GEOPHYSICAL REPORT
on a HELICOPTERBORNE MAGNETOMETER SURVEY

Claims WA#1-16, WC#1-60,#64-68,#74-76,#90-132,#135-141,#146-160,#162,#164,#169 Fr.,#168 Fr.
WB#2,#4,#6,#8,#10-16,#18,#20,#22,#24,#26,#28-32

Situated in the Clinton& Cariboo Mining Div.
Approx. 14 miles north of LacLaHache, B.C.
Latitude 51°58'N, Longitude 121°22'W
N.T.S. 92 P/14 and 93 A/3 for

AMAX POTASH LIMITED, Vancouver, B.C.

By S.L. SANDNER & ASSOCIATES, Vancouver, B.C.

Work was carried out during March 11 - April 28, 1972

Report by A. Mlcuch, PhD. Geophysicist and C.J. Hodgson, P.Eng.(B.C.)

92P/14E&W, 93A/3W

3882

3882

1972 Geophysical Report
Helicopterborne Magnetometer Survey

TITLE	Claims WA #1-16, WC #1-60,#64-68,#74-76, #90-132,#135-141,#146-160,#162,#164, #169Fr.,#168Fr., WB #2,#4,#6,#8,#10-16, #18,#20,#22,#24,#26,#28-32
AUTHOR	A. Mlcuch, PhD. Geophysicist and C.J. Hodgson, P.Eng. (B.C.)
DATE	July 1972
COMMODITY	Cu
LOCATION-Area	LacLaHache
-Mining Division	Clinton and Cariboo
-Coordinates	Latitude 51°58'W, Longitude 121°22'W
-NTS	92 P/14 and 93 A/3

AMAX Vancouver Office

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REPORT ON
HELICOPTERBORNE AEROMAGNETIC SURVEY
SPOUT LAKE AREA, FOR
AMAX EXPLORATION INC.

PREFACE

Magnetic susceptibility may change perceptibly from one lithologic unit to another; thus accurate detailed mapping of the geomagnetic field often provides valuable information about subsurface geology, even in heavily drift covered areas. Aeromagnetic surveying can aid in the delineation of buried contacts and disruptions, or the location of areas of possible plutonic differentiation. Often local magnetic patterns associated with known ore bodies can be identified, and the existence of similar variations in magnetic intensity elsewhere may lead to the discovery of new ore bodies.

INTRODUCTION

In March, 1972, S. L. Sandner & Associates of Vancouver, B.C., conducted an airborne magnetometer survey over a 65 square mile area, 12 air miles north of Lac la Hache in the Clinton Mining Division of British Columbia. A total of line miles of total intensity airborne magnetometer surveying was flown. This report describes the instrumentation, field procedure, data processing and discussion of the results obtained.

INTRODUCTION TO AEROMAGNETOMETRY

The earth has a magnetic field which is basically that of a magnetic dipole. There are, however, major and minor divergences from the basic dipolar field. Major diver-

gences are interpretable as indications of structure within the geoid proper and are of mostly academic interest. Minor differences are of more interest to the mineral prospector since they may be attributable to local variations in either the ferromagnetic susceptibility or the natural rock magnetism, or both. Since ferromagnetic susceptibility and natural rock magnetism change measurably from one rock type to another, accurate detailed mapping of the local geomagnetic field often provides valuable information about the subsurface geology (even in heavily drift-covered areas). Aeromagnetic surveys can provide information about the type, general attitude, configuration and complexity of the geo-superstructure. Local elements associated with known ore bodies can often be identified, and the existence of similar local elements elsewhere may lead to the discovery of new ore bodies. Aeromagnetic prospecting can be applied to the delineation of buried contacts and disruptions, or the location of areas of possible plutonic differentation and its varied products.

LOCATION AND ACCESS

The survey area covered by this report is approximately centered at Spout Lake, latitude 51° 58' N and longitude 121° 22' W (N.T.S. 92-P/14 and 93-A/3), 12 miles north of the town of Lac la Hache in Central British Columbia.

