

GM 55013

DIGHEM MAGNETIC/RADIOMETRIC SURVEY, VAL D'OR AREA

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Québec 

Ministère de l'Énergie et des Ressources

Programme « Prospection et exploration minière »

de l'Entente auxiliaire Canada-Québec

Volet 3B

Rapport de prospection

Pour : PLACER DOME CANADA

Projet : AEROPORTÉ

94-3B 602

SNRC : 32 C/04

Canton : VASSAN / DUBOISSON / MALARTIC

MRN - GÉOINFORMATION	1997
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Date : SEPT 94

Report #1171

DIGHEM MAGNETIC/
RADIOMETRIC SURVEY
FOR
PLACER DOME CANADA LIMITED
VAL D'OR AREA, QUEBEC

94-33-602

NTS 32C/3,4; 32D/1,8

MRN - GÉOINFORMATION

1997

GM 55013

DigheM, A division of CGG Canada Ltd.
Mississauga, Ontario
September 2, 1994

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SUMMARY

This report describes the logistics and results of a Dighem airborne geophysical survey carried out for Placer Dome Canada Limited, over a property located near Val d'Or, Quebec. Total coverage of the survey block amounted to 10,635 km. The survey was flown from June 21 to July 6, 1994.

The purpose of the survey was to detect anomalous magnetic and radiometric zones, and to provide information that could be used to map the geology and structure of the survey area. This was accomplished by using a high sensitivity Cesium magnetometer and a 256-channel spectrometer. The information from these sensors was processed to produce maps which display the magnetic and radiometric properties of the survey area. A GPS electronic navigation system, utilizing a UHF 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.

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.

