. (1988)

- Ms. Scaife participated in a field survey using ground penetrating radar to map paleo-karst features in the sub-surface in Orlando, Florida. This survey successfully located three sinkholes that had no surface expression.

LANGUAGES
Basic French and Spanish

RICHARD W. RISTO

Geologist
Watts, Griffis and McOuat Limited

As an exploration geologist with 20 years of experience, Rick Risto has supervised drilling and sampling programs for gold, iron, base metals, rare earths and gemstones in Canada, Greenland, Saudi Arabia and Southeast Asia. Mr. Risto also carries out ore reserve audits and participates in WGM's property valuation practice. His area of special interest is lithogeochemistry in Archean greenstone belts, particularly the definition and characterization of gold and volcanic associated massive sulphide deposit alteration patterns.

EDUCATION

M.Sc. (Mineral Exploration) - Queen's University, Canada (1983)
B.Sc. (Honours Geology) - Brock University, Canada (1977)

PROFESSIONAL EXPERIENCE

Watts, Griffis and McOuat Limited (since 1990)

- In 1998, Mr. Risto was field manager for an iron ore exploration program in Labrador. Over 18,000 m of drilling was completed in 75 drill holes. He conducted all of the drill hole planning, geological interpretations and supervised a geological, geotechnical, surveying and drilling crew comprising about twenty men through the duration of the program.

- In 1997, Mr. Risto visited Kazakhstan to review the sampling and assay data reliability aspects for a gold exploration program. He reviewed sampling and sample processing for a diamond exploration program in French Guiana and supervised a diamond drill program for base metals in the Timmins area, Ontario.

- In 1996, Mr. Risto visited and evaluated several hard rock and alluvial gold projects throughout Indonesia and was site geologist for a base metal and gold exploration program in Cape Breton Island, Nova Scotia.

- Mr. Risto has participated in many property valuations for gold and base metal prospects including Asamera's Meadowbank and Meliadine properties in the Northwest Territories, various properties owned by Comaplex, and the numerous properties held by Goldcorp Inc. and CSA Management in western Canada.

- Mr. Risto has carried out ore reserve estimates for deposits such as the Polaris Taku, British Columbia; the Corner Bay Explorations' property, Chibougamau area, Quebec; the Pine Cove deposit, Newfoundland; the Ganesh-Himal zinc deposit, Nepal; the K1-1 deposit, Thierry Mine property, Ontario; the Sao Vincente gold deposit, Brazil; the Parys Mountain deposit, Wales; and the As Suq gold deposit in Saudi Arabia.

H.E. Neal & Associates Ltd. (1977 - 1990)

- Mr. Risto was Party Chief on numerous programs in northeastern Ontario, northwest Quebec, and Northwest Territories. He has explored for uranium in Saskatchewan; chromite and rubies in Greenland; copper, nickel and rare earths in northern Quebec and Labrador; kimberlite in Ontario and gold in Northwest Territories; the Harker-Holloway-Marriott area in Ontario; and, Casa Berardi area in Quebec.

- Mr. Risto has supervised ten diamond drill programs totalling over 50,000 feet of drilling in Ontario, the Northwest Territories and Quebec. He was also responsible for ground magnetometer and VLF-EM surveys on a variety of properties in Ontario, Quebec and Northwest Territories, as well as aerial radiometric surveys in Quebec-Labrador.

- Mr. Risto supervised and interpreted centre lake sediment, lake bottom, surface water, humus and soil geochemical programs involving thousand of samples. He interpreted 2,000 whole rock and trace element lithogeochemical analyses in terms of anomaly recognition and chemostratigraphic correlation.

- Mr. Risto completed large scale, regional geological-exploration history compilations at the Yellowknife-Greenstone belt; the Holloway-Marriott-Hebecourt area, Ontario and Quebec; and the Guibord-Hislop area, Ontario. He prepared numerous property reports, evaluated exploration properties and assisted in tonnage and grade estimates.

PROFESSIONAL MEMBERSHIPS

Member, Association of Exploration Geochemists
Member, Prospectors and Developers Association of Canada

AMY J. NISHIO
Geologist
Watts, Griffis and McOuat Limited

Amy Nishio has almost fifteen years of experience in the mineral industry in North and South America. Her experience includes regional reconnaissance and detailed property exploration, prospect drilling, underground exploration and property evaluation. She has participated in field programs in epithermal gold, narrow vein silver, iron ore, contact skarn and Mississippi Valley type environments. Ms. Nishio has specific experience in the preparation of multi-property National 2A reports and she has participated in a number of valuations and resource estimations. Recently she has started working with Gemcom mining software.

EDUCATION

B.Sc. (Honours Geology) - University of Toronto, Canada (1985)

PROFESSIONAL EXPERIENCE

Watts, Griffis and McOuat Limited (since 1990)

- In 1998, Ms. Nishio participated in the field program, database management, construction of plans and sections using Gemcom software and report preparation of an advanced stage iron ore deposit located in northeastern Quebec.

- Ms. Nishio's assignments include precious and/or base metal property evaluations in Peru and Papua New Guinea; an ore reserve audit on a silver, narrow vein deposit; project management of the technical and valuation reports evaluating the assets of an uranium company.

- Ms. Nishio supervised a two month exploration program at the Helvecia zinc project in Argentina in 1995. Work carried out included geological mapping and sampling, geophysics and reverse circulation drilling.

- In 1994-1995, Ms. Nishio was Project Geologist for a major program exploring for silver and base metals in the historic Keno Hill silver mining camp. She participated in all aspects of field exploration and computer activities, including computerization and compilation of historical data, surface and underground diamond drilling, reverse circulation drilling, underground exploration development work and resource calculations.

- Ms. Nishio participated in two government contracts involving the search of the Mineral Deposits Inventory of over 200 townships in Ontario for the purpose of selecting abandoned mines and potential mine related hazards. She was responsible for the on-site planning and operation of the programs and assisted in the data compilation and report.

- Ms. Nishio assisted in a comprehensive project to review and evaluate the iron ore industry in Canada. She conducted a literature research and provided technical editing of the report.

- Ms. Nishio participated in a field program operating in the interior of Alaska for six months during 1991. Her field work involved geological mapping, geochemical sampling, claim staking, and geophysical surveying. She was responsible for the compilation of the geochemical database.

H.E. Neal & Associates Ltd. (1985 - 1990)

- Ms. Nishio supervised the logging and sampling of reverse circulation drilling for 260 drill holes in four programs in the Casa Berardi area, Quebec and Harker-Holloway area, Ontario and supervised logging and sampling in six diamond drilling programs totalling 46,500 feet in Ontario.

- Ms. Nishio completed geological mapping, geochemical sampling, and VLF-EM surveys on various properties in Ontario. She was responsible for the expediting and organization for field programs and assisted in the supervision of a "grassroot" prospecting program in the Marmora area, Ontario for wollastonite mineralization.

- Ms. Nishio assisted in the grade and tonnage estimation for a gold property and was responsible for literature research and evaluations for several properties. She has carried out the technical editing of reports and maintained a mining claims and assessment filing database.

Kerr Addison Mines (1985)

- Ms. Nishio served as Project Geologist on a reverse circulation drilling program in the Casa Berardi area, Quebec.

PROFESSIONAL MEMBERSHIPS

Member, Prospectors and Developers Association of Canada
Member, Education Committee, PDAC (1995)

LANGUAGES

French (fair)

PAUL S. MacRAE, P.Eng.
Mining Engineer
Watts, Griffis and McOuat Limited

Paul MacRae has over 18 years of experience in underground and open pit mining operations. He has extensive experience in management and operations, design, engineering and construction of mills and testwork from laboratory to plant scale. He has diverse experience in project management, environmental issues and computer applications.

EDUCATION

Diploma (Mine Engineering) - South Dakota School of Mines, South Dakota, USA
Graduated (Mining Technologist Program) - Haileybury School of Mines, Canada

PROFESSIONAL EXPERIENCE

Paul MacRae & Associates (November 1996 to present)

- Mr. MacRae is responsible for open pit design and scheduling as well as mine contractor negotiations. He reviews open pit mining costs and equipment of the Meadowbank Gold Project Pre-feasibility, provides revised costs for an alternate mining method to optimize ore recovery and explores alternative transportation routes for construction and annual re-supply and energy efficient camp facilities.

- With North American Palladium, Mr. MacRae was in a contract position as acting Mine Superintendent/Chief Engineer between January and December 1998. His responsibilities included day to day pit operations and short term planning. Other duties included engineering staff hiring and training, budgeting, waste dump design, issuing and reviewing blast hole drilling and explosive supply contracts and other projects such as pit electrification and de-watering.

- Will be working on site, assisting engineering staff with short-range planning and production fleet evaluation. In addition, he will be responsible for preparing a mine life plan and budget, overseeing the engineering of an optimized ultimate pit wall slope, and initiate a drill and blast program.

- He edited topographical data for GEMCOM input; redesigned main haulage road; designed a waste storage area; and assisted in the preparation of the mine site operating procedures manual.

- Calculated volumes for a materials handling schedule, designed the realignment of a major access to the plant site, assisted in the design of a 12-meter ore block model and designed a waste storage area.

Viceroy Resource Limited-Brewery Creek Mine (February 1996 to October 1996)

- As Chief Mine Engineer, Mr. MacRae was responsible for developing and guiding the mine engineering and geology department through the pre-production and start-up phase of this seasonal heap leach gold operation. Other duties included personnel selection, mining software selection, computer equipment selection, policy development, budgeting and rotational back up as mine superintendent.

Paul MacRae & Associates (March 1995 - January 1996)

- Mr. MacRae worked as a Contract Mine Engineer on the Loki Gold Corporation project. In association with K.C. Minty & Associates, he assisted in the mining portion of Loki's feasibility study. The work included preparation of an operating budget, overseeing of pit designs, checking of ore reserves and waste dump design.

Placer Dome Canada Inc.- Endako Mines Division (January 1991 to December 1994)

- Endako Mine is a 60,000 tonne per day open pit molybdenite mine, as Short Range Planning Engineer, Mr. MacRae was responsible for mine production and equipment allocation for weekly and quarterly forecasting using in-house mine planning software, AutoCad, and Lotus spread sheets. General duties included monitoring of daily production and equipment statistics and month end reporting, and yearly production and cost budgeting.

Stikine Management (November 1989 to May 1990)

- Mr. MacRae was General Manager responsible for the administrative functions of a major highways maintenance contract and the management of all operational functions of this contract within the guidelines of the contract standards. He developed an annual plan over and above the maintenance responsibilities to benefit both the contractor and the local area and other business opportunities related to the company's expertise.

Westmin Mines limited (July 1988 to July 1989)

- With Westmin Mines Limited Mr. MacRae was responsible for developing and guiding the mine department through the pre-production and start-up phase of this 18,000 t/day gold project. This encompassed complete authority over mine operations, mine maintenance, engineering, and geology. Other duties included personnel selection, equipment selection, policy development, and budgeting.

Cassiar Mining Corporation (January 1984 to July 1988)

- Mr. MacRae was responsible for supervision of a 20,000 t/day open pit asbestos mine. This included successful management of a budget in an economic down turn reflecting unfavourable market pressures. Other duties included participation in engineering, resolution of labour disputes, and monitoring environmental controls.

Luscar Sterco (1977) Limited (January 1982 to January 1984)

- Mr. MacRae was Senior Mine Engineer of this privately-owned thermal coal producer with operating mines in Alberta and Saskatchewan. He was responsible for the short and medium range planning this 70,000 t/day truck/shovel, strip coal mine. Duties included monitoring of slope stability, production forecasting, and the supervision of engineering and survey staff. During this period, a cost effective drilling and blasting program was implemented.

Iron Ore Company of Canada (June 1974 to January 1982)

- Within this time Mr. MacRae held several positions such as Senior Short Range Mine Engineer, Short Range Mine Engineer, Blasting Engineer, Blasting Foreman, Mine Operations Shift Foreman. The varied responsibilities associated with these positions allowed for the development of a wide range of skills and knowledge related to all facets of this open pit mine.

PROFESSIONAL AFFILIATIONS

Association of Professional Engineers and Geoscientists of Newfoundland.
Association of Professional Engineers and Geoscientists of British Columbia

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Stephen William Reford

Present Occupation:	Senior Consulting Geophysicist **Paterson, Grant & Watson Limited** Toronto, Canada
Born:	July 30, 1959, Canada
Family:	Married, 4 children
Languages:	English, French (good), German (some), Italian (some)
Education:	B.A.Sc., 1981, University of Toronto, Engineering Science (Geophysics Option). Completed course work towards an M.Sc. in Geophysics, University of Toronto, 1987.

Employment History

Feb. 1994-Present:	Vice-President and Partner/Director, **Paterson, Grant & Watson Limited**
May 1997-Present:	President and Partner/Director **PGW S.A. Incorporated**
August 1999-Present:	Vice-President and Partner/Director **SkyMapper Limited**
Nov. 1996-August 2000:	Director **GeosoftX Incorporated**

Appointed "OTH Geophysicist" to manage the geophysical component of Operation Treasure Hunt, Ministry of Northern Development and Mines, August 1999 to March 2001.

Interpretation of 55,000 line-km multi-client magnetic/radiometric survey, Calama West, Chile.

Training mission to Consejo de Recursos Minerales, Mexico for use of OASIS montaj software and applications for geophysical interpretation.

Technical Manager for the China Aeromagnetic Mapping Project (CHAMP), an industry-sponsored project for the recompilation of 7.5 million line km of aeromagnetic data, in cooperation with the Ministry of Geology and Mineral Resources, China (1996-1998).

Advisor in airborne geophysics to Servicio Geológico Minero Argentino, PASMA-World Bank Project.

Manager for recompilation and processing of 450,000 line-km of airborne magnetic and frequency/time-domain electromagnetic data for the Ontario Geological Survey (1994-1996).

Regional interpretation of magnetic, gravity and satellite data, northern Baffin Island.

Interpretation and processing of aeromagnetic and radiometric data for gold and diamond targets over several large blocks in Brazil, Guyana, Suriname, French Guiana and Venezuela.

Contractor selection and monitoring of airborne surveys in West Africa.

Evaluation of gold, base metal and diamond properties in Ontario, Quebec and Labrador.

Preparation of qualifying reports for the initial and subsequent public offerings of shares in Darnley Bay Resources Ltd., in relation to exploration of the Darnley Bay geophysical anomaly, Northwest Territories. Survey management and interpretation of aeromagnetic, gravity and UTEM data for nickel, PGE and diamond exploration.

Processing and interpretation of airborne and ground data for a major gold exploration campaign in the Kirkland Lake Area, Ontario (1994-1995).

Coordination of an R&D project with the Geological Survey of Canada to develop semiautomatic techniques for magnetic interpretation and preparation of a digital terrain model for Canada.

Processing of satellite imagery for diamond exploration.

Jan. 1991-Jan. 1994: Senior Geophysicist and Partner/Director,
Paterson, Grant & Watson Limited

Interpretation and processing of magnetic, radiometric, gravity and digital terrain data throughout Canada and in South America for diamond exploration (1992-1994).

Management of project to index and prepare a database from 35,000 assessment files and 30,000 reports of work, employing thirty people, for the Ministry of Northern Development and Mines, Ontario

Interpretation and processing of magnetic/radiometric survey for the Geological Survey of Malaysia and the UNDP, ground truth studies, GIPSI software installation and training (1991-92).

Development and application of Euler deconvolution for diamond exploration in Canada and Australia (1991-94).

Detailed processing and interpretation of helicopter aeromagnetic/electromagnetic survey incorporating gravity, radiometrics and paleomagnetism, for base and precious metals over the Sudbury Basin and vicinity (1989-1991).

Project manager for the African Magnetic Mapping Project (AMMP), an industry-sponsored digital compilation project of all available airborne/marine magnetic data for the continent of Africa and adjacent waters (1989-1992).

Supervisor for research, development and marketing of GIPSI geophysical applications software for UNIX systems (since 1990).

Development of Compu-drape(tm) technique for continuation of potential field data between arbitrary surfaces (since 1988).

June 1985-Dec. 1990: Senior Geophysicist,
Paterson, Grant & Watson Limited

Interpretation of magnetic, E.M., VLF and radiometric surveys, both airborne and ground, and of gravity, I.P., electrical and seismic surveys (since 1981).

Filtering, processing and presentation of millions of line km of potential field and radiometric data (since 1981).

Processing and interpretation of several aeromagnetic/radiometric datasets for gold exploration, Papua-New Guinea (1990).

Project manager for the compilation, levelling and linking of some fifty aeromagnetic surveys (1.7 million line km) covering Ontario (1.1 million sq. km) for the Ontario Geological Survey (1989).

Regional-scale interpretation of aeromagnetic data, integration with radiometric and VLF interpretations and recommendations for follow-up covering the southwest half of Thailand (1989).

Presented eight weeks of formal training in mineral exploration geophysics to thirty geophysicists for the Department of Mineral Resources, Thailand. The course comprised of personal computer software (two weeks), airborne electromagnetic methods (three weeks) and ground follow-up methods (three weeks) (1988).

Party chief for three E.M. (including horizontal loop, Turam and VLF) surveys, northern Baffin Island, for base and precious metals exploration. Interpretation and processing of data.

UNDP expert assigned to Kasai-Subarnarekha groundwater project, Eastern India, 1987. Training in data acquisition and interpretation.

Processing and interpretation of the KLAC (Kirkland Lake area) gravity dataset for the Ontario Geological Survey.

Interpretation and processing of an airborne magnetic/radiometric survey as part of a mineral exploration program for the Government of Malawi and the UNDP, 1986-87, including on-site ground truth studies and training in ground geophysical methods.

Project geophysicist on R&D program for the Ontario Geological Survey (ETDF) in magnetic, radiometric and EM interpretation.

Software development (mainframe and personal computer) for interpretation and/or data reduction of gravity, electromagnetic and resistivity data.

Sept. 1986-May 1987 Teaching Assistant,
University of Toronto

Time Series Analysis (Graduate Course)
Electromagnetism (Second Year Course)

June 1981 - June 1985 Staff geophysicist,
Paterson, Grant & Watson Limited

Development of computer software for geophysical applications (on mainframe and microcomputers), e.g. inversion of ground and airborne E.M. data, continuation of potential field data between arbitrary surfaces, and radioelement ternary zoning. Deputy project manager of five year R&D program of software development, partially sponsored by the Ontario Geological Survey.

Party chief of four detailed gravity surveys and one detailed magnetic survey of the East Bull Lake gabbro intrusion near Massey, Ontario for A.E.C.L. Radwaste Research, 1981-1983.
Interpretation and preparation of reports.

On-site quality control of an airborne magnetic survey in Burundi, Africa as part of a petroleum exploration program for the Government of Burundi and World Bank, August, 1982.
Interpretation and preparation of report.

Interpretation and processing of an airborne magnetic/radiometric survey as part of a mineral exploration program for the Government of Burkina Faso (Upper Volta) and CIDA, 1984.
Followed by on-site ground truth studies.

May-August 1980 Senior Assistant,
Ontario Geological Survey

Operated LaCoste and Romberg gravity meter, and altimeter.
Involved in field logistics and data reduction.

June-August 1978 Geophysical Operator,
Geoterrex Limited

Operated level and LaCoste and Romberg gravity meter as part of a uranium exploration survey in Northern Saskatchewan.

June-August 1977 Geophysical operator,
Geoterrex Limited

Worked half the summer as a rodman on a uranium exploration gravity survey in Northern Saskatchewan. Worked half the summer on a uranium exploration survey in Northern Saskatchewan. Operated I.P. transmitter, HLEM (Max-Min) system and ground magnetometer.

Other Offices: Canadian Exploration Geophysical Society (KEGS)

Secretary-Treasurer	1995-96
Vice-President	1996-97
President	1997-98
Past-President	1998-99

Society of Exploration Geophysicists (SEG)

Council Member	1997-98

Exploration' 97
Technical Program Committee and Session Organizer, 1995-97.

Societies:
Professional Engineers, Ontario (PEO)
Society of Exploration Geophysicists (SEG)
European Association of Geoscientists & Engineers (EAGE)
Australian Society of Exploration Geophysicists (ASEG)
Canadian Exploration Geophysical Society (KEGS)

Publications:

Bailey, Richard C., Colangelo, W. and **Reford, S. W.** 1989: Maximal Simplicity Gravity Interpretation; Annual Meeting of the Canadian Geophysical Union, Montreal, Quebec, May 18, 1989.

Bailey, Richard C. and **Reford, S. W.** 1987: Grant 290 Improved Computer Interpretation of Gravity and Magnetic Data; Geoscience Research Program, Summary of Research 1986-1987, Ontario Geological Survey, p.176-182.

Bailey, Richard C. and **Reford, S. W.** 1988: Grant 290 Maximal Simplicity Gravity Interpretation with Continuous Density Models; Geoscience Research Program, Summary of Research 1987-1988, Ontario Geological Survey, p.94-102.

Black, Paul A., Green, C. M. and **Reford, S.W.** 1995: A Pragmatic Approach to Continental Magnetic Compilations; 65th Annual Meeting of the Society of Exploration Geophysicists, Houston, Texas, October 8-13, 1995. Expanded Technical Abstracts, p. 773-774.

Fairhead, J. Derek, Misener, D. J., Green, C. M., Bainbridge, G. and **Reford, S.W.** 1997: Large Scale Compilation of Magnetic, Gravity, Radiometric and Electromagnetic Data: The New Exploration Strategy for the 90s; Proceedings of Exploration 97, ed. A. G. Gubins, p.805-816.

Fairhead, J. Derek, Williams, J. S., Misener, D. J. and **Reford, S.W.** 1996: Magnetic Compilations in South East Asia; Jakarta '96 International Geophysical Conference, Jakarta, Indonesia, April 27-May 2, 1996. Expanded Technical Abstracts, p. 140-144.

Gupta, Vinod, K., Paterson, N. R., **Reford, S. W.**, Kwan, K. C. H., Hatch, D. and MacLeod, I. N. 1989: Single Master Aeromagnetic Grid and Colour Maps for the Province of Ontario; Summary of Field Work and Other Activities 1989, Ontario Geological Survey, p.244-250.

Gupta, Vinod K., Rudd, J. and **Reford, S.W.** 1998: Reprocessing of Thirty-two Airborne Electromagnetic Surveys in Ontario, Canada: Experience and Recommendations; 68th Annual Meeting of the Society of Exploration Geophysicists, New Orleans, Louisiana, September 13-18, 1998. Extended Technical Abstracts.

Misener, D. James and **Reford, S. W.** 1986: Chapter X, Mining Geophysics; Canadian Geophysical Bulletin, Volume 39, ed. P. B. Robertson, Geological Survey of Canada, Energy, Mines and Resources Canada, p.197-202.

Misener, D. James, **Reford, S. W.**, Bailey, R. C. and Holroyd, M. 1984: Ternary Colour Plotting of Three Radioelement Spectrometer Data; 54th Annual Meeting of the Society of Exploration Geophysicists, Atlanta, Georgia, December 2-6, 1984. Extended Technical Abstracts, p. 750-751.

Misener, D. James, **Reford, S. W.** and Paterson, N. R. 1996: The Application of Regional Aeromagnetics in Gold Exploration; Jakarta '96 International Geophysical Conference, Jakarta, Indonesia, April 27-May 2, 1996. Expanded Technical Abstracts, p. 187-191.

Paterson, Norman R., Edwards, R. N. and **Reford, S. W.** 1982: Continuous Two-layer Inversion of Multi-coil EM Data; 9th Annual Meeting of the Canadian Geophysical Union, Toronto, May 10-12, 1982. Technical Program Abstracts, p.20. Preprint available from authors.

Paterson, Norman R., Kwan, K. C. H. and **Reford, S. W.** 1991: Use of Euler Deconvolution in Recognizing Magnetic Anomalies of Pipelike Bodies; 61st Annual Meeting of the Society of Exploration Geophysicists, Houston, Texas, November 10-14, 1991. Expanded Abstracts, p.642-645.

Paterson, Norman R. and **Reford, S. W.** 1984: Chapter X, Mining Geophysics; Canadian Geophysical Bulletin, Volume 37, ed. R. A. Gibb, Earth Physics Branch Energy, Mines and Resources Canada, p. 185-195.

Paterson, Norman R. and **Reford, S. W.** 1986: Inversion of Airborne Electromagnetic Data for Overburden Mapping and Groundwater Exploration; Airborne Resistivity Mapping, ed. G. J. Palacky, Geological Survey of Canada, Paper 86-22, p. 39-48.

Paterson, Norman R. and **Reford, S. W.** 1989: COMPU-DRAPE™: A Method for Draping Aeromagnetic Surveys Over an Irregular Basement Surface; Annual Meeting of the Canadian Society of Exploration Geophysicists, June 11-15, 1989. Program with Abstracts, p.106.

Paterson, Norman R., **Reford, S. W.** and Kwan, K. C. H. 1990: Continuation of Magnetic Data Between Arbitrary Surfaces: Advances and Applications; Expanded Abstracts of the Sixtieth Annual Meeting, Society of Exploration Geophysicists, p.666-669.

Reeves, Colin V., **Reford, S.W.** and Milligan, P. R. 1997: Airborne Geophysics: Old Methods, New Images; Proceedings of Exploration 97, ed. A. G. Gubins, p.13-30.

Reford, S.W. 1997: Geophysics of the West African Shield; Geology, Geochemistry, Geophysics, and Mineral Deposits of the Guiana and West African Shields, Short Course Proceedings, Northwest Mining Association.

Reford, S.W. and Fyon, A.J. 2000: Ontario's Operation Treasure Hunt: Stimulating Mineral Exploration in Ontario Through Airborne Geophysics; GeoCanada 2000, Calgary, Alberta, May 2000.

Reford, S.W. and Fyon, A.J. 2000: Ontario's Operation Treasure Hunt: Stimulating Mineral Exploration in Ontario Through Airborne Geophysics; Expanded Abstracts of the Seventieth Annual Meeting, Society of Exploration Geophysicists.

Reford, S. W., Gupta, V. K., Paterson, N. R., Kwan, K. C. H. and MacLeod, I. N. 1990: The Ontario Master Aeromagnetic Grid: A Blueprint for Detailed Compilation of Magnetic Data on a Regional Scale; Expanded Abstracts of the Sixtieth Annual Meeting, Society of Exploration Geophysicists, p.617-619.

Reford, S. W., Kwan, K. and Paterson, N. R. 1993: Progress in SVD Inversion of Airborne and Ground EM Data to a Multilayered Earth Model; International Workshop on Airborne Electromagnetic Methods, Tucson, Arizona, September 13-16, 1993.

Reford, S. W. and Misener, D. J. 1987: Chapter X, Mining Geophysics; Canadian Geophysical Bulletin, Volume 40, ed. P. B. Robertson, Geological Survey of Canada, Energy, Mines and Resources Canada, in press.

Reford, S. W. and Bailey, R. C. 1987: A Simplicity Norm Approach to Modelling Gravity Data; 49th Annual Meeting of the European Association of Exploration Geophysicists, Belgrade, Yugoslavia, June 9-12, 1987. Technical Program with Abstracts, p.101. Preprint available from authors.

Reford, S. W. and Paterson, N. R. 1984: New Development of Computer Software for Geophysical Interpretation; Computer Applications in Mineral Exploration 1984, Toronto, January 9-11, 1984. Program with Abstracts, p.17-29. Preprint available from authors.

Reford, S. W. and Paterson, N. R. 1985: Chapter X, Mining Geophysics; Canadian Geophysical Bulletin, Volume 38, ed. R. A. Gibb, Earth Physics Branch, Energy, Mines and Resources Canada, p.183-193.

Reford, S. W. and Paterson, N. R. 1985: Grant 089 Testing and Demonstration of Interpretation Software for Magnetic, EM and Spectrometry Inversion; Exploration Technology Program of the Board of Industrial Leadership and Development, Summary of Research 1984-1985, Ontario Geological Survey, p.80-84.

Reford, S. W. and Paterson, N. R. 1986: Grant 089 Testing and Demonstration of Interpretation Software for Magnetic, EM and Spectrometry Inversion; Exploration Technology Program of the Board of Industrial Leadership and Development, Summary of Research 1985-1986, Ontario Geological Survey, p.65-75.

Reford, S. W. and Paterson, N. R. 1988: Overburden Mapping by Airborne EM; Australian Society of Exploration Geophysicists International Geophysical Conference, Adelaide, Australia, February 14-21, 1988.

Reford, S. W. and Paterson, N. R. 1991: Applications of the Ontario Magnetic and Gravity Compilations to Geological Mapping; IUGG/IAGA Assembly, Vienna, August, 1991.

Reford, S. W. and Paterson, N. R. 1994: Airborne Geophysical Surveys in Weathered Terrain; Prospecting in Tropical and Arid Terrains, Short Course Proceedings, Prospectors and Developers Association of Canada, p.3-61 -3-109.

Reford, S. W., Paterson, N. R. and Edwards, R. N. 1985: Inversion and SVD Analysis of Frequency-Domain EM Data; 55th Annual Meeting of the Society of Exploration Geophysicists, Washington, D. C., October 6-10, 1985. Extended Technical Abstracts, p.251-254.

Reford, S. W., Paterson, N. R. and Kwan, K. C. H. 1991: Progress in the Draping of Aeromagnetic Data onto Arbitrary Surfaces; IUGG/IAGA Assembly, Vienna, August, 1991.

Reford, S. W., Paterson, N. R. and Misener, D. J. 1984: Grant 011 Development of Computer Software for Geophysical Interpretation; Exploration Technology Program of the Board of Industrial Leadership and Development, Summary of Research 1983-1984, Ontario Geological Survey, p.44-51.

Reford, S. W., Paterson, N. R. and Misener, D. J. 1991: Data Management and Presentation of Large Magnetic Compilations; IUGG/IAGA Assembly, Vienna, August, 1991.

Ugalde, Hernán A., **Reford, S. W.** and Colla, A. 2000: On the usefulness of high-resolution airborne magnetic and radiometric data in an area of sedimentary cover: Calama West, northern Chile; Expanded Abstracts of the Seventieth Annual Meeting, Society of Exploration Geophysicists.

CURRICULUM VITAE
D. James Misener

Present Occupation: Consulting Geophysicist, President,
Paterson, Grant & Watson Limited
Toronto, Canada

Born: 1945, Toronto, Canada

Family: Married, 2 children

Language: English, some French

Education: B.A.Sc., 1967, University of Toronto, Engineering Science.

M.A.Sc., 1971, University of British Columbia.

Ph.D., 1973, University of British Columbia, Geological Sciences (Geophysics/Geology).

Employment History (1990 - 1999)

- President of **Paterson, Grant & Watson Limited**
- Founding Partner of **PGW S.A. Inc.** (Santiago, Chile)
- Chief Scientist and Project Manager for the following projects:
  - X CHAMP - China Aeromagnetic Mapping Project
    Industry funded - US$1,500,000
  - X UGDB - Unified Geochemical Database for Brazil
    Industry funded - US$400,000
  - X BRMP - Brazil Radiometric Mapping Project
    Industry Government funded - US$800,000
  - X SAMMP - South American Magnetic Mapping Project
    Industry funded - US$ 3,000,000
- Project Manager and Chief Consulting Geophysicist (Interpreter) on the following major mining exploration programs:
  - X Alaska - Central Gold Belt - Kennecott Exploration Inc.
  - X US Mid Continent - 2 year program - Cominco Ltd.

X Brazil Proterozoic Study - Inco Ltd.

X Major International Oil Companies - world wide aeromagnetic compilation

X Ghana - regional/detailed gold exploration

Employment Chronology:

1985 - Present	Formed **Geosoft Inc.** from the software division of **Paterson, Grant & Watson Limited**. Became Director and Vice President of **Geosoft**, participating in planning and management of the company's ongoing software development and marketing activities.
1994	Appointed President of **Paterson, Grant & Watson Limited** to succeed Dr. N. R. Paterson who was appointed as Chairman of the Board.
April 1975 - 1999	Joined the firm of **Paterson, Grant & Watson Limited**, appointed Director and Vice-President 1978. Directed implementation of geophysical data processing systems; initiated and managed major continental scale compilations of aeromagnetic/marine magnetic data.

North America

Supervision and interpretation of all types of ground and aeromagnetic surveys in North America.

International

Interpretation of aeromagnetic, radiometric, gravity and electromagnetic surveys; Algeria, Brazil, Cameroon, Niger, Ivory Coast, Zimbabwe, Malawi, Kenya, China;
(see Significant Projects).

Management/supervision of Continental Scale Aeromagnetic Compilations - Africa (AMMP) 1989-1992, South America (SAMMP) 1993-1996, South East Asia (SEAM) 1995-1997, China (CHAMP), 1995-1997.

Research

Development and implementation of computer programs to assist in the interpretation of magnetic and radiometric data.

September 1975 - 1980

Lecturer at the **Department of Earth and Atmospheric Sciences, York University**, Toronto. Courses of instruction have included: Global Tectonics, Geology and Geochemistry of the Earth's Crust and Mantle, Chemical Thermodynamics.

1974 - 75

Eastern Canada Survey Manager and Airborne Manager, **McPhar Geophysics Company**, Don Mills, Ontario. Supervised eastern Canadian ground geophysical surveys; supervised airborne geophysical operations and interpretations until March 1975.

1973 - 74

Geophysicist, **McPhar Geophysics Company**, Don Mills, Ontario. Carried out or supervised ground geophysical surveys in Canada; supervised and interpreted airborne magnetic and electromagnetic survey in India.

1971 - 72

Research Associate, Geophysical Laboratory, **Carnegie Institute of Washington D.C.**

1967 - 71

Mining geophysical consulting (summers). Vancouver, B.C.

Societies Association of Professional Engineers, Ontario.
American Geophysical Union.
Canadian Society of Exploration Geophysicists.

Committees Ontario Geoscience Research Grant Committee (1983 - 1988).

