# ARIS SUMMARY SHEET

District Geologist, Kamloops | Off Confidential: 90.06.13

ASSESSMENT REPORT 18835 | MINING DIVISION: Clinton

PROPERTY: Midas
LOCATION: LAT 51 22 00 LONG 122 29 00
UTM 10 5690509 535968
NTS 092O07E 092O08W

CAMP: 035 Taseko - Blackdome Area

CLAIM(S): Midas,Midas 4.,Kado Fr.,Loki,Loki 2,Snowflake,B.Bob I-III
Oyster 1-2,A.J. Fr.,L.A. Fr.
OPERATOR(S): Blackdome Min.
AUTHOR(S): Peatfield,G.R.;Vaughan, C.J.
REPORT YEAR: 1989, 81 Pages
COMMODITIES
SEARCHED FOR: Gold,Silver
KEYWORDS: Eocene,Miocene,Rhyolites,Basalts,Andesites,Quartz Veins,Chalcedony
WORK
DONE: Geophysical
EMAB 150.0 km
Map(s) - 3; Scale(s) - 1:10 000
MAGA 150.0 km
Map(s) - 2; Scale(s) - 1:10 000
RELATED
REPORTS: 11615,12862

**AIRBORNE GEOPHYSICAL SURVEY**

**on the**

**MIDAS PROPERTY**

Clinton Mining Division

N.T.S. 92O/7E, 8W

centered at

Latitude 51° 22'N

Longitude 122° 29'W

UTM 536000E, 5690000N

by

G.R. Peatfield, Ph.D., P.Eng

&

C.J. Vaughan, B.Sc.

for

Blackdome Mining Corporation



Vancouver, B.C. June, 1989

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# 1.0 INTRODUCTION

## 1.1 Location, Access and Terrain

The MIDAS property is located to the north of Black Dome Mountain, some 70 kilometres west-northwest of Clinton (see Figure 1). Access is by good gravel road leaving Highway 97 at 58 Mile, about 15 kilometres north of Clinton. This road proceeds northwestward through the Canoe Creek Indian Reserve to the suspension bridge over the Fraser River south of Dog Creek, and thence south to Brown Lake, where a well marked road turns off to the Blackdome Mine, about 25 kilometres by road southwest of Brown Lake. From the Blackdome Mine road, a rough secondary road traverses the northwest portion of the MIDAS property (see Figure 2). The nearest commercial centres are Clinton and Williams Lake, but Blackdome Mining Corporation has an operating mine and mill with full camp facilities on its wholly-owned mining leases immediately south of the MIDAS property. This camp served as the base for the airborne geophysical survey.

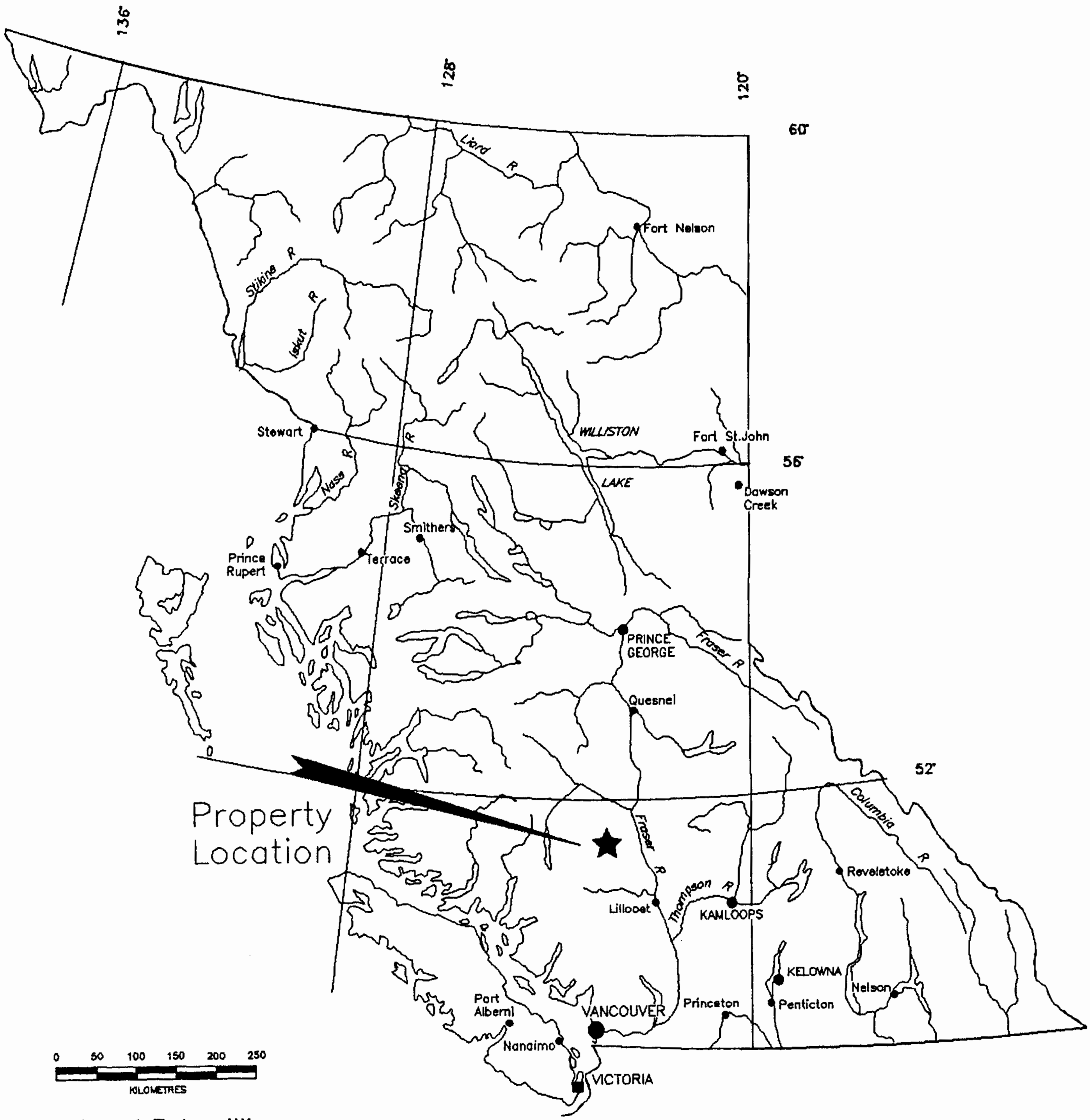
The terrain on the property is for the most part moderate, with total relief of the order of 425 metres. Elevations range from about 1980 metres at the top of the hills on the south boundary of the MIDAS claim to 1555 metres on Porcupine Creek to the southeast. Forest cover is open, mostly lodgepole pine with local whitebark pine, spruce, and willows along creeks. Some hills have open grasslands. There are numerous watercourses on the claims, some of which flow year-round. None of the ground has been logged.

Climatic conditions are typical of the high parts of the southern Chilcotin region of Central British Columbia. Summers are warm and generally dry; winters are cold but snowfall is moderate to slight.

## 1.2 Property Definition and History

The core claim of the property (MIDAS) was located in August 1979, with several other claims since lapsed, by Mr. C.E. Gunn. The Kado Fr. was staked by Mr. Gunn later in 1979 to fill a gap between the Blackdome property to the southwest and other (since lapsed) claims. The Midas #4 claim was added in August 1981. The claims were apparently staked as "tie-on" to the Blackdome property. In 1988, several claims were staked by Blackdome adjacent to MIDAS and surrounding claims (see Figure 2, and Section 1.3 below).

During the period 1980 to 1984, various programmes of soil geochemistry, geological mapping, ground geophysics, and a small amount of trenching were completed on the claims (see Drummond, 1983; Durfeld, 1984a&b; Drummond, <u>et al.</u>, 1988).

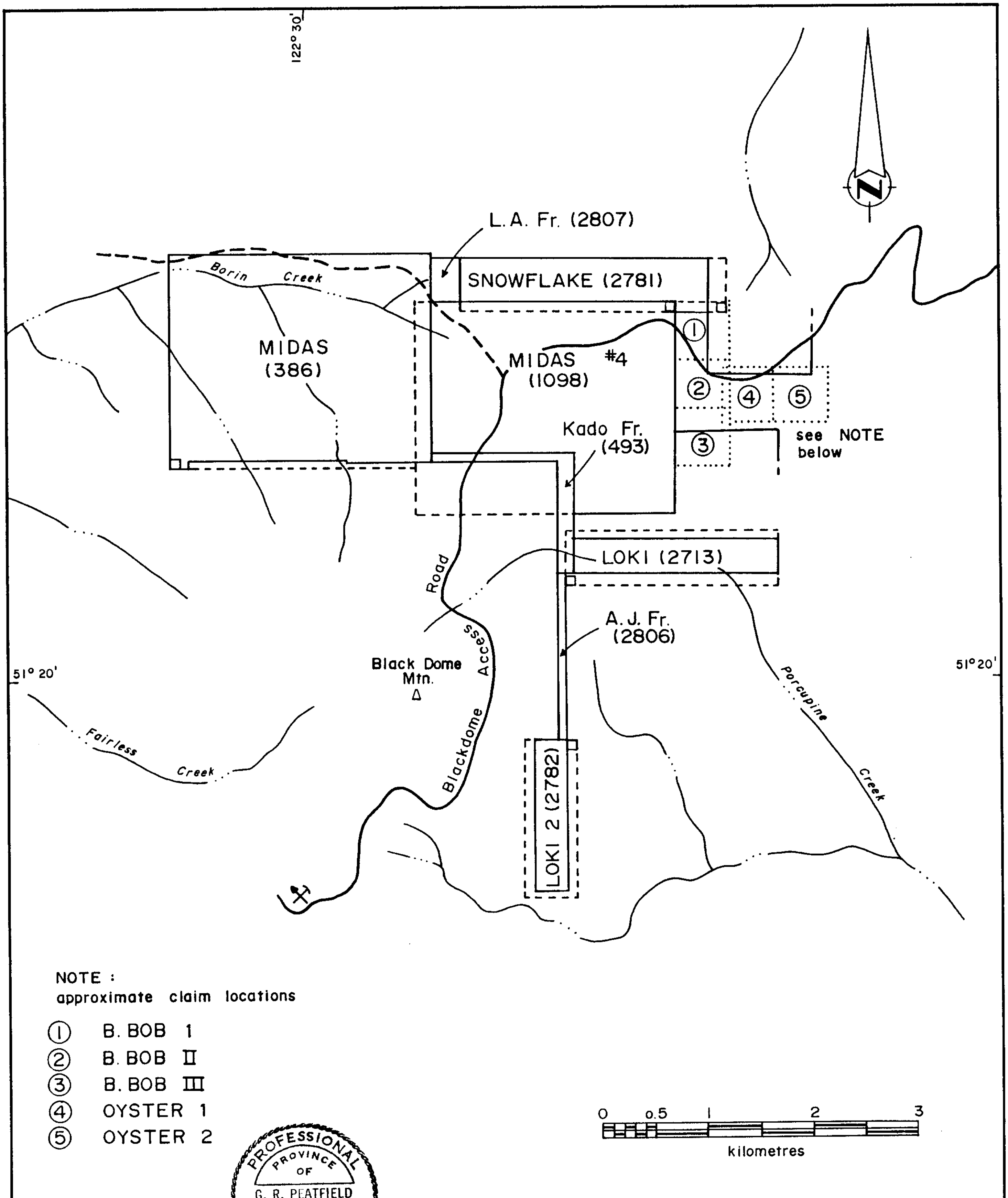



Scale 1:7.4 million

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
G. R. PEATFIELD

G.R. Peatfield
12 June '89

| BLACKDOME MINING CORPORATION | | |
|---|---|---|
| MIDAS PROPERTY<br>CLINTON M.D., B.C. | | |
| GENERAL LOCATION MAP | | |
| Date Feb. 1989 | N.T.S. 92 O/7E, 8W | Scale see above |
| G.R. Peatfield Ph.D.,P.Eng. | | Figure 1 |




| | | |
|---|---|---|
| BLACKDOME MINING CORPORATION | | |
| MIDAS PROPERTY<br>CLINTON M.D., B.C. | | |
| PROPERTY MAP | | |
| Date FEB. 1989 | NTS 92-0/7E, 8W | Scale 1:50 000 |
| G.R. Peatfield Ph.D., P. Eng. | | Figure 2 |

In 1988, the property was optioned to Blackdome Mining Corporation, who completed a soil geochemical programme as described by Peatfield (1989), and an airborne geophysical survey over this and adjacent ground, a portion of which survey is detailed in this report.

### 1.3 Claim Status

The MIDAS property consists of two contiguous aggregates of claims which have been grouped together for convenience of filing work for assessment credit.

The core block, or MIDAS property proper, consists of two contiguous MGS mineral claims and one fractional claim totalling 41 claim units covering about 950 hectares allowing for overlap (see Figure 2). These claims, registered in the name of Blackdome Mining Corporation, and held option from Clifford E. Gunn, David A. Howard and A. Darryl Drummond, are listed below:

| Claim Name | Record Number | No. of Units | Record Date | Expiry Year* |
|---|---|---|---|---|
| MIDAS | 386 | 20 | 23 Aug 79 | 1997 |
| Kado Fr. | 493 | 1 | 10 Oct 79 | 1997 |
| Midas #4 | 1098 | 20 | 09 Sep 81 | 1996 |

* expiry year after filing the work to which this report refers.

In addition, the MIDAS property for the purposes of this report includes a total of 10 MGS, MGS fractional and 2-post mineral claims owned 100% by Blackdome Mining Corporation. The claims in question, covering some 400 hectares allowing for overlap (see Figure 2), are listed below:

| Claim Name | Record Number | No. of Units | Record Date | Expiry Year* |
|---|---|---|---|---|
| LOKI | 2713 | 4 | 09 Oct 88 | 1993 |
| SNOWFLAKE | 2781 | 5 | 18 Oct 88 | 1993 |
| LOKI 2 | 2782 | 3 | 24 Oct 88 | 1993 |
| B.BOB I | 2801 | 1** | 02 Nov 88 | 1993 |
| B.BOB II | 2802 | 1** | 02 Nov 88 | 1993 |
| B.BOB III | 2803 | 1** | 02 Nov 88 | 1993 |
| OYSTER 1 | 2804 | 1** | 04 Nov 88 | 1993 |
| OYSTER 2 | 2805 | 1** | 04 Nov 88 | 1993 |
| A.J. Fr. | 2806 | 1 | 01 Nov 88 | 1993 |
| L.A. Fr. | 2806 | 1 | 02 Nov 88 | 1993 |

* expiry year after filing the work to which this report refers.

** 2-post claims.

### 1.4 Summary of Work Done, 1988

During October 1988, an airborne geophysical survey was completed covering the MIDAS property and surrounding claims owned or held under option by Blackdome. This survey is comprehensively described in the appended report by C.J. Vaughan of CGI Controlled Geophysics Inc. Data collected included total magnetic field intensity, three electromagnetic frequencies from coplanar coil pairs, one electromagnetic frequency from a coaxial coil pair, and VLF-EM.

Data presented with this report include maps showing flight line positions, contoured total field magnetics, contoured resistivities at two frequencies, and a map showing anomaly trends. Other data are available from Blackdome Mining Corporation. Only those portions of the total survey which cover the MIDAS property are shown on the maps included with this report, and Mr. Vaughan's report has been abstracted as appropriate.

## 2.0 GEOLOGY

### 2.1 Regional Geology

The MIDAS property, with the Blackdome Mine and several other claim blocks, lies within a region mapped by Tipper (1978) as underlain principally by Eocene acid to intermediate flows and pyroclastic rocks overlain by Miocene sediments and olivine basalt flows. Units of the upper Cretaceous Kingsvale Group lavas and clastic rocks and some older strata, are exposed locally. Numerous faults, dominantly west-northwest and northeast but with other directions represented, dissect the region, which lies between the west-northwesterly trending Chilcotin and Yalakom-Taseko fault systems, and west of the northerly trending Frazer Fault. These major faults have large right-lateral strike-slip movements; the area between has been subjected to considerable block faulting, probably since at least Cretaceous time.

### 2.2 Claim Group Geology

The geology of the MIDAS property and surrounding claims, including the Blackdome property to the south, has been described in numerous published and unpublished papers and reports. For the Blackdome property, good summaries are available in Church (1980, 1981, 1987), Faulkner (1986) and Schroeter (1987). For the CHURN CREEK property to the north and west, see McAllister and McPherson (1987) and, for a comprehensive list of references, Peatfield (1988). Reports on the geology of the MIDAS property, specifically of the core claims, are contained in Drummond (1983), Kerr (1983), Durfeld (1984a&b) and Drummond, et al. (1988).

Broadly speaking, the MIDAS property is underlain by a sequence of Eocene to Oligocene volcanic rocks, ranging from rhyolite to basalt, locally overlain by outliers of fresher Miocene plateau basalt. Some minor amounts of sedimentary and pryroclastic rocks are present within the flow units. Local areas of alteration and silica veining have been noted. For details of rock types, etc. the reader is referred to the reports listed above, especially Drummond (1983) and Drummond, et al. (1988)

### 2.3 Mineralization

No significant precious metal mineralization has yet been found in place on the MIDAS property. A few scattered boulders of vein quartz resembling that found at Blackdome have been found on the claims; some are anomalous in precious metals. It is not, however, clear that this obviously transported float was in fact transported from the mine area. A few zones of alteration and weak quartz veining have been found in place on the MIDAS property, and on some cases this material is weakly anomalous in precious metals (Drummond, 1983). Work to date has been by no means exhaustive.

## 3.0 AIRBORNE GEOPHYSICAL SURVEY

The design, methodology and results of the airborne geophysical survey, which was intended to test the MIDAS property for continuations of the Blackdome veins or for similar structures, are described in the comprehensive geophysical report by C.J. Vaughan, B.Sc. which is included as Appendix I to this report.