Access to the survey area is gained by a maintained (snow plowed in winter) road turning off at the village of

Lac la Hache, then northerly 15 miles to Spout Lake. Accommodations and radio-telephone communication facilities are available at Ta-hee-na Lodge on the western end of Spout Lake.

GENERAL SETTING

The area covered by this report lies in the northern region of the Thompson Plateau, a physiographic subdivision of the Interior Plateau. The maximum relief of the property is approximately 4,800 feet, but the mean elevation is 3,700 feet above sea-level.

The general geology of the area consists of the Nicola Group rocks, intrusive rocks and glacial deposits. The Nicola Group formation is assumed to be of Upper Triassic age. The intrusive rocks are similar in general composition and probably also in age to the Guichon Batholith (190 million years). Augite andesite flows and breccia (Nicola Group) cover the southeast part of the property. The volcanic rocks comprise a number of diverse types, but may be very largely grouped under the general term of greenstone. Associated with the lavas are tuffs, breccias, and agglomerates that also vary in colour and appearance. Among the lavas the most common type is a grey-green to bright green, fine-grained rock that shows much alteration to chlorite, calcite and epidote. A very similar rock carries phenocrysts of hornblende, which in many instances has developed by uralitic alteration of augite. The group also includes a number of feldspar porphyries. The porphyritic types generally show less alteration.

Rocks of Nicola Group exhibit a considerable alteration along the contact of the batholith on the east part of the property and are apparently more deformed than the younger rocks.

Primary rock-forming minerals in the batholith are hornblende-biotite, quartz diorite, and granodiorite. The rock is medium grained with plagioclase showing preferred orientation. Chlorite and epidote are widespread throughout the batholith in joints or other fractures, commonly accompanied by copper sulphides.

Glacial deposits mantle bedrock on the west side of the property.

The occurrence of several ages of intrusive rocks, of extensive fracturing, and of copper mineralization provides a combination suggesting that the area is geologically comparable to copper producing areas to the south.

* (1) Bulletin No. 56, K. E. Northcote, Geology and Geochronology of the Guichon Creek Batholith. British Columbia Department of Mines and Petroleum Resources, 1969.

(2) G.S.C. Memoir 243, H. M. A. Rice, Geology and Mineral Deposits of the Princeton Map-Area, British Columbia. Department of Mines and Technical Surveys, 1960.

(3) G.S.C. Memoir 249, W. E. Cockfield, Geology and Mineral Deposits of Nicola Map-Area, British Columbia. Department of Mines and Technical Surveys, 1961.

(4) Annual Report, Minister of Mines and Petroleum Resources, British Columbia, 1966.

AIRBORNE FIELD PROCEDURE

The total intensity of the geomagnetic field was measured and recorded along 72 flight lines, flown in a general east-west direction. Two tie lines were flown consecutively in a north-south direction.

The survey was flown in a Bell Jet Ranger 206A towing an air foil sensor with a Varian V4937A proton precission magnetometer (± 1 Gamma), Varian SDV 4991 digital paper punch recorder and a Neyhard Automax 35 m.m. pulse camera. The terrain clearance was recorded with a Bonzar pulse type radar altimeter.

Analog records were made of the total magnetic field intensity and terrain clearance during flight.

At one second intervals, the field amplitude and fiducial number were recorded on punch tape by the digital recording system. At thirty second intervals, the time and line number were punched on the tape. At five second intervals, a split image camera simultaneously photographed (1) the terrain,

and (2) the clock and fiducial display panel. Thus, each terrain photograph is bordered by a photograph of the clock, and fiducial number.

A ground magnetometer monitored the geomagnetic field during the survey.

Solar flare warnings and predictions, issued daily at the Space Disturbance Forecase Centre in Boulder, Colorado, were used to schedule the flight during a magnetically quiet period.

The punch tape, chart and strip photograph processing is described in the following section. Instrument specifications are in Appendix I.

DATA PROCESSING

The data processing procedure consisted of four steps discussed under the following headings:

1. Flight line X-Y positioning.
2. Editing of the paper tape.
3. Tabulation of critical fiducial numbers and their X-Y co-ordinates.
4. Contour plotting.

