Scott Claim Group

Prospecting & Geophysics Report

Scott 3-34
YC02457-YC02491

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MINING RECORDER
MAYO, Y.T.
INDIAN & NORTHERN AFFAIRS

Mayo Mining District
NTS 105K-16
Yukon Territory

Longitude 132 14' W
Latitude 62 57' N

for field work performed between Sept. 20 to Oct. 15, 2000

By: R.S. Berdahl B.Sc.
February 2002

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Summary

This report is submitted to meet the requirements for assessment work as stipulated under YQMA.

The GSC released Open File #2174 in 1989, a regional geochemical survey, for the Eastern half of the 105K NTS sheet. Much of the 105 K-16 map sheet is highly anomalous in base and precious metals, as well as pathfinder elements.

This outstanding anomalous fingerprint along with the numerous mineral occurrences and favorable geology prompted the initial investigation of the area, and subsequent staking of the Scott claims.

The Clearwater project was originally intended as an investigation of an Au target. Base metals, mainly Zn, were considered after encouraging trenching results at the nearby Andrew claims.. Prospecting in 1999 also lead to a new discovery, approximately 4.5km due W of the 'Andrew' showing. This new showing consists of a kill zone with lithologies similar to the later. Rusty shale returned 9.29% Zn. Thirty two additional "Scott" claims were staked to cover the showing and surrounding prospective lithologies.

Geology consists of typical Selwyn Basin stratigraphy of 'Grit Unit' overlain by Road River and Earn Group sequences. Additionally several variable sized Cretaceous bodies intrude the immediately adjacent area. Thus, one has the possibilities of deposit types ranging from Sedex Pb/Zn to Ft Knox-style Au's.

The work emphasis during 2000 was reconnaissance prospecting on the new claim block. Noranda, who optioned the adjacent Andrew claims earlier in the year, flew an air borne EM/Mag survey flown over the area. The prospecting results and air survey make up this report.

Claim Summary

Scott claims	Staked	Expiry Date *
Scott 3- 34, YC02457-88	Sept. 12,2000	Sept. 20, 2005

* if assessment work is accepted

Location and Access

The claim area is located approximately 65 air miles north of Ross River within the Mayo Mining District on NTS map sheet 105K-16. It is located east of the confluence of, and between the North and South Macmillian Rivers.

A winter road was constructed by Atlas from the North Canol Road at Dragon Lake. It's about 38 miles from the Canol to the claim area. Roads in the area of Atlas's work are in reasonable shape, passable by ATV. Two airstrips (1,300 and 1,000 feet) were built. The 1,000 foot strip is located just north of the claims. The strip was cleared and supported heavy use by an Otter aircraft. The lakes in the area are marginal for float plane use. Access in 2000 was via helicopter from Ross River.

Topography /Vegetation

Elevations in the claim area range from 1,200m to 1,900 m with tree line variable at 1,500m. The claims cover a small, tight, three mile square, north draining basin, Gentian Creek. Below 1,500m vegetation is moderate to heavy with white and black spruce, buckbrush and willows predominating, the latter three being most prevalent on north facing slopes. Sphagnum moss is a common cover over permafrost, especially on north and east facing slopes. The country is only moderately difficult to traverse. Bedrock is sparse away from creek beds, and below treeline. The lakes in the general region are set in deep canyons, or small, making their utilization by floatplane less than ideal.

Regional Geology

The Scott Claims are situated within the Selwyn Basin, part of the Ominica Belt (Wheeler et.al.,1991). The geology of the area has most recently been mapped by Gabrielse et.al., 1980 at a scale of 1:1,000,000. The Selwyn Basin is imperfectly defined and is used here to describe that part of the cordilleran miogeocline comprised of a prism of sedimentary rocks, of Precambrian to Jurassic age, deposited alone the western margin of ancestral North America. The eastern margin of the basin is marked by the Paleozoic shale - carbonate transition zone while the western margin is defined by the Teslin Fault. The sedimentary basin was active from the late Proterozoic to Mid Jurassic. Widespread thin mafic volcanic flows, breccias, and tuffs are found throughout the Basin. All of the large SEDEX Pb/Zn deposits in the northern cordillera are found within the Selwyn Basin.

Sedimentation ceased in the Mid Jurassic in the outer miogeocline with the collision of a Mesozoic island arc, the Yukon -Tanana Terrane. The collision spread eastward with the miogeocline being over thrust by oceanic rocks and the entire package being deformed.

Two suites of granitoid intrusives, ranging from Paleozoic to Cenozoic age, related to the underplating and or subduction, are found on both sides of the Tintina Fault. The Selwyn Plutonic Suite of granitoid intrusives are distributed along a northwest trending arcing belt within the Basin. These are mainly granitic in nature and are associated with tin, tungsten, and molybdenum mineralization.

Table of Geologic Formations

Mesozoic

Cretaceous

KQM - Quartz monzonite, granodiorite; alaskite

---------------------------------intrusive contact--

Paleozoic

Devonian-Mississippian

DME - Earn Group: chert arenite, shale, conglomerate

Ordovician, Silurian and Devonian

OSDR - Road River : black grapholitic shale, chert

------------------------------unconformity or fault--

Proterozoic

Hadrynian

HQP - Hyland Group: Gritty quartzite, argillite, shale, phyllite

Property Geology

The area is underlain mainly by quartzites, phyllites and limestones of supposed Proterozoic age (Grit or Hyland Group). Folded into this package are Ordovician to Devonian Road River rocks and Devonian to Mississippian Earn Group suite.

The Road River package consists of graptolitic shales, calcareous to non - calcareous black shales, graphitic shales, silty limestones and cherts. The Earn Group is distinguished by 'gun blue' weathering siliceous shales, chert, brown weathering shale and resistant chert pebble conglomerates.

Cretaceous quartz monzonites intrude these various sediments on the southern edge of the claim block. This is the edge of a large intrusive that covers Mt. Selous 7 km. To the northwest.

Structures and regional attitude of the sediments strike northwest/southeast. Sulphide 'veins' run from parallel to perpendicular to this general trend.

The Scott claims cover the new discovery, 9.29%, 5km west of the Andrew showing, which exhibits similar lithologies, with rusty black shale juxtaposed to quartzite on a small (30m width) kill zone. Gentian creek and its tributaries are milky, red or crystal clear.

Past Work Results

Atlas Exploration worked the Lad Claims during the period 1967 -1969. Sixty three km. of grids were cut. These grids or portions thereof were used for geophysical(mag and EM) and geochemical (Pb, Zn, Cu) surveys. An airborne EM survey was also flown. A D-7 cat dug 18 trenches on various showings and geological anomalies with mixed results. A 1968 report emphasized the difficulty caused by the lack of outcrop, yet the substantial number of sulphide showings discovered. The final Atlas report, in 1969 concluded " the extent of the sulphide mineralization was shown, in every case, to be much too limited to have any economic potential." In 1977 Cima drilled two aborted holes in a skarn. Mineralization (5.3%Pb, 4.7% Zn, 3.9opt Ag over 1.2m) was cut in both holes. Atlas also carried out a "regional" silt program that showed anomalous Zn, Cu, and Pb in the drainage (Gentian) now covered by the Scott claims. Despite Atlas's conclusion very few of the showings, or silt anomalies were investigated thoroughly.

The 1996 work revealed several showings, north and south of "J" showing creek with multi-percent Zn numbers. Values to 19.2% were found on the Andrew showing. Galena veins were widespread and contained Ag values to 4.32 opt. In 1999 trenching there 17.3% Zn over 25m. The 9.29 killzone was discovered and Atlas silt numbers in the immediate area reconfirmed.

Current Program

The 2000/01 program did follow-up work on the 1999 program that showed anomalous Pb/Zn/Cu in the tributary to Clear Creek, Gentian Creek. Samples were collected from over the entire claim block. Thirty seven rock and soil samples were analyzed at Northern Analytical Labs in Whitehorse for Au, FA/ AAS and 32-element ICP. For sample locations see appended map. In addition Fugro Airborn Surveys of Mississauga, Ont. flew an airborne EM (AEM) program, under contract with Noranda, over the Scott claims. The survey was flown between Oct.1 and 15. A report titled "Geophysical Survey Report" which includes the survey report titled: 'Dighem(v) Survey For Noranda Inc Andrew Survey Area, Yukon' is included as an appendix and describes the survey logistics, and system specs. Please note that the survey covers an area much larger than the 'Scott' claims and has been edited to reflect that. The geophysics survey includes 34 line kilometers, on ten separate lines, entirely covering the Scott claims.

Results

General Prospecting: The most significant find in 2000/01 was a new discovery 450 meters northwest of the 9.29% killzone. The 'Bordeleau' showing is exposed along a creek bed and consists of a one meter wide, steeply dipping, rusty shale unit in calcareous shales. The 'altered' shale contains pyrite and malachite along with 'veinletts' of galena and saphalerite with sparse quartz veins. Values of three grab samples range to 3.8% Zn, 1.6% Pb, 11.5g Ag, 500 ppm Cd, and 516 ppm Sb (R-36-38).

A third mineralized zone approximately 450 meters to the south southeast of 9.29 has visible saphalerite and galena with values to 281 ppm Zn and 460 ppm Pb, 347 ppm As. This zone is 50 meters long slump of silicified sediments with 'copious' amounts of phyrhotite. Significantly Cd numbers are elevated. (R-2-4).

One soil sample, D-15, ran 111 ppb Au with elevated Zn, Pb, Cu, Ag, and Cd. Beautifully multi colored, variably width banded rock is found at R-24. Colors in the rock range from red brown to white, and it seems heavy, but Zn and Ba numbers are very low.

Precipitates (white and red) and highly anomalous silts (from 1999) indicate much potential for further showings throughout the basin.

Geophysics:

Overall the air borne survey appears to reflect a general northwest trend, as does the regional geology. Whether this reflection is that of local geology and structure requires ground truthing. The area of highest resistivity and highest magnetics are on opposite sides of the claim block. The area of exposed intrusives to the southwest show low mag and very high resistivity. While along the northeast property boundary mag activity is the highest while resistivity is moderate to low, except between lines 10320-31 where an oblong area of good conductivity coincides with a circular mag high.

Mag lows may reflect faults.

The area of greatest conductivity is near the confluence of several creeks in the north of the property, roughly trending northwest. This area is bounded on two sides by two convoluted but roughly parallel striking areas of mag high. The better concentration of EM anomalies (>20) are in this area as well.

The '9.29%' area isn't associated with any resistivity or mag anomaly, high or low, but is flanked by a conductivity high and a mag low. The 'Bordeleau' occurrence, which strikes at 320 degrees, corresponds to a similar trending mag high, several EM anomalies >20, and a conductivity high.

Conclusions and Recommendations

The entire area continues to prove highly prospective for base metals. The number of unexplained anomalies, both geochemical and geophysical, suggests a high probability of discovering several new showings in the vicinity.

It is recommended that:

Several areas require ground truthing and more detailed ground mag and possibly HLEM and gravity surveys:

- An area near the northeast property boundary where a linear mag low juxtaposes a mag high, which are both flanked by areas of high conductivity, between flight lines 10300-10341.
- an area of creek confluence, in the north of the block, where a conductive area is flanked on the northeast and southwest by mag highs and peppered with several EM anomalies, along lines 10250-10290.
- Areas along mag lows (suspected faults).
- The 'slump' area (R2-4) where a mag high juxtapose a conductivity high.
- An area just downstream of Gentian Lake where a northwest striking mag low is coincident with a resistivity low.

In addition:
- a grid should be set for future ground geophysics and soils surveys.
- addition staking should be done to tie the Andrew and Scott blocks together, as well as tie the Scott block to a smaller Scott block three kilometers to the south.

References

-1968. Adamson, T.J. "Lad Group Showings Report." Atlas Exploration Ltd. AR#19012.
-1968. Brock, J.S. "Lad Group Ground/Airborne Geophysics Report." Atlas Exploration Ltd. AR#019011.
-1969. Adamson, T.J. "Lad Group Trenching Report." Atlas Exploration Ltd. AR#060718.
-1977. Cima Drill Logs.
-1996. Berdahl, R.S. "Clearwater Program Report". DIAND AR.#00000

APPENDIX A
SCOTT PROPERTY ROCK/SOIL SAMPLE DESCRIPTION

Scott Property Rock/Soil Description:
all samples are prefixed R(rock) or D(soil) 00K16; see map for locations

R-1 Siliceous, fine grained sediment w/ pyrite to 10%, float
R-2 rusty shale w/ sulfides, float
R-3 siliceous sediment w/ pyrhotite, float
R-4 saphalerite, galena disseminated in siliceous sediment, float
R-6 very black, to rusty, flat lying shale w/ pyrite in blebs, very fine dissemination, and veinlets perpendicular to bedding.
R-7 finely dissem. pyrite in calcareous shale, and in veinlets perpendicular to bedding
R-8 limonitic, to red altered shale, 2 m. topo above #7
R-9 pyrite and malachite in greenish phyllite/shale(?)
R-12 ferricrete like bedrock assoc. w/graphite/shale/quartzite (off claim block)
R-23 grey schistose, rusty rind w/dissem. white sulphides to 5%
R-24 banded silt stone, beautiful
R-25 heavily altered phylite w/manganese, limonite, relgar(?), possibly brecciated, float
R-26 black shale w/parallel pyrite veins, float
R-27 dark grey,white speckled quartzite, rusty on fractures, float
R-28 quartz float, grab bag, grey, white w/ pinkish hue, and white w/limonitic fractures.
R-29 rusty, manganese stained cherty /quartzite/phyllite, float
R-30 very rusty phyllite, float
R-31 grey chert w/ disseminated pyrite, float
R-32 intrusive outcrop w/ pyrite, strong sulfur smell
R-33 Phyllite/shale w/ pyrite thru out, trace limonite and quartz veining, outcrop
R-34 intrusive(?) w/ altered red surface, trace saphalerite(?), pyrite/chalco
R-35 shale/phyllite, strongly altered (red/black) surface, pyrite + malachite assoc. w/ minor quartz veins, blue hue on fresh breaks.
R-36 shale w/ Pyrite + galena, outcrop
R-37 shale w/quartzite 'veinlets', pyrite and chalco (lots?)
R-38 limonitic shale, looks like hydrozincite/scoridite

Soils: (typical profile in mag low area, at center of claim block: 3" white silt overlies 3" of orange silt which overlies brown silt.

D-5 corn starch like white soil w/ 5% black 'silt', from frost polygon
D-14 orange/white silt @ 4"
D-15 brown silt below 6", from site #14
D-16 white/orange silt from 9"
D-17 rusty orange/brown silt from below 8"
D-18 brown silt, under normal profile @ 9"
D-19 orange silt @ 18"
D-20 organics/ brown silts
D-21 brown silt from 6-9"
D-22 orange silt @ 4"

APPENDIX B
ASSAYS

Northern Analytical Laboratories ltd.

105 Copper Road
Whitehorse, Yukon
Y1A 2Z7
Ph: (867) 668-4968
Fax: (867) 668-4890
E-mail: NAL@hypertech.yk.ca

20/10/2000

Certificate of Analysis

of pages (not including this page): 2

Ron Berdahl

WO# 00159

Certified by ____________________
Justin Lemphers (Senior Assayer)

Date Received: 05/10/2000

SAMPLE PREPARATION:

Code	# of Samples	Type	Preparation Description (All wet samples are dried first.)
r	25	rock	Crush to -10 mesh; riffle split 200g; pulverize to -100 mesh
s	22	soil	Screen -80 mesh
r	13	rock	Crush to -10 mesh; riffle split 200g; pulverize to -200 mesh

ANALYTICAL METHODS SUMMARY:

Symbol	Units	Element	Method (A:assay) (G:geochem)	Fusion/Digestion	Lower Limit	Upper Limit
Au	ppb	Gold	G: FA/AAS	15g FA / aqua regia	5	7000
Au 30g	ppb	Gold	G: FA/AAS	30g FA / aqua regia	5	7000
Pt 30g	ppb	Platinum	G: FA/AAS	30g FA / aqua regia	5	7000
Pd 30g	ppb	Palladium	G: FA/AAS	30g FA / aqua regia	5	7000

AAS = atomic absorption spectrophotometry
FA = fire assay

1000ppb = 1ppm = 1g/mt = 0.0001% = 0.029166oz/ton

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20/10/2000 | Certificate of Analysis |

Ron Berdahl

WO# 00159

Certified by ________________

	Sample #	Au ppb	Au 30g ppb	Pt 30g ppb	Pd 30g ppb
r	R-00-K-16-01	94			
r	R-00-K-16-02	18			
r	R-00-K-16-03	19			
r	R-00-K-16-04	8			
r	R-00-K-16-06	10			
r	R-00-K-16-07	11			
r	R-00-K-16-08	26			
r	R-00-K-16-09	13			
r	R-00-K-16-12	50			
r	R-00-K-16-23	203			
r	R-00-K-16-24	13			
r	R-00-K-16-25	578			
r	R-00-K-16-26	16			
r	R-00-K-16-27	10			
r	R-00-K-16-28	10			
r	R-00-K-16-29	14			
r	R-00-K-16-30	24			
r	R-00-K-16-31	10			
r	R-00-K-16-32	14			
r	R-00-K-16-33	7			
r	R-00-K-16-34	5			
r	R-00-K-16-35	7			
r	R-00-K-16-36	99			
r	R-00-K-16-37	69			
	R-00-K-16-38	?			
s	AB008	8			
s	D-00-K-16-05	<5			
s	D-00-K-16-10	6			
s	D-00-K-16-11	<5			
s	D-00-K-16-14	5			

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20/10/2000 Certificate of Analysis

Ron Berdahl WO# 00159

Certified by ________________

	Sample #	Au ppb	Au 30g ppb	Pt 30g ppb	Pd 30g ppb
s	D-00-K-16-15	111			
s	D-00-K-16-16	<5			
s	D-00-K-16-17	7			
s	D-00-K-16-18	10			
s	D-00-K-16-19	<5			
s	D-00-K-16-20	7			
s	D-00-K-16-21	<5			
s	D-00-K-16-22	<5			
r	AB001		31	<5	<5
s	AB002		13	<5	<5
s	AB003		<5	19	<5
r	AB004		<5	17	8
s	AB005		<5	6	5
r	AB006		41	18	18
s	AB007		<5	15	6
r	R-00-H9-01		<5	22	12
r	R-00-H9-02		124	14	33
r	R-00-H9-03		90	5	6
r	R-00-H9-04		595	13	10
r	R-00-H9-05		<5	10	<5
s	D-00-H9-06		20	31	<5
s	D-00-H9-07		<5	15	<5
s	D-00-H9-08		<5	12	<5
r	R-00-H9-09		22	8	12
r	R-00-H9-09A		1282	15	<5
r	R-00-H9-09B		348	13	5
r	R-00-H9-10		186	17	<5
s	S-00-H9-11		<5	14	<5
r	R-00-H9-12		<5	16	<5
s	D-00-H9-13		36	<5	<5

INTERNATIONAL PLASMA LABORATORY LTD.