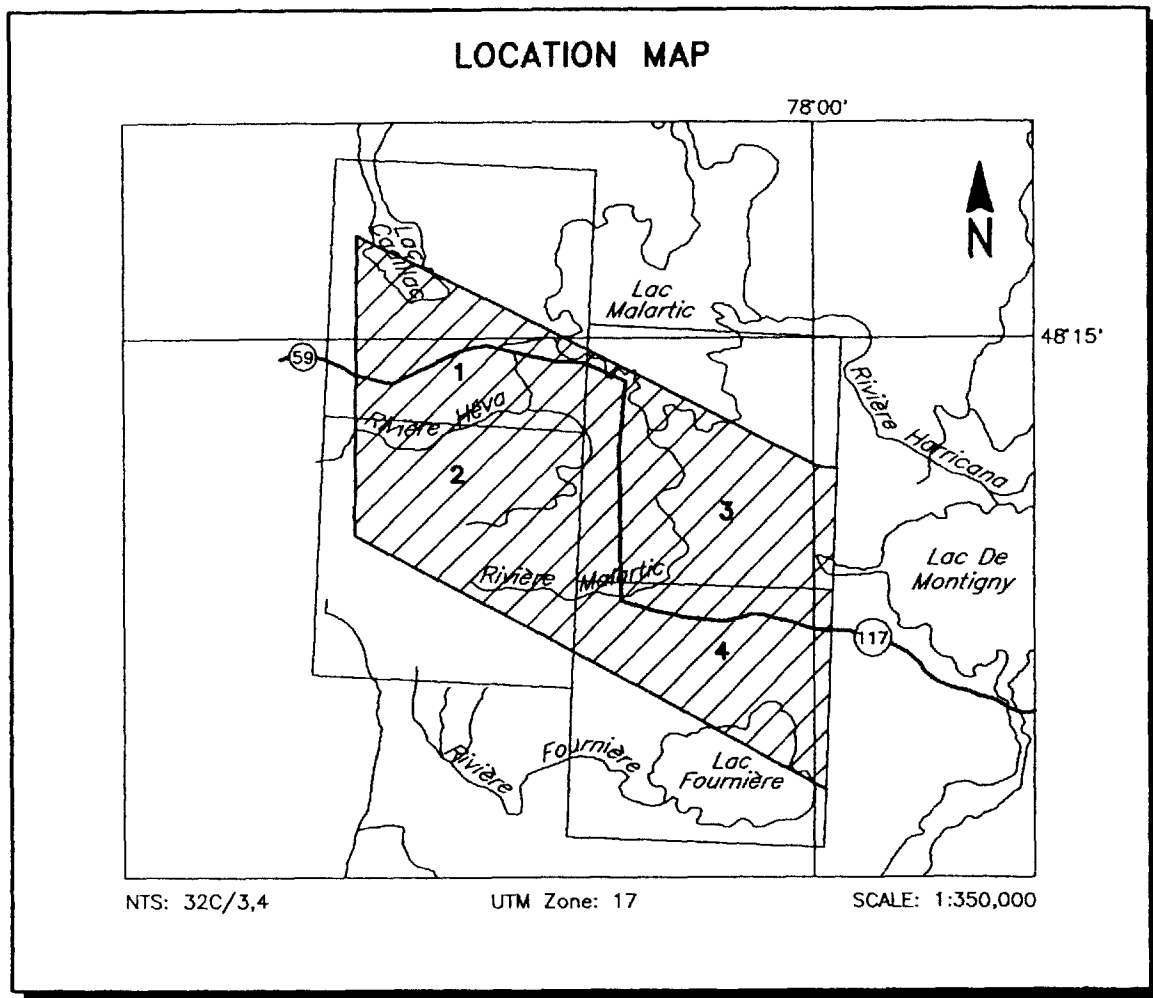


FIGURE 1
 PLACER DOME CANADA LIMITED
 VAL D'OR AREA, QUEBEC - 1171

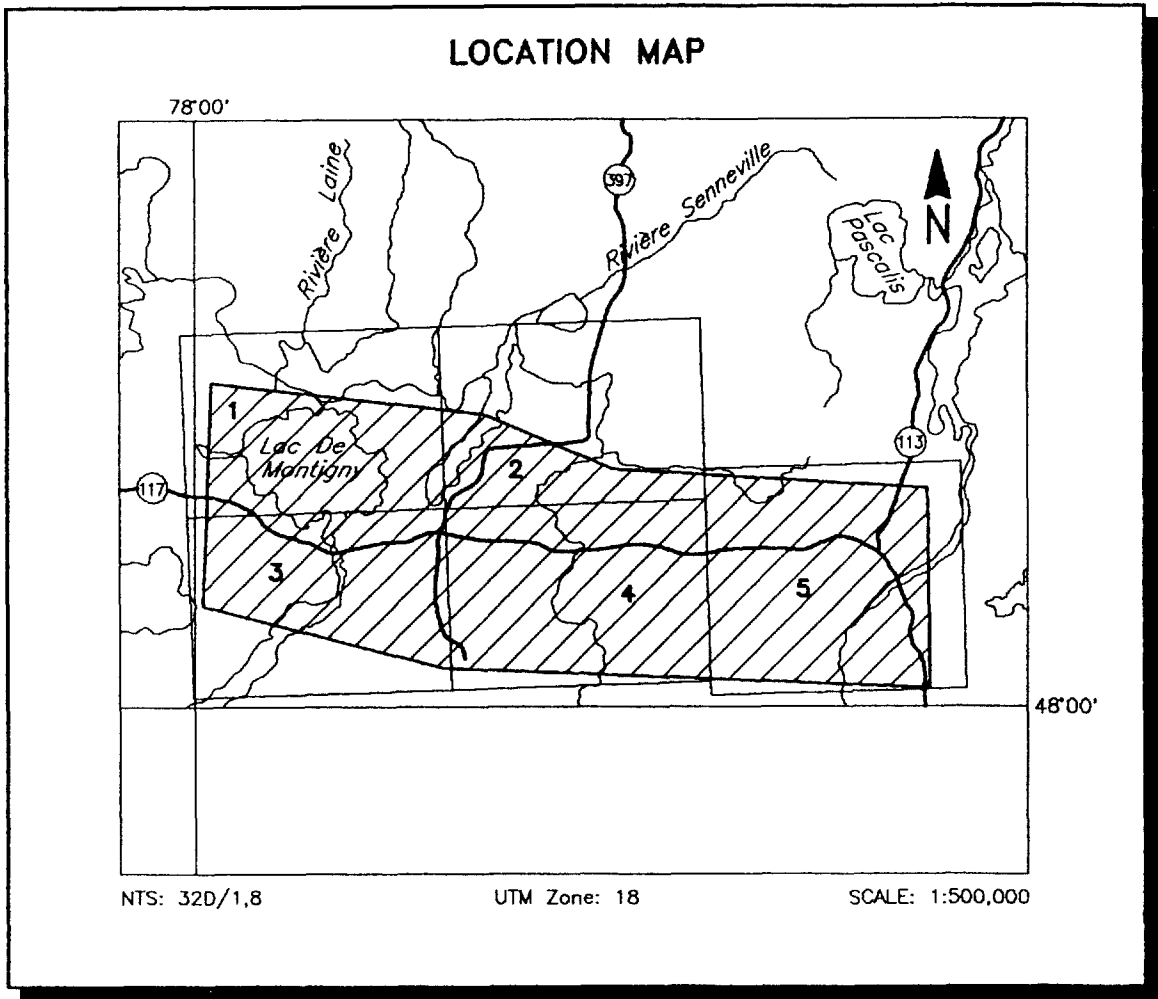


FIGURE 2
PLACER DOME CANADA LIMITED
VAL D'OR AREA, QUEBEC - 1171

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INTRODUCTION

A Dighem magnetic/radiometric survey was flown for Placer Dome Canada Limited from June 21 to July 6, 1994, over a survey block located near Val d'Or, Quebec. The survey area can be located on NTS map sheets 32C/3,4 and 32D/1,8 (see Figures 1 and 2).