1. Flight Line X-Y Positioning

From the aircraft, while the lines were being flown, the flight lines were roughly positioned on government aerial photographs. In the office, the beginning and end of each

flight line was marked on the strip photographs. S. L. Sandner & Associates personnel transferred the flight lines onto a mosaic prepared from the government photos.

An X-Y co-ordinate system was superimposed on the flight line mosaic with +Y north and +X east (see Figure 4). Thus, every position along a flight line was defined in terms of X (number of feet east of the origin) and Y (number of feet north of the origin), and has a corresponding magnetic value in gammas.

2. Editing of the Paper Tape

A computer printed listing of the contents of the paper tape was made and compared with the analogue record as a guard against possible machine or operator error.

3. Tabulation of Critical Fiducial Numbers

The first and last fiducial number on each line were tabulated along with their X-Y co-ordinates. In addition, points where the flight line changed direction were tabulated along with the appropriate fiducial number. The tabulated information was then keypunched onto computer cards.

4. Contour Plotting

The punch tape information was input to a computer, along with the X-Y co-ordinates of the start, end and any changes of direction that may have occurred in the flight line. The data sampling interval along the flight lines was roughly

200 feet. The magnetometer readings were evenly spaced along the line segments and posted by a computer-plotter unit. The posted values were than hand contoured at a contour interval of 100 gammas.

DISCUSSION OF AIRBORNE DATA

This section is intended as an aid to geologic interpretation of the airborne geophysical survey data.

In general, geophysical features which can originate from, or are associated with mineralization are used to localize favourable sites for more intensified exploration. The presence of certain minerals (e.g. magnetite), and geologic features (e.g. faulting) are detectable from geophysical observations. Faulting is sometimes expressed in a magnetic map as a steep gradient or magnetic low. Magnetic highs can be caused by increased concentrations of magnetic minerals.

Contact between two different rock types or phase differences within the same rock type often are expressed as moderate gradient along the interface. This effect is related to the difference in magnetic susceptibility between the two rock types.

In general, the geophysical data from a survey of this type can only be evaluated after a detailed examination and comparison of the geophysical data, terrain clearance charts, air photographs and government photograph mosaic. For instance, an anomaly on the magnetic map may be due to an occurrence of

concentrated magnetic minerals. However, relative to the other magnetic peaks it may be partially influenced by terrain clearance. Thus, an anomaly adjacent to it may prove to have an equal concentration of magnetic minerals.

COMMENTS ON RESULTS

Low level airborne magnetic survey gives many details of the single magnetic anomaly shown on the government aeromagnetic map. The total intensity contour map (Figure 5) displays very complex but very interesting results.

Of major interest is the contact of Nicola Group rocks with intrusive rocks south-east of Spout Lake. The most significant magnetic feature is the volcanic intrusive anomaly with high surrounding ridges and an extreme low in the centre. This unusual magnetic feature is shaped like a volcanic cone. A very broad high anomaly is observed along the contact. The east side of the anomaly has very steep gradient; the west side is more gentle.

This pattern resembles the Copper Mountain-Ingerbell anomaly, where the ore body lies on the slope near the highest magnetic value.

North of Spout Lake a basaltic flow creates an anomaly with higher magnetic values on the east. A south-west corner of a larger anomaly can be seen north of Canim Creek near the north boundary of the map sheet.

The highest magnetic value on this map sheet lies

immediately to the north of Rail Lake. A N-S fault pattern is apparent in this vicinity. The intensity markedly decreases to the west and the profile becomes very smooth. The local discontinuity can be interpreted as the expression of a basement fault.

It is suggested that aeromagnetic survey of this area provides a valuable assistance in the search for mineral deposits.

Respectfully Submitted:

Alexander Mlcuch

A. Mlcuch, PhD.
Geophysicist.

S. L. Sandner

S. L. Sandner, B.Sc.
Geologist/Geophysicist.

April 26, 1972.

