GM 60497

REPORT ON A HELICOPTER-BORNE TIME DOMAIN ELECTROMAGNETIC GEOPHYSICAL SURVEY, BLOCKS A AND B, RESERVOIR MANICOUAGAN AREA

REPORT ON A HELICOPTER-BORNE TIME DOMAIN ELECTROMAGNETIC GEOPHYSICAL SURVEY

Blocks A and B
Reservoir Manicouagan Area, Québec

for

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by Geotech Ltd.

Survey flown in December 2002

Project F 2002
January, 2003

TABLE OF CONTENTS

Figures

REPORT ON A HELICOPTER-BORNE TIME DOMAIN ELECTROMAGNETIC SURVEY

BLOCKS A and B, Reservoir Manicouagan Area, QUEBEC

1. INTRODUCTION

This report describes helicopter-borne geophysical survey carried out on behalf of Soquem Inc. by Geotech Ltd. under an agreement dated November 30, 2002. Principal geophysical sensors included a time domain electromagnetic system and a cesium magnetometer. Ancillary equipment included a GPS navigation system and a radar altimeter.

Two blocks, referred to as Block A and Block B, were surveyed. The survey blocks are located approximately 20-40 km south-west of Reservoir Manicouagan in Quebec. The area of the block A is 307.2 km^2, the area of the block B is 199.2 km^2. The total line kilometres flown for Block A was 1,662 km, for Block B was 883.4 km. Data acquisition was initiated on December 12th, 2002 and completed on December 20th, 2002.

This report describes the survey, the data processing and presentation and provides a brief interpretation.

2. SURVEY AREAS

The survey areas are shown in figure 1. The latitude-longitude of the centre of the Block A is roughly 51° N and 69° 15' W, of the Block B is 51° 6' N and 69° 6' W. The corner co-ordinates of the blocks in UTM zone 19 (NAD83) easting and northing are as follows.

Block A:

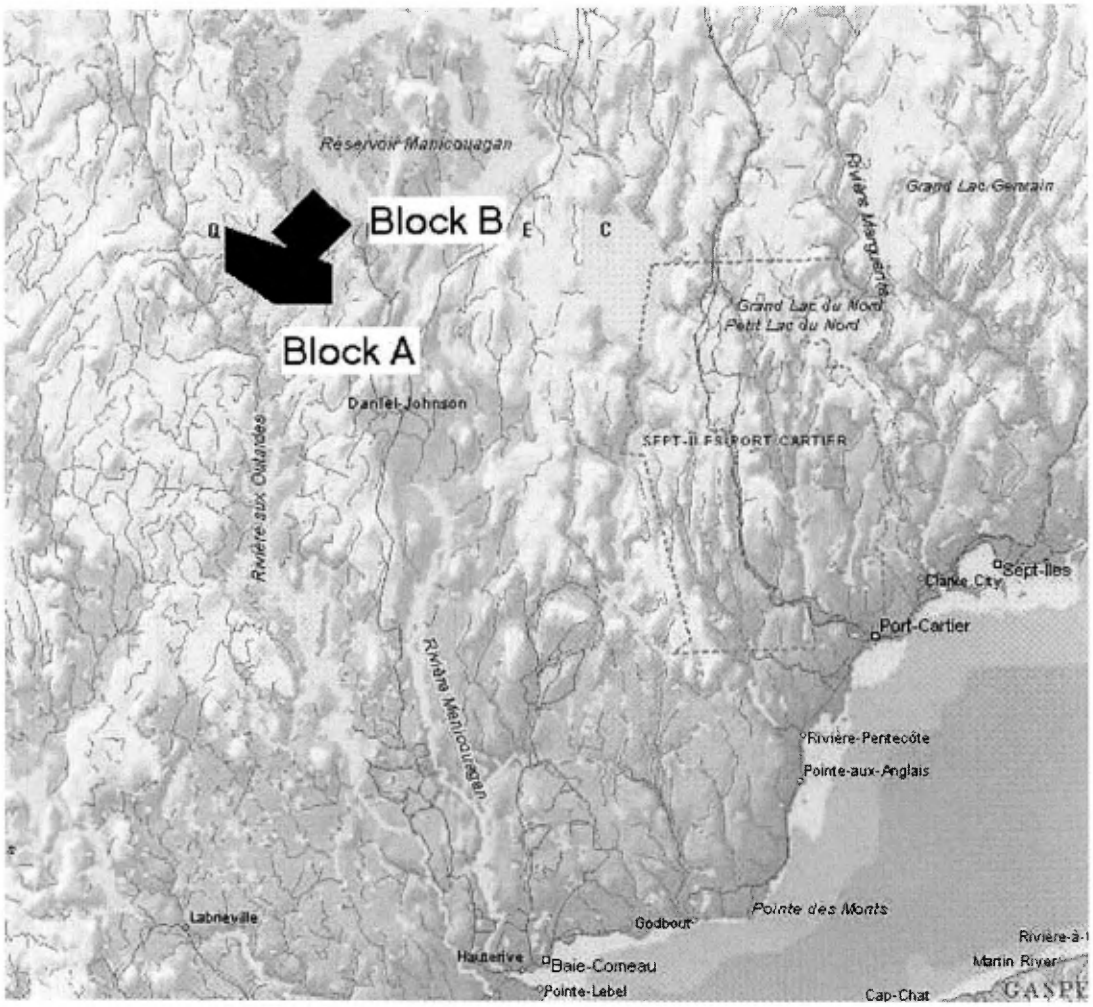
1. 498647 5649995
2. 498647 5641570
3. 483247 5641520
4. 471247 5650347
5. 471247 5659363

