## REPORT ON

INDUCED POLARIZATION SURVEY BARRETT PROPERTY, PROJECT 293 HOUSTON AREA, BRITISH COLUMBIA FOR

AMAX EXPLORATION INCORPORATED

OMINECA MINING DIVISION HOUSTON AREA 54°N 126°W SE

BY D. B. SUTHERLAND & P. G. HALLOF

WORK WAS CARRIED OUT FROM

AUGUST 26, - SEPTEMBER 11, 1966.

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REPORT ON INDUCED POLARIZATION SURVEY BARRETT PROPERTY, PROJECT 293 HOUSTON AREA, BRITISH COLUMBIA FOR AMAX EXPLORATION INCORPORATED

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D. B. SUTHERLAND AND PHILIP G. HALLOF, Ph.D.

NAME AND LOCATION OF PROPERTY

BARRETT PROPERTY, HOUSTON AREA

OMINECA MINING DIVISION, B.C. 54°N, 126°W SE

DATE STARTED: AUGUST 26, 1966

DATE FINISHED: SEPT. 11, 1966

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IP D	ata Plots	Dwgs. 1P 256	7-1 to 8

stocks extending between the Coast Range and the Omineca batholiths.

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Geological mapping indicates that the quartz feldspar plug measures 4500 by 2500 feet. The entire mass is highly argillized and impregnated with pyrite. Quartz veining is abundant near the eastern contact and the molybdenite appears to be intimately associated with this veining.

The geochemical results are not encouraging but glacial overburden is reported to average 6 feet in depth over the intrusive. There is little relief on the magnetic map but the contours do support the NW-SE trend along the eastern part of the plug.

#### 3. PRESENTATION OF RESULTS

The IP and resistivity results are shown on the following data plots in the manner described in the notes preceding this report.

Line	Dipole Length	Dwg. No.
105	<b>300 feet</b>	IP 2567-1
5S	<b>3</b> 00 feet	IP 2567-2
0	<b>3</b> 00 feet	IP 2567-3
5N	300 feet	IP 2567-4
10N	<b>3</b> 00 <b>feet</b>	IP 2567-5
15N	<b>3</b> 00 feet	IP 2567-6
20N	300 feet	IP 2567-7
25N	<b>3</b> 00 <b>feet</b>	IP 2567-8

Enclosed with this report is Dwg. Misc. 3126, a plan map of the grid area at a scale of 1'' = 400'. The definite and possible

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induced polarization anomalies are indicated by solid and broken bars respectively on this plan map as well as the data plots. These bars represent the surface projection of the anomalous zones as interpreted from the location of the transmitter and receiver electrodes when the anomalous values were measured.

Since the induced polarization measurement is essentially an averaging process, as are all potential methods, it is frequently difficult to exactly pinpoint the source of an anomaly. Certainly, no anomaly can be located with more accuracy than the spread length; i.e. when using 200 foot spreads the position of a narrow sulphide body can only be determined to lie between two stations 200 feet apart. In order to locate sources at some depth, larger spreads must be used, with a corresponding increase in the uncertainties of location. Therefore, while the center of the indicated anomaly probably corresponds fairly well with source, the length of the indicated anomaly along the line should not be taken to represent the exact edges of the anomalous material.

#### 4. DISCUSSION OF RESULTS

Pyrite mineralization is reported to be widespread in the area and some IP effects are evident on almost all of the observations made on the grid. The IP anomaly symbols have been used to illustrate the relative concentration of the widespread metallic material.

#### Line 10S

There is a strong, shallow response centered near 27W that indicates a concentrated portion at least 300 feet wide. The source may

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continue at depth to the west but the data is incomplete. East of 24W, the metal factor values become progressively smaller which indicates a gradual decrease in metallic content.

#### Line 5S

Two concentrated portions are centered near 1W and 9W on this line.

The contours near 9W suggest that the metallic content increases with depth and that the strongest portion lies at a depth of 300 feet or more.

A shallow, and probably narrow source appears to be the cause of the increased values near 1W. Detailing with shorter dipoles would be required to fully evaluate this indication.

West of 12W, the metallic concentration improves with depth and the IP effects could be caused by moderately concentrated metallics located at a depth of 300 to 400 feet. Shallower indications occur on the extreme west of the data and the surveying should be extended in this direction.

#### Line 0

The highest metal factor values encountered on the grid occur between 3W and 8W. These appear to be due to a narrow, shallow core of concentrated metallics centered near 5W that may continue at depth to the west. This material is flanked on either side by 600 to 900 feet of moderately concentrated metallics.