CERTIFICATE OF ANALYSIS
iPL 00J1375

Vancouver, B.C.
Canada V5Y 3E1
Phone (604) 879-7878
Fax (604) 879-7898
Email ipl@direct.ca

ISO 9002 REGISTERED KPMG

Northern Analytical Laboratories | **60 Samples** | Out: Oct 25, 2000 In: Oct 12, 2000 | [137517:17:04:00102500]

Project : WO#00159
Shipper : Norm Smith
Shipment: PO#: 568103
Analysis:
ICP(AqR)30

Comment:

CODE	AMOUNT	TYPE	PREPARATION DESCRIPTION	PULP	REJECT
B31100	60	Pulp	Pulp received as it is, no sample prep.	12M/Dis	00M/Dis

NS=No Sample Rep=Replicate M=Month Dis=Discard

Document Distribution

1 Northern Analytical Laboratories
105 Copper Road
Whitehorse
YT Y1A 2Z7
Canada
Att: Norm Smith

EN	RT	CC	IN	FX
1	2	1	1	0
DL	**3D**	**EM**	**BT**	**BL**
0	0	0	0	0

Ph:867/668-4968
Fx:867/668-4890
Em:NAL@hypertech.yk.ca

Analytical Summary

##	Code	Method	Units	Description	Element	Limit Low	Limit High
01	0721	ICP	ppm	Ag ICP	Silver	0.1	99.9
02	0711	ICP	ppm	Cu ICP	Copper	1	20000
03	0714	ICP	ppm	Pb ICP	Lead	2	20000
04	0730	ICP	ppm	Zn ICP	Zinc	1	20000
05	0703	ICP	ppm	As ICP	Arsenic	5	9999
06	0702	ICP	ppm	Sb ICP	Antimony	5	999
07	0732	ICP	ppm	Hg ICP	Mercury	3	9999
08	0717	ICP	ppm	Mo ICP	Molydenum	1	999
09	0747	ICP	ppm	Tl ICP (Incomplete Digestion)	Thallium	10	999
10	0705	ICP	ppm	Bi ICP	Bismuth	2	9999
11	0707	ICP	ppm	Cd ICP	Cadmium	0.1	99.9
12	0710	ICP	ppm	Co ICP	Cobalt	1	9999
13	0718	ICP	ppm	Ni ICP	Nickel	1	9999
14	0704	ICP	ppm	Ba ICP (Incomplete Digestion)	Barium	2	9999
15	0727	ICP	ppm	W ICP (Incomplete Digestion)	Tungsten	5	999
16	0709	ICP	ppm	Cr ICP (Incomplete Digestion)	Chromium	1	9999
17	0729	ICP	ppm	V ICP	Vanadium	2	9999
18	0716	ICP	ppm	Mn ICP	Manganese	1	9999
19	0713	ICP	ppm	La ICP (Incomplete Digestion)	Lanthanum	2	9999
20	0723	ICP	ppm	Sr ICP (Incomplete Digestion)	Strontium	1	9999
21	0731	ICP	ppm	Zr ICP	Zirconium	1	9999
22	0736	ICP	ppm	Sc ICP	Scandium	1	9999
23	0726	ICP	%	Ti ICP (Incomplete Digestion)	Titanium	0.01	1.00
24	0701	ICP	%	Al ICP (Incomplete Digestion)	Aluminum	0.01	9.99
25	0708	ICP	%	Ca ICP (Incomplete Digestion)	Calcium	0.01	9.99
26	0712	ICP	%	Fe ICP	Iron	0.01	9.99
27	0715	ICP	%	Mg ICP (Incomplete Digestion)	Magnesium	0.01	9.99
28	0720	ICP	%	K ICP (Incomplete Digestion)	Potassium	0.01	9.99
29	0722	ICP	%	Na ICP (Incomplete Digestion)	Sodium	0.01	5.00
30	0719	ICP	%	P ICP	Phosphorus	0.01	5.00

EN=Envelope # RT=Report Style CC=Copies IN=Invoices Fx=Fax(1=Yes 0=No) Totals: 1=Copy 1=Invoice 0=3½ Disk
DL=Download 3D=3½ Disk EM=E-Mail BT=BBS Type BL=BBS(1=Yes 0=No) ID=C030901
* Our liability is limited solely to the analytical cost of these analyses.

BC Certified Assayer: David Chiu

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CERTIFICATE OF ANALYSIS
iPL 00J1375

Vancouver, B.C.
Canada V5Y 3E1
Phone (604) 879-7878
Fax (604) 879-7898
Email ipl@direct.ca

ISO 9002 REGISTERED KPMG

Client : Northern Analytical Laboratories
Project: WO#00159

60 Samples
60=Pulp

[137517:17:04:00102500]

Out: Oct 25, 2000
In : Oct 12, 2000

Sample Name		Ag ppm	Cu ppm	Pb ppm	Zn ppm	As ppm	Sb ppm	Hg ppm	Mo ppm	Tl ppm	Bi ppm	Cd ppm	Co ppm	Ni ppm	Ba ppm	W ppm	Cr ppm	V ppm	Mn ppm	La ppm	Sr ppm	Zr ppm	Sc ppm	Ti %	Al %	Ca %	Fe %	Mg %	K %	Na %	P %
R-00-K-16-01	P	0.7	17	43	25	328	<	<	2	<	<	0.5	9	11	21	<	100	106	205	8	18	5	4	0.09	0.54	0.18	4.48	0.70	0.04	0.05	0.07
R-00-K-16-02	P	0.3	30	25	34	347	<	<	3	<	<	<	21	9	7	<	66	76	324	7	93	10	11	0.10	3.70	1.67	6.77	1.22	0.29	0.29	0.05
R-00-K-16-03	P	0.2	27	14	46	65	<	<	3	<	<	0.8	10	11	45	<	49	31	263	9	12	3	2	<	2.13	0.19	5.77	1.75	0.18	0.02	0.14
R-00-K-16-04	P	1.2	35	460	281	<	<	<	2	<	<	2.3	12	29	244	<	125	72	582	9	11	8	2	0.12	1.55	0.54	2.56	1.67	0.27	0.02	0.09
R-00-K-16-06	P	0.5	65	21	227	<	6	<	7	<	<	0.7	14	96	18	<	111	187	196	4	69	16	3	0.03	3.02	1.24	2.37	1.33	0.69	0.25	0.08
R-00-K-16-07	P	0.5	59	18	221	<	<	<	7	<	<	<	13	81	13	<	136	119	183	6	190	13	4	0.07	4.01	2.67	3.54	0.83	0.39	0.38	0.14
R-00-K-16-08	P	0.3	74	20	202	<	<	<	9	<	<	<	15	61	275	7	58	39	158	7	38	15	2	0.22	1.89	0.26	10%	0.46	0.14	0.03	0.05
R-00-K-16-09	P	0.2	9	3	13	<	<	<	4	<	<	<	3	9	129	<	30	20	370	6	874	2	2	0.02	0.80	28%	0.98	1.13	0.23	0.06	0.04
R-00-K-16-12	P	27.1	294	815	2483	275	62	<	21	<	<	2.8	17	291	82	<	101	164	306	9	30	6	3	<	0.35	0.32	8.85	0.03	0.06	0.01	0.14
R-00-K-16-23	P	<	27	24	32	248	<	<	1	<	<	0.6	15	31	26	<	33	15	425	10	5	9	2	0.01	1.13	0.04	4.35	0.66	0.26	0.02	0.03
R-00-K-16-24	P	0.3	42	9	76	<	<	<	6	<	<	<	10	26	273	<	59	105	161	7	252	9	2	0.12	4.45	8.16	1.77	3.57	1.79	0.20	0.04
R-00-K-16-25	P	<	8	12	30	<	<	<	1	<	<	0.5	4	10	65	<	54	16	225	33	7	4	2	0.03	1.13	0.04	3.42	0.39	0.25	0.03	0.04
R-00-K-16-26	P	0.2	55	18	14	23	6	<	5	<	<	0.9	16	23	47	<	115	95	257	13	104	9	4	0.14	1.92	1.62	2.94	1.49	0.52	0.11	0.48
R-00-K-16-27	P	<	22	16	43	<	<	<	4	<	<	<	16	4	70	<	94	81	339	11	160	8	15	0.11	5.94	2.82	4.32	1.50	0.90	0.49	0.05
R-00-K-16-28	P	<	18	7	31	<	<	<	2	<	<	0.3	6	14	16	<	152	6	300	7	4	4	1	<	0.79	0.03	2.24	0.33	0.05	0.02	0.02
R-00-K-16-29	P	0.5	77	36	69	<	<	<	4	<	<	<	11	14	65	9	28	43	199	5	17	6	<	0.01	0.55	0.02	19%	0.11	0.15	0.02	0.07
R-00-K-16-30	P	<	18	17	35	<	5	<	2	<	<	0.7	6	16	87	<	49	18	471	25	7	5	2	0.12	1.20	0.02	4.35	0.36	0.28	0.02	0.05
R-00-K-16-31	P	<	19	20	43	<	<	<	1	<	<	0.6	10	15	86	<	155	13	335	12	17	3	1	0.01	0.88	0.16	2.61	0.36	0.14	0.02	0.08
R-00-K-16-32	P	<	13	19	59	<	<	<	4	<	<	<	13	4	242	<	91	66	467	10	116	15	13	0.14	4.30	2.49	3.33	1.03	0.90	0.32	0.05
R-00-K-16-33	P	<	41	11	29	13	<	<	4	<	<	0.2	13	26	26	<	118	10	273	5	3	5	1	<	1.65	0.04	5.17	0.71	0.08	0.02	0.01
R-00-K-16-34	P	0.1	54	12	37	<	<	<	4	<	<	<	20	6	64	<	84	66	253	14	90	8	13	0.12	3.63	1.59	5.53	0.96	0.55	0.24	0.05
R-00-K-16-35	P	0.2	47	13	69	<	<	<	3	<	<	1.0	23	45	17	<	112	32	133	10	35	3	2	<	1.45	0.48	3.19	1.05	0.23	0.02	0.06
R-00-K-16-36	P	11.5	147	16236	3.8%	639	516	<	<	<	<	0.5m	12	27	<	<	53	33	158	2	6	11	2	<	1.68	0.10	4.47	1.42	0.23	0.02	0.04
R-00-K-16-37	P	1.8	42	592	13717	587	26	<	<	<	<	0.2m	23	64	2	<	62	28	268	<	35	10	1	<	1.42	1.53	7.71	1.31	0.17	0.02	0.04
R-00-K-16-38	P	5.7	7	1090	501	273	24	<	5	<	<	4.9	1	5	34	<	84	19	26	5	8	8	1	<	0.50	0.02	1.74	0.19	0.33	0.02	0.01
AB008	P	<	13	8	49	<	<	<	1	<	<	0.7	8	7	83	<	15	49	227	9	43	2	4	0.06	0.99	0.79	1.70	0.40	0.05	0.04	0.08
D-00-K-16 5	P	<	7	2	12	<	<	<	<	<	<	0.1	1	1	26	<	1	4	26	<	8	<	<	0.01	0.22	0.09	0.17	0.03	0.04	0.04	0.03
D-00-K-16-10	P	1.2	33	7	60	54	<	<	1	<	<	3.4	12	14	207	<	3	19	628	10	13	<	<	0.01	0.80	0.25	0.91	0.04	0.03	0.04	0.08
D-00-K-16-11	P	0.1	6	5	13	<	<	<	1	<	<	0.4	2	2	359	<	1	14	22	2	11	1	<	0.02	0.29	0.16	0.40	0.03	0.02	0.03	0.04
D-00-K-16-14	P	<	8	3	12	<	<	<	2	<	<	0.4	3	3	25	<	2	18	77	3	10	<	<	0.03	0.60	0.13	0.65	0.05	0.02	0.03	0.05
D-00-K-16-15	P	0.3	60	47	167	26	<	<	4	<	<	1.4	40	60	202	<	26	47	913	26	37	2	2	0.02	2.76	0.16	4.42	0.93	0.09	0.02	0.08
D-00-K-16-16	P	<	7	6	5	<	<	<	1	<	<	0.3	1	1	24	<	1	12	18	3	7	<	<	0.02	0.55	0.08	0.31	0.03	0.02	0.04	0.04
D-00-K-16-17	P	0.2	31	42	92	<	<	<	4	<	<	1.6	13	23	111	<	24	50	443	18	17	2	2	0.03	2.88	0.07	3.89	0.49	0.09	0.02	0.06
D-00-K-16-18	P	<	20	25	56	<	<	<	3	<	<	0.5	6	11	110	<	15	42	205	15	14	<	1	0.01	1.47	0.08	2.06	0.30	0.06	0.02	0.06
D-00-K-16-19	P	0.1	3	3	5	<	<	<	<	<	<	0.1	2	1	11	<	2	13	20	2	8	1	<	0.02	0.44	0.09	0.35	0.03	0.03	0.04	0.03
D-00-K-16-20	P	0.1	29	31	76	<	<	<	4	<	<	1.0	10	22	119	<	21	47	337	17	17	1	1	0.02	2.24	0.07	3.13	0.53	0.08	0.02	0.05
D-00-K-16-21	P	<	25	40	87	<	<	<	3	<	<	0.7	8	24	84	<	19	40	455	17	12	1	1	0.02	1.77	0.08	2.86	0.47	0.07	0.02	0.06
D-00-K-16-22	P	<	3	2	6	<	<	<	1	<	<	0.1	1	1	13	<	2	10	17	<	7	<	<	0.02	0.41	0.05	0.31	0.02	0.02	0.03	0.02
AB001	P	1.4	295	28	43	<	<	<	7	<	<	<	23	45	30	<	24	292	67	<	4	13	<	0.01	0.15	0.07	26%	0.04	0.03	0.02	0.06
Min Limit		0.1	1	2	1	5	5	3	1	10	2	0.1	1	1	2	5	1	2	1	2	1	1	1	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Max Reported*		99.9	20000	20000	20000	9999	999	9999	999	999	9999	99.9	9999	9999	9999	999	9999	9999	9999	9999	9999	9999	9999	1.00	9.99	9.99	9.99	9.99	9.99	5.00	5.00
Method		ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP

——=No Test Ins=Insufficient Sample Del=Delay Max=No Estimate Rec=ReCheck m=x1000 %=Estimate % NS=No Sample P=Pulp