Block B

1. 503069 5664837
2. 491788 5652368
3. 482704 5659990
4. 493986 5672458

Topographic relief for the Block A is in the range of 393 metres to approximately 851 with the average of 577 metres, for the Block B – from 360 to 724 metres with the average of 533 m.

Figure 1 - LOCATION MAP



3. SURVEY SPECIFICATIONS AND PROCEDURES

The survey specifications are summarised in the following table:

AREA NAME	AREA KM^2	LINE SPACING	LINE KM	FLIGHT DIRECTION
Block A	307.2	200/3000m	1662.0	N-S
Block B	199.2	200/3000m	883.4	N50W
TOTALS:	**506.4**		**2545.4**	

Table 1 - Survey Blocks

Nominal EM sensor terrain clearance was 35 m (EM bird height above ground, i.e. helicopter is maintained 80 m above ground). Nominal survey speed was 70 km/hr. The data-recording rates of the data acquisition was 0.1 second for electromagnetics and magnetometer, 0.2 second for altimeter, 1 second for GPS. This translates to a geophysical reading about every 2 metres along flight track. Navigation was assisted by a GPS receiver and data acquisition system, which reports GPS co-ordinates as latitude/longitude and directs the pilot over a pre-programmed survey grid.

The operator was responsible for monitoring of the system integrity. He also maintained a detailed flight log during the survey noting the times of the flight as well as any unusual geophysical or topographic feature.

On return of the aircrew to the base camp the survey data was transferred from a compact flash card (PCMCIA) to the data processing computer.

4. AIRCRAFT AND EQUIPMENT

4.1 Aircraft

An Astar D helicopter - owned and operated by Canadian Helicopters was used for the survey. Installation of the geophysical and ancillary equipment was carried out by Geotech Inc. at the survey location in Manic V. The survey aircraft was flown at a nominal terrain clearance of 80 m.

4.2 Electromagnetic System

The electromagnetic system was a Geotech Scorpion Time Domain EM system. The receiver and transmitter coils were concentric and Z-direction oriented. The transmitter coil diameter was 18.5 metres, the number of turns was 5. The receiver coil diameter was 1.1 metre. The number of turns in the receiver coil was 30. The transmitter pulse repetition rate was 30 Hz. The peak current was 110 A. The duty cycle was 50%. The twenty-one measurement gates were used in the range from 205 ?s to 6330 ?s. The recording sampling rate was 10 samples per second. The EM bird was towed 45 m below the helicopter.