NAME: **GREG M. LIPTON**

ACADEMICS:

1971 – 1975 University of Western Ontario
London, Ontario
Hons. Bachelor of Science: Geology

PROFESSIONAL MEMBERSHIPS:

- Current chairman of the Geoscience Advisory Group for the National Remote Sensing Advisory Groups
- Prospectors and Developers Association
- American Society for Photogrammetry and Remote Sensing

PROFESSIONAL EXPERIENCE:

June 1998 – Present **EarthScan Ltd.**

Position: **President and owner of company**
Responsible for processing, analysing, interpreting and advising on global mineral exploration programs utilizing spectral, hyperspectral, and radar remote sensing data. Client base includes both 'major' and 'junior' mining companies working on exploration programs worldwide. Recent work has included analysis and interpretation of data from the 'Probe-1' airborne hyperspectral instrument for base and precious metal exploration, as well as forestry applications.

June 1997 – May 1998 **Geomatics International Inc.**

Position: **Manager of Remote Sensing for Mineral Exploration**
Responsible for the 'Mineral Exploration Business Area' for Geomatics International. Responsibilities included project development and the application and implementation of spectral and radar remote sensing and GIS technologies to the mineral exploration industry. Clients included 'major' and 'junior' mining companies as well as foreign government agencies worldwide.

February 1987 – May 1997 **BHP Minerals**

Position: **Head Geologist Remote Sensing, World Technical Services Group**
Resposibilities were to all of BHP's global exploration programs utilizing spectral and radar remote sensing. Mineral exploration included base metal, precious metal, diamonds, and industrial mineral

projects worldwide. Geologic environments included porphyry, epithermal, VMS, Sedex, and BHT in North America, Central America, Africa, Australia, Southeast Asia, and the Middle East.

Remote sensing involved computer analysis, and interpretation of satellite spectral systems such as Landsat TM , IRS-1, and microwave systems such as JERS-1, Radarsat, and SIR-A, -B, -C radars. Additional spectral remote sensing included computer analysis and evaluation of airborne hyperspectral sensors such as AVIRIS for mineral exploration and involvement in the mineral exploration field evaluation team for the CCRS protoype airborne hyperspectral scanner known as 'SFSI'.

Spectral remote sensing efforts successfully defined base and precious metal deposits in epithermal and porphyry-type systems on several continents.

March 1980 – Feb. 1987 **BHP Minerals / Utah International**

Position: **Senior Exploration Geologist / Remote Sensing, Eastern Canada**

Responsibilities included base and precious metal exploration throughout eastern Canada through management of field crews including geological, geophysical, and geochemical surveys, core drilling programs, and mineral prospect and mining property evaluations. Geologic environments included Archean VMS and lode gold, Paleozoic porphyry-type, and MVT.

- Remote sensing involved pioneering work in using airborne multispectral techniques to study metal induced stress in boreal forest environments in Canada and applying this to mineral exploration.

May 1975 – March 1980 **Utah International**

Position: **Project Geologist, Eastern Canada**

Responsibilities included base and precious metal exploration throughout Eastern Canada utilizing geologic mapping, geochemistry, geophysical surveying, and core drilling programs, as well as mineral prospect evaluation. Geologic environments included Archaen VMS and lode gold, Paleozoic porphyry-type, and MVT.

WORKSHOPS / PRESENTATIONS:

- March, 1999. Keynote speaker at ERIM's "Thirteenth International Conference on Applied Geologic Remote Sensing". Topic: "Exploration"
- September, 1997. Keynote speaker at: "Exploration '97 – Geophysics and Geochemistry at the Millenium"; Fourth Decennial International Conference on Mineral Exploration. Topic: "Spectral and Microwave Remote Sensing: An Evolution from Small Scale Regional Studies to Mineral Mapping and Ore Deposit Targeting"
- March, 1994. Prospectors and Developers Association Workshop: "Prospecting in Tropical and Arid Terrains". Topic: "SAR Radar Remote Sensing for Mineral Exploration".

COMPUTER SKILLS:

- Research Systems Inc. 'ENVI' Hyperspectral Analysis Software, for UNIX platforms.
- PCI 'EASI / PACE' Image Analysis Software, for UNIX platforms
- Microsoft office: 'PowerPoint', 'Word', 'Excel', etc.

RECENT PUBLICATIONS:

1) Lipton, G., Rivard, B., 1999, Lithologic Mapping in the Abitibi Greenstone Belt Using Probe Hyperspectral Data (in press).
2) Lipton, G., Rivard, B., Borstad, G., Kowalczyk, P., 1999, Hyperspectral Imager Technology Assessment (HITA) – Geology Applications. Prepared for: The Canadian Space Agency. MacDonald, Dettwiler and Associates Ltd. 1999, Richmond, British Columbia.
3) Lipton, G., 1997, Spectral and Microwave Remote Sensing: An Evolution from Small Scale Regional Studies to Mineral Mapping and Ore Deposit Targeting: Exploration '97 – Geophysics and Geochemistry at the Millenium; Proceeding of the Fourth Decennial International Conference on Mineral Exploration, p. 43 – 57.
4) Hauff, P., Lipton, G., et al, 1996, The CCRS SWIR Full Spectrum Imager: Mission to Nevada: Proceedings of the 11th Thematic Conference on Applied Geologic Remote Sensing, Las Vegas, Nevada, Vol. I, p.38 – 47.

APPENDIX C

PGW AND EARTHSCAN PROPOSALS FOR IOC ASSESSMENT PROGRAM

PROPOSAL FOR PHASE I OF THE IRON ORE EXPLORATION PROGRAM LABRADOR CITY AREA, NEWFOUNDLAND

Proposal prepared for: Robert Didur, P.Eng.
Superintendent Mine Technical Services
Iron Ore Company of Canada
P.P. Box 1000
Labrador City, Newfoundland
A2V 2L8

Proposal prepared by: Stephen Reford, B.A.Sc., P.Eng.
Vice-President
Paterson, Grant & Watson Limited
85 Richmond Street West, Eighth Floor
Toronto, Ontario
M5H 2C9
tel: (416) 368-2888
fax: (416) 368-2887
email: stephen.reford@pgw.on.ca

Date: September 28, 2000

This proposal revises and refines our earlier proposal dated September 18, 2000, as a result of the kick-off meeting on September 25, 2000.

Recommendation: The GSC aeromagnetic data indicates that virtually the entire proposed survey area hosts iron formation. We recommend that IOC stake the available ground within the survey area as soon as possible. Later today, we will email the revised survey area boundaries.

PATERSON, GRANT & WATSON PROPOSAL

We are assuming that Watts, Griffis and McOuat will be engaged as overall project managers, and that PGW will coordinate the geophysical and remote sensing aspects of the program with IOC and WGM. PGW will also provide digitising services to WGM in the GIS compilation phase, as required.

This proposal covers "Phase I", namely the collection and review of existing and new data over the regional area of interest, ending in target selection and follow-up recommendations in February, 2001. A proposal for "phase II", which covers the actual follow-up of the targets, will be prepared towards the end of Phase I. Phase I includes a fixed wing aeromagnetic survey. Any helicopter geophysical survey, if required, will be incorporated in Phase II.

PGW's cost estimates are based on the following rates:

Senior Consulting Geophysicist (Misener, Reford, Paterson)	$145/hour ($1,015/day)
Senior Geophysicist (Kwan, Davitt)	$105/hour ($735/day)
Staff Geophysicist (Cao, Milicevic, Mueller, Zhu)	$75/hour ($525/day)
Senior Technician/Cartographer (Lawrence, Tang)	$55/hour ($385/day)
Technician/Digitiser	$30/hour ($210/day)

Cost estimates are prepared by estimating the time required for each of the staff levels, and adding applicable expenses (map plotting, shipping, travel). The cost estimates can be considered as a fixed quotation that would only change if the scope of work changes, in agreement with IOC. We rarely overestimate the time required for a particular task, so the client usually receives good value as compared to working on a "time and materials" basis.

Task 1: Airborne Survey Tender and Contracting

Phil McInerney has laid the groundwork for this task, assuming a fixed wing aeromagnetic survey at 200 m line spacing. We will finalise the survey boundaries using the available published geology and geophysical data, supplemented by IOC input. We propose to request final quotations given a set of well-defined technical parameters, including the issues raised in the North and Rio Tinto memos. We will include a list of final products in digital and map form for use in the interpretation and for archiving by IOC.

For the proposed fixed wing aeromagnetic survey, we have requested budgetary quotations for 100 m, 150 m and 200 m line spacings from seven airborne survey contractors. Once the available airborne survey budget, and therefore line spacing, is finalised, we will request formal proposals from these contractors, and select the preferred bidder based on a price/performance evaluation. For the survey contract, we have model contracts available from recent Ontario government surveys to work from, as well as the standard contract offered by the contractor itself. The final contract will incorporate stringent technical specifications to ensure high quality data from the outset. The contract will be signed between IOC (or WGM if preferred) and the airborne contractor. If IOC has any specific clauses it requires in its contracts, these should be provided to PGW.

Cost Estimate – Senior Consulting Geophysicist	3 days	$3,045
Staff Geophysicist	2 days	$1,050
	Total	$4,095

Timing – The request for proposal, proposal preparation, proposal evaluation and contractor selection will be completed two weeks after we are notified to proceed by IOC. The survey will be scheduled to commence data acquisition in early November and be completed prior to Christmas, with delivery of final products by the end of January, 2001.

Task 2: Airborne Survey Quality Assurance and Quality Control

Phil McInerney states that on-site technical supervision of the survey is essential, and we heartily agree. This ensures that the contractor meets or exceeds the survey specifications, and is able to receive a quick decision on the quality of questionable data. It tends to raise the level of effort put forth by the contractor. It also allows for immediate follow-up of target areas interpreted in the field (e.g. flying infill areas), if desired. The PGW QA/QC geophysicist will:

a) review all pre-survey calibrations and test flights, to ensure the geophysical system is working properly and within specifications;
b) coordinate the location of the magnetic base station(s) with the contractor;
c) review the contractor's in-field data reduction and compilation processes;
d) review the production data acquired on a daily basis for adherence to the specifications;
e) review the processed data on a daily basis for adherence to the specifications;
f) prepare ongoing high-resolution digital products and an initial interpretation as the data is collected; and
g) review the geological and geophysical material available from IOC and copy what is relevant for the GIS compilation and geophysical interpretation.

In addition to the above, we will provide QA/QC on the final digital and map products prepared by the contractor. If near Toronto, this will include a site visit.

Cost Estimate – The cost estimate for this task depends on the length of time required for the survey, which in turn will depend on the size of the survey and downtime due to weather. We would prefer to charge this task on a time and materials basis, at $525/day (including one day of travel) for a staff geophysicist plus travel and living expenses. For a 10,000 line-km survey, this would amount to approximately $7,875 in fees and $2,800 in expenses. For a 20,000 line-km survey, this would amount to approximately $14,175 in fees and $4,240 in expenses. In the latter case, we might want to consider two one-week visits at the beginning and end of the survey, with data transmissions from the contractor to Toronto in the interim. This could save a few thousand dollars if it proves to be practical. In addition, the cost for the QA/QC of the digital products would be $1,050. We have assumed living expenses of $120/day in Labrador City, and $1,000 for the airfare to/from Toronto (advance booking).

Task 3: Remote Sensing Data Processing and Interpretation

The attached proposal from Greg Lipton of EarthScan Ltd. covers this task. EarthScan is a separate company from PGW, but rents an office at PGW's Toronto premises. Therefore, the two companies work well together on projects that incorporate both remote sensing and geophysical data. EarthScan will prepare the digital products in a "GIS-ready" format for incorporation in the IOC GIS.

Task 4: Data Gathering and Compilation

The Geological Survey of Canada's aeromagnetic coverage of the region (52°N to 54°N, 65°W to 69°W) consists of surveys flown in 1973-74 at 800 m (half-mile) line spacing and 300 m (1000′) above terrain, mainly along E-W oriented flightlines. There are also ~300 gravity stations in the region. The magnetic data will be useful for finalising the aeromagnetic survey boundary. Both datasets will provide regional control for the interpretation. PGW has a copy of this data in-house and can prepare digital products immediately. These data have been acquired and maps prepared, initially to refine the airborne survey boundaries.

IOC had a helicopter-borne magnetic/electromagnetic survey flown in 1972 by Sander Geophysics. The line spacing was half-mile, quite coarse for a helicopter survey. The data have been provided in hard copy form as two sets of 44 map sheets (many with minimal coverage), one set of contours of the total magnetic field, and the other of contours of the induced electromagnetic field (inphase?). Assuming the area covered by the Sander survey is entirely reflown, the new aeromagnetic survey will be much superior to the Sander data, even if a fixed wing platform is used, due to tighter line spacing, improved equipment and survey capabilities. The Sander magnetic data could prove useful over deposits that have been mined since 1972 and/or where post-72 cultural sources contaminate the new data. This amounts to the equivalent of 4 map sheets in the mine area, which will be excluded from the new aeromagnetic survey due to cultural contamination. The electromagnetic data will provide some idea of what EM anomaly sources are present, and how a new helicopter-EM survey might be applicable.

We recommend that the Sander data be digitised to supplement the new data, specifically the 4 map sheets of magnetic data in the mine area, and all 44 sheets of the electromagnetic data. These data will be digitised by capturing the contours where they intersect the flightlines, thereby regenerating the original flightline data. They will then be processed into grid images for interpretation. The magnetic data are fairly continuous. However, there are electromagnetic data contours over anomalies only.

We will also source the most recent geological maps and reports on the region from the geological surveys for Newfoundland, Quebec and Canada, in digital form if they are available.

Cost Estimate

- The cost to license the GSC geophysical data is $540. The cost for PGW to prepare digital and hard copy products from the GSC data is $700.
- The cost to digitise the geophysical maps depends on their complexity – it will be $250/map for the magnetic data ($1,000 in total), and $3,000 for all 44 electromagnetic maps, which includes processing and compilation of the data after it is digitised.
- The purchase of the government geological data will be charged at cost (~$200).

Task 5: Data Processing, Modelling, Interpretation and Target Definition

The objective of this task will be the direct and indirect detection of possible ore zones, the latter through lithologic and structural interpretation. It will require processing of the magnetic data in profile and gridded form to extract the highest resolution possible from the data, as we anticipate complex structure and stratigraphy will play an important role in localizing ore zones. Specialized filters will be designed to minimise the effects of potentially quite strong magnetic responses over certain types of iron mineralisation, which could overwhelm more subtle, but important anomalies.

The interpretation of iron-rich rocks can be quite complex, as factors such as self-demagnetization, magnetic remanence and anisotropy make results derived from conventional modelling, particularly dip, inaccurate (magnetite mapping using EM data is much less affected by these issues). We have recommended a physical property study of existing samples to contribute to the modelling. In this regard, we have opened a dialogue between Bill Morris, Professor of Geophysics at McMaster University, and IOC, regarding physical property analysis from samples collected as part of the current drill program for the Luce Deposit. The analysis cost is $65/sample, and we recommend that ~$5,000 be budgeted for this work.

One aspect of the interpretation will be to determine signatures of the known ore zones, incorporating the Sander data where applicable, and using these in the target selection. The products of this task will include:

a) processed profile and image data in digital and map form;
b) modelling results in plan and section form;
c) litho-structural interpretation in digital and map form, with accompanying report;
d) delineation of follow-up targets within and outside IOC leases in digital and map form, with accompanying report; and
e) recommendations for follow-up using airborne and ground techniques, by area and field season.

The interpretation phase will be completed by February 2000, allowing for ground follow-up prior to break-up, if appropriate, and eventually leading to an initial drilling campaign in the fall/winter of 2001.

Cost Estimate – The cost to prepare the interpretation is a bit hard to quantify at this stage, as it will depend somewhat on the complexity of the responses. We suggest the following guidelines, depending on the size of the survey:

10,000 line-km	$2.50/line-km	$25,000
15,000 line-km	$2.25/line-km	$33,750
20,000 line-km	$2.00/line-km	$40,000

This estimate includes a significant amount of magnetic modelling to determine the source geometries and their magnetic properties.

Task 6: Geophysical Project Management

We anticipate a variety of management requirements in addition to those listed above. These include:

a) ongoing liaison with the airborne survey contractor;
b) project team meetings with WGM and IOC;
c) scoping of follow-up airborne and/or ground geophysical surveys with appropriate contractors.

Cost Estimate – This is also difficult to quantify at this stage. We suggest allocating $5,000 for the tasks, plus any costs associated with travel to Labrador City.

Conclusions

We would be pleased to elaborate on any of the above. Our overall cost estimate for the six tasks described above ranges from $69,510 to $92,250 plus GST. The final cost will depend mainly on the size of the aeromagnetic survey and the complexity of the responses.

In summary, we anticipate monthly expenditures as follows:

OctoberSurvey tender/contract		$4,095
	Data purchases (geophysics/geology)	$740
	Data processing (geophysics)	$700
	Data purchases (remote sensing)	$10,500
	Management	$1,000
	Total	$17,035
November	Digitising	$4,000
	QA/QC	$8,000 to $10,000
	Data processing (remote sensing)	$3,050
	Management	$1,000
	Total	$16,050 to $18,050
December	QA/QC	$2,675 to $8,415
	Data processing (geophysics)	$10,000
	Management	$1,000
	Total	$13,675 to $19,415
January	QA/QC	$1,050
	Modeling (geophysics)	$5,000 to $8,000
	Interpretation (geophysics)	$5,000 to $12,000
	Interpretation (remote sensing)	$4,700
	Management	$1,000
	Total	$16,750 to $26,750
February	Interpretation (geophysics)	$5,000 to $10,000
	Management	$1,000
	Total	$6,000 to $11,000

The following is not included in the budget above:

1) travel and living expenses associated with team meetings in Labrador City (~1,300 per trip);
2) McMaster University's costs for physical property analysis (~$5,000);
3) digitising of any historical maps beyond the Sander Geophysics survey maps (not yet determined);
4) cost for hard copy of remote sensing products (~$1,000 to $2,000); and
5) cost of the aeromagnetic survey (not yet determined).

Please contact us if your require any clarifications or additions to this proposal.

Respectfully Submitted,

PATERSON, GRANT & WATSON LIMITED

Stephen Reford, B.A.Sc., P.Eng.
Vice-President

EarthScan Ltd.

PRICE QUOTE

For Phase I
REMOTE SENSING DIGITAL DATA ACQUISITION AND DIGITAL IMAGE PROCESSING

CLIENT: Iron Ore Company of Canada Ltd.
DATE: September 27, 2000

DESCRIPTION:
This price quote pertains to costs of acquisition of digital remote sensing and digital elevation data, and processing of that data as per discussions on September 25, 2000 with IOC, WGM, and PGW regarding only 'Phase I' of the Wabush license / lease exploration and evaluation initiative. It is expected that completion of 'Phase I' will culminate with ground target definition. 'Phase II' may include acquisition of high spatial resolution remote sensing data such as 'IKONOS', however, a decision regarding this will be contingent on 'Phase I' results.
At the time of the September 25 meeting it was decided that digital remote sensing and digital elevation data would include:

- Landsat 7 Thematic Mapper (TM) and panchromatic digital data
- Radarsat 'Standard Mode' digital data
- Digital Elevation Data

In subsequent discussions with WGM, it was decided that Radarsat 'Fine Mode' digital data is preferred, given the increase in spatial resolution from 25 m to 8 m. This appraoch is recommended due to the importance of structural mapping of the target horizons.

DATA COSTS
(costs are not marked up from data distributor)

1) LANDSAT 7 TM (WITH PANCHROMATIC)

Cost:
Landsat 7, raw data = $CAN 900.00 / scene

Number of scenes required for region of interest = 1

2) RADARSAT

Cost:
Radarsat 'Fine Mode', raw data = $CAN 4,400.00 / scene

Number of scenes required for region of interest = 2 (50 km x 100 km)

3) DIGITAL ELEVATION DATA

Data is purchased from Natural Resources Canada (NRCAN). The existing digital elevation data at NRCAN is at 1:250,000 scale. NRCAN, however, provides digital contours, as vectors, for each 1:50,000 map sheet from which the user can build their own digital elevation model (DEM). Unfortunately, the planimetric accuracy of these data sets is currently only ± 100 metres. This will produce offsets along map boundaries. NRCAN is in the process of building accurate DEMs at 1:50,000 scale for the Wabush region but completion of this project is in excess of a year away.
The airborne magnetic survey project, however, will produce an accurate and seamless DEM. It is recommended that the high resolution DEM be acquired from this survey data.
Purchase of the 1:250,000 scale DEMs is recommended for 'Phase I' of this project. This will allow for at least a rudimentary 'shaded relief' data set which will provide a regional overview of the geologic structure in 3-D.

Cost
Digital elevation data 1:250,00 scale maps with hydrography overlay = $CAN 400.00 per map.

Number of map sheets required for region of interest = 2

Total cost of DEM data = $CAN 800.00

TOTAL DATA COSTS: ITEMS (1) + (2) + (3) = $CAN 10,500.00

IMAGE PROCESSING

1) Orthorectification of Landsat 7 data	$CAN 750.00
2) Orthorectification of Radarsat data	$CAN 2,000.00
3) Co-registration of Landsat 7 and Radarsat data	$CAN 300.00

TOTAL IMAGE PROCESSING COSTS:
ITEMS (1) + (2) + (3) = $CAN 3,050.00

DIGITAL IMAGE ANALYSIS AND INTERPRETATION

1) Spectral analysis of Landsat 7 digital data using computer image processing system.	$CAN 1,200.00
2) Enhancement of radar data (speckle removal, filtering, etc.).	$CAN 400.00
3) Production of 'shaded relief' digital image from digital elevation data (either NRCAN data or from airmag survey).	$CAN 500.00
4) Merging of DEM (either NRCAN data or from airmag survey) and airborne magnetic data.	$CAN 300.00
5) Merging of DEM (either NRCAN data or from airmag survey) and Landsat 7 data.	$CAN 300.00
6) Structural interpretation of 'shaded relief' image, 'shaded relief' with magnetics, and with Landsat 7 @ $CAN 0.05 per sq. km. ($CAN 600.00 minimum)	$CAN 600.00
7) Structural interpretation of Radarsat data	$CAN 1,400.00
TOTAL IMAGE ANALYSIS AND INTERPRETATION COSTS: ITEMS (1) – (7) =	**$CAN 4,700.00**

TOTAL QUOTE = **$CAN 18,250.00**

Note: hardcopy product charges are extra and dependent on final scale of products, number of products, and medium of products.

By:

Greg Lipton
EarthScan Ltd.

September 27, 2000

APPENDIX D

PGW AEROMAGNETIC SURVEY MEMO FOR IOC ASSESSMENT PROGRAM

Paterson, Grant & Watson Limited

Consulting Geophysicists

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85 Richmond Street West
Toronto, ON
M5H 2C9
Canada

Telephone: (416) 368-2888
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email:
stephen.reford@pgw.on.ca

MEMORANDUM

Date: October 3, 2000

To: Iron Ore Company of Canada

Attn: Robert Didur

Stephen Reford, B.A. Sc., P. Eng. Job No: 2000-65
OTH Geophysicist

1) Attached to this memorandum is a summary of the budgetary quotations provided by the seven contractors for nominal surveys totalling 10,000 line-km (200 m line spacing), 13,333 line-km (150 m line spacing) and 20,000 line-km (100 m line spacing). If the final bids hold true to form, then Terraquest looks to be the best choice due to its relatively low bid, and inclusion of a horizontal gradiometer system (i.e. three magnetometers mounted on the aircraft tail, and two wingtips). The gradiometer data should improve resolution of the target horizons, and is less affected by magnetic diurnal variation.

   The published geology (digital map of Labrador) and the GSC regional aeromagnetic data were studied to refine the aeromagnetic survey outline. The area has been divided in three blocks (see DXF and GeoTIFF files). The Main Block covers the area of interest (outer boundaries could be further adjusted). The Mine Block covers the mine area and the neighbouring area to the east. The Quebec block covers the extension of the iron formation into Quebec. The latter two blocks have been separated as they are considered lower priority than the main block.

   Main Block - 2150 km^2
   It covers the main area of interest, including the bits in Quebec where the border wiggles. The part at the northwest end includes the iron formation that extends north along the Trough. We have included some linears in the adjacent mapped granite, which could indicate southward

extensions of iron formation. In any case, they form part of the controlling structure.

Mine Block - 230 km^2
It covers the mine area plus the area to the east (Wabush Lake and possibly some iron formation on the east shore). If we exclude the actual mine area and just ask for the eastern part of this block, contractors would probably over fly the mine area anyway. Please check our interpretation of the mine area boundaries, in case this block is excluded.

Quebec Block - 424 km^2
It covers the southern extension of the iron formation into Quebec.

2) The budget for the survey is estimated below using the Terraquest prices, which are near the lowest, and include the horizontal gradiometer. The line-km totals assume a control line spacing of ten times the traverse line spacing.

Line Spacing	Main Block (2150 km^2)	Survey Cost	All 3 Blocks (2804 km^2)	Survey Cost
100 m	23,650 line-km	$252,325	30,844 line-km	$327,862
150 m	15,767 line-km	$169,554	20,563 line-km	$219,912
200 m	11,825 line-km	$128,163	15,422 line-km	$165,931

If the 100 m line spacing proves a little too rich, then the line-km and cost totals for a survey at 120 m line spacing are at the midpoint between 100 m and 150 m. One should also bear in mind that 65%-75% of the survey contract would be payable in 2000 (i.e. once data acquisition is complete), and the remainder in 2001 (i.e. once all final products are delivered).

3) A survey in excess of 20,000 line-km may be difficult to complete before Christmas, depending on the start date.

4) The total PGW costs (see our proposal for details), including the remote sensing and other fixed costs, are estimated as follows:

Line Spacing	Main Block (2150 km^2)	PGW Cost	All 3 Blocks (2804 km^2)	PGW Cost
100 m	23,650 line-km	$99,346	30,844 line-km	$107,861
150 m	15,767 line-km	$85,078	20,563 line-km	$93,468
200 m	11,825 line-km	$74,750	15,422 line-km	$83,957

5) The costs listed above do not include GST.

6) If the survey exceeds 30,844 line-km through further expansion of area, allocate $10.50/line km for the contractor costs and $2.30/line-km for PGW's costs.

7) We recommend that the following, very approximate costs be allocated for geophysical follow-up in 2001:

a) $40,000 for 500 line-km ($70,000 for 1,000 line-km) of helicopter-borne magnetic and electromagnetic surveys (±radiometrics) over the Luce Deposit and two to three additional targets;
b) $15,000 for follow-up gravity surveys over the Luce Deposit and two to three additional targets;
c) $12,000 for management, QA/QC and interpretation of the above surveys; and
d) $10,000 for purchase, processing and interpretation of IKONOS imagery covering 25-30 km^2.

Kindest Regards,
PATERSON, GRANT & WATSON LIMITED

Stephen W. Reford, B.A. Sc., P.Eng.
Vice-President

The following tables outline the budgetary quotations provided by the seven contractors for nominal surveys totalling 10,000 line-km (200 m line spacing), 13,333 line-km (150 m line spacing) and 20,000 line-km (100 m line spacing).

Notes:

1) We have assumed 10 days, 12 days and 15 days of stand-by respectively to compute the total survey price.
2) Aero Surveys does not charge for the first five days of stand-by.
3) Sander has raised its prices from the earlier quotation due to anticipated lower production later in the year.
4) Sial has varied its prices slightly from the earlier quotation earlier quotation.
5) The Fugro prices are quoted at ±10%, and are higher than the earlier quotation.
6) Fugro will not charge stand-by if production averages more than 500 line-km/day.
7) The price for the Fugro helicopter survey included in Table I is taken from its earlier quotation (we asked for fixed wing prices only for the budgetary quotation).

Table I. 10,000 line-km survey (200 m line spacing)

Contractor	**System**	**Mob/ Demob**	**Cost /km**	**Stand-by /day**	**Total**
Terraquest	Fixed Wing (Cessna 206) Horizontal Gradiometer	$ 4,000	$10.50	$0	$109,000
Aero Surveys	Fixed Wing (Cessna 206) Standard	$15,000	$9.95	$1,500	$122,000
Aero Surveys	Fixed Wing (Cessna 206) Horizontal Gradiometer	$15,000	$10.95	$1,500	$132,000
Aero Surveys	Fixed Wing (Piper Navajo) Standard	$22,000	$13.95	$2,000	$171,500
Aero Surveys	Fixed Wing (Piper Navajo) Vertical Gradiometer	$22,000	$14.95	$2,000	$181,500
Sander	Fixed Wing (Cessna 402) Standard	$10,000	$14.20	$0	$152,000
SIAL	Fixed Wing (Piper Navajo) Standard	$0	$10.00	$0	$100,000
Fugro	Fixed Wing (Cessna Caravan) Standard	$11,900	$12.90	$950	$150,400
Fugro	Helicopter Standard	$7,500	$32.50	$950	$342,000
Scintrex	Helicopter Horizontal/Vertical Gradiometer	$0	$25.00	$0	$250,000
Goldak	Fixed Wing (Piper Navajo) Horizontal/Vertical Gradiometer	$0	$13.75	$0	$137,500

Table II. 13,333 line-km survey (150 m line spacing)

Contractor	System	Mob/ Demob	Cost /km	Stand-by /day	Total
Terraquest	Fixed Wing (Cessna 206) Horizontal Gradiometer	$ 4,000	$10.50	$0	$144,000
Aero Surveys	Fixed Wing (Cessna 206) Standard	$15,000	$9.75	$1,500	$155,500
Aero Surveys	Fixed Wing (Cessna 206) Horizontal Gradiometer	$15,000	$10.75	$1,500	$168,830
Aero Surveys	Fixed Wing (Piper Navajo) Standard	$22,000	$13.50	$2,000	$216,000
Aero Surveys	Fixed Wing (Piper Navajo) Vertical Gradiometer	$22,000	$14.50	$2,000	$229,330
Sander	Fixed Wing (Cessna 402) Standard	$10,000	$13.60	$0	$191,330
SIAL	Fixed Wing (Piper Navajo) Standard	$0	$9.83	$0	$131,000
Fugro	Fixed Wing (Cessna Caravan) Standard	$11,900	$12.40	$950	$188,630
Fugro	Helicopter Standard				
Scintrex	Helicopter Horizontal/Vertical Gradiometer	$0	$24.38	$0	$325,000
Goldak	Fixed Wing (Piper Navajo) Horizontal/Vertical Gradiometer	$0	$12.75	$0	$170,000

Table III. 20,000 line-km survey (100 m line spacing)

Contractor	System	Mob/ Demob	Cost /km	Stand-by /day	Total
Terraquest	Fixed Wing (Cessna 206) Horizontal Gradiometer	$ 4,000	$10.50	$0	$214,000
Aero Surveys	Fixed Wing (Cessna 206) Standard	$15,000	$9.50	$1,500	$220,000
Aero Surveys	Fixed Wing (Cessna 206) Horizontal Gradiometer	$15,000	$10.50	$1,500	$240,000
Aero Surveys	Fixed Wing (Piper Navajo) Standard	$22,000	$12.95	$2,000	$301,000
Aero Surveys	Fixed Wing (Piper Navajo) Vertical Gradiometer	$22,000	$13.95	$2,000	$321,000
Sander	Fixed Wing (Cessna 402) Standard	$10,000	$12.50	$0	$260,000
SIAL	Fixed Wing (Piper Navajo) Standard	$0	$9.50	$0	$190,000
Fugro	Fixed Wing (Cessna Caravan) Standard	$11,900	$11.90	$950	$264,150
Fugro	Helicopter Standard				
Scintrex	Helicopter Horizontal/Vertical Gradiometer	$0	$23.00	$0	$460,000
Goldak	Fixed Wing (Piper Navajo) Horizontal/Vertical Gradiometer	$0	$11.90	$0	$238,000

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3 of 5

SRK Consulting
Integrated Science and Engineering Consultancy

Iron Ore Company of Canada

IOC

Preliminary Structural Synthesis of the Wabush Lake Area, Labrador

January 2000

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IRON ORE COMPANY OF CANADA

Preliminary Structural Synthesis of the Wabush Lake Area, Labrador,

SRK PROJECT CODE: 2CI002.00

January 2000

Compiled by:

Christopher Lee, MSc
Project Consultant

Executive Summary

- The distribution of iron ore bodies in the Wabush Lake area of western Labrador is controlled by a combination of geological, structural and metamorphic variables.
- The distribution of geological assemblages around the current mine workings, and northward into the large exploration area, indicate different geological settings that will have an impact on the way new ore bodies will be found and subsequently mined. The key differences between the two areas are the depths of exposure and deformation intensity.
- Structural analysis of the current ore bodies reveals a dependence ore development on a previously unrecognized, early generation of folds, that predate the main structural features of the area. Recognition of this structural history will greatly enhance the efforts of the current exploration program.
- The region around the current mine workings is characterized by a staurolite-bearing metamorphic assemblage. This association, is not well-understood, but may be an important field indicator for the definition of buried ore bodies.
- Fold interference patterns, even between only two fold phases, can be extremely complex, therefore, a brief guide to the identification of fold geometries is provided to assist in their definition in map scale and in the field.

Table of Contents

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List of Figures

List of Tables

800-580 Hornby Street, Vancouver, BC, V6C 3B6, Canada, ph: (604) 681-4196, fax: (604) 687-5532

1 Introduction and Scope

IOC has recently initiated an exploration program to evaluate its holdings in western Labrador, and define new ore bodies to add to its current reserves near Wabush Lake. As part of this initiative, SRK was asked to provide a preliminary structural synthesis of the region to help guide the exploration efforts.

Iron ore bodies around Wabush Lake are found within a distinct member in the Sokoman Fm, of the Paleoproterozoic Knob Lake Group. The ore is found in the synclinal keels of large-scale folds and have been affected by amphibolite facies metamorphism; both associated with the Grenville Orogeny. Deformation and metamorphism, are therefore considered to have had an important impact on the distribution and quality of the ore.