Scott 3-34

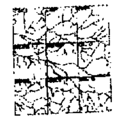
NOTICE

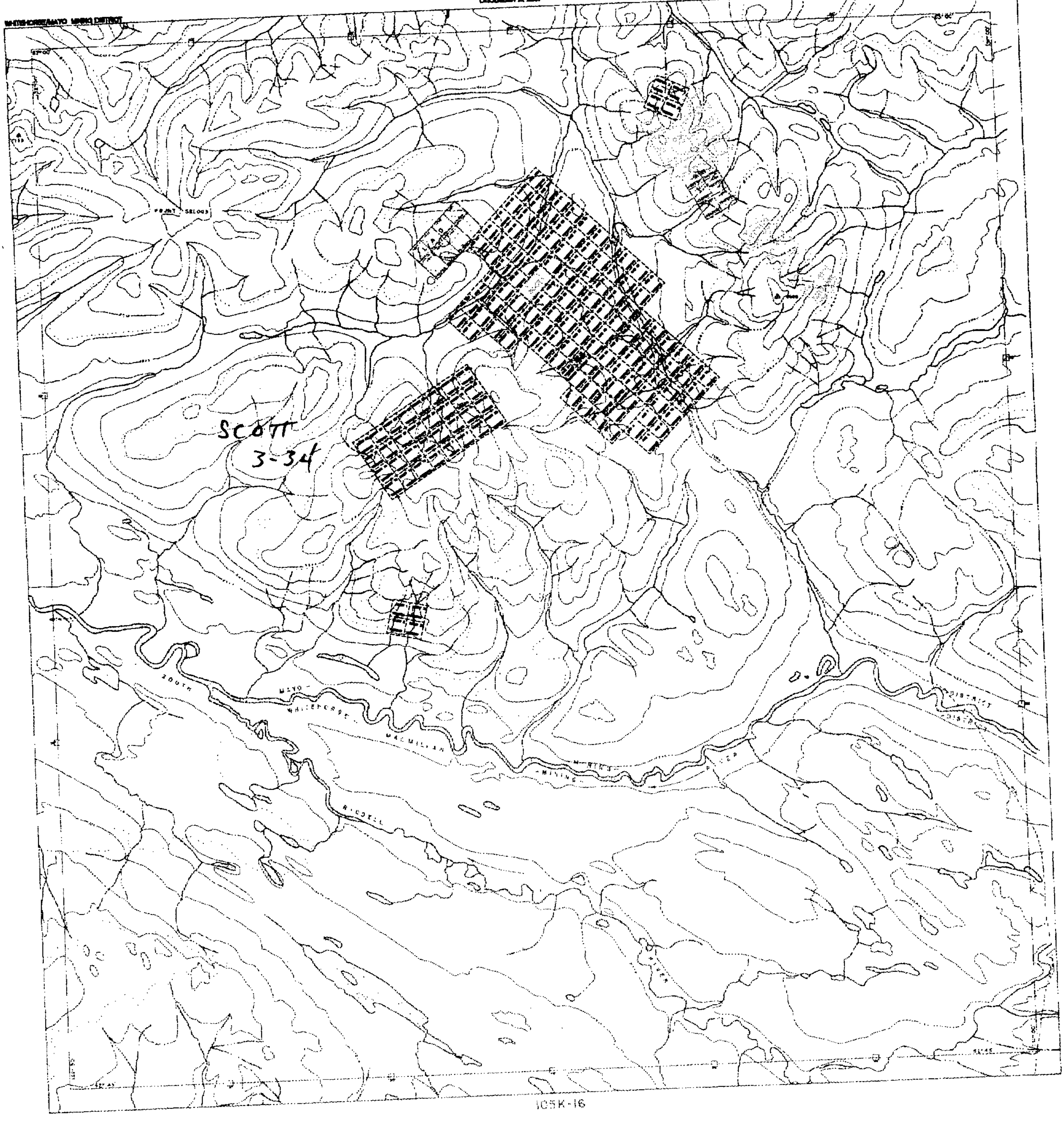
SEE ADJACENT MAP SHEET(S) EDGES FOR ADJOINING MINERAL CLAIMS NOT SHOWN ON THIS MAP

SHEET 105K-16

CANADA

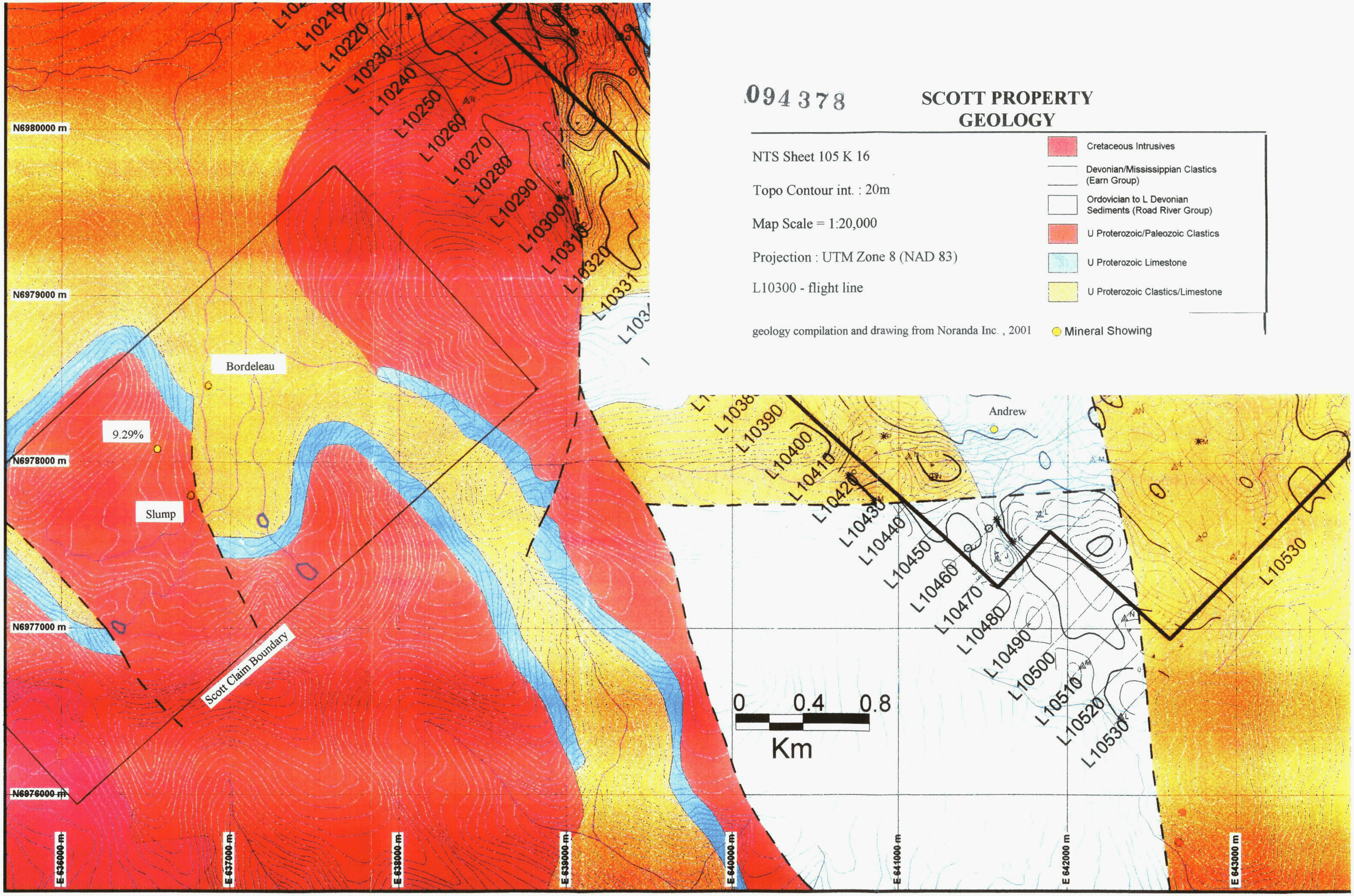
DECEMBER 18, 2001





105K-16

APPENDIX D
SCOTT PROPERTY KEY MAP


094378
SCOTT PROPERTY
GEOLOGY
NTS Sheet 105 K 16
Topo Contour int. : 20m
Map Scale = 1:20,000
Projection : UTM Zone 8 (NAD 83)
L10300 - flight line
geology compilation and drawing from Noranda Inc. , 2001
Cretaceous Intrusives
Devonian/Mississippian Clastics (Earn Group)
Ordovician to L Devonian Sediments (Road River Group)
U Proterozoic/Paleozoic Clastics
U Proterozoic Limestone
U Proterozoic Clastics/Limestone
Mineral Showing
Bordeleau
9.29%
Slump
Andrew
Scott Claim Boundary
N6980000 m
N6979000 m
N6978000 m
N6977000 m
N6976000 m
E 636000 m
E 637000 m
E 638000 m
E 639000 m
E 640000 m
E 641000 m
E 642000 m
E 643000 m
0
0.4
0.8
Km
L10210
L10220
L10230
L10240
L10250
L10260
L10270
L10280
L10290
L10300
L10320
L10331
L10390
L10400
L10410
L10420
L10430
L10440
L10450
L10460
L10470
L10480
L10490
L10500
L10510
L10520
L10530

APPENDIX E
SUMMARY OF COSTS STATEMENT

Summary of Costs Statement

Prospecting:	
Assays - 35 rock, soil and stream seds @ $20.00/ea	$ 700.00
Helicopter, Ross River-Scott Property, return	$2,762.00
Vehicle, Whitehorse/Ross River return. 1000km @ $.42/km	$ 420.00
Laborer - 8 man-days @ $250.00/day	$2,000.00
Per diem - includes camp, food supplies	$ 500.00
Report	$ 500.00
Sub Total	$6,882.00
Geophysics: (from Fugro Statement of Cost, attached)	
34 km of flying @$93.00/km.	$3,162.00
plus mobilization costs (not claimed by Noranda)	$3,500.00
Sub Total	$6,662.00
TOTAL	$13,544.00

Asking for: four years on Scott Claims 3-34	$12,800

APPENDIX F
STATEMENT OF QUALIFICATIONS

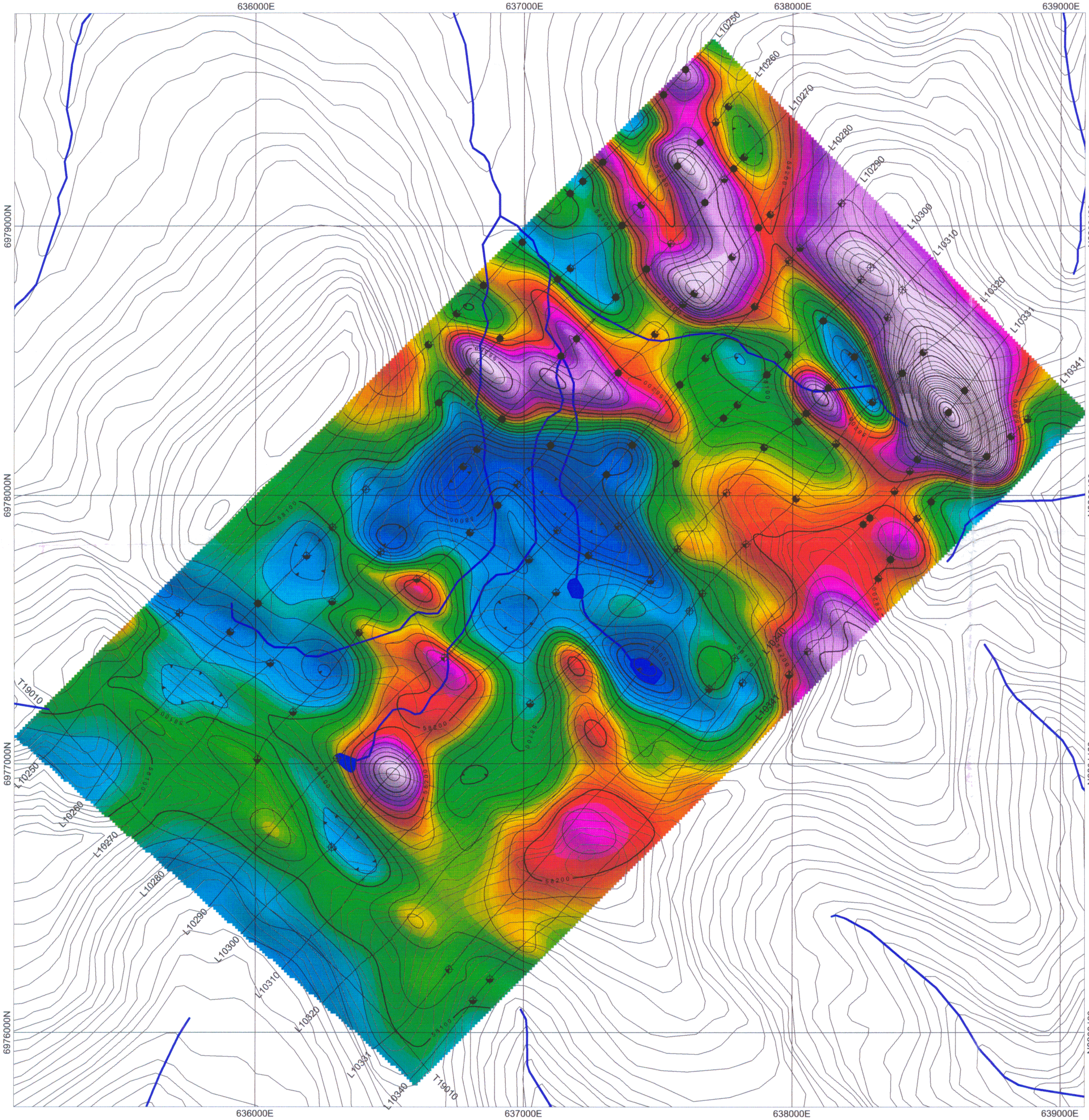
Statement of Qualifications

I, Ron Berdahl, declare I am an independent prospector who has worked the Scott Claims during the 2000/01 field seasons.

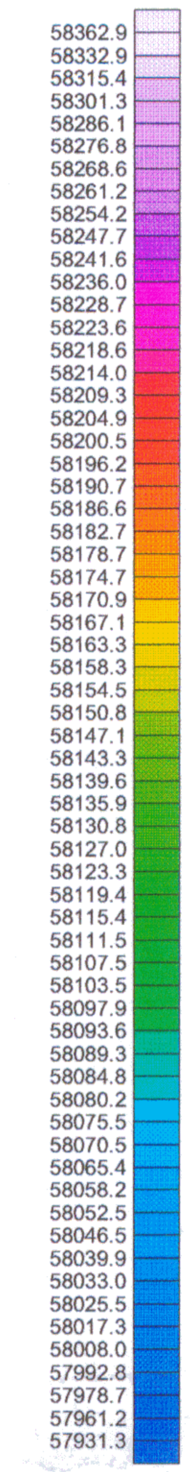
I have worked several years in the Selwyn Basin and taken several courses related to prospecting and in addition make the bulk of my living from prospecting.

The data contained herein is true and correct to the best of my knowledge.

[signature]	March 7, 02
Ron S. Berdahl	Date



094378



Magnetics
nT

EM Anomalies

- > 20
- 10 - 20
- 5 - 10
- 2 - 5
- 1 - 2
- < 1

Electromagnetic System

DIGHEMV: Towed bird, symmetric dipole configuration operated at a nominal survey altitude of 30 metres. Coil separation is 8 metres for 900 Hz,5500 Hz and 7200 Hz, and 6.3 metres for the 56,000 Hz coil-pair.
Coil Orientaiton and Frequency:
coaxial 1,000 Hz
coplanar 900 Hz
coaxial 5,500 Hz
coplanar 7,200 Hz
coplanar 56,000 Hz

Magnetometer

Model: Picodas MEP-710 processor with Geometrics G822 sensor
Type: Optically pumped cesium vapour
The magnetometer sensor is housed in the EM bird, 28 m below the helicopter

Scale 1:10000

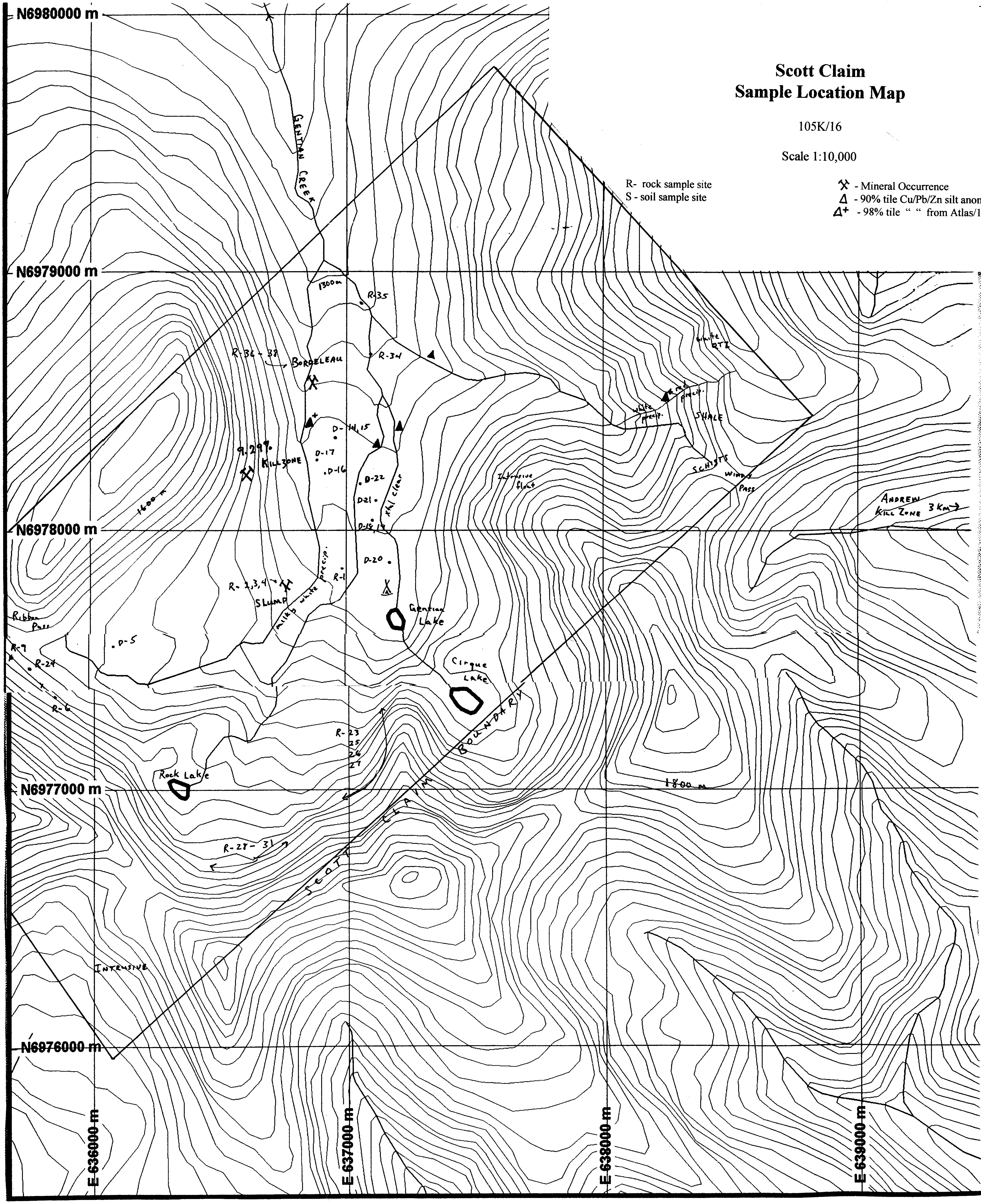
200 0 200 400 600
metres
NAD83 / UTM zone 8N