4.3. Airborne magnetometer

The magnetic sensor utilized for the survey was a Geometrics G-823A, optically pumped cesium vapor magnetic field sensor, mounted in a separate bird towed 15 m below the helicopter. The sensitivity of the magnetic sensor is 0.02 nanoTesla (nT) at a sampling interval of 0.1 seconds. The G-823A Magnetometer consists of a sensor head and sensor driver electronics with CM-201 counter joined by a cable. The magnetometer sends the measured magnetic field strength as nanoTeslas to the data acquisition system via the RS-232 port.

4.4 Ancillary Systems

Radar Altimeter

A Terra TRA 3000/TRI 40 radar altimeter was used to record terrain clearance. The antenna was mounted beneath the bubble of the helicopter cockpit.

GPS Navigation System

The navigation system used was a Geotech PC based navigation system utilizing an Ashtech GG24 navigation card, Geotech navigate software, a full screen display with controls in front of the pilot to direct the flight and an Ashtech GPS antenna mounted on the helicopter top assembly.
The co-ordinates of the blocks were set-up prior to the survey and the information was fed into the airborne navigation system.

Digital Acquisition System

A Geotech data acquisition system recorded the digital survey data on an internal compact flash card. Data is displayed on an LCD screen as traces to allow the operator to monitor the integrity of the system. Contents and update rates were as follows:

DATA TYPE	SAMPLING
TDEM	0.1 sec
Magnetometer	0.1 sec
GPS Position	1.0 sec
RadarAltimeter	0.2 sec

4.5 Base Station

A combine magnetometer/GPS base station was utilized on this project. A Scintrex CS-2 Cesium vapour magnetometer was used as a magnetic sensor with a sensitivity of 0.001 nT. The base station was recording the magnetic field together with the GPS time at 1 Hz on a base station computer. The base station magnetometer sensor was installed in the remote corner of Manic V away from electric transmission lines and moving ferrous objects such as motor vehicles. The magnetometer base station's data was backed-up to the data processing computer at the end of each survey day.

5. PERSONNEL

The following Geotech Ltd. personnel were involved in the project

Field		
	Geophysicists:	Petr Kuzmin
		Andrei Bagrianski
	System Engineer/Operator:	Pavel Tishin
Office		
	Data Processing/Reporting:	Andrei Bagrianski
		Petr Kuzmin

The survey pilot was employed directly by the helicopter operator – Canadian Helicopters. Overall management of the survey was carried out from the Aurora offices of Geotech Ltd. by Edward Morrison, President.

6. DELIVERABLES

The survey is described in a report, which is provided in two copies. The maps were produced at a scale of 1:20,000.

MAPS

The results of the survey are presented in a series of colour maps at a scale of 1:20,000. The EM Offset Profile Maps contain skeletal topographic features. The basic coordinate/projection system used is Universal Transverse Mercator, zone 19. For reference the NAD83(WGS84) latitude and longitude are also noted on the maps. All the maps show the flight path trace.

For each block the map products are as follows:

1. Offset TDEM Profile Map of the twenty one gate times (205 – 6330 ?s) on the GPS flight path, on paper in two copies
2. Total Field Magnetic contour map on the GPS flight path, on paper in two copies

DIGITAL DATA on CD-ROM

A CD-ROM was prepared to accompany the report. It contains a digital file of the line data in ASCII format for each block in addition to the maps in Geosoft format. A *readme.txt* file may be found on the CD-ROM which describes the contents in more detail.

7. DATA PROCESSING AND PRESENTATION

Skeletal base

The skeletal base seen on the maps was received from Soquem Inc. in a form of ACAD DXF files and was imported in Geosoft Oasis Montaj.

The basic geographic projection/coordinate system used to create all the maps is the Universal Transverse Mercator system (UTM), zone 19, WGS84 (NAD83).

Flight Path

The flight path, recorded by the acquisition program as WGS 84 latitude/longitude, was converted into the UTM co-ordinate system in Oasis Montaj.