Figure 3 is a flight line map for the MIDAS property and adjacent claims to the south and west. Figures 4 to 6 inclusive are maps showing survey results (total field magnetics and two frequencies of resistivity), and Figure 8 is a summary map showing "anomaly trends". These latter maps have been abstracted from the overall maps so that they show only those results applicable to the MIDAS property.

## 4.0 GENERAL CONCLUSIONS

The airborne geophysical survey was moderately successful in outlining several geophysical trends, mostly parallel to known Blackdome structures, across the MIDAS property. These anomaly trends can only be evaluated by a combination of ground geophysics, possibly some detailed geochemistry, backhoe trenching, and diamond drilling if warranted.

## 5.0 RECOMMENDATIONS

The various geophysical trends outlined on the MIDAS property should be subjected to a programme of ground geophysics, soil geochemistry if ground conditions are appropriate, and backhoe trenching. Linear zones of alteration and silicification, if anomalous in precious metals or indicator elements, should be tested by diamond drilling.

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
G. R. PEATFIELD

G.R. Peatfield 12 June '89

G.R. Peatfield, P.Eng.

## 7.0 BIBLIOGRAPHY

CHURCH, B.N. 1980. Exploration for Gold in the Black Dome Mountain Area (920/7E, 8W. British Columbia Ministry of Energy, Mines and Petroleum Resources ("BCMEMPR"). Geological Fieldwork 1979. Paper 1980-1, pp. 52-54.

CHURCH, B.N. 1982. The Black Dome Mountain Gold-Silver Prospect (920/7E,8W). BCMEMPR. Geological Fieldwork 1981. Paper 1982-1, pp. 106-108.

CHURCH, B.N. 1987. Blackdome. BCMEMPR. Exploration in British Columbia 1986, pp. B40-B49.

DRUMMOND, A.D. 1983. Geological and Geochemical Report on the Midas Claim Group, Clinton Mining Division. Prepared by D.D.H. Geomanagement Ltd. as an Assessment Report, submitted to the BCMEMPR.

DRUMMOND, A.D., D.A. HOWARD and C.E. GUNN. 1988. Report on the Midas, Midas No. 4 and Kado Fractional Mineral Claims, Blackdome (sic) Mountain Area, Clinton Minng Division. Unpublished report.

DURFELD, R.M. 1984a. Geochemical, Geophysical and Geological Report on the Midas Claim Group. Report prepared by Teck Explorations Ltd. for Bankit Resources Corporation.

DURFELD, R.M. 1984b. Report in the Trenching and Soil Sampling Follow-up Program on the Midas Claim Group, Clinton MIning Division. Report prepared by Teck Explorations Ltd. for Bankit Resources Corporation.

FAULKNER, E.L. 1986. Blackdome Deposit (920/7E,8W). BCMEMPR. Geological Fieldwork 1985. Paper 1986-1, pp. 106-109.

KERR, J.R. 1983. Report on the Midas Property, Clinton Mining Division. Report prepared by Kerr, Dawson and Associates Ltd. for Navarone Power Corporation, for inclusion in a prospectus.

McALLISTER, S.G. and M.D. McPHERSON. 1987. Geological and Geochemical Report on the ACE I&2, BORIN I, CHURN I-III, KING 3-4, KING VI, MINK I-II, MINT 1-4, QUEEN 4-5, QUEEN VI, REBORIN and SWAMP 2 Claims, Clinton Mining Division, B.C. Prepared by Chevron Canada Resources Limited as an Assessment Report, submitted to the BCMEMPR.

PEATFIELD, G.R. 1988. Geology, Geochemistry and Post Location Survey on the Churn Creek Property;, Clinton Mining Division. Prepared as an Assessment Report, submitted to the BCMEMPR.

PEATFIELD, G.R. 1989. Soil Geochemistry on the MIDAS Property, Clinton Mining Division. Prepared as an Assessment Report, submitted to the BCMEMPR.

SCHROETER, T.G. 1987. Brief studies of selected gold deposits in Southern British Columbia. BCMEMPR. Geological Fieldwork 1986. Paper 1987-1, pp. 15-22. (Blackdome Deposit - pp. 17-18).

TIPPER, H.W. 1978. Taseko Lakes (92O) Map-Area. Geological Survey of Canada, Open File Map 534, Scale 1:125,000.

**APPENDIX I**

Selected Portions of Geophysical Report

by

C.J. Vaughan, B.Sc.

CGI Controlled Geophysics Inc.

CONTROLLED GEOPHYSICS

CGI CONTROLLED GEOPHYSICS INC.

Suite 31, 400 Matheson Blvd. East, Mississauga, Ontario L4Z 1N8 Telephone (416) 568-4040 Fax (416) 568-4041

# REPORT ON A HELICOPTER-BORNE EM AND MAGNETIC SURVEY IN THE BLACKDOME MINE AREA, B.C. FOR BLACKDOME MINING CORPORATION

**Distribution:**

2 - Blackdome Mining Corporation, Toronto, Ontario

1 - Controlled Geophysics Inc., Mississauga, Ontario

**File: 6021**

**April, 1989**

## EXECUTIVE SUMMARY

During October of 1988, a combined Helicopter borne frequency domain EM and magnetic survey was carried out by Controlled Geophysics Inc. for Blackdome Mining Corporation over their property surrounding the Blackdome Mine located 115 km south of Williams Lake, British Columbia. The objectives of the survey were to employ geophysics to map in detail the geological structure of the area, to create a regional exploration database for future ground follow-up programs, and to identify targets of potential economic value, especially extensions of known gold vein structures. A total of 1,660 line kilometres were flown in one primary and two secondary survey blocks. The latter were inside the main survey area but orthogonal to the primary survey direction in order to identify cross-striking geological structures.

The geophysical parameters measured during the survey comprised of total magnetic field intensity, three electromagnetic frequencies from coplanar coil pairs, one electromagnetic frequency from a coaxial coil pair, and VLF-EM. Preliminary data compilation consisted of flight path recovery preparation, electromagnetic data first pass levelling, calculation of apparent resistivity from the three coplanar coil frequencies, and generation of contour maps of the total magnetic field intensity, three resistivities, and VLF-EM total field intensity.

During an interim presentation to Blackdome's exploration representatives, all the geophysical parameters were reviewed on a colour image processing workstation and a set of four final colour deliverables were selected, magnetic total field and three apparent resistivities. At this time a series of colour slides were also prepared. Colour maps of these parameters were prepared at scales of 1:10,000 and 1:20,000.

The electromagnetic data were further processed using Controlled Geophysics' custom processing techniques to create interpretation aid maps. The final geophysical interpretation was based on all the products generated including the processed EM data, the colour products, and a limited knowledge of the geological setting.

Overall, the combination of electromagnetics and magnetic total field has successfully imaged a complex geological structure within the Blackdome property and identified a large number of geophysical targets which may have mineralization of economic value. Where the survey blocks coincide, the data redundancy and second line direction improved the descrimination of cross-structures. Of particular interest is the unique character of the geophysics in the mine area and the existance of other areas of similar character within the survey area.

A total of * unique targets have been selected for ground follow-up. The anomalies have not presently been rated for economic potential because so little is known about the source of the response. When more ground truthing data become available, the interpretations can be refined. In the meantime, a review of existing information and a detailed program of ground geophysics, geochemistry, and drilling follow-up on the selected targets is recommended.

* For the MIDAS property, 8 targets have been outlined.

G.R. Peatfield

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* Rolls of chart not bound in this document.

## LIST OF FIGURES

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# 1. INTRODUCTION

During the period October 2 to October 18 of 1988, a combined helicopter-borne frequency domain electromagnetic and magnetic survey was carried out by Controlled Geophysics Inc. for Blackdome Mining Corporation on their Blackdome Mine property south of Williams Lake, British Columbia. The objectives of the survey were to use geophysics to map in detail the geological structure of the area, to create a regional exploration database for future ground follow-up programs, and to identify targets of potential economic value, especially extensions of known gold vein structures. A total of 1,660 line kilometres were flown in one primary and two secondary survey blocks. The latter were coincident with but orthogonal to the primary survey direction in order to identify cross-striking geological structures in the mine area and in the relatively unknown northwestern portion of the survey area.

The setting of survey specifications was determined by Controlled Geophysics Inc. personnel in consultation with Blackdome after an on-site evaluation by a CGI representative. The survey data were acquired with the DIGHEM IV system via a subcontract to Dighem Surveys and Processing Inc. who were also responsible for preparing flight path recovery, calculation of apparent resistivities, and plotting of colour contour maps.

The EM data were further compiled, processed, and plotted by Controlled Geophysics Inc. custom processing techniques to generate interpretation aids. The geophysical interpretation was prepared by the writer and the selected targets are described in Section 5. below.

This report describes the survey logistics, the data compilation and preparation of deliverables, and presents the interpretation.

## 2. SITE DESCRIPTION

The Blackdome Mine property is located approximately 115 kilometres south of Williams Lake, British Columbia (See Figure 1). The survey area is encompassed within the following geographic coordinates:

122° 25' W to 122° 38' W in longitude
51° 15' N to 51° 25' N in latitude

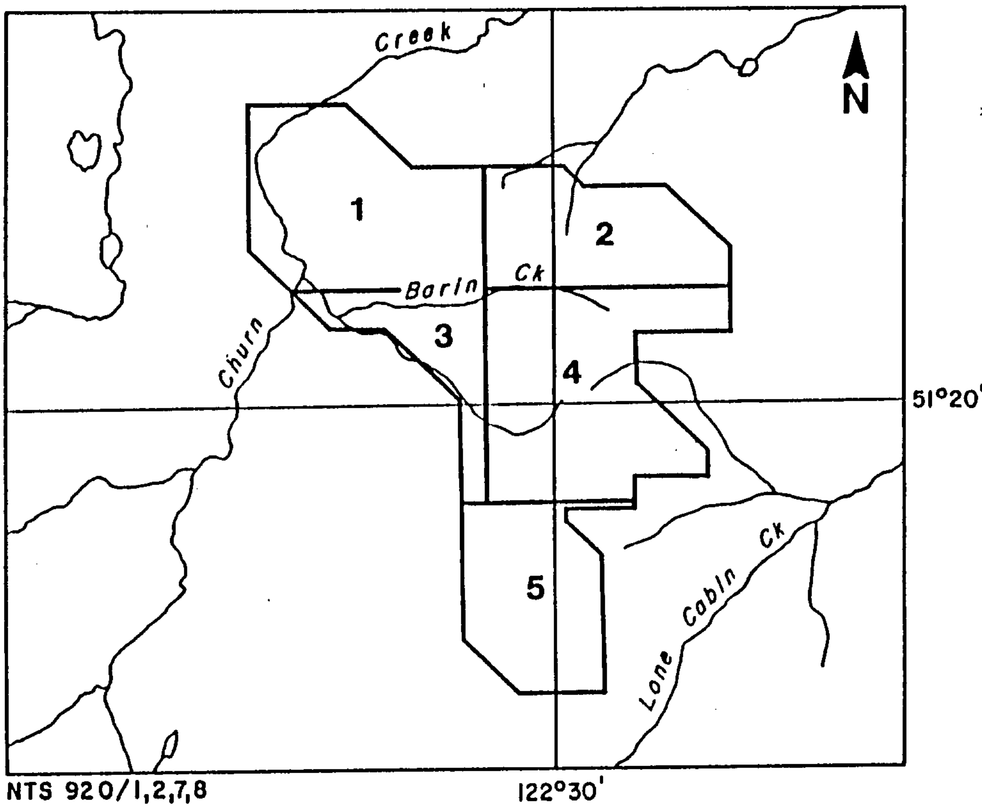
The coordinates used on the maps are expressed in metres north of the Equator and east of the false easting for the local UTM grid. The false easting origin is a line 500,000 metres west of 123° W longitude. The UTM limits of the Blackdome survey are:

525,000 to 541,000 metres Easting
5,677,500 to 5,696,000 metres Northing

The geological setting for the mine area has been reported to consist of Eocene age andesite and rhyolite flows in which occur Tertiary epithermal gold-silver deposits hosted in a steeply dipping quartz stockwork of several metres width. The stockworks appear to be associated with northeast trending fault zones. Clay alteration products have been observed. Unconformably overlying the Eocene rocks are post-ore basalts. Late Cretaceous quartz monzonite and Middle Jurassic granodiorite intrusive rocks have been mapped in the northwestern part of the survey area. In most of the survey area, only a limited amount of geological data has been compiled to date.

The relief of the mountainous terrain is not too severe however the altitude of the Blackdome Mountain peak and the presence of networks of stream valleys represent a challenge to both visual and radio navigation as well as to maintaining constant survey clearance. Many of the stream-filled valleys within the survey area are potential sources of anomalous EM response if they contain concentrations of conductive sediment. The heights of land may be anomalously resistive if very dry and covered with scree. Sources of cultural response include the Blackdome Mine along with its associated roads, hydro, and water line, and the conductive mine settling ponds.

## LOCATION MAP




Scale 1:250,000

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| *CONTROLLED* GEOPHYSICS | BLACKDOME MINE AREA, B.C.<br>HEM SURVEY LOCATION MAP<br>AND SHEET LAYOUT GUIDE |
| Job 6021 | Figure 1 |

## 3. FIELD WORK

### 3.1 Survey Specifications

Following an on-site evaluation by a Controlled Geophysics representative, the survey specifications were set jointly by Controlled Geophysics Inc. and Blackdome personnel based on detailed knowledge of the airborne system performance and some **a priori** knowledge of the regional geological setting. The latter was derived from existing exploration geology maps.

The uniform line spacing of 100 metres was chosen to map the property in sufficient detail to resolve structures as there was evidence of short strike length targets. The primary survey line direction was N 45° W true to couple most strongly with the northeastern striking fault zones. Two additional survey blocks were flown in an orthogonal direction. The first set located directly over the mine were selected to detect any northwestern striking feeder systems or offshoots to the vien systems in the mine area. The second set was positioned across the northwestern arm of the survey area where less was known about the dominant geological strike direction.

The flying specifications in Table 1 are commensurate with usual industry standards.

### 3.2 Survey Operations

The survey operations are described by the airborne sub-contractor in an appendix of this report. Described are their field personnel, instrumentation and production rates. A Controlled Geophysics Inc. representative was on site at the Blackdome Mine camp to monitor data quality and coverage. As a result, approximately 35% of the survey was reflown by the airborne subcontractor to meet acceptable quality standards. The location of the secondary survey blocks for cross-line flying was determined at the time of the survey based on the airborne results.

# 4. DATA COMPILATION, PROCESSING AND PRESENTATION

## 4.1 Flight Path Recovery

The flight path recovery was carried out by the airborne sub-contractor and is described in Appendix C of this report. The finalized flight path has been plotted on a screened topographic base in 5 sheets at a scale of 1:10,000. A plain screened topographic base has also been provided in 5 sheets at the same scale. Claim boundaries provided by Blackdome have been drafted upon the flight path maps to make anomaly locating easier.

## 4.2 Total Magnetic Field Preparation and Display

The total magnetic field measured during the survey was edited and levelled by the airborne sub-contractor. The final edited magnetic data were then isomagnetically contoured at 5 nT intervals and plotted in 5 mylar sheets on topographic base at a scale of 1:10,000. The contour map was used to correct any flight path recovery problems and the final map was generated. See Appendix C in this report for more information on magnetic data compilation, processing and presentation. The gridded data for the contours of total field were also used to prepare coloured maps at a scale of 1:10,000 and at 1:20,000. The warm colours correspond to magnetic highs and the cool colours to magnetic lows. The numerical sheet designations and layouts are identical for the contoured and coloured maps.

During an interim meeting, the total magnetic field data were presented to Blackdome exploration representatives on an interactive colour graphics workstation. At that time, the magnetic images were manipulated to produce false-colour images and shadow plots. A series of colour slides were obtained to assist in later analysis of the data.

## 4.4 Electromagnetic Data Preparation and Display

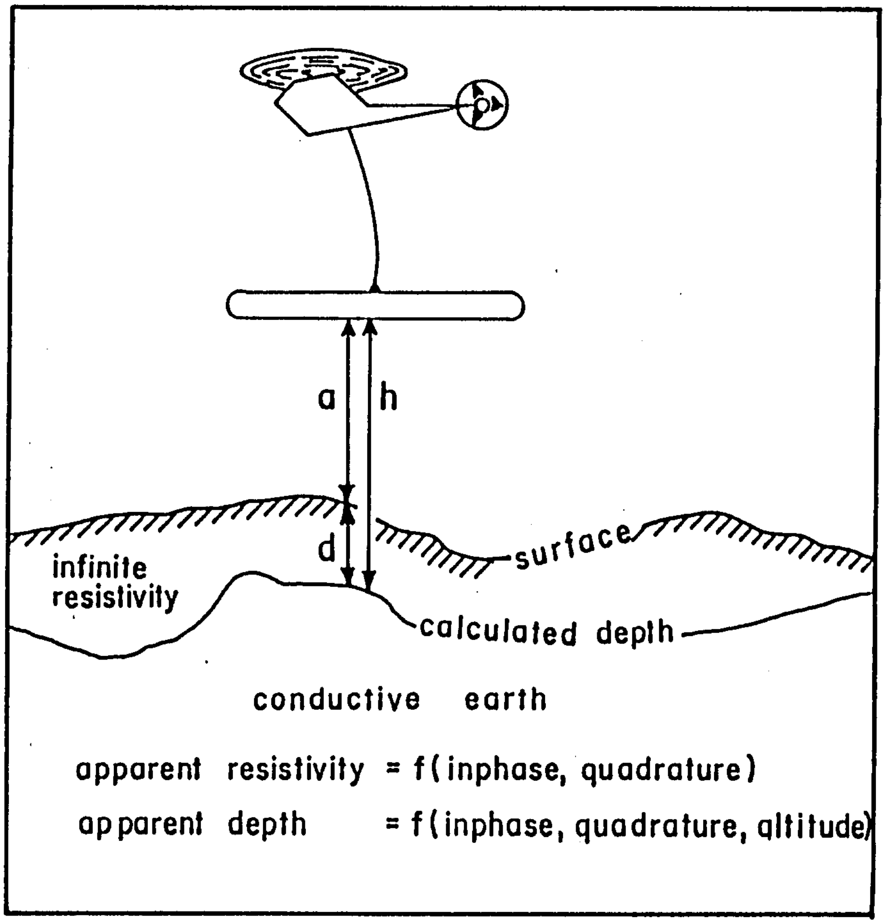
The principles of operation of the frequency domain electromagnetic survey system are illustrated in Figure 2. As the helicopter transports the towed "bird" along each survey line at as close as possible to a fixed terrrain clearance, the electromagnetic transmitter for each coil pair inside the bird energizes the conductors in the ground below the system. A corresponding receiver coil pair measures the secondary EM fields produced by the conductors. The data recorded consists of In-phase and Quadrature amplitudes for each of the four coil pairs. The strength of the signals detected are influenced by the size and conductivity of the conductor as well as its geometry and depth of burial.