SCOTT PROPERTY fig 2

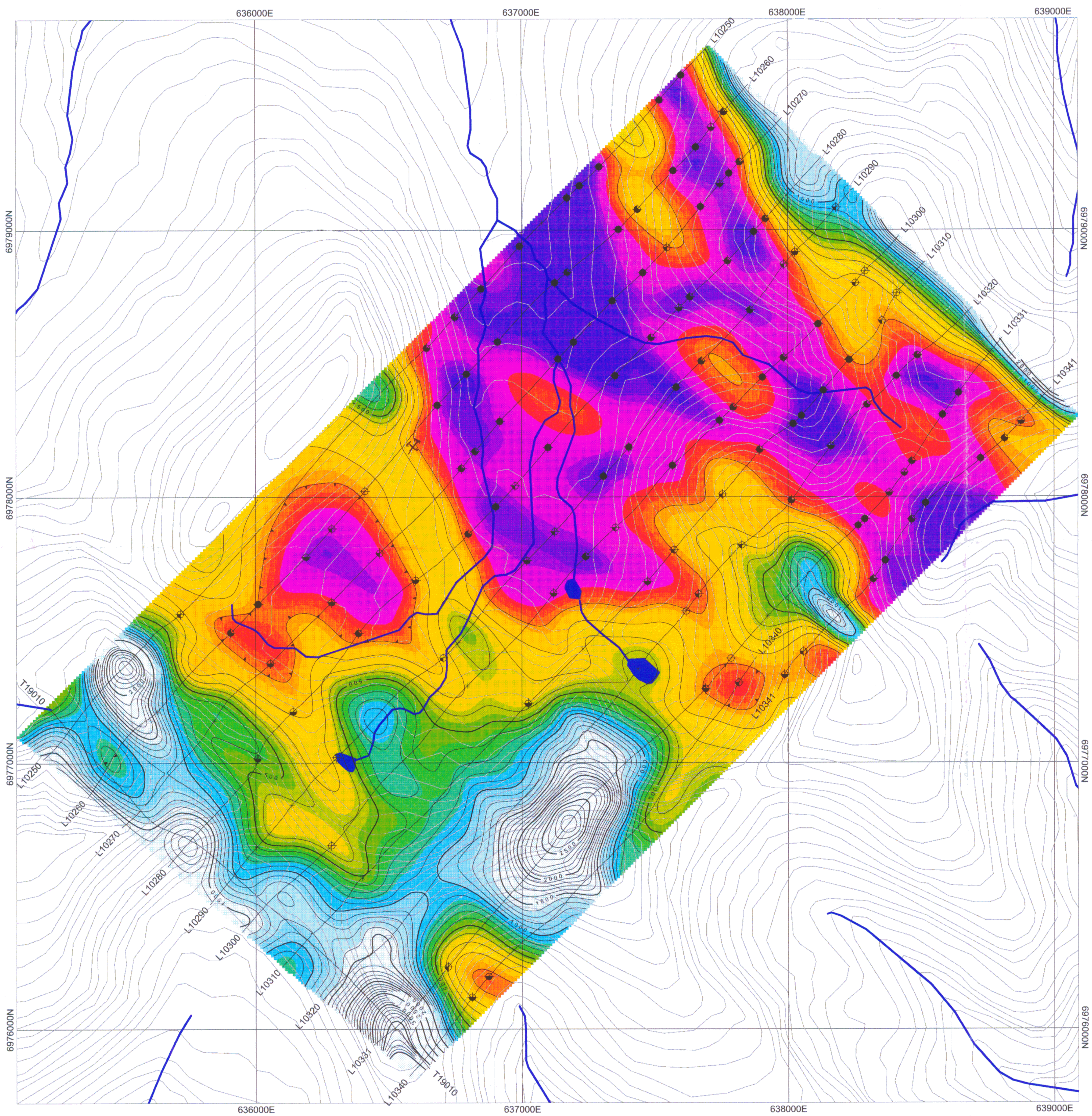
Airborne Geophysics Resutls
Total Field Magnetics
with EM Picks

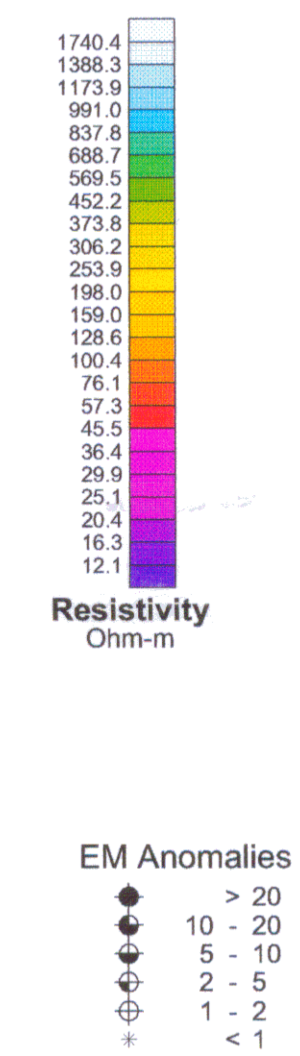
Survey By: Fugro
Survey Flown: Dec. 2000
Processed By: G. Ascough, 02/27/2002
Projection: UTM Zone 8 (NAD83)

NORANDA INC.


Scott Claim
Sample Location Map
105K/16
Scale 1:10,000
N
R- rock sample site
S - soil sample site
- Mineral Occurrence
- 90% tile Cu/Pb/Zn silt anomaly
- 98% tile " " from Atlas/1999
N6980000 m
N6979000 m
N6978000 m
N6977000 m
N6976000 m
E 636000 m
E 637000 m
E 638000 m
E 639000 m
GENTIAN CREEK
1300m
R-35
R-34
R-36 - 38
BORDELEAU
D-14,15
D-17
D-16
D-22
D21
D-20
9.29%
KILLZONE
1600 m
R-2,3,4
SLUMP
R-1
Gentian Lake
Cirque Lake
Rock Lake
D-5
R-7
R-24
R-6
R-23
25
26
27
R-28-31
SCOTT CLAIM BOUNDARY
INTRUSIVE
SHALE
SCHISTS
Windy Pass
white precip.
white QTZ
ANDREW KILL ZONE 3 km
1800 m

094378





Electromagnetic System

DIGHEMV: Towed bird, symmetric dipole configuration operated at a nominal
survey altitude of 30 metres. Coil separation is 8 metres for
900 Hz,5500 Hz and 7200 Hz, and 6.3 metres for the 56,000 Hz coil-pair.
Coil Orientaiton and Frequency:
coaxial 1,000 Hz
coplanar 900 Hz
coaxial 5,500 Hz
coplanar 7,200 Hz
coplanar 56,000 Hz

Magnetometer

Model: Picodas MEP-710 processor with Geometrics G822 sensor
Type: Optically pumped cesium vapour
The magnetometer sensor is housed in the EM bird, 28 m below the helicopter

Scale 1:10000

200 0 200 400 600
metres
NAD83 / UTM zone 8N

SCOTT PROPERTY fig 3

Airborne Geophysics Resutls
Calculated Resistivity - 7200Hz Coplanar
with EM Picks

Survey By: Fugro
Survey Flown: Dec. 2000
Processed By: G. Ascough, 02/27/2002
Projection: UTM Zone 8 (NAD83)

NORANDA INC.

GEOPHYSICAL SURVEY REPORT

Report on airborne Magnetic and Electromagnetic Surveys completed on the Scott Property, October 2000

NTS 105K/16

Prepared by: R.Berdahl
after G. Ascough
February 2002

Table of Contents

LIST OF FIGURES

Introduction:

An airborne geophysical survey comprising electromagnetic (EM) and magnetometer measurements was completed over the Scott Property in the fall of 2000. The purpose of the survey was to map zones of conductive and/or magnetic mineralization to provide direct targets for exploration and to delineate different lithologies and structures. A logistics/interpretation report provided by the airborne contractor (Fugro Airborne Surveys) is attached as an Appendix. This report, in conjunction with the accompanying prospecting/geophysics report, presents a summary of the survey specifications and results with some recommendations for follow up work. The interpretation, such as it is, is included in the above mentioned report. At least four targets are recommended for follow up work at Scott based on geophysics and geochemistry.

Property Location and Access:

The Scott property is located approximately 100 km. North of the town of Ross River, Yukon, Mayo Mining District. The survey area covers parts of 105k/16 and 105N/1. The property can be accessed by helicopter from Ross River. A winter cat trail extends to the adjacent Andrew property, leaving the North Canol at Dragon Lake. A 1,000 ft. airstrip has also been renovated at the Andrew property, about four kilometer north of the property.

Claim Status:

Currently the Scott Property comprises 32 claims as depicted on figure 1.

Regional Geology

The Scott Claims are situated within the Selwyn Basin, part of the Ominica Belt (Wheeler et.al.,1991). The geology of the area has most recently been mapped by Gabrielse
et.al., 1980 at a scale of 1:1,000,000. The Selwyn Basin is imperfectly defined and is used here to describe that part of the cordilleran miogeocline comprised of a prism of sedimentary rocks, of Precambrian to Jurassic age, deposited alone the western margin of ancestral North America. The eastern margin of the basin is marked by the Paleozoic shale - carbonate transition zone while the western margin is defined by the Teslin Fault. The sedimentary basin was active from the late Proterozoic to Mid Jurassic. Widespread thin mafic volcanic flows, breccias, and tuffs are found throughout the Basin. All of the large SEDEX Pb/Zn deposits in the northern cordillera are found within the Selwyn Basin.

Sedimentation ceased in the Mid Jurassic in the outer miogeocline with the collision of a Mesozoic island arc, the Yukon -Tanana Terrane. The collision spread eastward with the miogeocline being over thrust by oceanic rocks and the entire package being deformed.

Two suites of granitoid intrusives, ranging from Paleozoic to Cenozoic age, related to the underplating and or subduction, are found on both sides of the Tintina Fault. The Selwyn Plutonic Suite of granitoid intrusives are distributed along a northwest trending arcing belt within the Basin. These are mainly granitic in nature and are associated with tin, tungsten, and molybdenum mineralization.

Property Geology and Mineralization:

The area is underlain mainly by quartzites, phyllites and limestones of supposed Proterozoic age (Grit or Hyland Group). Folded into this package are Ordovician to Devonian Road River rocks and Devonian to Mississippian Earn Group suite.

The Road River package consists of graptolitic shales, calcareous to non - calcareous black shales, graphitic shales, silty limestones and cherts. The Earn Group is distinguished by 'gun blue' weathering siliceous shales, chert, brown weathering shale and resistant chert pebble conglomerates.

Cretaceous quartz monzonites intrude these various sediments on the southern edge of the claim block. This is the edge of a large intrusive that covers Mt. Selous 7 km. To the northwest.

Structures and regional attitude of the sediments strike northwest/southeast. Sulphide 'veins' run from parallel to perpendicular to this general trend.

The Scott claims cover the new discovery, 9.29%, 5km west of the Andrew showing, which exhibits similar lithologies, with rusty black shale juxtaposed to quartzite on a small (30m width) kill zone. Gentian creek and its tributaries are milky, red or crystal clear.

Previous Work:

- Originally targeted for base metals by Atlas Exploration in 1967 during the Faro rush.

- Work conducted by Atlas to the immediate north in 1967-69 resulted in the discovery of 14 separate base metal showings. Work included geology, geophysics, bulldozer trenching, winter road construction and the building of a 300m airstrip. Atlas also conducted a mini regional silt program on ground between the two branches of the MacMillian River.

- GSC released results of a regional stream silt program in 1989 that showed highly anomalous base, precious and pathfinder metals, through out the area.

Prospector R. Berdahl did follow up work on Atlas and GSC silt programs and discovered the 9.29% showing and staked the Scott claims. Noranda optioned the adjacent Andrew Claims the previous month.

Current Work:

An airborne EM (AEM) program was contracted to Fugro Airborne Surveys of Mississauga, Ont. They flew an airborne EM (AEM) program, under contract with Noranda, over the Scott claims. The survey was flown between Oct.1 and 15. A report titled "Geophysical Survey Report" which includes the survey report titled: 'Dighem(v) Survey For Noranda Inc Andrew Survey Area, Yukon' is included as an appendix and describes the survey logistics, and system specs. Please note that the survey covers an area much larger than the 'Scott' claims and has been edited to reflect that. The geophysics survey includes 34 line kilometers, on ten separate lines, entirely covering the Scott claims.

Overall the air borne survey appears to reflect a general northwest trend, as does the regional geology. Whether this reflection is that of local geology and structure requires ground truthing.

The area of highest resistivity and highest magnetics are on opposite sides of the claim block. The area of exposed intrusives to the southwest show low mag and very high resistivity. While along the northeast property boundary mag activity is the highest while resistivity is moderate to low, except between lines 10320-31 where an oblong area of good conductivity coincides with a circular mag high.

Mag lows may reflect faults.

The area of greatest conductivity is near the confluence of several creeks in the north of the property, roughly trending northwest. This area is bounded on two sides by two convoluted but roughly parallel striking areas of mag high. The better concentration of EM anomalies (>20) are in this area as well.

The '9.29%' area isn't associated with any resistivity or mag anomaly, high or low, but is flanked by a conductivity high and a mag low. The 'Bordeleau' occurrence, which strikes at 320 degrees, corresponds to a similar trending mag high, several EM anomalies >20, and a conductivity high.

Conclusion and Recommendations:

The AEM survey over the Scott claims successfully delineated several targets that require follow up.

It is recommended that:

Several areas require ground truthing and more detailed ground mag and possibly HLEM and gravity surveys:

- An area near the northeast property boundary where a linear mag low juxtaposes a mag high, which are both flanked by areas of high conductivity, between flight lines 10300-10341.
- an area of creek confluence, in the north of the block, where a conductive area is flanked on the northeast and southwest by mag highs and peppered with several EM anomalies, along lines 10250-10290.
- Areas along mag lows (suspected faults).
- The 'slump' area (R2-4) where a mag high juxtapose a conductivity high.
- An area just downstream of Gentian Lake where a northwest striking mag low is coincident with a resistivity low.

