

GM 59384

GEOPHYSICAL SURVEY, LOGISTICS REPORT REGARDING THE FIXED LOOP TRANSIENT ELECTROMAGNETIC SURFACE AND BOREHOLE PROFILING SURVEYS, AND TOTAL MAGNETIC FIELD SURVEYS OVER THE MATAGAMI PROPERTIES DANIEL, ISLE DIEU, ISLE DIEU-5, ISLE DIEU 1-98 AND MCINTYRE

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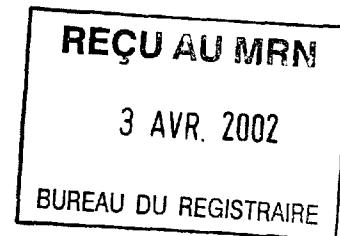
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Geophysical Survey Logistics Report



Quantec



***Regarding the FIXED LOOP TRANSIENT
ELECTROMAGNETIC SURFACE and
BOREHOLE PROFILING SURVEYS,
and TOTAL MAGNETIC FIELD SURVEYS
over the Matagami Properties, Daniel, Isle Dieu, Isle Dieu-5,
Isle Dieu-1-98 and McIntyre in Daniel Twp, QC, on behalf of
NORANDA INC., Rouyn-Noranda, QC***

QGI QGI QGI QGI QGI QGI

MRN-GÉOINFORMATION 2002

GM 59384

D Eastcott
S.T. Coulson
D. Lapointe
January, 2002
Project QG-191

Reçu le 23 AVR 2002

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1. INTRODUCTION

- **QGL Project No:** QG-191
- **Project Name:** Matagami #1612
- **Survey Period:** July to December, 2001
- **Survey Type:** Fixed In/Off -Loop Transient EM Surface and Borehole, Total Magnetic Field, TDIP Gradient array, DPDP and RealSection
- **Client:** NORANDA INC.
- **Client Address** 101 Ave. Portelance, CP 4000,
Rouyn-Noranda, QC
J9X 5B6
Canada
- **Representatives:** Michel Allard
Grant Arnold
- **Objectives:**

To provide detailed resolution of the location and transient electromagnetic and total magnetic field signatures over anomalous zones located by previous airborne electromagnetic surveys.
- **Report Type:** Logistics

2. GENERAL SURVEY DETAILS

2.1 LOCATION

- **Township:** Daniel (see also Table I)
- **Province:** Quebec
- **Country:** Canada
- **Nearest Settlement:** Matagami
- **NTS Map Reference #:** 32 F/12

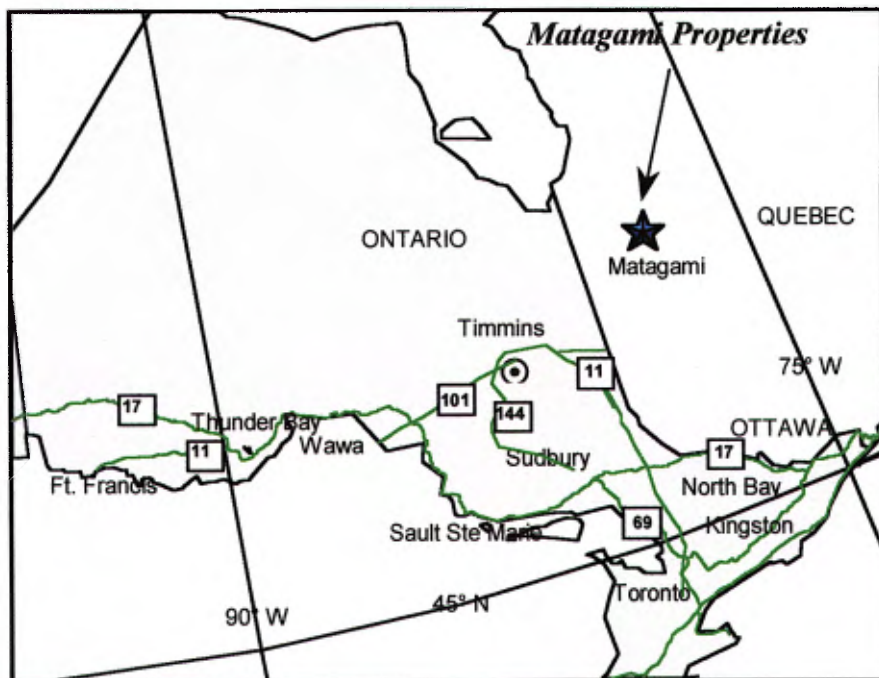


Figure 1: General Location of the Matagami Properties.

2.2 ACCESS

- **Base of Operations:** Matagami, QC.
- **Mode of Access:** Via road and trails.

2.3 SURVEY GRIDS

- **Coordinate Reference System:** Local exploration grids, referenced to NAD 27 UTM coordinates.
- **Established:** Prior to survey execution
- **Baseline Direction:** N130 E
- **Line Separation:** 100 meters
- **Station Interval:** 25 meters
- **Method of Chaining:** Metric, slope distance

3. SURVEY WORK UNDERTAKEN

3.1 GENERALITIES

- **Survey Dates:**
 - July 14th to 16st, 2001
 - July 22nd to 24th, 2001
 - July 31st to August 6nd, 2001
 - August 14th to 31st, 2001
 - September 5th to October 8th, 2001
 - October 19th to November 2nd, 2001
 - November 6th to 10th, 2001
 - November 27th to December 2nd, 2001

- **Survey Period:** 83 days

- **Survey Days (read time):**
 - TEM surface = 7 days
 - TEM borehole = 38 days
 - TFM = 1 day
 - Gradient IP = 11 days
 - DPDP IP = 2 days
 - RealsectionTM* = 1 day

- **Survey Coverage:**
 - TEM surface = 11.60 Line-kilometres
 - TEM borehole = 10721 metres
 - TFM = 2.00 Line-kilometres
 - Gradient IP = 35.925 Line kilometres
 - DPDP IP = 2.900 Line kilometres
 - RealsectionTM* = 1500 metres

3.2 PERSONNEL

- **Project Supervisor:** Sherwood Coulson, Porcupine, ON
- **Project Managers:** Jonathon Davis, Kanata, ON
Ray Meikle, North Bay, ON
David MacGillivray, Timmins, ON
Kevin McKenzie, Sydney, NS
- **Technicians:** Richard Chassé, Kirkland Lake, ON
Eric Dufour, Val-d'Or, QC
Alain Dufour, Val-d'Or, QC

3.3 SURVEY SPECIFICATIONS

3.3.1 TEM Survey

- **Configuration:** Off-loop and In-loop profiling
- **Output Power Stage:** Low Power (2.8 kW)
- **Dimension:** 3 Component (X,Y and Z)
- **Surveyed Area:** 9 lines (Table I)
- **Loop Sizes and Location:** 500x800m. L236+00E/100+00N; L244+00E/105+00N
- **Line Interval:** 100 meters
- **Sampling Interval:** 25 meters

3.3.2 TEM Borehole Survey

- **Holes** 20 DDH, 23 Loops (Tables II & III)
- **Configuration:** 3D Borehole
- **Output Power Stage:** Low Power (2.8 kW)
- **Dimension:** 3 Component (X,Y and Z)
- **Loop Size and Location:** Variable (Tables II & III)
- **Sampling Interval:** 5-10 meters
- **Borehole Azimuth/Dip:** Variable (Table II)

3.3.3 Magnetic Survey

- **Method:** Total Magnetic Field profiling
- **Configuration:** Base Station Diurnal Drift Corrected
- **Line Interval:** 100 meters
- **Sampling Interval:** 12.5 meters
- **Magnetic Datum:** Average base station value, see Table IV
- **Base Station Sampling:** 3 seconds (GEM-19)
- **Base Station Location:** Intersection between highway and airport road.

3.3.4 Gradient TDIP

- **Array:** Gradient (see Figure 2)
- **AB (Tx dipole spacing)** 1800 metres
- **MN (Rx dipole spacing):** 25 metres
- **Sampling Interval:** 25 metres
- **Total Gradient AB Blocks:** 5
- **Total Gradient Lines:** 31 (see Table V)
- **Approximate Aerial Coverage:** approx. 3.3 km²

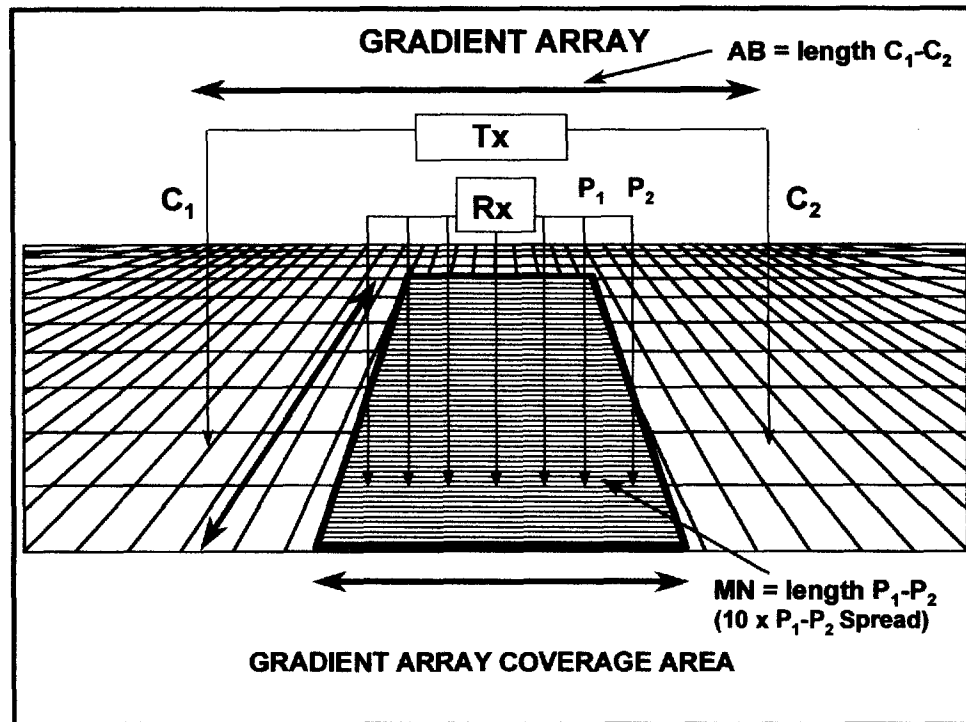


Figure 2: Gradient Array Layout

3.3.5 TDIP DPDP

- **Array:** Dipole Dipole (see Fig. 3)
- **Dipole spacing:** 25 - 50 metres
- **Rx-Tx Separation:** N = 1 to 6
- **Line Interval:** L202+50E
- **Sampling Interval:** 25 - 50 metres
- **Coverage:** see Table VI