Three of these coil pairs are oriented in a horizontal coplanar manner and employ frequencies of 900 Hz, 7,200 Hz, and 56 kHz respectively. The fourth coil pair is oriented in a vertical coaxial manner and employs a 7,200 Hz frequency.

The coplanar coil pairs are most sensitive to flat lying conductors. For this reason they may be used to prepare maps of the apparent resistivity distribution in the survey area. The three frequencies allow one to interpret the conductivity distribution vs depth because lower frequencies penetrate the ground more deeply than high frequencies. Because signal level generally increases with frequency, employing low, medium, and high frequencies ensures that adequate signal can be measured even where resistive ground produces small response.

The coaxial coil pair is most sensitive to vertical narrow conductors that strike normal to the direction of survey. Because the two coil orientations in the bird respond differently to different types of conductors, a comparison of the signals from them permit an interpretation of the target geometry. Maps of the difference between the 7,200 Hz Coplanar and 7,200 Hz Coaxial Inphase amplitude were used in the interpretation to discriminate vertical conductors from flat conductive areas. More details about the EM technique are available in Appendix C.

The first pass on the EM data entailed editing and levelling each channel and preparing a set of digital profile sheets on which are displayed all EM data, altimeter, magnetics and calculated resistivity and depth values. In addition to these data, a computer generated set of anomaly picks are plotted at the bottom of the chart. The anomalies are suspect because no human qualification has been applied. The worksheets contain a




This is the buried earth model. The top of the conductive earth is defined numerically by the output parameter h. The buried earth model is equivalent to a two-layer case where the upper layer has an infinite resistivity. The depth d is the difference between the interpreted height h and the bird altitude a.

| | | |
|---|---|---|
| *CONTROLLED* GEOPHYSICS | HELICOPTER-BORNE EM AND RESISTIVITY MAPPING PRINCIPLES OF OPERATION | |
| | Job 6021 | Figure 2 |

lot of cluttered information. The contents are summarized in Appendix C. To improve the interpretability of these data, Controlled Geophysics has prepared a new version which are presented as Appendices A and B.

The contents of the new analogue chart are summarized in Table 2. Note that channels from a given coil pair have common zero levels to allow direct estimates of Inphase-to-Quadrature ratios to be made. The Inphase channels have been bolded to make the distinction easier. The apparent resistivity from the 7,200 Hz coplanar coils supplied by Dighem has been presented along with a calculated Apparent Conductivity. The latter allow good conductors to display a peak instead of a subtle resistivity low. The Inphase and Quadrature differences between coaxial and coplanar for the 7,200 Hz frequency have been displayed as well. The total magnetic field data are plotted to permit responses to be checked for magnetic correlation. The altimeter profile is used to ensure that anomalies produced only by severe variations in terrain clearance are not picked.

The airborne contractor was also responsible for generating the colour maps of apparent resistivity from each of the three coplanar coil pairs, while Controlled Geophysics prepared EM profiles in stacked profile and colour difference maps. The latter were used as tools in the airborne interpretation, but did not form part of the deliverables for this project.

A set of maps showing the computer-generated anomaly picks was prepared for interest sake, but they were not helpful to the interpretation.

# 5. INTERPRETATION OF RESULTS

## 5.1 Introduction

The following interpretation is just that, a geophysical interpretation. As such it reflects the biases of the interpreter. It was generated based on the digital chart records, the results of the EM processing, the magnetic maps, and a limited knowledge of the geological setting. The interpretation may be refined with modelling of EM responses and the addition of more ground control obtained through geophysical surveys, geochemical sampling, and drilling.

To be sure of catching even the subtle responses, the interpretation was carried out with reference to the analogue charts, the coloured contoured maps of three apparent resistivities and total magnetic field, the topographic base map, plotted stacked profiles of the Inphase and Quadrature amplitudes measured in the 7,200 Hz coaxial coil pair, and a map of 7,200 Hz Inphase differences.

The interpretation maps are designed to present the interpreted anomalous trends and areas. These include conductive and resistive responses with or without direct magnetic correlation and, occasionally, pure magnetic anomalies. Emphasis has been placed on subtle anomalies or unique response that need to be followed up. Major magnetic and conductive belts produced by gross geological variations are self-evident on the maps and should correlate with present or future geological mapping.

On the interpretation maps, a solid line indicates a definite axis while a dashed or dotted line implies tentative line-to-line correlation and/or uncertainty in location. An anomalous area is surrounded by a dashed line. Ground follow-up usually requires a blanket approach in such areas until the orientation of geological structures are better defined. The major trends on each sheet have been given a name, i.e., 4-1 or 3-20 where '4' and '3' indicate Sheet 4 and Sheet 3 respectively. The anomalies are summarized in Table 9 and are discussed in detail in the following sections. Related ones are treated together. In some cases, estimates of dip and depth are provided. Note that all anomalies listed are recommended for follow-up unless specifically noted otherwise.

Priorities for the anomalies have not been provided; however, when more ground truth becomes available, the responses can be rated for priority of follow-up. In general, those responses that correlate with or extend known mineralization should be persued first.

## 5.2 The Geophysical Response over Blackdome Mine

This section reviews in general the geophysical responses in the vicinity of the mine, especially in relation to geology and mine maps supplied by Blackdome. The producing mine workings in No. 1 & No. 2 veins may be traced from the summit of Blackdome Mountain south and west for approximately three kilometres. Good Gold values have also been obtained in parallel vein structures located northwest of the peak. These include the Red Bird, Honey, and Giant veins. Most of these structures have NNE strikes.

Not applicable to this report.

Note: Pages 9 - 20 not applicable to this report.

Not applicable to this report.

**Anomaly 4-2**

Anomaly 4-2 consists of a broken series of conductive lows over magnetic highs that may be traced for more than 2 km. The Airstrip vein lies parallel to and south of the strongest magnetic high. This anomaly should be followed up with particular attention north of the magnetic high. The 900 Hz resistivity map suggests a continuation of this trend through to Line 10390 but possibly at greater depth. The 7,200 Hz difference profiles suggest a thin vertical conductor.

Not applicable to this report.

**Anomaly 4-6**

Anomaly 4-6 lies parallel to 4-5 along a weakly conductive trend. It is of interest because of its narrow, but distinctive magnetic high. To the northeast lies a strong conductive zone which, based on all three frequencies, dips to the southeast.

Not applicable to this report.

**Anomaly 4-13**

Anomaly 4-13 consists of a resistor on a magnetically defined contact intersected by a narrow, weak resistor and magnetic high. The strong magnetic dipole on Lines 10710 and 10720 should be checked for massive mineralization.

**Anomaly 4-14**

This anomaly consists of a strong conductor lying on a moderate magnetic high that strikes N-S.

**Anomaly 4-15**

Anomaly 4-15 is an E-W conductor lying along an abrupt magnetic break. On Line 10510, the conductivity peaks, but the magnetics are low. Based on all three frequencies, the conductor migrates southeast with increasing depth. If the break is a fault then attention may also be placed on the magnetic structure 1 km east of the end of Anomaly 4-15.

**Anomaly 4-16**

This anomaly lies on strike with Anomaly 4-1 and exhibits a strong conductive response on the 900 Hz map. It appears to follow a narrow magnetic high that lies along the eastern boundary of a broad conductive area. If favorable geology is found in the location of Anomaly 4-16, follow up may be continued north along these trends. Attention should be placed where the structure splits at Line 10320.

**Anomaly 4-17**

A small area has been outlined for Anomaly 4-17. Both conductive highs and coincident magnetic highs are present. Two intersecting trends are observed.

Not applicable to this report.

**Anomaly 4-19**

A large complex area encompassing magnetic and conductivity highs on all frequencies forms Anomaly 4-19. Both along flight and across flight line structures are possible. It lies on strike with the Blackdome Mine mineralization.

Note: Pages 24 - 31 not applicable to this report.

## 6. CONCLUSIONS AND RECOMMENDATIONS

The combined airborne frequency domain electromagnetic and magnetic survey of the Blackdome Mine property has provided a good picture of the structures and conductors in the area. Most of this information is new and must now be reconciled with the previously available geological and geochemical database.

Five interpretation maps have been prepared showing the selected anomalous trends and areas superimposed on a topographic base map. The property boundaries have also been added to make locating the targets easier. The best way of evaluating the targets using the survey data is to overlay the interpretation maps on the maps of Apparent Resistivity and Total Magnetic Field.

A total of * anomalies have been recommended for follow-up. They are listed and rated in Table 4. The selections include anomalous magnetic responses with and without conductive or resistive trends as well as purely electromagnetic responses. The selection of resistors is not standard practice in HEM surveys. However, in the Blackdome area, we feel that resistors may be important targets for identifying quartz stockworks. Ground follow up will be required to confirm this theory.

A detailed program of ground geophysics and geochemistry is recommended to pinpoint targets before drilling especially in areas where data indicate that complex structures are present and the survey was not able to resolve conductor axes uniquely. A small test survey over the Giant Vein using VLF-EM was carried out during the airborne survey. The results suggest that carefully controlled VLF surveys may be the best geophysical technique for follow-up.

As more geological information becomes available, a more detailed program of modelling and interpretation can be carried out to refine the present interpretation.

Respectfully submitted,
CGI CONTROLLED GEOPHYSICS INC.

G. Vaughan

C. J. Vaughan, B.Sc.,
Senior Geophysicist



* For the MIDAS property, 8 targets have been outlined.

G.R. Peatfield

## STATEMENT OF QUALIFICATIONS

I, Christopher Vaughan residing at 136 Croteau Crescent in the city of Thornhill, province of Ontario do hereby certify that:

1. I am a geophysicist.

2. I graduated from the University of Toronto in 1982 with a B.Sc. in Geology and Physics.

3. I have been actively engaged in applied geophysics since 1982 and in geophysical exploration since 1984.

4. I have held associate and active membership in the Society of Exploration Geophysicists since 1982 and hold memberships in other professional societies involved with mining geophysics.

5. I was personally responsible for the interpretation of the geophysical data presented in this report.

6. I have no interest, direct, or indirect, in the property described nor do I hold securities in Blackdome Mining Corporation.

CGI CONTROLLED GEOPHYSICS INC.

C. J. Vaughan, B.Sc.
Senior Geophysicist

## TABLE 1 - HEM Survey Flying Specifications

| | |
|---|---|
| Line Spacing: | - 100 metres |
| Line Direction(s) | - N 45° W Main Block, N 135° W Secondary Blocks |
| Tolerance: | - up to 0.50 of line spacing allowed for a distance along line not to exceed 2.0 km. |
| Survey Altitude: | - 35 metres ± 15 metres. Not to exceed 60 m for a distance exceeding 1.0 km |
| Survey Speed: | - 110 km/hr. |
| EM Noise Levels: | - 900 Hz channels noise not to exceed +2 ppm over a distance of 1.0 km. Other frequencies pro-rated. |
| Real-Time Chart Display: | - Altimeter, Coarse Magnetics, Fine Magnetics, 8 EM channels, 4 VLF EM channels. |
| Magnetic Diurnal Tolerance: | - Not to exceed 10 nT change during a 2 minute interval. |
| Magnetic Noise Levels: | - Not to exceed +0.5 nT peak to peak over a distance of 1.0 km or more. |

## TABLE 2 - Analogue Chart Record Contents

| Parameter (and Chart Label) | Scale (or format) | Zero Position |
|---|---|---|
| Flight Number | - Flight No. labelled at the start of each line. | |
| Line Number | - Block No. x 10000 plus Line No. x 10 plus attempt number or direction code labelled at start of each line. | |
| Fiducial | - Lines for every 2nd fiducial and every 10th fiducial labelled along edges of chart. 5 data measurements per fiducial. | |
| Altimeter (ALTM) | - at 50 feet/chart cm | 04.0 cm |
| Total Magnetic Field (RMAG)* | - at 200 nT/chart cm (60,000 nT removed) | 06.0 cm |
| 900 Hz CP Inphase (CPI9)* | - at 50 ppm/chart cm | 22.0 cm |
| 900 Hz CP Quadrature (CPQ9) | - at 50 ppm/chart cm | 22.0 cm |
| 7,200 Hz CP Inphase (CPI7)* | - at 50 ppm/chart cm | 16.0 cm |
| 7,200 Hz " Quadrature (CPQ7) | - at 50 ppm/chart cm | 16.0 cm |
| 7,200 Hz CX Inphase (CXI7)* | - at 25 ppm/chart cm | 20.0 cm |
| 7,200 Hz " Quadrature (CXQ7) | - at 25 ppm/chart cm | 20.0 cm |
| 56 kHz CP Inphase (CPI5)* | - at 50 ppm/chart cm | 12.0 cm |
| 56 kHz " Quadrature (CPQ5) | - at 50 ppm/chart cm | 12.0 cm |
| 7,200 Hz Coplanar Apparent Resistivity(RES7) | - at 100 Ohm-m/chart cm | 26.0 cm |
| 7,200 Hz Coplanar Apparent Conductivity (CON7)* | - at 0.01 Mho/m/chart cm | 26.0 cm |
| 7,200 Hz Coplanar Apparent Depth (DPT7) | - at 50 metres/chart cm | 26.0 cm |
| Surface for Depth Reference (SURF) | - N/A | 26.0 cm |
| 7,200 Hz Coil Inphase Difference (DIFI)* | - at 250 ppm/chart cm | 28.0 cm |
| 7,200 Hz Coil Quadrature Difference (DIFQ) | - at 250 ppm/chart cm | 28.0 cm |

Note: Zero Position is measured from the top of the chart down.
* These profiles are bolded.

## TABLE 3 - Blackdome Survey Project 6021 Deliverables

| DESCRIPTION | MEDIUM | QUANTITY |
|---|---|---|
| Flight path recovery on screened topographic base with property boundaries at 1:10,000 | Mylar<br>Whiteprint | 5 sheets<br>5 sheets |
| Clean screened topographic base at 1:10,000 | Mylar<br>Whiteprint | 5 sheets<br>5 sheets |
| Contoured Total Magnetic Field on screened topographic base at 1:10,000 | Mylar<br>Whiteprint | 5 sheets<br>5 sheets |
| Coloured Total Magnetic Field with blackline contours and flight path at 1:10,000 | Laminated Bond* | 5 sheets |
| Coloured Total Magnetic Field with blackline contours at 1:20,000 | Laminated Bond* | 1 sheet |
| Shadowed Total Magnetic Field with 180° azimuth sun angle at 1:20,000 | Laminated Bond | 1 sheet |
| Shadowed Total Magnetic Field with 270° azimuth sun angle at 1:20,000 | Laminated Bond | 1 sheet |
| Contoured Computed Apparent Resistivity for 900 Hz at 1:10,000 | Mylar<br>Whiteprint | 5 sheets<br>5 sheets |
| Contoured Computed Apparent Resistivity for 7,200 Hz at 1:10,000 | Mylar<br>Whiteprint | 5 sheets<br>5 sheets |
| Contoured Computed Apparent Resistivity for 56 kHz at 1:10,000 | Mylar<br>Whiteprint | 5 sheets<br>5 sheets |
| Coloured Apparent Resistivity with blackline contours and flight path for 900 Hz at 1:10,000 | Laminated Bond* | 5 sheets |
| Coloured Apparent Resistivity with blackline contours and flight path for 7,200 Hz at 1:10,000 | Laminated Bond* | 5 sheets |
| Coloured Apparent Resistivity with blackline contours and flight path for 56 kHz at 1:10,000 | Laminated Bond* | 5 sheets |
| Coloured Apparent Resistivity with blackline contours for 900 Hz at 1:20,000 | Laminated Bond* | 1 sheet |
| Coloured Apparent Resistivity with blackline contours for 7,200 Hz at 1:20,000 | Laminated Bond* | 1 sheet |
| Coloured Apparent Resistivity with blackline contours for 56 kHz at 1:20,000 | Laminated Bond* | 1 sheet |
| Interpretation on screened topographic base at 1:10,000 | Mylar<br>Whiteprint* | 5 sheets<br>5 sheets |

TABLE 3 con't - Blackdome Survey Project 6021 Deliverables

| DESCRIPTION | MEDIUM | QUANTITY |
|---|---|---|
| Analogue Chart of Altimeter, Magnetic, EM, and 7,200 Hz Resistivity, Conductivity, and Difference Data - CGI Version | Roll Format | 2 rolls |
| Digital Profiles of Peripheral and Processed EM Data - Subcontractor version | Sheet Format | 3 pads |
| Microfilmed Analogue Chart | Film Spools | 2 films |
| Digital Archives of survey data | 9-track tape | 3 tapes |
| Grid Archives of survey data | 9-track tape | 1 tape |
| Flight Path Recovery Video Tapes | VHS Tape | 6 tapes |
| Data Processing/Compilation/Interpretation Report including sub-contractor Report | Text | 2 copies |

* Two copies of this sheet prepared and delivered.

