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Courtesy W.A. Gerber, Oct 15th '68.

GEOPHYSICAL NOTE

on the

INDUCED POLARIZATION TEST

of a portion of the

MOUSE CLAIM GROUP

owned by

Nicola Lake Mining Company, Limited

situated immediately

south of

Nicola Lake

Nicola M.D.

British Columbia

Work done between September 5th and 7th, 1968

by

D.R. Cochrane, P.Eng.

September 18th, 1968

604-685-4296
TELEX 04-50404

GEO-X SURVEYS LTD. 627 HORNBY STREET, VANCOUVER 1, B.C.

15 October 1968

Dr. Michael Carr

compliments of J. M. Ashton
Exploration Director
Nicola Lake Mining Company Ltd

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INTRODUCTION

Between September 5th and 7th, 1968, a Geo-X Surveys field crew completed three test lines over the Mouse Claims Group, owned by Nicola Lake Mining Company, Limited.

This report briefly discusses the field procedure and results of the I.P. test.

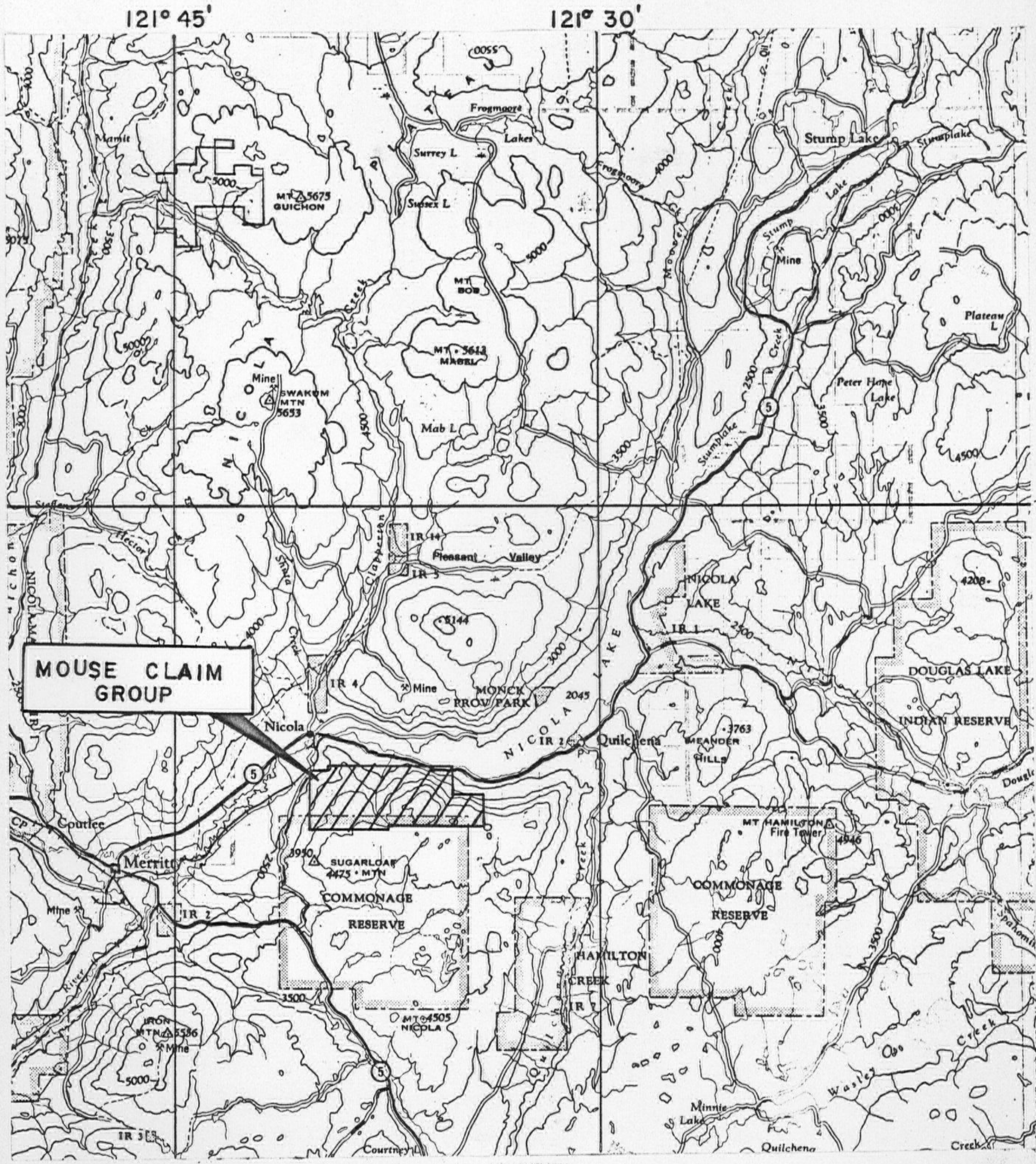
FIELD PROCEDURES

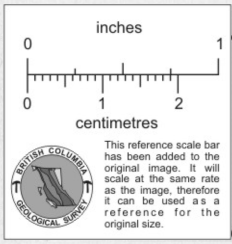
A Hewitt Enterprises pulse type polarization unit was used and instrument specifications are outlined in Appendix II.