The flight path was drawn using linear interpolation between x,y positions from the navigation system. Positions are updated every second and expressed as UTM eastings (x) and UTM northings (y).

Electromagnetic Data

A three stage digital filtering process was used to reject major sferic events and to reduce system noise. Local sferic activity can produce sharp, large amplitude events that cannot be removed by conventional filtering procedures. Smoothing or stacking will reduce their amplitude but leave a broader residual response that can be confused with geological phenomena. To avoid this possibility, a computer algorithm searches out and rejects the major sferic events. The filter used was a 16 point non-linear filter.

The signal to noise ratio was further improved by the application of a low pass linear digital filter. This filter has zero phase shift which prevents any lag or peak displacement from occurring, and it suppresses only variations with a wavelength less than about 1 second or 20 metres. This filter is a symmetrical 1 sec linear filter.

Following the filtering process, a base level correction was done using 200 sec non-linear filter, which is applicable due to the small width of anomalies. The primary voltage data was normalized to the one square metre coil areas and one-ampere transmitter current. The result was corrected to the rectangular transmitter current pulse shape.

The results are presented as stacked profiles of EM voltages for the gate times.
Most of the EM data is a good quality though the noise level was higher then usually. Some occasional noise increase on some lines might have been due to the radio transitions from the local radio station.

Magnetic Data

The processing of the magnetic data involved the correction for diurnal variations by using the digitally recorded ground base station magnetic values and the adjustment using the flight-line and tie-line information to level the survey data set. The base station magnetometer data was edited and merged into the Geosoft GDB database on a daily basis. The aeromagnetic data was corrected for diurnal variations by subtracting the observed magnetic base station deviations. The corrected magnetic line data from the survey was interpolated between survey lines using a random point gridding method to yield x-y grid values for a standard grid cell size of approximately 0.25 cm at the mapping scale. The Minimum Curvature algorithm was used to interpolate values onto a rectangular regular spaced grid.

8. RESULTS

Block A

The TDEM survey over the Block A yielded a number of anomaly groups many of them are well correlated with the magnetic features. The survey block appears to be divided in two different magnetic domains on the southern and on the northern sides. In the southern part of the block the predominant trend well defined by a high magnetic zone is NW-SE on the west, turning NEE-SWW on the east. The northern sector shows a medium-low and fairly homogeneous magnetic response. The first group of EM anomalies starts at the west side of the block and trends NWW-SEE along the magnetic high, changing the direction to E-W and in the eastern part of the block to SWW-NEE. The EM responses of this group of anomalies are increasing from weak on the west to moderate-strong on the east. Along the northern border of the block there are five-six groups of EM anomalies associated with the moderate high in the magnetic field. All these anomalies have the EM response from moderate to high and probably reflect similar geological structures. An interesting group of EM anomalies is located in the eastern part of the block with the centre approximately at 492877E, 5646012N. This group has a round shape with the diameter of approximately 1600 metres and associated with the magnetic low.

Block B

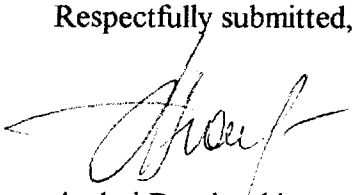
The magnetic map of the block is dominated by a number of very strong magnetic anomalies with the amplitude up to 26 000 nT located in the middle part of the block. The strongest magnetic response exceeding 82000 nT observed on the line 3360. Such strong anomalies are most probably caused by a high content of magnetite in the rocks. The TDEM survey discovered a number of groups of strong anomalies with the predominant SE-NW trend. Most of the anomaly groups are associated with the moderate-to-strong magnetic responses; but the picks of the strongest magnetic anomalies have no EM response.

9. CONCLUSIONS

A time domain electromagnetic helicopter-borne geophysical survey has been completed over Blocks A and B south-west of Reservoir Manicouagan in Quebec. Areal coverage amounts to 506.4 km^2. Total survey line coverage is 2,545.4 line kilometres. Sensors included a Time Domain EM system and a magnetometer. Results have been presented as colour line maps at a scale of 1:20,000.