TABLE 4 - Summary of Blackdome Anomalies for Follow-up

| Anomaly Name | Line Range |
|---|---|
| 4-2 | 10510 - 10650 |
| 4-6 | 10550 - 10601 |
| 4-13 | 10640 - 10730 |
| 4-14 | 10560 - 10601 |
| 4-15 | 10510 - 10580 |
| 4-16 | 10280 - 10460 |
| 4-17 | 10260 - 10310 |
| 4-19 | 10290 - 10390 |

# APPENDIX C

## Airborne Sub-Contractor Data Collection Report

Report #1052

# DIGHEM$^{IV}$ SURVEY
# FOR
# CONTROLLED GEOPHYSICS INC.
# BLACKDOME MINE PROJECT AREA,
# BRITISH COLUMBIA

DIGHEM SURVEYS & PROCESSING INC.
MISSISSAUGA, ONTARIO
January 16, 1989

Douglas L. McConnell
Geophysicist

A1052JAN.90R

# SUMMARY

A DIGHEM$^{IV}$ survey was flown for Controlled Geophysics Inc. over the Blackdome Mine project area in British Columbia.

The purpose of the survey was to detect conductive zones, and to map bedrock structure and lithology using apparent resistivity and the magnetic properties of the rock units within the survey area.

Numerous conductors were identified by a computer anomaly picking routine. These anomalies were not interpreted. The total field magnetic maps yield valuable information about the geology and bedrock structure. The coplanar EM 900 Hz, 7200 Hz and 56,000 Hz data were used to produce resistivity maps which show the conductive properties of the survey area.

The survey area exhibits potential as a host for both conductive massive sulphide deposits and weakly conductive zones of disseminated mineralization. Interpretation of the EM anomalies and a comparison of the various geophysical parameters, compiled with geological and geochemical information, should be useful in selecting targets for follow-up work.

# CONTENTS

## INTRODUCTION

A DIGHEM$^{IV}$ electromagnetic/resistivity/magnetic/VLF survey was flown for Controlled Geophysics Inc. from October 2 to October 17, 1988, in the Blackdome Mine project area, British Columbia (Figure 1). Project management was by Controlled Geophysics Inc.

Survey coverage consisted of approximately 1,666 line-km. The flight lines were flown with a 100 m line separation in an azimuthal direction of 135°/315°. Tie lines were flown perpendicular to the flight line direction. Coverage, utilizing an alternate flight line direction of 45°/225°, was flown over two blocks within the area covered by the main survey block. The data from these areas were merged with the main grid during processing. Block A comprises line numbers 10010 to 11640; block B, lines 20270 to 20480; and block C, lines 30560 to 30810.

The survey employed a DIGHEM$^{IV}$ electromagnetic system. Ancillary equipment consisted of a magnetometer, radio altimeter, video camera, analog and digital recorders, a VLF receiver and an electronic navigation system.

This report is divided into six sections. Section 2 provides details on the equipment used in the survey and



lists the recorded data and computed parameters. Section 3 reviews the data processing procedures, with further information on the various parameters provided in Section 5. Section 4 describes the geophysical results.

The survey results are shown on five separate map sheets for each parameter. Table 1-1 lists the products which can be obtained from the survey. Those which are part of the contract are indicated on this table by showing the presentation scale. These total twenty-five maps and twenty colour plots.

Recommendations for additional products are included in Table 1-1. These recommendations are based on the information content of products that would contribute to meeting the objectives of the survey.

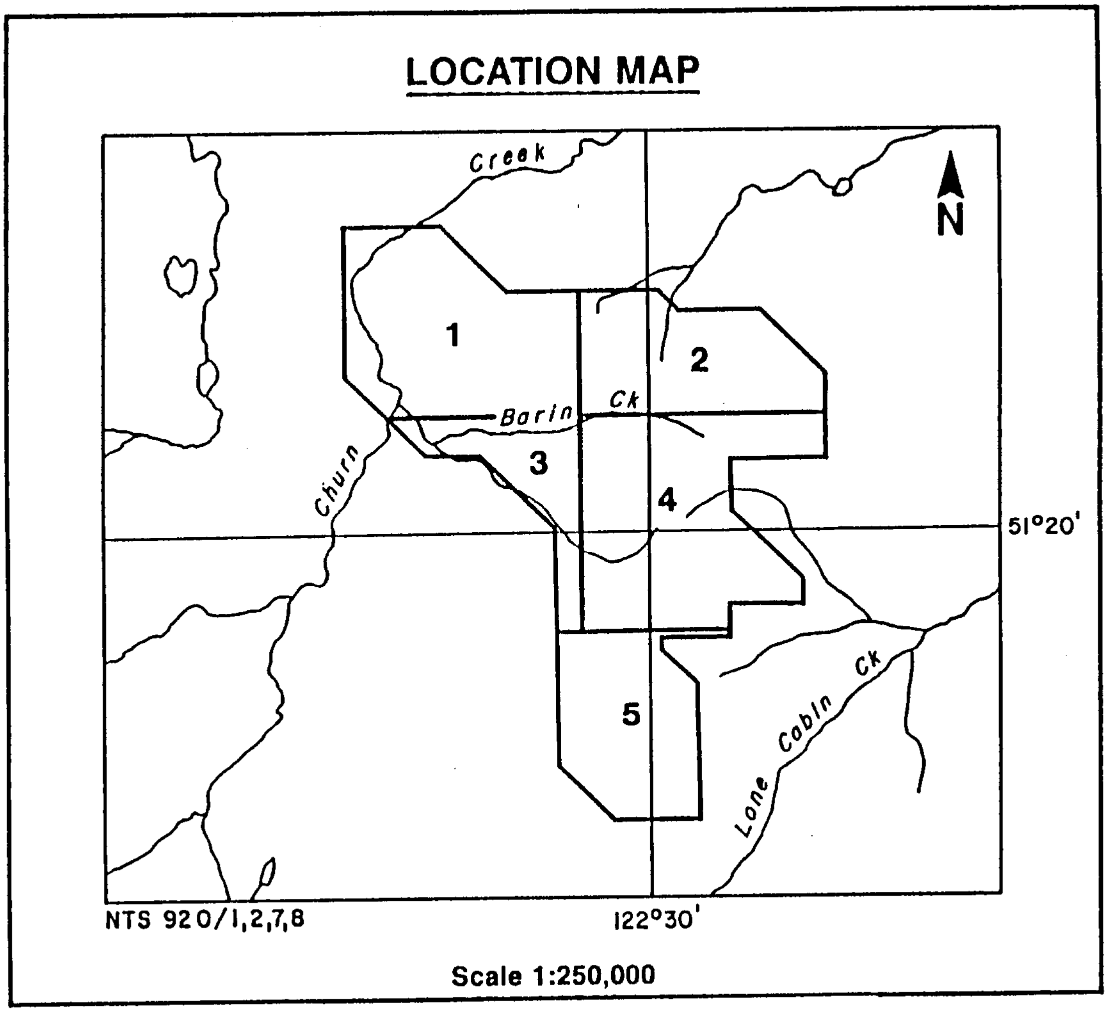



FIGURE 1

THE SURVEY AREA

Table 1-1 Plots Available from the Survey

| MAP | NO. OF SHEETS | ANOMALY MAP | PROFILES ON MAP | CONTOURS INK | CONTOURS COLOR | SHADOW MAP |
|---|---|---|---|---|---|---|
| Plain Topographic Map | 5 | N/A | N/A | 10,000 | N/A | N/A |
| Electromagnetic Anomalies | - | *** | - | N/A | N/A | N/A |
| Flight Lines | 5 | N/A | - | 10,000 | N/A | N/A |
| Probable Bedrock Conductors | - | - | N/A | N/A | N/A | N/A |
| Resistivity ( 900 Hz) | 5 | N/A | - | - | 10,000 | - |
| Resistivity ( 7,200 Hz) | 5 | N/A | - | 10,000 | 10,000 | ** |
| Resistivity (56,000 Hz) | 5 | N/A | - | 10,000 | 10,000 | - |
| EM Magnetite | - | N/A | - | * | - | - |
| Total Field Magnetics | 5 | N/A | - | 10,000 | 10,000 | *** |
| Enhanced Magnetics | - | N/A | - | - | - | - |
| Vertical Gradient Magnetics | - | N/A | - | - | - | - |
| 2nd Vertical Derivative Magnetics | - | N/A | - | - | - | - |
| Magnetic Susceptibility | - | N/A | - | - | - | - |
| Filtered Total Field VLF | - | N/A | - | ** | - | - |
| Electromagnetic Profiles( 900 Hz) | - | N/A | - | N/A | N/A | N/A |
| Electromagnetic Profiles(7200 Hz) | - | N/A | - | N/A | N/A | N/A |
| Overburden Thickness | - | N/A | - | - | - | - |
| Digital Profiles | | Worksheet profiles | | | | 10,000 |
| | | Interpreted profiles | | | | - |

N/A Not available
*** Highly recommended due to its overall information content
** Recommended
* Qualified recommendation, as it may be useful in local areas
- Not recommended
10,000 Scale of delivered map, i.e, 1:10,000



## SURVEY EQUIPMENT

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

### Electromagnetic System

Model: DIGHEM$^{IV}$

Type: Towed bird, symmetric dipole configuration, operated at a nominal survey altitude of 30 metres. Coil separation is 8 metres for all coil-pairs except the 56,000 Hz coil-pair, which has a separation of 6.3 metres.

Coil orientations/frequencies:
coaxial / 7,200 Hz
coplanar/ 900 Hz
coplanar/ 7,200 Hz
coplanar/56,000 Hz

Sensitivity:
0.2 ppm at 900 Hz
0.4 ppm at 7,200 Hz
1.0 ppm at 56,000 Hz

Sample rate: 10 per second

The electromagnetic system utilizes a multi-coil coaxial/coplanar technique to energize conductors in different directions. The coaxial transmitter coil is vertical with its axis 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 inphase and a quadrature channel from each transmitter-receiver coil-pair.

Magnetometer

Model: Picodas Cesium

Sensitivity: 0.1 nT

Sample rate: 10 per second

The magnetometer sensor is towed in a bird 15 m below the helicopter.

Magnetic Base Station

Model: Geometrics G-826A

Sensitivity: 0.50 nT

Sample rate: once per 5 seconds

An Epson 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.

VLF System

Manufacturer: Herz Industries Ltd.

Type: Totem-2A

Sensitivity: 0.1%



The VLF receiver measures the total field and vertical quadrature components of the secondary VLF field. Signals from two separate transmitters can be measured simultaneously. The VLF sensor is towed in a bird 10 m below the helicopter.

Radio Altimeter

Manufacturer: Honeywell/Sperry

Type: AA 220

Sensitivity: 1 ft

The radio 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: GR33 dot-matrix graphics recorder

Resolution: 4x4 dots/mm

Speed: 1.5 mm/sec

The analog profiles were 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: Scintrex

Type: CDI-6

Tape Deck: RMS TCR-12, 6400 bpi, tape cartridge recorder

The digital data were used to generate several computed parameters.

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.

Navigation System

Model: Del Norte 547

Type: UHF electronic positioning system

Sensitivity: 1 m

Sample rate: 0.5 per second

The navigation system uses ground based transponder stations which transmit distance information back to the helicopter. The ground stations are set up well away from the survey area and are positioned such that the signals



cross the survey block at an angle between 30° and 150°. After site selection, a baseline is flown at right angles to a line drawn through the transmitter sites to establish an arbitrary coordinate system for the survey area. The onboard Central Processing Unit takes any two transponder distances and determines the helicopter position relative to these two ground stations in cartesian coordinates.

Aircraft

The instrumentation was installed in an Aerospatiale Lama turbine helicopter. The helicopter flew at an average airspeed of 110 km/h with an average EM bird height of approximately 35 m. Bird height in excess of 30 m was necessary for the safety of the helicopter crew due to the rugged terrain and tree cover. This is to be expected in mountainous areas of British Columbia.

Table 2-1. The Analog Profiles

| Channel Name | Parameter | Sensitivity per mm | Designation on digital profile |
|---|---|---|---|
| CX1I | coaxial inphase (7200 Hz) | 5.0 ppm | CXI (7200 Hz) |
| CX1Q | coaxial quad (7200 Hz) | 5.0 ppm | CXQ (7200 Hz) |
| CP2I | coplanar inphase ( 900 Hz) | 2.5 ppm | CPI ( 900 Hz) |
| CP2Q | coplanar quad ( 900 Hz) | 2.5 ppm | CPQ ( 900 Hz) |
| CP3I | coplanar inphase (7200 Hz) | 5.0 ppm | CPI (7200 Hz) |
| CP3Q | coplanar quad (7200 Hz) | 5.0 ppm | CPQ (7200 Hz) |
| CP4I | coplanar inphase ( 56 kHz) | 10.0 ppm | CPI ( 56 kHz) |
| CP4Q | coplanar quad ( 56 kHz) | 10.0 ppm | CPQ ( 56 kHz) |
| CXSP | coaxial sferics | 2.5 ppm | |
| CPSP | coplanar sferics | 2.5 ppm | |
| ALT | altimeter | 3 m | ALT |
| VF1T | VLF-total: primary station | 5% | |
| VF1Q | VLF-quad: primary station | 5% | |
| VF2T | VLF-total: secondary stn. | 5% | |
| VF2Q | VLF-quad: secondary stn. | 5% | |
| CMGC | magnetics, coarse | 50 nT | MAG |
| CMGF | magnetics, fine | 5.0 nT | MAG |

Table 2-2. The Digital Profiles

| Channel Name (Freq) | Observed parameters | Scale units/mm |
|---|---|---|
| MAG | magnetics | 10 nT |
| ALT | bird height | 6 m |
| CXI (7200 Hz) | vertical coaxial coil-pair inphase | 4 ppm |
| CXQ (7200 Hz) | vertical coaxial coil-pair quadrature | 4 ppm |
| CPI ( 900 Hz) | horizontal coplanar coil-pair inphase | 2 ppm |
| CPQ ( 900 Hz) | horizontal coplanar coil-pair quadrature | 2 ppm |
| CPI (7200 Hz) | horizontal coplanar coil-pair inphase | 4 ppm |
| CPQ (7200 Hz) | horizontal coplanar coil-pair quadrature | 4 ppm |
| CPI ( 56 kHz) | horizontal coplanar coil-pair inphase | 20 ppm |
| CPQ ( 56 kHz) | horizontal coplanar coil-pair quadrature | 20 ppm |
| | Computed Parameters | |
| CDT | conductance | 1 grade |
| RES ( 900 Hz) | log resistivity | .06 decade |
| RES (7200 Hz) | log resistivity | .06 decade |
| RES ( 56 kHz) | log resistivity | .06 decade |
| DP ( 900 Hz) | apparent depth | 6 m |
| DP (7200 Hz) | apparent depth | 6 m |
| DP ( 56 kHz) | apparent depth | 6 m |
| DIFI (7200 Hz) | | 4 ppm |
| DIFQ (7200 Hz | | 4 ppm |



## 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 1-1 for a summary of the maps which accompany this report and those which are recommended as additional products. Most parameters can be displayed as contours, profiles, or in colour.

### Base Maps

Base maps of the survey area were prepared from 1:50,000 topographic maps that were enlarged photographically to a scale of 1:10,000.

### Flight Path

The cartesian coordinates produced by the electronic navigation system were transformed into UTM grid locations during data processing. These were tied to the UTM grid on the base map.

Prominent topographical features are correlated with the navigational data points, to check that the data accurately relates to the base map.

Electromagnetic Anomalies

Anomalous electromagnetic responses are selected and analysed by computer to provide a preliminary electromagnetic anomaly map. This preliminary EM map is used, by the geophysicist, in conjunction with the computer generated digital profiles, to produce the final interpreted EM anomaly map. This map includes bedrock, surficial and cultural conductors. A map containing only bedrock conductors can be generated, if desired.

Resistivity

The apparent resistivity in ohm-m may be generated from the inphase and quadrature EM components for any of the frequencies, using a pseudo-layer halfspace 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.

EM Magnetite

The apparent percent magnetite by weight is computed



wherever magnetite produces a negative inphase EM response. The results are usually displayed on a contour map.

Total Field Magnetics

The aeromagnetic data are corrected for diurnal variation using the magnetic base station data. The regional IGRF gradient is removed from the data, if required under the terms of the contract.

Enhanced Magnetics

The total field magnetic data are subjected to a processing algorithm. This algorithm enhances the response of magnetic bodies in the upper 500 m and attenuates the response of deeper bodies. The resulting enhanced magnetic 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 magnetic map. However, regional magnetic variations, and magnetic lows caused by remanence, are better defined on the total field magnetic map. The technique is described in more detail in Section 5.

Magnetic Derivatives

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

vertical gradient
second vertical derivative
magnetic susceptibility with reduction to the pole
upward/downward continuations

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. Dighem's proprietary enhanced magnetic technique is designed to provide a general "all-purpose" map, combining the more useful features of the above parameters.

VLF

The VLF data can be digitally filtered to remove long wavelengths such as those caused by variations in the transmitted field strength. The results are usually presented as contours of the filtered total field.



Digital Profiles

Distance-based profiles of the digitally recorded geophysical data are generated and plotted by computer. These profiles also contain the calculated parameters which are used in the interpretation process. These are produced as worksheets prior to interpretation, and can also be presented in the final corrected form after interpretation. The profiles display electromagnetic anomalies with their respective interpretive symbols. The differences between the worksheets and the final corrected form occur only with respect to the EM anomaly identifier.

Contour, Colour and Shadow Map Displays

The geophysical data are interpolated onto a regular grid using a cubic spline technique. The resulting grid is suitable for generating contour maps of excellent quality.

Colour maps are produced by interpolating the grid down to the pixel size. The distribution of the colour ranges is normalized for the magnetic parameter colour maps, and matched to specific contour intervals for the resistivity and VLF colour maps.

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, as shown in Figure 3-1. The various shadow techniques may be applied to total field or enhanced magnetic data, magnetic derivatives, VLF, resistivity, etc. Of the various magnetic products, the shadow of the enhanced magnetic parameter is particularly suited for defining geological structures with crisper images and improved resolution.



Dighem software provides several shadowing techniques. Both monochromatic (commonly green) or polychromatic (full color) maps may be produced. Monochromatic shadow maps are often preferred over polychromatic maps for reasons of clarity.

**Spot Sun**

The spot sun technique tends to mimic nature. The sun occupies a spot in the sky at a defined azimuth and inclination. The surface of the data grid casts shadows. This is the standard technique used by industry to produce monochromatic shadow maps.