HOLE	COLLAR LOCATION	AZIMUTH/DIP (at surface)	LOOP	SW LOOP CORNER	NE LOOP CORNER
DJV-01-52	191+20E;100+15N	270/-75	COLLAR	188+50E;98+00N	191+50E;101+00N
			COLLAR	189+00E;98+50N	192+00E;101+50N
			EAST	191+50E;98+00N	194+50E;101+00N
DJV-01-53	190+00E;92+50N	042/-70	COLLAR	187+00E;91+50N	192+00E;95+50N
DJV-01-54	173+80E;97+60N	018/-80	COLLAR	171+00E;95+00N	176+00E;100+00N
DJV-01-55	193+00E;104+22N	040/-80	COLLAR	191+00E;103+00N	194+00E;106+00N
DJV-01-56	206+00E;113+50N	220/-85	COLLAR	204+00E;111+50N	207+00E;114+50N
DJV-01-57	172+00E;104+75N	040/-80	COLLAR	169+00E;103+00N	174+00E;108+00N
DJV-01-58	191+50E;105+75N	040/-75	COLLAR	189+00E;103+50N	192+00E;106+50N
			COLLAR	189+00E;105+00N	192+00N;108+00N
DJV-01-59	219+50E;94+80N	000/-90	COLLAR	215+00E;91+50N	223+00E;98+00N
DJV-01-60	187+00E;102+55N	040/-80	COLLAR	185+00E;100+00N	189+00E;104+00N
DJV-01-61	243+00E;109+15N	040/-85	COLLAR	241+00E;108+00N	244+00E;111+00N
DJV-01-62	196+00E;123+50N	220/-60	COLLAR	195+00E;121+00N	198+00E;124+00N
DJV-01-63	180+00E;103+80N	040/-80	COLLAR	178+00E;101+50N	182+00E;105+50N
DJV-01-64	193+00E;104+0N	040/-80	COLLAR	192+00E;112+75N	195+00E;115+75N
DJV-01-65	194+00E;99+30N	040/-70	COLLAR	192+00E;97+00N	195+00E;100+00N
DJV-01-66	188+50E;15+70N	040/-80	COLLAR	187+00E;104+00N	190+00E;107+00N
DJV-01-68	203+25E;92+75N	018/-60	COLLAR	201+00E;92+00N	204+00E;95+00N
DJV-01-69	185+50E;90+85N	040/-66	COLLAR	184+00E;89+25N	186+00E;91+25N
DJV-01-70	205+00E;91+45N	040/-80	COLLAR	204+00E;90+00N	206+00E;92+00N
DJV-89-19	189+75E;131+10N	170/-50	SOUTH	190+00E;127+25N	193+00E;130-25N
DJV-89-20	191+85E;129+45N	170-50	SOUTH	191+00E;126+00N	194+00E;129+00N

Table II: Borehole TEM Specifications.

HOLE	PROPERTY	LOOP	LOOP SIZE	DATE	FROM (m)	TO (m)	LENGTH LOGGED (m)
DJV-01-52	DANIEL-JV	COLLAR 1	300x300	15-JUL	40	520	480
		EAST	300x300	23 JUL	40	530	490
		COLLAR 2	300x300	05 AUG	40	520	480
DJV-01-53	DANIEL-JV	COLLAR	500x400	05 AUG	60	740	680
DJV-01-54	DANIEL-JV	COLLAR	500x500	24 AUG	60	780	720
DJV-01-55	DANIEL-JV	COLLAR	300x300	18 AUG	40	420	380
DJV-01-56	DANIEL-JV	COLLAR	300x300	26 AUG	40	336	296
DJV-01-57	DANIEL-JV	COLLAR	500x500	02 OCT	40	980	940
DJV-01-58	DANIEL-JV	COLLAR N	300x300	21 SEPT	0	410	410
		COLLAR S	300x300	30 SEPT	60	410	650
DJV-01-59	DANIEL-JV	COLLAR	800x650	03 OCT	60	760	700
DJV-01-60	DANIEL-JV	COLLAR	400x400	05 OCT	90	550	460
DJV-01-61	ISLE-DIEU	COLLAR	300x300	06 OCT	50	255	205
DJV-01-62	DANIEL-JV	COLLAR	300x300	21 OCT	50	480	430
DJV-01-63	DANIEL-JV	COLLAR	400x400	24 OCT	40	780	740
DJV-01-64	DANIEL-JV	COLLAR	300x300	27 OCT	40	320	280
DJV-01-65	DANIEL-JV	COLLAR	300x300	30 OCT	30	450	420
DJV-01-66	DANIEL-JV	COLLAR	300x300	31 OCT	50	450	400
DJV-01-68	DANIEL-JV	COLLAR	300x300	08 NOV	20	450	430
DJV-01-69	DANIEL-JV	COLLAR	200x200	09 NOV	40	290	250
DJV-01-70	DANIEL-JV	COLLAR	200x200	07 NOV	20	170	150

HOLE	PROPERTY	LOOP	LOOP SIZE	DATE	FROM (m)	TO (m)	LENGTH LOGGED (m)
DJV-89-19	DANIEL-JV	SOUTH	300x300	29 OCT	40	430	390
DJV-89-20	DANIEL-JV	SOUTH	300x300	28 OCT	40	380	340
				TOTAL			10721

Table III: Borehole TEM Survey Coverage

GRID	LINES	EXTENT	EXTENT	TOTAL (m)	INSTRUMENT
DANIEL-JV	194+00E	120+00N	124+00N	400	GEM GSM-19
DANIEL-JV	195+00E	120+00N	124+00N	400	GEM GSM-19
DANIEL-JV	196+00E	120+00N	124+00N	400	GEM GSM-19
DANIEL-JV	197+00E	120+00N	124+00N	400	GEM GSM-19
DANIEL-JV	198+00E	120+00N	124+00N	400	GEM GSM-19
			TOTAL	2000	

Table IV: TFM Survey Coverage

GRID	AB	LINES	EXTENT	EXTENT	TOTAL (m)
DANIEL-JV	L168+00N 1800m	L165+00E	99+00N	110+75N	1175
DANIEL-JV	L168+00N 1800m	L166+00E	99+50N	111+00N	1150
DANIEL-JV	L168+00N 1800m	L167+00E	99+50N	110+00N	1050
DANIEL-JV	L168+00N 1800m	L168+00E	99+00N	111+00N	1200
DANIEL-JV	L168+00N 1800m	L169+00E	99+00N	111+00N	1200
DANIEL-JV	L168+00N 1800m	L170+00E	99+00N	111+00N	1200
DANIEL-JV	L173+00N 1800m	L171+00E	97+00N	109+00N	1200
DANIEL-JV	L173+00N 1800m	L172+00E	97+00N	109+00N	1200
DANIEL-JV	L173+00N 1800m	L173+00E	97+00N	109+00N	1200
DANIEL-JV	L173+00N 1800m	L174+00E	97+00N	109+00N	1200
DANIEL-JV	L173+00N 1800m	L175+00E	97+00N	109+00N	1200
DANIEL-JV	L178+00E 1800m	L176+00E	99+00N	111+00N	1200
DANIEL-JV	L178+00E 1800m	L177+00E	99+00N	111+00N	1200
DANIEL-JV	L178+00E 1800m	L178+00E	99+00N	111+00N	1200
DANIEL-JV	L178+00E 1800m	L179+00E	99+00N	111+00N	1200
DANIEL-JV	L178+00E 1800m	L180+00E	99+00N	111+00N	1200
DANIEL-JV	L178+00E 1800m	L181+00E	99+00N	111+00N	1200
DANIEL-JV	L185+00E 1800m	L182+00E	102+00N	112+50N	1050
DANIEL-JV	L185+00E 1800m	L183+00E	102+00N	112+50N	1050
DANIEL-JV	L185+00E 1800m	L184+00E	102+00N	112+50N	1050
DANIEL-JV	L185+00E 1800m	L185+00E	102+00N	112+50N	1050
DANIEL-JV	L185+00E 1800m	L186+00E	102+00N	112+50N	1050
DANIEL-JV	L185+00E 1800m	L187+00E	102+00N	112+50N	1050
DANIEL-JV	L185+00E 1800m	L188+00E	102+00N	112+50N	1050
DANIEL-JV	L192+00E 1800m	L189+00E	99+00N	111+00N	1200
DANIEL-JV	L192+00E 1800m	L190+00E	99+00N	111+00N	1200
DANIEL-JV	L192+00E 1800m	L191+00E	99+00N	111+00N	1200
DANIEL-JV	L192+00E 1800m	L192+00E	99+00N	111+00N	1200
DANIEL-JV	L192+00E 1800m	L193+00E	99+00N	111+00N	1200

GRID	AB	LINES	EXTENT	EXTENT	TOTAL (m)
DANIEL-JV	L192+00E 1800m	L194+00E	99+00N	111+00N	1200
DANIEL-JV	L192+00E 1800m	L195+00E	99+00N	111+00N	1200
				TOTAL	35925

Table V: Gradient TDIP Survey Coverage

GRID	LINES	EXTENT	EXTENT	TOTAL (m)	METHOD
DANIEL-JV	L202+50E	89+00N	102+50N	1350	DPDP 50m
DANIEL-JV	L202+50E	102+50N	106+00N	350	DPDP 25m
DANIEL-JV	L202+50E	92+00N	104+00N	1200	DPDP 25m
DANIEL-JV	L202+50E	91+50N	97+50N	600	RSIP AB800
DANIEL-JV	L202+50E	91+50N	96+00N	450	RSIP AB600
DANIEL-JV	L202+50E	96+00N	97+50N	150	RSIP AB600
DANIEL-JV	L202+50E	93+00N	96+00N	300	RSIP AB400
			TOTAL	4400	

Table VI: TDIP Survey Test Coverage

3.5 INSTRUMENTATION

3.5.1 TEM Survey

- **Receiver:** Geonics Digital Protem, 3D-3 coil (200 m² effective area)
- **Transmitter:** Geonics EM-37(2.8 kW output)
- **Power Supply:** Geonics EM-37