Scott 3-34

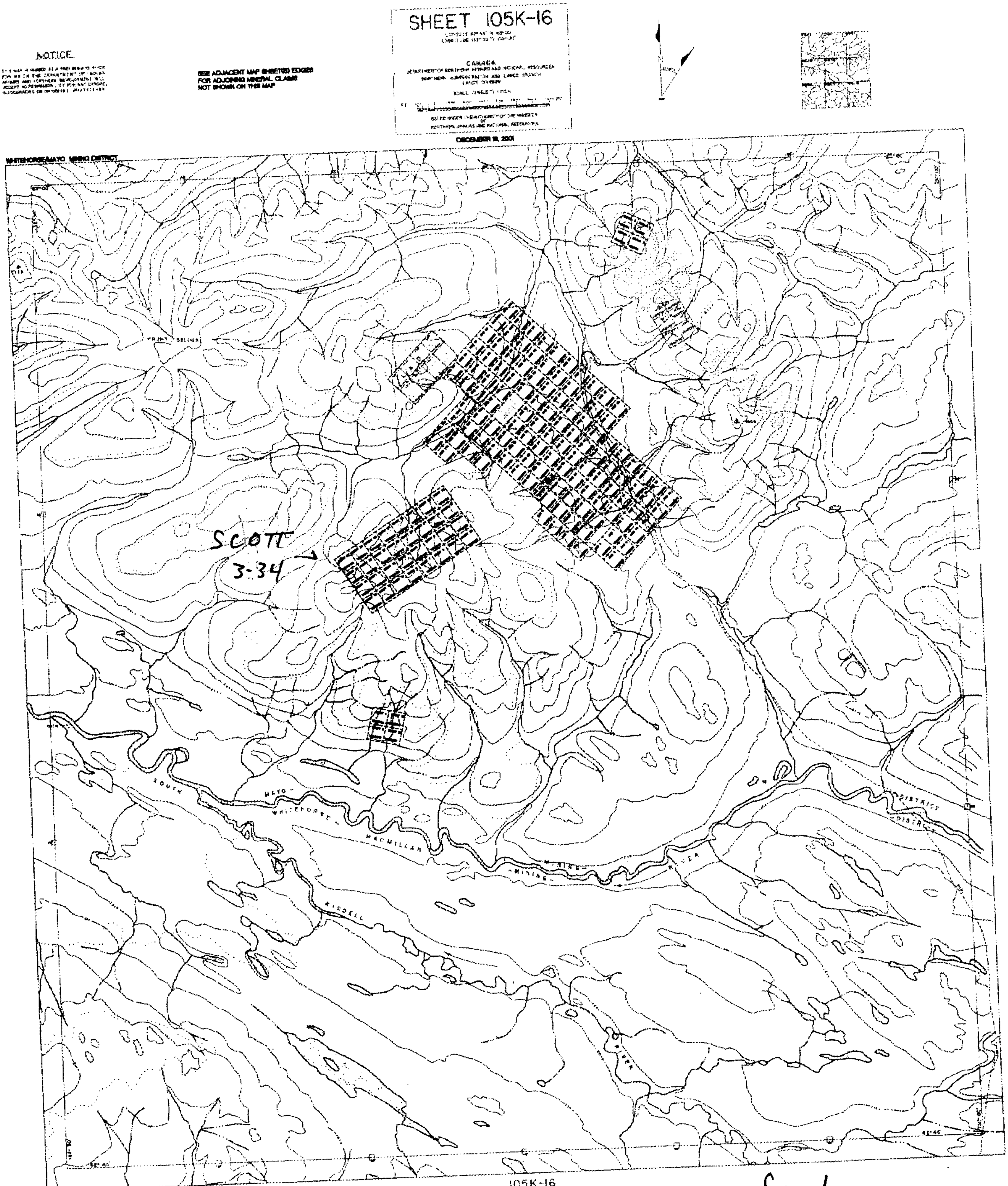


fig 1

APPENDIX A

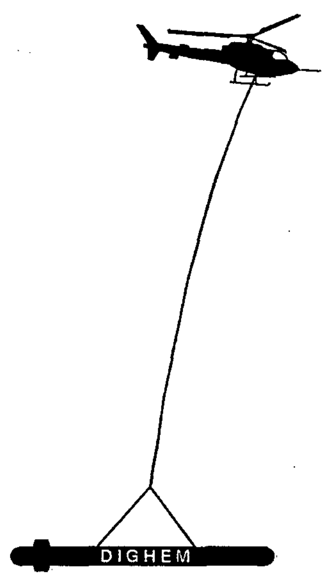
DIGHEM^V SURVEY FOR NORANDA INC.
ANDREW SURVEY AREA, YUKON

By: Fugro Airborne Surveys
January 26th, 2001

Report #2033

DIGHEM^V SURVEY
FOR
NORANDA INC.
ANDREW SURVEY AREA, YUKON

NTS 105K/16; 105N/1



Fugro Airborne Surveys Corp.
Mississauga, Ontario

Paul A. Smith
Geophysicist

January 26, 2001
EDITED BY G. ASCOUGH, Noranda Inc, February 20, 2001

Fugro Airborne Surveys, 2270 Argentia Road, Unit 2, Mississauga, Ontario, Canada, L5N 6A6
Phone: 1 905 812 0212, Fax: 1 905 812 1504

SUMMARY

This report describes the logistics and results of a DIGHEM^V airborne geophysical survey carried out for Noranda Inc., over a property located north of Ross River, Yukon Territory. The survey was flown from October 1 to October 15, 2000.

The purpose of the survey was to detect zones of conductive mineralization and to provide information which could be used to map the geology and structure of the survey area. This was accomplished by using a DIGHEM^V multi-coil, multi-frequency electromagnetic system, supplemented by a high sensitivity cesium magnetometer. The information from these sensors was processed to produce maps which display the magnetic and conductive properties of the survey area. A GPS electronic navigation system, utilizing a satellite link, ensured accurate positioning of the geophysical data with respect to the base maps. Visual flight path recovery techniques were used to confirm the location of the helicopter where visible topographic features could be identified on the ground.

The survey property contains numerous anomalous features, many of which are considered to be of moderate to high priority as exploration targets. Most of the inferred bedrock conductors appear to warrant further investigation using appropriate surface exploration techniques. Areas of interest may be assigned priorities on the basis of supporting geophysical, geochemical and/or geological information. After initial investigations have been carried out, it may be necessary to re-evaluate the remaining anomalies based on information acquired from the follow-up program.

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1. INTRODUCTION

A DIGHEM^V electromagnetic/resistivity/magnetic survey was flown for Noranda Inc., from October 1 to October 15, 2000, over a survey block located approximately 100 km north of Ross River, Yukon Territory. The survey area can be located on NTS map sheets 105K/16 and 105N/1 (Figure 1).

Flight lines were flown in an azimuthal direction of 042°/222° with a line separation of 200 metres.

The survey employed the DIGHEM^V electromagnetic system. Ancillary equipment consisted of a magnetometer, radar and barometric altimeters, video camera, analog and digital recorders, and an electronic navigation system. The instrumentation was installed in an AS350B2 turbine helicopter (Registration C-FZTA) which was provided by Questral Helicopters Ltd. The helicopter flew at an average airspeed of 90 km/h with an EM sensor height of approximately 30.

Section 2 provides details on the survey equipment, the data channels, their respective sensitivities, and the navigation/flight path recovery procedure. Noise levels of less than 2 ppm are generally maintained for wind speeds up to 35 km/h. Higher winds may cause the system to be grounded because excessive bird swinging produces difficulties in flying the helicopter. The swinging results from the 5 m^2 of area which is presented by the bird to broadside gusts.

In some portions of the survey area, the steep topography forced the pilot to exceed normal terrain clearance for reasons of safety. It is possible that some weak conductors may have escaped detection in any areas where the bird height exceeded 120 m.

2. SURVEY EQUIPMENT

This section provides a brief description of the geophysical instruments used to acquire the survey data and the calibration procedures employed.

Electromagnetic System

Model: DIGHEM^V

Type: Towed bird, symmetric dipole configuration operated at a nominal survey altitude of 30 metres. Coil separation is 8 metres for 900 Hz, 5500 Hz and 7200 Hz, and 6.3 metres for the 56,000 Hz coil-pair.

Coil orientations/frequencies:

orientation		nominal	actual
coaxial	/	1,000 Hz	1,074 Hz
coplanar	/	900 Hz	864 Hz
coaxial	/	5,500 Hz	5,956 Hz
coplanar	/	7,200 Hz	7,237 Hz
coplanar	/	56,000 Hz	56,460 Hz

Channels recorded:

5 in-phase channels
5 quadrature channels
2 monitor channels

Sensitivity:

0.06 ppm at 1,000 Hz Cx
0.12 ppm at 900 Hz Cp
0.12 ppm at 5,500 Hz Cx
0.24 ppm at 7,200 Hz Cp
0.60 ppm at 56,000 Hz Cp

Sample rate: 10 per second, equivalent to 1 sample every 3 m, at a survey speed of 110 km/h.

The electromagnetic system utilizes a multi-coil coaxial/coplanar technique to energize conductors in different directions. The coaxial coils are vertical with their axes in the flight direction. The coplanar coils are horizontal. The secondary fields are sensed simultaneously by means of receiver coils which are maximum coupled to their respective transmitter coils. The system yields an in-phase and a quadrature channel from each transmitter-receiver coil-pair.

The Dighem calibration procedure involves four stages; primary field bucking, phase calibration, gain calibration, and zero adjust. At the beginning of the survey, the primary field at each receiver coil is cancelled, or "bucked out", by precise positioning of five bucking coils.

The phase calibration adjusts the phase angle of the receiver to match that of the transmitter. A ferrite bar, which produces a purely in-phase anomaly, is positioned near each receiver coil. The bar is rotated from minimum to maximum field coupling and the responses for the in-phase and quadrature components for each coil pair/frequency are measured. The phase of the response is adjusted at the console to return an in-phase only response for each coil-pair. Phase checks are performed daily.

The gain calibration uses external coils designed to produce an equal response on in-phase and quadrature components for each frequency/coil-pair. The coil parameters and distances are designed to produce pre-determined responses at the receiver, due to the current induced in the calibration coil by the transmitter when a switch closes the loop at the coil. The gain at the console is adjusted to yield secondary responses of exactly 100 ppm. Gain calibrations are carried out at the beginning and end of the survey.

The phase and gain calibrations each measure a relative change in the secondary field, rather than an absolute value. This removes any dependency of the calibration procedure on the secondary field due to the ground, except under circumstances of extreme ground conductivity.

During each survey flight, internal (Q-coil) calibration signals are generated to recheck system gain and to establish zero reference levels. These calibrations are carried out at intervals of approximately 20 minutes with the system out of ground effect. At a sensor height of more than 250 m, there is no measurable secondary field from the earth. The remaining residual is therefore established as the zero level of the system. Linear system drift is automatically removed by re-establishing zero levels between the Q-coil calibrations.

Magnetometer

Model:	Picodas MEP-710 processor with Geometrics G822 sensor
Type:	Optically pumped cesium vapour
Sensitivity:	0.01 nT
Sample rate:	10 per second

The magnetometer sensor is housed in the EM bird, 28 m below the helicopter.

Magnetic Base Station

Model:	Picodas MEP-710 processor with Geometrics G822 sensor
Type:	Digital recording cesium vapour
Sensitivity:	0.01 nT
Sample rate:	1 per second

A digital recorder is operated in conjunction with the base station magnetometer to record the diurnal variations of the earth's magnetic field. The clock of the base station is synchronized with that of the airborne system to permit subsequent removal of diurnal drift.

Radar Altimeter

Manufacturer:	Honeywell/Sperry
Model:	AA 330
Type:	Short pulse modulation, 4.3 GHz
Sensitivity:	0.3 m

The radar altimeter measures the vertical distance between the helicopter and the ground. This information is used in the processing algorithm which determines conductor depth.

Barometric Pressure and Temperature Sensors

Model:	DIGHEM D 1300	
Type:	Motorola MPX4115AP analog pressure sensor AD592AN high-impedance remote temperature sensors	
Sensitivity:	Pressure:	150 mV/kPa
	Temperature:	100 mV/°C or 10 mV/°C (selectable)
Sample rate:	10 per second	

The D1300 circuit is used in conjunction with one barometric sensor and up to three temperature sensors. Two sensors (baro and temp) are installed in the EM console in the aircraft, to monitor pressure and internal operating temperatures.

Analog Recorder

Manufacturer:	RMS Instruments
Type:	DGR33 dot-matrix graphics recorder
Resolution:	4x4 dots/mm
Speed:	1.5 mm/sec

The analog profiles are recorded on chart paper in the aircraft during the survey. Table 2-1 lists the geophysical data channels and the vertical scale of each profile.

Table 2-1. The Analog Profiles

Channel Name	Parameter	Scale units/mm	Designation on Digital Profile
1X9I	coaxial in-phase (1000 Hz)	2.5 ppm	CXI1000
1X9Q	coaxial quad (1000 Hz)	2.5 ppm	CXQ1000
3P9I	coplanar in-phase (900 Hz)	2.5 ppm	CPI900
3P9Q	coplanar quad (900 Hz)	2.5 ppm	CPQ900
2P7I	coplanar in-phase (7200 Hz)	5 ppm	CPI7200
2P7Q	coplanar quad (7200 Hz)	5 ppm	CPQ7200
4X7I	coaxial in-phase (5500 Hz)	5 ppm	CXI5500
4X7Q	coaxial quad (5500 Hz)	5 ppm	CXQ5500
5P5I	coplanar in-phase (56000 Hz)	10 ppm	CPI56K
5P5Q	coplanar quad (56000 Hz)	10 ppm	CPQ56K
ALTR	altimeter (radar)	3 m	ALTBIRDM
CMGC	magnetics, coarse	20 nT	
CMGF	magnetics, fine	2.0 nT	MAGFIN
CXSP	coaxial sferics monitor		CXSP
CPSP	coplanar sferics monitor		CPSP
CXPL	coaxial powerline monitor		PWRL
CPPL	coplanar powerline monitor		
1KPA	altimeter (barometric)	30 m	
2TDC	internal (console) temperature	1° C	
3TDC	external temperature	1° C	

Digital Data Acquisition System

Manufacturer:	RMS Instruments
Model:	DGR 33
Recorder:	48 Mb Flash card

The data are stored on a 48 Mb Flash card and are downloaded to the field workstation PC at the survey base for verification, backup and preparation of in-field products.

Video Flight Path Recording System

Type:	Panasonic VHS Colour Video Camera (NTSC)
Model:	AG 2400/WVCD132

Fiducial numbers are recorded continuously and are displayed on the margin of each image. This procedure ensures accurate correlation of analog and digital data with respect to visible features on the ground.

Navigation (Global Positioning System)

Airborne Receiver

Model:	Ashtech Glonass GG24
Type:	SPS (L1 band), 24-channel, C/A code at 1575.42 MHz, S code at 0.5625 MHz, Real-time differential.
Sensitivity:	-132 dBm, 0.5 second update
Accuracy:	Manufacturer's stated accuracy is better than 10 metres real-time

Base Station

Model:	Marconi Allstar OEM, CMT-1200
Type:	Code and carrier tracking of L1 band, 12-channel, C/A code at 1575.42 MHz
Sensitivity:	-90 dBm, 1.0 second update
Accuracy:	Manufacturer's stated accuracy for differential corrected GPS is 2 metres

The Ashtech GG24 is a line of sight, satellite navigation system which utilizes time-coded signals from at least four of forty-eight available satellites. Both Russian GLONASS and American NAVSTAR satellite constellations are used to calculate the position and to provide real time guidance to the helicopter. The Ashtech system can be combined with a RACAL or similar GPS receiver which further improves the accuracy of the flying and subsequent flight path recovery to better than 5 metres. The differential corrections, which are obtained from a network of virtual reference stations, are transmitted to the helicopter via a spot-beam satellite. This eliminates the need for a local GPS base station. However, the Marconi Allstar OEM (CMT-1200) was used as a backup to provide post-survey differential corrections.

The Marconi Allstar OEM (CMT-1200) is operated as a base station and utilizes time-coded signals from at least four of the twenty-four NAVSTAR satellites. The base station raw XYZ data are recorded, thereby permitting post-survey flight path processing for theoretical accuracies of better than 2 metres.

The Ashtech receiver is coupled with a PNAV navigation system for real-time guidance. The raw navigation data are stored on a 100 Mb Iomega Zip drive.

Although the base station receiver is able to calculate its own latitude and longitude, a higher degree of accuracy can be obtained if the reference unit is established on a known benchmark or triangulation point. For this survey, the GPS station was located at latitude 62°13.89502'N, longitude 133°20.65359'W at an ellipsoidal elevation of 754.6 m. The GPS records data relative to the WGS84 ellipsoid, which is the basis of the revised North American Datum (NAD83). Conversion software is used to transform the WGS84 latitude/longitude coordinates to the NAD83 UTM system displayed on the base maps.

Field Workstation

A PC is used at the survey base to verify data quality and completeness. Flight data are transferred to the PC hard drive to permit the creation of a database using a proprietary software package (typhoon-version 17.01.04). This process allows the field operators to display both the positional (flight path) and geophysical data on a screen or printer.

3. PRODUCTS AND PROCESSING TECHNIQUES

Table 3-1 lists the maps and products that have been provided under the terms of the survey agreement. Other products can be prepared from the existing dataset, if requested. These include magnetic enhancements or derivatives, percent magnetite, digital terrain or resistivity-depth sections. Most parameters can be displayed as contours, profiles, or in colour.

Base Maps

Base maps of the survey area have been produced from digital (.dwg) topographic files, supplied by Noranda. These provide a relatively accurate, distortion-free base which facilitates correlation of the navigation data to the UTM grid. The digital topographic files are combined with geophysical data for plotting the final maps. All maps were created using the following parameters:

Projection Description:

Datum:	NAD83
Ellipsoid:	Geodetic Reference System 1980 (WGS84)
Projection:	UTM (Zone: 8)
Central Meridian:	135°W
False Northing:	0
False Easting:	500000
Scale Factor:	0.9996
WGS84 to Local Conversion:	Molodensky
Datum Shifts:	DX: 0 DY: 0 DZ: 0

Table 3-1 Survey Products

1. Final Transparent Maps (+4 prints) @ 1:20,000

   Dighem EM anomalies
   Total magnetic field
   Calculated vertical magnetic gradient
   Apparent resistivity (7200 Hz)
   Apparent resistivity (56,000 Hz)

2. Colour Maps (2 sets) @ 1:20,000

   Total magnetic field
   Calculated vertical magnetic gradient
   Apparent resistivity (7200 Hz)
   Apparent resistivity (56,000 Hz)

3. Additional Products

   Database in Geosoft (.GDB) format
   Digital XYZ archive in Geosoft format (CD-ROM)
   Digital grid archives in Geosoft .GRD format (CD-ROM)
   Survey report (4 copies)
   Multi-channel stacked profiles
   Analog chart records
   Flight path video cassettes

Note: Other products can be produced from existing survey data, if requested.