Survey coverage consisted of approximately 10,635 line-km, including tie lines. Flight lines were flown in an azimuthal direction of $0^{\circ}/180^{\circ}$ with a line separation of 100 metres.

The survey equipment consisted of a magnetometer, radar altimeter, video camera, analog and digital recorders, a 256-channel spectrometer and an electronic navigation system. The instrumentation was installed in an Aerospatiale AS350D turbine helicopter (Registration C-FPHN) which was provided by Questral Helicopters Ltd. Lac de Montigny was flown, for safety reasons, with an AS355F1 twinstar helicopter (C-FUHF) which was provided by Heli-fortex Inc. This block was flown at the end of the job, flights 50 through 54 inclusive. The helicopters flew at an average airspeed of 130 km/h with a magnetometer bird height of approximately 45 m.

Section 2 provides details on the survey equipment, the data channels, their respective sensitivities, and the navigation/flight path recovery procedure. Section 3 gives a brief summary of the processing procedures and the delivered products.

SURVEY EQUIPMENT

This section provides a brief description of the geophysical instruments used to acquire the survey data:

Magnetometer

Model: Picodas 3340
Type: Optically pumped Cesium vapour
Sensitivity: 0.01 nT
Sample rate: 10 per second

The magnetometer sensor is towed in a bird 20 m below the helicopter.

Magnetic Base Station

Model: Scintrex MP-3
Type: Digital recording proton precession
Sensitivity: 0.10 nT
Sample rate: 0.2 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

Type: AA 220

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.

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.

Digital Data Acquisition System

Manufacturer: RMS Instruments
Model: DGR 33
Recorder: RMS TCR-12, 6400 bpi, tape cartridge recorder

Tracking Camera

Type: Panasonic Video
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.

Table 2-1. The Analog Profiles

Channel Name	Parameter	Scale units/mm
CMGC	magnetics, coarse	20 nT
CMGF	magnetics, fine	2.0 nT
TC	total count	200 cps
K	potassium count	20 cps
U	uranium count	20 cps
TH	thorium count	20 cps
ALTR	radar altimeter	3 m

Navigation System (RT-DGPS)

Model:	Sercel NR106, Real-time differential positioning
Type:	SPS (L1 band), 10-channel, C/A code, 1575.42 MHz.
Sensitivity:	-132 dBm, 0.5 second update
Accuracy:	< 5 metres in differential mode, ± 50 metres in S/A (non differential) mode

The Global Positioning System (GPS) is a line of sight, satellite navigation system which utilizes time-coded signals from at least four of the twenty-four NAVSTAR satellites. In the differential mode, two GPS receivers are used. The base station unit is used as a reference which transmits real-time corrections to the mobile unit in the aircraft, via a UHF radio datalink. The on-board system calculates the flight path of the helicopter while providing real-time guidance. The raw XYZ data are recorded for both receivers, thereby permitting post-survey processing for accuracies of approximately 5 metres.

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. 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 coordinates to the system displayed on the base maps.

Field Workstation

Manufacturer: Dighem
Model: FWS: V2.65
Type: 80486 based P.C.

A portable PC-based field workstation is used at the survey base to verify data quality and completeness. Flight tapes are dumped to a hard drive to permit the creation of a database. This process allows the field operators to display both the positional (flight path) and geophysical data on a screen or printer.

Spectrometer

Manufacturer: Exploranium
Model: GR-820
Type: 256 Multichannel, Potassium stabilized
Accuracy: 1 count/sec.
Update: 1 integrated sample/sec.

The GR-820 Airborne Spectrometer employs four downward looking crystals (1024 cu. in.) and one upward looking crystal (256 cu. in.). The downward crystal records the radiometric spectrum from 410 KeV to 3 MeV over 256 discrete energy windows, as well

as a cosmic ray channel which detects photons with energy levels above 3.0 MeV. From these 256 channels, the standard Total Count, Potassium, Uranium and Thorium channels are extracted. The upward crystal is used to measure and correct for Radon.

The shock-protected Sodium Iodide (Thallium) crystal package is unheated, and is automatically stabilized with respect to the Potassium peak. The GR-820 provides raw or Compton stripped data which has been automatically corrected for gain, base level, ADC offset and dead time.

PRODUCTS AND PROCESSING TECHNIQUES

The following products are available from the survey data. Those which are not part of the survey contract may be acquired later. Refer to Table 3-1 for a summary of the delivered products, some of which may be sent under separate cover. Most parameters can be displayed as contours, profiles, or in colour.