3.5.2 TEM Borehole Survey

- **Receiver:** Geonics Digital Protem
- **Receiver Coil:** BH-43 3-D with Tilt Sensors coil (100 m² effective area)
Probe + 1600m or 600m cable/winch
- **Transmitter:** Geonics EM-37(2.8 kW output)
- **Power Supply:** Geonics EM-37

3.5.3 Magnetic Survey

- **Magnetometers:** GEM GSM-19 (Overhauser) Magnetometers

3.5.4 Gradient Survey

- **Receiver:** Iris Elrec IP-6 (6 channels)
- **Transmitter:** Phoenix IPT-1 (2.5 kW / 600 - 2400V output)
- **Power Supply:** Phoenix MG-3 (2.5KVA, 60V, 3 phase, 400 Hz)
+ Honda 5.5 hp motor generator

3.5.5 TDIP DPDP

- **Receiver:** IRIS IP-6 (6 channel / Time Domain)
- **Transmitter:** Phoenix IPT-1 (3 kW / 75 - 1200V output)
- **Power Supply:** MG-2 (400 Hz / 110V / 3 phase) + Honda Gx-60 (5.5hp)

3.5.6 Realsection™ Survey

- **Receiver:** IRIS IP-6 (6 channel / Time Domain)
- **Transmitter:** Phoenix IPT-1 (3 kW / 75 - 1200V output)
- **Power Supply:** MG-2 (400 Hz / 110V / 3 phase) + Honda Gx-60 (5.5hp)

3.5.7 Global Positioning

- **GPS Receiver:** Garmin-12

3.6 PARAMETERS

3.6.1 TEM Survey

Pulse repetition frequency:	30Hz
Gain:	4-5
Integration number:	15 sec
Approximate Loop Sizes:	500 x 800 meters
Current:	7.0 Amps (see Appendix F)
Turn-off times:	200 us (see Appendix F)
Gate positions	80-6136us (see Appendix C)
Synchronization mode:	Crystal

Table VII: System Parameters for TEM Survey

- **Coil Conventions:** (see Appendix C)

COMPONENT	COIL ORIENTATION
Z	Positive Up
X	Positive north
Y	Positive east

Table VIII: Coil Conventions for TEM Survey

- **Measured Parameters:** dB/dt, nV/m².
- **Data Reduction¹:** nanoVolts/Ampere-metre²

3.6.2 Borehole TEM

Pulse repetition frequency:	25 – 30Hz
Gain:	2
Integration number:	15 sec
Approximate Loop Sizes:	Variable (Table II)
Current:	9.5 to 17.7 Amps
Turn-off times:	120-320µs (-80µs Rx delay)
Gate positions	80-6136us (see Appendix C)
Synchronization mode:	Crystal

Table IX: System Parameters for Borehole TEM Survey

- **Coil Conventions:** (see Appendix B)

COMPONENT	COIL ORIENTATION
Z	Axial component positive up along axis of borehole
X	Positive with azimuth of borehole
Y	Positive defined by right hand rule according to Z, X

Table X: Coil Conventions for Borehole TEM Survey

- **Data Reduction²:** nanoVolts/ meter squared (using Geonics Datem)

3.6.3 TFM Survey

- **Measured Parameters:** Total magnetic field nanoTesla (nT)

¹ Equivalent to Crone units of nanoTesla/second normalized to a unit current.

² Equivalent to Crone units of nanoTesla/second.

3.6.4 Gradient Survey

- **Input Waveform:** 0.125 Hz square wave at 50% duty cycle (2 seconds On/Off)
- **Receiver Sampling Parameters:** ten programmable chargeability windows (see Table XI)
- **Measured Parameters:**
 - 1) Chargeability in millivolts/Volt. Total Chargeability is calculated over an integration period of 40 to 1770 ms.
 - 2) Primary Voltage in millivolts and Input Current in amperes for Resistivity calculation according to the gradient array geometry factor (Appendix B).

Slice	Duration (msec)	Start (msec)	End (msec)	Mid-Point (msec)
T _d	40	0	40	NA
T ₁	20	40	60	50
T ₂	30	60	90	75
T ₃	30	90	120	105
T ₄	30	120	150	135
T ₅	180	150	330	240
T ₆	180	330	510	420
T ₇	180	510	690	600
T ₈	360	690	1050	870
T ₉	360	1050	1410	1230
T ₁₀	360	1410	1770	1590
Total T_n	1770			

Table XI: Iris ELREC 6 Decay Curve Sampling.

3.6.5 TDIP DPDP

- **Input Waveform:** 0.125 Hz square wave at 50% duty cycle (2 seconds On/Off)
- **Receiver Sampling Parameters:** ten programmable chargeability windows (see Table XI)
- **Measured Parameters:**
 - 3) Chargeability in millivolts/Volt. Total Chargeability is calculated over an integration period of 40 to 1770 ms.
 - 4) Primary Voltage in millivolts and Input Current in amperes for Resistivity calculation according to the gradient array geometry factor (Appendix B).

3.6.6 Realsection™ Survey

- **Input Waveform:** 0.125 Hz square wave at 50% duty cycle
(2 seconds On/Off)
- **Receiver Sampling Parameters:** ten programmable chargeability windows
(see Table XI)
- **Measured Parameters:**
 - 5) Chargeability in millivolts/Volt. Total Chargeability is calculated over an integration period of 40 to 1770 ms.
 - 6) Primary Voltage in millivolts and Input Current in amperes for Resistivity calculation according to the gradient array geometry factor (Appendix B).

3.7 MEASUREMENT ACCURACY AND REPEATABILITY

3.7.1 TEM Survey

- **Number of Repeats per Station:** 0-3
- **Number of Repeats per Day:** 0-12
- **Number of Repeats per Grid:** 0-12
- **Average Repeatability:** 2% in early channels
- **Worst Repeatability:** 10% in early channels

3.7.2 Borehole TEM

- **Number of Repeats per Station:** 0-1
- **Number of Repeats per Borehole:** 4
- **Average Repeatability:** 1%
- **Worst Repeatability:** 2%
- Noisy or bad data was recognized by operator and removed during data collection.

3.7.3 TFM Survey

- **Number of Repeats per Station:** 0 - 3
- **Number of Repeats per Day:** 3 - 30
- **Number of Repeats per Grid:** 3 - 30
- **Average Repeatability:** +/- 3 nT
- **Worst Repeatability:** +/- 9 nT

3.7.4 TDIP Surveys

- **Chargeability:** generally < ± 0.4 mV/V but acceptable to ± 1.0 mV/V.
- **Resistivity:** less than 5% cumulative error from Primary voltage and Input current measurements.

3.7.5 GPS Locations

- **Number of Repeats per Station:** 0
- **Average Accuracy:** +/- 20 m

3.8 DATA PRESENTATION

3.8.1 TEM Surface and Borehole Survey

- **Profiles:** X,Y,Z components, and Total EM Field @ 1:5000 with variable vertical (profile) scales to best display data.

Profile Format	4-Axis
# of Profiles:	36
Horizontal Map Scale:	1:5000
Vertical Profile Scales:	Varies to best display data for each component (see profiles in Appendix F)
Components Profiled:	3D survey: Total Field ³ , X, Y and Z

Table XII: Surface TEM Profile Specifications

Profile Format	4-Axis (see Fig. 4), Lin-Log
# of Profiles:	184
Horizontal Map Scale:	1:2500
Vertical Profile Scales:	Varies to best display data for each component (see profiles in Appendix G)
Components Profiled:	3D survey: Total Field, X, Y and Z
Borehole & Loop location	23 maps
Scale	1:5000

Table XIII: Borehole TEM Profile Specifications

- **Plan Maps:**

Plan Map Types:	Posted/Contoured TEM X Component
Channel Contoured:	10
# of TEM Plan Maps:	1
Map Scale:	1:5000
Grid Cell Size:	5 meters
Gridding Method:	Random
Contouring Method:	Linear
Contour Interval:	1, 5, 20 nanoVolt/A*m ²

Table XIV: Plan Map Specifications for Surface TEM Survey

- **Digital Data:** Daily raw files and processed data (Geosoft .XYZ format) on 3.5 inch HD (1.44 Mbytes) diskettes
 - a) raw data dump files, according to acquisition date (DDMMYY.RAW ie. 210299.raw) Geonics Digital Protem format (refer to Protem manual)
 - b) reduced XYZ ASCII data files, according to line number and component (i.e. I1900ek.xyz where, k=component – Z, X, Y or T for Total Field).

³ TF = SQRT { (dB_x/dt)² + (dB_y/dt)² + (dB_z/dt)² }, using Quantec Geoparse™

Column 1: N-S Line/E-W Station number
 Column 2: E-W Station/N-S Line number
 Column 3: Primary pulse (milliVolts)
 Column 4: Channel 1 secondary rate of decay of TEM field (nanoVolt/ampere*m²)
 Column 5: Channel 2

↓

Column 23: Channel 20 secondary rate of decay of TEM field (nanoVolt/ampere*m²)

3.8.2 TFM Survey

- **Plan maps:** Stacked profile plan maps and contoured plan maps of the diurnal corrected Total Magnetic Field, referenced to NAD 27 coordinates @ 1:5000.
- **Note:** Magnetometer data has been reprocessed to reference datum for the data from arbitrary value of 57500 nt to average total field at the base station location for each survey grid.

Plan Map Types:	Stacked Profile Plan Maps and Posted/Contoured Total Magnetic Field Plan Maps
Map Scale:	1:5000
Grid Cell Size:	5 meters
Gridding Method:	Random
Profile Scale or Contour Interval:	100 nT/cm 10,50 and 200 nT

Table XV: Plan Map Specifications for TFM Survey

- **Digital Data TFM:** Daily raw files and processed data (GSM .XYZ format) on CD Rom.
 - c) raw data dump files, according to acquisition date (DDMMYY.RAW ie. 210299.raw) GSM-19 format (refer to GSM-19 manual) or OMNI IV format (refer to OMNI IV manual)
 - d) reduced XYZ ASCII data files
 - Column 1: Easting
 - Column 2: Northing
 - Column 3: Station Number
 - Column 4: Uncorrected Total Magnetic Field (nanoTeslas)
 - Column 5: Corrected Total Magnetic Field (nanoTeslas)

3.8.3 TDIP Surveys

- **Maps:**

Pseudosections maps:

DPDP Survey
Stacked posted contoured dipole-dipole sections and profiles (a=25-50 / n=1-6) of the apparent resistivity, total chargeability and metal factor, with Interpretation overlay, at 1:2500 & 1 5000 scale (2 maps).