C. J. Hodgson, P.Eng. (B.C.)

C. J. Hodgson

APPENDIX I

SPECIFICATIONS OF THE V-4937A MAGNETOMETER SYSTEM

Performance

Range:	20,000 to 100,000 gamma (worldwide)
Sensitivity:	± 1/2 and ± 1 gamma in any field.
Sampling Rate:	manual and "clock" operation permits any timing sequence.

Power Requirements

22-30 V, 6 amps for magnetometer, 60 watts for analog recorder and 100 watt maximum for digital recorder.

Physical Specifications

Console:	size - 19 x 17 x 24 inches; Weight 68 lbs.
Analog Recorder:	dual channel - 15 x 10 x 10 inches, 30 lbs.
Scanner-coupler:	fucical counter, ident. control, 24 hr. clock, 40 lbs.
Recorder:	size - 14 x 11 x 28 inches; Weight 41 lbs.

Data Output

Digital Recording:	BCD 1-2-4-8 (four line output) "O" state - 18 to -30v through 100K ohms 1 state -1 to +3v through 100k ohms
Print Command:	Positive going 12 to 25v pulse; 15M second.
Auxiliary Channels:	A & B for radio altimeter and navigation equipment.
Analog Recording:	Galvanometric -1 mA full scale into 1500 ohms Potentiometric: 100mV full scale. Minimum load resistance 20K Full scale resolution of the least most significant digits of the total geomagnetic field 0-99, 0-999 at 1 gamma sensitivity; 0-49, 0-499 at 1/2 gamma sensitivity.

APPENDIX I Cont'd.

Instrument Specifications

Camera

Type:	Neyhard Automax 35 m.m. pulse camera
Model:	G-2 with auxiliary data box
Pulse Rate:	Up to 10 frames per second
Film Format:	0.738" x 0.738" square picture with 0.200" x 0.738" data area.
Magazine:	Mitchell 400 foot 35 m.m.
Lenses:	(a) 17 m.m. F/14 Super-Takumar Fish-eye (b) 35 m.m. F/2.0 Super Takumar
Data Box:	(a) 24 hour Accutron Clock (b) Frame counter (c) Available for optional feature
Dimensions (less magazine):	8 3/8" high, 4 1/2" deep, 6 1/4" wide.
Weight (less lens and magazine):	12 lbs.

APPENDIX II

PERSONNEL AND DATES WORKED

A. Field Work:

S.L. Sandner	Supervisor	March 11 - 13 incl.
Chad Murray	Pilot	March 11 - 21 incl.
Joe Denham	Operator	March 11 - 21 incl.

B. Report Preparation:

S.L. Sandner	April 26 - 28
A. Mlcuch - Data Processor	March 1 - 3 22 - 24 27 - 30 April 19 - 21 21 - 28