Electromagnetic Anomalies

EM data are processed at the recorded sample rate of 10 samples/second. If necessary, appropriate spheric rejection median or Hanning filters are applied to reduce noise to acceptable levels. EM test profiles are then created to allow the interpreter to select the most appropriate EM anomaly picking controls for a given survey area. The EM picking parameters depend on several factors but are primarily based on the dynamic range of the resistivities within the survey area, and the types and expected geophysical responses of the targets being sought.

Anomalous electromagnetic responses are selected and analysed by computer to provide a preliminary electromagnetic anomaly map. The automatic selection algorithm is intentionally oversensitive to assure that no meaningful responses are missed. Using the preliminary map in conjunction with the multi-parameter stacked profiles, the interpreter then classifies the anomalies according to their source and eliminates those that are not substantiated by the data. The final interpreted EM anomaly map includes bedrock, surficial and cultural conductors. A map containing only bedrock conductors can be generated, if desired.

Apparent Resistivity

The apparent resistivity in ohm-m can be generated from the in-phase and quadrature EM components for any of the frequencies, using a pseudo-layer half-space model. A resistivity map portrays all the EM information for that frequency over the entire survey area. This contrasts with the electromagnetic anomaly map which provides information only over interpreted conductors. The large dynamic range makes the resistivity parameter an excellent mapping tool.

The preliminary resistivity maps and images are carefully inspected to locate any lines or line segments which might require levelling adjustments. Subtle changes between in-flight calibrations of the system can result in line to line differences, particularly in resistive (low signal amplitude) areas. If required, manual levelling is carried out to eliminate or minimize resistivity differences which can be caused by changes in operating temperatures. These levelling adjustments are usually very subtle, and do not result in the degradation of anomalies from valid bedrock sources.

After the manual levelling process is complete, revised resistivity grids are created. The resulting grids can be subjected to a microlevelling filter in order to smooth the data for contouring. The coplanar resistivity parameter has a broad 'footprint' which requires very little filtering.

The calculated resistivities for the three coplanar frequencies are included in the XYZ and grid archives. Values are in ohm-metres on all final products.

EM Magnetite (optional)

The apparent percent magnetite by weight is computed wherever magnetite produces a negative in-phase EM response. This calculation is more meaningful in resistive areas.

Total Magnetic Field

The aeromagnetic data are corrected for diurnal variation using the magnetic base station data. Manual adjustments are applied to any lines that require levelling, as indicated by shadowed images of the gridded magnetic data or tie line/traverse line intercepts. The IGRF gradient can be removed from the corrected total field data, if requested.

Calculated Vertical Magnetic Gradient

The diurnally-corrected total magnetic field data are subjected to a processing algorithm which enhances the response of magnetic bodies in the upper 500 m and attenuates the response of deeper bodies. The resulting vertical gradient map provides better definition and resolution of near-surface magnetic units. It also identifies weak magnetic features which may not be evident on the total field map. However, regional magnetic variations and changes in lithology may be better defined on the total magnetic field map.

Magnetic Derivatives (optional)

The total magnetic field data can be subjected to a variety of filtering techniques to yield maps of the following:

- enhanced magnetics
- second vertical derivative
- reduction to the pole/equator
- magnetic susceptibility with reduction to the pole
- upward/downward continuations
- analytic signal

All of these filtering techniques improve the recognition of near-surface magnetic bodies, with the exception of upward continuation. Any of these parameters can be produced on request.

Multi-channel Stacked Profiles (Single working copy only)

Distance-based profiles of the digitally recorded geophysical data are generated and plotted at an appropriate scale. These profiles also contain the calculated parameters which are used in the interpretation process. These are produced as worksheets prior to interpretation, and are also presented in the final corrected form after interpretation. The profiles display electromagnetic anomalies with their respective interpretive symbols. Table 3-2 shows the parameters and scales for the multi-channel stacked profiles.

In Table 3-2, the log resistivity scale of 0.06 decade/mm means that the resistivity changes by an order of magnitude in 16.6 mm. The resistivities at 0, 33 and 67 mm up from the bottom of the digital profile are respectively 1, 100 and 10,000 ohm-m.

Contour, Colour and Shadow Map Displays

The geophysical data are interpolated onto a regular grid using a modified Akima spline technique. The resulting grid is suitable for generating contour maps of excellent quality. The grid cell size is usually 25% of the line interval, i.e., 50 metres.

Colour maps are produced by interpolating the grid down to the pixel size. The parameter is then incremented with respect to specific amplitude ranges to provide colour "contour" maps. Colour maps of the total magnetic field are particularly useful in defining the lithology of the survey area.

Table 3-2. Multi-channel Stacked Profiles

Channel Name (Freq)	Observed Parameters	Scale Units/mm
MAGFIN	total magnetic field (fine)	5 nT
ALTBIRDM	EM sensor height above ground	6 m
CXI1000	vertical coaxial coil-pair in-phase (1000 Hz)	4 ppm
CXQ1000	vertical coaxial coil-pair quadrature (1000 Hz)	4 ppm
CPI900	horizontal coplanar coil-pair in-phase (900 Hz)	4 ppm
CPQ900	horizontal coplanar coil-pair quadrature (900 Hz)	4 ppm
CXI5500	vertical coaxial coil-pair in-phase (5500 Hz)	4 ppm
CXQ5500	vertical coaxial coil-pair quadrature (5500 Hz)	4 ppm
CPI7200	horizontal coplanar coil-pair in-phase (7200 Hz)	8 ppm
CPQ7200	horizontal coplanar coil-pair quadrature (7200 Hz)	8 ppm
CPI56K	horizontal coplanar coil-pair in-phase (56,000 Hz)	10 ppm
CPQ56K	horizontal coplanar coil-pair quadrature (56,000 Hz)	10 ppm
CXSP	coaxial spherics monitor	
PWRL	coaxial powerline monitor	
CPSP	coplanar spherics monitor	
	Computed Parameters	
DIFI (900 Hz)	difference function in-phase from CXI and CPI	4 ppm
DIFQ (900 Hz)	difference function quadrature from CXQ and CPQ	4 ppm
RES900	log resistivity	.06 decade
RES7200	log resistivity	.06 decade
RES56K	log resistivity	.06 decade
DP900	apparent depth	6 m
DP7200	apparent depth	6 m
DP56K	apparent depth	6 m
CDT	Conductance	1 grade

Monochromatic shadow maps or images are generated by employing an artificial sun to cast shadows on a surface defined by the geophysical grid. There are many variations in the shadowing technique. These techniques can be applied to total field or enhanced magnetic data, magnetic derivatives, VLF, resistivity, etc. The shadow of the enhanced magnetic parameter is particularly suited for defining geological structures with crisper images and improved resolution.

Resistivity-depth Sections (optional)

The apparent resistivities for all frequencies can be displayed simultaneously as coloured resistivity-depth sections. Usually, only the coplanar data are displayed as the close frequency separation between the coplanar and adjacent coaxial data tends to distort the section. The sections can be plotted using the topographic elevation profile as the surface. The digital terrain values, in metres a.m.s.l., can be calculated from the GPS z-value or barometric altimeter, minus the aircraft radar altimeter.

Resistivity-depth sections can be generated in three formats:

(1) Sengpiel resistivity sections, where the apparent resistivity for each frequency is plotted at the depth of the centroid of the in-phase current flow[1]; and,

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1 Sengpiel, K.P., 1988, imate Inversion of Airborne EM Data from Multilayered Ground: Geophysical Prospecting 36, 446-459.

(2) Differential resistivity sections, where the differential resistivity is plotted at the differential depth[2].

(3) Occam[3] or Multi-layer[4] inversion.

Both the Sengpiel and differential methods are derived from the pseudo-layer half-space model. Both yield a coloured resistivity-depth section which attempts to portray a smoothed approximation of the true resistivity distribution with depth. Resistivity-depth sections are most useful in conductive layered situations, but may be unreliable in areas of moderate to high resistivity where signal amplitudes are weak. In areas where in-phase responses have been suppressed by the effects of magnetite, the computed resistivities shown on the sections may be unreliable.

Both the Occam and Multi-layer Inversions compute the layered earth resistivity model which would best match the measured EM data. The Occam inversion uses a series of thin, fixed layers (usually 20 x 5m and 10 x 10m layers) and computes resistivities to fit the EM data. The multi-layer inversion computes the resistivity and thickness for each of a defined number of layers (typically 3-5 layers) to best fit the data.

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2 Huang, H. and Fraser, D.C., 1993, Differential Resistivity Method for Multi-frequency Airborne EM Sounding: presented at Intern. Airb. EM Workshop, Tucson, Ariz.

3 Constable et al, 1987, Occam's inversion: a practical algorithm for generating smooth models from electromagnetic sounding data: Geophysics, 52, 289-300.

4 Huang H., and Palacky, G.J., 1991, Damped least-squares inversion of time domain airborne EM data based on singular value decomposition: Geophysical Prospecting, 39, 827-844.

Digital Terrain (optional)

The radar altimeter values (ALTR - aircraft to ground clearance) can be subtracted from the differentially corrected GPS-Z values, which are transformed to the local datum, to produce profiles of the height above mean sea level along the survey lines. These values are gridded to produce contour maps showing approximate elevations within the survey block. The resulting digital terrain contours are compared against published topographic maps. The data can be manually adjusted to remove differences between the two and then subjected to a microlevelling algorithm to remove any remaining small line-to-line discrepancies.

The accuracy of the elevation calculation is directly dependent on the accuracy of the two input parameters, ALTR and GPS-Z. The ALTR value may be erroneous in areas of heavy tree cover, where the altimeter reflects the distance to the tree canopy rather than the ground. The GPS-Z value is primarily dependent on the number of available satellites. Although post-processing of GPS data will yield X and Y accuracies in the order of 5 metres, the accuracy of the Z value is usually much less, sometimes in the ±20 metre range. Further inaccuracies may be introduced during the interpolation and gridding process.

Because of the inherent inaccuracies of this method, no guarantee is made or implied that the information displayed is a true representation of the height above sea level. Although this product may be of some use as a general reference, <u>THIS PRODUCT MUST NOT BE USED FOR NAVIGATION PURPOSES</u>.

4. SURVEY RESULTS

General Discussion

The survey results are presented on two separate map sheets for each parameter at a scale of 1:20,000.

The anomalies shown on the electromagnetic anomaly maps are based on a near-vertical, half plane model. This model best reflects "discrete" bedrock conductors. Wide bedrock conductors or flat-lying conductive units, whether from surficial or bedrock sources, may give rise to very broad anomalous responses on the EM profiles. These may not appear on the electromagnetic anomaly map if they have a regional character rather than a locally anomalous character. These broad conductors, which more closely approximate a half-space model, will be maximum coupled to the horizontal (coplanar) coil-pair and should be more evident on the resistivity parameter. Resistivity maps, therefore, may be more valuable than the electromagnetic anomaly maps, in areas where broad or flat-lying conductors are considered to be of importance. Contoured resistivity maps, based on the 7200 Hz and 56,000 Hz coplanar data are included with this report.

Excellent resolution and discrimination of conductors was accomplished by using a fast sampling rate of 0.1 sec and by employing a common frequency (900 Hz) on two orthogonal coil-pairs (coaxial and coplanar). The resulting "difference channel" parameters often permit differentiation of bedrock and surficial conductors, even though they may exhibit similar conductance values.

Anomalies which occur near the ends of the survey lines (i.e., outside the survey area), should be viewed with caution. Some of the weaker anomalies could be due to aerodynamic noise, i.e., bird bending, which is created by abnormal stresses to which the bird is subjected during the climb and turn of the aircraft between lines. Such aerodynamic noise is usually manifested by an anomaly on the coaxial in-phase channel only, although severe stresses can affect the coplanar in-phase channels as well.

Magnetics

A Picodas MEP-710 cesium vapour magnetometer was operated at the survey base to record diurnal variations of the earth's magnetic field. The clock of the base station was synchronized with that of the airborne system to permit subsequent removal of diurnal drift.

The total magnetic field data have been presented as contours on the base maps using a contour interval of 1 nT where gradients permit. The maps show the magnetic properties of the rock units underlying the survey area.

The total magnetic field data have been subjected to a processing algorithm to produce maps of the calculated vertical gradient. This procedure enhances near-surface magnetic units and suppresses regional gradients. It also provides better definition and resolution of magnetic units and displays weak magnetic features which may not be clearly evident on the total field maps.

There is some evidence on the magnetic map(s) which suggests that the survey area has been subjected to deformation and/or alteration. These structural complexities are evident on the contour maps as variations in magnetic intensity, irregular patterns, and as offsets or changes in strike direction. Some of the more prominent linear features are also evident on the topographic base maps.

The magnetic relief varies from a low of less than 57,770 nT to a high of more than 59,700 nT.

The total field map shows a major unit that strikes roughly east-southeast, on the western portion of the area of interest, this trend is interupted by a north-trending low. Within this unit, the vertical gradient map shows a structurally complex core. This magnetic unit hosts numerous southeast-trending conductors.

Although the regional geological strike is southeast, there are several east-trending linear lows that can be inferred from the magnetic results. In addition, there are also south-southeast and east-southeast trending linear features which indicate probable structural breaks or contacts.

The vertical gradient maps define the contacts and linear trends more clearly, and demonstrate the highly complex nature of the underlying geology.

If a specific magnetic intensity can be assigned to the rock type which is believed to host the target mineralization, it may be possible to select areas of higher priority on the basis of the total field magnetic data. This is based on the assumption that the magnetite content of the host rocks will give rise to a limited range of contour values which will permit differentiation of various lithological units.

The magnetic results, in conjunction with the other geophysical parameters, have provided valuable information which can be used to effectively map the geology and structure in the survey area.

Apparent Resistivity

Apparent resistivity maps, which display the conductive properties of the survey area, were produced from the 900Hz, 7200 Hz and 56,000 Hz coplanar data. The maximum resistivity values, which are calculated for each frequency, are 1,000; 8,000 and 20,000 ohm-m respectively. These cutoffs eliminate the erratic higher resistivities which would result from unstable ratios of very small EM amplitudes.

In general, the resistivity patterns show good agreement with the magnetic trends. This suggests that many of the resistivity lows and highs are probably related to bedrock features, rather than surficial causes. There are some areas, however, where contour patterns appear to be influenced by conductive surficial material.

Although magnetic and resistivity trends correlate well, moderate to strong conductors are associated with both the magnetic and non-magnetic units. In the "background" areas, most conductors are associated with the less magnetic units. However, in the western portion of the AOI many of the EM anomalies exhibit direct magnetic correlation. The highly conductive magnetic and non-magnetic units suggest the presence of both pyrrhotitic and graphitic sources, within a very complex and altered environment.

There are a few areas where the effects of magnetite are evident on the inphase profiles. In some cases, the suppressed inphase responses yield apparent resistivities that are slightly above background. In other areas, the coincident quadrature responses indicate the presence of weakly conductive material associated with the magnetite-rich units.

Electromagnetic Anomalies

The EM anomalies resulting from this survey appear to fall within one of three general categories. The first type consists of discrete, well-defined anomalies which yield marked inflections on the difference channels. These anomalies are usually attributed to conductive sulphides or graphite and are generally given a "B", "T" or "D" interpretive symbol, denoting a bedrock source.

The second class of anomalies comprises moderately broad responses which exhibit the characteristics of a half-space and do not yield well-defined inflections on the difference channels. Anomalies in this category are usually given an "S" or "H" interpretive symbol. The lack of a difference channel response usually implies a broad or flat-lying conductive source such as overburden. Some of these anomalies could reflect conductive rock units, zones of deep weathering, or lacustrine clays, all of which can yield “non-discrete” signatures.

The effects of conductive overburden are evident over most of the streams and low-lying portions of the survey area. Although the difference channels (DIFI and DIFQ) are extremely valuable in detecting bedrock conductors which are partially masked by conductive overburden, sharp undulations in the bedrock/overburden interface can yield anomalies in the difference channels which may be interpreted as possible bedrock conductors. Such anomalies usually fall into the "S?" or "B?" classification but may also be given an "E" interpretive symbol, denoting a resistivity contrast at the edge of a conductive unit.

The "?" symbol does not question the validity of an anomaly, but instead indicates some degree of uncertainty as to which is the most appropriate EM source model. This ambiguity results from the combination of effects from two or more conductive sources, such as overburden and bedrock, gradational changes, or moderately shallow dips. The presence of a conductive upper layer has a tendency to mask or alter the characteristics of bedrock conductors, making interpretation difficult. This problem is further exacerbated in the presence of magnetite.

The third anomaly category includes responses which are associated with magnetite. Magnetite can cause suppression or polarity reversals of the in-phase components, particularly at the lower frequencies in resistive areas. The effects of magnetite-rich rock units are evident on a few of the multi-parameter geophysical data profiles, as negative excursions of the 900 Hz in-phase channels.