Realsection™

Posted/contoured/leveled depth section maps of Total Chargeability and Apparent Resistivity, at 1:5000 scale (1 contoured maps + 1 profile maps).

Plans Maps:

Gradient Survey
Compiled posted contoured plans of Filtered Total Chargeability, Apparent Resistivity (After linear leveling of eastern and western blocks, and first degree trend removal and linear leveling for central block), plotted at 1:5000 scale (2 maps).

-

Digital:

Raw data:

IP-6 digital dump file (See Appendix D).

Processed data:

a) ASCII GEOSOFT .DAT file format with file-name relating to profile, for example:

7500e.DAT = Line 75+00E using the following format:

Line 1:	Title
Line 2:	Header information, including Line, Array, Dipole, Units.
Line 3:	Column headings
Columns 1-4:	Electrode station positions (metres)
Column 5:	Primary Voltage (milliVolts)
Column 6:	Transmitted Current (amperes)
Column 7:	Spontaneous Potential
Column 8:	Chargeability Windows (msec)

b) ASCII GEOSOFT IPPLOT file format with file-name relating to profile, and file-spec relating to data type (*RES* = app. resistivity, *IP* = total charg., *MF* = metal factor), for example:

7500e.RES = Line 75+00E Apparent Resistivity, using the following format:

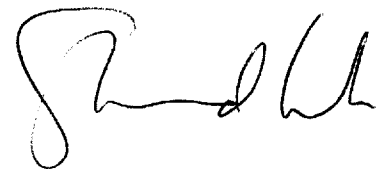
Line 1:	Title
Line 2:	Header information, including Line, Array, Dipole, Units.
Line 3:	Column headings
Column 1:	Station/Plot Point (metres)
Column 2:	Filter Data Value (using Geosoft Flt4leg.fit)
Column 3:	N=1 Data Value (Res = ohm-metres, IP = mV/V, MF = unitless)
Column 4:	N=2 Data Value
Column 5:	N=3 Data Value
Column 6:	N=4 Data Value

Column 7: N=5 Data Value
Column 8: N=6 Data Value

c) ASCII GEOSOFT .XYZ format, for Plan Map data (ex. Mmsr.XYZ), using the following format:

Header Lines:	Identified by "f" in 1 st column, containing Header information, including Line, Array, Dipole, Units, etc.
Column 1:	Plot-point Station Easting (metres)
Column 2:	Plot-point Station Northing (metres)
Column 3:	Station Number (optional)
Column 4:	Filtered Total Chargeability (millivolts per volt)
Column 5:	Filtered Apparent Resistivity (ohm-metres)


**RESPECTFULLY SUBMITTED
QUANTEC GEOSCIENCE INC.**



Sherwood T. Coulson
Senior Geophysicist



David Eastcott
Technical Services



Daniel Lapointe, M. Sc.
Geologist-Geophysicist

APPENDIX A

STATEMENT OF QUALIFICATIONS

I, David Eastcott, hereby declare that:

1. I am a geophysical technologist with residence in South Porcupine, Ontario and am presently employed in this capacity with Quantec Geoscience Ltd. of Waterdown, Ontario.
2. I have practiced my profession continuously since 1996, in Canada, the United States, Mexico and Mongolia.
3. I have no interest, nor do I expect to receive any interest in the properties or securities of **Noranda Inc.**
4. I am the editor of the logistics portion of this report; reviewed and assisted in the preparation of the final map products included. The statements made in this report represent my professional opinion based on my consideration of the information available to me at the time of writing this report.

Porcupine
January, 2002


David Eastcott
Technical Services
Quantec Group

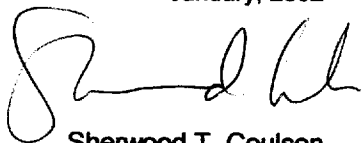
APPENDIX A

Statement of Qualifications

I, Sherwood T. Coulson, hereby declare that:

1. I am a consulting geophysicist with residence in Porcupine, Ontario and am presently employed in this capacity with Quantec Consulting Inc. of Porcupine, Ontario.
2. I am a graduate of Cambrian College, Sudbury, Ontario in 1974 with an Honours Diploma in Geophysical Engineering Technology.
3. I have practiced my profession in Europe and North and South America continuously since graduation.
4. I am a member of the Canadian Society of Exploration Geophysicists and the Prospectors and Developers Association.
5. I have no interest nor do I expect to receive any interest, direct or indirect, in the properties or securities of **NORANDA INC.**
6. I supervised the survey execution and reviewed the data as it was collected. The statements made by me represent my best opinion and judgment based on the information available to me at the time of the writing.

Porcupine, ON
January, 2002



Sherwood T. Coulson
Senior Geophysicist


APPENDIX A

STATEMENT OF QUALIFICATIONS

I, Daniel Lapointe, hereby declare that:

1. I am a geologist-geophysicist with residence in Val-d'Or, Quebec and am presently employed in this capacity with Quantec Geoscience Inc. of Porcupine, Ontario.
2. I am a graduate of University of Ottawa, Ottawa, ON, with a degree of Bachelor of Science (Diploma in Honour Standing), Geology (1982), and Université Laval, Ste-Foy, QC with a degree of Master of Science, Geology (1986).
3. I have practiced my profession in Canada, South America and Africa since graduation.
4. I have no interest nor do I expect to receive any interest, direct or indirect, in the properties or securities of Noranda Inc.
5. I am the responsible for the processing and validation of the survey results and of the compilation portion of this report and the statements made by me accurately represent my professional opinion based on the information given to me at the time of the preparation of this report.

Porcupine, Ontario
January, 2002


Daniel Lapointe, M. Sc.
Geologist-Geophysicist

APPENDIX B

THEORETICAL BASIS AND SURVEY PROCEDURES

TEM SURFACE AND BOREHOLE PROFILING

TEM profiling is conducted on lines either adjacent to (Off-Loop mode) or surrounded by (In-Loop mode) a large fixed rectangular transmit loop. Current is passed through the loop which following the Turn-Off, produces a primary magnetic field (H) both inside and outside (Figure B1). This primary field induces a vortex current pattern, which energizes conductors and which in turn create their own secondary magnetic field (Bs). The rate of change of the decaying secondary magnetic flux (dBs/dt) is measured as the vertical (Hz), in-line horizontal (Hx) and/or cross line horizontal (Hy) vector components on surface using an air-core sensor coil. These measurements of the TEM decay (20 log-time slices) are taken during the "Off-Time", using a 30 cycle/sec, base repetition rate.

In keeping with the industry standard, the primary field is always considered positive up inside the loop and negative down outside. Similarly, for secondary EM fields, the receiver coil is oriented positive vertical up for the Hz component. The convention for In-Loop surveys, has the in-line component, Hx oriented either positive east (for grid EW lines) or north (for grid NS lines). The Off-Loop survey convention differs, with the receiver coil orientation for Hx pointing positive away from the transmit loop (for EW or NS lines). Finally, the sign convention in all cases, has the Hy component pointing positive orthogonal to the left of the Hx, according to the right-hand-rule.

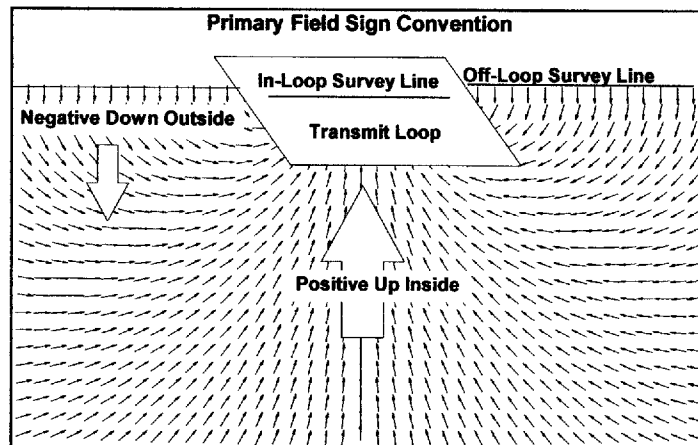


Figure B1: Primary field sign convention for TEM surveys.

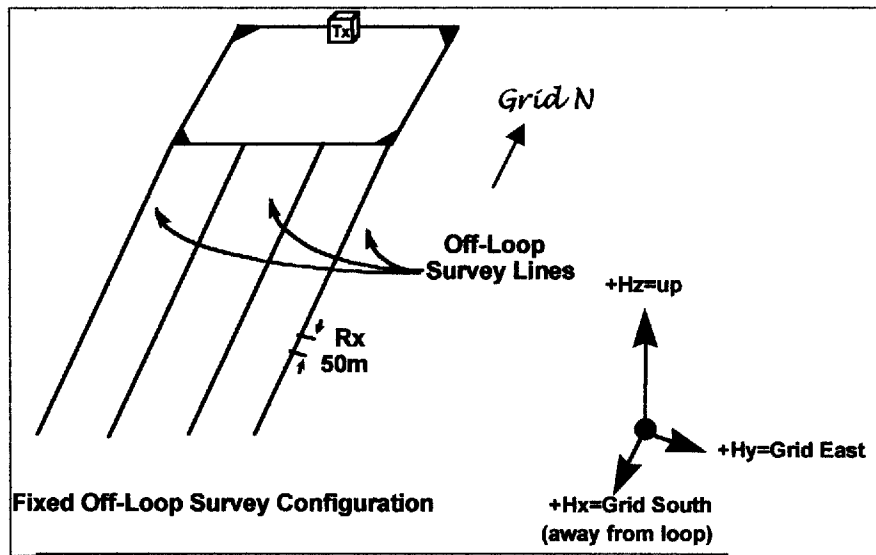


Figure B2: Loop Configuration and Polarity Conventions for Off-Loop Profiling Surveys

The borehole survey is particularly useful to determine the geometrical relationship between a conductor or a complex swarm of conductors around the drill hole. Of particular importance is its application in cases where the drilling is believed to have missed the target of interest. A 3-D borehole survey can effectively determine the direction and distance from the drill hole to the conductor by measuring two orthogonal secondary field components in addition to the axial component. Additionally, conductors located below the end of a drill hole, which either may be too deep and/or have gone previously undetected from surface, may be discovered during the course of a borehole survey.

The probe is manually lowered down the borehole at the end of a cable and, at successive depths, measurements of three (3-D) orthogonal components of the TEM field (H_x , H_y , H_z) are individually obtained in succession by electronically switching the sensor coils in the borehole antenna through the use of a relay/switching system from surface, via the borehole-cable shield. As the probe is free to rotate on its vertical axis, a correction is later applied to the 3-D data in order to rotate the components into their respective coordinate axis.