Near 10E, the results suggest a source that is narrower than the spread length of 300 feet. Detailing should be carried out with shorter dipoles to assess its metallic content. Between 27W and 39W the data is quite complex. A shallow source is indicated near 31W and a deep and more concentrated source near 36W.

Low magnitude metal factor values between these concentrated sources suggest areas of weaker mineralization.

#### Line 5N

On this line, the shallowest part of the concentrated portion occurs near 11W and the contours indicate that it broadens appreciably at depth. The full width of this source could be as much as 1,800 feet.

Shallow indications on the west end of the data may be due to a second near surface portion located west of 24W. Additional surveying should be considered for this vicinity.

#### Line 10N

All of the stronger portions of the source occur at depth on this line. The strongest metal factor values indicate a deep source of moderate to high metallic content centered near 11W. The depth to the strongest portion of this anomaly is estimated at 200 to 300 feet.

The broad source appears to end in the vicinity of 3W, but there is no indication of its western limit on this line.

#### Line 15N

A shallow source of concentrated metallics is indicated to the west of 30W but the data is incomplete.

Moderate magnitude metal factor values extend over the

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remainder of the line. The improvement in the vicinity of 15W may be due to an increased concentration in the near-surface material or shallower overburden.

#### Line 20N

The broad response that is continuous over most of the traverses is somewhat weaker than on the lines to the south.

There is a narrow concentrated portion that is shallow near 13W and a similar indication that appears to be deeper near 33W. The increased values near 24W suggest a concentrated source that is remote from the line and probably located at depth.

#### Line 25N

The IP response is much weaker on this line but appears to represent a broad area of low metallic content. However, there is some improvement in the vicinity of 18W.

#### 5. SUMMARY AND RECOMMENDATIONS

Eight E-W traverses spaced at 500 foot intervals have been surveyed with the induced polarization method to investigate an altered quartz feldspar porphyry plug that is reported to contain up to 6% pyrite. Quartz veining containing molybdenite is reported along the eastern margin of the plug.

The resistivities are unusually low and suggest a high degree of alteration and/or pyritization. Some IP effects are evident on virtually every observation on the grid and the results suggest an area of widespread metallic material that varies appreciably in concentration and depth of burial. None of the lines have been surveyed far enough to establish definitely the limits of the mineralized area. The eastern end of Line 0+00 and Line 10N may extend beyond its edge, but there is no indication of the western limit. On Line 25N the anomalous effects are quite weak and this line may be close to the northern edge of the mineralized zone.

Most of the more concentrated sources appear to be located at depth. This could be due to variations in the overburden thickness or a leaching of the near surface material. The best examples of deep sources, or sources that improve markedly with depth, occur near the following localities: 9W on Line 5S, 6W on Line 0, and 10W on Line 5N. These indications, together with several shallow sources, suggest that several bands of more concentrated material trend NW-SE through the center of the porphyry stock.

Strong responses occur to the west of the indicated boundaries of the plug. The best of these occur near 33W on Line 15N, 36W on Line 0 and 27W on Line 10S. These may represent a sub-parallel band of more concentrated metallics. However, the intervening lines would have to be extended to establish this continuity.

Further investigations are definitely warranted on this property. However, since molybdenum deposits can occur either within zones of high metallic content or on the edges of highly pyritized areas, the details of the follow-up program will be finalized by Mr. W. W. Shaw who is in close liaison with the regional geologists.

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D. B. Sutherland, Geophysicist.

Philip G. Hallof, Geophysicist.

Dated: November 3, 1966

#### ASSESSMENT DETAILS

PROPERTY: Barrett Project	MINING DIVISION: Omineca
SPONSOR: Amax Exploration Inc.	PROVINCE: British Columbia
LOCATION: Houston Area, B. C.	

TYPE OF SURVEY: Induced Polarization

OPERATING MAN DAYS:	25	DATE STARTED: August 26, 1966
EQUIVALENT 8 HR. MAN DAYS:	37.5	DATE FINISHED: Sept. 11, 1966
CONSULTING MAN DAYS:	2	NUMBER OF STATIONS: 114
DRAUGHTING MAN DAYS:	5	NUMBER OF READINGS: 496
TOTAL MAN DAYS:	44.5	MILES OF LINE SURVEYED: 6.1

CONSULTANTS:

D. B. Sutherland, Apt. 807, 43 Thorncliffe Park Drive, Toronto 17, Ontario. P. G. Hallof, 5 Minorca Place, Don Mills, Ontario.

FIELD TECHNICIANS: J. Parker, Box 340, Choiceland, Saskatchewan.