This report, solicited by Marcus Flis, on behalf of IOC, describes the structural geological setting of the area, at both regional and local scales. It draws upon published literature, and internal reports and maps, provided by IOC.

2 Program Objectives and Work Program

2.1 Program objectives

The primary objective of this study is to provide a preliminary structural geology framework for the Wabush-Shabogamo Lake area to support IOC's current exploration program.

To achieve this goal, the program followed three subtasks:

- Acquire an understanding of the tectonic setting of the iron rich beds, their deformation history, and metamorphism of the Wabush Lake area, at a regional scale.
- Determine the structural setting of current and historically produced iron ore bodies, at a local scale, in order to help constrain targets within the exploration property.
- Develop criteria to help in the recognition of favourable geological and structural settings for targeting.

2.2 Work program

Following a one day review of relevant published literature, a total of 11 days were spent on site, alongside the project team led by Marcus Flis. This time was used to collect and review all data (primarily, maps and reports), pertaining to the structural geology of the area, and to formulate a structural framework to support the new exploration program. A subsequent 5 days were spent finalizing maps, sections and this report, in Vancouver.

3 Structural Geology Synthesis

3.1 Regional Tectonic Setting

The area of interest in IOC's current exploration program is largely centered on rocks of the Knob Lake Group, in the Proterozoic Grenville Province of western Labrador. The **Knob Lake Group** is a continental margin, metasedimentary sequence, consisting of pelitic schists, dolomitic marbles, mafic volcanics, quartzites and iron formations, that has been deformed and metamorphosed within a northwesterly-directed, foreland fold and thrust belt, during the **Grenville Orogeny**.

In western Labrador, the foreland fold and thrust belt of the Grenville Orogen is comprised of three, structurally bound, lithotectonic terranes, including the **Gagnon Terrane**, at the base, the overlying **Molson Lake Terrane**, and the uppermost **Lac Joseph Terrane**. The Gagnon Terrane is a composite terrane consisting of the Knob Lake Group and its re-worked, Archean basement, the **Ashuanipi Metamorphic Complex** of the Superior Province, and is structurally juxtaposed with the relatively undeformed *(i.e. Grenvillian deformation)*, foreland rocks of the Superior province, along the **Grenville Front**. The Molson Lake and Lac Joseph terranes are dominated by intrusive rocks and paragneisses, respectively, and have limited significance to the Knob Lake iron formations, other than their contribution to burial and metamorphism, and will not be considered further.

The Knob Lake Group is best preserved southeast of the Grenville Front, in the region immediately west of the Wabush and Shabogamo lakes. Current mining operations are focused on the iron formations west of Wabush Lake, and the area of interest for exploration extends southeast, to the Quebec border, and northeast, as far as the extensively drift-covered areas, north of Shabogamo Lake.

3.1.1 Geology

The Knob Lake Group predominantly consists of an eastward thickening wedge of sediments that accumulated unconformably on the passive continental margin of the Superior Craton, during Paleoproterozoic time. It has been divided into six formations (Table 1), which occur in varying proportions along the northeast trending belt (Figure 1), and are briefly described, below, from oldest to youngest.

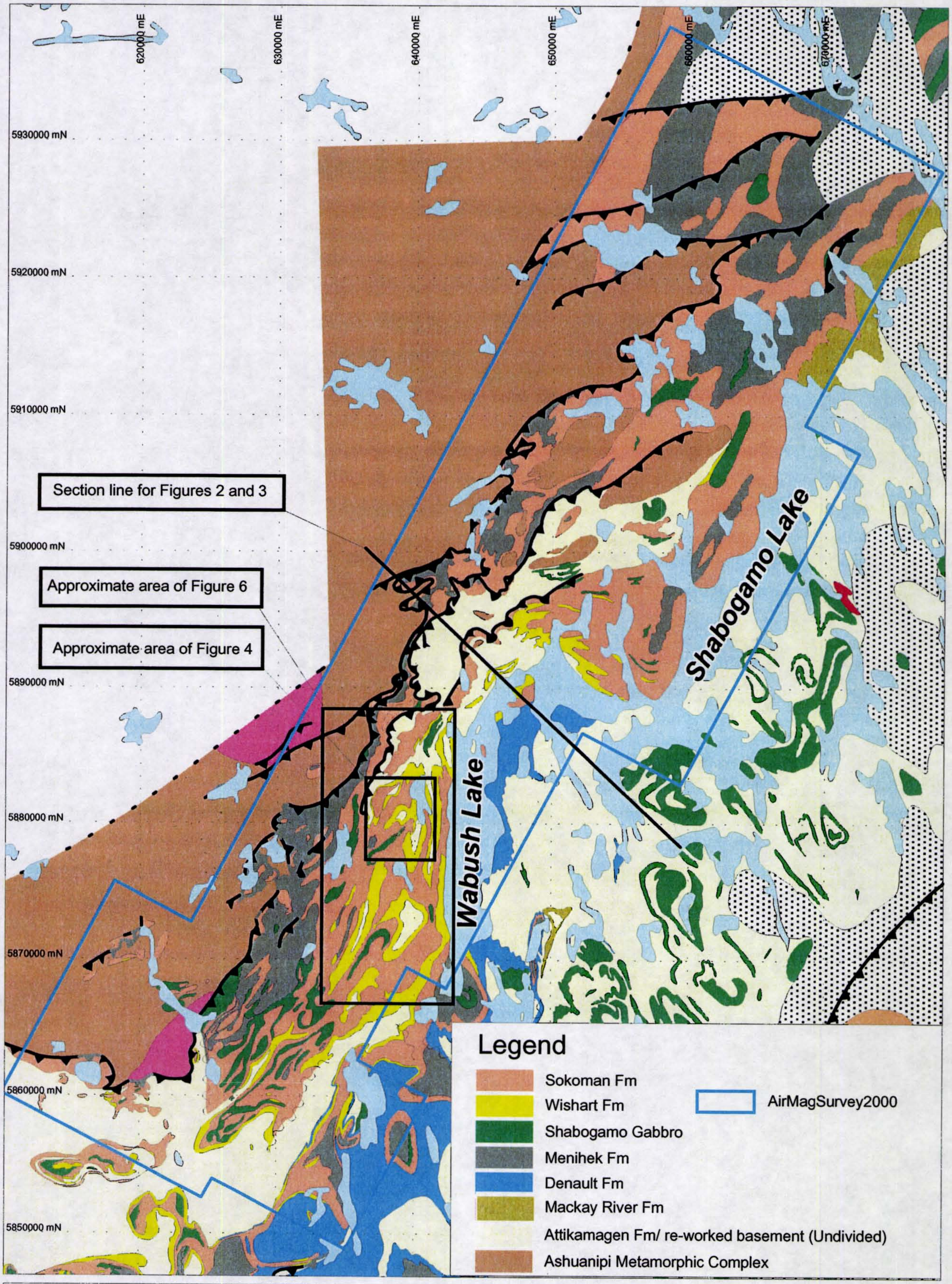


Figure 1 - Regional geology map of the Knob Lake Gp and surrounding area. Legend includes only those lithologies referred to in the text, and are listed in no particular order (for true stratigraphic order, see Table 1)

The lowermost **Attikamagen Formation** schists and gneisses have significantly different distributions on different maps, and have been misinterpreted as Ashuanipi Metamorphic Complex rocks, on pre-1983 maps, due to their migmatitic nature in higher metamorphic grade occurrences to the southeast. According to Rivers (1983a), they appear to be best preserved in the deeper portions of the continental shelf, east of Wabush and Shabogamo lakes, where the formation thickness is greatest. Towards the foreland, in the northwest, the formation tapers out and disappears, leaving upper units of the Knob Lake stratigraphy in contact with the Archean basement.

Table 1
Lithological Units of the Knob Lake Group

Formation Name	Lithological Description
Menihek Fm	• Graphitic schist or gneiss
Sokoman Fm	*Upper Member* – banded silicate-carbonate-facies iron formation
	Middle Member (ore) – banded cherty oxide-facies iron formation
	Lower Member – banded silicate-carbonate-facies iron formation • May contain ore (oxide-facies iron formation) locally
Wishart Fm	• Predominantly quartzite, with subordinate pelitic schist • Well-exposed only in southern half of exploration area
Mackay River Fm	• Mafic volcanics • Rare to absent west of Wabush and Shabogamo Lakes
Denault Fm	• Dolomitic marble • Well-developed east and south of Wabush Lake, only
Attikamagen Fm	• Biotite schist, gneiss, or pelitic schist

Denault Formation carbonates have only been identified in the southern half of the exploration property. They mark the southeastern boundary of the upper parts of the Knob Lake stratigraphy, in this area, and are thought to occur at the transition between shallow parts of the continental shelf, to the northwest, and relatively deeper parts, to the southeast.

The **Mackay River Formation** consists of a few very rare occurrences of mafic volcanics in the area, the largest of which extends northeast of Shabogamo Lake.

The **Wishart Formation** is best preserved immediately west of Wabush Lake and is rare to absent in northern exposures. The erosion-resistant quartzite beds form prominent ridges in the area, and thus serve as excellent marker horizons to outline fold structures, faults, and the locations of the adjacent Sokoman Fm.

Iron-rich rocks of the **Sokoman Formation** are the most abundant rock type in the exploration area, and increase in abundance to the northeast. The formation occurs directly above the Wishart Fm, where it is present, but also locally shares its basal contact with the Denault, Mackay Lake, Attikamagen formations, and the Ashuanipi Metamorphic Complex. The Sokoman comprises upper and lower members dominated by carbonate and silicate facies iron formation, and a middle member of oxide facies iron formation, forming the principal ore unit. The Lower Member may also contain ore locally.

The sequence is capped by the **Menihek Formation.** This unit is well-preserved adjacent to the craton in the southern region, and within broad synclinal regions in the north.

All units have been intruded by **Shabogamo Gabbro** 'sill-like bodies'. The sills appear to be roughly parallel to stratigraphy, and thus, locally, act as good marker horizons for outlining structure. They are most abundant southeast of the exploration area, in the Molson Lake Terrane, and in southwestern exposures of the Knob Lake group. The distribution of these intrusions likely reflects the structural architecture of the basement rocks, in terms of fault pathways for magma migration, which could potentially help with reconstructing gross basin geometries.

The distribution and thicknesses of the various units in the Knob Lake Group allows reconstruction of the broad basin architecture at the time of deposition (Figure 2). This architecture, particularly the configuration of basement blocks, may be expected to have had a profound influence on the style of subsequent deformation during the Grenvillian Orogeny.

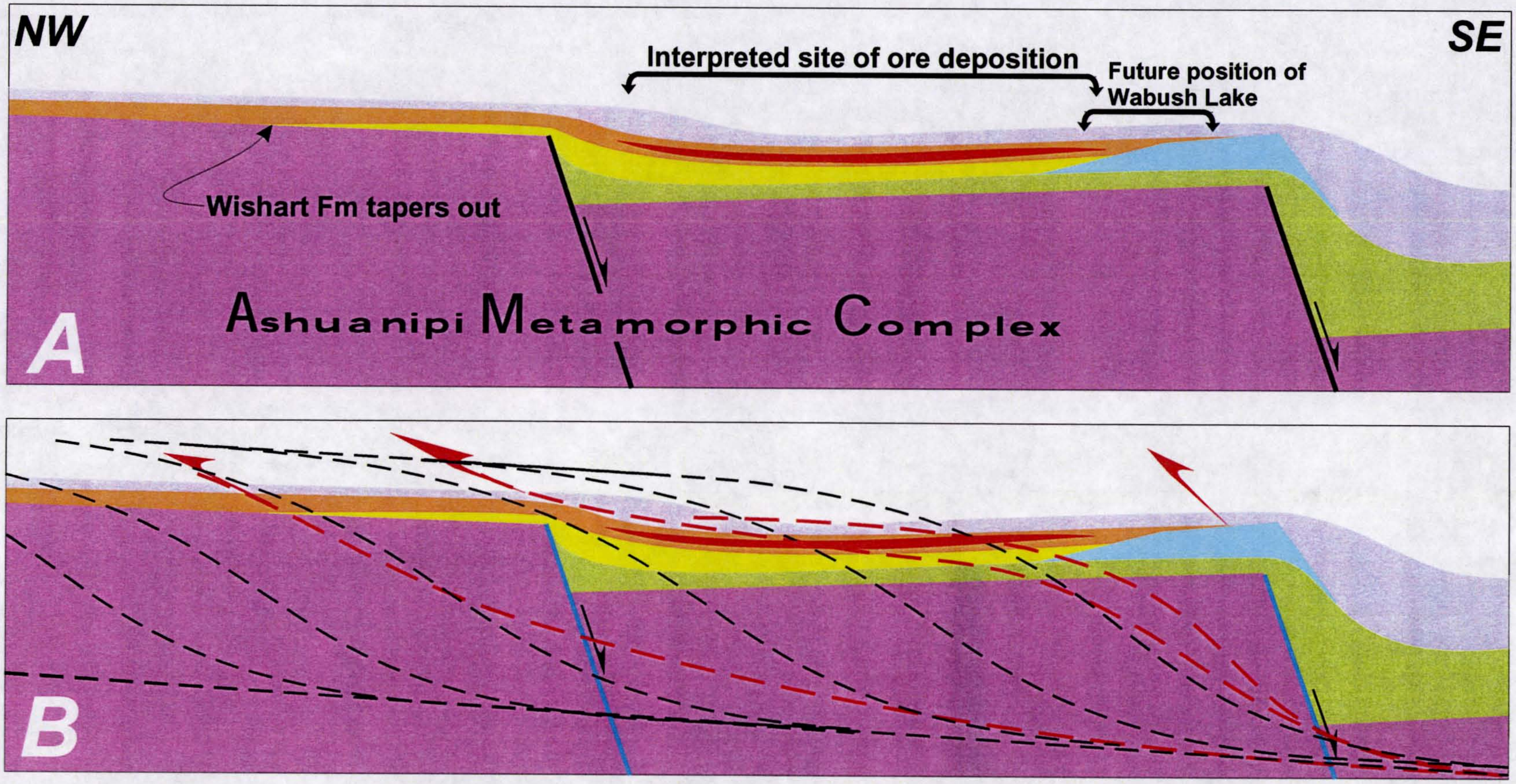
The main ore units appear to be confined to the shallower part of the basin, on the craton side of the carbonate reefs, but at depths where the Attikamagen and Wishart formations are still present. Closer to the craton, the sequence tapers out, such that these two lower units are no longer present, and to date, no ore has been found in these areas. The presence or absence of the Attikamagen and Wishart formations may have some implications on the precipitation of iron ore beds, as discussed below (*Section 3.1.4.1*).

3.1.2 Structural Geology

The three episodes of deformation associated with the Grenville Orogeny, in this area, were developed during a protracted history of NW-directed thrusting.

The Grenville Orogeny produced three generations of structures (D_1-D_3) that are variably developed throughout the belt (Rivers, 1983a; Connelly *et al.*, 1996). The structures consist of deformation fabrics, thrust faults and folds, all of which are considered to have developed as result of NW-directed thrusting in the Grenvillian foreland fold and thrust belt.

D_1 structures consist of a regionally-developed, southeast-dipping foliation (S_1), with a down-dip stretching lineation (L_1), associated with folds, thrusts and shear zones. F_1 folds were rarely observed by previous workers, and where they have been recognized, consist of very small scale, isoclinal, intrafolial folds,



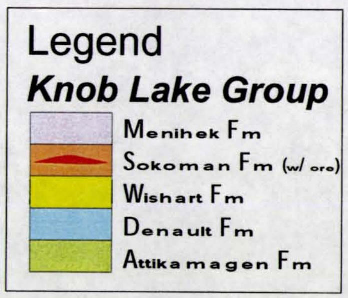


Figure 2 - Pre-Grenvillian basin architecture. A - *Regional cross-section through the Gagnon Terrane (Knob Lake Group and Archean basement), prior to Grenville Orogeny, at the northern tip of Wabush Lake (see Figure 1 for section location). Interpreted from van Gool's map of the area, and the interpreted section of figure 3.* ***B -*** *Future sites of Grenvillian-aged thrust faulting. Red faults are early faults that repeat stratigraphy prior to subsequent faulting (interpreted from Figure 3, see text). Black line duplex faults are drawn schematically to illustrate general form of later structures. Early extensional faults (blue) are likely to have been reactivated during the Grenvillian Orogeny.*

Previously unrecognized, large-scale F_1 folds, in the existing IOC mine workings, appear to have a significant control on ore distribution.

with an axial planar S_1 fabric (e.g. figure 46.4, van Gool *et al.*, 1987). Mesoscale, and larger, F_1 folds were not observed, and due to the apparent lack of major repetition of units in the Knob Lake group, F_1 folding has previously been considered to be relatively insignificant by these workers. Structural observations made during this review have identified large scale F_1 folds, in the area around the current IOC ore bodies, that appear to be very significant in terms of producing economic ore bodies (*see section 3.2.1*).

D_1 thrusts and shear zones occur within the Archean basement and overlying supracrustal rocks, as well as, along their contact. These structures are interpreted to have been initially, gently southeast-dipping, but have been subsequently reactivated and/or folded during D_2. The high strain and relatively complex thrust system(s) associated with D_2, have made recognition of D_1 thrusts fairly difficult, and little to no information about the distribution of these structures can be found on existing maps.

D_2 structures consist of a system of northwest-verging thrusts and folds that are primarily responsible for the dominant northeast trending structural grain of the exploration area. D_2 deformation post-dates attainment of the thermal metamorphic peak in the area, and thus temperatures were insufficient for the formation of a regionally penetrative D_2 fabric. Locally, in zones of relatively high strain, such as fold hinges, an axial planar crenulation cleavage (S_2) is developed, but the dominant fabric, throughout the area is S_1, which has been folded and transposed during D_2.

D_2 structures are described as having formed in a composite thrust system that included both basement-controlled and cover-controlled systems (van Gool *et al.*, 1993). The cover-controlled system, mostly confined to the supracrustal rocks, consists of moderately, southeast-dipping, duplexed, thrust structures, separating tightly folded rocks of the cover sequence. This system was overprinted, late during the D_2 event, by relatively steep, southeast-dipping thrusts that originate in the deeper basement rocks. This latter system of thrusts is associated with very limited ductile deformation within the intervening blocks, and is expressed mainly as narrow zones of high strain that transect and offset pre-existing folds and thrusts. The sole thrust of the basement-dominated system is defined locally as the Grenville Front.

The vergence of the supracrustal D_2 structures varies locally as a function of basement topography, as depicted in figure 2. During northwest-directed thrusting, the continental rise, seaward from the Denault Fm carbonate reef, acted as a rigid barrier, impeding the northwesterly flow of rock. As a result, continued shortening could only be achieved through back folding (i.e. local SE-verging folds), as exemplified by fold structures in the Mount Wright area, immediately south of the Aeromag 2000 survey boundary (see figures 3 and 4; Rivers and Chown, 1986). Back-folding is not considered to be a major control in the exploration area, but local examples may be developed in places.

D_3 structures consist of very open to very tight, upright folds (F_3) with northwest-trending axial planes. The intensity of F_3 folding is highest, southeast of the exploration area, where it defines the dominant structural trend of the region. In the exploration area, F_3 folds are, for the most part, very poorly developed, and expressed simply as gently undulating structures that have little to no effect on the overall map pattern or ore distribution, except in one area - at the north end of Wabush Lake. Here, the entire Knob Lake Group is wrapped around an F_3 axial plane (approximately parallel to the section line drawn for figures 2 and 3, in figure 1).

The dramatic changes in the intensity of D_3 deformation is doubtless a function of the basement topography and architecture. Rivers (1983a) suggests that the northeast-southwest compression, responsible for the F_3 folds, may reflect squeezing of the thrust slices into a more narrow portion of the foreland zone. In the area north of Wabush Lake, the large scale F_3 fold may have developed as a result of lateral ramping onto a higher basement shelf, underlying the region west of Shabogamo Lake. This inferred basement ridge may also be responsible for development of the Julienne Lake Fault.

3.1.3 Metamorphism

The regional metamorphic gradient in this part of the Grenville orogen increases from greenschist facies in the west, adjacent to the Grenville Front Tectonic Zone, to upper amphibolite facies towards the interior of the orogen, in the Molson Lake terrane. Metamorphism in the exploration area is described by Rivers (1983b) in terms of a single prograde event, locally followed by minor retrogression. Peak metamorphic minerals define S_1, or have S_1 slightly wrapped around them, indicating that peak metamorphism was attained late during D_1 deformation. Metamorphic assemblages in the Gagnon Terrane suggest depths of burial between 8 km near the foreland, and 27 km adjacent to the Molson Lake Terrane, which implies that: (1) D_1 involved a significant amount of tectonic thickening (increasing away from the foreland), and, (2) cooling, and thus, exhumation, was very rapid and likely occurred prior to, and during, D_2 deformation.

Isograds have been mapped by Rivers (1983b) on the basis of the distribution of diagnostic metamorphic assemblages, found in pelitic and quartzofeldspathic rocks of the Knob Lake Group, including pelitic lenses in the Wishart and Sokoman formations. Five metamorphic zones, of increasing metamorphic grade, have been mapped in the exploration area (see figure 2; Rivers, 1983b):

Zone 1: muscovite-chlorite
Zone 2: muscovite-chlorite-biotite
Zone 3: muscovite-chlorite-garnet-biotite
Zone 4: muscovite-kyanite-staurolite
Zone 5: muscovite-biotite-kyanite-garnet

However, since these zones formed prior to D_2 folding and thrusting, much disruption and telescoping of the mapped boundaries is expected.

Zone 1 occurs in the northern portion of the area. The appearance of biotite marks the boundary with Zone 2, which is largely restricted to a narrow

Staurolite defines a distinct metamorphic zone in the vicinity of known iron ore

corridor adjacent to the exposed Archean craton. Biotite-bearing and biotite-free assemblages occur in a zone 3 km wide in the vicinity of this boundary, possibly implying some degree of structural reworking. Zone 3 is poorly defined, based on the presence of garnet in localities. Zone 5 covers most of the exposed Sokoman Fm, in the exploration area, except for a narrow swath of Zone 4, which straddles all of the known iron ore bodies west of Wabush Lake. The appearance of staurolite marks the transition between greenschist and amphibolite facies metamorphism.

3.1.4 Implications of regional setting

3.1.4.1 Geological Implications

Prominent geological elements in the Wabush Lake area, spatially associated with the known ore bodies, at a regional scale, include: the Wishart Fm quartzite, the Denault Fm carbonates and the Shabogamo gabbro dykes/sills. The presence of the very mature quartzite and carbonates may be an indicator for a favourable depositional environment for iron-rich sediments. In other words, paleodepths and the type of organic activity may have been a controlling factor on the initial accumulation of iron. Further, contact metamorphism associated with intrusion of the Shabogamo gabbros (in addition to regional metamorphism) may have contributed to the recrystallization and coarsening of magnetite grains in the iron-enriched sediments, facilitating their economic extraction. As there is currently very little understanding of the genesis of these ores, these statements are fairly speculative. However, if there is an element of truth to any of these statements, they raise some concern about the prospectivity of the northern regions, where the geological assemblage is slightly different.

Contrasting geological assemblages between southern and northern regions may indicate shallower depths of erosion north of Wabush Lake.

The Wishart Fm, Denault Fm and Shabogamo gabbros are conspicuously less well developed, to absent, north of Wabush Lake. This may be indicative of a couple different scenarios, each with potential implications on the prospectivity of the northern regions. First, it may indicate that the platformal environment of these northern regions was not conducive to the formation of a carbonate reef and/or deposition of highly mature sandstones. Alternatively, it may mean that the depths exposed by the current erosion surface are less than those exposed immediately east of Wabush Lake.

The first scenario is supported by the fact that mafic volcanics of the Mackay River Fm, which are thought to occur below the Wishart Fm and above the Denault Fm (Connelly, *et al.*, 1996), are found in direct contact with the Sokoman and Attikamagen formations. This relationship suggests that the Wishart and Denault formations are absent in these areas. If the absence of these units is an indicator of a different depositional environment (as opposed to structural complications), and the precipitation of iron-rich sediments is favoured in an environment where they are present, then this area may be reduced in importance in terms of its prospectivity.

Preservation of iron ore at deeper levels, north of Wabush Lake, will include both anticlinal and synclinal ore bodies.

The alternative explanation, that the apparent lack of Wishart Fm quartzites, in particular, is due to the depths of exposure, is supported by the relative abundance, in the northern regions, of preserved Menihek Fm, which occurs much higher up in the stratigraphy. This scenario implies that the iron-rich portions of the Sokoman Fm, and their subjacent Wishart Fm, simply occur at a deeper level than they do west of Wabush Lake. This has two important implications for the prospectivity of this area. First, deeper deposits are more difficult to find, and more costly to mine. But, second, none of the ore will have been lost to erosion. West of Wabush Lake, all the existing ore bodies are preserved in synclinal structures with the intervening anticlines eroded away, whereas, to the north, both the anticlinal and synclinal portions of the ore-bearing structures will have been preserved.

3.1.4.2 Structural Geology Implications

Figure 3 is a cross-section through the area at the northern tip of Wabush Lake, and is based on structures drawn on van Gool's (1992) thesis map. The section presents an interpretation of the effects of D_2 deformation that accounts for a number of relationships seen on the map. Two of the most important features, in terms of delineating the structure in the area, are: (1) younger rocks in thrust contact with older rocks, and, (2) multiple ages of D_2 thrusts.

In a number of places on van Gool's (1993) map, the Sokoman Fm lies on top of, and in thrust contact with, either the Attikamagen Fm or Ashuanipi basement rocks (could not be distinguished on his map, and the same rocks are interpreted differently in other maps), both of which are older than the Sokoman Fm. This relationship of younger rocks in thrust contact with older rocks can mean one of three things. First, it could mean that the thrust is a reactivated normal fault, in which the vertical displacement during normal faulting exceeded that of the subsequent thrust reactivation. Second, it could mean that the thrust developed on the steepened limb of a pre-existing anticline. Third, it could mean that the stratigraphic succession had been structurally repeated by earlier thrusting (or recumbent folding), such that the younger rocks were in a structurally lower position than the older rocks, prior to thrusting.

Considering the overall evolution of the Grenville Orogeny, and the general structure of the belt, the first two options, above, do not appear reasonable, whereas, the third option involves the incorporation of a significant amount of basement rocks into the thrust system early in its history, which apparently contradicts van Gool *et al.*'s (1993) model. van Gool *et al.* describe D_2 deformation in terms of two northwest-directed thrust systems, one characterized by moderately dipping thrusts, broadly confined to the

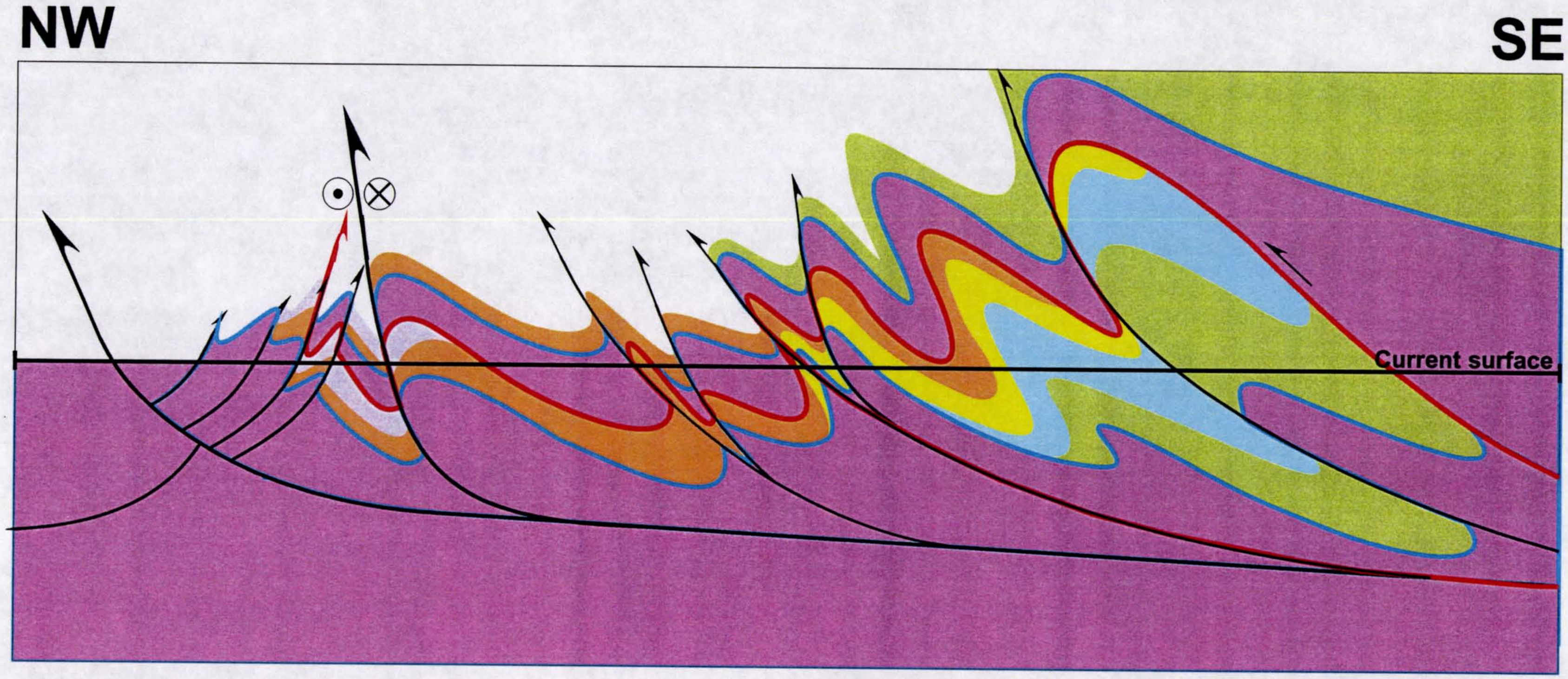


Figure 3 - Regional cross-section (interpreted from van Gool, 1992) through exploration area, north of Wabush Lake. *Lithology legend as in Figure 2.* ***Red*** *lines are early faults,* ***Blue*** *lines are unconformable contacts between basement and cover rocks,* ***Black*** *lines are the youngest faults. Strike-slip fault with movement into (⊗) and out of (⊙) the page. Note interpreted emplacement of basement nappe, to account for relationships depicted in van Gool's map, requires excessive amount of NW-directed transport. This model is more compatible with early thrusting (D_1) into or out of the page. F_1 folds in the vicinity of the existing mine workings support this interpretation.*

supracrustal rock package, and a second characterized by more steeply dipping, basement-controlled thrusts. In this model, basement involvement in the supracrustal system is limited to irregularities in the basement-cover contact, and was believed to be relatively insignificant.

The interpretation shown in Figure 3 incorporates a thin wedge (or wedges) of basement into an early, shallow-dipping thrust system, which serves to repeat the stratigraphy, such that Sokoman Fm rocks appear at surface, as well as, in the subsurface beneath an overthrust sliver of basement rock. The resulting section involves some very complicated interaction between folding and thrusting of the early thrust system, and seems unreasonable if it is assumed that all transport was from the southeast to the northwest. If the only transport direction was northwest-directed, then the overthrust basement block would have to have been transported fairly large distances to be emplaced in its current configuration. However, the fact that the mapped geology requires thrust slices that incorporate the Sokoman-Ashuanipi unconformity to be emplaced on top of rocks with the same unconformity (northwest of central portion of section; Figure 3), argues against such large transport distances. Comparison of this section with figure 2, shows that this unconformity only occurs in a limited area, near the foreland, where the lower parts of the succession are absent.

The complexity of the D_2 system is a result of it being superimposed on an earlier thrust and fold belt system (D_1), and the local involvement of rheologically distinct basement rocks.

A more reasonable interpretation for this section is that D_1 deformation involved some degree of movement in a northeasterly or southwesterly direction. If true, then the basement sliver depicted in the section would need not have traveled very far; it could simply be a small southeasterly-directed D_1 thrust or F_1 fold nappe. This is the preferred explanation for the structural relationships observed here, and a greater significance of D_1 structures than is accounted for in the published literature, is also apparent in the more detailed structure of the iron ore bodies, as discussed below (Section 3.2).

The overall structure, north of Wabush Lake, appears to be much simpler than that to the south. In the Julienne Lake area, this may be due to the lack of marker units such as the Wishart Fm or the gabbro sills, but farther north, contacts between the Sokoman and Menihek formations define a relatively simple structure consisting of broad synclines. This transition appears to coincide with the basement-controlled lateral ramp proposed above, and the geological contrasts described in the previous section. If this region has indeed been protected by a basement buttress, this would support the notion that deeper units such as the Wishart Fm and the iron rich middle member of the Sokoman Fm are still buried at depth, having escaped uplift by the intense folding and thrusting that characterize the southern areas.

West of Wabush Lake, the economics of the ore units are enhanced by the fact that they have been tightly-folded by F_1 and F_2 structures. The apparently simple structure of the northern areas may therefore have a significant impact on the economic viability of potential ore bodies found there, unless other factors such as thickness of the iron oxide members in the Sokoman Fm are greater here.

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3.1.4.3 Metamorphic Implications

The two most important features of the metamorphism in terms of exploration are that: (1) staurolite appears to be spatially associated with economic concentrations of iron ore, and, (2) peak metamorphism occurred during D_1.

The reason for the coincidence of Zone 4 staurolite and the occurrence of iron ore, is unknown, but may be very significant in terms of exploration. Staurolite, an iron-rich mineral, may have grown simply as a result of the high iron content of its host protolith, or it may define a zone of distinct metamorphic conditions, which may, or may not, have provided favourable conditions for the economic development of iron ore. In either case, identification of staurolite-bearing assemblages should be a top priority in the field mapping component of the exploration program.

Mapping the distribution of staurolite-bearing assemblages should be a top priority.