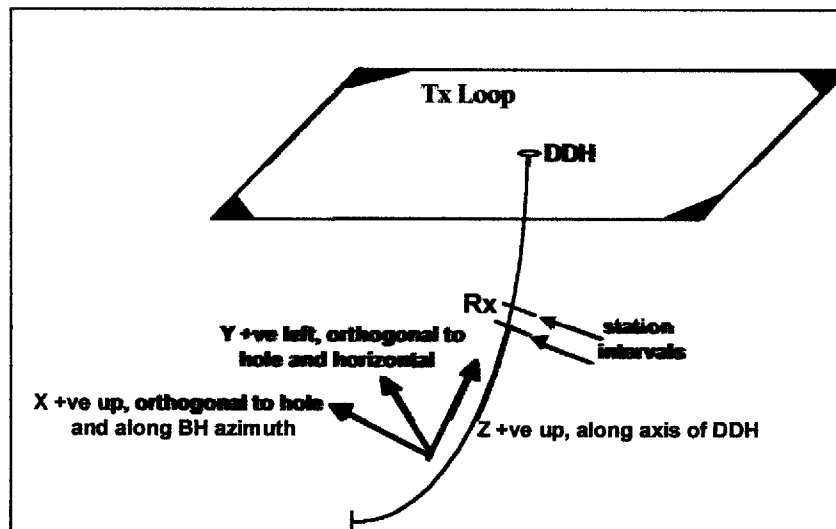


Figure B3: Loop Configuration and Polarity Conventions for 3-D Borehole Surveys

The secondary fields induced decay at a rate proportional to the conductivity-thickness and are then measured and profiled by the borehole sensor-probe.

- a) H_z is positive up along the axis of borehole,
- b) H_x is positive perpendicular to the borehole axis and pointing upward, in a vertical plane, in the direction of the azimuth of the hole,
- c) H_y is positive 90° counterclockwise to H_x and horizontal, according to the right-hand rule.

At the end of each survey day, the stored data are transferred to a microcomputer where they corrected for the turn-off time, loop area, system gain and current, and converted from millivolts to nanoVolts per ampere meter squared or nanoVolts per meter squared. The data are then transferred to disk for storage and processing. Report quality field plots are generated on site, using a 24-pin printer in order to monitor the data characteristics and to provide a preliminary interpretation capability.

The following equations govern the transient EM response for buried plate-like conductive bodies¹

Target Response to Transmitter Current Waveform:

$$emf = \frac{1}{\tau} e^{-t/\tau}$$

where: t = fixed time

e = exponential decay

τ = time constant of conductor

Equation 1: Conductor Response to the Transient EM Waveform

The time constant of the response is alternatively defined as the slope of the lin-log decay curve (Geonics) or, more exactly, as the time channel where the amplitude of the decay collapses to 37% (1/e) of its maximum value. Both τ and the analogous decay strength (ie., the number of anomalous channels above background), are commonly used as indicators of conductor quality. This relationship between decay-strength and the conductivity-thickness can easily be demonstrated in the following equation for a vertically dipping conductive sheet:

$$\tau = \frac{\sigma\mu h}{\pi^2} \text{ for a thin plate}$$

where σ = conductivity of target

μ = magnetic susceptibility

t = thickness of plate

h = vertical extension of plate

Equation 2: Transient EM Decay Time Constant

¹ From Geonics Limited, EM-37 TEM System Design Parameter, Mississauga, Ont., 1982.

thereby giving, for an infinite vertical sheet:

$$\sigma t = \frac{\pi^2}{\mu h} \tau \approx \tau / 0.31 \text{ mhos / metre (siemens)}$$

Equation 3 Conductivity Thickness

From these equations and relationships, it therefore becomes obvious of the common use of the anomaly strength of decay as a simple, rule-of thumb indicator of the relative conductivity-thickness product for TEM surveys.

In addition, the total secondary field is calculated using the three components (Hx, Hy and Hz) in the following formula

$$H_{tot} = \sqrt{H_x^2 + H_y^2 + H_z^2} \text{ nanoVolt / Am}^2.$$

Equation 4: Transient EM Total Secondary Field

TOTAL FIELD MAGNETIC SURVEY

Base station corrected Total Field Magnetic surveying is conducted using at least two synchronized magnetometers of identical type. One magnetometer unit is set in a fixed position in a region of stable geomagnetic gradient, and away from possible cultural effects (i.e. moving vehicles) to monitor and correct for daily diurnal drift. This magnetometer, given the term 'base station', stores the time, date and total field measurement at fixed time intervals over the survey day. The second, remote mobile unit stores the coordinates, time, date, and the total field measurements simultaneously. The procedure consists of taking total magnetic measurements of the Earth's field at stations, along individual profiles, including Tie and Base lines. A 2 meter staff is used to mount the sensor, in order to optimally minimize localized near-surface geologic noise. At the end of a survey day, the mobile and base-station units are linked, via RS-232 ports, for diurnal drift and other magnetic activity (ionospheric and spheric) corrections using internal software.

GRADIENT REALSECTION™ INDUCED POLARIZATION SURVEY

The "RealSection™" survey design uses multiple gradient arrays - with variable depths of investigation controlled by successive changes in array size/geometry. The method of data acquisition and the "RealSection" presentation are based on the specifications developed by Dr. Perparim Alikaj, of the Polytechnic University of Tirana, Albania, over the course of approx. 20 years of application. This technique has been further developed for application in Canada during the past six years, in association with Mr. Dennis Morrison, president of Quantec IP Inc.

The Gradient Array measurements are unique in that they best represent a bulk average of the surrounding physical properties within a relatively focused sphere of influence, roughly equal to the width of the receiver dipole, penetrating vertically downward from surface to great depths. These depth of penetration and lateral resolution characteristics are showcased when presented in plan, however through the use of multiple-spaced and focused arrays, the advantages of the gradient array are further highlighted when the IP/Resistivity data are fully developed in cross-section, using RealSections.

The resistivity is among the most variable of all geophysical parameters, with a range exceeding 10^6 . Because most minerals are fundamentally insulators, with the exception of massive accumulations of metallic and submetallic ores (electronic conductors) which are rare occurrences, the resistivity of rocks depends primarily on their porosity, permeability and particularly the salinity of fluids contained (ionic conduction), according to Archie's Law. In contrast, the chargeability responds to the presence of polarizable minerals (metals, submetallic sulphides and oxides, and graphite), in amounts as minute as parts per hundred. Both the quantity of individual chargeable grains present, and their distribution within subsurface current flow paths are significant in controlling the level of response. The relationship of chargeability to metallic content is straightforward, and the influence of mineral distribution can be understood in geologic terms by considering two similar, hypothetical volumes of rock in which fractures constitute the primary current flow paths. In one, sulphides occur predominantly along fracture surfaces. In the second, the same volume percent of sulphides are disseminated throughout the rock. The second example will, in general, have significantly lower intrinsic chargeability.

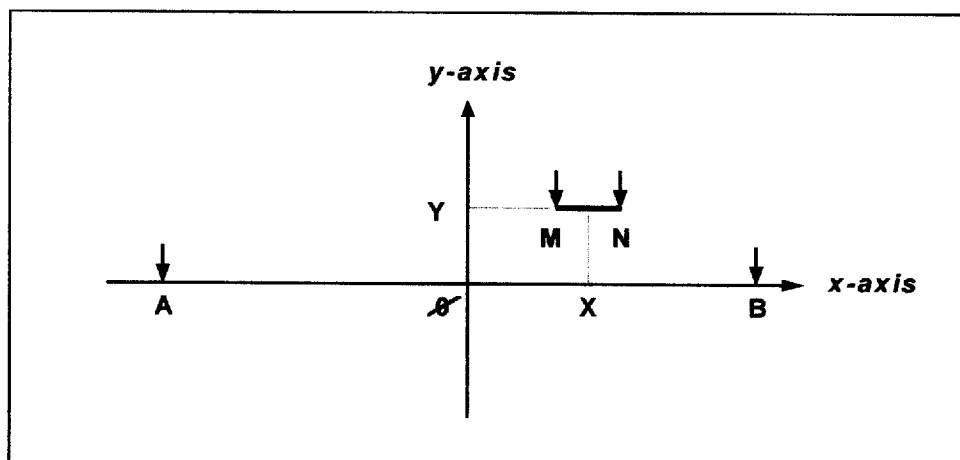


Figure B1: Gradient array configuration

Using the diagram in Figure B1 for the gradient array electrode configuration and nomenclature:⁴, the gradient array apparent resistivity is calculated:

where: the origin 0 is selected at the center of AB
 the geometric parameters are in addition to $a = AB/2$ and $b = MN/2$
 X is the abscissa of the mid-point of MN (positive or negative)
 Y is the ordinate of the mid-point of MN (positive or negative)

Gradient Array Apparent Resistivity:

$$\rho_a = K \frac{VP}{I} \text{ ohm-metres}$$

$$\text{where: } K = \frac{2\pi}{(AM^{-1} - AN^{-1} - BM^{-1} + BN^{-1})}$$

$$AM = \sqrt{(a+x-b)^2 + y^2}$$

$$AN = \sqrt{(a+x+b)^2 + y^2}$$

$$BM = \sqrt{(x-b-a)^2 + y^2}$$

$$BN = \sqrt{(x+b-a)^2 + y^2}$$

Using the diagram in Figure B2 for the Total Chargeability:

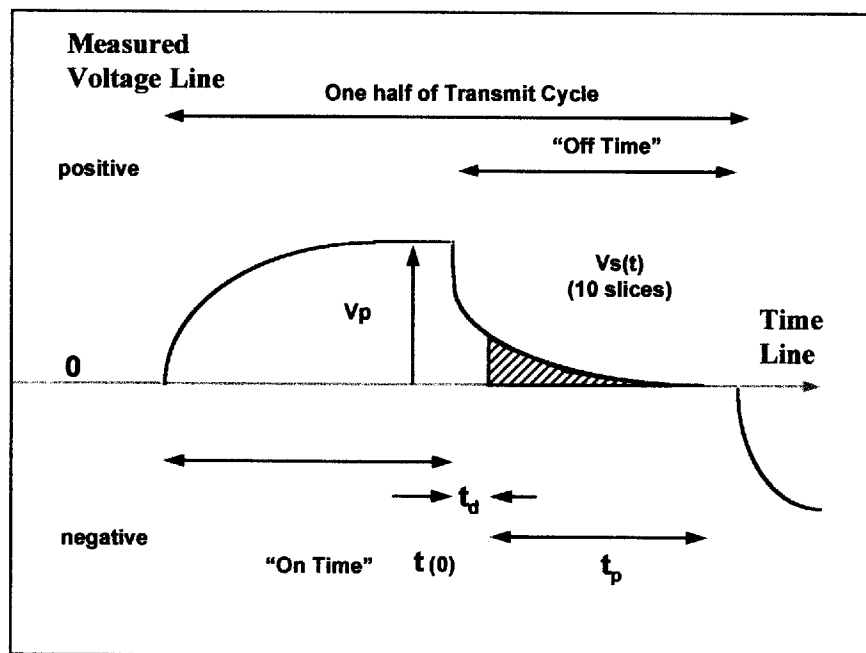


Figure B2: The measurement of the time-domain IP effect

⁴ From Terraplus\BRGM, IP-6 Operating Manual, Toronto, 1987.

the total apparent chargeability is given by:

Total Apparent Chargeability:⁵

$$M_T = \frac{1}{t_p V_p} \sum_{i=1}^{10} \int_{t_i}^{t_{i+1}} V_s(t) dt \quad \text{millivolts per volt}$$

where t_i , t_{i+1} are the beginning and ending times for each of the chargeability slices,

More detailed descriptions on the theory and application of the IP/Resistivity method can be found in the following reference papers:

Cogan, H., 1973, Comparison of IP electrode arrays, *Geophysics*, 38, p 737 - 761.

Langore, L., Alikaj, P., Gjovreku, D., 1989, Achievements in copper sulphide exploration in Albania with IP and EM methods, *Geophysical Prospecting*, 37, p 925 - 941.

⁵ From Telford, et al., Applied Geophysics, Cambridge U Press, New York, 1983.

APPENDIX C

INSTRUMENT SPECIFICATIONS

GEONICS LIMITED Digital Protem Receiver

Digital Protem Ground Transient Electromagnetic System Technical Specifications

Receiver

Measured Quantity:	Time rate of decay of magnetic flux along 3 axes
Sensors:	
1. (L.F.):	Air-cored coil of bandwidth 60 kHz; 100 cm diameter
2. (H.F.):	Air-cored coil of bandwidth 850 kHz; 100 cm diameter
3. (3D-3):	Three orthogonal component sensor; simultaneous operation
4. (3D-1):	Three orthogonal component sensor; sequential operation
Time channels:	20 geometrically spaced time gates for each base frequency gives range from 6 μ sec to 800 msec.
Repetition Rate:	0.3 Hz, 0.75, 3, 7.4, 30, 75 or 285 Hz for 60 Hz power-line networks (Base Frequency)
Synchronization:	1) reference cable. 2) high stability (oven controlled) quartz crystals. (Switch selectable)
Integration time:	2, 4, 8, 15, 30, 60, 120, 240 sec.
Calibration:	Internal self calibration External Q coil calibration (optional)
Keyboards:	Two 3 x 4 matrix sealed key pads with positive tactile feedback
Gain:	Automatic or manual control
Dynamic Range:	23 bits (132 dB)
Display Quantity:	(1) Table of time rate of decay of magnetic flux (dB/dt) (2) Curve of rate of decay of magnetic flux (dB/dt) (3) Table of apparent resistivity (ρ_a) (4) Curve of apparent resistivity (ρ_a) (5) Profile of dB/dt (6) Real time noise monitor (7) Calibration curve (8) Data acquisition statistics (real time)
Storage:	Solid state memory with capacity for over 3000 data sets
Display:	8 lines by 40 character (240 x 64 dot) graphic LCD

Data Transfer: Standard RS-232 communications port.

Processor: CMOS 68HC000 8 MHz CPU

Receiver Battery: 12 volts rechargeable battery for 8 hours continuous operation. 6 hours in XTAL mode

Receiver Size: 34 x 38 x 27 cm

Receiver Weight: 15 kg

Operating Temp.: -40^oC to +50^oC

Transmitters: (1) Geonics TEM47
(2) Geonics TEM57
(3) Geonics TEM37

GATE	285/237.5 Hz			75/62.5 Hz			30/25 Hz			GATE
1	6.000	6.813	1.625	32.00	35.25	6.500	80.00	88.13	16.25	1
2	7.625	8.688	2.125	38.50	42.75	8.500	96.25	106.9	21.25	2
3	9.750	11.13	2.750	47.00	52.5	11.00	117.5	131.3	27.5	3
4	12.50	14.19	3.375	58.00	64.75	13.50	145.0	161.9	33.75	4
5	15.88	18.07	4.375	71.5	80.25	17.50	178.8	200.6	43.75	5
6	20.25	23.06	5.625	89.00	100.3	22.50	222.5	250.6	56.25	6
7	25.88	29.44	7.125	111.5	125.8	28.50	278.8	314.4	71.25	7
8	33.00	37.56	9.125	140.0	158.3	36.50	350.0	395.6	91.25	8
9	42.13	47.94	11.63	176.5	199.8	46.50	441.3	499.4	116.3	9
10	53.75	61.13	14.75	223.0	252.5	59.00	557.5	631.3	147.5	10
11	68.50	77.94	18.88	282.0	319.8	75.50	705.0	799.4	188.8	11
12	87.38	99.38	24.00	357.5	405.5	96.00	893.8	1014	240.0	12
13	111.4	126.7	30.63	453.5	514.8	122.5	1134	1287	306.3	13
14	151.7**	166.4	29.38	576.0	654.3	156.5	1440	1636	391.3	14
15	181.1	206.0	49.88	732.5	832.3	199.5	1831	2081	498.8	15
16	231.0	262.8	62.63	932.0	1059	254.5	2330	2648	636.3	16
17	294.6	335.2	81.25	1187	1349	325.0	2966	3373	812.5	17
18	375.9	427.7	103.6	1512	1719	414.5	3779	4297	1036	18
19	479.5	545.6	132.1	1926	2190	528.5	4815	5475	1321	19
20	611.6	695.9	168.5	2455	2792	674.0	6136	6978	1685	20
21*	780.1			3129			7821			21*

Table C1: Digital Protem Gate Locations

* End of Gate 20

** A Gap of 9.7 µsec exists between Gate 13 and Gate 14 in the micro-frequency range/

This Table applies to both synchronization modes regardless of which of TEM37, TEM47 and TEM57 transmitters is used, provided that correct Tx model is selected in Header (2.4).

Note: 7.5/6.25 and 0.75/0.625 Hz proportional to 75/62.5 Hz
3/2.5 and 0.3/0.25 Hz proportional to 30/25 Hz

GEONICS LIMITED EM-37 Transmitter

EM-37 Transmitter

Technical Specifications

Current Wave form:	bipolar square wave.
Repetition Rate:	3Hz, 7.5Hz or 30Hz in countries using 60Hz power line frequency; 2.5Hz, 6.25Hz or 25Hz in countries using 50Hz power line frequency; all six base frequencies are switch selectable.
Turn-off Time(t):	fast linear turn-off maximum of 450 μ sec. at 30 amps into a 300x600 meter loop. Decreases proportionally with current and the root of the loop area to a maximum of 20 μ sec. Actual value of t read on front panel meter.
Transmitter Loop:	any dimensions from 40x40 meters to 300x600 meters maximum at 30 amps. Larger dimensions at reduced current. Transmitter output voltage switch adjustable for smaller loops. Value of loop resistance read from front panel meter; resistance must be greater than 1 ohm on lowest setting to prevent overload.
Protection:	circuit breaker protection against input over voltage; instantaneous solid state protection against output short circuit; automatically resets on removal of short circuit. Input voltage output voltage and current indicated on front panel meter.
Output voltage:	24 to 160 volts (zero to peak) maximum
Output power:	2800 watt maximum
Motor generator:	5 HP Honda gasoline engine coupled to a 120 volt, three phase, 400 Hz alternator. Approximately 8 hours continuous operation from built-in fuel tank.

Component Dimensions and Weights

Transmitter Console :	20 by 42 by 32 cm, 20 kg
GPU:	44 by 32 by 21 cm, 65 kg

Geonics Limited: BH-43-3D Borehole Probe

GEONICS LIMITED

**BH-43 3-D Borehole Probe with Tilt Sensors
Technical Specifications**

Measured Quantity:	Time derivative of axial and radial magnetic field
Sensors:	Three orthogonal coils (one axial, two radial)
Overall Length:	334 cm
Maximum Diameter:	3.8 cm
Weight:	9.5 kg
Sensor-Preamplifier Resonant Frequency:	10 kHz
Sensor Areas:	100 m ²
Operating Temperature:	-30 degrees C to +80 degrees C
Probe Rotation Correction:	Two orthogonal tilt meters with range $\pm 1^\circ$ to $\pm 80^\circ$ from vertical
Battery:	Rechargeable NiCd sealed pack for 15 hours continuous operation

Cable

Type:	Two-conductor shield polyurethane jacket Kevlar membrane
Diameter:	5.6 mm
Weight:	40 kg/km
Length:	600m

GEM SYSTEMS GSM-19

(from GSM-19 Overhauser Magnetometer Operating Manual)

Weather proof case

Dimensions: Console 223 mm x 69 mm x 240 mm Sensor 170 mm x 71 mm diameter cylinder

Weight: Console 2.1 kg; Sensor 2.2 kg (staff included)

Operating temperature: -40°C to 60°C

Power supply: 12V 1.9 Ah sealed lead acid battery

Power Consumption: 2 Ws per reading

Resolution: 0.01 nT

Relative Sensitivity: 0.02 nT

Absolute Accuracy: 0.2 nT

Range: 20,000 to 120,000 nT

Gradient Tolerance: Over 10,000 nT/m

Operating Modes: Base station- time/date reading stored 3 to 60 sec Walking- time/date reading stored at coordinates of fiducial with 0.5 to 2 sec. cycle time

Memory Capacity: Base station- 43,000 readings standard

Walking- 131,000 readings

Data transfer: Serial link @ 300 to 19200 baud; remote control capability through serial link @ 19200 baud

IRIS ELREC 6 RECEIVER

(from IRIS Instruments IP 6 Operating Manual)