In areas where EM responses are evident primarily on the quadrature components, zones of poor conductivity are indicated. Where these responses are coincident with magnetic anomalies, it is possible that the in-phase component amplitudes have been suppressed by the effects of magnetite. Most of these poorly-conductive magnetic features give rise to resistivity anomalies which are only slightly above or slightly below background. If it is expected that poorly-conductive economic mineralization could be associated with magnetite-rich units, most of these weakly anomalous features will also be of interest. In areas where magnetite causes the in-phase components to become negative, the apparent conductance and depth of EM anomalies may be unreliable. Magnetite effects usually give rise to overstated (higher) resistivity values and understated (shallow) depth calculations.

As economic mineralization within the area may be associated with massive to weakly disseminated sulphides, which may or may not be hosted by magnetite-rich rocks, it is impractical to assess the relative merits of EM anomalies on the basis of conductance. It is recommended that an attempt be made to compile a suite of geophysical "signatures" over any known areas of interest. Anomaly characteristics are clearly defined on the computer-processed geophysical data profiles which are supplied as one of the survey products.

A complete assessment and evaluation of the survey data should be carried out by one or more qualified professionals who have access to, and can provide a meaningful compilation of, all available geophysical, geological and geochemical data.

Conductors in the Survey Area

The electromagnetic anomaly maps show the anomaly locations with an ID that can be referenced to the anomaly table to look up the interpreted conductor type, dip, conductance and depth. Direct magnetic correlation is also indicated in the table if it exists. The strike direction and length of the conductors are indicated only where anomalies can be correlated from line to line with a reasonable degree of confidence.

In areas where several conductors or conductive trends appear to be related to a common geological unit, these have been outlined as "zones" on the EM anomaly maps. The zone outlines usually approximate the limits of conductive units defined by the resistivity contours, but are not necessarily related to distinct rock units which can be inferred from the magnetic data.

It is beyond the scope of this report to attempt to describe the numerous conductors in this survey area. However, in the search for magnetic sulphide deposits, there are five main criteria that can often be used to select the high priority targets:

1. Conductors with strike lengths of less than 1 km are generally considered to be more attractive than the much longer "formational" conductors. Formational conductors that exhibit changes along strike, however, can also be of interest.

2. The more conductive zones usually give rise to distinct resistivity lows that can be used to detect concentrations of conductive material.

3. Anomalies that exhibit direct magnetic correlation are usually assigned a higher priority than the strong, non-magnetic conductors that are more likely to be caused by graphite.

4. Conductors that are associated with, or in close proximity to, zones of structural deformation, are also considered to be more attractive targets for follow-up work.

5. Any conductors that occur in areas of favourable geology or anomalous geochemical results, will obviously be assigned a higher priority than those that do not.

It is extremely difficult to assign priorities to the conductors within the complex zones of magnetics and conductivity. However, using the criteria outlined above, those anomalies which exhibit magnetic correlation and appear to be related to zones of structural deformation, would normally be considered to be of higher priority.

The complex magnetic patterns are intersected by at several east/west breaks that are evident on the magnetic data. These linear trends are observed as relative lows, striking east through many EM anomalies. Any conductors that occur in close proximity to these inferred structural breaks may be of interest.

5. CONCLUSIONS AND RECOMMENDATIONS

This report provides a very brief description of the survey results and describes the equipment, procedures and logistics of the survey.

There are 1915 anomalies in the survey block at least 1500 of which are deemed to be due to bedrock sources. Many of these exhibit signatures that are typical of massive sulphide or graphitic responses. The survey was also successful in locating several moderately weak or broad conductors which may also warrant additional work. The various maps included with this report display the magnetic and conductive properties of the survey area. It is recommended that the survey results be reviewed in detail, in conjunction with all available geophysical, geological and geochemical information. Particular reference should be made to the multi-parameter geophysical data profiles which clearly define the characteristics of the individual anomalies.

Most anomalies in the area are moderately strong and well-defined. Some have been attributed to conductive overburden or deep weathering, although others are clearly associated with magnetite-rich rock units. Many coincide with magnetic gradients which may reflect alteration zones, contacts, faults or shears. These zones of structural deformation are considered to be of particular interest as they may have influenced mineral deposition within the survey area.

Conductors occur in both the magnetic and non-magnetic units, but most of the stronger anomalies appear to be related to the less magnetic units.

It is beyond the scope of this report to describe all of the anomalous responses in the survey area. The brief anomaly descriptions address only a few of the more interesting responses.

Most of the interpreted bedrock conductors defined by the survey are considered to be potential targets which should be subjected to further investigation, using appropriate surface exploration techniques. Anomalies which are currently considered to be of moderately low priority may require upgrading if follow-up results are favourable.

It is also recommended that image processing of existing geophysical data be considered, in order to extract the maximum amount of information from the survey results. Current software and imaging techniques often provide valuable information on structure and lithology, which may not be clearly evident on the contour and colour maps. These techniques can yield images which define subtle, but significant, structural details.

Respectfully submitted,

FUGRO AIRBORNE SURVEYS CORP.

Paul A. Smith
Geophysicist

PAS/sdp

R2033JAN.01

EDITED BY: G. Ascough, February 20th, 2001

APPENDIX A

LIST OF PERSONNEL

The following personnel were involved in the acquisition, processing, interpretation and presentation of data, relating to a DIGHEM^V airborne geophysical survey carried out for Noranda Inc., over the Andrew Survey Area, Y.T.

David Miles	Manager, Helicopter Operations
Emily Farquhar	Manager, Data Processing and Interpretation
Frank Corbin	Senior Geophysical Operator
Patrick Dickenson	Second Geophysical Operator
Nick Venter	Field Geophysicist
Don Ellis	Electronics Engineer
Mark Lapointe	Pilot (Questral Helicopters Ltd.)
Gordon Smith	Data Processing Supervisor
Russell Imrie	Data Processor
Paul A. Smith	Interpretation Geophysicist
Lyn Vanderstarren	Drafting Supervisor
Susan Pothiah	Word Processing Operator
Albina Tonello	Secretary/Expeditor

The survey consisted of 1099 km of coverage, flown from October 1 to October 15, 2000.

All personnel are employees of Fugro Airborne Surveys, except for the pilot who is an employee of Questral Helicopters Ltd.

APPENDIX B

STATEMENT OF COST

Date: January 26, 2001

IN ACCOUNT WITH FUGRO AIRBORNE SURVEYS

To: Fugro flying of Agreement dated August 13, 2000, pertaining to an Airborne Geophysical Survey in the Andrew Survey Area, Yukon Territory.

Survey Charges

1065 km of flying @ $93.00/km plus mobilization costs of $3,500.00.	$128,545.00

Allocation of Costs

- Data Acquisition	(80%)
- Data Processing	(10%)
- Interpretation, Report and Maps	(10%)

APPENDIX C

BACKGROUND INFORMATION

BACKGROUND INFORMATION

Electromagnetics

DIGHEM electromagnetic responses fall into two general classes, discrete and broad. The discrete class consists of sharp, well-defined anomalies from discrete conductors such as sulphide lenses and steeply dipping sheets of graphite and sulphides. The broad class consists of wide anomalies from conductors having a large horizontal surface such as flatly dipping graphite or sulphide sheets, saline water-saturated sedimentary formations, conductive overburden and rock, and geothermal zones. A vertical conductive slab with a width of 200 m would straddle these two classes.

The vertical sheet (half plane) is the most common model used for the analysis of discrete conductors. All anomalies plotted on the geophysical maps are analyzed according to this model. The following section entitled **Discrete Conductor Analysis** describes this model in detail, including the effect of using it on anomalies caused by broad conductors such as conductive overburden.

The conductive earth (half-space) model is suitable for broad conductors. Resistivity contour maps result from the use of this model. A later section entitled **Resistivity Mapping** describes the method further, including the effect of using it on anomalies caused by discrete conductors such as sulphide bodies.

Geometric Interpretation

The geophysical interpreter attempts to determine the geometric shape and dip of the conductor. Figure C-1 shows typical DIGHEM anomaly shapes which are used to guide the geometric interpretation.

Discrete Conductor Analysis

The EM anomalies appearing on the electromagnetic map are analyzed by computer to give the conductance (i.e., conductivity-thickness product) in siemens (mhos) of a vertical sheet model. This is done regardless of the interpreted geometric shape of the conductor. This is not an unreasonable procedure, because the computed conductance increases as the electrical quality of the conductor increases, regardless of its true shape. DIGHEM anomalies are divided into seven grades of conductance, as shown in Table C-1. The conductance in siemens (mhos) is the reciprocal of resistance in ohms.

The conductance value is a geological parameter because it is a characteristic of the conductor alone. It generally is independent of frequency, flying height or depth of burial, apart from the averaging over a greater portion of the conductor as height increases. Small anomalies from deeply buried strong conductors are not confused with small anomalies from shallow weak conductors because the former will have larger conductance values.

Table C-1. EM Anomaly Grades

Anomaly Grade	Siemens
7	> 100
6	50 - 100
5	20 - 50
4	10 - 20
3	5 - 10
2	1 - 5
1	< 1

Conductive overburden generally produces broad EM responses which may not be shown as anomalies on the geophysical maps. However, patchy conductive overburden in otherwise resistive areas can yield discrete anomalies with a conductance grade (cf. Table C-1) of 1, 2 or even 3 for conducting clays which have resistivities as low as 50 ohm-m. In areas where ground resistivities are below 10 ohm-m, anomalies caused by weathering variations and similar causes can have any conductance grade. The anomaly shapes from the multiple coils often allow such conductors to be recognized, and these are indicated by the letters S, H, and sometimes E on the geophysical maps (see EM legend on maps).

For bedrock conductors, the higher anomaly grades indicate increasingly higher conductances. Examples: DIGHEM's New Insco copper discovery (Noranda, Canada) yielded a grade 5 anomaly, as did the neighbouring copper-zinc Magusi River ore body; Mattabi (copper-zinc, Sturgeon Lake, Canada) and Whistle (nickel, Sudbury, Canada) gave grade 6; and DIGHEM's Montcalm nickel-copper discovery (Timmins, Canada) yielded a grade 7 anomaly. Graphite and sulphides can span all grades but, in any particular survey area, field work may show that the different grades indicate different types of conductors.

Strong conductors (i.e., grades 6 and 7) are characteristic of massive sulphides or graphite. Moderate conductors (grades 4 and 5) typically reflect graphite or sulphides of a less massive character, while weak bedrock conductors (grades 1 to 3) can signify poorly connected graphite or heavily disseminated sulphides. Grades 1 and 2 conductors may not respond to ground EM equipment using frequencies less than 2000 Hz.

The presence of sphalerite or gangue can result in ore deposits having weak to moderate conductances. As an example, the three million ton lead-zinc deposit of Restigouche Mining Corporation near Bathurst, Canada, yielded a well-defined grade 2 conductor. The 10 percent by volume of sphalerite occurs as a coating around the fine grained massive pyrite, thereby inhibiting electrical conduction. Faults, fractures and shear zones may produce anomalies which typically have low conductances (e.g., grades 1 to 3). Conductive rock formations can yield anomalies of any conductance grade. The conductive materials in such rock formations can be salt water, weathered products such as clays, original depositional clays, and carbonaceous material.

For each interpreted electromagnetic anomaly on the geophysical maps, a letter identifier and an interpretive symbol are plotted beside the EM grade symbol. The horizontal rows of dots, under the interpretive symbol, indicate the anomaly amplitude on the flight record. The vertical column of dots, under the anomaly letter, gives the estimated depth. In areas where anomalies are crowded, the letter identifiers, interpretive symbols and dots may be obliterated. The EM grade symbols, however, will always be discernible, and the obliterated information can be obtained from the anomaly listing appended to this report.

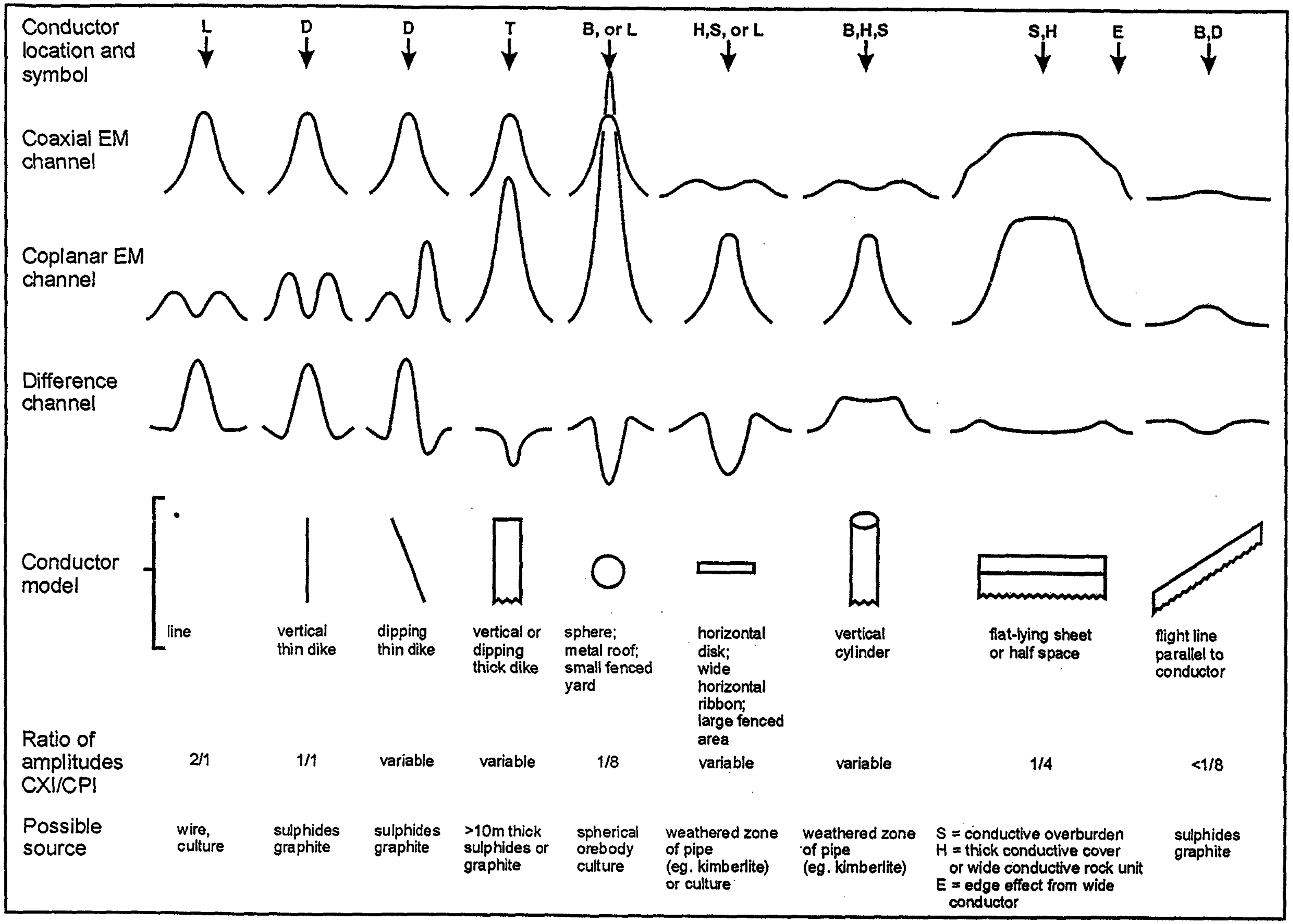
The purpose of indicating the anomaly amplitude by dots is to provide an estimate of the reliability of the conductance calculation. Thus, a conductance value obtained from a large ppm anomaly (3 or 4 dots) will tend to be accurate whereas one obtained from a small ppm anomaly (no dots) could be quite inaccurate. The absence of amplitude dots indicates that the anomaly from the coaxial coil-pair is 5 ppm or less on both the in-phase and quadrature channels. Such small anomalies could reflect a weak conductor at the surface or a stronger conductor at depth. The conductance grade and depth estimate illustrates which of these possibilities fits the recorded data best.

The conductance measurement is considered more reliable than the depth estimate. There are a number of factors which can produce an error in the depth estimate, including the averaging of topographic variations by the altimeter, overlying conductive overburden, and the location and attitude of the conductor relative to the flight line. Conductor location and attitude can provide an erroneous depth estimate because the stronger part of the conductor may be deeper or to one side of the flight line, or because it has a shallow dip. A heavy tree cover can also produce errors in depth estimates. This is because the depth estimate is computed as the distance of bird from conductor, minus the altimeter reading. The altimeter can lock onto the top of a dense forest canopy. This situation yields an erroneously large depth estimate but does not affect the conductance estimate.

Dip symbols are used to indicate the direction of dip of conductors. These symbols are used only when the anomaly shapes are unambiguous, which usually requires a fairly resistive environment.

A further interpretation is presented on the EM map by means of the line-to-line correlation of bedrock anomalies, which is based on a comparison of anomaly shapes on adjacent lines. This provides conductor axes which may define the geological structure over portions of the survey area. The absence of conductor axes in an area implies that anomalies could not be correlated from line to line with reasonable confidence.