C. Drafting and Reproduction:

T. Malesku	March 22 - 24 27 - 30 April 24 - 28

D. Addresses:

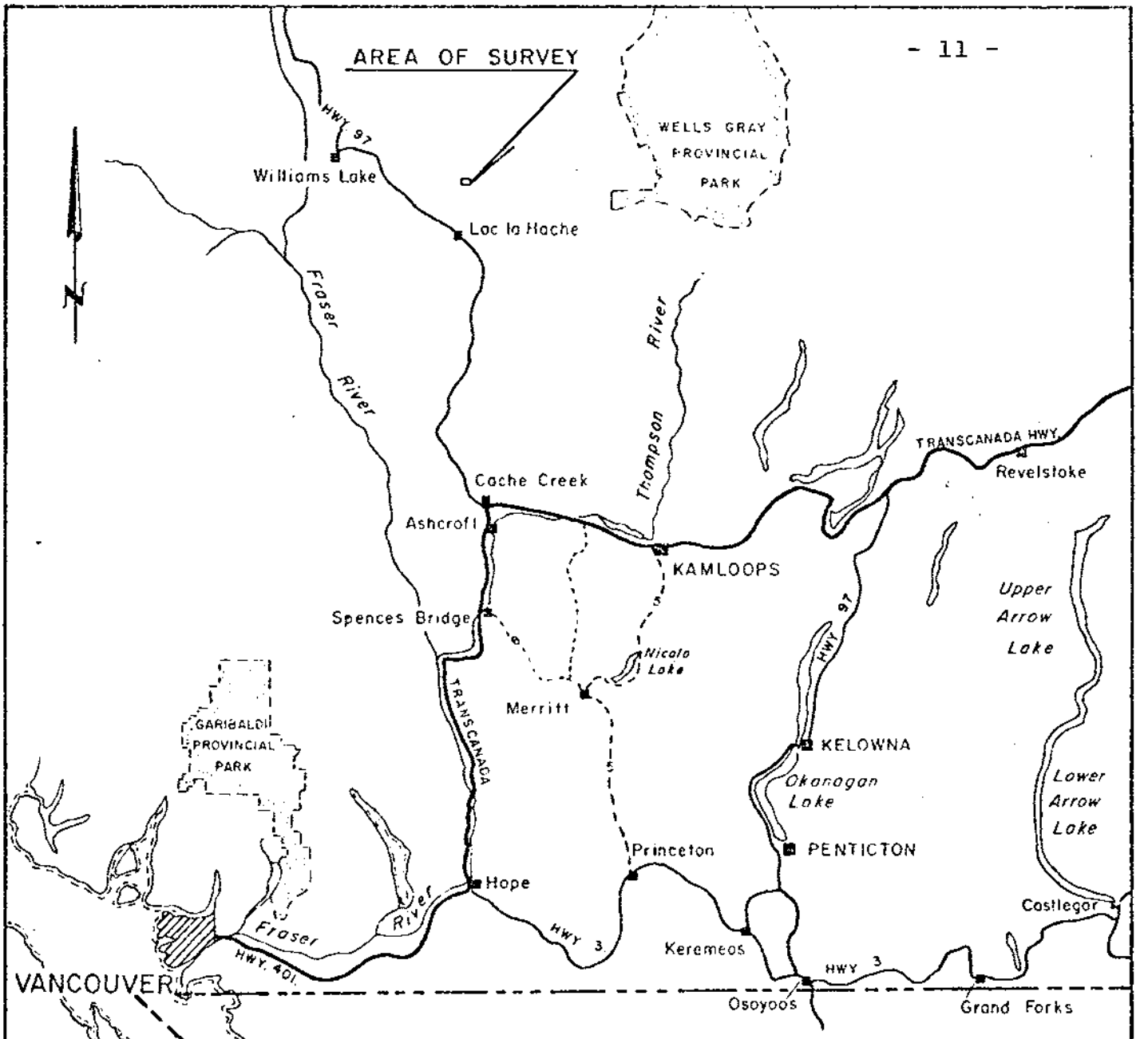
S.L. Sandner
6187 Granville St.,
Vancouver, B.C.

A. Mlcuch
#307 - 1234 Barclay St.
Vancouver, B.C.

T.D. Malesku
#310 - 1150 Burnaby St.,
Vancouver, B.C.

Joe Denham
6187 Granville St.
Vancouver, B.C.

Chad Murray (Pilot Highland Helicopters)
#806 - 7360 Halifax St.,
Burnaby 2, B.C.



Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 3882 MAP #1

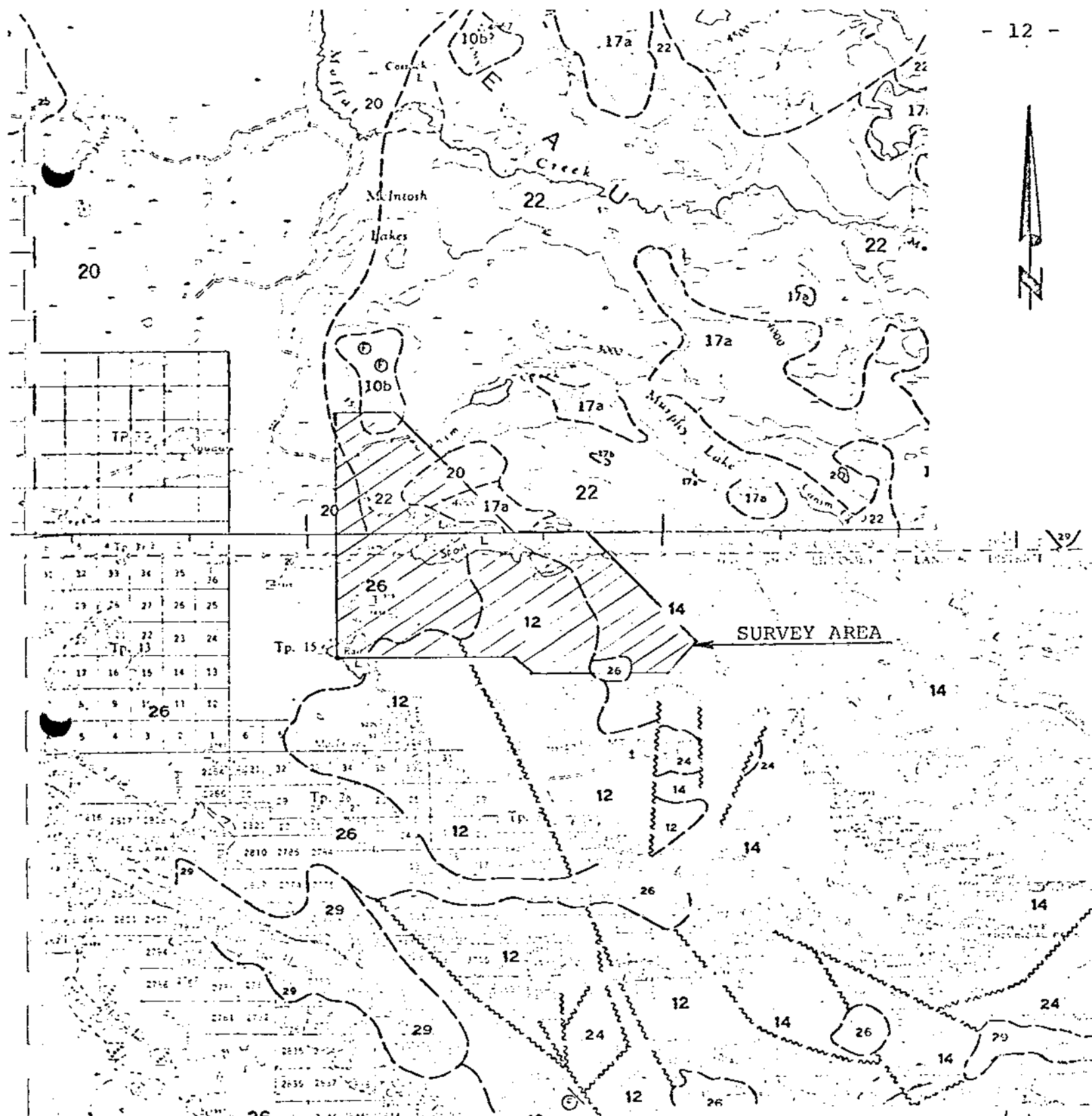
C J Hodgson

0 40 80 120
SCALE : MILES

AMAX EXPLORATION INC.
SPOUT LAKE AREA
BRITISH COLUMBIA

LOCATION MAP

DRAWN T.M.	DATED APRIL 28, 72	FIG. NO. 1
CHECKED	JOB NO. 1202	



LEGEND

10b, 12 - NICOLA GROUP

14, 17a - INTRUSIVE ROCKS

22, 26 - GLACIAL DEPOSITS

20 - BASALTIC FLOWS

Scale: 1 inch = 4 miles

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Fig. 2

Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 3882 MAP #3

E-M 3882

APPENDIX III

COST BREAKDOWN

As per agreement dated February 15, 1972, between Sandner & Associates and Amax Exploration Inc.

a) A total of 545 line miles of Helicopterborne Aeromagnetic Survey was completed

(i) 465 line miles are plotted on the mosaic

(ii) 80 line miles of extension lines and flights beyond the boundary of the survey used for contour control to the boundary. Data from these lines are included in the flight tape records.