A characteristic of the spot sun technique is that shadows are cast in proportion to how well the sunlight intersects the feature. Features which are almost parallel to the sun's azimuth may cast no shadow at all. To avoid this problem, Dighem's hemispheric sun technique may be employed.

**Hemispheric Sun**

The hemispheric sun technique was developed by Dighem. The method involves lighting up a hemisphere. If, for example, a north hemispheric sun is selected, features of all strikes will have their north side in sun and their south side in shadow. The hemispheric sun lights up all features, without a bias caused by strike. The method yields sharply defined monochromatic shadows.

The hemispheric sun technique always improves shadow casting, particularly where folding and cross-cutting structures occur. Nevertheless, it is important to center the hemisphere perpendicular to the regional strike. Features which strike parallel to the center of the hemisphere result in ambiguity. This is because the two sides of the feature may yield alternating patterns of sun and shadow. If this proves to be a problem in your survey area, Dighem's omni sun technique may be employed.

**Omni Sun**

The omni sun technique was also developed by Dighem. The survey area is centered within a ring of sunlight. This lights up all features without any strike bias. The result is brightly defined monochromatic features with diffuse shadows.

**Multi Sun**

Two or three spot suns, with different azimuths, may be combined in a single presentation. The shadows are displayed on one map by the use of different colors, e.g., by using a green sun and a red sun. Some users find the interplay of colors reduces the clarity of the shadowed product.

**Polychromatic Maps**

Any of the above monochromatic shadow maps can be combined with the standard contour-type solid color map. The result is a polychromatic shadow map. Such maps are esthetically pleasing, and are preferred by some users. A disadvantage is that ambiguity exists between changes in amplitude and changes in shadow.

Fig. 3-1 Shadow Mapping

# SURVEY RESULTS

## GENERAL DISCUSSION

Tables 4-1 to 4-3 summarize the EM responses, with respect to conductance grade and interpretation.

The electromagnetic anomalies are presented on the digital profiles. These were picked by a computer picking routine and have not been corrected by manual interpretation.

An accompanying volume contains a list of all the anomalies picked. It lists the amplitudes of the EM parameters and the conductivity, resistivity and depth calculated from various models.

Excellent resolution and discrimination of conductors was accomplished by using a fast sampling rate of 0.1 sec and by employing a common frequency (7200 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. The inphase and quadrature difference channels are displayed on the digital profiles.



TABLE 4-1

EM ANOMALY STATISTICS

FOR THE BLACKDOME MINE PROJECT AREA, BRITISH COLUMBIA, AREA A

| CONDUCTOR GRADE | CONDUCTANCE RANGE SIEMENS (MHOS) | NUMBER OF RESPONSES |
|---|---|---|
| 7 | > 100.0 | 2 |
| 6 | 50.0 - 100.0 | 5 |
| 5 | 20.0 - 50.0 | 49 |
| 4 | 10.0 - 20.0 | 119 |
| 3 | 5.0 - 10.0 | 360 |
| 2 | 1.0 - 5.0 | 3570 |
| 1 | < 1.0 | 3260 |
| * | INDETERMINATE | 1561 |
| TOTAL | | 8926 |

| CONDUCTOR MODEL | MOST LIKELY SOURCE | NUMBER OF RESPONSES |
|---|---|---|
| D | DISCRETE BEDROCK CONDUCTOR | 1078 |
| B | DISCRETE BEDROCK CONDUCTOR | 2064 |
| S | CONDUCTIVE COVER | 4149 |
| L | CULTURE | 1195 |
| ? | QUESTIONABLE | 440 |
| TOTAL | | 8926 |

(SEE EM MAP LEGEND FOR EXPLANATIONS)

TABLE 4-2

EM ANOMALY STATISTICS

FOR THE BLACKDOME MINE PROJECT AREA, BRITISH COLUMBIA, AREA B

| CONDUCTOR GRADE | CONDUCTANCE RANGE SIEMENS (MHOS) | NUMBER OF RESPONSES |
|---|---|---|
| 7 | > 100.0 | 0 |
| 6 | 50.0 - 100.0 | 0 |
| 5 | 20.0 - 50.0 | 0 |
| 4 | 10.0 - 20.0 | 6 |
| 3 | 5.0 - 10.0 | 12 |
| 2 | 1.0 - 5.0 | 255 |
| 1 | < 1.0 | 382 |
| * | INDETERMINATE | 191 |
| TOTAL | | 846 |

| CONDUCTOR MODEL | MOST LIKELY SOURCE | NUMBER OF RESPONSES |
|---|---|---|
| D | DISCRETE BEDROCK CONDUCTOR | 208 |
| B | DISCRETE BEDROCK CONDUCTOR | 220 |
| S | CONDUCTIVE COVER | 314 |
| L | CULTURE | 27 |
| ? | QUESTIONABLE | 77 |
| TOTAL | | 846 |

(SEE EM MAP LEGEND FOR EXPLANATIONS)



TABLE 4-3

EM ANOMALY STATISTICS

FOR THE BLACKDOME MINE PROJECT AREA, BRITISH COLUMBIA, AREA C

| CONDUCTOR GRADE | CONDUCTANCE RANGE SIEMENS (MHOS) | NUMBER OF RESPONSES |
|---|---|---|
| 7 | > 100.0 | 0 |
| 6 | 50.0 - 100.0 | 1 |
| 5 | 20.0 - 50.0 | 6 |
| 4 | 10.0 - 20.0 | 11 |
| 3 | 5.0 - 10.0 | 59 |
| 2 | 1.0 - 5.0 | 398 |
| 1 | < 1.0 | 187 |
| * | INDETERMINATE | 118 |
| TOTAL | | 780 |

| CONDUCTOR MODEL | MOST LIKELY SOURCE | NUMBER OF RESPONSES |
|---|---|---|
| D | DISCRETE BEDROCK CONDUCTOR | 19 |
| B | DISCRETE BEDROCK CONDUCTOR | 37 |
| S | CONDUCTIVE COVER | 502 |
| L | CULTURE | 199 |
| ? | QUESTIONABLE | 23 |
| TOTAL | | 780 |

(SEE EM MAP LEGEND FOR EXPLANATIONS)

Zones of poor conductivity are indicated where the inphase responses are small relative to the quadrature responses. Where these responses are coincident with strong magnetic anomalies, it is possible that the inphase 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 below background. If it is expected that poorly-conductive economic mineralization may be associated with magnetite-rich units, most of these weakly anomalous features will be of interest. In areas where magnetite causes the inphase components to become negative, the apparent conductance values may be understated and the calculated depths of EM anomalies may be erroneously shallow.

Due to the extent of cultural activity in this area, and the absence of up-to-date maps, all anomalies of interest in follow-up work should be checked on-site. Furthermore, anomalies due to geological sources may be partially obscured by cultural responses.

## Resistivity

Apparent resistivity maps were prepared from the 900 Hz,



7200 Hz and 56,000 Hz coplanar EM data. These maps show the conductive properties of the survey area.

The 56,000 Hz data has the greatest dynamic range but is biased towards surficial conductivity. It will primarily provide information about surface detail in the areas with conductive near-surface material. The 56,000 Hz resistivity also appears to be more active than the 7200 Hz resistivity.

The resistivity contour patterns are similar for the 7200 Hz and 900 Hz, however, the 7200 Hz yields lower resistivities. This is due to greater attenuation of the higher frequency in conductive surficial material.

## Magnetics

The total field magnetic data have been presented as contours on the base maps using a contour interval of 5 nT where gradients permit. The maps show the magnetic properties of the rock units underlying the survey area.

There is ample evidence on the magnetic maps 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.

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 maps. 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, should provide valuable information which can be used to effectively map the geology and structure in the survey area.

VLF

VLF results were obtained from transmitting stations at Seattle, Washington (NLK - 24.8 kHz) and Annapolis, Maryland (NSS - 21.4 kHz). Contour maps were not required as a final product but may be generated on request.



The VLF method is quite sensitive to the angle of coupling between the conductor and the proposed EM field. Consequently, conductors which strike towards the VLF station will usually yield a stronger response than conductors which are nearly orthogonal to it.

Closely-spaced conductors, conductors of short strike length or conductors which are poorly coupled to the VLF field, may escape detection with this method. Erratic signals from the VLF transmitters can also give rise to strong, isolated anomalies which should be viewed with caution.

## BACKGROUND INFORMATION

This section provides background information on parameters which are available from the survey data. Those which have not been supplied as survey products may be generated later from raw data on the digital archive tape.

## 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 sulfide lenses and steeply dipping sheets of graphite and sulfides. The broad class consists of wide anomalies from conductors having a large horizontal surface such as flatly dipping graphite or sulfide 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 electromagnetic map 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 sulfide bodies.

### Geometric interpretation

The geophysical interpreter attempts to determine the geometric shape and dip of the conductor. Figure 5-1 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

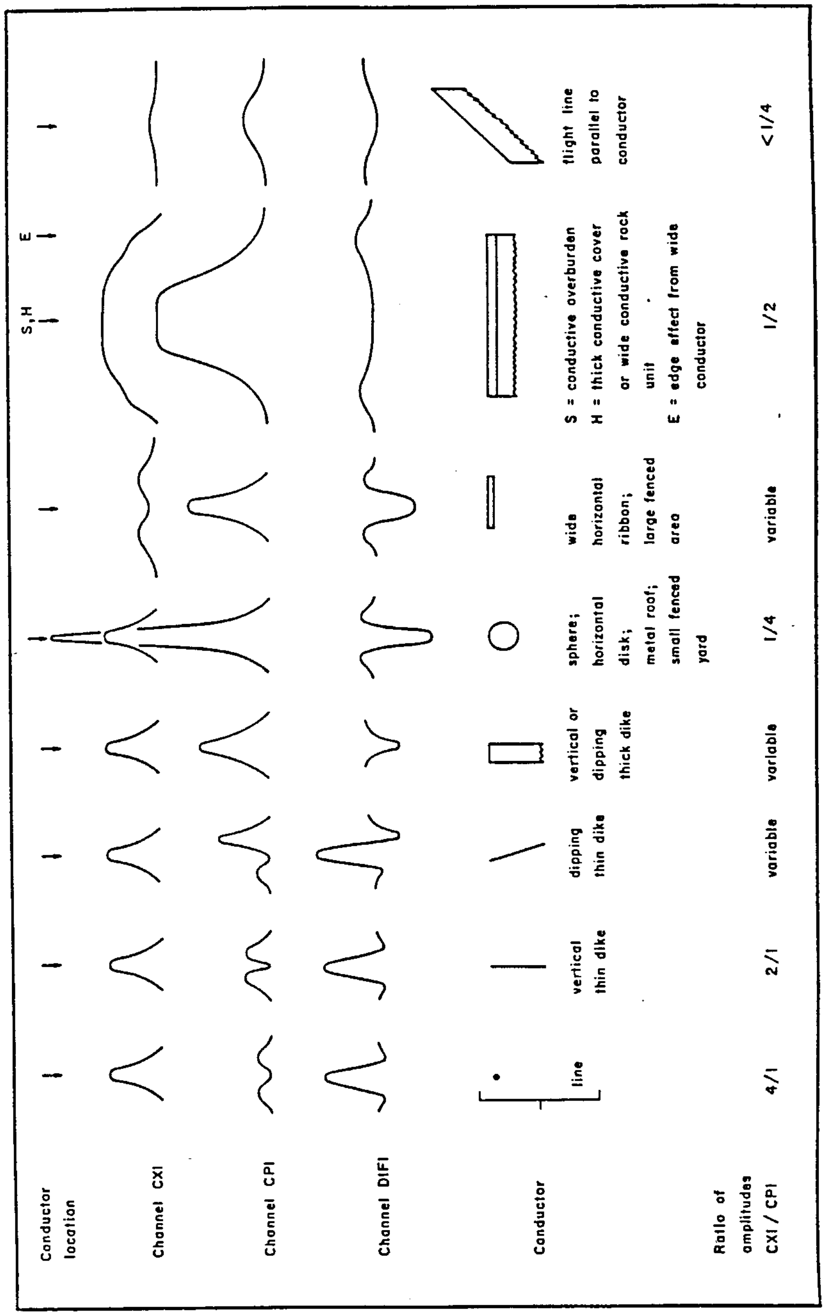



Fig. 5-1 Typical DIGHEM anomaly shapes



are divided into seven grades of conductance, as shown in Table 5-1 below. The conductance in siemens (mhos) is the reciprocal of resistance in ohms.

Table 5-1. 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 |

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.

Conductive overburden generally produces broad EM responses which may not be shown as anomalies on the EM maps. However, patchy conductive overburden in otherwise resistive areas can yield discrete anomalies with a conductance grade (cf. Table 5-1) 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 electromagnetic anomaly map (see EM map legend).

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 sulfides 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 sulfides or graphite. Moderate conductors (grades 4 and 5) typically reflect graphite or sulfides of a less massive character, while weak bedrock conductors (grades 1 to 3) can signify poorly connected graphite or heavily disseminated sulfides. 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.

On the interpreted electromagnetic map, 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 inphase 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.

Flight line deviations occasionally yield cases where two anomalies, having similar conductance values but dramatically different depth estimates, occur close together on the same conductor. Such examples illustrate the reliability of the conductance measurement while showing that the depth estimate can be unreliable. 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 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 maps 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.

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 sulfide 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 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 that have the appearance of valid bedrock anomalies on the flight profiles are indicated by appropriate interpretive symbols (see EM map legend). 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 sulfide 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

Areas of widespread conductivity are commonly



encountered during surveys. 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 inphase 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 trends in the bedrock and those patterns typical of 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 resistivity profiles and the resistivity contour maps present the apparent resistivity using the so-called pseudo-layer (or buried) half space model defined by Fraser (1978)[1]. This model consists of a resistive layer overlying

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

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 cover). The inputs to the resistivity algorithm are the inphase 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 are independent of the flying height. 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.

The resistivity map often yields more useful information on conductivity distributions than the EM map. In comparing the EM and resistivity maps, keep in mind the following:

(a) The resistivity map portrays the absolute value of the earth's resistivity, where resistivity = 1/conductivity.

(b) The EM map portrays anomalies in the earth's resistivity. An anomaly by definition is a change from the norm and so the EM map displays anomalies, (i) over narrow, conductive bodies and (ii) over the boundary zone between two wide formations of differing conductivity.

The resistivity map might be likened to a total field map and the EM map to a horizontal gradient in the direction of flight[2]. Because gradient maps are usually more sensitive than total field maps, the EM map therefore is to be preferred in resistive areas. However, in conductive areas, the absolute character of the resistivity map usually causes it to be more useful than the EM map.

Interpretation in conductive environments

Environments having background resistivities below 30 ohm-m cause all airborne EM systems to 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. These are the inphase and quadrature difference channels (DIFI and DIFQ), 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

2 The gradient analogy is only valid with regard to the identification of anomalous locations.



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.

The conductance channel CDT identifies discrete conductors which have been selected by computer for appraisal by the geophysicist. Some of these automatically selected anomalies on channel CDT are discarded by the geophysicist. The automatic selection algorithm is intentionally oversensitive to assure that no meaningful responses are missed. The interpreter then classifies the anomalies according to their source and eliminates those that are not substantiated by the data, such as those arising from geologic or aerodynamic noise.

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 inphase and DIFQ for quadrature) tend to eliminate the response of conductive overburden. This marked a unique development in airborne EM technology, as DIGHEM is the only EM system which yields channels having an exceptionally high degree of immunity to



conductive overburden.

Magnetite produces a form of geological noise on the inphase channels of all EM systems. Rocks containing less than 1% magnetite can yield negative inphase anomalies caused by magnetic permeability. When magnetite is widely distributed throughout a survey area, the inphase 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 inphase 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 inphase 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 inphase component which is negative in sign. When magnetic permeability manifests itself by decreasing the measured amount of positive inphase, its presence may be difficult to recognize. However, when it manifests itself by yielding a negative inphase 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 technique yields a channel (designated FEO) which displays apparent weight percent magnetite according to a homogeneous half space model.[3] 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

[3] Refer to Fraser, 1981, Magnetite mapping with a multi-coil airborne electromagnetic system: Geophysics, v. 46, p. 1579-1594.



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 inphase 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. Channel CPS monitors 60 Hz radiation. An anomaly on

this channel 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 center-peaked coaxial anomaly and an m-shaped coplanar anomaly.[4] When the flight crosses the cultural line at a high angle of intersection, the amplitude ratio of coaxial/coplanar response is 4. 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 2 rather than 4. Consequently, an m-shaped coplanar anomaly with a CXI/CPI amplitude ratio of 4 is virtually a guarantee that the source is a cultural line.

3. A flight which crosses a sphere or horizontal disk yields center-peaked coaxial and coplanar anomalies with a CXI/CPI amplitude ratio (i.e., coaxial/coplanar) of 1/4. In the absence of geologic bodies of this

[4] See Figure 5-1 presented earlier.



geometry, the most likely conductor is a metal roof or small fenced yard.[5] Anomalies of this type are virtually certain to be cultural if they occur in an area of culture.

4. A flight which crosses a horizontal rectangular body or wide ribbon yields an m-shaped coaxial anomaly and a center-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 center-peaked coplanar anomaly occurred, there would be concern that a thick geologic conductor coincided with the cultural line.

[5] 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.

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 channel CPS and on the camera film or video records.

## MAGNETICS

The existence of a magnetic correlation with an EM anomaly is indicated directly on the EM map. In some geological environments, an EM anomaly with magnetic correlation has a greater likelihood of being produced by sulfides than one that is non-magnetic. However, sulfide 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).



The magnetometer data are digitally recorded in the aircraft to an accuracy of one nT (i.e., one gamma) for proton magnetometers, and 0.01 nT for cesium magnetometers. The digital tape is processed by computer to yield a total field magnetic contour map. When warranted, the magnetic data may also be treated mathematically to enhance the magnetic response of the near-surface geology, and an enhanced magnetic contour map is then produced. The response of the enhancement operator in the frequency domain is illustrated in Figure 5-2. This figure shows that the passband components of the airborne data are amplified 20 times by the enhancement operator. This means, for example, that a 100 nT anomaly on the enhanced map reflects a 5 nT anomaly for the passband components of the airborne data.