DIGHEM electromagnetic anomalies are designed to provide a correct impression of conductor quality by means of the conductance grade symbols. The symbols can stand alone with geology when planning a follow-up program. The actual conductance values are printed in the attached anomaly list for those who wish quantitative data. The anomaly ppm and depth are indicated by inconspicuous dots which should not distract from the conductor patterns, while being helpful to those who wish this information. The map provides an interpretation of conductors in terms of length, strike and dip, geometric shape, conductance, depth, and thickness. The accuracy is comparable to an interpretation from a high quality ground EM survey having the same line spacing.



Typical DIGHEM anomaly shapes
Figure C-1

The attached EM anomaly list provides a tabulation of anomalies in ppm, conductance, and depth for the vertical sheet model. The EM anomaly list also shows the conductance and depth for a thin horizontal sheet (whole plane) model, but only the vertical sheet parameters appear on the EM map. The horizontal sheet model is suitable for a flatly dipping thin bedrock conductor such as a sulphide sheet having a thickness less than 10 m. The list also shows the resistivity and depth for a conductive earth (half-space) model, which is suitable for thicker slabs such as thick conductive overburden. In the EM anomaly list, a depth value of zero for the conductive earth model, in an area of thick cover, warns that the anomaly may be caused by conductive overburden.

Since discrete bodies normally are the targets of EM surveys, local base (or zero) levels are used to compute local anomaly amplitudes. This contrasts with the use of true zero levels which are used to compute true EM amplitudes. Local anomaly amplitudes are shown in the EM anomaly list and these are used to compute the vertical sheet parameters of conductance and depth. Not shown in the EM anomaly list are the true amplitudes which are used to compute the horizontal sheet and conductive earth parameters.

Questionable (Surficial) Anomalies

DIGHEM maps may contain EM responses which are displayed as asterisks (*). These responses denote weak anomalies of indeterminate conductance, which may reflect one of the following: a weak conductor near the surface, a strong conductor at depth (e.g., 100 to 120 m below surface) or to one side of the flight line, or aerodynamic noise. Those responses which have the appearance of valid bedrock anomalies on the flight profiles are indicated by appropriate interpretive symbols (see EM legend on maps). The others probably do not warrant further investigation unless their locations are of considerable geological interest.

The Thickness Parameter

DIGHEM can provide an indication of the thickness of a steeply dipping conductor. The amplitude of the coplanar anomaly (e.g., CPI channel on the digital profile) increases relative to the coaxial anomaly (e.g., CXI) as the apparent thickness increases, i.e., the thickness in the horizontal plane. (The thickness is equal to the conductor width if the conductor dips at 90 degrees and strikes at right angles to the flight line.) This report refers to a conductor as thin when the thickness is likely to be less than 3 m, and thick when in excess of 10 m. Thick conductors are indicated on the EM map by parentheses "( )". For base metal exploration in steeply dipping geology, thick conductors can be high priority targets because many massive sulphide ore bodies are thick, whereas non-economic bedrock conductors are often thin. The system cannot sense the thickness when the strike of the conductor is subparallel to the flight line, when the conductor has a shallow dip, when the anomaly amplitudes are small, or when the resistivity of the environment is below 100 ohm-m.

Resistivity Mapping

Resistivity mapping is useful in areas where broad or flat lying conductive units are of interest. One example of this is the clay alteration which is associated with Carlin-type deposits in the south west United States. The Dighem system was able to identify the clay alteration zone over the Cove deposit. The alteration zone appeared as a strong resistivity low on the 900 Hz resistivity parameter. The 7,200 Hz and 56,000 Hz resistivities show more of the detail in the covering sediments, and delineate a range front fault. This is typical in many areas of the south west United States, where conductive near surface sediments, which may sometimes be alkalic, attenuate the higher frequencies.

Resistivity mapping has proven successful for locating diatremes in diamond exploration. Weathering products from relatively soft kimberlite pipes produce a resistivity contrast with the unaltered host rock. In many cases weathered kimberlite pipes were associated with thick conductive layers which contrasted with overlying or adjacent relatively thin layers of lake bottom sediments or overburden.

Areas of widespread conductivity are commonly encountered during surveys. These conductive zones may reflect alteration zones, shallow-dipping sulphide or graphite-rich units or conductive overburden. In such areas, anomalies can be generated by decreases of only 5 m in survey altitude as well as by increases in conductivity. The typical flight record in conductive areas is characterized by in-phase and quadrature channels which are continuously active. Local EM peaks reflect either increases in conductivity of the earth or decreases in survey altitude. For such conductive areas, apparent resistivity profiles and contour maps are necessary for the correct interpretation of the airborne data. The advantage of the resistivity parameter is that anomalies caused by altitude changes are virtually eliminated, so the resistivity data reflect only those anomalies caused by conductivity changes. The resistivity analysis also helps the interpreter to differentiate between conductive bedrock and conductive overburden. For example, discrete conductors will generally appear as narrow lows on the contour map and broad conductors (e.g., overburden) will appear as wide lows.

The apparent resistivity is calculated using the pseudo-layer (or buried) half-space model defined by Fraser (1978)[5]. This model consists of a resistive layer overlying a conductive half-space. The depth channels give the apparent depth below surface of the conductive material. The apparent depth is simply the apparent thickness of the overlying resistive layer. The apparent depth (or thickness) parameter will be positive when the upper layer is more resistive than the underlying material, in which case the apparent depth may be quite close to the true depth.

The apparent depth will be negative when the upper layer is more conductive than the underlying material, and will be zero when a homogeneous half-space exists. The apparent depth parameter must be interpreted cautiously because it will contain any errors which may exist in the measured altitude of the EM bird (e.g., as caused by a dense tree

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5 Resistivity mapping with an airborne multicoil electromagnetic system: Geophysics, v. 43, p.144-172

cover). The inputs to the resistivity algorithm are the in-phase and quadrature components of the coplanar coil-pair. The outputs are the apparent resistivity of the conductive half-space (the source) and the sensor-source distance. The flying height is not an input variable, and the output resistivity and sensor-source distance are independent of the flying height when the conductivity of the measured material is sufficient to yield significant in-phase as well as quadrature responses. The apparent depth, discussed above, is simply the sensor-source distance minus the measured altitude or flying height. Consequently, errors in the measured altitude will affect the apparent depth parameter but not the apparent resistivity parameter.

The apparent depth parameter is a useful indicator of simple layering in areas lacking a heavy tree cover. The DIGHEM system has been flown for purposes of permafrost mapping, where positive apparent depths were used as a measure of permafrost thickness. However, little quantitative use has been made of negative apparent depths because the absolute value of the negative depth is not a measure of the thickness of the conductive upper layer and, therefore, is not meaningful physically. Qualitatively, a negative apparent depth estimate usually shows that the EM anomaly is caused by conductive overburden. Consequently, the apparent depth channel can be of significant help in distinguishing between overburden and bedrock conductors.

Interpretation in Conductive Environments

Environments having low background resistivities (e.g., below 30 ohm-m for a 900 Hz system) yield very large responses from the conductive ground. This usually prohibits the recognition of discrete bedrock conductors. However, DIGHEM data processing techniques produce three parameters which contribute significantly to the recognition of bedrock conductors in conductive environments. These are the in-phase and quadrature difference channels (DIFI and DIFQ, which are available only on systems with common frequencies on orthogonal coil pairs), and the resistivity and depth channels (RES and DP) for each coplanar frequency.

The EM difference channels (DIFI and DIFQ) eliminate most of the responses from conductive ground, leaving responses from bedrock conductors, cultural features (e.g., telephone lines, fences, etc.) and edge effects. Edge effects often occur near the perimeter of broad conductive zones. This can be a source of geologic noise. While edge effects yield anomalies on the EM difference channels, they do not produce resistivity anomalies. Consequently, the resistivity channel aids in eliminating anomalies due to edge effects. On the other hand, resistivity anomalies will coincide with the most highly conductive sections of conductive ground, and this is another source of geologic noise. The recognition of a bedrock conductor in a conductive environment therefore is based on the anomalous responses of the two difference channels (DIFI and DIFQ) and the resistivity channels (RES). The most favourable situation is where anomalies coincide on all channels.

The DP channels, which give the apparent depth to the conductive material, also help to determine whether a conductive response arises from surficial material or from a conductive zone in the bedrock. When these channels ride above the zero level on the digital profiles (i.e., depth is negative), it implies that the EM and resistivity profiles are responding primarily to a conductive upper layer, i.e., conductive overburden. If the DP channels are below the zero level, it indicates that a resistive upper layer exists, and this usually implies the existence of a bedrock conductor. If the low frequency DP channel is below the zero level and the high frequency DP is above, this suggests that a bedrock conductor occurs beneath conductive cover.

Reduction of Geologic Noise

Geologic noise refers to unwanted geophysical responses. For purposes of airborne EM surveying, geologic noise refers to EM responses caused by conductive overburden and magnetic permeability. It was mentioned previously that the EM difference channels (i.e., channel DIFI for in-phase and DIFQ for quadrature) tend to eliminate the response of conductive overburden.

Magnetite produces a form of geological noise on the in-phase channels of all EM systems. Rocks containing less than 1% magnetite can yield negative in-phase anomalies caused by magnetic permeability. When magnetite is widely distributed throughout a survey area, the in-phase EM channels may continuously rise and fall, reflecting variations in the magnetite percentage, flying height, and overburden thickness. This can lead to difficulties in recognizing deeply buried bedrock conductors, particularly if conductive overburden also exists. However, the response of broadly distributed magnetite generally vanishes on the in-phase difference channel DIFI. This feature can be a significant aid in the recognition of conductors which occur in rocks containing accessory magnetite.

EM Magnetite Mapping

The information content of DIGHEM data consists of a combination of conductive eddy current responses and magnetic permeability responses. The secondary field resulting from conductive eddy current flow is frequency-dependent and consists of both in-phase and quadrature components, which are positive in sign. On the other hand, the secondary field resulting from magnetic permeability is independent of frequency and consists of only an in-phase component which is negative in sign. When magnetic permeability manifests itself by decreasing the measured amount of positive in-phase, its presence may be difficult to recognize. However, when it manifests itself by yielding a negative in-phase anomaly (e.g., in the absence of eddy current flow), its presence is assured. In this latter case, the negative component can be used to estimate the percent magnetite content.

A magnetite mapping technique was developed for the coplanar coil-pair of DIGHEM. The method can be complementary to magnetometer mapping in certain cases. Compared to magnetometry, it is far less sensitive but is more able to resolve closely spaced magnetite zones, as well as providing an estimate of the amount of magnetite in the rock. The method is sensitive to 1/4% magnetite by weight when the EM sensor is at a height of 30 m above a magnetitic half-space. It can individually resolve steep dipping narrow magnetite-rich bands which are separated by 60 m. Unlike magnetometry, the EM magnetite method is unaffected by remanent magnetism or magnetic latitude.

The EM magnetite mapping technique provides estimates of magnetite content which are usually correct within a factor of 2 when the magnetite is fairly uniformly distributed. EM magnetite maps can be generated when magnetic permeability is evident as negative in-phase responses on the data profiles.

Like magnetometry, the EM magnetite method maps only bedrock features, provided that the overburden is characterized by a general lack of magnetite. This contrasts with resistivity mapping which portrays the combined effect of bedrock and overburden.

Recognition of Culture

Cultural responses include all EM anomalies caused by man-made metallic objects. Such anomalies may be caused by inductive coupling or current gathering. The concern of the interpreter is to recognize when an EM response is due to culture. Points of consideration used by the interpreter, when coaxial and coplanar coil-pairs are operated at a common frequency, are as follows:

1. Channels CXP and CPP monitor 60 Hz radiation. An anomaly on these channels shows that the conductor is radiating power. Such an indication is normally a

guarantee that the conductor is cultural. However, care must be taken to ensure that the conductor is not a geologic body which strikes across a power line, carrying leakage currents.

2. A flight which crosses a "line" (e.g., fence, telephone line, etc.) yields a centre-peaked coaxial anomaly and an m-shaped coplanar anomaly.[6] When the flight crosses the cultural line at a high angle of intersection, the amplitude ratio of coaxial/coplanar response is 8. Such an EM anomaly can only be caused by a line. The geologic body which yields anomalies most closely resembling a line is the vertically dipping thin dike. Such a body, however, yields an amplitude ratio of 4 rather than 8. Consequently, an m-shaped coplanar anomaly with a CXI/CPI amplitude ratio of 8 is virtually a guarantee that the source is a cultural line.

3. A flight which crosses a sphere or horizontal disk yields centre-peaked coaxial and coplanar anomalies with a CXI/CPI amplitude ratio (i.e., coaxial/coplanar) of 1/8. In the absence of geologic bodies of this geometry, the most likely conductor is a metal roof or small fenced yard.[7] Anomalies of this type are virtually certain to be cultural if they occur in an area of culture.

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6 See Figure C-1 presented earlier.

7 It is a characteristic of EM that geometrically similar anomalies are obtained from: (1) a planar conductor, and (2) a wire which forms a loop having dimensions identical to the perimeter of the equivalent planar conductor.

4. A flight which crosses a horizontal rectangular body or wide ribbon yields an m-shaped coaxial anomaly and a centre-peaked coplanar anomaly. In the absence of geologic bodies of this geometry, the most likely conductor is a large fenced area.[5] Anomalies of this type are virtually certain to be cultural if they occur in an area of culture.

5. EM anomalies which coincide with culture, as seen on the camera film or video display, are usually caused by culture. However, care is taken with such coincidences because a geologic conductor could occur beneath a fence, for example. In this example, the fence would be expected to yield an m-shaped coplanar anomaly as in case #2 above. If, instead, a centre-peaked coplanar anomaly occurred, there would be concern that a thick geologic conductor coincided with the cultural line.

6. The above description of anomaly shapes is valid when the culture is not conductively coupled to the environment. In this case, the anomalies arise from inductive coupling to the EM transmitter. However, when the environment is quite conductive (e.g., less than 100 ohm-m at 900 Hz), the cultural conductor may be conductively coupled to the environment. In this latter case, the anomaly shapes tend to be governed by current gathering. Current gathering can completely distort the anomaly shapes, thereby complicating the identification of cultural anomalies. In such circumstances, the interpreter can only rely on the radiation channels and on the camera film or video records.

- Appendix C.19 -

Magnetics

Total field magnetics provides information on the magnetic properties of the earth materials in the survey area. The information can be used to locate magnetic bodies of direct interest for exploration, and for structural and lithological mapping.

The total field magnetic response reflects the abundance of magnetic material, in the source. Magnetite is the most common magnetic mineral. Other minerals such as ilmenite, pyrrhotite, franklinite, chromite, hematite, arsenopyrite, limonite and pyrite are also magnetic, but to a lesser extent than magnetite on average.

In some geological environments, an EM anomaly with magnetic correlation has a greater likelihood of being produced by sulphides than one which is non-magnetic. However, sulphide ore bodies may be non-magnetic (e.g., the Kidd Creek deposit near Timmins, Canada) as well as magnetic (e.g., the Mattabi deposit near Sturgeon Lake, Canada).

Iron ore deposits will be anomalously magnetic in comparison to surrounding rock due to the concentration of iron minerals such as magnetite, ilmenite and hematite.

Changes in magnetic susceptibility often allow rock units to be differentiated based on the total field magnetic response. Geophysical classifications may differ from geological classifications if various magnetite levels exist within one general geological classification.

Geometric considerations of the source such as shape, dip and depth, inclination of the earth's field and remanent magnetization will complicate such an analysis.

In general, mafic lithologies contain more magnetite and are therefore more magnetic than many sediments which tend to be weakly magnetic. Metamorphism and alteration can also increase or decrease the magnetization of a rock unit.

Textural differences on a total field magnetic contour, colour or shadow map due to the frequency of activity of the magnetic parameter resulting from inhomogeneities in the distribution of magnetite within the rock, may define certain lithologies. For example, near surface volcanics may display highly complex contour patterns with little line-to-line correlation.

Rock units may be differentiated based on the plan shapes of their total field magnetic responses. Mafic intrusive plugs can appear as isolated "bulls-eye" anomalies. Granitic intrusives appear as sub-circular zones, and may have contrasting rings due to contact metamorphism. Generally, granitic terrain will lack a pronounced strike direction, although granite gneiss may display strike.

Linear north-south units are theoretically not well-defined on total field magnetic maps in equatorial regions due to the low inclination of the earth's magnetic field. However, most stratigraphic units will have variations in composition along strike which will cause the units to appear as a series of alternating magnetic highs and lows.

Faults and shear zones may be characterized by alteration which causes destruction of magnetite (e.g., weathering) which produces a contrast with surrounding rock. Structural breaks may be filled by magnetite-rich, fracture filling material as is the case with diabase dikes, or by non-magnetic felsic material.

Faulting can also be identified by patterns in the magnetic total field contours or colours. Faults and dikes tend to appear as lineaments and often have strike lengths of several kilometres. Offsets in narrow, magnetic, stratigraphic trends also delineate structure. Sharp contrasts in magnetic lithologies may arise due to large displacements along strike-slip or dip-slip faults.

Costs associated with this report have been approved in the amount of $ 10,000.00 for assessment credit under Certificate of Work No. WM00362 QM00340

Mining Recorder
Mayo Mining District