As per Paragraph 8 of the said agreement:

545 line miles @ $11.00/mile = $5,995.00

S. L. SANDNER & ASSOCIATES
GEOLOGISTS/GEOPHYSICISTS
6-815 W. HASTINGS ST.
VANCOUVER 1, B. C

To be applied as one year assessment work on

WA #1-16
WB #2,#4,#6,#8,#10-16,#18,#20,#22,#24,#26,#28-32
WC #101-106,#112,#123-130,#135-141

C.J. Hodgson

C.J. Hodgson, P.Eng. (B.C.)

Declared before me at the City

of Vancouver, in the

Province of British Columbia, this 4

day of Aug. 1972. , A.D.

E.K. Boyd

A Commissioner for taking Affidavits within British Columbia or
A Notary Public in and for the Province of British Columbia,

Sub-Mining Recorder

APPENDIX IV

CERTIFICATE

Name:	MALESKU, Terrance D.
Education:	Grade XII - Balfour Technical School, Regina, Saskatchewan.
Experience:	September 1971 - September 1965 as Geological Draftsman for Marathon Oil Co., Regina, Saskatchewan.
	September 1965 - December 1968 as Structural Draftsman for Con-Force Products, Regina, Saskatchewan.
	April 1969 - February 1970 employed as Geological Draftsman for Geo-X Surveys Ltd.
	Presently employed with S.L. Sandner & Associates