3 Helpers supplied by client.

DRAUGHTSMEN:

- F. R. Peer, 38 Torrens Avenue, Toronto 6, Ontario.
- P. Coulson, 6 Paradise Avenue, Markham, Ontario.
- B. Marr, 19 Kenewen Court, Toronto 16, Ontario.
- S. Heyes, 30 Esterbrooke Avenue, Apt. 306, Willowdale, Ontario.

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D. B. Sutherland, Geophysicist.

Dated: November 3, 1966

#### SUMMARY OF COST

### Barrett Creek Property

#### ${\tt Crew}$

6 1/4 days Operating	@ \$175.00/day	\$1,093.75
2 1/4 days Travel )		
1/4 day Bad Weather) 6 1/4	@ \$ 75.00/day	468.75
3 3/4 days Standby )		
Extra 1 abour \$15.00 ± 20%		18.00

#### Expenses

Rented Vehicles	<b>\$108.8</b> 8
Taxis and Bus	11.43
Meals and Accommodation	142.85
Telephone and Telegraph	18.31
Freight and Brokerage	89.00
Camp Supplies	26.49
Supplies	19.50

416.46

\$1,996.96

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D. B. Sutherland, Geophysicist.

Dated: November 3, 1966

#### CERTIFICATE

I, Don Benjamin Sutherland of the City of Toronto, Province of Ontario, do hereby certify that:

I am a geophysicist residing at 43 Thorncliffe Park Drive,
Apt. 807, Toronto 17, Ontario.

2. I am a graduate of the University of Toronto in Physics and Geology with the degree of Bachelor of Arts (1954); and a graduate of the University of Toronto in Physics with the degree of Master of Arts (1955.)

3. I am a member of the Society of Exploration Geophysicists and a member of the European Association of Exploration Geophysicists.

4. I have been practising my profession for over eight years.

5. I have no direct or indirect interest, nor do I expect to receive any interest directly or indirectly, in the property or securities of Amax Exploration Incorporated.

6. The statements made in this report are based on a study of published geological literature and unpublished private reports.

Dated at Toronto

6. Something

This 3rd day of November 1966

Don B. Sutherland, M.A.

REPORT ON INDUCED POLARIZATION SURVEY BARRETT PROPERTY, PROJECT 293 HOUSTON AREA, BRITISH COLUMBIA

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FOR

AMAX EXPLORATION INCORPORATED

#### 1. INTRODUCTION

At the request of Mr. W. W. Shaw, Geophysicist for the Company, an induced polarization survey has been carried out on the Barrett Property, Project 293 in the Houston Area of British Columbia for Amax Exploration Incorporated. The property lies in the SW quadrant of the 1° quadrilateral whose SE corner is at 54°N, 126°W in the Omineca Mining Division.

The field surveying was carried out using a McPhar frequency domain IP unit, during September 1966.

#### 2. GEOLOGY AND PREVIOUS WORK

Previous work includes geological mapping, geochemical sampling and magnetometer surveying. These data have been made available to us for correlation with the IP results.

The Smith-Barrett molybdenum prospect occurs in a quartz feldspar stock that intrudes a thick succession of Hazelton volcanics. This intrusive is situated within a broad northeast trending belt of Tertiary acid

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# NOTES ON THE THEORY OF INDUCED POLARIZATION AND THE METHOD OF FIELD OPERATION

Induced Polarization as a geophysical measurement refers to the blocking action or polarization of metallic or electronic conductors in a medium of ionic solution conduction.

This electro-chemical phenomenon occurs wherever electrical current is passed through an area which contains metallic minerals such as base metal sulphides. Normally, when current is passed through the ground, as in resistivity measurements, all of the conduction takes place through ions present in the water content of the rock, or soil, i. e. by ionic conduction. This is because almost all minerals have a much higher specific resistivity than ground water. The group of minerals commonly described as "metallic", however, have specific resistivities much lower than ground waters. The induced polarization effect takes place at those interfaces where the mode of conduction changes from ionic in the solutions filling the interstices of the rock to electronic in the metallic minerals present in the rock.

The blocking action or induced polarization mentioned above, which depends upon the chemical energies necessary to allow the ions to give up or receive electrons from the metallic surface, increases with the time that a d.c. current is allowed to flow through the rock; i. e. as ions pile up against the metallic interface the resistance to current flow increases. Eventually, there is enough polarization in the form of excess ions at the interfaces to effectively stop all current flow through the metallic particle. This polarization takes place at each of the infinite number of solution-metal interfaces in a mineralized rock.

When the d.c. voltage used to create this d.c. current flow is cut off, the Coulomb forces between the charged ions forming the polarization cause them to return to their normal position. This movement of charge creates a small current flow which can be measured on the surface of the ground as a decaying potential difference.