Since peak metamorphism was reached at a late stage during D_1, the isograds defining the various metamorphic zones, may be expected to be discordant with D_1 structures, but should have had a fairly uniform distribution prior to D_2. The apparent absence of Zone 4, to the north of Wabush Lake, may be an artifact of the quality of exposure in this area, or it may reflect the general difference in the overall structure between north and south, as discussed in previous sections. The fact that intense deformation of the area west of Wabush Lake, which to a large extent is D_2 deformation, is less well-developed in the north, suggests that similar units, and metamorphic zones may not have been exhumed, and may still be preserved at depth. Detailed definition of the isograds may therefore provide additional insight into the distribution of D_2 structures, and thus the potential for discovery of ore-bearing units.

3.2 Local Structural Geology

The local structure around the current and historic mining areas is dominated by folds (Figure 4). Very few thrusts, and faults in general, have been observed in any of the pits or in drill core (B.K., *pers. comm.*). Current sections, built from drill hole data, are based on the interpretation of Muwais (1974) that F_2 folds are the dominant, if not the only significant, fold phase affecting the host rocks. This interpretation contradicts earlier suggestions of Hamilton (1972) that the ore horizons have been isoclinally folded, and thus doubled in thickness.

Hamilton's interpretation of the Lorraine orebody (Figure 5), is built on an extrapolation of field observations of isoclinal, intrafolial, F_1 folds (e.g. Figure 46.4; van Gool *et al.*, 1987, p. 439), to the scale of the ore body. In this interpretation, the presence of two ore members is a result of large-scale isoclinal F_1 folding. However, this interpretation was based on a relatively simple stratigraphy for the Sokoman Fm, which only had two members (upper and lower 'Wabush Fm'), and one ore-bearing horizon.

Later work by Muwais (1974) redefined the detailed stratigraphy of the Sokoman Fm (Wabush Fm) to include the three currently accepted members,

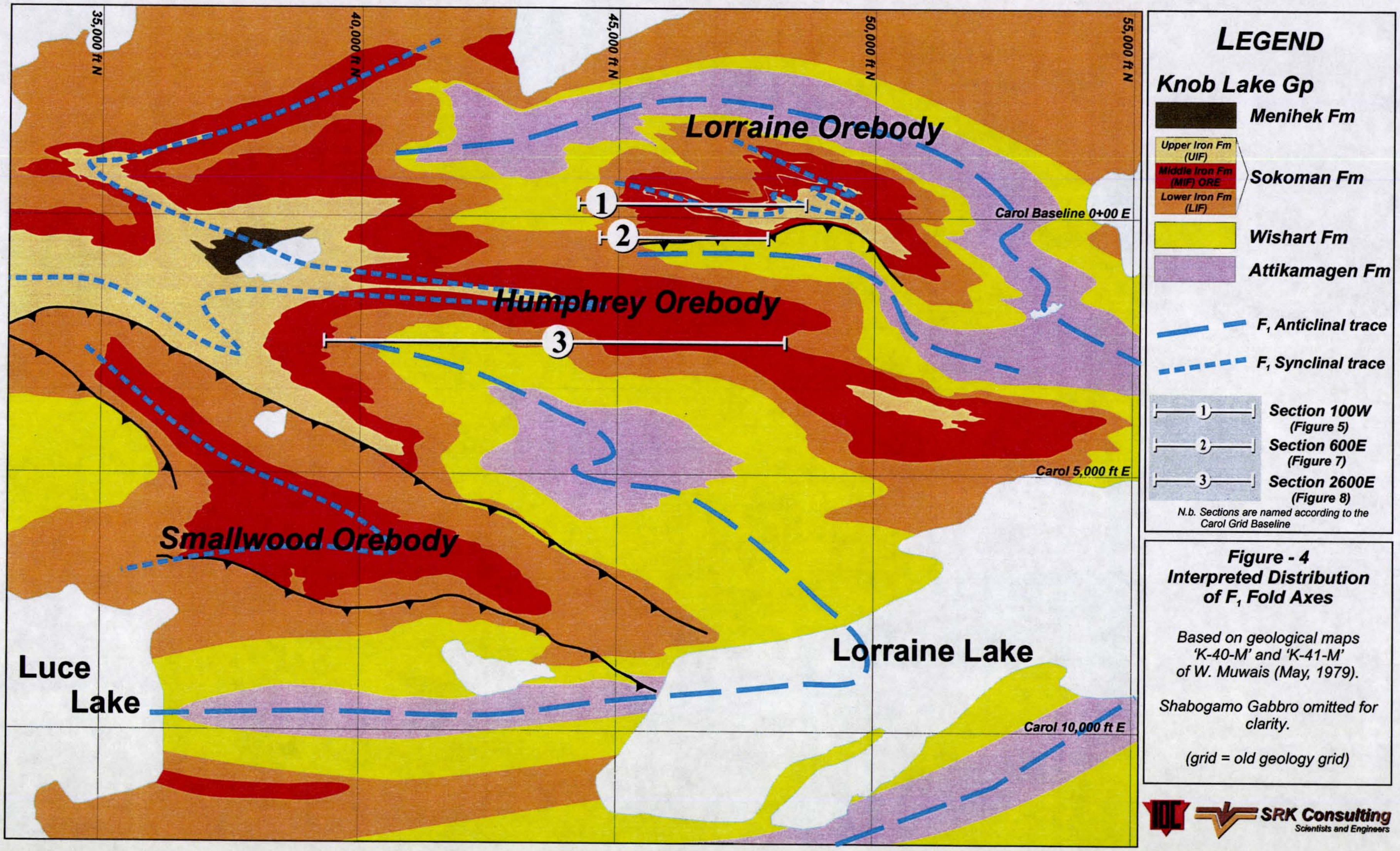


Figure - 4
Interpreted Distribution of F_1 Fold Axes

Based on geological maps 'K-40-M' and 'K-41-M' of W. Muwais (May, 1979).

Shabogamo Gabbro omitted for clarity.

(grid = old geology grid)

SRK Consulting
Scientists and Engineers

Lorraine Orebody

NE-SW Longitudinal Section at ~100 ft west of Carol Main (Baseline)

(looking towards ~290')

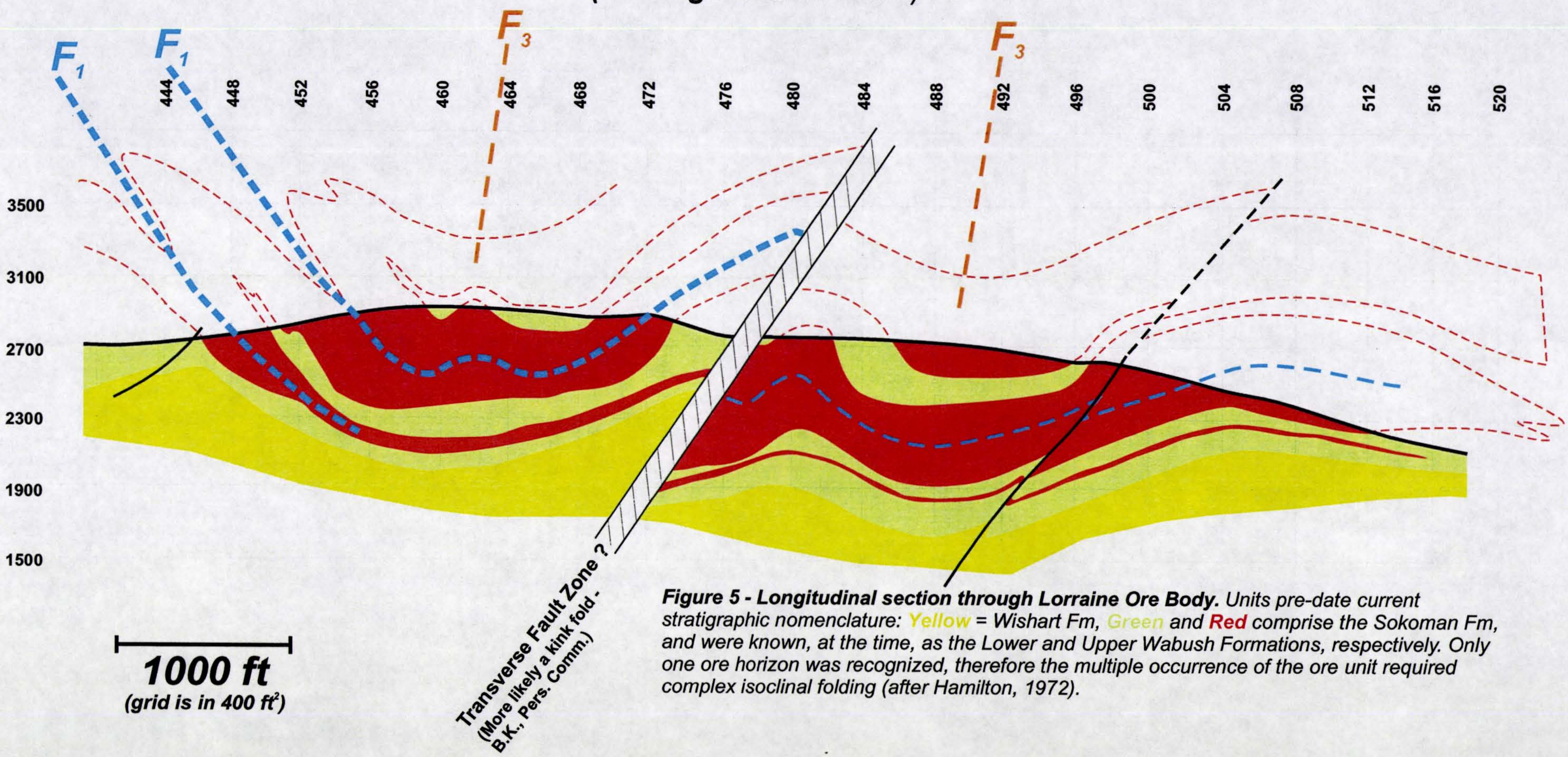


Figure 5 - Longitudinal section through Lorraine Ore Body. *Units pre-date current stratigraphic nomenclature: Yellow = Wishart Fm, Green and Red comprise the Sokoman Fm, and were known, at the time, as the Lower and Upper Wabush Formations, respectively. Only one ore horizon was recognized, therefore the multiple occurrence of the ore unit required complex isoclinal folding (after Hamilton, 1972).*

and argued strongly against an early isoclinal fold phase, on the basis of this new stratigraphy. Subsequent mining of the ore bodies interpreted by Muwais have borne out the veracity of his proposed stratigraphic column (B.K., *pers. comm.*), and the observations of Hamilton have largely been ignored.

However, recent interpretation efforts on the less tightly-folded Luce ore body have encountered apparent inconsistencies with Muwais' model (B.K., *pers. comm.*), that can be resolved by incorporating an earlier fold phase that predates the F_2 tightening. Observations made on maps at scales of 1:5,000 to 1:50,000, during this review, support the conclusion that F_1 folding played an important role in the distribution and structure of the existing ore bodies.

3.2.1 Structural Controls on Existing Ore Bodies

Structures, in general, tend to have a fractal distribution in nature. In fact, the basic premise of structural geology is that structures observed at small scales generally reflect the larger scale structure of a region. For this reason, the small scale F_1 folds observed by Hamilton (1972) and van Gool *et al.* (1987) are likely to have some expression at a larger scale. Rheological contrasts, between the relatively stiff quartzites of the Wishart Fm and the relatively soft pelites and carbonates of the Sokoman Fm, would create differences between the small scale and larger scale structures, but some correlation should still exist.

Using the Wishart Fm as a marker unit, a large scale, type II fold interference pattern has been identified in the region west of Wabush Lake (Figure 6). This structure is result of the superposition of F_2 folding on a pre-existing F_1 fold. Type II interference occurs when the axial plane of the pre-existing fold is orthogonal, or at a high angle, to the later fold phase. In this case, the F_2 axial plane is NNE-trending and moderately SE-dipping, whereas the F_1 axial plane must have contained a line trending NW-SE, parallel to the regional stretching lineation, L_1, as in the small scale examples of F_1. The dip of the F_1 axial plane, and the tightness of the fold, prior to F_2 folding, is unknown, due to the lack of structural data, but if the small scale, isoclinal, intrafolial F_1 folds observed by others elsewhere may be used as a guide, then it could have been a very tight, NE-dipping structure. The isoclinal shape of the F_1 folds outlined in figure 6 may reflect the original shape of the fold, but may also be a function of transposition and tightening during D_2.

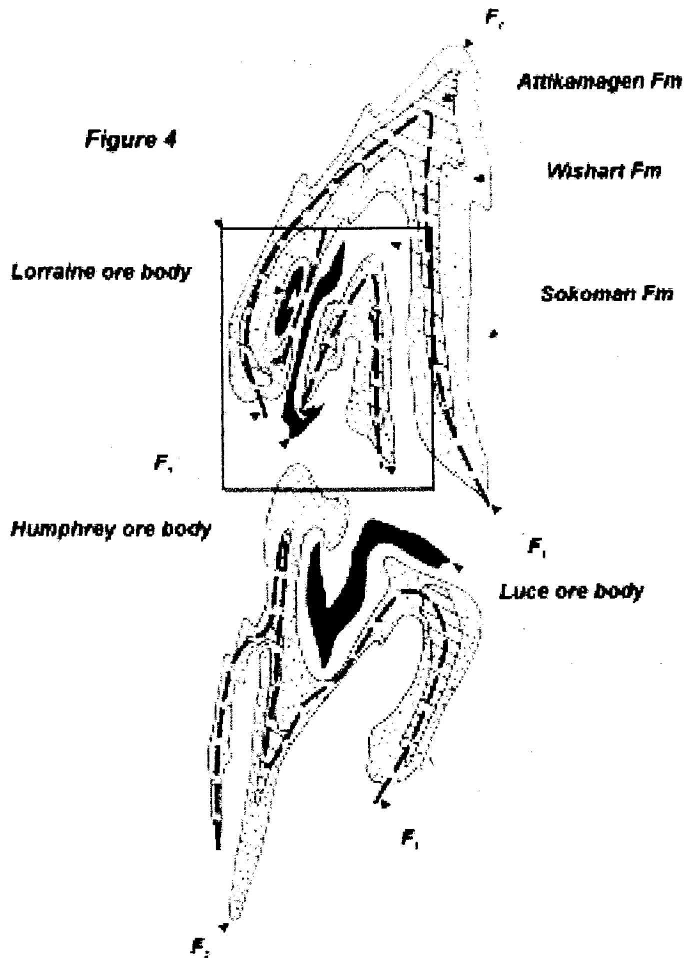


Figure 6 – Distribution of key stratigraphic units, west of Wabush Lake. The outcrop shape of the Wishart Fm defines a Type II fold interference pattern, demonstrating the presence of pre-F_2 folding. Dashed line shows axial trace of F_1 anticlines (highlighted by the presence Attikamagen Fm, flanked by Wishart Fm). Wishart Fm contacts have been slightly modified, based on a reinterpretation of 1:12,000 geology map sheets.

In figure 6, F_1 anticlines are identified by the presence of Attikamagen Fm within the core of folded Wishart Fm, with Sokoman Fm within the corresponding F_1 synclines. F_1 folds have been transposed into the F_2 structural trend, such that the F_1 anticline-syncline pairs can be mistaken for F_2 folds. However, the fact that the F_1 folds can be traced around F_2 hinges, is indisputable evidence that they are indeed F_1 folds, or more precisely, composite F_1/F_2 folds.

One reason why these structures may not have been identified in the detailed mine sections is due to the orientation at which the sections are interpreted. The sections show 'apparent' (i.e. oblique) section, rather than a profile view of the folds. For example, figure 7 is a detailed section (Muwais, 1978) drawn through the eastern limit of the Lorraine ore body (see figure 4 for location). The fold depicted here could easily be an F_2 fold shown in a section sub-parallel to its fold hinge, with the apparent recumbent shape being due to the fact that it is the apparent dips of the fold limbs that appear sub-parallel and sub-horizontal in the section. However, when one compares this section with the equally detailed surface maps (digitized and scaled down in figure 4), one can readily recognize that the surface expression of this fold is wrapped around an F_2 fold axis.

Similarly, a section through the Humphrey ore body (Muwais, 1972) shows that ore occupies an obvious recumbent fold structure, which is likely an apparent view of an F_2 fold (Figure 8). However, the reappearance of the ore unit further north, at higher and lower structural levels, may be a result of folding into or out of the section plane. This section may be an oblique view of another type II interference fold as seen at a larger scale in the same rock package (Figures 4 and 6).

Evidence for refolding of an earlier, tight to isoclinal fold phase (i.e. F_1) can be found in a number of places on figure 4 (see F_1 axial traces), and throughout the region west of Wabush Lake (e.g. Smallwood and Luce ore bodies). Note that the Sokoman Fm and its contained iron formations deform much more readily than the underlying Wishart Fm quartzite, and are therefore prone to disharmonic folding and multiple repetitions within the larger scale structures.

3.2.2 Implications of Local Structural Geology

The presence of a significant amount of F_1 folding, therefore, appears to be a prerequisite for the development of the existing ore bodies. Their appearance and disappearance along strike is a function of F_1 and F_2 fold closures. F_1 and F_2 have also both served to upgrade the economics of the ore by tightening the originally flat-lying ore horizons into doubly-plunging, synclinal keels, amenable to open pit extraction. While Hamilton's (1972) interpretations may have been a little overzealous in outlining recumbent F_1 structures, Muwais' (1972; 1974; and later) rejection of their existence has impeded understanding of the structural controls on the ore distribution. Recognition of these structures, along with the detailed stratigraphic understanding, developed by Muwais (1974), provides a more coherent structural framework to help define and refine targets in the current exploration effort.

Re-examination of the Julienne Lake area, in light of the above, suggests that this area is also the locus of F_1/F_2 interference, along with a significant F_3 component. The rotation of fold axes, expressed by the Wishart Fm, Shabogamo Gabbro and the Sokoman-Menihek contact, from northeast to southeast, along the shore of Julienne Lake, then back to northeast along the shore of Shabogamo Lake (Figure 1), may be a function of $F_1/F_2/F_3$ interference. Farther north, this region is separated from widespread outcroppings of Menihek Fm (synclines) by a broad anticlinal structure defined

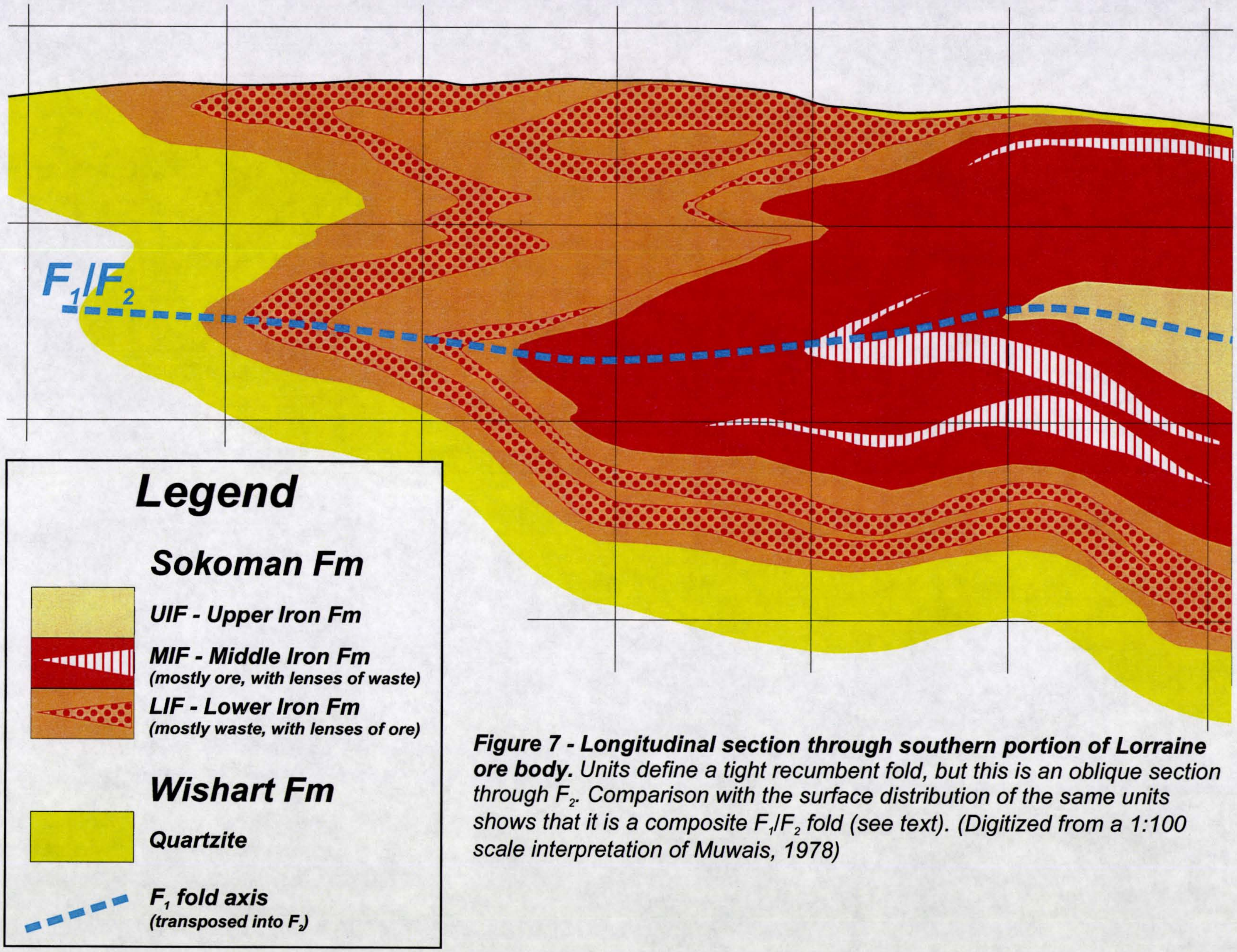
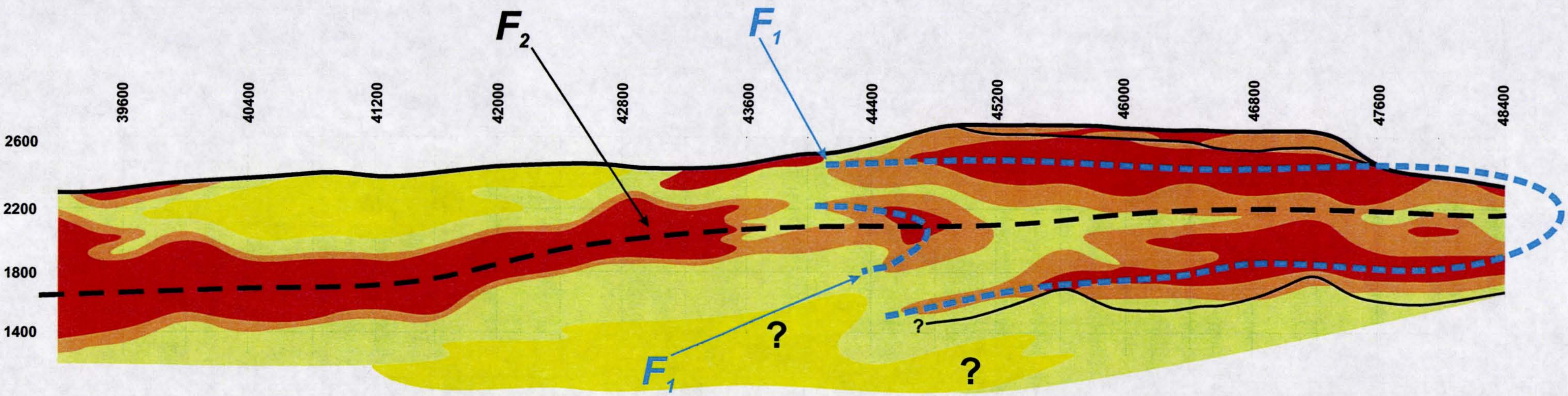


Figure 7 - Longitudinal section through southern portion of Lorraine ore body. *Units define a tight recumbent fold, but this is an oblique section through F_2. Comparison with the surface distribution of the same units shows that it is a composite F_1/F_2 fold (see text). (Digitized from a 1:100 scale interpretation of Muwais, 1978)*

Humphrey Orebody

NE-SW Longitudinal Section (looking towards 290')
2600' east of Carol Main (Baseline)

1000 ft
(grid is in 400 ft²)



Legend

- Ore
- Upper Wabush Fm
- Lower Wabush Fm
- Wishart Fm

Figure 8 - Longitudinal section through the Humphrey ore body. *Oblique section through F_2 gives impression of isoclinal recumbent folding. Reappearance of the ore horizon at higher and lower structural levels may be a function of F_1 folding into or out of the page. Small F_1 fold is based on a slightly modifed shape for the ore in this part of the section. Digitized from Muwais, 1972).*

by a number of outcrops of the Ashuanipi Complex, isolated by younger rocks of the Sokoman and Attikamagen formations. The broad distribution of these Ashuanipi basement windows roughly defines a fold shape that opens to the northeast. If this is truly a F_1/F_2 fold interference, similar to that depicted in figure 6, then the potential for finding more in the northern regions is very high. The intensity of F_2 folding, as discussed above, however, does imply that structures may not be as tight as those to the west of Wabush Lake, but the potential for the preservation of anticlinal, as well as, synclinal ore bodies may make up for these concerns.

3.3 Structural Criteria for Target Definition

The key control on the distribution of iron ore bodies is the interference between F_1 and F_2 folds. They control both the tightness of the synclines, as well as, their distribution along strike (ore bodies terminate at F_1, F_2, and F_1/F_2 fold noses). From a structural point view, therefore, understanding the distribution and geometry of F_1/F_2 interference patterns across the map area is of the highest priority.

This approach can be applied to both the interpretation of the new aeromagnetic data, as well as, to field mapping. The stratigraphy of the Knob Lake group should be readily discernible in the magnetic data, particularly that of the Sokoman Fm, due to its high iron content. Care must be taken to properly identify structural versus depositional contacts in order to properly delineate the fold structures. Units may tend to disappear and reappear along strike as a result of F_1/F_2 interference, rather than faulting. In existing map interpretations, the lack of understanding of the F_1 influence has led to the requirement for interpreted faults where none exist.

Figure 9 is an illustration of the variety of map patterns one can expect from the overprinting of two phases of folding at varying angles to each other. The fold interference pattern identified in figure 6 is approximately equivalent to cube O or P in figure 9. This type II interfernce is a result of refolding a fold with a new axial plane orientation that is at a very high angle to the first axial plane orientation, and the early fold phase has some degree of asymmetry. However, the style of folding of F_1 may be expected to vary slightly in terms of intensity, and perhaps, locally, in orientation. As a result, other fold patterns may more accurately represent the mapped patterns in different areas. For example, southwest of the Luce ore body (Figure 6), the F_1/F_2 interference appears more similar to the right hand side of cube G in figure 9.

In the aeromag data, the surface on which these patterns will be interpreted is essentially uniformly horizontal. This facilitates the interpretation, since exposures on differently oriented planes through the same fold interference can show dramatically different fold patterns (Figure 10).

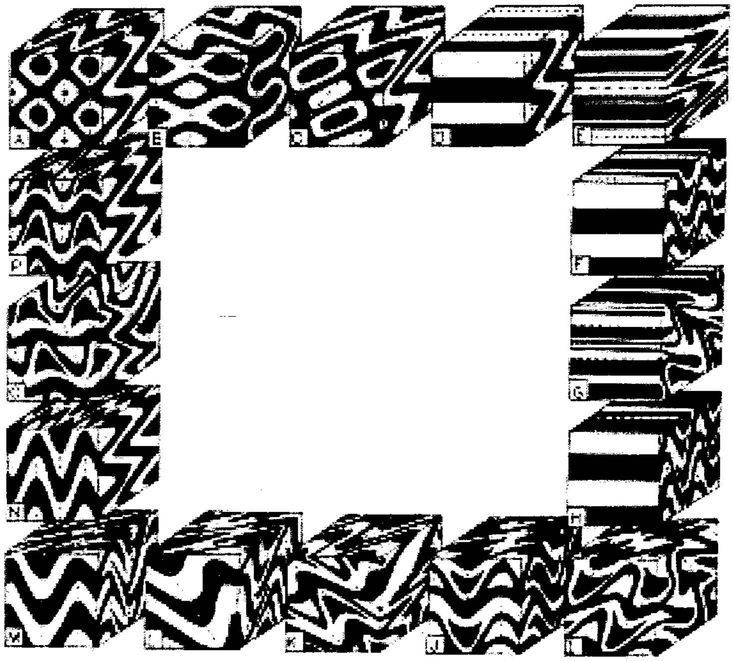


Figure 9 – Fold interference patterns developed from two folding events, superimposed on each other at varying orientations. In all cases, layering was initially parallel to the front cube face. The first folds resembled case D, with initially horizontal axial planes (dotted lines) and fold axes parallel to the front bottom edge of each cube. The second folds are sine waves, similar in form to case D, but with varying orientations of their axial plane. (from Thiessen and Means, 1980)

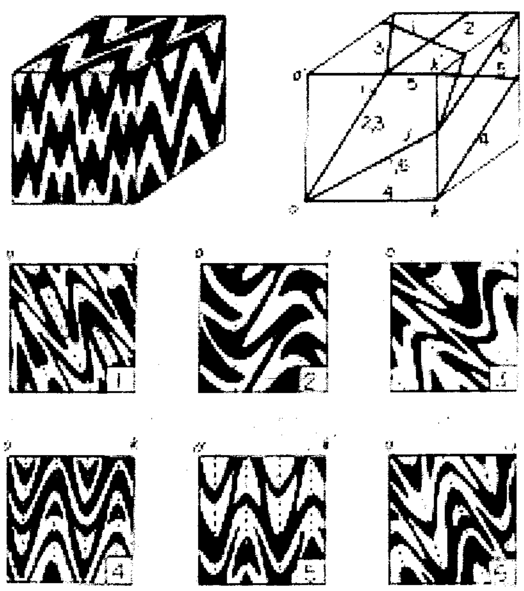


Figure 10 - Variety of two-dimensional patterns that can arise from a single three-dimensional pattern, depending on the orientation of the surface being viewed. The top left cube is the same as case N (F1 and F2 axes and hinges are mutually perpendicular), but is viewed differently. The top right cube shows orientations of the six planes cut through this case that are represented in the six squares below. (from Thiessen and Means, 1980)

In the field, minor folds will be observed on a greater variety of surfaces at different orientations, and figure 10 may be more representative of the structures that will need to be mapped and measured. The complexity of this variation in fold patterns illustrates the need for structural measurements, since a simple sketch or description of the structure provides little in terms of defining the larger scale geometry of the folds.

The fact that the regional fabric is S_1 will facilitate the identification of F_1 folds in the field. The axial planar fabric observed in F_1 fold noses will be the same as the regional fabric, whereas the axial planar fabric in F_2 fold noses will be a crenulation cleavage, and only locally developed. Folding and truncation of the regional S_1 fabric will help to define the structure of F_2 and its associated thrusts, but definition of F_1 folds in the subsurface will depend on careful mapping of bedding/S_1 relationships and the associated fold interference patterns. The S_1 fabric is in most cases bedding parallel, therefore F_1 is likely close to isoclinal, so bedding and S_1 are expected to deviate from each other only in small areas, in F_1 fold hinges.

4 Conclusions

The structural geology of the Knob Lake Group, around Wabush and Shabogamo Lakes, is governed by the effects of the Grenvillian Orogeny and the architecture of its Archean basement rocks. Three distinct episodes of deformation have been recognized, which have a varied expression in different parts of the belt.

In the area of interest for the current exploration program, D_1 and D_2 structures are the most important in terms of the distribution of existing iron ore bodies, and these controls should guide future exploration efforts and target definition.

- Dominant structural trends in the area around the mine, west of Wabush Lake are controlled by NE-trending folds (F_2) and thrust faults, which cut, overturn, and repeat the ore horizon. These structures also transpose the earlier F_1 structures, the interference of which is largely responsible for the structural geology of the area.

All of the ore produced to date has been extracted from the synclinal keels of F_1/F_2 interference folds.

- North of the known ore occurrences, the entire sequence is openly folded about a NW-trending, F_3 anticlinal fold axis. Marker units in the northern limb of this fold (Julienne Lake area; Blocks 36 and 37) exhibit a high degree of thickening in the east-plunging fold hinges, and fold interference structures suggest that refolded F_1 structures may also be present in this region.

- North of Julienne Lake, the preservation of a greater volume of rocks from the upper portions of the stratigraphic succession suggests that the ore horizon will likely occur at deeper levels than in the areas currently being mined. However, the potential for fold repeated ore horizons in this area, and the preservation of both the anticlinal and synclinal portions of the ore structures, elevates its prospectivity compared to areas farther south.

In the northern regions, the potential for preservation of greater volumes of iron ore is very high.

Considering the apparent importance of F_1 folding to the relatively high ore concentrations in the Lorraine and Humphreys ore bodies, and its potential to elevate tonnage in prospective targets, delineation of these folds should be a high priority in future geological investigations. However, due to the relatively high strain associated with F_2, F_1 folds are difficult to identify and have either not been recognized, or have been largely ignored by the mine geologists, and their distribution is poorly understood. Detailed structural interpretations of the aeromagnetic data should provide a much greater understanding of the regional and local scale structure of the area.

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REPORT ON THE STRUCTURAL INTERPRETATION FROM LANDSAT TM IMAGERY FOR IRON ORE COMPANY OF CANADA, RESOURCE ASSESSMENT PROGRAM.

May 8, 2001
Toronto, Canada

Watts, Griffis and McOuat Limited
Consulting Geologists and Engineers

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

TABLE OF CONTENTS
(continued)

Page

1. INTRODUCTION AND TERMS OF REFERENCE

1.1 GENERAL

Iron Ore Company of Canada ("IOC") has embarked upon a Resource Assessment Program ("RAP") covering the Wabush Iron Formation in western Labrador (Figure 1). The program objectives are to ensure a long term and sustainable resource base within economic reach of the Carol Project and to provide a foundation for IOC's Strategic Plan.