The enhanced map, which bears a resemblance to a downward continuation map, is produced by the digital bandpass filtering of the total field data. The enhancement is equivalent to continuing the field downward to a level (above the source) which is 1/20th of the actual sensor-source distance.

Because the enhanced magnetic map bears a resemblance to a ground magnetic map, it simplifies the recognition of trends in the rock strata and the interpretation of geological structure. It defines the near-surface local

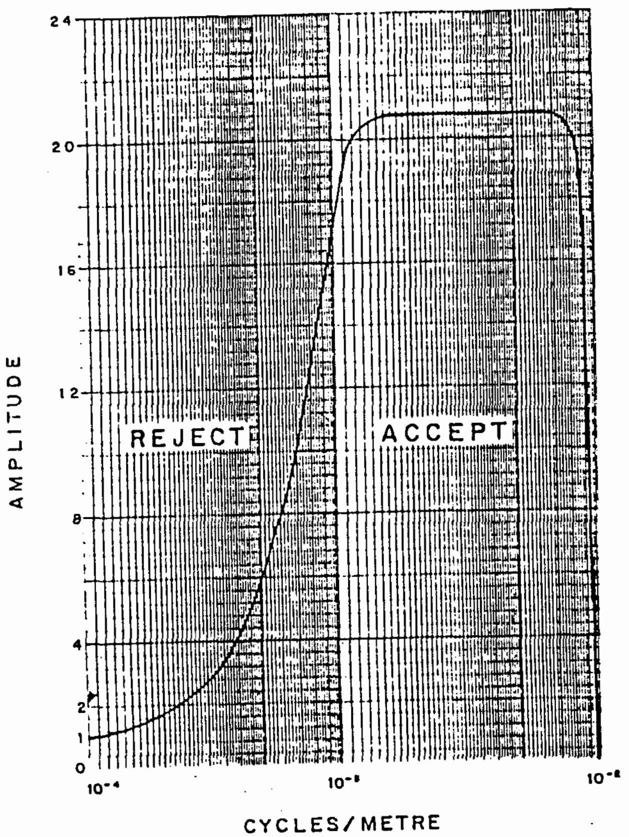



Fig. 5-2 Frequency response of magnetic enhancement operator for a sample interval of 50 m.



geology while de-emphasizing deep-seated regional features. It primarily has application when the magnetic rock units are steeply dipping and the earth's field dips in excess of 60 degrees.

Any of a number of filter operators may be applied to the magnetic data, to yield vertical derivatives, continuations, magnetic susceptibility, etc. These may be displayed in contour, colour or shadow.

**VLF**

VLF transmitters produce high frequency uniform electromagnetic fields. However, VLF anomalies are not EM anomalies in the conventional sense. EM anomalies primarily reflect eddy currents flowing in conductors which have been energized inductively by the primary field. In contrast, VLF anomalies primarily reflect current gathering, which is a non-inductive phenomenon. The primary field sets up currents which flow weakly in rock and overburden, and these tend to collect in low resistivity zones. Such zones may be due to massive sulfides, shears, river valleys and even unconformities.

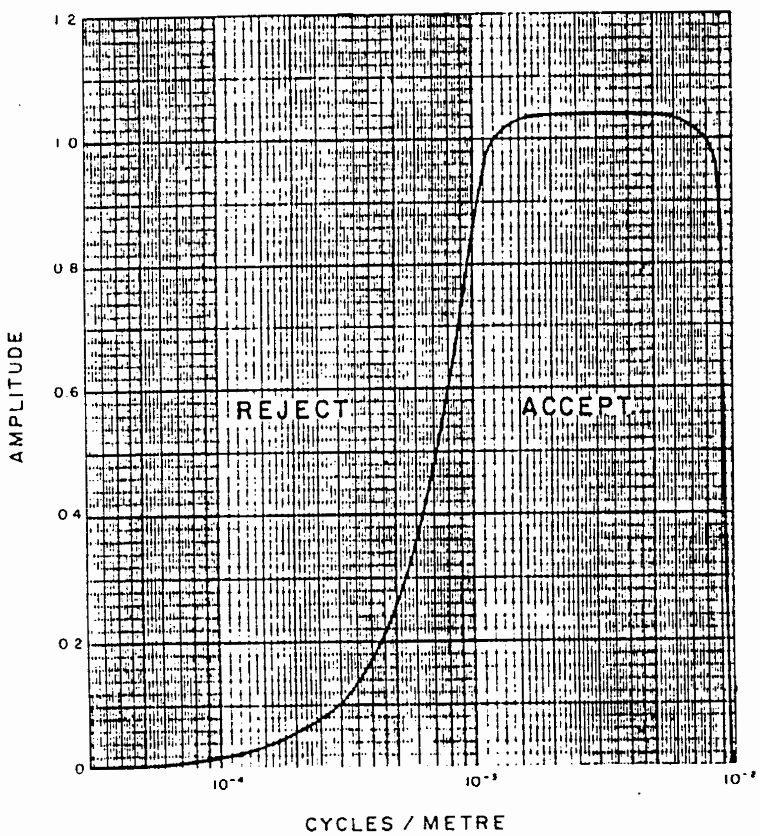



Fig. 5-3 Frequency response of VLF operator.



The VLF field is horizontal. Because of this, the method is quite sensitive to the angle of coupling between the conductor and the transmitted VLF field. Conductors which strike towards the VLF station will usually yield a stronger response than conductors which are nearly orthogonal to it.

The Herz Industries Ltd. Totem VLF-electromagnetometer measures the total field and vertical quadrature components. Both of these components are digitally recorded in the aircraft with a sensitivity of 0.1 percent. The total field yields peaks over VLF current concentrations whereas the quadrature component tends to yield crossovers. Both appear as traces on the profile records. The total field data are filtered digitally and displayed as contours to facilitate the recognition of trends in the rock strata and the interpretation of geologic structure.

The response of the VLF total field filter operator in the frequency domain (Figure 5-3) is basically similar to that used to produce the enhanced magnetic map (Figure 5-2). The two filters are identical along the abscissa but different along the ordinant. The VLF filter removes long wavelengths such as those which reflect regional and wave transmission variations. The filter sharpens short wavelength responses such as those which reflect local geological variations.

## CONCLUSIONS AND RECOMMENDATIONS

This report describes the equipment, procedures and logistics of the survey.

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 conjunction with all available geological, geophysical and geochemical information by qualified personnel. Areas of interest defined by the survey should be subjected to further investigation, using appropriate surface exploration techniques.

The use of Dighem's Imaging Workstation may provide additional useful information from the survey. Current processing techniques can yield structural detail that may be important in further defining the geologic setting.

Respectfully submitted,

**DIGHEM SURVEYS & PROCESSING INC.**

Douglas L. McConnell
Geophysicist

DLM/sdp

A1052JAN.90R

## APPENDIX A

### LIST OF PERSONNEL

The following personnel were involved in the acquisition, processing, interpretation and presentation of data, relating to a DIGHEM$^{IV}$ airborne geophysical survey carried out for Controlled Geophysics Inc., in the Blackdome Mine Project Area, British Columbia.

| | |
|---|---|
| Phillip Miles | Senior Geophysical Operator |
| G. Reigh | Pilot (Peace Helicopters Ltd.) |
| Pierre Brule | Pilot (Peace Helicopters Ltd.) |
| Gordon Smith | Computer Processor |
| Douglas L. McConnell | Geophysicist |
| Gary Hohs | Draftsperson |
| Susan Pothiah | Word Processing Operator |

The survey consisted of 1666 km of coverage, flown from October 2 to October 17, 1988. Geophysical data were compiled utilizing a VAX 11-780 computer.

All personnel are employees of Dighem Surveys & Processing Inc., except for the pilots who are employees of Peace Helicopters Ltd.

DIGHEM SURVEYS & PROCESSING INC.

Douglas L. McConnell
Geophysicist

DLM/sdp

Ref: Report #1052

A1052JAN.90R

# APPENDIX II

## Statement of Qualifications

G.R. Peatfield, P.Eng.

**STATEMENT OF QUALIFICATIONS**

I, Giles R. Peatfield, do hereby certify that:

1. I am a consulting Geological Engineer with an office at 104-325 Howe Street, Vancouver, V6C 1Z7.

2. I am a graduate of the University of British Columbia (B.A.Sc., Geological Engineering, 1966) and of Queen's University at Kingston (Ph.D., 1978).

3. I am a Fellow of the Geological Association of Canada, and a Member of the Canadian Institute of Mining and Metallurgy, of the Mineralogical Association of Canada, of the Association of Exploration Geochemists, and of the Association of Professional Engineers of British Columbia.

4. I have practiced my professsion as an exploration geologist for more than twenty years.

5. I am familiar with the MIDAS property and have been involved in programmes on the ground. I was present when the airborne programme was in progress, and have reviewed the results of the programme on this and adjacent ground.

PROFESSIONAL PROVINCE OF G. R. PEATFIELD

G. R. Peatfield

G.R. Peatfield,
Ph.D., P.Eng.

Dated at Vancouver, B.C. this 07 day of June, 1989

# APPENDIX III

## Statement of Qualifications

C.J. Vaughan, B.Sc. - Geophysicist

## STATEMENT OF QUALIFICATIONS

I, Christopher Vaughan residing at 136 Croteau Crescent in the city of Thornhill, province of Ontario do hereby certify that:

1. I am a geophysicist.
2. I graduated from the University of Toronto in 1982 with a B.Sc. in Geology and Physics.
3. I have been actively engaged in applied geophysics since 1982 and in geophysical exploration since 1984.
4. I have held associate and active membership in the Society of Exploration Geophysicists since 1982 and hold memberships in other professional societies involved with mining geophysics.
5. I was personally responsible for the interpretation of the geophysical data presented in this report.
6. I have no interest, direct, or indirect, in the property described nor do I hold securities in Blackdome Mining Corporation.

CGI CONTROLLED GEOPHYSICS INC.

C. J. Vaughan, B.Sc.
Senior Geophysicist

# APPENDIX IV

## Cost Statement

## APPENDIX IV

## COST STATEMENT - MIDAS PROPERTY

### Fees

| | | |
|---|---|---|
| G.R. Peatfield, P.Eng. - 30 hours office, reporting, etc. @ $65 | $1,950.00 | |
| | 1,950.00 | 1,950.00 |

### Disbursements

| | | |
|---|---|---|
| Pro-rated share of invoice from CGI Controlled Geophysics Inc. | 16,500.00 | |
| | 16,500.00 | 16,500.00 |

### Report Preparation

| | | |
|---|---|---|
| Word Processing | 120.00 | |
| Drafting charges | 100.00 | |
| Photocopies | 65.00 | |
| Reprographics | 150.00 | |
| Supplies | 15.00 | |
| | 450.00 | 450.00 |
| | | $18,900.00 |

PROFESSIONAL PROVINCE OF G. R. PEATFIELD BRITISH COLUMBIA ENGINEER

G.R. Peatfield

G.R. Peatfield, P.Eng.

## APPENDIX V

Statement of Work

&

Notice to Group

Province of British Columbia
Ministry of Energy, Mines and Petroleum Resources
MINERAL RESOURCES DIVISION — TITLES BRANCH

**MINERAL ACT**

DOCUMENT No ________
OFFICE USE ONLY

RECORDING STAMP

# Statement of Work — Cash Payment

I, Giles R. Peatfield (Name)
Valid subsisting FMC No. 280825 PEATGR
104-325 Howe Street (Address)
Vancouver, B.C.
V6C 1Z7 (Postal Code) (604) 685-3441 (Telephone Number)

Agent for Blackdome Mining Corporation (Name)
Valid subsisting FMC No. 280870 BLAMIC
P.O. Box 549 (Address)
Clinton, B.C.
V0K 1K0 (Postal Code) (604) 684-6031 (Telephone Number)

STATE THAT: [NOTE: If only paying cash in lieu, turn to reverse and complete columns G to J and S to V.]

1. I have done, or caused to be done, work on the MIDAS, Kado Fr., Midas #4, SNOWFLAKE, B. BOB I, B. BOB II, B. BOB III, OYSTER 1, OYSTER 2, L.A. Fr Claim(s)
Record No(s). 386, 493, 1098, 2781, 2801, 2802, 2803, 2804, 2805, 2807
Situate at Borin Creek in the Clinton Mining Division,
Work was done from Sept. 15, 19 88, to June 01, 19 89.

TYPE OF WORK

PHYSICAL: Work such as trenches, open cuts, adits, pits, shafts, reclamation, and construction of roads and trails. Details as required under section 13 of the Regulations, including the map and cost statement, must be given on this statement.

PROSPECTING: Details as required under section 9 of the Regulations must be submitted in a technical report. Prospecting work can *only be claimed once by the same owner of the ground, and only during the first three years of ownership.*

GEOLOGICAL, GEOPHYSICAL, GEOCHEMICAL, DRILLING: Details must be submitted in a technical report conforming to sections 5 through 8 (as appropriate) of the Regulations.

PORTABLE ASSESSMENT CREDIT (PAC) WITHDRAWAL: A maximum of 30% of the approved value of geological, geophysical, geochemical and/or drilling work on this statement may be withdrawn from the owner's or operator's PAC account and added to the work value on this statement.

| TYPE OF WORK (Specify Physical (include details), Prospecting, Geological, etc.) | VALUE OF WORK Physical | *Prospecting | *Geological etc. | |
|---|---|---|---|---|
| Pro-rated share of airborne geophysical survey on the MIDAS 1989 Group and surrounding claims, as detailed in the accompanying report. | | | 18,900 | |
| TOTALS | A + | B + | C 18,900 = | D 18,900 |
| PAC WITHDRAWAL — Maximum 30% of Value in Box C Only | | | E 900 → | E 900 |
| from account(s) of ~~Blackdome Mining Corporation~~ | | | TOTAL | F 19,800 |

* Who was the operator (provided the financing)?
Name Blackdome Mining Corporation
Address P.O. Box 549
Clinton, B.C. Phone: 684-6031

Transfer amount in Box F to reverse side of form and complete as required.

M28-2024 MTL 112

F $ 19,800 I WISH TO APPLY $ 19,800 OF THE TOTAL VALUE FROM BOX F AS FOLLOWS:

Columns G through R inclusive MUST BE COMPLETED before work credits can be granted to claims.
Columns G through J and S through V inclusive MUST BE COMPLETED before a cash payment or rental payment can be credited.
Columns not applicable need not be completed.

# Cash Payment

CLAIM IDENTIFICATION | APPLICATION OF WORK CREDIT | CASH IN LIEU OF WORK OR LEASE RENTAL

| | G | H | I | J | K | L | | N | O | P | Q | R | S | T | U | V |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CLAIM NAME (one claim/lease per line) | RECORD No. | No. OF UNITS* | CURRENT EXPIRY DATE | WORK TO BE APPLIED VALUE | YEARS | | RECORDING FEES 5% OF K | | PRIOR EXCESS CREDIT BEING USED | NEW EXPIRY DATE | EXCESS CREDIT REMAINING | C/L | RECORDING FEE | LEASE RENTAL | NEW EXPIRY DATE |
| 1 | MIDAS | 386 | 20 | 1995 | 8,000 | 2 | - | 400 | - | - | 23 Aug 97 | - | | | | |
| 2 | Midas #4 | 1098 | 20 | 1994 | 8,000 | 2 | - | 400 | - | - | 09 Sep 96 | - | | | | |
| 3 | LOKI | 2713 | 4 | 1992 | 800 | 1 | - | 40 | - | - | 09 Oct 93 | - | | | | |
| 4 | SNOWFLAKE | 2781 | 5 | 1992 | 1,000 | 1 | - | 50 | - | - | 18 Oct 93 | - | | | | |
| 5 | LOKI 2 | 2782 | 3 | 1992 | 600 | 1 | - | 30 | - | - | 24 Oct 93 | - | | | | |
| 6 | B.BOB I | 2801 | 1 | 1992 | 200 | 1 | - | 10 | - | - | 02 Nov 93 | - | | | | |
| 7 | B. BOB II | 2802 | 1 | 1992 | 200 | 1 | - | 10 | - | - | 02 Nov 93 | - | | | | |
| 8 | B. BOB III | 2803 | 1 | 1992 | 200 | 1 | - | 10 | - | - | 02 Nov 93 | - | | | | |
| 9 | OYSTER 1 | 2804 | 1 | 1992 | 200 | 1 | - | 10 | - | - | 04 Nov 93 | - | | | | |
| 10 | OYSTER 2 | 2805 | 1 | 1992 | 200 | 1 | - | 10 | - | - | 04 Nov 93 | - | | | | |
| 11 | A.J. Fr. | 2806 | 1 | 1992 | 200 | 1 | - | 10 | - | - | 01 Nov 93 | - | | | | |
| 12 | L.A. Fr. | 2807 | 1 | 1992 | 200 | 1 | - | 10 | - | - | 02 Nov 93 | - | | | | |
| 13 | | | | | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | | | | | |
| 16 | | | | | | | | | | | | | | | | |
| 17 | | | | | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | | | | | |
| | | | | | 19,800 TOTAL OF K | | | 990 TOTAL OF N | - TOTAL OF O | | | | TOTAL OF S | TOTAL OF T | TOTAL OF U | |

NOTICE TO GROUP No. ________ RECORDED 01 March 1989

* 2 POST FRACTION, REV CROWN GRANT ARE 1 UNIT EACH

Value of work to be credited to portable assessment credit (PAC) account(s).
[May only be credited from the approved value of Box C not applied to claims.]

| | Name | AMOUNT |
|---|---|---|
| Name of owner/operator | 1. | |
| | 2. | |
| | 3. | |

I, the undersigned Free Miner, hereby acknowledge and understand that it is an offence to knowingly make a false statement or provide false information under the *Mineral Act*. I further acknowledge and understand that if the statements made, or information given, in this Statement of Exploration and Development are found to be false and the exploration and development has not been performed, as alleged in this Statement of Exploration and Development, then the work reported on this statement will be cancelled and the subject mineral claim(s) may, as a result, forfeit to and vest back to the Province.