APPENDIX IV

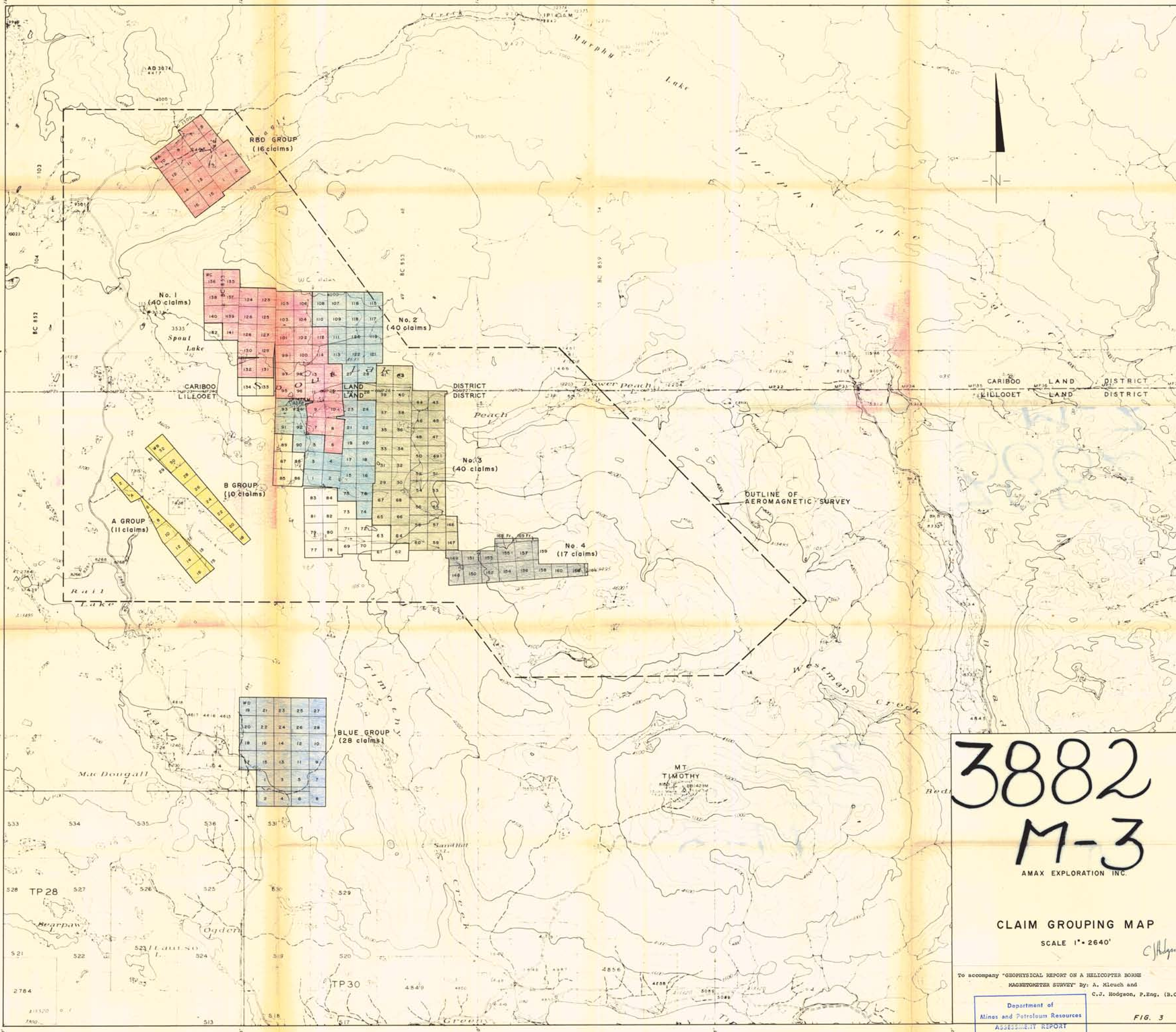
CERTIFICATE

Name:	SANDNER, Stanley L.
Education:	B.Sc. - University of British Columbia (Honours - Geology)
Professional Associations:	Registration pending - Association of Professional Engineers of British Columbia
Experience:	9 years active exploration and production experience throughout western North and western South America. Most of this experience was directly involved in geophysical, geological and geochemical studies of base metal and iron deposits. Directly involved in bringing two properties into profitable production. Past President and Director of Geo-X Surveys Ltd. 50% owner of Nucleonics Scientific Devices Ltd. Presently President and Director of S.L. Sandner & Associates

APPENDIX IV

CERTIFICATE

Name:	MLCUCH, Alexander
Education:	Ph.D. Physics - Komensky University Bratislava Czechoslovakia
Experience:	Programming course at the British Columbia Institute of Technology
	Lectured and did research work in Astronomy for five years
	Assistant Professor of Physics at Slovak Technical College for four years
	Research Assistant in Physics Department at the University of British Columbia
	Formerly employed with Geo-X Surveys Ltd.
	Presently employed with S.L. Sandner & Associates



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AMAX EXPLORATION INC.

CLAIM GROUPING MAP

SCALE 1" = 2640'

To accompany "GEOPHYSICAL REPORT ON A HELICOPTER BORNE MAGNETOMETER SURVEY" By: A. Micuch and C.J. Hodgson, P.Eng. (B.C.)

FIG. 3

AREA OF SURVEY

RAIL LAKE

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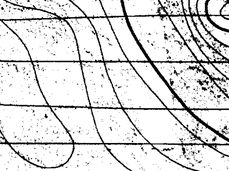
To accompany "GEOPHYSICAL REPORT ON A HELICOPTER BORNE MAGNETOMETER SURVEY" By: A. Mlcuch and C.J. Hodgson, P.Eng. (B.C.)

N

1000 0 1000 2000 3000
SCALE FEET



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AMAX EXPLORATION INC.
SPOUT LAKE AREA
BRITISH COLUMBIA

#5

ISOMAGNETIC PLAN

C.J. Hodgson

DRAWN	T.M.	JOB NO.	FIG. NO.
DATED	APRIL 28, 1972	1202	4B
CHECKED			

AREA OF SURVEY

1000 0 1000 2000 3000
SCALE FEET

INDEX MAP

AMAX EXPLORATION INC.
SPOUT LAKE AREA
BRITISH COLUMBIA

ISOMAGNETIC PLAN

DRAWN	T.M.	JOB NO	FIG NO
DATED	APRIL 28, 1972	1202	4A
CHECKED			

To accompany "GEOPHYSICAL REPORT ON A HELICOPTER BORNE MAGNETOMETER SURVEY" By: A. Mlcuch and C.J. Hodgson, P.Eng. (B.C.)

C.J. Hodgson

3882 #4

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