The RAP project area covers existing Mining Leases and Licences and open ground between the Quebec border and Sawbill Lake to the north of Carol Project (Figure 2). The RAP area is a complex, overprinted tectonic body of banded iron formations contained in the Labrador Trough. The supracrustal rocks have undergone multiple tectonic overprints during the Grenvillean orogeny. The folded body lies in thrust fault contact with the Archean basement.

1.2 TERMS OF REFERENCE

Watts, Griffis and McOuat Limited ("WGM") was requested by IOC to provide a structural interpretation of LandSAT TM data supplied by IOC to be used as part of the RAP.

The purpose of this report is to identify prospective areas that may contain magnetite-specularite deposits of substantial size (+500 million tonnes) that can be treated in the present facilities at Labrador City.

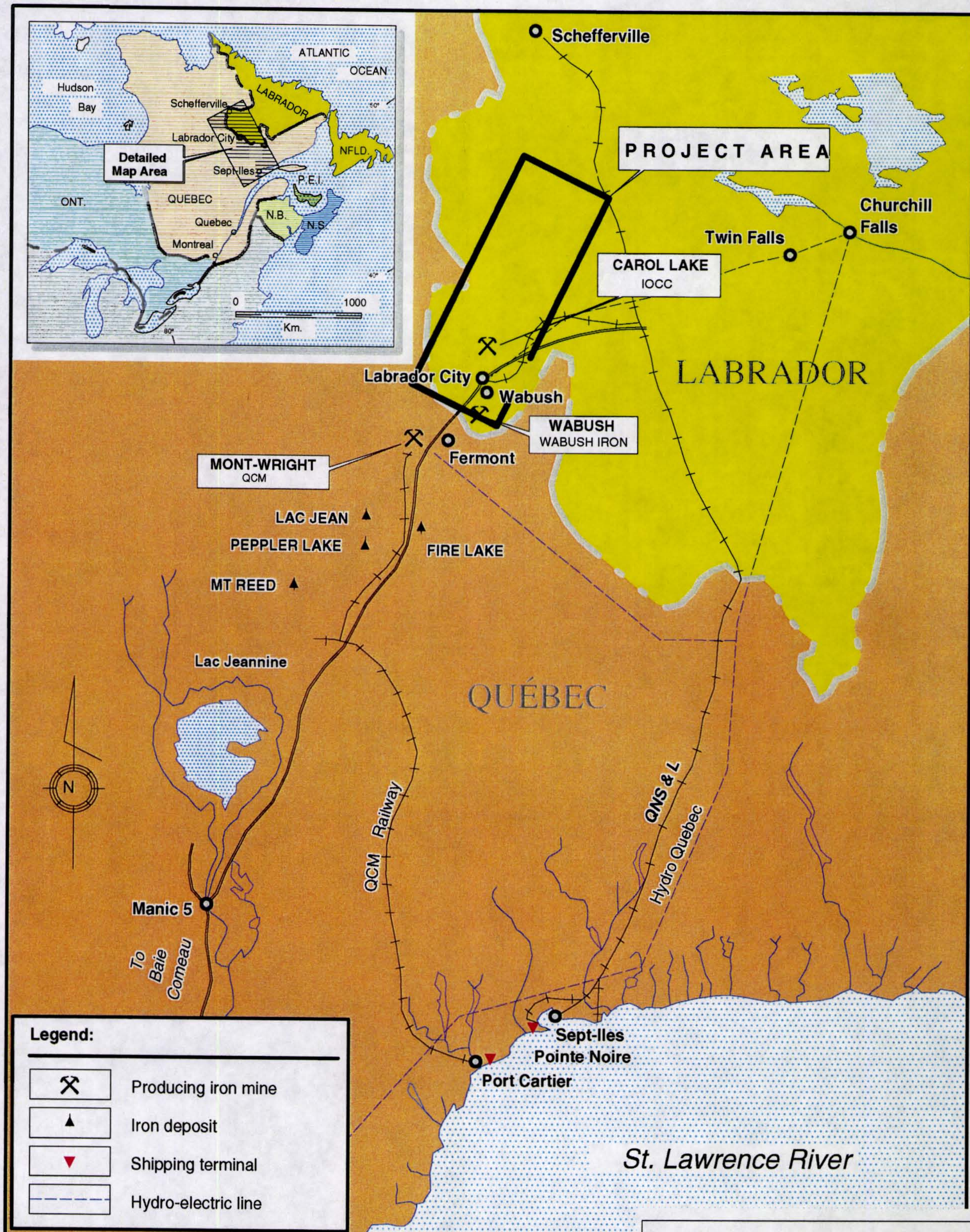

Figure 1.

Iron Ore Company of Canada

RESOURCE ASSESSMENT PROGRAM
West Labrador

Location Map

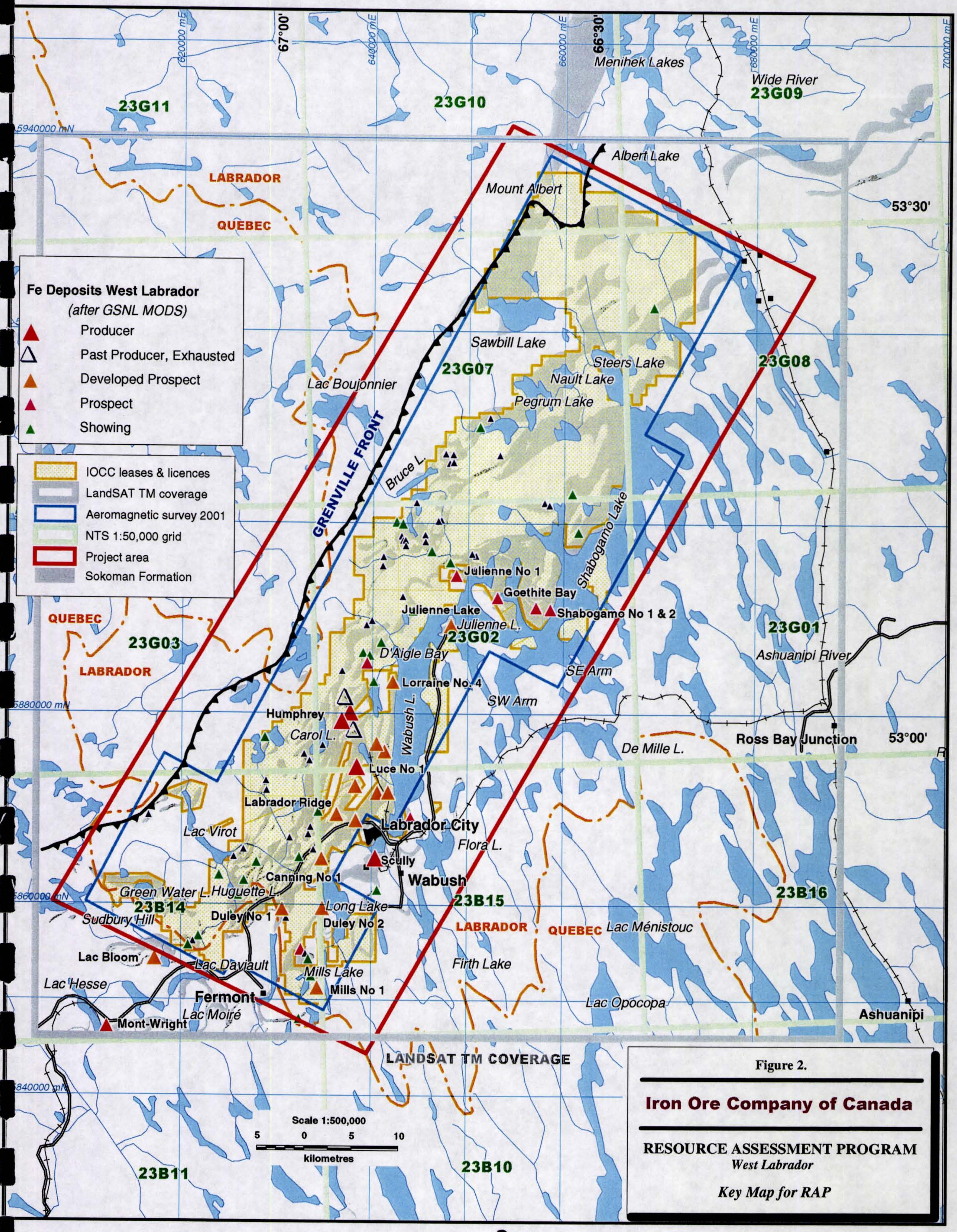

Figure 2.

Iron Ore Company of Canada

RESOURCE ASSESSMENT PROGRAM
West Labrador

Key Map for RAP

2. STRUCTURAL INTERPRETATION

2.1 GENERAL

The structural interpretation was done by delineating structural features of the Labrador Trough, within the project area, that would help identify target areas for more detailed ground follow-up. Particular emphasis was placed on identifying structures that may have caused possible thickening of iron formations (in fold noses, for example), repetition of units by faulting and/or thrusting, and features that suggest buried or unknown deposits.

The structural interpretation was done by Jens Touborg, Senior Structural Geological Associate, with the assistance of Dave Beggs, GIS/Remote Sensing Geological Associate, who was also responsible for incorporating the interpretation into IOC's Geographic Information System ("GIS"). Buzz Neal, Senior Geological Associate, and Michael Kociumbas, Geologist, reviewed the final structural interpretation and recommendations.

The interpretive maps contained in this report are based on a structural analysis, at scales of 1:50,000 and 1:100,000, of LandSAT imagery of the Wabush - Mont-Wright region and surrounding area. The structural analysis also included regional geologic and magnetic maps and shadow plots of 1:250,000 Digital Elevation Model ("DEM"), as well as 1:250,000 topographic maps.

The maps show the correlation of surface drainage trends with geology, magnetics and overprinted tectonics. The study provides important structural interpretation keys and is an invaluable aid to magnetic imaging.

The present correlation of LandSAT imagery, DEM shadow plots, total field magnetics, and regional geology is excellent and warrants detailed follow-up.

2.3 METHODOLOGY

2.3.1 GENERAL APPROACH

LandSAT multispectral imagery, when registered to a UTM grid database, is a unique photogeological exploration tool. It enables the explorationist to view a project area at any scale, from 1:1,000,000 down to 1:20,000 prospect-scale, thus providing a direct link to airphoto interpretation and prospect follow up. The LandSAT image enhancements provide undisturbed views permitting down plunge reconnaissance mapping of a fold system or a fault array, which is invaluable in the structural analysis of polyaxial, multi-overprinted tectonic terranes where a new and unbiased interpretation is necessary.

LandSAT image data sets, when followed up in the field and integrated with the total exploration base of geologic, mineral occurrence, potential field magnetic and gravity and EM data sets, are an important mapping tool in poorly exposed, forest covered and glaciated terranes. The image enhancements bring out subtle surface drainage signatures of buried geological structures and are a valuable aid in the modelling and interpretation of geophysical signatures. In addition, the multi-scale image data sets help to put these fragmentary observational data into a regional and detailed perspective and to establish the order of scale.

In regards to seeing bedrock structures under glacial or younger cover, it is a general axiom that post-glacial, buoyancy uplifts. starting at the retreat of the Laurentide glaciers (30-40,000 years ago), caused an elastic stress relaxation along bedrock faults and fractures. The subsequent brittle imprint in the permafrosted glacial cover, thus formed a skeleton structural picture of the underlying bedrock.

While drainage analysis is a key to seeing buried structures, it is not a stand-alone data set and the detailed integration and correlation with other exploration data sets is imperative for determining the relative chronology and sequence of kinematic events.

In the Wabush area, LandSAT is an important tool for mapping the surface expression of large-scale crustal structures, in understanding the complex triple point junction of intersecting orogens and, most importantly, restoring the structural picture in sparsely mapped and poorly exposed terrane.

The LandSAT imagery bridges the gap between GSC regional geologic, magnetic and gravity data and IOC's detailed exploration information and is an important tool in generating targets for ground exploration follow-up.

2.3.2 DATA FOR INTERPRETATION

For the structural interpretation, IOC provided hard copies of the georeferenced data sets. Copies of the imagery were provided as both inkjet prints and high-quality photographic prints. The images were processed for IOC by Greg Lipton, EarthScan Ltd., Toronto, and were as follows:

LandSAT TM

- 7-4-2 colour composite image fused with panchromatic band (15 m resolution); and,
- Panchromatic, edge-enhanced, black/white image.

Digital Elevation Model

- Shadowed images with three different sun angles to reveal structures with different orientations.

2.3.3 INTERPRETATION PROCEDURES

Detailed lineament interpretation was obtained from a structural analysis of 1:50,000 scale panchromatic and colour composite LandSAT images. This was integrated with regional geologic, magnetic and DEM shadow plots to establish a correlation between surface drainage patterns and geologic structures.

The interpretation included:

1. A structural reconnaissance and raw data lineament analysis, which documented tectonic regimes and established an inventory of tectonic fabrics;

2. Refinement of the analysis by systematic "down-plunge viewing" of each of the structural systems determined in Step 1. The lineament data was compiled onto clear overlays to the hard copy imagery;

3. Conversion of the lineament data to digital form by scanning the overlays and using raster-to-vector software. The vector data was attributed and converted to MapInfo format for incorporation into IOC's GIS;

4. Review of regional data and literature; and,

5. Preparation of interpretation maps from the raw 1:50,000 lineament maps and integration with regional geologic and magnetic maps.

2.4 GEOLOGICAL SETTING

The RAP area is geologically complex, straddling the Archean Ashuanipi granite gneiss complex to the west, the Grenville Front and NNE trending thrust faults, the Grenville Foreland, the para-autochthonous, overthrusted Gagnon and Molson Lake terranes and the allochthonous Lac Joseph Terrane in the east (Figure 3). There is a great diversity of lithological assemblages ranging from charnockitic basement gneiss to highly metamorphosed banded iron formation and schists.

In the NW part of the study area, the Archean Superior Province basement complex consists of NE-trending gneissic fold belts and large domal intrusions. The NW limit of the RAP project area is bounded by the Grenville Front and the NNE-trending thrust faults, with WSW deflections, which truncate the Archean basement trend.

The Grenville thrust fault corridor, formed by Grenvillean overthrust tectonics, consists of the para-autochthonous Gagnon Terrane and Molson Lake Terrane (see Figure 3). On a broad scale, the Gagnon Terrane consists of thrust slices of metasediments, interlayered with slices of Archean basement.

The Gagnon Terrane, viewed on regional geologic and aeromagnetic maps, has a central magnetic axis oriented N20°E, extending from Long Lake to Sawbill Lake. The Molson Lake Terrane consists of Shabogamo gabbro and Labradorian granitoid rocks.

The major regional structural elements are well illustrated on the regional geology map (Figure 4), the shadow map of the 1:250,000 scale DEM (Figure 5) and the drainage map (Figure 6).

2.5 STRUCTURAL TRENDS

The five major structural trends identified in the RAP area, along with trends in the Archean basement, are summarized in Table 1 and illustrated in Figures 7 to 12.

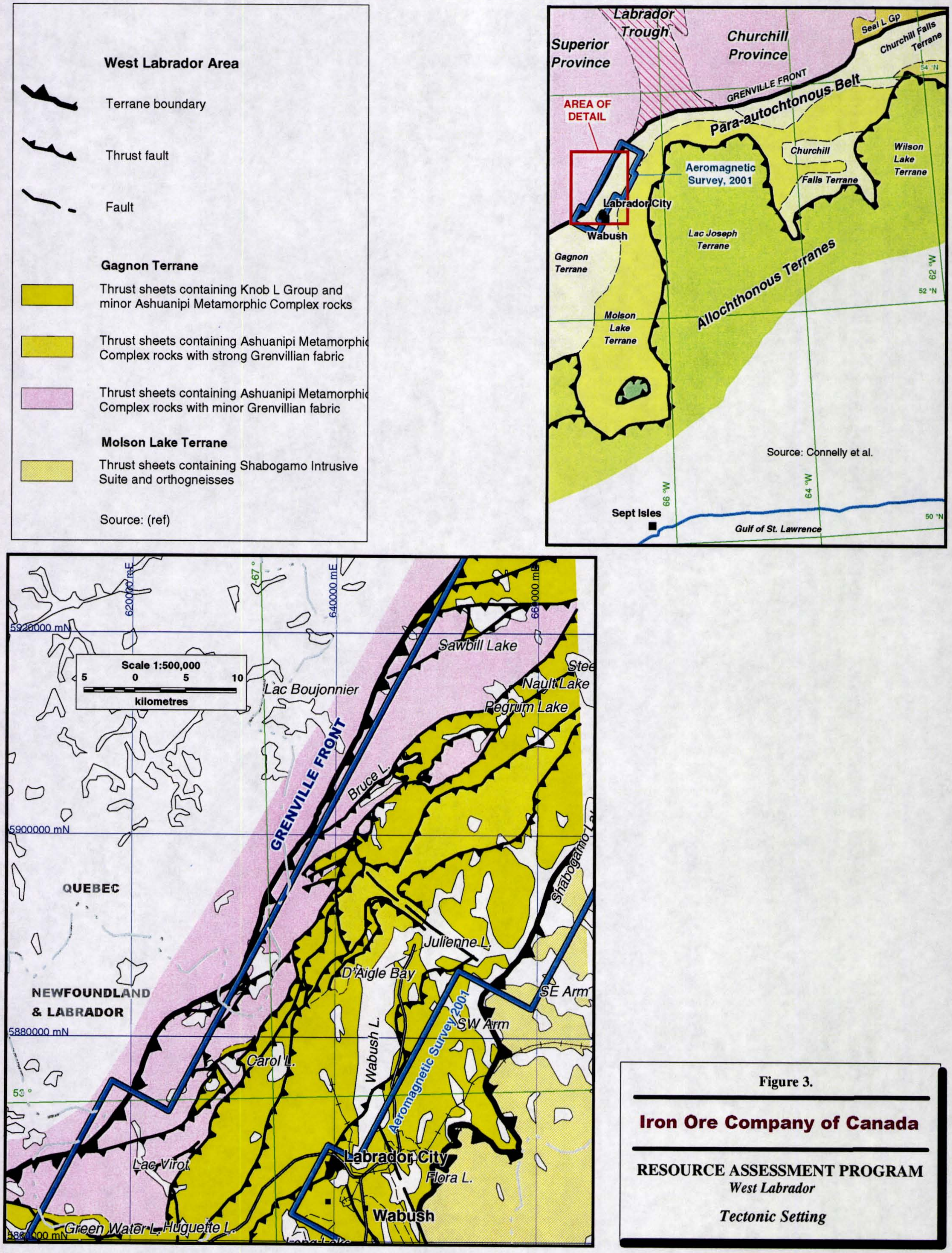

Figure 3.

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Tectonic Setting

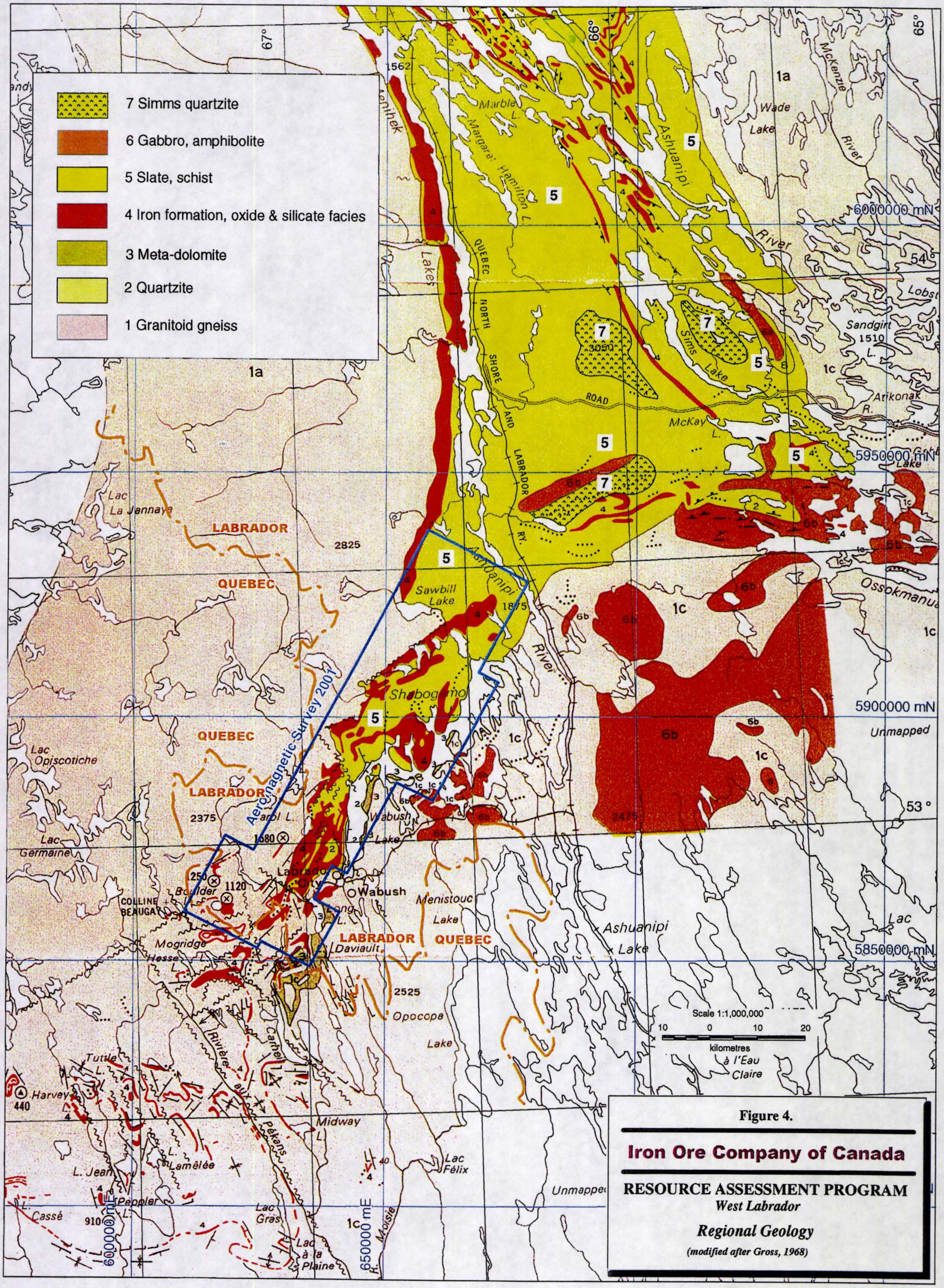

Figure 4.

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Regional Geology

(modified after Gross, 1968)

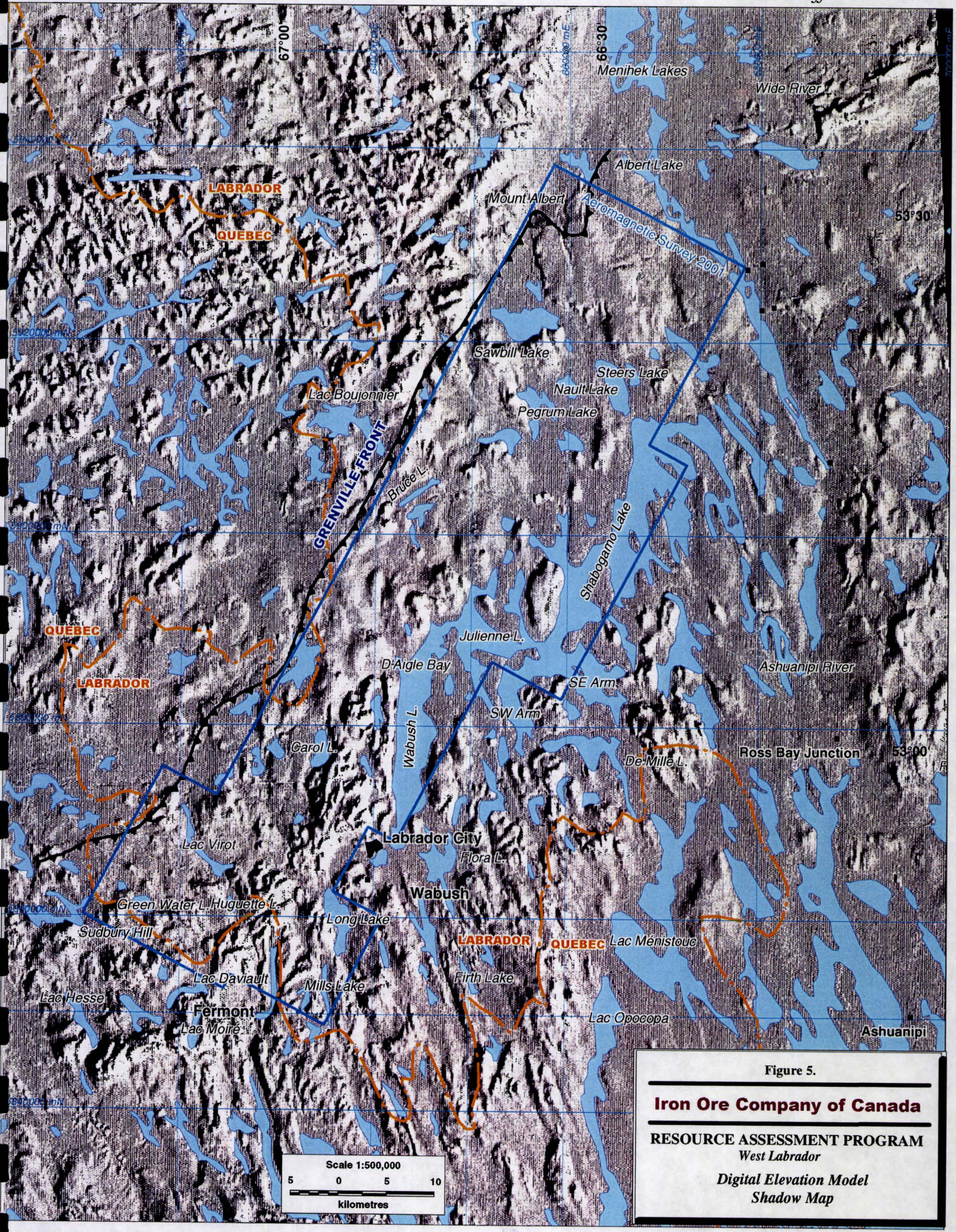

Figure 5.

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Digital Elevation Model Shadow Map

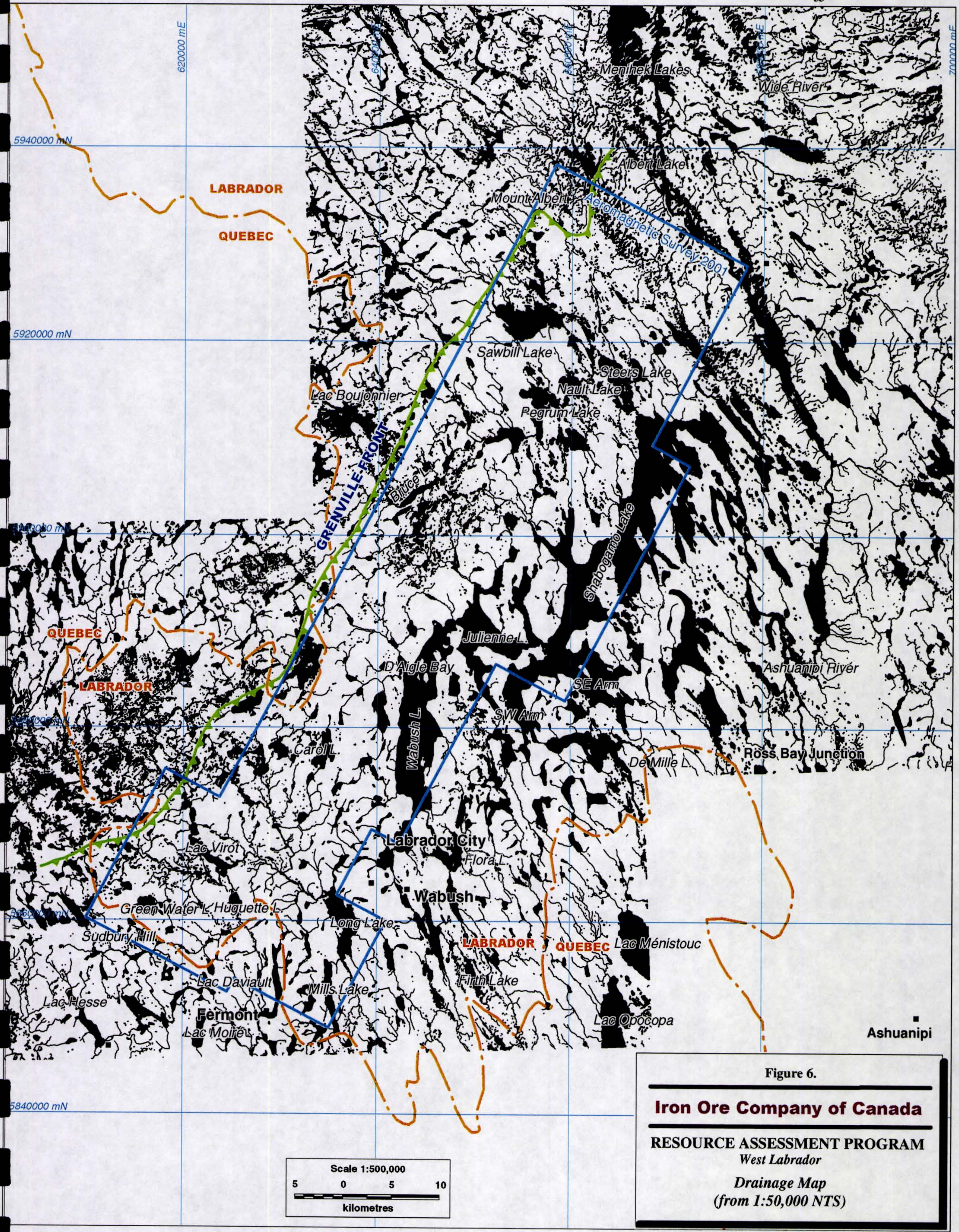

Figure 6.

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Drainage Map

(from 1:50,000 NTS)

TABLE 1
MAJOR STRUCTURAL TRENDS FROM LANDSAT TM IMAGERY

Trend	Direction of Displacement	Type of Stress	Original Formation Age
N-S	Sinistral	Extensional	Late Proterozoic
NW	Sinistral	Compressional	Mid Proterozoic
WNW	Sinistral	Compressional	Late Archean to Early Proterozoic
NNE	Sinistral	Extensional	Late Archean to Early Proterozoic
ENE	Dextral	Extensional	Late Archean to Early Proterozoic
Archean		Compressional	Archean

2.5.1 ARCHEAN BASEMENT TRENDS

Drainage systems in the Ashuanipi high-grade metamorphic granite gneiss complex, bordering the Grenville Front tectonic zone in the NW part of the study area (Figure 7) illustrate:

- A large circular-curvilinear and concentric structure approximately 30 km in diameter, elongated in NE-SW direction, centred around Lac Boujonnier, suggesting a major dome structure;

- Between Lac Boujonnier and Mount Albert at the Grenville Front, an ENE alignment along a 20 km strike length of intrusive, radially fractured structures (4 km to 8 km in diameter), suggesting possible younger diatreme magmatic activity. These structures are well illustrated on the shadowed DEM's (see Figure 5); and,

- The Archean-Grenville contact extending NNE-SSW from Mount Albert to west of Bruce Lake, where it is offset to the SW through a series of dextral strike-slip faults. The area from Bruce Lake to the SW is little known, and the mapped Grenville Front contact does not agree/conform with LandSAT, DEM and regional magnetic data sets.

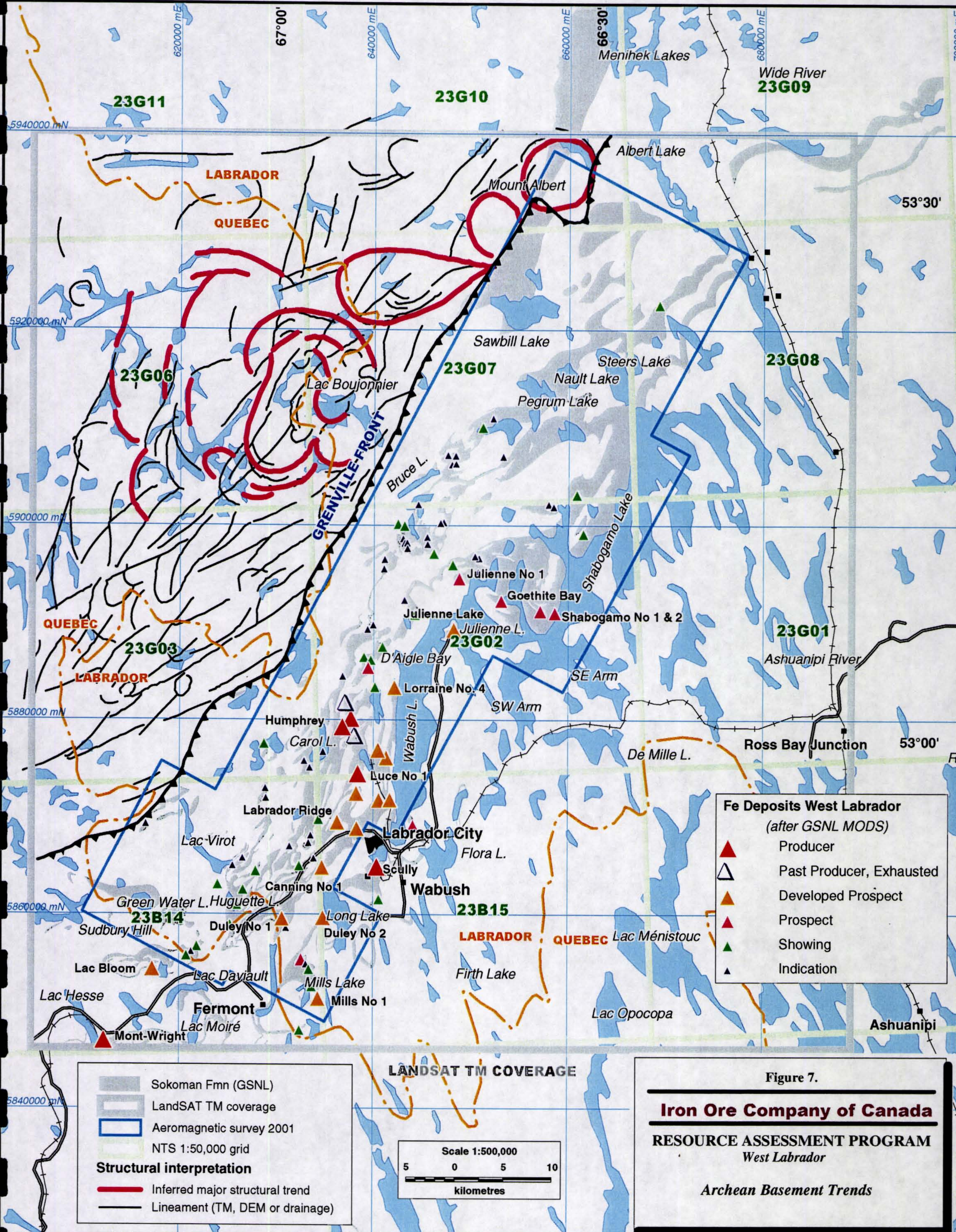

Figure 7.