Signature of Applicant

Province of British Columbia
Ministry of Energy, Mines and Petroleum Resources
MINERAL RESOURCES DIVISION — TITLES BRANCH

DOCUMENT No. ______
OFFICE USE ONLY

SUB-RECORDER
RECEIVED
MAR 1 1989
M.R. # ...... $ ......
VANCOUVER, B.C.

RECORDING STAMP

*Mineral Tenure Act*
SECTION 28

# NOTICE TO GROUP

INDICATE TYPE OF TITLE MINERAL
(Mineral or Placer)*

I, Giles R. Peatfield (Name)
104-325 Howe Street (Address)
Vancouver, B.C.
(604) 685-3441 (Telephone) V6C 3Z1 (Postal Code)
Valid subsisting FMC No. 280825
FMC Code PEATGR

Agent for Blackdome Mining Corporation (Name)
P.O. Box 549 (Address)
Clinton, B.C.
(604) 684-6031 (Telephone) V0K 1K0 (Postal Code)
Valid subsisting FMC No. 280870
FMC Code BLAMIC

request that the following mineral titles be grouped under group name MIDAS 1989

Mining Division Clinton

Map No. 92O/7E,8W

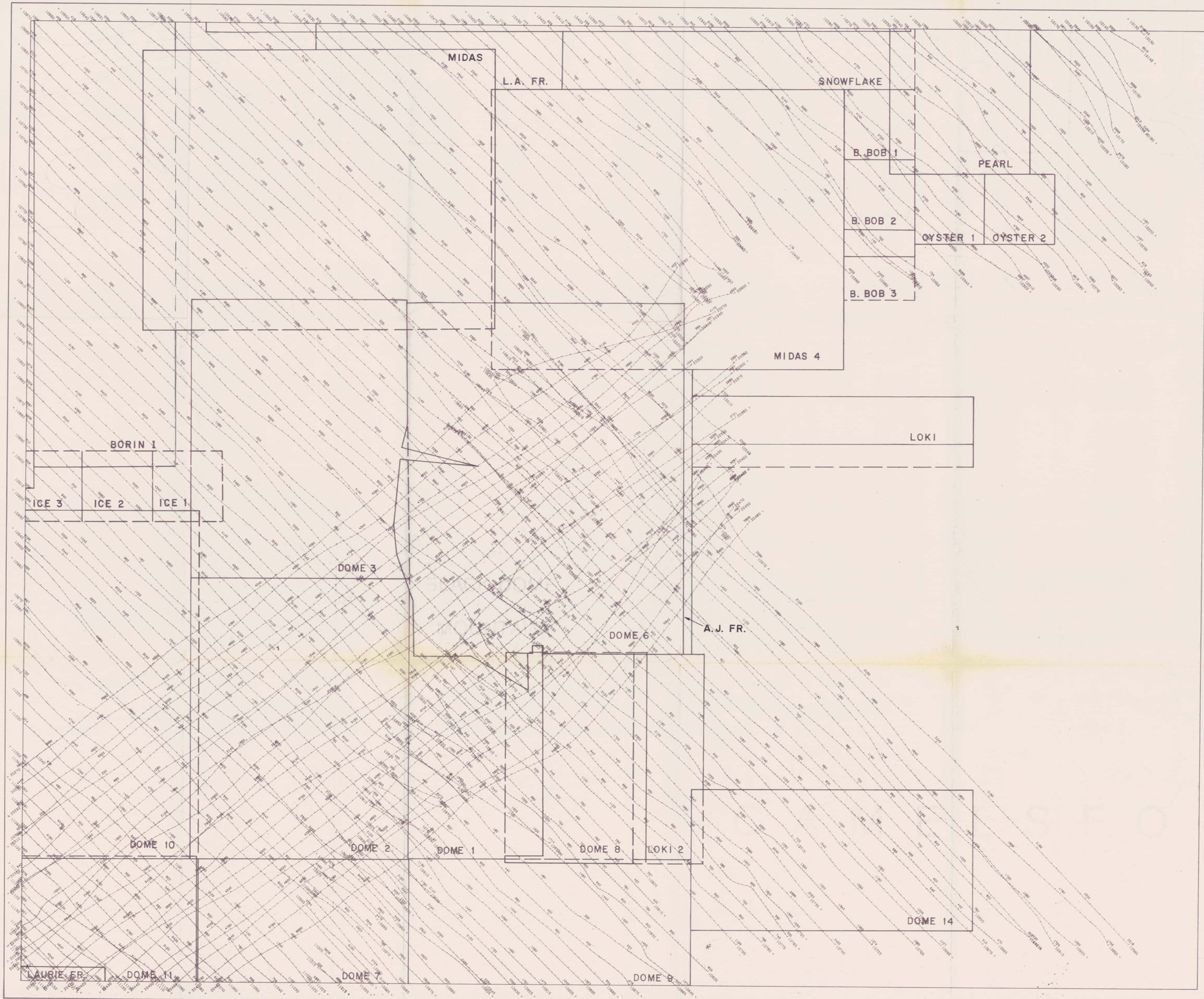
| Name of Claim | No. of Units | Title Number |
|---|---|---|
| MIDAS | 20 | 386 |
| Kado Fr. | 1 | 493 |
| Midas #4 | 20 | 1098 |
| LOKI | 4 | 2713 |
| SNOWFLAKE | 5 | 2781 |
| LOKI 2 | 3 | 2782 |
| B.BOB 1 | 1 | 2801 |
| B.BOB II | 1 | 2802 |
| B.BOB III | 1 | 2803 |
| OYSTER 1 | 1 | 2804 |
| OYSTER 2 | 1 | 2805 |

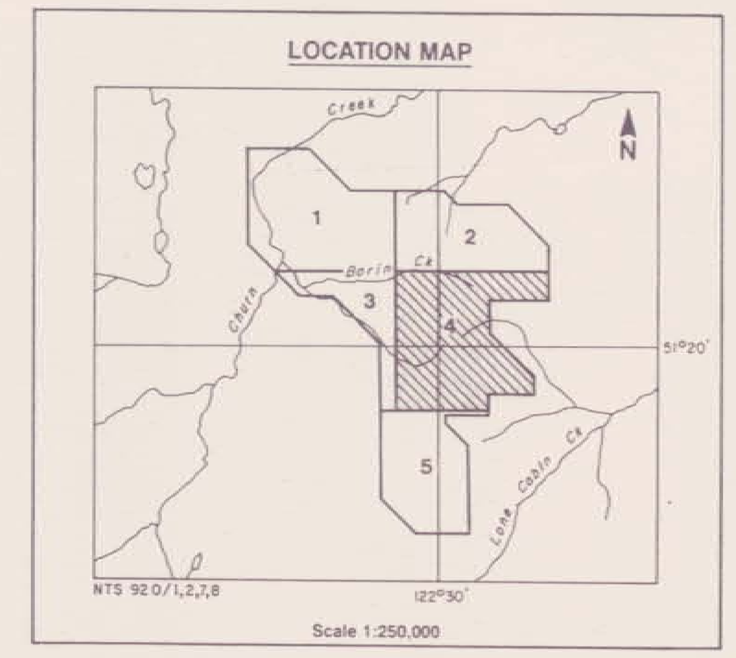
| Name of Claim | No. of Units | Title Number |
|---|---|---|
| A.J. Fr. | 1 | 2806 |
| L.A. Fr. | 1 | 2807 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

(Signature of Applicant)

*NOTE: Mineral claim(s) and lease(s) cannot be grouped with placer claims and leases

MTL 114 REV. 88/07
W-1426




## FLIGHT LINES

13010 13020 — Flight direction

Flight line number

Fiducials identified on profiles

*NOTE:* There are some minor changes to claim boundaries - see figure 2

GEOLOGICAL BRANCH
ASSESSMENT REPORT

18,835

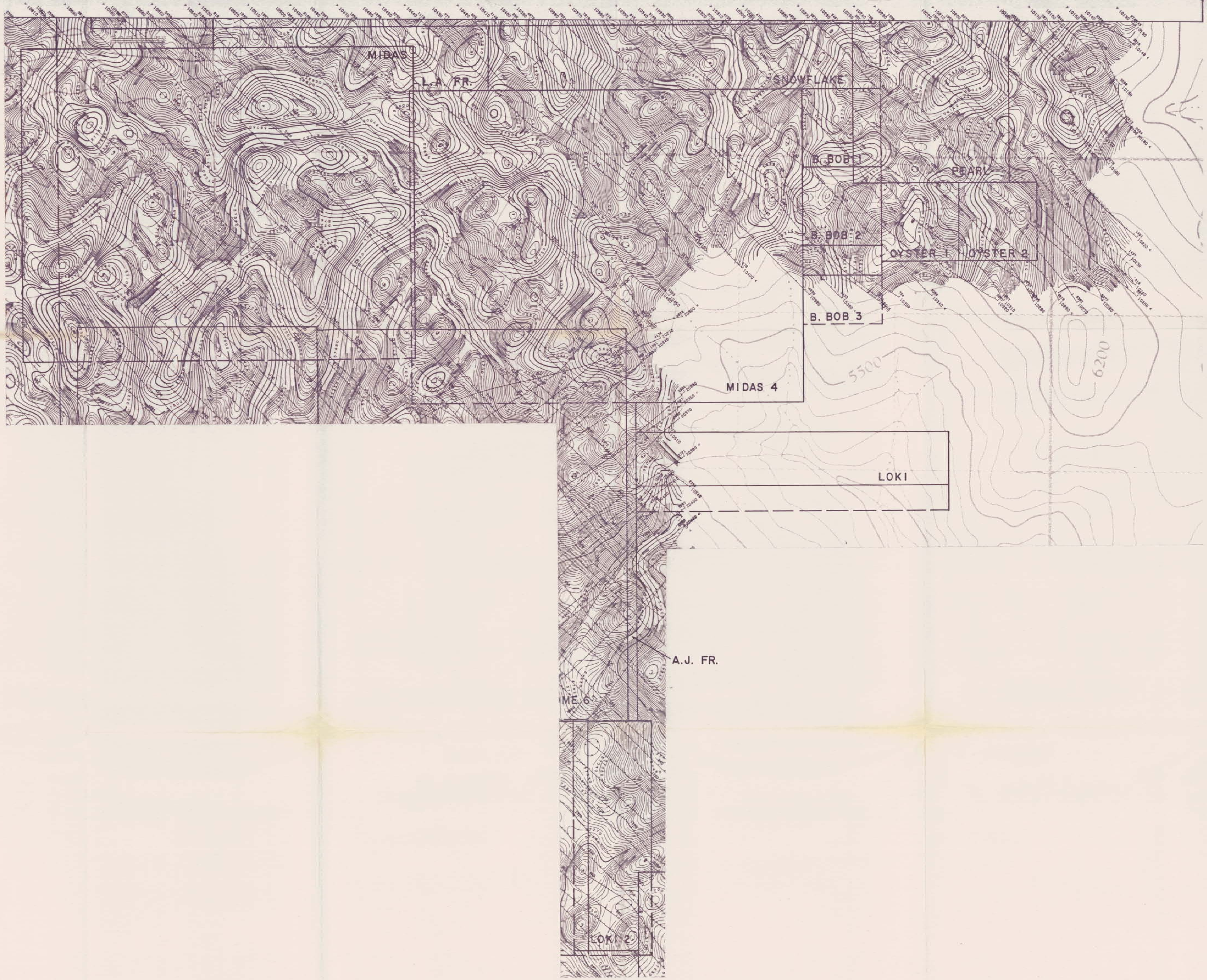
**BLACKDOME MINING CORP.**
BLACKDOME MINE AREA
PROJECT MANAGEMENT BY: CONTROLLED GEOPHYSICS INC.

# FLIGHT LINES

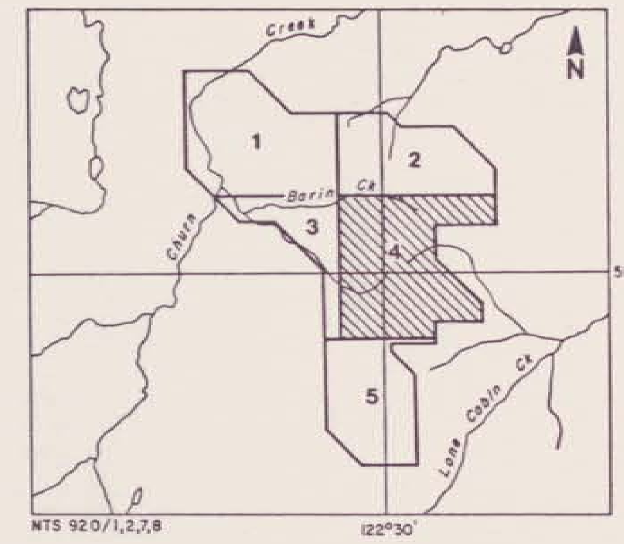
| | | |
|---|---|---|
| DIGHEM[IV] SURVEY | GEOPHYSICIST: D.M. | DRAFTING By: G.H. |
| DATE: DEC. 1988 | JOB: 1052 | SHEET: 4 |

Scale 1:10,000
0 — 1 Km
0 — 0.5 Mi

Figure 3

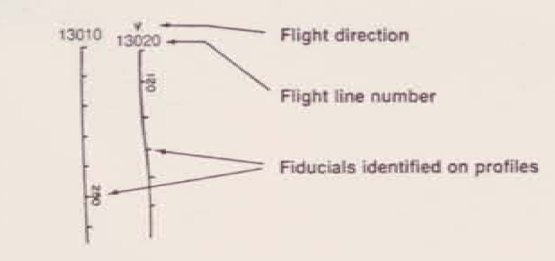



LOCATION MAP




Scale 1:250,000

FLIGHT LINES




LEGEND

Isomagnetic lines (total field)

250 ............ 250nT

50 ............ 50nT

10 ............ 10nT

............ 5nT

....... magnetic depression

Magnetic inclination within the survey area: 72°

*NOTE*: There are some minor changes to claim boundaries - see figure 2



**BLACKDOME MINING CORP.**
**BLACKDOME MINE AREA**
PROJECT MANAGEMENT BY: CONTROLLED GEOPHYSICS INC.

## TOTAL FIELD MAGNETICS

**BY DIGHEM SURVEYS & PROCESSING INC.**

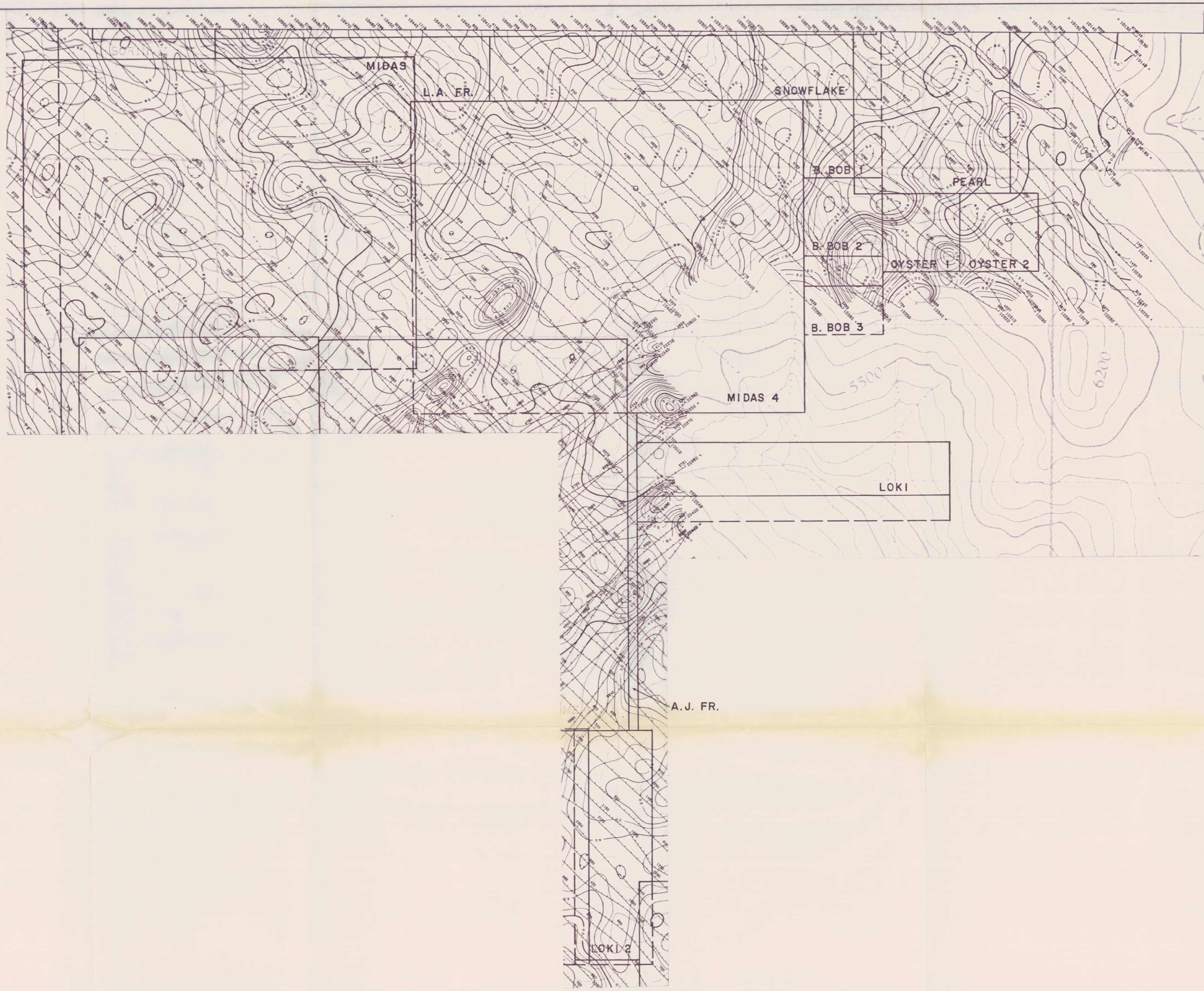
| | | |
|---|---|---|
| DIGHEM$^{IV}$ SURVEY | GEOPHYSICIST: D.M. | DRAFTING By: G.H. |
| DATE: DEC, 1988 | JOB: 1052 | SHEET: 4 |