From an alternate viewpoint it can be seen that if the direction of the current through the system is reversed repeatedly before the polarization occurs, the effective resistivity of the system as a whole will change as the frequency of the switching is changed. This is a consequence of the fact that the amount of current flowing through each metallic interface depends upon the length of time that current has been passing through it in one direction.

The values of the "metal factor" or "M.F." are a measure of the amount of polarization present in the rock mass being surveyed. This parameter has been found to be very successful in mapping areas of sulphide mineralization, even those in which all other geophysical methods have been unsuccessful. The induced polarization measurement is more sensitive to sulphide content than other electrical measurements

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because it is much more dependent upon the sulphide content. As the sulphide content of a rock is increased, the "metal factor" of the rock increases much more rapidly than the resistivity decreases.

Because of this increased sensitivity, it is possible to locate and outline zones of less than 10% sulphides that can't be located by E. M. Methods. The method has been successful in locating the disseminated "porphyry copper" type mineralization in the Southwestern United States.

Measurements and experiments also indicate that it should be possible to locate most massive sulphide bodies at a greater depth with induced polarization than with E. M.

Since there is no I. P. effect from any conductor unless it is metallic, the method is useful in checking E. M. anomalies that are suspected of being due to water filled shear zones or other ionic conductors. There is also no effect from conductive overburden, which frequently confuses E. M. results. It would appear from scale model experiments and calculations that the apparent metal factors measured over a mineralized zone are larger if the material overlying the zone is of low resistivity.

Apropos of this, it should be stated that the induced polarization measurements indicate the total amount of metallic constituents in the rock. Thus all of the metallic minerals in the rock, such as pyrite, as well as the ore minerals chalcopyrite, chalcocite, galena, etc. are responsible for the induced polarization effect. Some

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oxides such as magnetite, pyrolusite, chromite, and some forms of hematite also conduct by electrons and are metallic. All of the metallic minerals in the rock will contribute to the induced polarization effect measured on the surface.

In the field procedure, measurements on the surface are made in a way that allows the effects of lateral changes in the properties of the ground to be separated from the effects of vertical changes in the properties. Current is applied to the ground at two points a distance (X) apart. The potentials are measured at two other points (X) feet apart, in line with the current electrodes. The distance between the nearest current and potential electrodes is an integer number (N) times the basic distance (X).

The measurements are made along a surveyed line, with a constant distance (NX) between the nearest current and potential electrodes. In most surveys, several traverses are made with various values of (N); i. e. (N) = 1, 2, 3, 4, etc. The kind of survey required (detailed or reconnaissance) decides the number of values of (N) used.

In plotting the results, the values of the apparent resistivity and the apparent metal factor measured for each set of electrode positions are plotted at the intersection of grid lines, one from the center point of the current electrodes and the other from the center point of the potential electrodes. The resistivity values are plotted above the line and the metal factor values below. The lateral displacement of a given value is determined by the location along the survey line of the center point between the current and potential electrodes. The distance of the value from the line is determined by the distance (NX) between the current and potential electrodes when the measurement was made.

The separation between sender and receiver electrodes is only one factor which determines the depth to which the ground is being sampled in any particular measurement. These plots then, when contoured, are not section maps of the electrical properties of the ground under the survey line. The interpretation of the results from any given survey must be carried out using the combined experience gained from field, model and theoretical investigations. The position of the electrodes when anomalous values are measured must be used in the interpretation.

In the field procedure, the interval over which the potential differences are measured is the same as the interval over which the electrodes are moved after a series of potential readings has been made. One of the advantages of the induced polarization method is that the same equipment can be used for both detailed and reconnaissance surveys merely by changing the distance (X) over which the electrodes are moved each time. In the past, intervals have been used ranging from 100 feet to 1000 feet for (X). In each case, the decision as to the distance (X) and the values of (N) is largely determined by the expected size of the mineral deposit being sought, the size of the expected anomaly and the speed with which it is desired to progress.

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The diagram in Figure 1 below demonstrates the method used in plotting the results. Each value of the apparent resistivity and the apparent "Metal factor" is plotted and identified by the position of the four electrodes when the measurement was made. It can be seen that the values measured for the larger values of (n) are plotted farther from the line indicating that the thickness of the layer of the earth that is being tested is greater than for the smaller values of (n); i. e. the depth of the measurement is increased.

> METHOD USED IN PLOTTING DIPOLE-DIPOLE INDUCED POLARIZATION AND RESISTIVITY RESULTS





NOTE: CONTOURS AT LOGARITHMIC MULTIPLES OF 10-15-20-30-50-75-100

> $\rho_{a/2\pi}$ (OHM FEET)

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LINE NO-10

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(M.F.) a



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