A number of EM anomaly groupings were identified. Ground follow-up of the EM anomalies should be carried out if favourably supported by other geoscientific data.

Respectfully submitted,



Andrei Bagrianski,
Geotech Ltd.

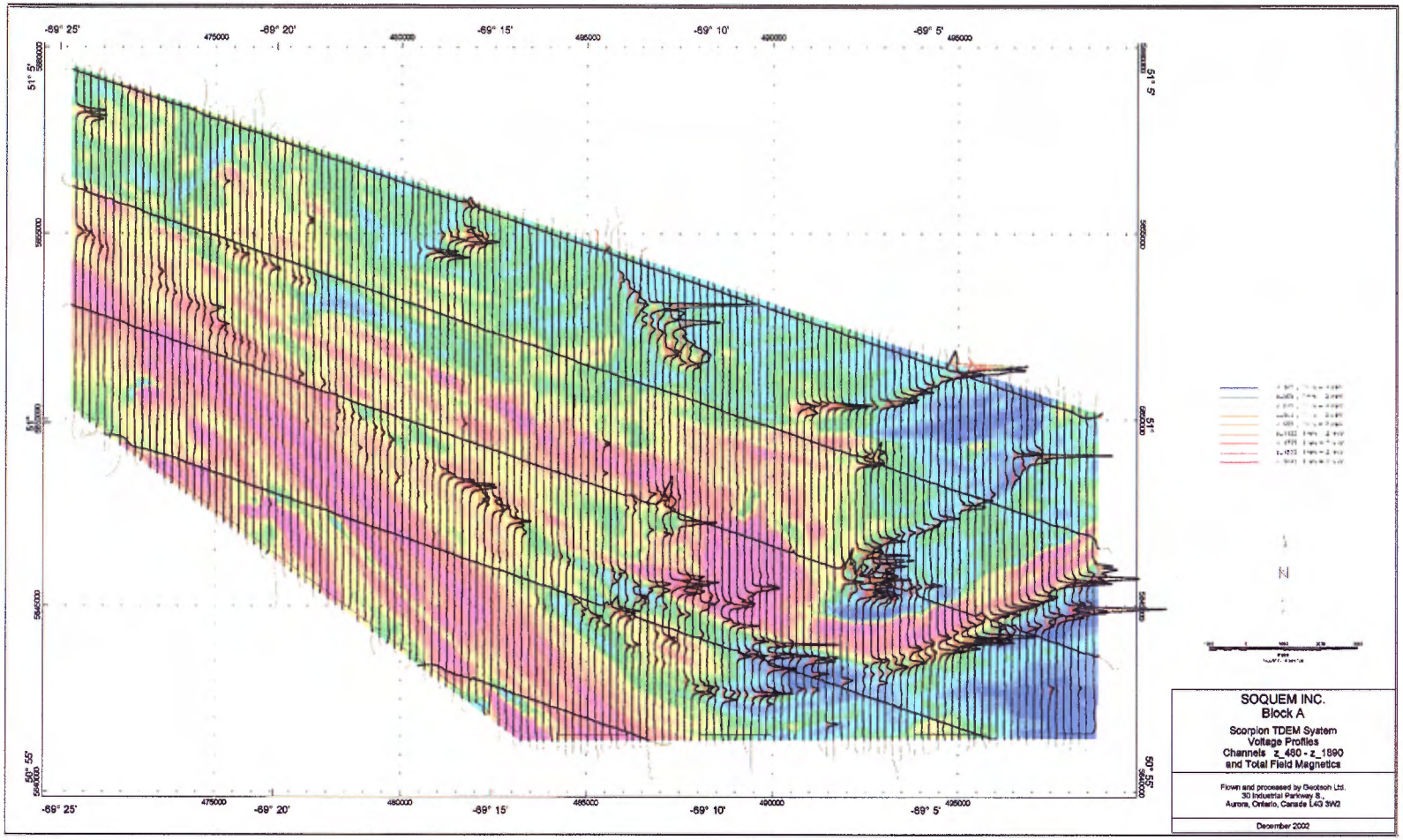


Figure 2 – Block A, Voltage Profiles and Total Field Magnetics Map

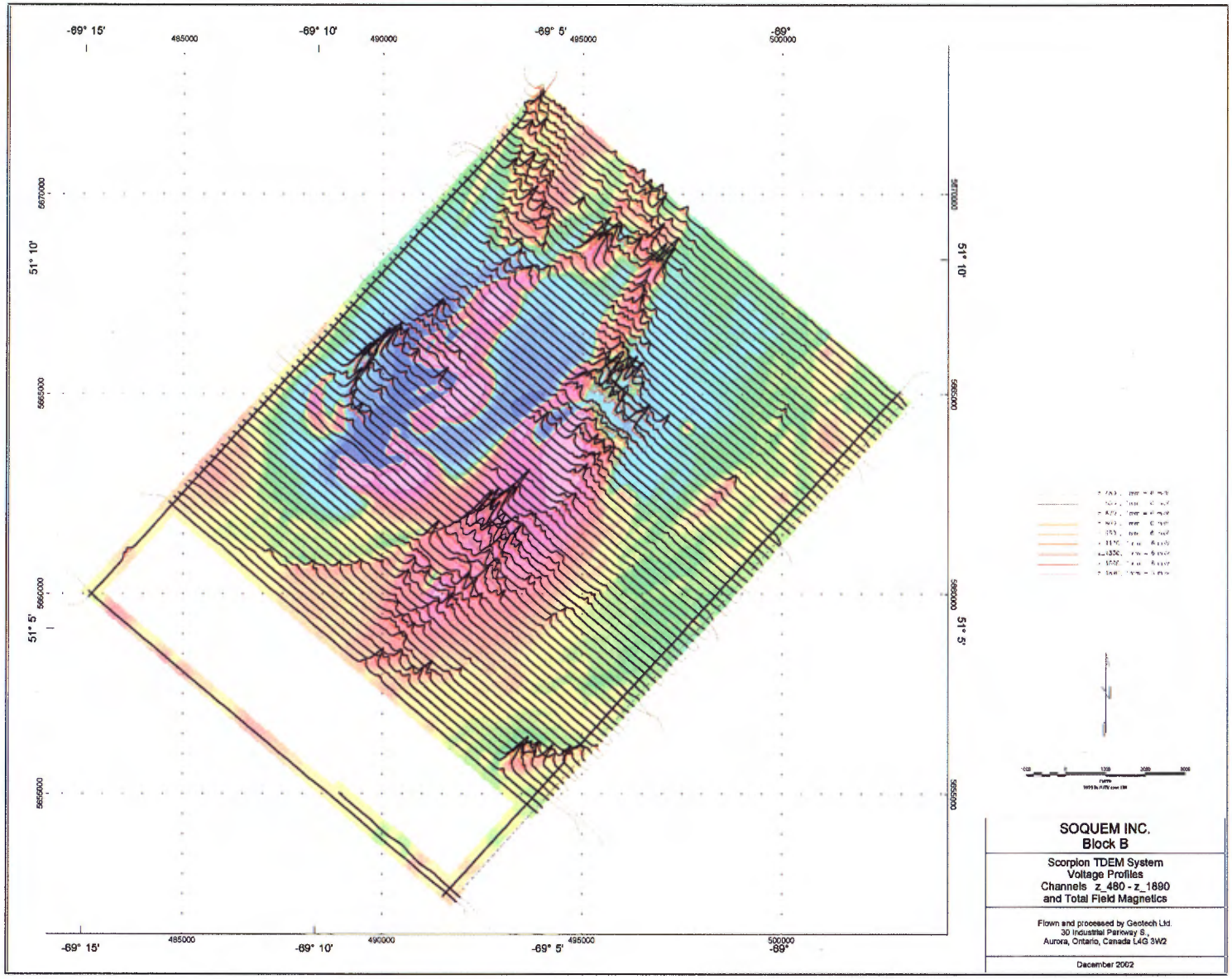


Figure 3 – Block B, Voltage Profiles and Total Field Magnetics Map