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Archean Basement Trends

Although these trends are outside the present RAP area, a study of the Archean basement structures will help in the overall understanding of the complex structural history of the area and the distribution of the iron deposits.

2.5.2 ENE TRENDS

The ENE structural system (Figure 8) forms part of a large, regional dextral strike-slip fault corridor, 250 km by 50 km in area, and is an integral part of the Labrador triple junction of intersecting Precambrian orogenic belts.

The ENE structural system has well developed drainage expressions (see Figure 6) in major lake systems and smaller river trends. Geologically, it appears in the above mentioned dextral offsets of the Archean-Grenville contact. This system is viewed as one of the principal Labrador Trough rift basin trends, hosting large-scale en echelon (bayonet) configurations of Sokoman formational trends in ENE-trending dextral and NNE-trending sinistral strike-slip faults.

Abrupt strike swings and a complete change in structural style occurs around large fault junctions and basement tectonic windows. These rift basin systems underwent thrust faulting and multiple tectonic overprints, and host hypabyssal gabbro intrusions of the Shabogamo suite, which were emplaced during an extensional fault reactivation, approximately 1,440 MA.

2.5.3 NNE TRENDS

The NNE structural system (Figure 9) is a rift basin and sinistral strike-slip fault basement thrust trend, with a possible granite doming trend. It has a well developed drainage expression (see Figure 6) in the Grenville Foreland, the Gagnon Terrane and the west part of the Molson Lake para-autochtonous Terrane.

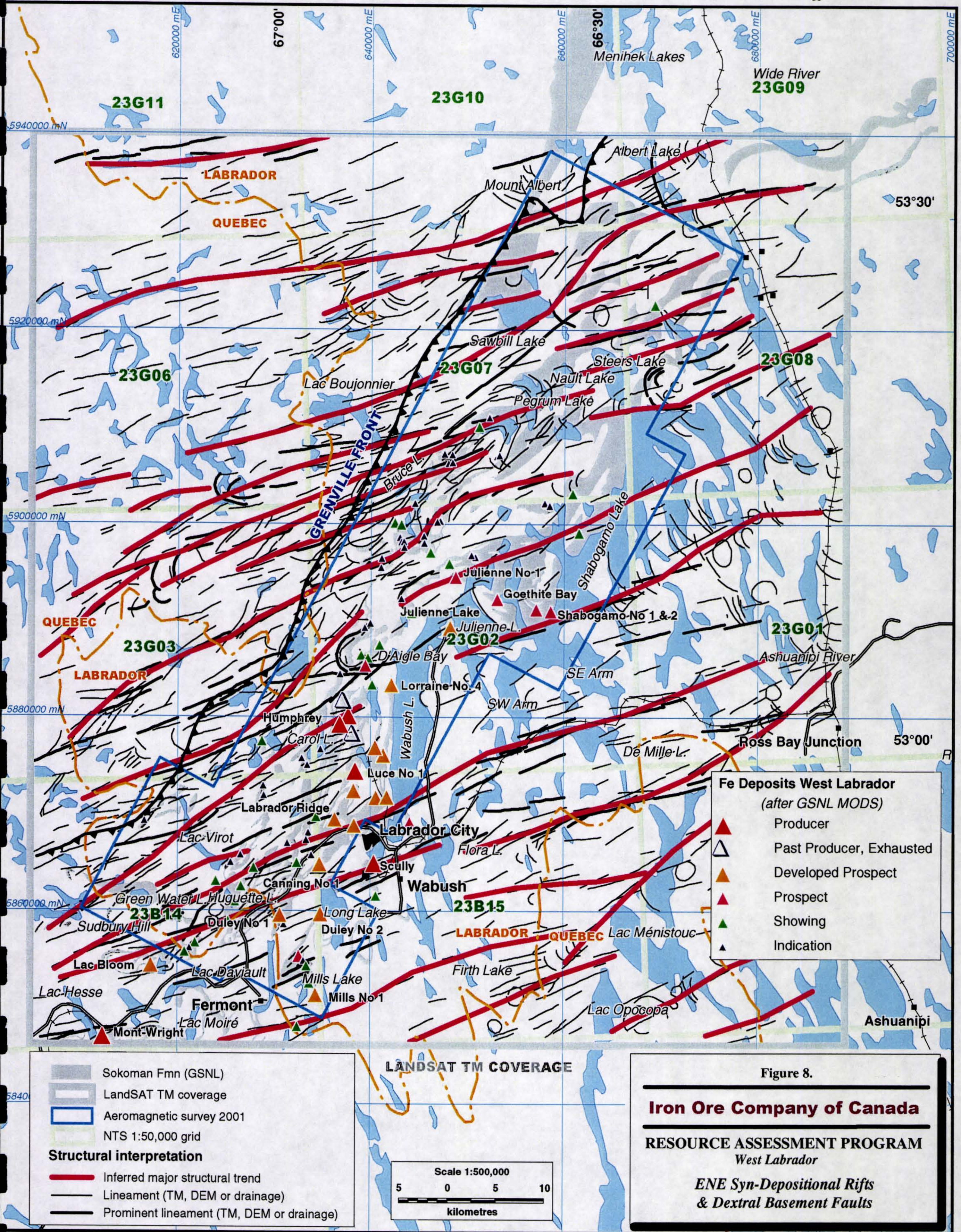

Figure 8.

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ENE Syn-Depositional Rifts & Dextral Basement Faults

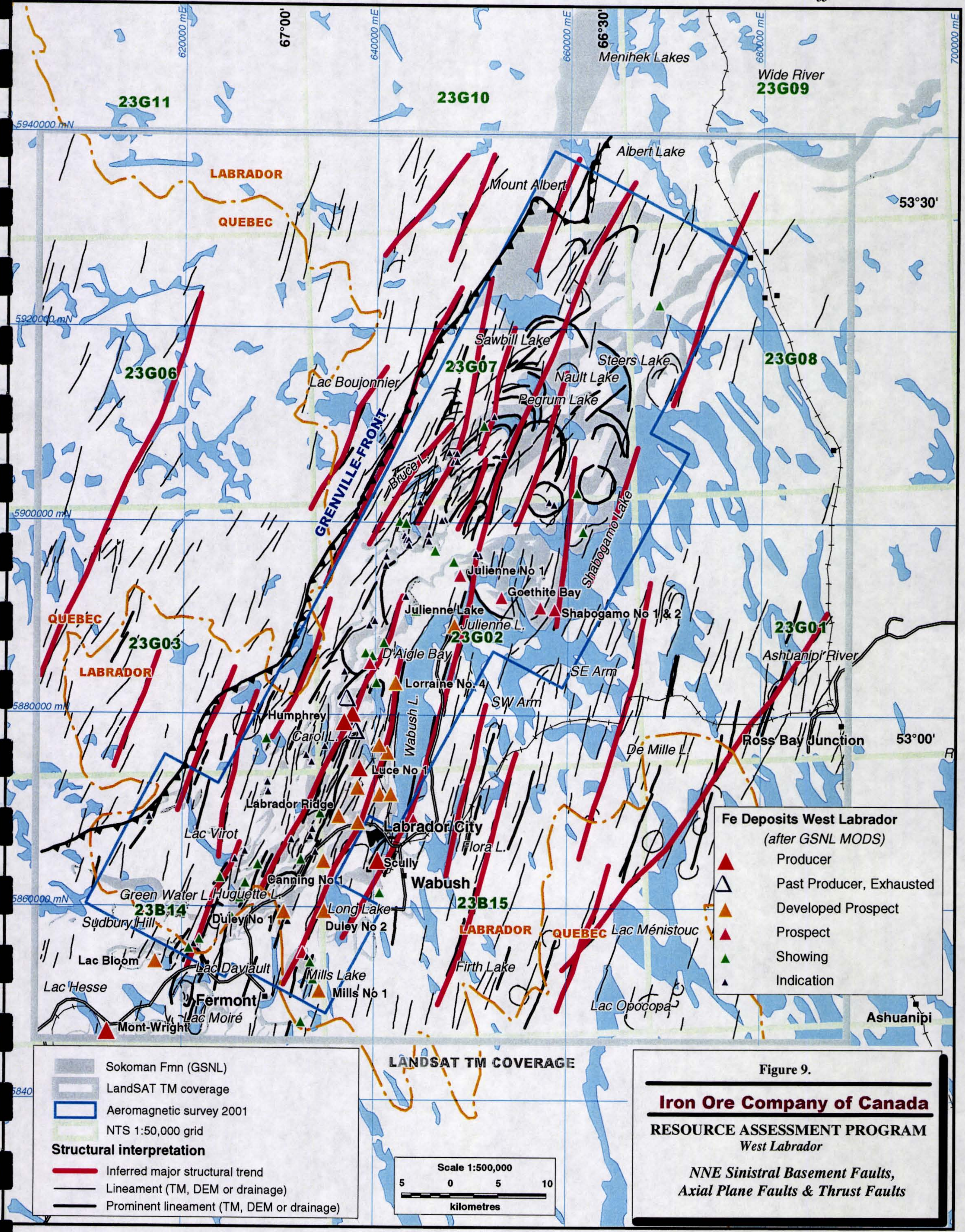

Figure 9.

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NNE Sinistral Basement Faults, Axial Plane Faults & Thrust Faults

In addition to the large lake configurations, seen in the apparent sinistral offset of Wabush and Shabogamo lakes, this trend appears in a system of parallel fracture arrays around the Grenville Front tectonic zone from Albert Lake to Bruce Lake, and in basement thrusts in the Wabush domain. Part of this system hosts major iron formations in the area, namely the Humphrey deposits.

There are also large-scale, elongated fold-axial plane fault corridors, 40 km by 10 km in area, extending from D'Aigle Bay to Sawbill Lake, and a truncated closure, 20 km in diameter, located at the NE arm of Shabogamo Lake. This is inferred from the curvilinear morphology of lake arms, suggesting basement granitoid doming activity in both the Gagnon and Molson Lake para-autochtonous terranes.

2.5.4 WNW TRENDS

The WNW structural system (Figure 10) is a Grenville-activated Hudsonian basement fold-fault trend that occurs throughout the Grenville Foreland and para-autochtonous Gagnon metasedimentary and Molson Lake terranes. It is not present in the Superior Province.

The WNW trend is best known from the Mont-Wright-Lac Bloom area. In this area, migmatitic basement gneisses are congruently folded with Sokoman iron formation that hosts major iron deposits in E-W to WNW oriented fold closures. The LandSAT imagery illustrates an alignment of small lake systems, suggesting a swath of tight folds and closely spaced axial plane trends, extending from west of Lac Virot to Labrador City.

Major WNW fold-fault corridors extend from Carol Lake to Labrador City. A large WNW-trending corridor, separating the Wabush NNE from the Shabogamo ENE domains, is axial planar to a central fault junction around D'Aigle Bay-Julienne Lake-Shabogamo SW and SE arms and is coincident with a major fault through D'Aigle Bay. This corridor

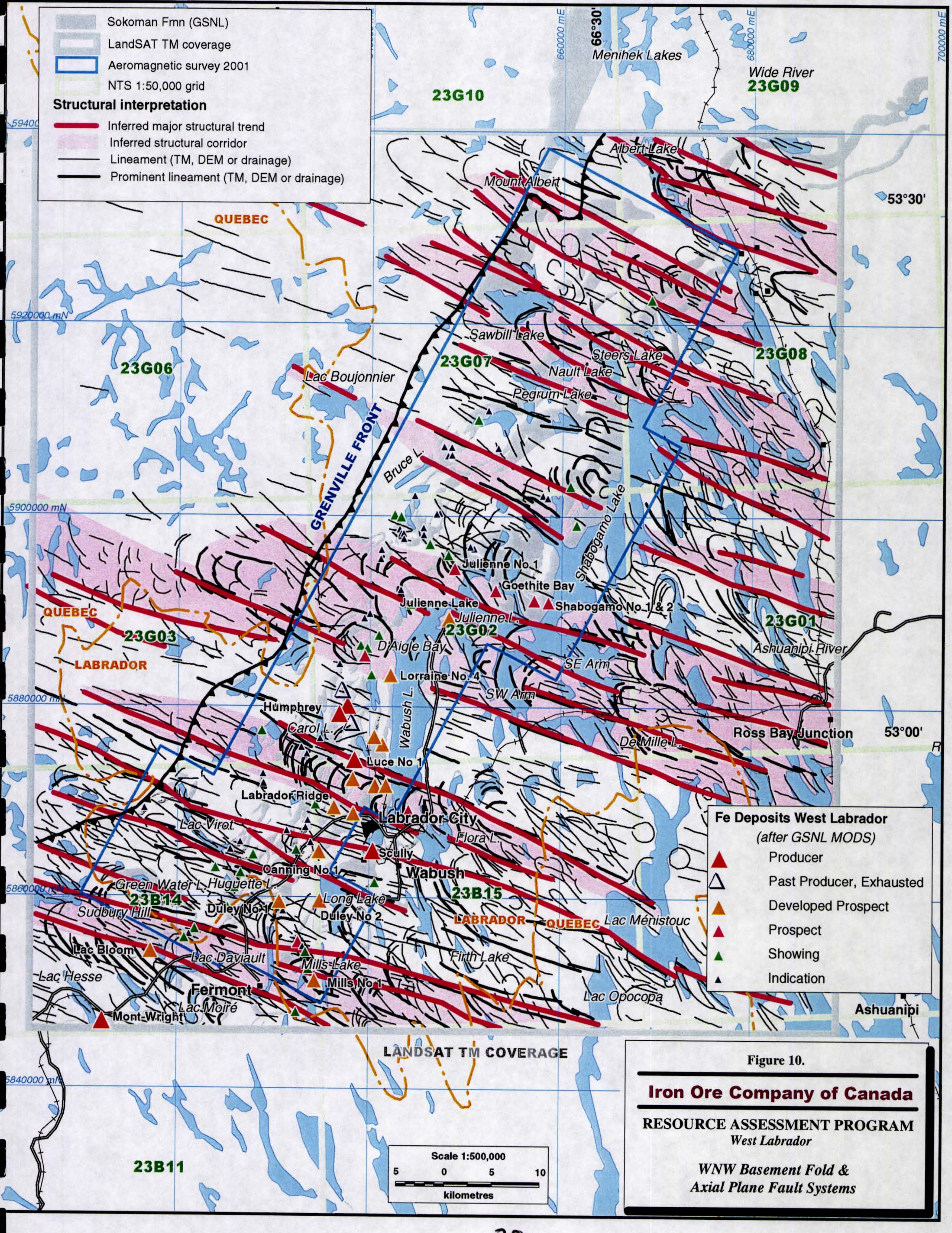

Figure 10.

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WNW Basement Fold & Axial Plane Fault Systems extends from the Grenville Foreland, across the overthrust terranes, to Ross Bay Junction at the contact of the Lac Joseph allochthon and orthogneiss complex, suggesting a major reactivated basement fault and fold system.

2.5.5 NW TRENDS

The NW structural system (Figure 11) comprises a system of fold closures, apparent domal culminations and axial plane faults with a NW strike. It defines a congruent deformation of the Grenville Foreland and the Gagnon and Molson Lake para-autochtonous terranes, suggesting an enormous compressive, SW-directed deformation event during the peak of the Grenville orogeny.

The figure illustrates a series of parallel axial plane faults, 8 km to 15 km apart, with distinct curvilinear drainage patterns between the faults, suggesting fold closures. These fold structures were imprinted on SE-dipping, stacked thrust sheets (right side up).

While the largest fold closure occurs in the D'Aigle Bay-Julienne Lake-Shabogamo Lake area, there is a conspicuous alignment of circular to ellipse-shaped structures along an ENE or NE trend along the north shore of Shabogamo Lake. The circular structures are outlined by lake morphology and curvilinear patterns, and suggests granitic doming activity in the basement. This theory is further supported by the regional geologic and DEM data sets.

2.5.6 N-S TRENDS

The N-S structural system (Figure 12) is an integral part of the SW bend of the Labrador Trough, the triple junction and a large-scale extensional fault corridor. It appears as a large-scale sinistral fault and fracture corridor more than 300 km by 50 km in area, extending from Menihek Lake, through Shabogamo, Wabush and Opocopa lakes.

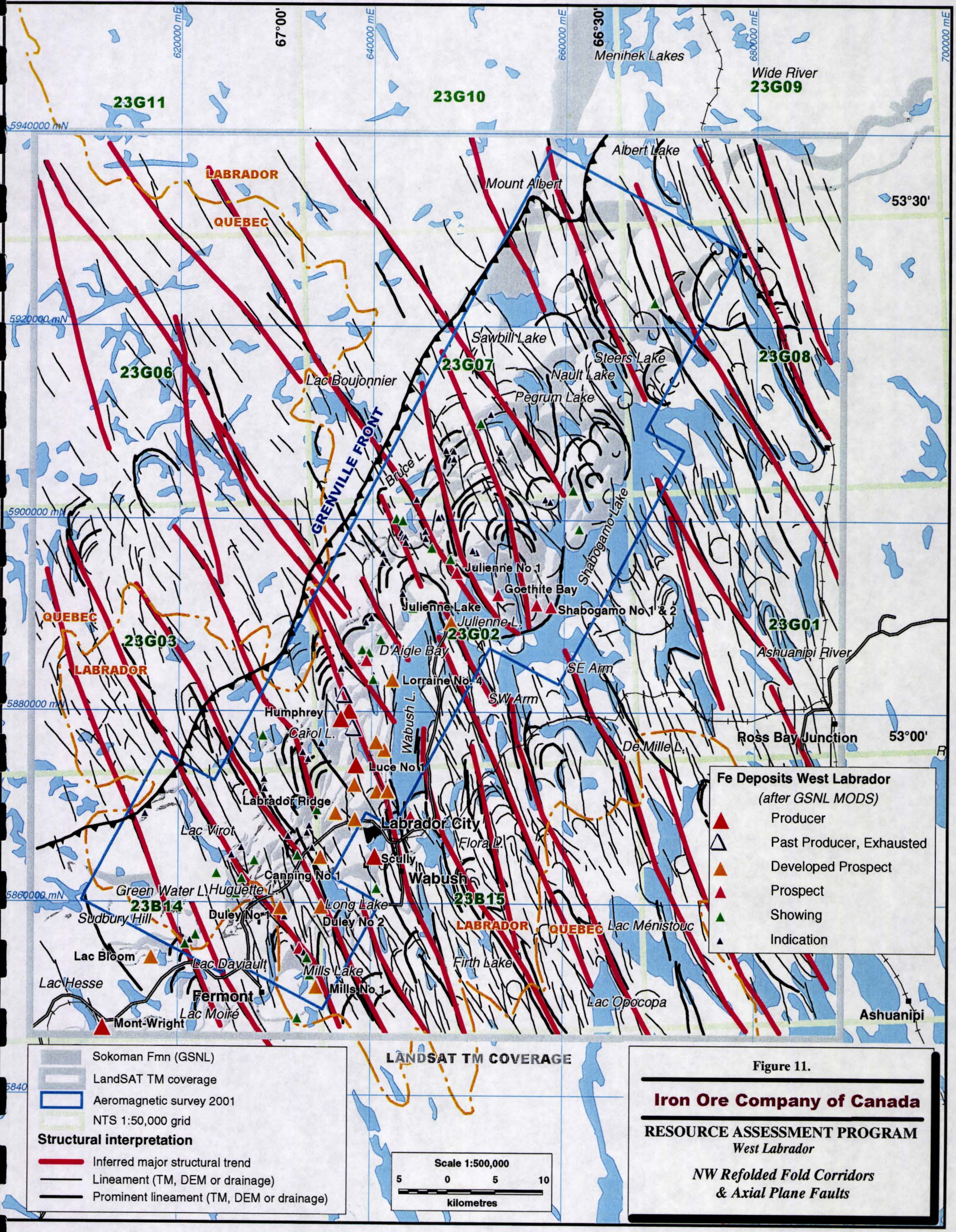

Figure 11.

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NW Refolded Fold Corridors & Axial Plane Faults

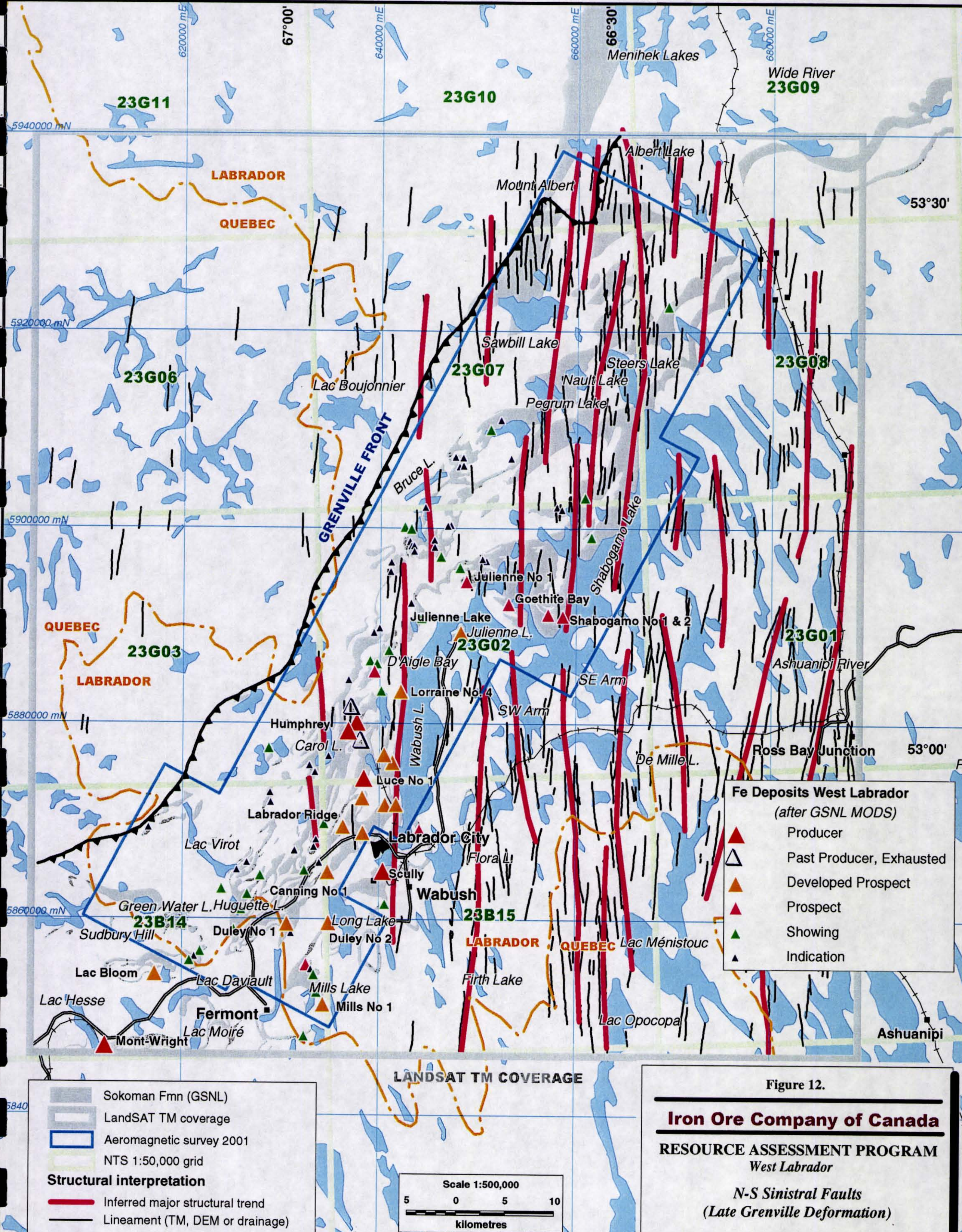

Figure 12.

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N-S Sinistral Faults (Late Grenville Deformation)

Within the RAP area, this system is expressed in shorelines and in the left lateral offset of the Wabush and Shabogamo lake systems. In addition, it appears in closely spaced fracture swarms, suggesting post-orogenic magmatic dyke swarms in the Gagnon and Molson Lake terranes. While there are no geological field or aeromagnetic data sets to confirm this interpretation, the N-S system also hosts glacial eskers.

It is believed that the N-S system was continuously reactivated in conjunction with crustal extensions and continental drift in late Proterozoic, Paleozoic, Mesozoic and Cenozoic times.

2.6 DEFORMATION HISTORY AND TECTONIC SUMMARY

The RAP area lies on the SW arm of a Precambrian triple point junction and straddles the Grenville metamorphic arm of the PaleoProterozoic Labrador Trough. The Trough extends in a hook-shaped configuration from Ungava Bay to Schefferville to Menihek Lake, where it bends to the SW in a wrap-around of the Archean craton in the Wabush area.

The major controlling features in the study area are:

a) A regional triple point junction of intersecting Archean, Proterozoic Hudsonian and Grenville orogens, with further late Proterozoic and Phanerozoic extensional re-activations during continental rifting;

b) Dextral strike-slip rift basins hosting Proterozoic cherty iron formations of the Sokoman; and,

c) Major Grenvillean basement re-activation.

Fold and fracture corridors on ENE, NNE, WNW, NW and N-S trends (Figure 13) suggest multiple fault and basement re-activation, polyphase folding, overprinted tectonism and a deformation history of at least seven principal events including:

1. Formation of Labrador Trough rift basins on ENE dextral and NNE sinistral strike-slip faults (see Figures 8 and 9);

2. Hudsonian basement re-activation on WNW trends (see Figure 10) during high-grade metamorphism;

3. Emplacement of Shabogamo gabbro along extensional ENE (dominant) and NNE corridors;

4. NW directed overthrusting of Lac Joseph orthogneiss batholith east of the project area, during accretion of the Grenville orogen to the Superior craton, resulting in the formation of stacked, SE dipping thrust sheets;

5. NW-trending refolding (see Figure 11) on SE-plunging axes with congruent deformation of the Grenville Foreland and the Gagnon and Molson Lake terranes during SW-directed compression and basement doming;

6. N-S to NNE sinistral fault re-activation (see Figure 12) and dyke emplacement associated with NNW-directed late kinematic, thrusting and late Proterozoic to Phanerozoic continental rifting; and,

7. Cretaceous-Tertiary supergene weathering and secondary iron ore enrichment.

Figure 13.

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West Labrador

Summary of Major Inferred Structural Trends

Table 2 summarizes the major tectonic and structural events.

TABLE 2
SUMMARY OF CHRONOLOGICAL EVENTS AND KINEMATIC DEVELOPMENT

Phase / Age	Description of Event
Pleistocene	Laurentide glaciation, formation of N-S esker systems.
Cretaceous-Tertiary	Erosion and supergene weathering under tropical conditions.
Unconformity	
Paleozoic-Mesozoic and Cenozoic Phase –extensional	Deformation during opening and closing of the Iapetus Ocean and opening of the Atlantic Ocean. Emplacement of magmatic dyke swarms.
Grenville Late Orogenic Phase - large scale extension	Large-scale sinistral strike-slip faulting on N-S trends. Emplacement of magmatic dyke swarms.
Principal Grenville Orogenic Phase - SW-directed compression	Congruent NW-SE folding of Grenville Foreland, Gagnon and Molson Lake para-autochtonous terranes on SE-plunging fold axes. Large-scale basement doming and diapirism during high grade amphibolite-granulite facies conditions.
Shabogamo Gabbro Emplacement – extensional phase	Emplacement of Shabogamo gabbro sills on ENE, NNE and N-S trends (contemporaneous with Voisey's Bay norite intrusions).
Grenville Overthrust – compressional phase	NW-directed compression and accretion of Grenville orogen to Superior craton. During emplacement of the Lac Joseph orthogneiss batholith and allochton, the Molson Lake metamorphic schist terrane was thrust onto the metasedimentary Gagnon Terrane in the Grenville Foreland. The thrust fold-fault geometry in the para-autochtonous lands appears to have been controlled by basement structures such as pre-Grenville rift basins and basement highs. This caused accentuation of existing en echelon configuration and reactivation of ENE dextral and NNE sinistral strike-slip faults and the Grenville Front was offset to the SW. Considerable basement reactivation took place forming WNW-trending fold and axial plane fault systems throughout the Wabush-Shabogamo camp. There was apparent granite doming west of Shabogamo Lake on NNE axes in both the Gagnon and Molson Lake para-autochtonous terranes.
Pre-Grenville –extensional phase	Rift basin development in dextral strike-slip basins around the edge of the Superior craton and deposition of the Labrador Trough sediments in ENE dextral and NNE sinistral strike-slip basins in en echelon configuration and abrupt strike bends around paleogeographic highs or horsts.
Proterozoic	Proterozoic erosion and peneplanation.
Superior Craton – compressional phase	Formation of Superior craton and high-grade metamorphic Ashuanipi complex. Granite gneiss doming.

3. RECOMMENDATIONS FOR EXPLORATION

For the purpose of defining new exploration or mining targets, it is proposed to combine geological base maps, LandSAT and airphoto digital enhancements, geophysical data and a detailed surface mapping project. This would be used to document fold closures, axial plane faults, linear fabrics, brittle fault and fracture arrays and supergene alteration patterns, associated with the ENE, NNE, WNW, NW and N-S structural systems and to determine the iron ore potential associated with the down-plunge extension. A 1:20,000 compilation map scale is a link between the regional 1:50,000 scale LandSAT image data set and available 1:12,000 and 1:5,000 scale detailed geologic data sets.

3.1 PROPOSED FOLLOW-UP PROGRAM

Based on WGM's knowledge of the geology and history of the area, and our interpretation of the LandSAT and DEM data, the following recommendations are made:

1. Take the LandSAT image study to a workable field scale through multi-scale data integration with IOC's magnetic, gravimetric, geologic, mineral occurrence and airphoto information to produce new geological maps. These maps are required as a base for follow-up ground exploration. In regards to detailed follow-up, the LandSAT TM-7 data sets possess inherent quality that image enhancements can be taken to a maximum enlargement of 1:20,000 scale without significant loss of resolution. The 1:20,000 scale maps can be integrated with orthophoto mosaics, available regional and detailed (open pit) geological maps to create detailed base maps at a 1:10,000 or 1:5,000 scale.

   Recognizing that the large-scale structures control the small-scale ones, the correlation should be done at all map scales, from 1:250,000 down to 1:10,000 scale, pending availability of data sets and priority rating.

2. A series of magnetic shadow maps, from the 2001 aeromagnetic survey, of the five major structural trends will aid in the interpretation of reworked faults, and more importantly will generate new iron ore exploration targets. A 1:250,000 scale analysis of shadow enhanced DEMs (data sets are on hand) will more fully define the regional extent of the five major fold-fault-fracture corridors in the study area. The major trends are:

   a) The ENE-trending rifts and Sokoman source basins and the basement thrust faults generated along these during later events;

   b) The NNE-trending systems and the large fold closures inferred in the Bruce Lake-Pegrum Lake-Nault Lake-Albert Lake area;

   c) The WNW-trending basement structural systems and their propagation under para-autochthonous cover for further definition of basement tectonic windows in the Gagnon Terrane;

   d) The NW-trending systems and the large basement domes along the north shore of Shabogamo Lake; and,

   e) The N-S systems and the elongation parameters associated with this trend.

3. Complete the compilation of available data, with subsequent ground follow-up to confirm the type and extent of oxide iron formation. Detailed structural mapping and sampling of all oxide iron formation will assist in a new geological interpretation.

   Important questions to be addressed during this program are; How much iron formation has been mapped and sampled ?, and Are there sections/sequences of iron formation that have only sparse mapping or have not been looked at all ? Previous sampling, and the next exploration phase, has to be adequate to establish the iron formation's facies and grade characteristics.

The field program must first attempt to confirm the quality of the old geological interpretation with respect to the surface extent of iron formation and then begin to fill in the holes in the facies and grade picture. In the second instance, work needs to be done on stratigraphic relationships and improvements to understanding the deposit scale structure. With a better understanding of structure, the possibility exists to improve a partially known iron deposit with regards to tonnage potential and grade profile.

4. To expand the regional geologic interpretation base of the southern Labrador Trough and the Labrador triple junction by merging GSC regional aeromagnetic and gravity data sets with the current high resolution magnetic survey for further definition of the ENE-trending rift basins and new exploration concepts.