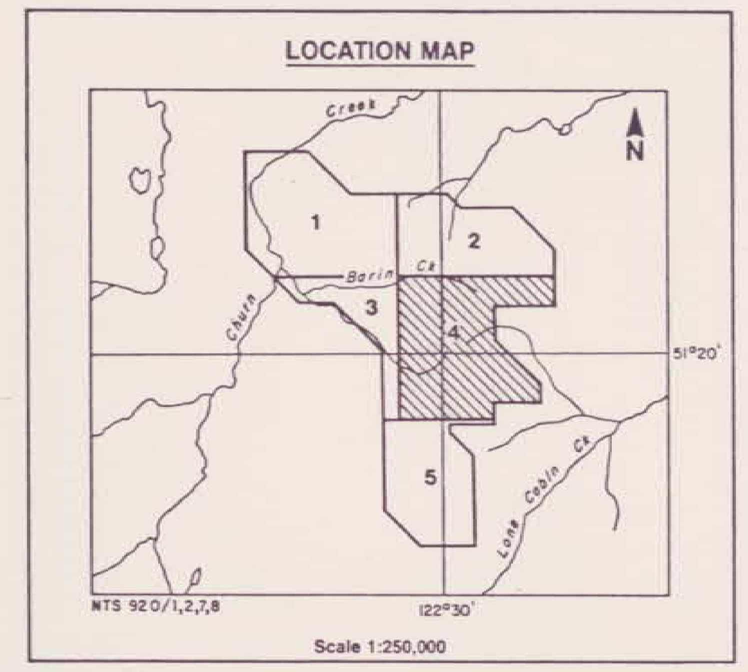
Scale 1:10,000

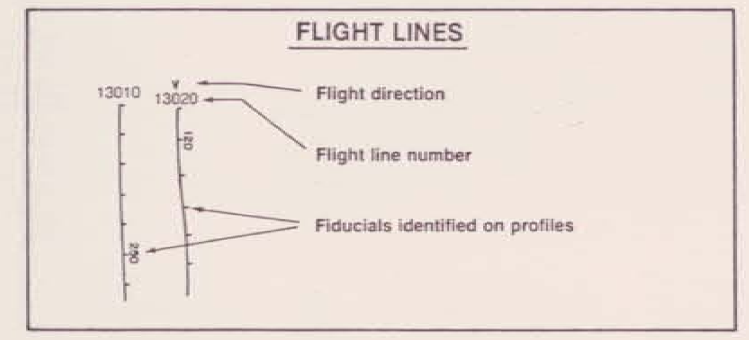
0 — 1 Km

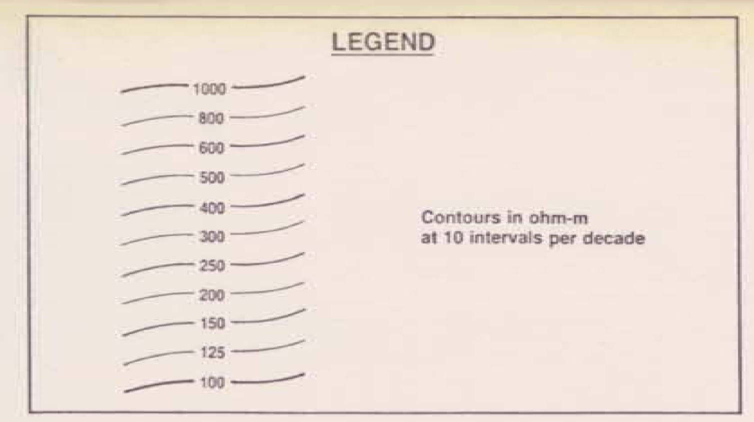
0 — 0.5 Mi

Figure 4




*NOTE:* There are some minor changes to claim boundaries – see figure 2

GEOLOGICAL BRANCH
ASSESSMENT REPORT

18,835

**BLACKDOME MINING CORP.**
**BLACKDOME MINE AREA**
**PROJECT MANAGEMENT BY: CONTROLLED GEOPHYSICS INC.**

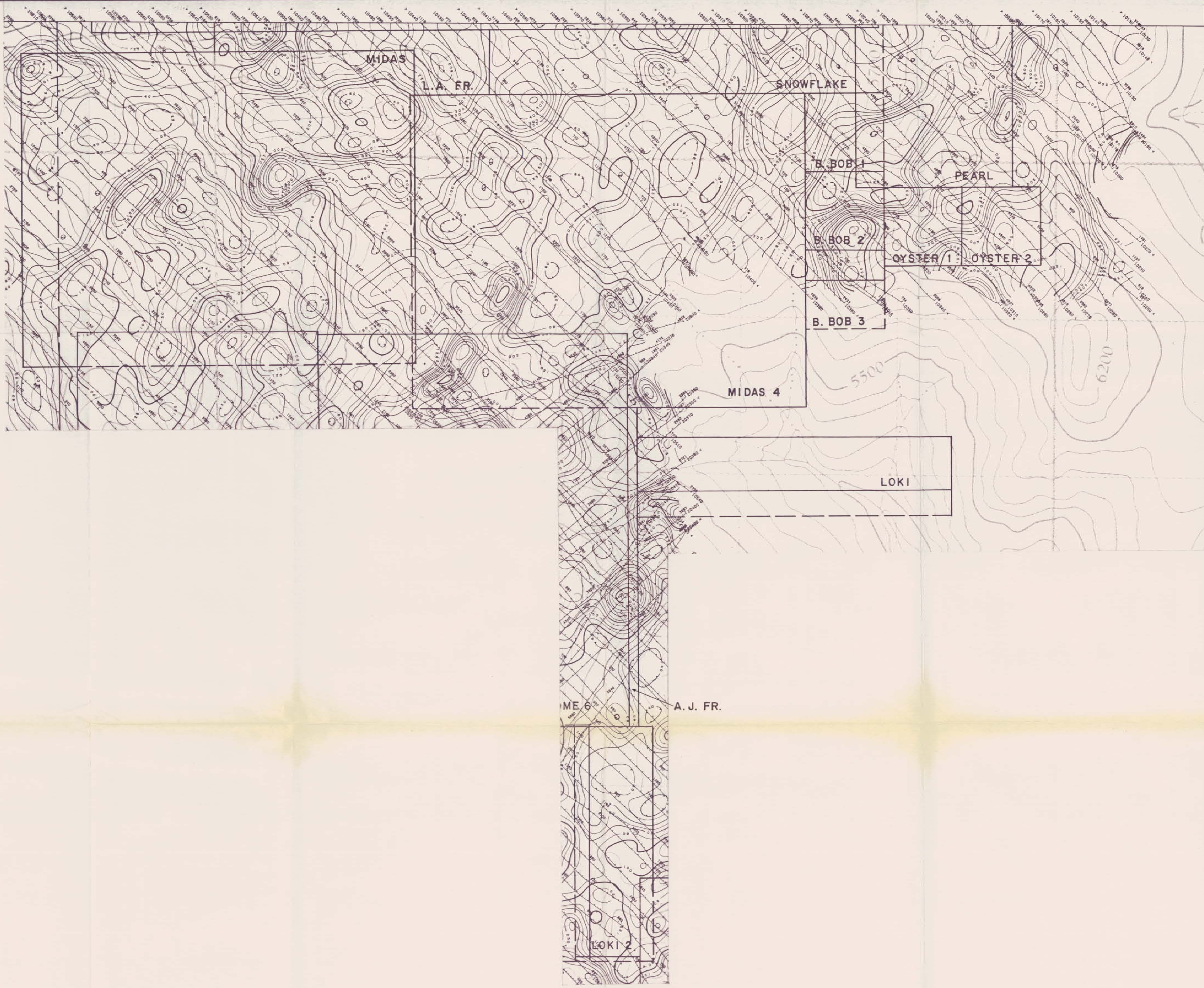
## RESISTIVITY (7200 Hz)

**BY DIGHEM SURVEYS & PROCESSING INC.**

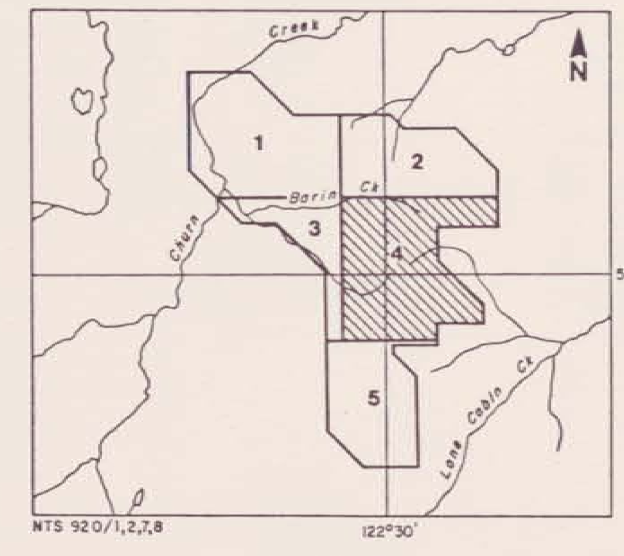
| | | |
|---|---|---|
| DIGHEM IV SURVEY | GEOPHYSICIST: D.M. | DRAFTING By: G.H. |
| DATE: DEC. 1988 | JOB: 1052 | SHEET: 4 |

Scale 1:10,000
0 — 1 Km
0 — 0.5 Mi

Figure 5

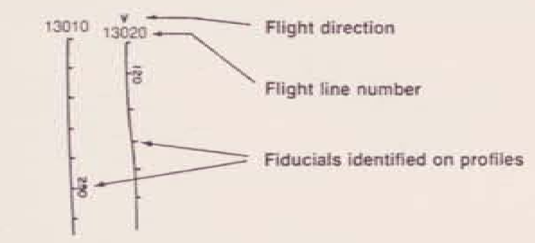



## LOCATION MAP

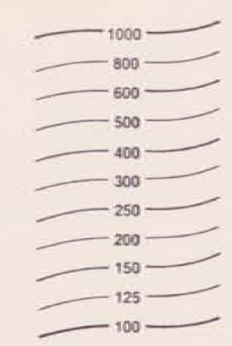



Scale 1:250,000

## FLIGHT LINES




## LEGEND




Contours in ohm-m
at 10 intervals per decade

*NOTE:* There are some minor changes to claim boundaries - see figure 2



**BLACKDOME MINING CORP.**
**BLACKDOME MINE AREA**
**PROJECT MANAGEMENT BY: CONTROLLED GEOPHYSICS INC.**

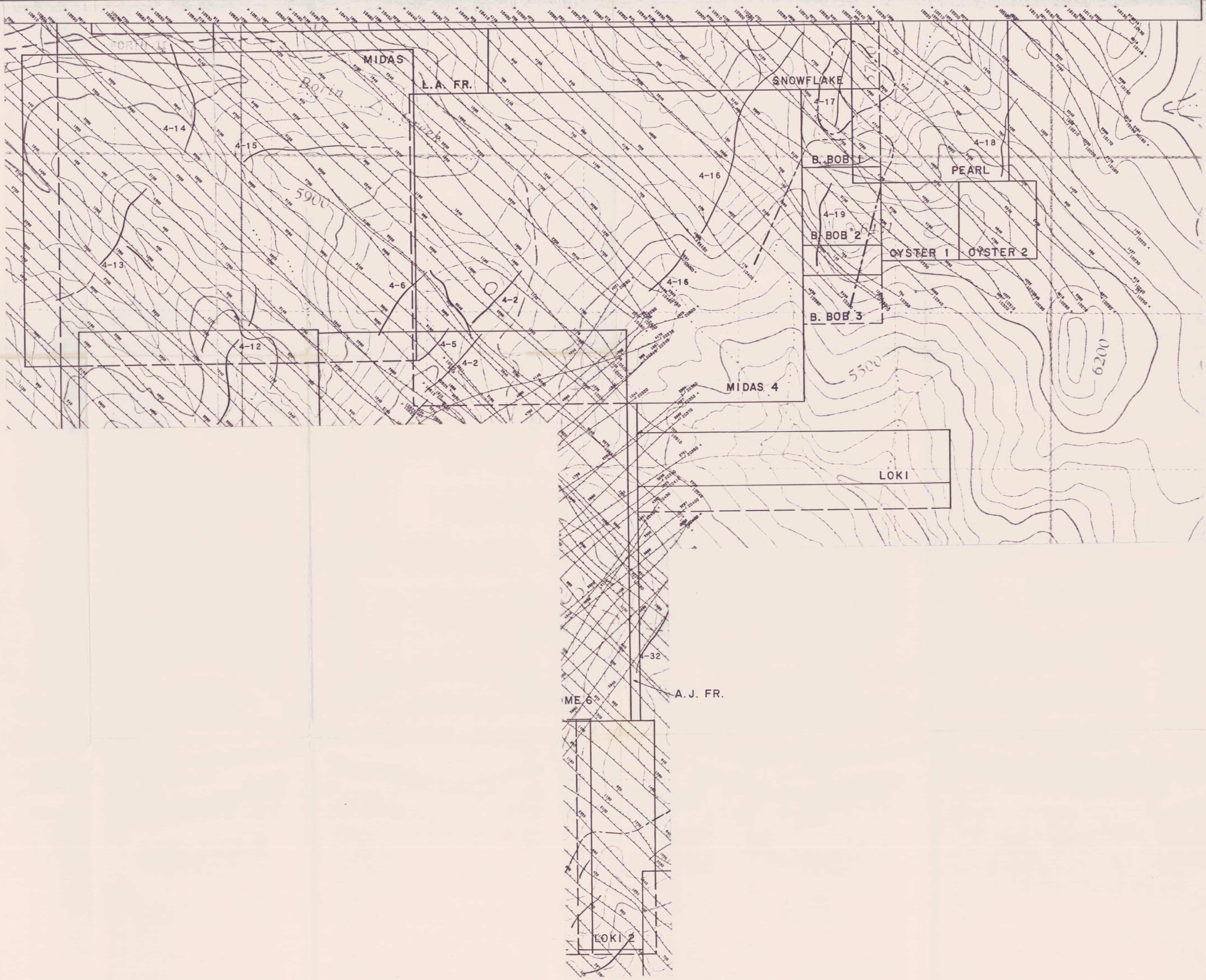
# RESISTIVITY (56,000 Hz)

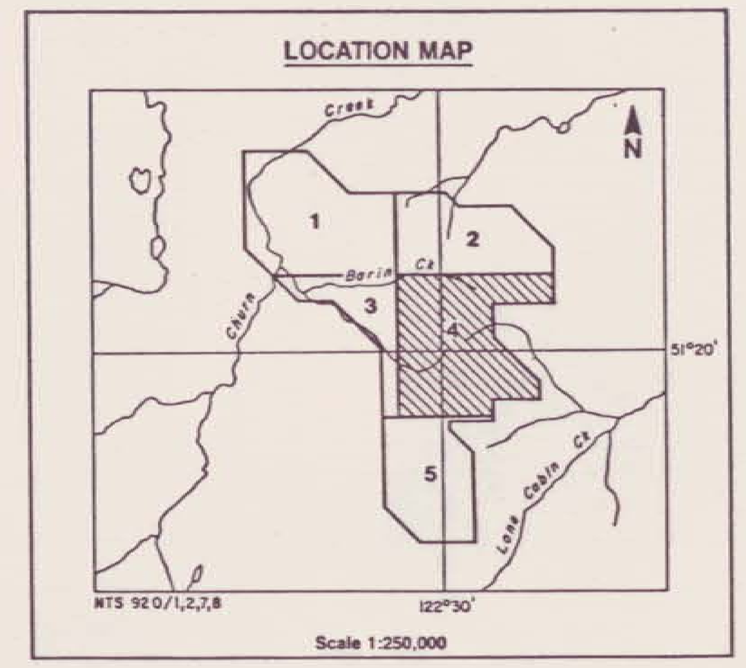
**BY DIGHEM SURVEYS & PROCESSING INC.**

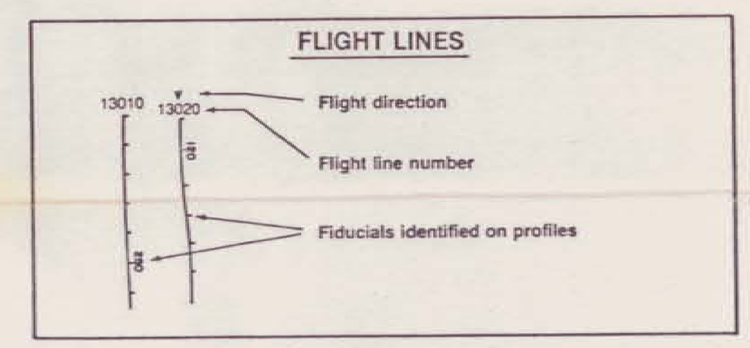
| | | |
|---|---|---|
| DIGHEM IV SURVEY | GEOPHYSICIST: D.M. | DRAFTING By: G.H. |
| DATE: DEC. 1988 | JOB: 1052 | SHEET: 4 |

Scale 1:10,000
0 — 1 Km
0 — 0.5 Mi

Figure 6




*NOTE:* There are some minor changes to claim boundaries - see figure 2

GEOLOGICAL BRANCH
ASSESSMENT REPORT

18,835

BLACKDOME MINING CORPORATION

Blackdome Mine Area, B.C.

– GEOPHYSICAL INTERPRETATION –
ANOMALOUS TRENDS AND AREAS

Mar. 1989 Sheet 4/5 Job # 6021

Data Compiled and Plotted by

*CONTROLLED* GEOPHYSICS

CGI CONTROLLED GEOPHYSICS INC.
Suite 31, 400 Matheson Blvd East, Mississauga, Ontario L4Z 1N8
Telephone (416) 568-4040 Fax (416) 568-4041

Scale 1:10,000
0 1 Km
0 0.5 Mi

Figure 7