Base Maps

Base maps of the survey area have been produced from published topographic maps. These provide a relatively accurate, distortion-free base which facilitates correlation of the navigation data to the UTM grid. Photomosaics are useful for visual reference and for subsequent flight path recovery, but usually contain scale distortions. Orthophotos are ideal, but their cost and the time required to produce them, usually precludes their use as base maps. The survey results are presented on nine separate map sheets for each parameter at a scale of 1:20,000. Because the survey block spanned two UTM zones, 17 and 18, four sheets display UTM coordinates from the west zone, and five display those of the east zone. The final gridded data will honour the UTM coordinate system of the eastern block.

Table 3-1 Survey Products

1. Preliminary Products

Total field magnetic and total count grids

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

Total field magnetic contours

Calculated vertical magnetic gradient contours

Total count contours

Potassium count contours

Uranium count contours

Thorium count contours

K/Th ratio contours

K/U ratio contours

3. Colour Maps (4 sets) @ 1:20,000

Total field magnetics

Calculated vertical magnetic gradient

Total count

Potassium count

Uranium count

Thorium count

K/Th ratio

K/U ratio

Shadowed total field magnetic maps at a scale of 1:50,000

4. Additional Products

Digital XYZ archive in Geosoft format (CD-ROM)

Digital grid archives in Geosoft format (CD-ROM)

Survey report (4 copies)

Analog chart records

Flight path video cassettes

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

Magnetics

A Scintrex MP-3 proton precession 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 background magnetic level has been adjusted to match the International Geomagnetic Reference Field (IGRF) for the survey area. The IGRF gradient across the survey block is left intact.

The total field magnetic data have been presented as contours on the base maps using a contour interval of 10 nT where gradients permit. The maps show the magnetic properties of the rock units underlying the survey area.

The total field magnetic data have been subjected to a processing algorithm to produce first vertical magnetic gradient maps. 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. Maps of the second vertical magnetic derivative can also be prepared from existing survey data, if requested.

Radiometrics

The data from the GR-820 spectrometer are processed to yield contour maps of the Total Count, and counts per second for each of the Potassium, Uranium and Thorium windows. Maps have also been produced for the K/Th and K/U ratios. Appropriate calibrations and corrections are applied to eliminate all sources of drift, including variations in temperature and moisture content. The 1024 cu.in. downward-looking crystals, and the 256 cu.in. upward-looking crystals are automatically stabilized. The GR-820 provides data which has been corrected for gain, base level changes, ADC offset, dead time, cosmic background, altitude attenuation and Compton scatter.

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.

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.

Monochromatic shadow maps 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 may be applied to total field or enhanced magnetic data, magnetic derivatives, etc. The shadow of the enhanced magnetic parameter is particularly suited for defining geological structures with crisper images and improved resolution.

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 Placer Dome Canada Limited, near Val d'Or, Quebec.

Steve Kilty	Vice President, Operations
Greg Paleolog	Survey Operations Supervisor
Steve Haney	Senior Geophysical Operator
David Trivett	Second Operator/Field Dataman
Bill Hofstede	Pilot (Questral Helicopters Ltd.)
Ted Hay	Pilot (Questral Helicopters Ltd.)
C. Chauvette	Pilot (Heli-fortex Inc.)
Gordon Smith	Data Processing Supervisor
Jonathan Rudd	Computer Processor
Ruth Pritchard	Interpretation Geophysicist
Lyn Vanderstarren	Drafting Supervisor
Mike Armstrong	Draftsperson (CAD)
Susan Pothiah	Word Processing Operator
Albina Tonello	Secretary/Expeditior

The survey consisted of 10,635 km of coverage, flown from June 21 to July 6, 1994.

All personnel are employees of Dighem, except for the pilots who are employees of Questral Helicopters Ltd. and Heli-fortex Inc.

DIGHEM



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APPENDIX B
STATEMENT OF COST

Date: September 2, 1994

IN ACCOUNT WITH DIGHEM

To: Dighem flying of Agreement dated March 21, 1994, pertaining to an Airborne Geophysical Survey in the Val d'Or area, Quebec.

Survey Charges

10,200 km of flying @ \$23.50/km	\$ 239,700.00
Plus radiometric survey charges of 10,200 km @ \$4.35/km	\$ 44,370.00
Plus additional costs incurred for charter of AS355F1 twin engine helicopter for survey flying over Lac de Montigny	\$ <u>2,518.50</u>
	<u>\$ 286,588.50</u>

Allocation of Costs

- Data Acquisition	(60%)
- Data Processing	(20%)
- Interpretation, Report and Maps	(20%)

DIGHEM



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