Weather proof case

Dimensions:	31 cm x 21 cm x 21 cm
Weight:	6 kg with dry cells 7.8 kg with rechargeable bat.
Operating temperature:	-20°C to 70°C (-40°C to 70°C with optional screen heater)
Storage:	(-40°C to 70°C)
Power supply:	6 x 1.5 V dry cells (100 hr. @ 20°C) or 2 x 6 V NiCad rechargeable (in series) (50 hr. @ 20°C) or 1 x 12 V external
Input channels:	6
Input impedance:	10 Mohm
Input overvoltage protection:	up to 1000 volts
Input voltage range:	10 V maximum on each dipole 15 V maximum sum over ch. 2 to 6
SP compensation:	6 automatic ± 10 V with linear drift correction up to 1 mV/s
Noise rejection:	50 to 60 Hz powerline rejections 100 dB common mode rejection (for $R_s = 0$) automatic stacking
Primary voltage resolution:	1 μ V after stacking
Accuracy:	0.3% typically; maximum 1 over whole temperature range
Secondary voltage windows:	up to 10 windows; 3 preset window specs. plus fully pro- grammable sampling.
Sampling rate:	10 ms
Synchronization accuracy:	10 ms, minimum 40 μ V
Chargeability resolution:	0.1 mV/V
Accuracy:	typically 0.6%. maximum 2% of reading ± 1 mV/V for $V_p > 10$ mV
Battery test:	manual and automatic before each measurement
Grounding resistance:	0.1 to 467 kohm
Memory capacity:	2505 records, 1 dipole/record
Data transfer:	serial link @ 300 to 19200 baud

IRIS IP 6 Dump File Format

* ELREC 6 V9.41 *

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#191 Aug 5 1999 12:29
dipole 1 trigger 1 domain Time T wave
Programmable wind. Grad. RCTGL array

V= 95.814 Sp= 83 I= 7000.00 Rs= 0.20
Ro= 577.3 Ohm.m M= 8.60 E= 0.0
M1= 24.71 M2= 21.35 M3= 19.29 M4= 17.87
M5= 14.47 M6= 11.03 M7= 9.06 M8= 7.18
M9= 5.62 M10= 4.58

cycl= 10 Time= 4000 V_D= 2620 M_D= 60
T_M1= 60 T_M2= 60 T_M3= 60 T_M4= 60
T_M5= 360 T_M6= 360 T_M7= 360 T_M8= 720
T_M9= 720 T_M10= 720

Spacing config. : Imperial
XP=-3600.0 li.P= 800.0
D= 100.0 XA= 2450.0
XB=-5000.0 l.AB= 1200.0

#192 Aug 5 1999 12:29
dipole 2 trigger 1 domain Time T wave
Programmable wind. Grad. RCTGL array

V= 84.644 Sp= -57 I= 7000.00 Rs= 0.12
Ro= 569.4 Ohm.m M= 8.40 E= 0.1
M1= 24.14 M2= 21.01 M3= 18.95 M4= 17.48
M5= 14.14 M6= 10.81 M7= 8.83 M8= 7.00
M9= 5.44 M10= 4.48

cycl= 10 Time= 4000 V_D= 2620 M_D= 60
T_M1= 60 T_M2= 60 T_M3= 60 T_M4= 60
T_M5= 360 T_M6= 360 T_M7= 360 T_M8= 720
T_M9= 720 T_M10= 720

Spacing config. : Imperial
XP=-3500.0 li.P= 800.0
D= 100.0 XA= 2450.0
XB=-5000.0 l.AB= 1200.0

APPENDIX D

PRODUCTION LOG

Date	Description	Line/ Bore-hole	Min Ex-tent	Max Ex-tent	Total Sur-vey (m)
14-Jul	Jonathan Davis and Richard Chasse pack TEM Borehole gear and Mob to Matagami.				
15-Jul	Two man TEM crew established 300m x 300m Tx loop and reads borehole DJV-01-52. Hole read at 25 Hz. Borehole TEM charge	DJV-01-52	40m	520m	480
16-Jul	Two man crew retrieves Tx loop and Demobs to Timmins. Demob charge				
22-Jul	Prepare equipment and mob Timmins to Matagami				
23-Jul	Establish 300x300 meter east loop, 19150E,9800N & 19450E,10100N Collar @ 19120E,10015N, Azm N270, Dip -75 T/O = 140 IN=15.2 Defective slip ring, part of the data set is unusable	DJV-52-01	40	530	490
24-Jul	Demob to Timmins				
31-Jul	Jonathan Davis and Eric Hotvedt mob to Matagami and establish 300m x 300m Tx loop (192+00E,101+50N 189+00E,98+50N) for borehole DJV-01-52 Mob charge				
1-Aug	Two Man TEM crew attempts to locate borehole DJV-01-53, coordinates for hole given by client were incorrect (L19100 at 92+50N) a hole was found on a line 100m west but was poorly labeled. One man begins to establish 500m x 400m Tx loop for DJV-01-53 (18 1/2 Borehole TEM charge	DJV-01-52	40m	520m	480m
2-Aug	Two man TEM crew confirms location of DJV-01-53 and attempts to begin survey. On the way to the hole crew experiences J6 and truck problems and spend remainder of the retrieving J6. Return to Timmins to get J5. Down Day				
3-Aug	Pick up J5 muskeg and return to Matagami. Down Day				
4-Aug	Two man TEM crew moves gear to DJV-01-53 and begins survey. Problems encountered with equipment 1/4 of the way down the hole. When problems are resolved an electrical storm moves in and survey is shut down. 1/2 Weather Day Charge				
5-Aug	Two man TEM crew survey DJV-01-53 and DJV-01-52 and re-read hole. Retrieves 500m x 400m Tx loop for DJV-01-53. Borehole TEM charge	DJV-01-53	60m	740m	680m
6-Aug	Two man crew retrieves Tx loop for both DJV-01-52 and demobs to Timmins. Demob charge	DJV-01-52	40m	520m	480m
14-Aug	Prepare equipment, Mob to Matagami 1 day mob charge				
15-Aug	Prepare 300 x 300 metre loop for borehole DJV-01-55 19100E,10300N - 298861E,5516688N 19100E,10600N - 299045E,5516449N 19400E,10600N - 299042E,5516447N 19400E,10300N - 299042E,5516447N Dummied hole and was clear Survey suspended due to Tx problem 1/2 day survey charge				
16-Aug	Established 1800m AB on line 17800E @ 9600N & 11400N				

Date	Description	Line/ Bore-hole	Min Ex- tent	Max Ex- tent	Total Sur- vey (m)
	Received a new Tx from Timmins in the afternoon				
	Redummy hole after the drill was removed still clean				
	Generator problems return to base of operations to conduct repairs.				
	1/2 day survey charge				
17-Aug	Established 1800m AB on line 19200e @ 9600n & 11400n				
	Established 1800m AB on line 16800e @ 9600n & 11400n				
	1 person return to Timmins for Alternator repairs				
	3 man survey charge				
18-Aug	Borehole Survey, DJV-55-01, 19300E, 10422N	55-01	40	420	380
	In=12.5A, TIO=160, Rx Delay = -80				
	Hole blocked at 283m, re-dummed hole, ctd survey				
	One day borehole charge				
19-Aug	Gradient IP Survey	17800E	9900N	11100N	1200
		17900E	9900N	11100N	1200
	Total Survey				2400
	Survey lines 18100E & 18000E data was lost due to Rx failure				
	1/2 day survey charge				
20-Aug	Gradient IP Survey - 4 men	18100E	9900N	11100N	1200
		18000E	9900N	11100N	1200
		17700E	9900N	11100N	1200
		17600E	9900N	11100N	1200
	Total Survey				4800
	1 Day Survey Charge				
21-Aug	Gradient IP Survey - 4 men	16500E	9900N	11075N	1275
		16600E	9950N	11100N	1150
		16700E	9950N	11000N	1050
		16800E	9900N	11100N	1200
		16900E	9900N	10500N	600
	Total Survey				5275
	1 Day Survey Charge				
22-Aug	Gradient IP Survey - 4 men	16900E	10500N	11100N	600
		17000E	9900N	11100N	1200
		18900E	9900N	11100N	1200
		19000E	9900N	11100N	1200
	Total Survey				4200
	1 Day Survey Charge				
23-Aug	Gradient IP Survey - 4 men	19100E	9900N	11100N	1200
		19200E	11100N	9900N	1200
		19300E	9900N	11100N	1200
		19400E	11100N	9900N	1200
		19500E	9900N	11100N	1200
	Total Survey				6000
	1 Day Survey Charge				
24-Aug	BHEM Survey DJV -01-55 to 830m, lay loop & survey	DJV-01-54	50	830	780
	Muskeg Charge				
25-Aug	Started to go to DJV 5601, Muskeg not working, talked to Mario Mason, arrange to use drill muskeg on Sunday. Picked up AB wire, lay AB. 3 men, 1 day				
26-Aug	Lay & PU loop for and Survey DJV 5601, 336m	DJV-01-56	40	336	296
27-Aug	Start IP Survey, Noise due to low signal, high cont. res. Phoned Kevin B. re shrinking AB, etc, Lay 2nd AB & take Muskeg to garage.				
	3 men, 1day				
28-Aug	Gradient IP Survey - 4 man crew	17100E	9700N	10900N	1200
	AB=L173E	17200E	9700N	10900N	1200
		17300E	9700N	10900N	1200
		17400E	9700N	10900N	1200
	Total Survey				4800
29-Aug	Gradient IP Survey - 4 man crew AB=L173E	17500E	9700N	10900N	1200
	AB=L185E	18200E	10200N	11250N	1050