5. A reconnaissance compilation of the Archean, Proterozoic and Phanerozoic geologic and metallogenic history in the Labrador triple junction and SW and southern Labrador Trough focusing on the Cretaceous-Tertiary unconformity and supergene iron ore enrichment and the lesser known Proterozoic-Phanerozoic hydrothermal basement overprint. Using the LandSAT maps as a correlation base, it is proposed to explore the three large fault junctions at:

   - D'Aigle Bay-Julienne Lake-Shabogamo Lake;
   - Labrador City-Wabush; and,
   - Steers Lake-Shabogamo Lake north.

   Lithological mapping, further definition of thrust faults, fold closures and delineation of Cretaceous-Tertiary weathering imprint will be aided with band ratioing and additional colour composites of the LandSAT imagery.

3.2 PROSPECTIVE AREAS

The most prospective areas within the RAP study area that may contain magnetite-specularite deposits of +500 million tonnes are shown on Figure 14 and are described below:

1. The Wabush Lake domain, which has been extensively explored and mined, warrants additional prospecting for blind fold closures and axial plane fault targets with secondary enriched, weakly magnetic signatures, possibly overlooked during previous exploration. The area southwest of the Humphrey Mine and past the Labrador Ridge deposit to the Quebec border should be examined in more detail, based on new geological and structural interpretations and information compiled from the current operating mines. The detailed mine geology should be projected into adjacent areas.

2. The D'Aigle Bay-Julienne Lake-north shore of Shabogamo Lake multiple fold closure and dome culmination belt contained in a 40 km by 10 km corridor, oriented ENE. This area warrants regional exploration follow-up due to the NW alignment of mineral occurrences, the known iron prospects at Julienne 1 and 2 and Shabogamo 1 and 2, and the conspicuous NW-trending internal structural fabric and unusual geometry.

   While this junction hosts multiple fold closures and multiple axial planar fault trends on WNW, ENE, NW, N-S and NNE orientations, the NW trend is possibly the most penetrative structural system in terms of down-plunge elongation and alignment of iron formations.

3. A composite NNE-trending structure discordant to the mapped thrust belt of stacked Sokoman Formation and basement slices extends from Bruce to Pegrum to Nault lakes, and almost to Albert Lake, suggesting a domal axis. The structure is inferred from alignment of linear and curvilinear drainage systems and warrants follow-up.

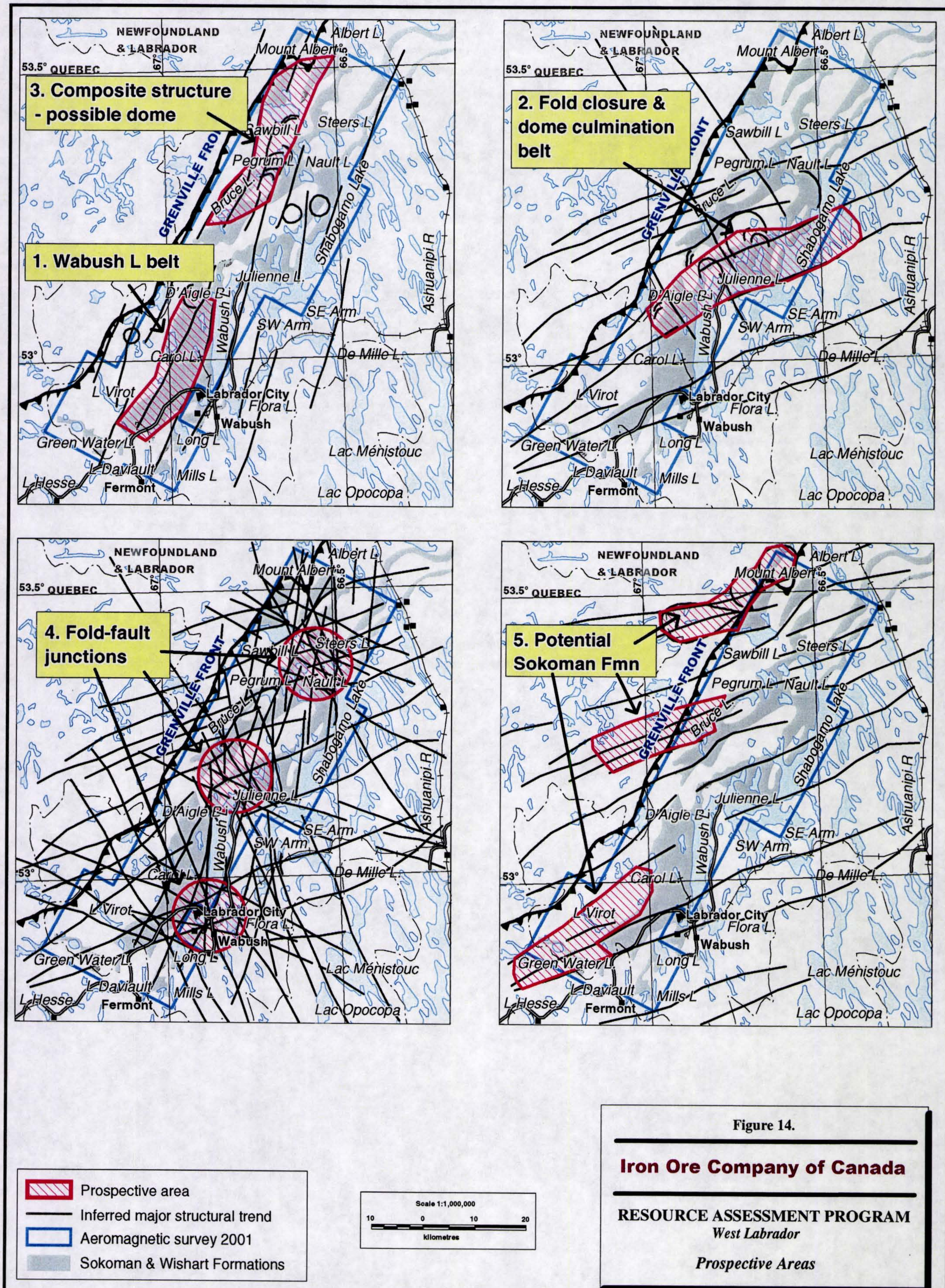

Figure 14.

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RESOURCE ASSESSMENT PROGRAM
West Labrador

Prospective Areas

4. To explore for Cretaceous-Tertiary unconformity controlled, secondary enriched iron oxide mineralization at structurally controlled sites (dilational and suitable for ground water action), such as fold-fault junctions and their down-plunge extensions at major intersections such as Julienne Lake-Shabogamo SW and SE arm, Labrador City, and Steers Lake-Shabogamo Lake north.

   Within the same context, the many fold closures and fracture intersections generated during the multiple overprints could be potential enrichment sites for secondary hematite. These targets may have a vague magnetic signature and may have been missed during previous exploration surveys. It is acknowledged that supergene enriched iron deposits cannot be treated in the present pellet plant operations.

5. Prospecting for Sokoman rift basins and their WSW extensions into the Archean craton and little known terranes. For example:

   - The Menihek Lake and Mount Albert belts North of Sawbill Lake where an alignment of ENE-WSW and circular curvilinear drainages suggest a potential extension of the Menihek Lake belt; and,

   - The inferred dextral strike-slip basins in the Grenville Foreland, west and SW of Bruce Lake, Carol Lake and Lac Virot.

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PHYSICAL ROCK PROPERTY STUDY

Labrador City

IRON ORE COMPANY

PETROPHYSICAL MEASUREMENT SERVICES
MORRIS MAGNETICS Inc.
820 Chantler Road
Fenwick Ontario
L0S 1C0

March 2001

Field Sampling Procedure:

Block samples were collected in December 2000 from a number of locations within the Iron Ore Company mine area. The location of individual samples was estimated in two ways. First the location was measured using a hand-held Garmin GPS system. Surprisingly this gave answers in most locations. However there are two limitations to this procedure. First, the Garmin unit that we used is not capable of providing a resolution of better than 15m without additional base station correction. Second in the deep pits it is possible to have significant multi-path interference effects that will bias the observed location point. The GPS approach gave site locations in UTM coordinates. The second method of sample location was by reference to a detailed site map provided by IOC. Using this map it was possible to locate the sample position to better than 5m. A digital estimate of the sample location was then subsequently derived by mapping the site location within AutoCAD. The specimen location could then be estimated in the mine site coordinate system. Conversion from UTM coordinates to mine coordinates could possible be achieved through the use of a simple conversion routine. Based on current review it is felt that the map extraction procedure provides a better estimate of the sample location.

All samples were oriented in the field. The inclination of the oriented surface was measured using a standard inclinometer. Three methods were tried to estimate the azimuthal orientation of the specimen. The first method used a standard magnetic compass. Local changes in the Earth's magnetic field vector associated with the iron ore produced large and non-systematic changes in compass. This method offers the least reliability. A second approach involved the use of a sun-compass. Simply, knowing the relationship between time and movement of the Earth relative to the Sun it is possible to derive a direction estimate. This procedure is extremely reliable and is easily capable of providing orientation estimates that are better than 5°. Of course the major limitation to this method is that it requires adequate sunshine. During the field collection this was limited because a) the weather was very poor, and b) the high walls of the pits and the low inclination of the sun during winter only permits line-of-sight views of the sun for short periods of time. This was further compounded by the generally N-S orientation of the pits. With longer days and a steeper sun angle during the summer this method will be very effective. The third approach used a modified triangulation procedure. This procedure assumed that it was possible to estimate the general orientation of the rock face in the proximity of the sample from the detailed survey maps. The trend of the orientation azimuth was then measured relative to the local rock face. The absolute orientation of the sample was then derived from a combination of deviation angle, rock face orientation, AND a correction for the rock face being estimated in mine coordinate space. It is estimated that this procedure gave orientation of a sample to within 10°. Extreme caution must be exercised when using this procedure since it is quite easy to misalign the direction one is estimating. Accordingly we made a field sketch of each location where this procedure was used. As a direct result of the inclement conditions this is the orientation procedure that we most commonly adopted.

Laboratory Sampling Procedure:

All laboratory measurement procedures have been standardized around a 1 inch diameter by 1 inch long specimen. Our objective was to obtain three core specimens from each oriented sample. The samples when collected were frozen. When we drilled the samples they had become unfrozen. In a few cases we were not able to obtain any specimens from the sample blocks (locations 6, 46, 41 and 42). They crumbled in to a powder after they became unfrozen. Defrosting also caused some problems with sample identification. Specifically the exact orientation of samples 19 and 23 is questionable.

Cores were drilled perpendicular to the oriented reference surface. These were then referenced relative to the orientation line. Subsequently the cores were sliced into 1-inch lengths. A specimen nomenclature system was adopted where #A, #B, and #C refers to separate specimens from each sample. A number such as #B2 indicates that this is a second specimen from the same core as the #B specimen.

Most cores were drilled much longer than the required 1-inch length. The cut-off fractions have been numbered and preserved for future potential petrological and geochemical analyses.

Laboratory Measurement Procedures:

Density

Dry density is defined through two measurements of sample weight, the weight of the sample measured in air and the weight of the sample suspended in water. Caution must be exercised in this method since air trapped in the pore structure of the sample can affect the sample weight measured in water. Since it is possible to use the same information to calculate the specimen volume this was used as a method for checking the validity of the density calculation. All specimens were cut to the same size. Hence the volume could not exceed an expected value. This was set at 13.00 cc. The density of any specimen that had an apparent volume of greater than this threshold value was recalculated with a volume of 12.61 cc (the modal value for all specimens).

Magnetic Susceptibility

All magnetic susceptibility measurements were made with a Bartington MS-2 susceptibility bridge. Two different sensor coil configurations were used. Firstly, the bulk susceptibility (Z-axis) of each specimen was measured using the standard laboratory B sensor. This has a limited dynamic range. Specifically it is designed for use with common rock specimens. Iron ore does not fall into this category. Many of the specimens gave values that over-ranged the limit of this sensor. Unfortunately since the read out is limited to a four-digit display it was not possible to tell if over-ranging had occurred or not. The specimens were then re-measured using the C core-logging sensor. The diameter of the sensing coil for this sensor is much larger and is therefore capable of reading all of the values.

During the measurement procedure the sensor coil system was reset to zero at regular intervals. In addition two reference samples with known susceptibility value were also measured after every ten field specimen measurements.
Since the reference specimens were measured with the two coil sets it was possible to recalculate the bulk susceptibility to a value consistent wit apparent measurement with the B sensor.

Iron formation samples are known to have significant magnetic fabrics. In many cases the susceptibility may vary by up to an order of magnitude between different axes within the specimen. To address this problem the magnetic susceptibility fabric of each specimen was measured using the C coil sensor and the AMS-BAR program written by the author. After correction for specimen orientation this program gives the relative magnitude and orientation of the susceptibility tensor for each specimen relative to the current horizontal surface. For the purposes of magnetic anomaly modeling one might conceive of an "effective susceptibility" value; this would be the susceptibility in the direction of the local Earth's magnetic field direction. For example, if the fabric defined a strong flat-lying foliation it is quite possible that iron-ore could produce only a minimal magnetic anomaly. Calculation of the "effective susceptibility" was derived through a comparison between the orientation of the Earth's magnetic field the orientation of the fabric susceptibility axes, and the magnitude of the susceptibility on those respective axes.

Like most susceptibility instruments the Bartington system operates through an inductive flux measurement. Since electrical conductivity and magnetic susceptibility are related by a 90° phase difference these systems are sensitive affected by highly conductive specimens. Generally this is reflected by a reduction in the apparent susceptibility value reported by the instrument. In this study no attempt has been made to correct for electrical conductivity effects.

Magnetic Remanence

All magnetic remanence measurements were made using a Schonstedt SSM-1A spinner magnetometer. Each measurement comprised 12 readings of the magnetic field induced in the fluxgate sensor. The12 readings reduced to 4 readings of the magnetic vector along three orthogonal axes X, Y and Z. The magnetic remanence vector was calculated from these values and then corrected for specimen orientation.

Two values of sample mean magnetic remanence have been calculated. For magnetic anomaly modeling purposes it is the vector average that is important. That is, the magnitude of each specimen is used in the mean vector orientation. For paleomagnetic and structural applications no weighting is applied to each vector. Rather the sample mean direction is calculated using standard Fisher statistics.

Saturation remanence analysis of the specimens was performed using a ASC pulse magnetizer. Each specimen was measured after being subjected to three different direct magnetic fields. First, the specimens are magnetized at the maximum achievable with the pulse magnetizer (1.1 Tesla). This produces a *saturation magnetization*. Then two subsequent magnetization steps are applied in opposition to the saturation magnetic field. The 3 and then 30 mT steps are designed to separate magnetic fractions on the basis of their coercivity spectrum. In effect the 3mT corresponds to magnetite, while the higher 30mT step corresponds to fine-grained magnetite and hematite. From these measurements it is possible to derive estimates of the varying magnetic mineral content of each specimen.

Gamma Ray Spectrometry

Gamma Ray spectrometry measurements were performed using an Exploranium GRS 320. The specimens were placed inside a lead walled container and then the spectrometer was placed on top. Calibration of the system was achieved in two ways. First, channel calibration was achieved with an internal Cs reference. Second, calibration of elemental content was derived through prior measurement of a suite of reference samples with known potassium content.

Results:

The results of this study are summarized in the accompanying Excel spreadsheet. The last worksheet provides the overall values for each sample. Results from each pit are presented in a series of plots. Each of these plots presents the following information: a) the magnetic remanence direction data, b) the magnetic fabric data, and c) the magnetic rock property data.

Rock Property Measurements

Remanence directions are presented relative to the present horizontal. For the purposes of magnetic anomaly modeling it is the remanence direction relative to the present horizontal that is appropriate.

No attempt has been made to calculate a fold test. Since the measured direction is the NRM, which might represent a vector sum of both present Earth's field and a number of old remanence directions it was felt that attempting a fold test would not be profitable. Rather I have adopted a compromise approach. Assuming that there is some component of pre-folding magnetization present in the specimens then the remanence directions should exhibit a small circle distribution. Further the axis of this small circle must correspond to the fold axis. Hence, I found the best-fit small circle to the data from each of the individual pits. This procedure gave some interesting results. First, it suggested that there are some variations in the trend of the axial planar surfaces of the folds. Second, it suggested that there are some noticeable differences between results from the northerly and southerly pits. Because of the variation in axial fold direction the small circles define intersection points. These intersection points represent the only remanence direction that is common. As such they represent the best estimate of the pre-folding magnetization direction. Taking this one set further suggests that over the extent of the mine area we observe a change in remanence polarity. Humphrey South, which lies in the middle of this transition, gives remanence directions that are also transitional between the two polarity states.

Specimens exhibited a wide range of anisotropy. Some specimens have little, or no anisotropy. In others it was quite marked. Both lineation and foliation fabrics are present within the site. To overcome the impact of magnet fabric on magnetic anomaly modeling I have introduced the concept of "effective susceptibility". This is defined as the component of the magnetic susceptibility in the direction of the present Earth's magnetic field. It will be noticed that the "effective susceptibility" is only occasionally noticeably different from the "bulk susceptibility". This arises from the fortuitous circumstance that at this site the majority of rocks are steeply dipping. The areas of fold closure where the magnetic fabrics are sub-horizontal are of only limited occurrence.

As might be expected the magnetic fabric measurements are also subject to the same fold axis rotations as the remanence direction data. Indeed this provided an additional check on the ability to define the orientation of the fold axis. Plots of fabric directions from the individual pits present the orientation of the fabric maxima (stars) and fabric minima (triangles). Groupings of maxima are indicative lineation fabrics, while groupings of minima define the pole to foliation fabrics. Numerous overlaps occur. Many specimens have both foliations and lineations.

Koenigsberger ratio of remanence and induced magnetic field strengths were derived using applied field strength of 60,000 nT. Plotting induced versus remanent show that for the majority of samples in the study area the induced magnetic field predominates. Indeed all of the most strongly magnetised samples have predominant induced magnetizations. Hence use of the present Earth's field direction would provide a first level estimate of the applied magnetic vector for modeling purposes.

Density values represent a combination of particle mass and pore space. Massive samples give higher density values, increased pore space leads to a reduction in density. Additional measurements of the wet density will be performed on these specimens. From these measurements we will be able to derive a porosity estimate for each specimen.

Magnetic Property Measurements

Rocks containing different phases of iron-rich minerals can often be distinguished on the basis of their magnetic characteristics. Magnetic susceptibility and saturation remanent magnetization are controlled by the oxide mineral content, oxide grain size, and oxide composition. As the specific magnetization of magnetite is much higher than most other magnetic minerals the amplitude of the susceptibility value is commonly taken to ~~be~~ assay ~~of~~ the magnetite content. While providing first order information this may be quite misleading. First, as noted in this study the presence of a magnetic fabric might substantially change the susceptibility value that one measures. Second, the assay assumes that there are NO changes in magnetic mineralogy, or grain size. In the iron formation these assumptions might be invalid.

Accepting the assumption of uniform mineralogy and uniform grain size then a plot of magnetic susceptibility versus saturation remanence should give a single straight line that corresponds to the varying content of magnetic mineral present in the sample. Data from this study shows that this is not true. Rather the data appears to suggest that there are two quite distinct linear trends in the data. One (phase) trend is characterized by a higher remanent magnetization than the other.

Backfield analysis is based on the hysteresis properties of the minerals and is therefore independent of the magnetic mineral content rather it is controlled by magnetic mineral composition and grain size. Through a process of selecting backfield levels it is possible to obtain some estimate of the variation of magnetic mineralogy within the site. Two backfield values were used, 3mT and 30mT, these effectively separate magnetite from hematite and fine grained hematite. In this study I have adopted the terms "soft", "hard", and "very hard" to represent, respectively, this potential mineralogical variation.

A three-dimensional cross-plot of these values again indicate that there are two quite distinct population within the mine site. It is possible to examine the spatial variation of these properties by converting each sample observation to a simple pie-chart and then placing this on the map. (The "soft" component is blue, the "hard" component is red, and the "vhard" component is beige). The result is quite striking. First, there is quite clearly a zonation of mineralogy. It is possible to distinguish zones characterized by variations in the percentage of the "hard" component. Second, the change from one type of mineralogy to another appears to quite sharp. There are some localities where ~~one~~ changes from ~~the~~ type of mineralisation to the other over a relatively short distance.

As a final approach to lithological discrimination, I calculated the ratio of the "soft" component to the sum of the "hard" and "vhard" components. I then constructed a histogram of the ratios. The difference between the "soft" and "hard" components is quite distinct. As is suggested by the other plots, there are only a few sites that have a significant~~ly~~ content of the "hard" magnetic mineral phase. This histogram plot, however also suggests that that there may be two distinct phases of the "soft" magnetization phase. Indeed a cluster analysis of the ratios does identify three distinct clusters. Looking again at the pie-charts it is possible to distinguish samples that have almost no "hard" phase from those that have a little (~10%) of the "hard" phase present.

On the basis of the information currently available it is possible to show that the magnetic property measurements are discriminating variations in the mineralogy of the iron ore. The boundaries between individual phases appear to occur over short distances. There is some repetition ~~of the~~ across the mine. Interspersing of the three phases can be seen in a number of the pits. It is quite probable that this methodology is actually discriminating lithological variations within the iron formation. However, this remains to be proven through a combination of petrological study of the current samples and a future study of a suite of stratigraphically controlled samples.

Recommendations:

Immediate future:

The data produced in this report suggest that magnetic property studies can provide information regarding the systematic variation of mineralisation within the pit environment. Currently we are dependent upon the interpretation of some geophysical values. What do these actually represent in terms of mineralogical variations. This can only be achieved through mineralogical and petrological assessment of the samples. I am shipping the rocks onto McGill so that this information can be obtained. Further there is question of what this information means in terms of iron content. It would be helpful to establish what these results mean in terms of ore grade.

Near term:

In thinking about how one proceed from our current position I came up with three notions:

a) Regional studies. Part of the objective associated with this study was to provide some base information that might of use to better constrain geophysical models of the source rock. Ideally it would help to decide on which land holdings to retain. To date all of the samples we have examined are from the immediate mine area. Samples should also be examined from the wider property area. Can we be certain that the magnetic properties and specifically the magnetic fabrics that we see at the mine site can be extended to all other areas? A larger regional sample area would address these concerns.
b) Mine Site studies. The information that we have to date provides some clues about the variation of magnetic properties among the various pits. There is a strong suggestion that there are some systematic changes in remanence direction from north to south across the pit area. There are some clear indications that the magnetic property measurements are defining spatial variation in the mineralogy. The magnetic fabric information contains information about spatial variations in foliation and lineation. In addition to having an impact on magnetic modeling it is suspected that this might also impact of the extraction process. The samples examined in this study were collected under very difficult field conditions. A more detailed sampling program collected during better weather conditions would permit more exact orientation measurements and the recording of more field geology information. It is anticipated that this type of survey would add to knowledge base of systematic variations on mineral types within the mine.
c) Production studies. Planning for future extraction usually involves an extensive drilling program. This provides a core with well defined stratigraphic horizons. This study has shown that simple magnetic susceptibility measurements will probably not provide direct evidence of mineral grade. It would be useful to establish physical property variations from a grid of 5 holes. This would allow one to establish what physical properties can be used to identify specific stratigraphic horizons, and it would also what properties might be used to differentiate ore grade mineralisation. This might be considered as a precursor to developing a systematic borehole logging program.

W. A. Morris

Table 1. Summary of Physical Properties.

	LOCATION		NRM VECTOR			EFFECT	NRM DIRN		FABRIC MAX		FABRIC MIN		MAGNETIC MINERALOGY			DRY
	EAST	NORTH	DECLN	INCLN	INT	SUSC	DECLN	INCLN	DECLN	INCLN	DECLN	INCLN	% SOFT	% HARD	% V HARD	DENSITY
SPOOKS																
S4	1283.1	15467.4	207.8	12.9	0.4	201.6	215.2	12.1	160.7	40.6	348.3	48.8	72	27	1	3.41
S5	1274.5	15621.4	350.1	76.1	0.6	66.8	355.9	74.8	274.7	39.1			74	23	2	3.21
S6	1525.9	16011.3														
S7	1484.0	16124.6	22.5	-12.1	216.8	60.3	27.7	-11.9	243.4	41.4	152.9	2.9	92	6	2	3.39
S8	1289.3	15296.2	149.5	53.6	56.7	3.2	157.6	49.9	135.1	18.5	28.8	39.7	81	16	3	3.20
S9	1217.8	16168.9	136.2	17.1	30.3	223.0	137.6	21.5	109.2	10.6	8.7	43.0	57	38	5	3.05
S10	1216.5	16154.2	148.0	9.3	5.6	32.5	148.6	8.8	176.6	50.1	11.8	39.3	77	6	17	3.21
S11	1322.5	16096.3	347.6	6.7	73.6	663.8	347.9	6.3	58.3	41.7	182.7	35.0	78	20	2	3.49
LORRAINE																
L1	-58.4	14402.7	89.5	27.3	19.6	236.9	89.6	27.9	279.3	56.6	121.4	32.0	88	12	1	3.11
S2	314.9	14449.6	220.3	33.5	0.0	0.0	217.7	35.0								3.19
S3	376.0	14791.6	244.0	42.1	0.0	0.0	268.6	37.1								3.20
L12	-162.1	13886.5	213.5	-16.9	15.1	47.3	216.9	-18.9	178.7	44.6	297.7	25.6	55	40	5	3.20
L13	-117.1	13871.7				229.0							51	49	0	3.49
L14	58.1	14415.0	118.7	58.8	0.1	157.3	117.7	50.7	25.3	63.4	195.2	25.7	57	26	17	2.92
L15	84.2	14413.7	40.6	31.9	92.6	85.9	40.7	32.8	50.9	24.8	293.6	44.0	77	16	7	3.22
L16	136.5	14417.7	51.3	5.8	23.2	16.1	53.9	6.1	346.1	46.9	93.9	16.0	71	26	3	3.21
L17	174.8	14439.2	88.3	37.5	23.6	142.4	88.9	37.3	57.1	60.3	200.7	21.7	63	31	6	3.04
L18	189.5	14285.2	206.5	-25.4	3.5	73.7	209.0	-19.0			210.0	35.3	86	11	2	2.77
L19	172.8	14200.1	45.7	26.1	90.1	20.9	47.9	29.1	130.0	76.1	218.9	0.7	53	35	12	3.22
L20	116.4	13888.6	221.0	64.7	195.1	1829.3	214.5	60.5	309.6	39.4	191.1	30.9	96	1	3	3.42

→ Local grid

ADD columns of "real space" geo-referencing (UTM eastings and northings).
(To within 15m is good relative to most studies.)

LOCATION			NRM VECTOR			EFFECT	NRM DIRN		FABRIC MAX		FABRIC MIN		MAGNETIC MINERALOGY			DRY
	EAST	NORTH	DECLN	INCLN	INT	SUSC	DECLN	INCLN	DECLN	INCLN	DECLN	INCLN	% SOFT	% HARD	% V HARD	DENSITY
HUMPHREY MAIN																
HM21	769.5	12264.9	335.7	49,8	152.0	832.2	335.6	49.9	93.5	13.3	0.0		93	6	1	3.22
HM22	767.0	12402.9	274.2	44.8	133.1	1509.7	268.7	45.9	110.8	16.9	355.0	55.0	96	4	1	3.22
HM23	873.0	11923.6	115.7	-27.3	78.8	39.8	112.6	-23.9	305.9	43.2	176.1	40.7	89	7	4	3.25
HM24	758.4	11741.3	306.4	4.7	212.0	867.9	307.0	15.4	306.8	11.3	214.5	33.3	97	3	0	3.60
HM25	770.7	12576.9	39.8	0.2	36.7	54.1	39.4	-1.6	93.1	12.2			90	8	2	3.24
HM26	781.8	12720.2	30.4	52.2	43.5	72.2	31.0	58.3	267.2	40.2	8.8	8.4	78	18	5	3.34
HM27	781.7	12774.4	26.3	-35.7	201.4	545.1	36.3	-32.7	179.1	39.2	327.9	39.7	94	5	1	3.61
HM28	780.6	12956.0	293.7	-57.9	184.3	959.7	294.8	-59.4	110.4	40.5	322.9	45.0	89	9	2	3.14
HM29	780.6	12956.0	37.9	1.2	99.2	2342.5	35.4	1.3	200.3	10.8	292.2	13.5	84	16	1	4.29
HM30	609.4	13703.9	130.7	-27.1	110.4	84.5	130.3	-28.5	195.9	37.3	53.8	51.1	84	16	0	3.56
HM31	649.7	13936.9	336.3	57.9	13.0	0.6	336.1	56.4					69	26	4	2.67
HM32	640.3	14318.9	158.9	27.3	44.5	270.2	156.1	21.5	183.9	48.1	3.8	38.2	54	33	13	3.88
HM33	651.7	14533.9	156.2	45.8	66.9	603.7	161.4	42.7	293.0	27.0			78	14	7	3.19
HM34	851.7	14710.9	129.3	21.9	7.6	6.6	134.1	22.1	200.4	33.3	83.3	35.0	51	25	24	3.60
HM35	762.4	13458.1	347.7	24.9	58.5	495.8	347.5	27.6	268.9	5.5	356.5	7.0	93	6	1	2.94
HM36	775.2	13248.9	35.2	-12.5	71.1	85.3	33.7	-17.2	127.6	13.7	21.3	49.1	75	20	5	3.42
HM68	-65.1	12452.4	74.1	36.0	87.7	558.6	75.9	34.0	52.9	15.1	159.6	51.5	86	4	10	2.99
HM69	39.7	12511.5	353.0	-17.7	59.9	314.9	352.3	-17.1	202.6	19.4			87	13	0	3.19
HM70	109.9	12406.8	27.1	22.1	81.0	428.4	26.1	17.8	77.7	33.6	322.8	33.7	91	9	0	3.11
LUCE																
LU37	2419.9	6880.9	358.4	54.9	0.4	575.1	0.3	52.9	293.6	37.3	180.3	28.0	87	13	0	3.11
LU38	2491.9	6916.7	18.1	-4.9	132.4	841.6	17.0	-5.8	333.6	45.5	235.0	8.9	93	6	1	2.98
LU39	2541.3	6999.1	43.3	61.5	8.6	120.2	32.8	67.9	109.9	53.3	19.5	-0.7	86	10	4	3.21
LU40	2553.1	7060.4	342.3	65.6	5.3	122.3	330.8	58.0	107.5	46.1	205.8	7.9	84	13	3	3.07
LU41	2668.6	7246.4														
LU42	2328.5	7060.9														
LU43	2303.3	7011.9	19.6	-13.7	28.9	171.2	20.1	-13.2	295.3	14.0	38.1	41.3	61	36	3	2.56

LOCATION			NRM VECTOR			EFFECT	NRM DIRN		FABRIC MAX		FABRIC MIN		MAGNETIC MINERALOGY			DRY
	EAST	NORTH	DECLN	INCLN	INT	SUSC	DECLN	INCLN	DECLN	INCLN	DECLN	INCLN	% SOFT	% HARD	% V HARD	DENSITY
HUMPHREY SOUTH																
HS44	14.7	9962.2	204.3	46.2	0.1	5.5	207.0	37.7								3.27
HS45	-147.4	9008.5	65.6	56.1	0.0	197.5	65.6	56.1					52	29	19	2.87
HS46	-132.9	9113.7														
HS47	-95.4	9379.9	232.2	9.6	111.2	1189.9	232.6	11.1					68	33	0	3.13
HS48	-44.6	9335.2	277.1	-16.9	118.6	1087.5	283.8	-13.6	158.4	37.2	31.1	39.0	89	11	0	3.28
HS49	-43.4	9384.7	99.1	-31.8	69.2	343.4	96.2	-33.2	236.8	61.7	142.1	7.1	63	36	1	2.95
HS50	-161.9	8244.2	273.7	-51.6	147.5	78.9	274.0	-51.5	311.1	37.4	191.8	32.5	71	24	5	3.12
HS51	-132.3	8246.6	340.9	-25.2	31.5	184.9	340.4	-21.9	336.9	66.2	200.6	18.8	58	36	6	3.18
HS52	-114.7	8244.2	295.0	29.0	77.7	44.1	291.7	29.1	355.9	35.8	244.3	23.6	87	12	0	3.22
HS53	-238.1	8235.7														
HS54	-217.5	8241.8	246.7	-46.3	57.0	104.4	254.5	-49.3	211.7	19.9	107.7	32.8	50	39	11	3.34
HS55	-190.9	8241.8	299.4	56.6	34.8	573.4	295.2	56.0			116.9	19.3	62	36	2	3.31
HS56	-113.5	8346.9	332.6	3.2	50.9	142.7	334.4	3.8	281.0	34.4	170.4	27.2	59	35	6	3.06
HS57	-84.5	8608.8	277.4	33.4	2.6	3.8	278.4	33.5					52	16	32	2.72
HS58	-65.1	8591.9	218.9	-71.3	15.5	88.2	217.0	-69.6	228.5	56.0			86	14	0	2.25
HS59	3.8	8607.6	316.6	1.6	151.2	456.6	314.3	-8.7			228.0	45.0	88	12	0	3.84
HS60	44.9	8612.4	138.7	43.2	44.4	207.9	139.1	46.9	63.9	23.2	232.8	63.1	58	39	2	3.12
HS61	94.5	8641.1	281.7	56.4	0.0	3.6	285.2	46.0								2.72
HS62	117.5	8707.6	273.8	53.5	231.2	1205.7	272.8	53.6	51.4	53.6	233.2	35.7	78	21	0	3.16
HS63	69.1	10142.3	42.8	-35.1	102.3	569.8	36.2	-42.0	91.8	55.3	185.4	3.2	89	11	0	3.26
HS64	112.7	10326.8	282.1	2.8	349.3	1253.2	279.5	1.9	291.0	33.7	152.5	49.6	96	4	0	3.31
HS65	163.5	10774.3	253.4	-39.1	3.9	71.5	249.0	-25.6	91.1	41.0	241.9	45.2	81	10	8	2.96
HS66	194.9	10694.5	302.2	-5.4	235.7	1597.2	302.5	-9.6	250.7	45.5	20.1	30.2	97	3	0	3.48
HS67	232.4	10945.9	208.2	73.4	254.8	706.6	208.6	73.3	290.4	31.4	37.7	25.7	90	6	3	2.91