Date	Description	Line/ Bore-hole	Min Ex- tent	Max Ex- tent	Total Sur- vey (m)
		18300E	10200N	11250N	1050
	Total Survey				3300
30-Aug	Gradient IP Survey - 3 man crew AB=L185E	18400E	10200N	11250N	1050
		18500E	10200N	11250N	1050
		18600E	10200N	11250N	1050
		18700E	10200N	11250N	1050
					4200
31-Aug	E	18800E	10200N	11250N	1050
	Total Survey				1050
	Drive to New Liskard with Eric & Alan, R.Meikle to North Bay				
5-Sep	R.Meikle drive, North Bay to Timmins, PU Richie & drive to Matagami				
6-Sep	Thunder/Lightning heavy rain in morning. Lay Surface loop 23600E-24400E, 10000N-10500N				
	Muskeg Charge				
7-Sep	Surface TDEM 2 man crew. XY data no good, RJM 1/2 way to Timmins to get new RX & coil.				
8-Sep	Surface TDEM 2 man crew. Test equip, old RX no good for x,y, comp. Re-read Lines 243E & 244E.	24300E	10000N	11400N	1400
		24400E	10500N	11400N	1400
9-Sep	Surface TDEM with 2 man crew.	24200E	10000N	11400N	1400
		24100E	10000N	11400N	1400
	Muskeg Charge				
10-Sep	Weather day - rain/lightning most of day. Gave profiles to Mario, decide to lay loop for DJV-01-58. Road to hole impassable with J5 due to extreme swampy conditions.				
11-Sep	Surface TDEM Survey with 2 man crew	24000E	10000N	11400N	1400
		23900E	10000N	11400N	1400
12-Sep	Surface TDEM Survey with 2 man crew	23800E	10000N	11400N	1400
		23700E	10000N	11400N	1400
13-Sep	Out to grid in morning but heavy rain persists all day. Muskeg blows sprockets due to heavy clay on winter road. Weather day.				
14-Sep	Surface TDEM Survey, finish & carry bx equip out by hand	23600E	10500N	11400N	900
15-Sep	R.Meikle drive to North Bay, Richie stayed.				
16-Sep	Richie Chasse on mag survey.	19800E	12000N	12400N	400
		19700E	12400N	12000N	400
		19699E	12000N	12400N	400
		19500E	12400N	12000N	400
		19400E	12000N	12000N	400
19-Sep	BHEM with 2 man crew. Drillers had to provide access to hole 58. Muskeg broke an axle 1/2 way to hole. Standby charge.				
20-Sep	BHEM with 2 man crew. Drillers Muskeg stuck, pulled out with Skidder. Got equip to hole 58, layed loop, heavy rain.				
21-Sep	BHEM with 2 man crew. Log hole 58 - north loop.	DJV-01-58	0	410	410
22-Sep	BHEM with 2 man crew. Log hole #5801 - south loop. Unable to demob equipment from hole due to drillers muskeg broken down.	DJV-01-58	0	410	410
23-Sep	Crew departs Matagami to address equipment problems and permit drillers time to repair muskeg.				
30-Sep	BH-TEM 2 man re-survey DJV-01-58 Deep swamp, access poor, equipment working and survey completed. Recover loop and demob.	DJV-01-58	60m	410m	350m
1-Oct	BH-TEM 2 man survey. DJV-01-60 Install 400 x 400m loop, Hole blocked at 62 meters. All attempts to clear blockage failed. Eventually, dummy probe stuck at 65 meters. Requires drill to clear blockage.	DJV-01-60			
2-Oct	BH-TEM 2 man survey DJV-01-57 Install 500 x 500m loop. Survey hole and recover equipment.	DJV-01-57	40m	980m	940m

Date	Description	Line/ Bore-hole	Min Extent	Max Extent	Total Survey (m)
3-Oct	BH-TEM 2 man survey DJV-01-59 Install 600 x 800m loop. Survey hole and recover equipment. J-5 is immobile so drillers equipment used to access borehole. Very wet ground conditions, both Noranda truck and Quantec truck got stuck trying to access hole.	DJV-01-59	60m	760m	700m
4-Oct	Attempted to survey DJV-01-60, Drillers unable to move drill onto collar because wet ground required different (wider) tires for heavy equipment. Standby for 1 day. Recover some loop wire and equipment maintenance				
5-Oct	BH-TEM 2 man survey DJV-01-60. Complete survey, recover some of equipment	DJV-01-60	90m	550m	460m
6-Oct	BH-TEM 2 man survey DJV-01-61 Install 300 x 300m loop, survey hole recover loop and some equipment. Drillers heavy equipment necessary to recover some survey gear from holes 59, 60, 61.	DJV-01-61	50m	255m	205m
7-Oct	BH-TEM-2 man survey. Attempted to access Veract-01-01. Extremely wet conditions, large swamp blocking access. Quad was stuck several times in mud and swamp, and the closest we got to the borehole collar was 800 meters. Standby on survey until access improves.				
8-Oct	Recover remaining wire from ground, prepare plots, demob to Timmins.				
19-Oct	Mob to Matagami via Kirkland Lake				
20-Oct	Locate DJV-01-62 (difficult access) Dummy hole and establish 300x300m loop.		No survey		
21-Oct	Survey BH-TEM DJV-01-62	DJV-01-62	50m	480m	430m
22-Oct	Recover loop Establish 400 x 400m loop for DJV-01-63 No survey. 1/2 Day Charge				
23-Oct	J-5 (muskeg) breakdown Spent day replacing wheel bearing No charge				
24-Oct	Survey BH-TEM DJV-01-63	DJV-01-63	40m	780m	740m
25-Oct	Weather Day Equipment Maintenance				
26-Oct	Establish 300x300m loop for DJV-01-64 Dummy DJV-01-64, DJV-89-19,20.				
27-Oct	Survey BH-TEM DJV-01-64 Recover loop	DJV-01-64	40m	320m	280m
28-Oct	Establish 300m x300m loop Survey BH_TEM DJV-89-20	DJV-89-20	40m	380m	340m
29-Oct	Establish 300m x300m loop Survey BH_TEM DJV-89-19	DJV-01-19	40m	430m	390m
30-Oct	Establish 300m x300m loop Survey BH_TEM DJV-01-65	DJV-01-65	30m	450m	420m
31-Oct	Establish 300m x300m loop Survey BH_TEM DJV-01-66	DJV-01-66	50m	450m	400m
1-Nov	Standby, weather				
2-Nov	Demob to Porcupine				
6-Nov	Mob to Matagami				
7-Nov	BH-TEM DJV-01-70 Establish and recover 200 x 200m loop	DJV-01-70	20m	170m	150m
8-Nov	BH-TEM DJV-01-68 Establish and recover 300 x 300m loop	DJV-01-68	20m	450m	430m
9-Nov	BH-TEM DJV-01-69 Establish and recover 200 x 200m loop J-5 charge	DJV-01-69	40m	290m	250m

Date	Description	Line/ Bore-hole	Min Extent	Max Extent	Total Survey (m)
10-Nov	Demob to Porcupine				
27-Nov	Mob to Matagami				
28-Nov	BH TEM OR-01-33 Establish 600 x 600m loop. Read hole from 100m to 930m. This hole was problematic. The drillers had problems dumming the hole and made three passes before the geophysics dummy probe would pass to the bottom. Even with this effort, the EM probe got stuck at 930m and we could read no further.	OR-01-33	100m	930m	830m
	Four men were available to install the loop and set up the EM equipment, while borehole was being ready by K MacKenzie, E. Dufour, R. Chasse, and A. Dufour. Began setting up DPDP array.				
	2 Extra Man Charge				
29-Nov	DPDP survey (50m spacing) Complete setup on L20250E, Test equipment and begin Survey.	L20250e	8900n	10250n	1350m
30-Nov	DPDP survey Complete survey at 50m spacing. Begin survey of same line at 25m spacing	L20250e	10250n	10600n	350m
		L20250e	10400n	9200n	1200m
1-Dec	Recover loop from OR-01-33. Establish four AB locations on L20250e				
	800m AB on L20250e at 9050n and 9850n	L20250e	9150n	9750n	600m
	600m AB on L20250e at 9050n and 9650n	L20250e	9150n	9600n	450m
	600m AB on L20250e at 9250n and 9850n	L20250e	9600n	9750n	150m
	400m AB on L20250e at 9250n and 9650n	L20250e	9300n	9600n	300m
	Total				1500m
2-Dec	Pack up equipment and Quantec property from apartment and demob to Timmins				

APPENDIX E

LIST OF MAPS

- **LPTEM Surface Profiles: Multi-Channel 4-Axis Profile Plots:** showing time rate of decay of the secondary electromagnetic field, for X, Y, Z and Total Field components, 1:5000 scale, ch. 1-20 divided according to 4 vertical (linear) axes, nanoVolts per Ampere-meter²

Drawing #s=QG191-4AXIS-K-Line#, where K=Z, X, Y, TF (Total Field).

GRID	LINES	TOTAL LINES	TOTAL MAPS
1	236+00E to 244+00E	9	36
		TOTAL MAPS	36

- **Posted/Contoured X Component Plan Maps:** showing time rate of decay of the secondary electromagnetic field, for X component, 1:5000 scale, nanoVolts per Ampere-meter²

Drawing #s=QG191-TEM-CONT-ROT-K, where K = component contoured.

GRID	X component contoured	TOTALMAPS
1	10	1
	TOTAL MAPS	1

- **LPTEM 4 Axis Borehole Profile Plots:** showing time rate of decay of the secondary electromagnetic field, for X, Y, Z and Total Field components, 1:2000 scale, ch. 1-20 divided according to 4 vertical (linear) axes, nanoVolts per meter²

Drawing #s=QG191-BH4A-K-Hole#, where K=Z, X, Y, TF (Total Field).

GRID	BH #	Plot Type	TOTAL MAPS
1	20 holes – 23 loops	Profile	92
1	20 holes 23 loops	Lin Log	92
1	20 holes – 23 loops	Loop Location	23
		TOTAL MAPS	207

- **Total magnetic field Contour and Profile Plan maps: scale 1:5000**

GRID	CONTOUR	PROFILE
1	1	1
Total Maps	1	1

- **Gradient TDIP Posted/Contour Plan maps: scale 1:5000**

	Drawing Number
Total Chargeability	QG-191-PLAN-CHG-1
Apparent Resistivity	QG-191-PLAN-RES-1
Total Maps	2

- **Posted/contoured Profiled Pseudosections at a scale of 1:5000**

LINE	Drawing Number
20250E	QG-191-IP-DD-LINE 20250 E
Total map	1

- **Posted/contoured Profiled Pseudosections at a scale of 1:2500**

LINE	Drawing Number
20250E	QG-191-IP-DD-LINE 20250 E
Total map	1

- **Posted/contoured Realsection™ at a scale of 1:5000**

LINE	TOTAL CHARGEABILITY / APPARENT RESISTIVITY
20250E	QG191-RSIP-CHG-RES-202+50E
Total map	1

- **Location Plan Map:** showing borehole and loop location, Surface TEM surveyed lines with loop, Gradient Blocks with AB's, magnetic survey and TDIP test line on grid, 1:25000 scale.

	SUMMARY OF WORK, 2001
	QG191-SUMMARY-DANIEL-JVE
Total map	1

Total Profiles: 223
Total Plans: 29

APPENDIX F

PLAN MAPS AND SECTIONS