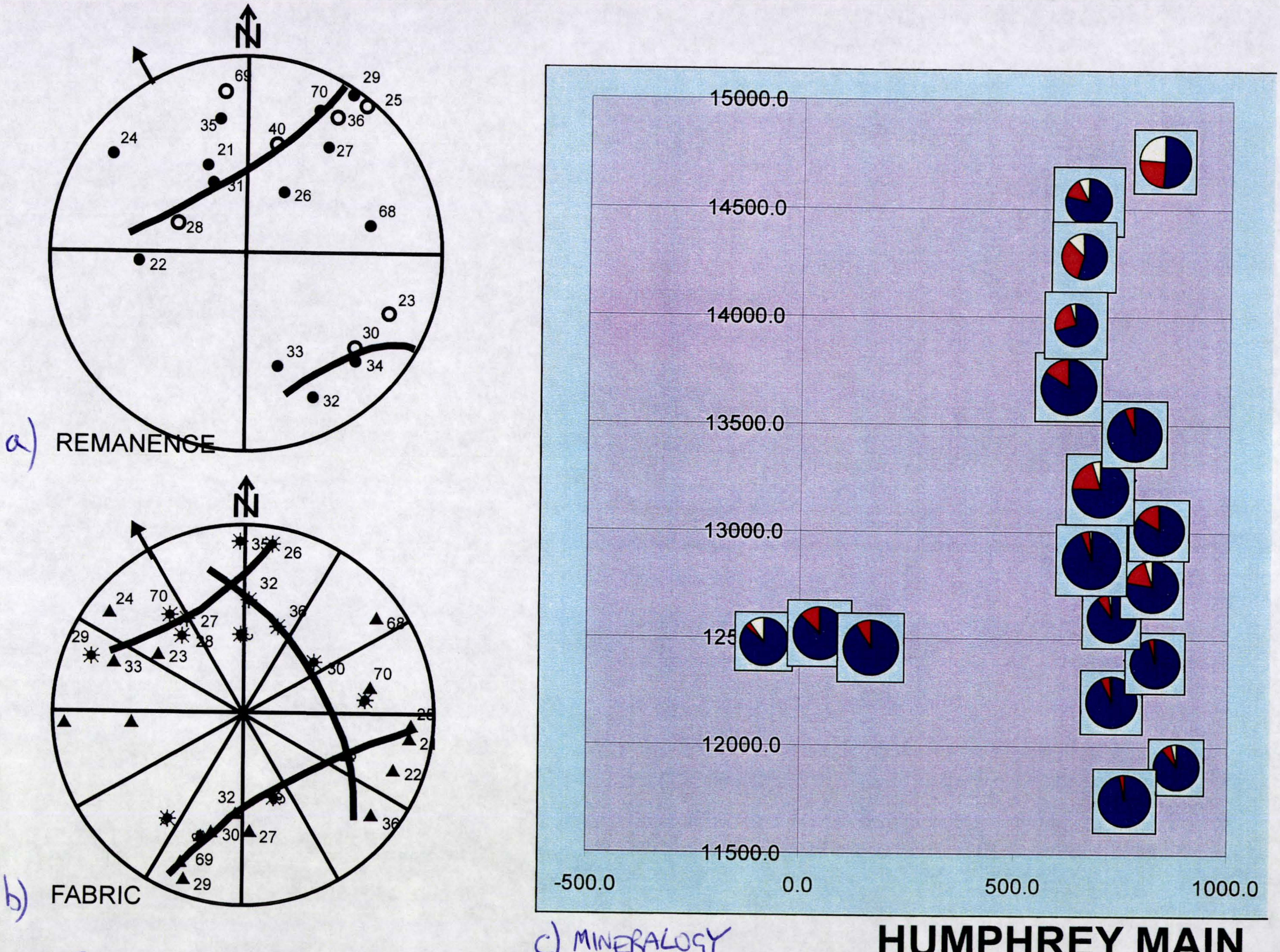
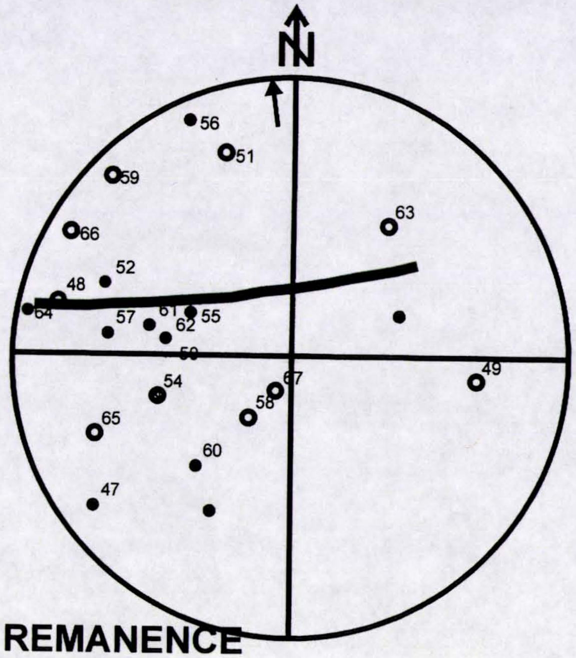

N
a) REMANENCE
N
b) FABRIC
15000.0
14500.0
14000.0
13500.0
13000.0
12000.0
11500.0
-500.0
0.0
500.0
1000.0
c) MINERALOGY
HUMPHREY MAIN

Figure 2.



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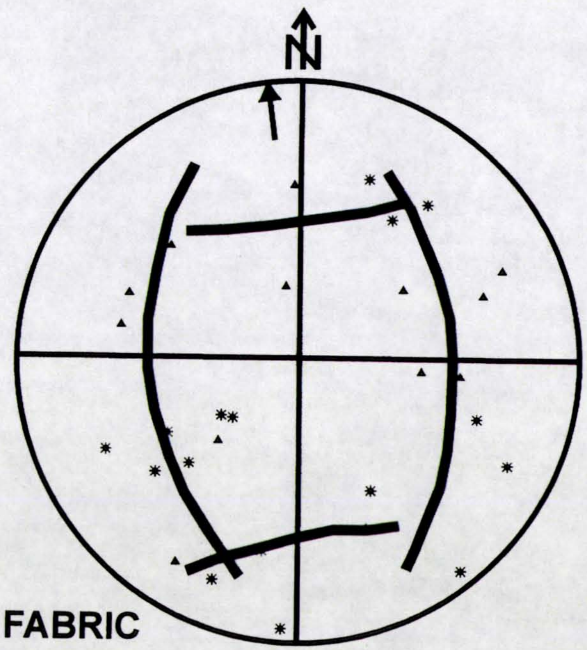

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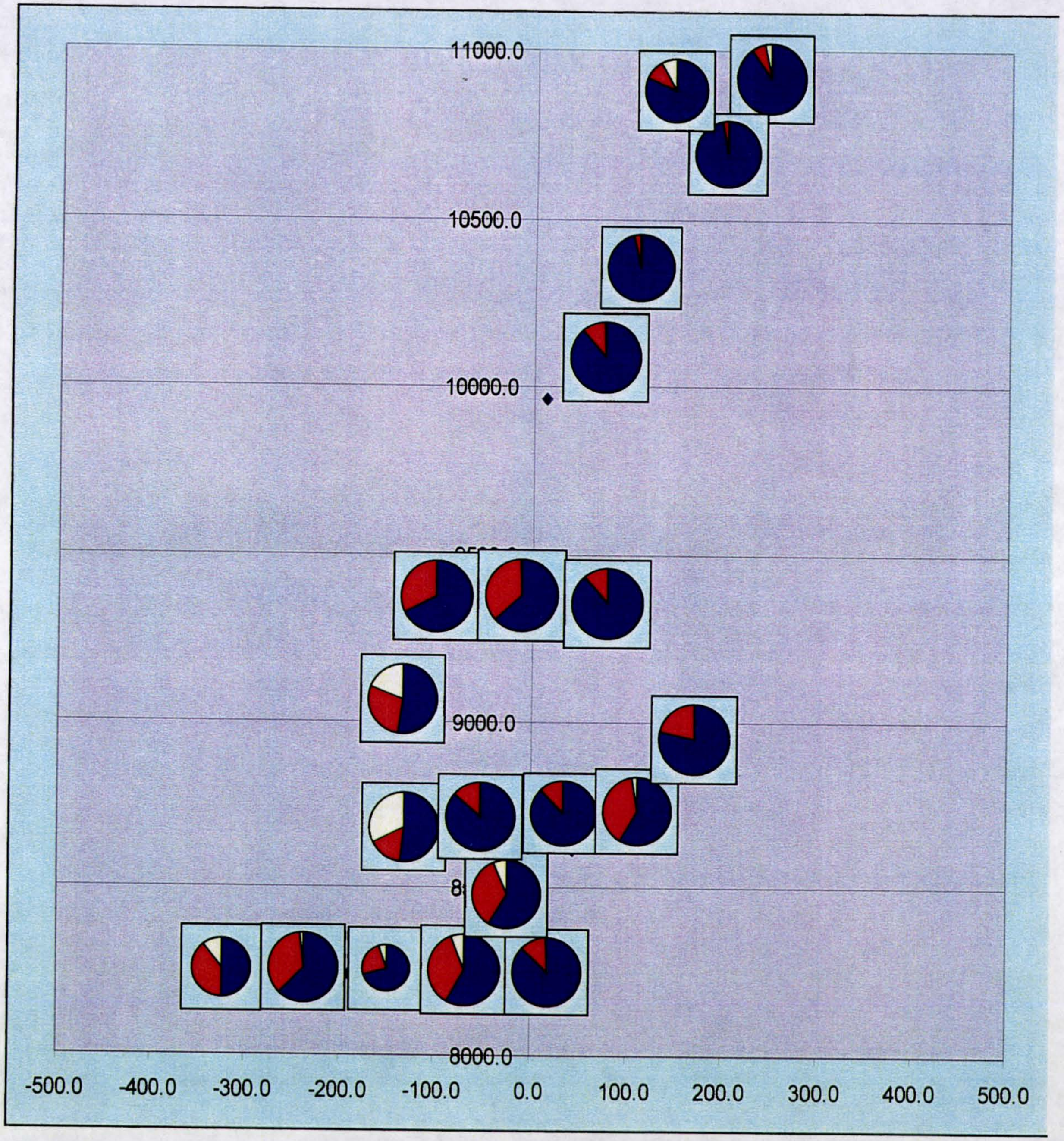
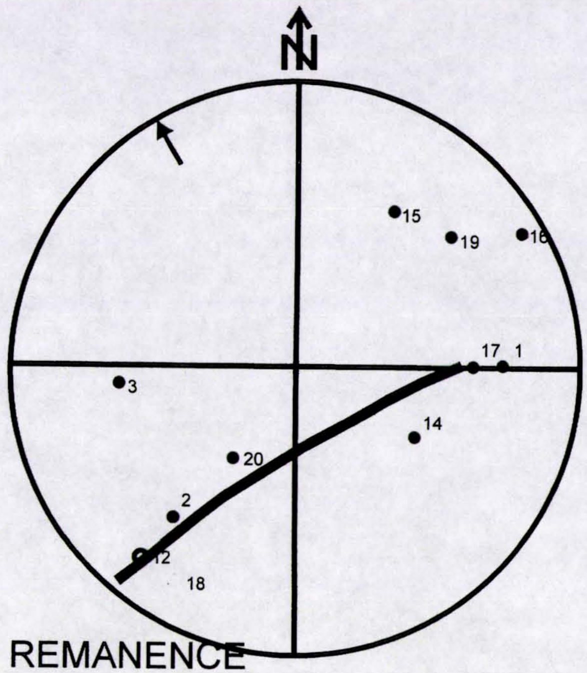


HUMPHREY SOUTH

Figure 3. etc.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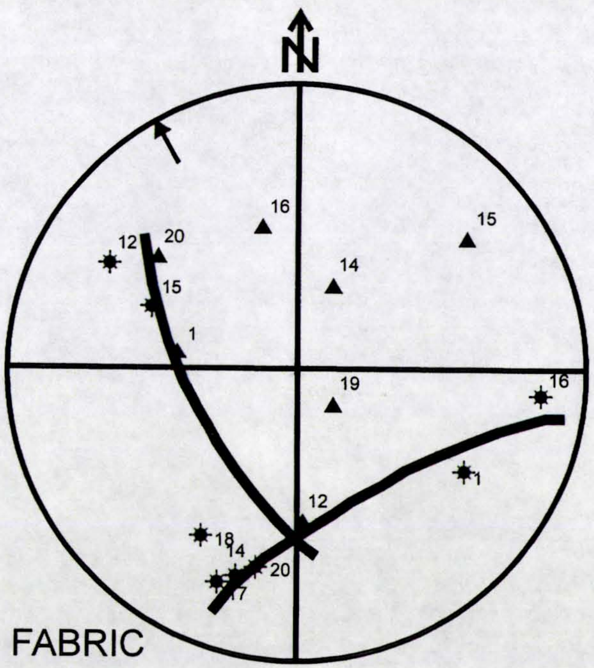
15
19
16
17
1
3
14
20
2
12
18
REMANENCE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1
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14
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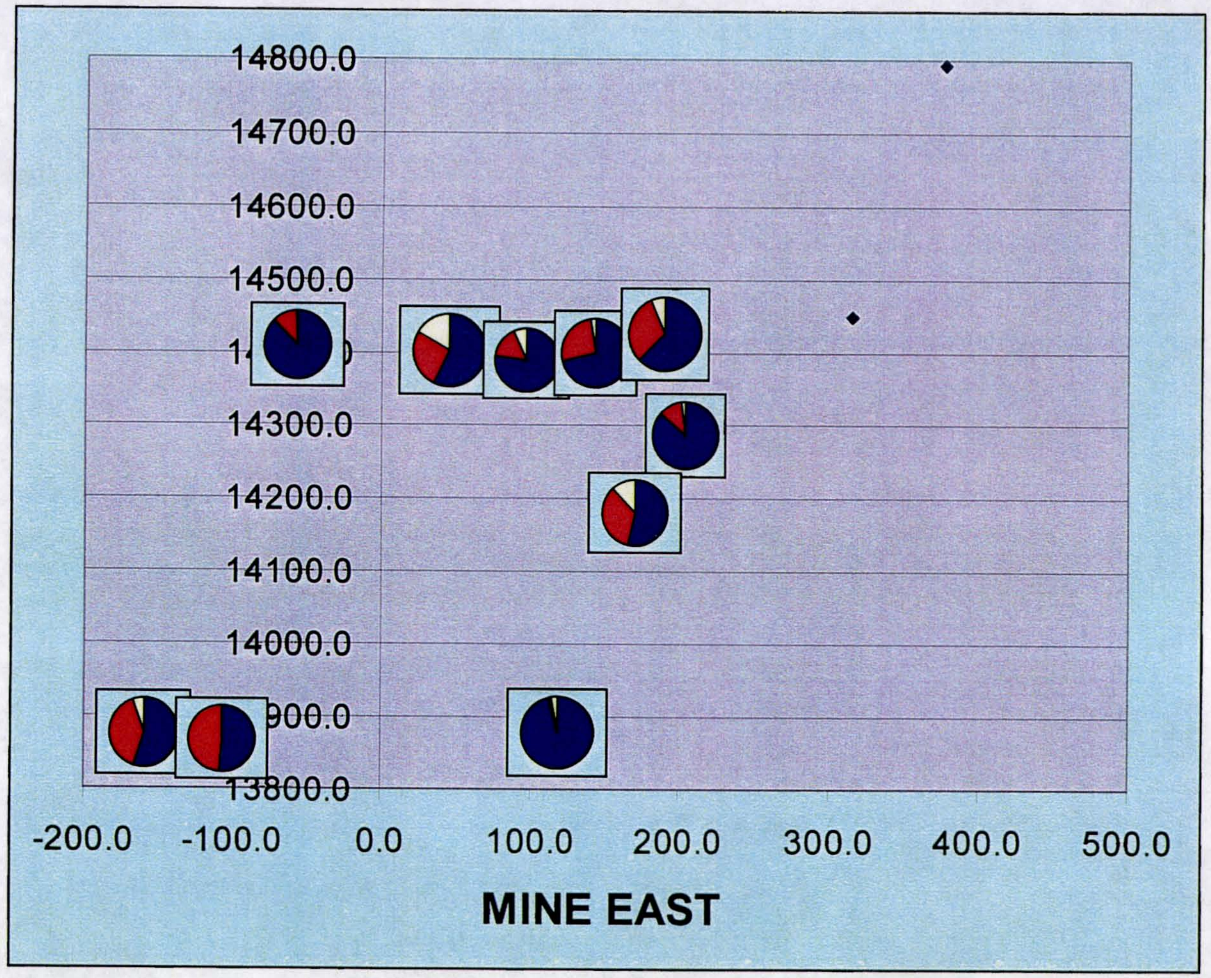
17
FABRIC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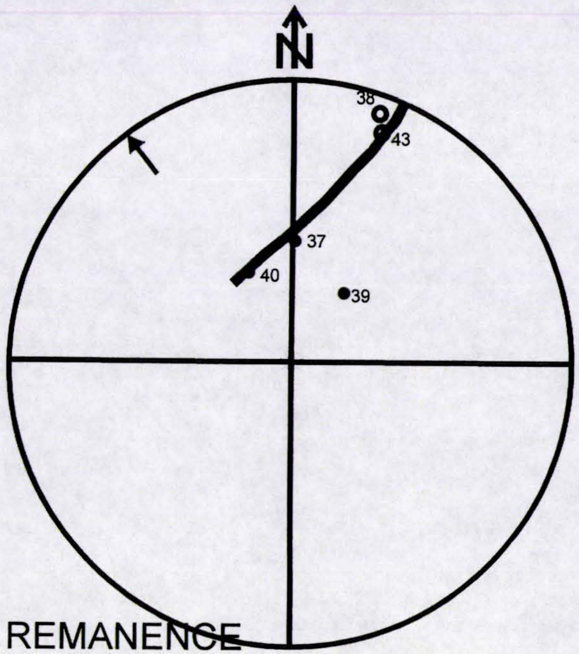
-100.0
0.0
100.0
200.0
300.0
400.0
500.0
MINE EAST

LORRAINE



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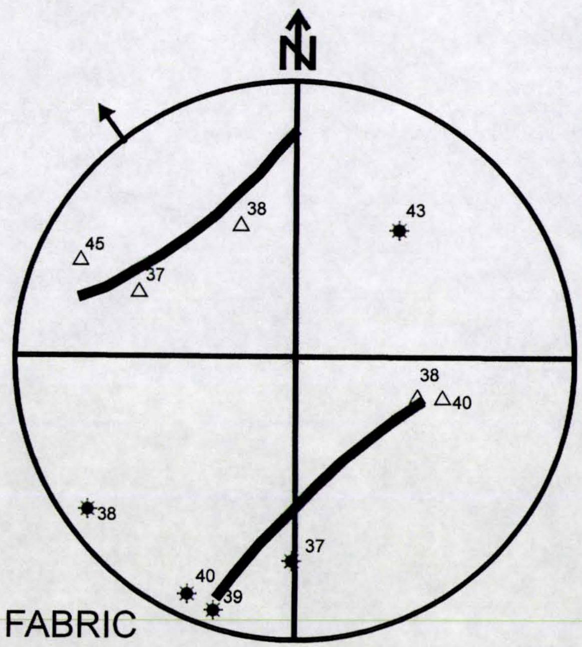
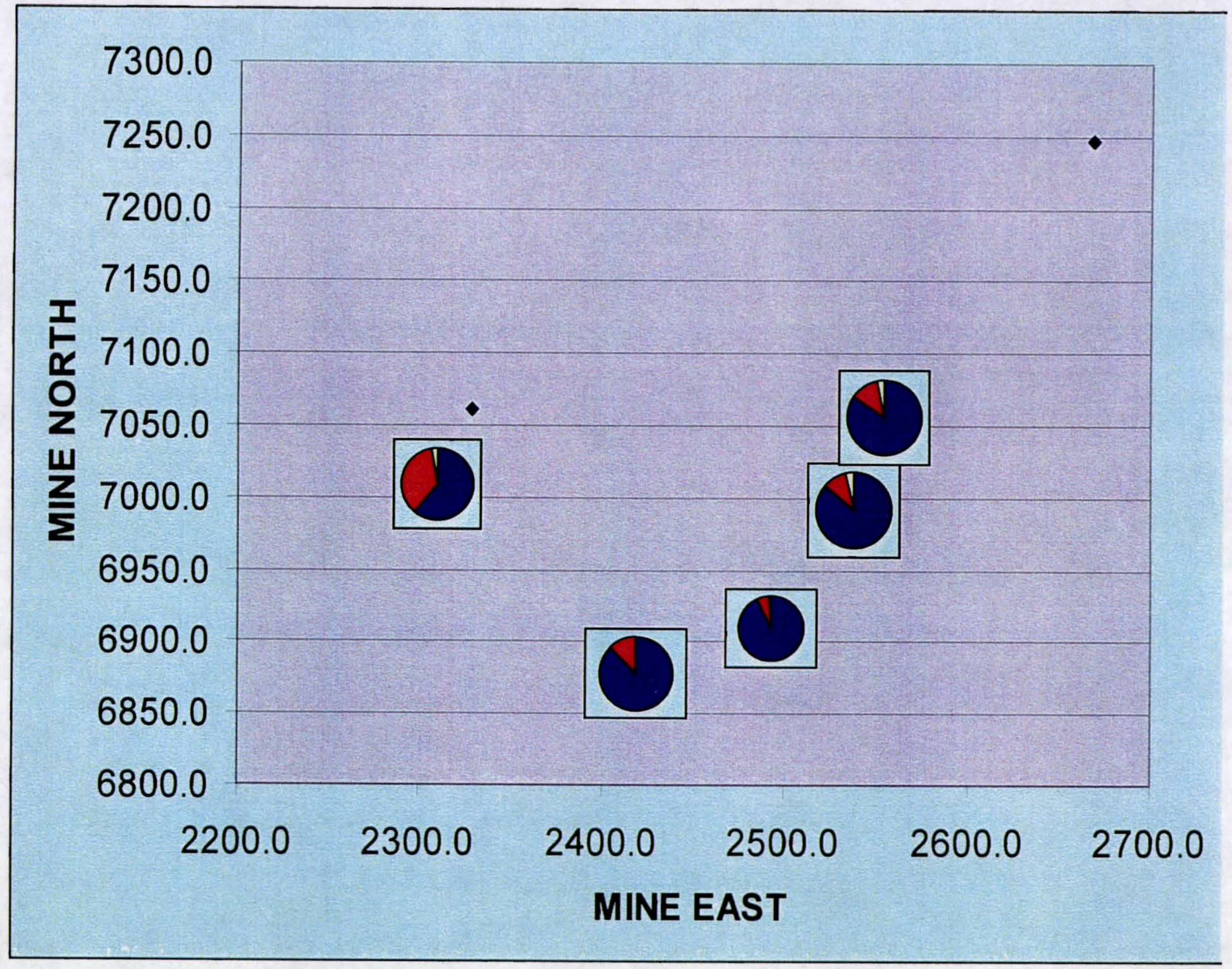
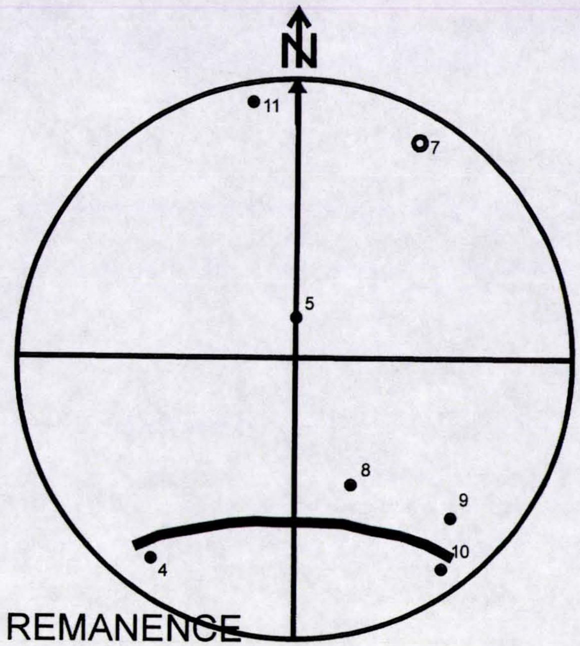
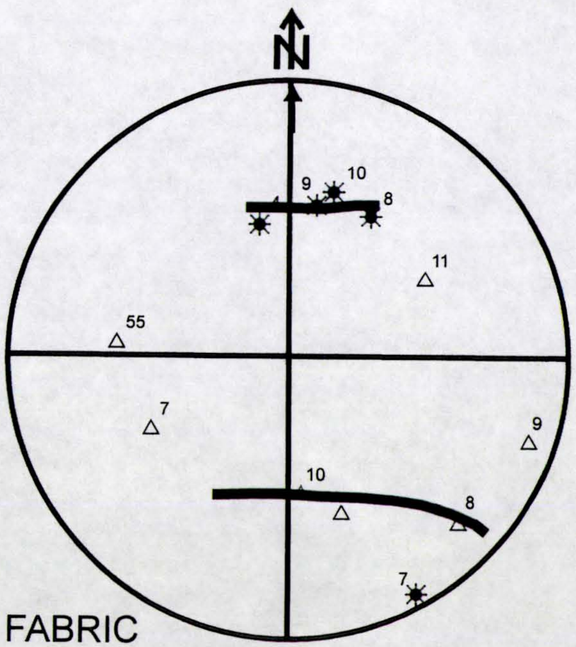


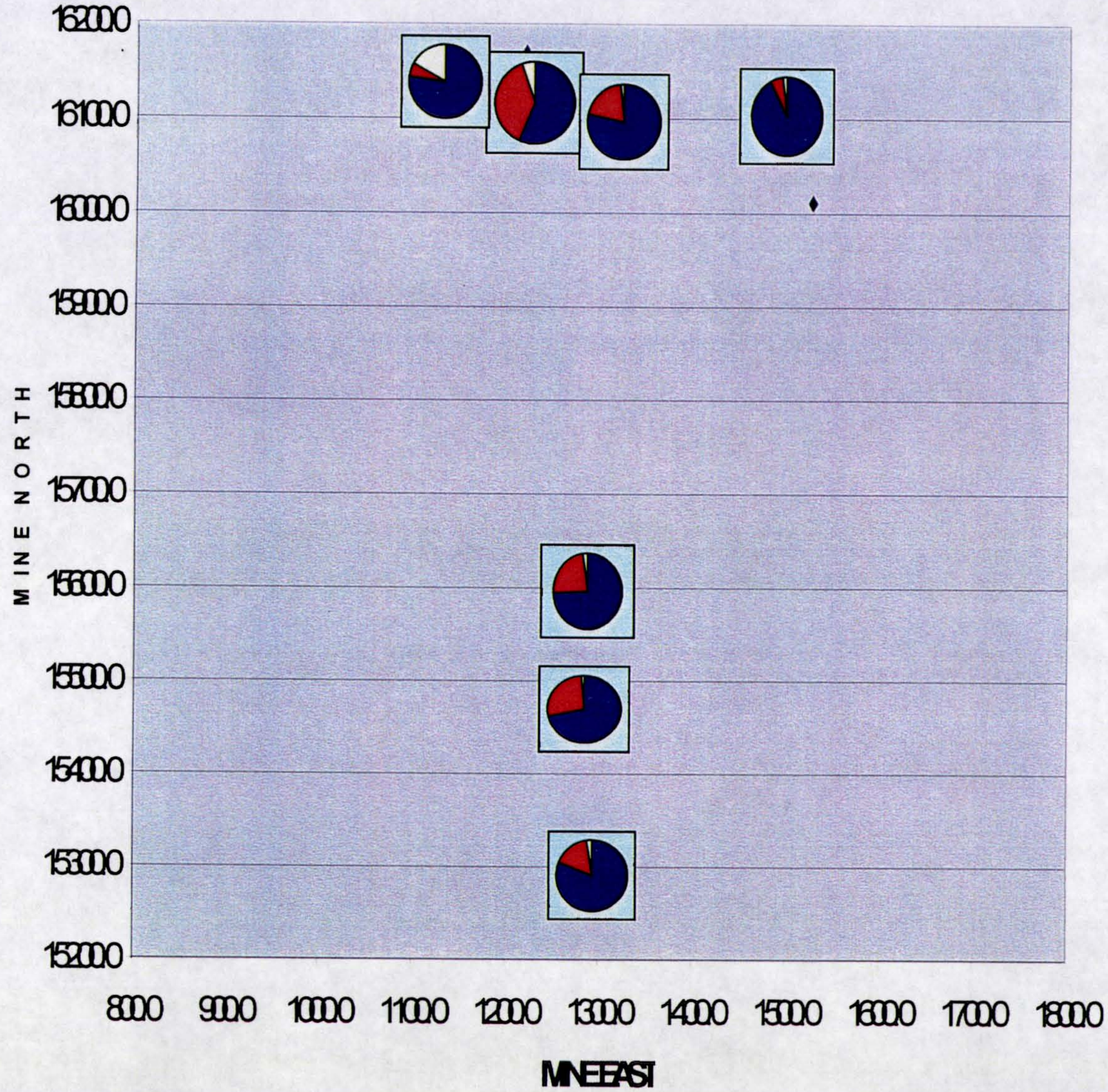
FABRIC



LUCE


N
11
7
5
8
9
10
4
REMANENCE


N
9
10
8
11
55
7
9
10
8
7
FABRIC


MINE NORTH
MINE EAST

SPOOKS

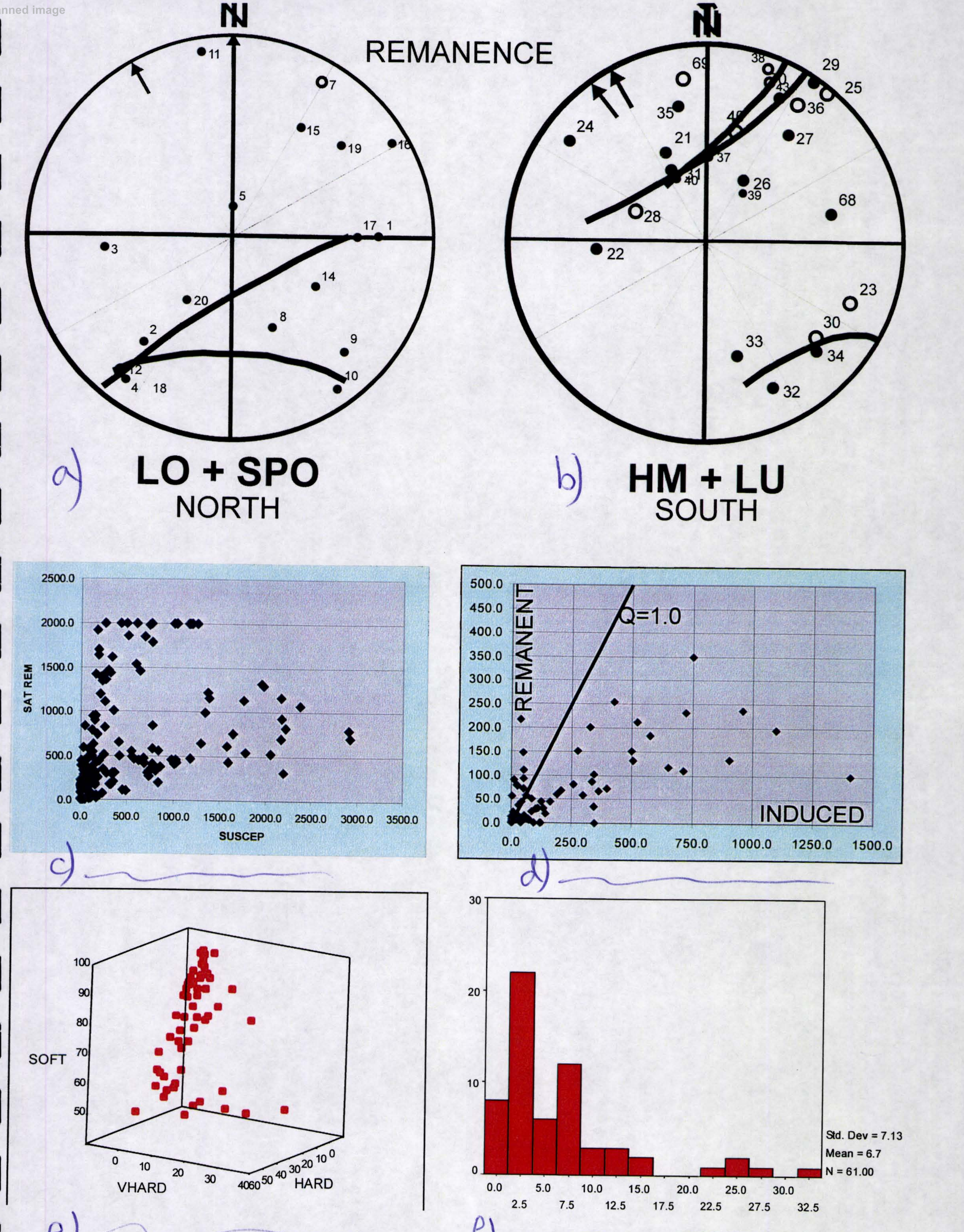

REMANENCE
a)
LO + SPO
NORTH
b)
HM + LU
SOUTH
SAT REM
SUSCEP
c)
REMANENT
INDUCED
Q=1.0
d)
SOFT
VHARD
HARD
e)
Std. Dev = 7.13
Mean = 6.7
N = 61.00
f)

Figure 7.