A standard Wenner electrode array was employed with an "a" spacing ("a" being one third of the distance between the current electrodes) of 600 and 1000 feet.

Prior to voltage application, the receiving pots are balanced, and this, the self potential reading in millivolts is recorded on standard field note forms.

A voltage setting of 250, 500, and 1000 volts was used at different stations depending on the apparent bed-rock resistivity encountered. A four second pulse was initiated, and 0.3 seconds after cessation of pulse, the decay voltage is integrated for 0.8 seconds. During the pulse the current (I in milliamperes) and primary voltage (dv in millivolts) is recorded. During integration the decay voltage I.P. (mv) is observed





GEO-X SURVEYS Ltd.

NICOLA LAKE MINES LIMITED
MOUSE CLAIM GROUP
LOCATION MAP

and recorded. ~~Interpretation~~ Integration of the decay voltage was completed mainly on a single integration function, with re-checks on a double integration function setting.

Between two and twenty pulses were initiated at each set up. The arithmetic mean of the decay voltage was used for normalizing.

The transit interval was 600 feet at a = 600 and 1000 feet at a = 1000 feet.

From the field data, the apparent resistivity and normalized induced polarization values were calculated and plotted on the accompanying maps.

DATA PROCESSING

The following information was recorded by the instrument operator at each pulse station:

1. The property, operator's initials, job and page number, "a" spacing, transit interval and remarks on topography;
2. The line and station co-ordinates;
3. The self potential reading in millivolts (S.P. m.v.);
4. The current in milliamperes (I ma);
5. The impressed emf in millivolts (dVmv);
6. The induced polarization decay voltage in millivolts (IPmv);
7. The resistor-capacitor switch (R.C.);
8. The current electrode voltage switch value;
9. The integration function switch (I.F.);

10. The pulse time in seconds.

From this data, the apparent resistivity is calculated from the following relation:

$$\rho = \frac{2\pi \times a \times dV}{I(ma)}$$

Where: ρ = apparent resistivity in ohm-feet

π = 3.1416

"a" = 1/3 distance between the current electrodes.

The normalized IP value is obtained by utilization of the following relation:

$$\text{IP norm.} = \frac{IP(mv) \times 100 \times k}{dV(mv)}$$

Where: IP norm = normalized IP in millivolt seconds per millivolt or milliseconds

k = a constant depending on the IF setting

A specific example from the data collected on line C at 15+00 follows:

Pulse No.	I(ma)	dV	IP(mv)	RC	IF	Voltage
1	300	350	12	2	1	1000
2	290	350	12	2	1	1000
3	290	350	13	2	1	1000
4	290	350	11	2	1	1000
Arithmetic mean	290	350	12	2	1	1000

$$\rho = \frac{3769.89 \times 350xk}{290} = 1387 \text{ ohm-meters}$$

$$\text{IP norm} = \frac{2 \times 2 \times 1 \times 100}{350} = 6.8 \text{ milliseconds}$$

On the accompanying maps, the IP and resistivity values are calculated and plotted on the accompanying maps.

GENERAL CONSIDERATIONS OF THE PULSE TYPE INDUCED POLARIZATION METHOD

Two induced polarization methods are in common use today in mineral exploration. The first is the time domain or pulse type method in which a steady direct current is impressed on the ground for a few seconds and then abruptly terminated. A fraction of a second after cessation of current impulse, the decay voltage, caused by capacitive-like storage, is measured. The second method is the variable (dual) frequency technique or frequency domain. In this variety, the percentage difference between the impedance (a.c. resistance) offered at two separate frequencies, is measured.

The Hewitt (HEW-100) I.P. unit is a time domain unit and the exact method employed is outlined in the field procedure section.

The reader is referred to Wait, J.R. (1966), for a thorough treatment of frequency domain, and Seigel, H.O. (1966) and/or Brant (1966), for a discussion of time domain.

I.P. effect occurs when a current is passed through a volume of rock containing electronic conductors. Geophysical electronic conductors, or "metallic minerals" include most sulphides (pyrite, chalcopyrite, bornite, molybdenite but not sphalerite), certain oxides, clays, graphite and certain micas. Apart from the sulphides, minerals with highly unsatisfied basal lattice surfaces act as leaky condensers and give rise to I.P. effects. All rocks are responsive to some degree, and this response is designated background. It is often equivalent to one volume percent of scattered pyrite, and probably due to unsatisfied charges at lattice imperfections, boundaries, fractures, and so on. Background in various parts of B.C. with the HEW-100 I.P. unit follows:

Area	Lithology	Background (Mv/v)
Mamit Lake	Guichon Batholith (granodiorite)	5.9
Tonasket, Wash.	Granodiorite plug	12.3
Aspen Grove	Nicola Volcanics	7.6
Princeton	Princeton sediments	17.2

Factors other than the amount of metallic conductors which affect I.P. response are grain size, conductivity of mineral, porosity, tortuosity (pore geometry), type of gangue minerals, composition and amount of pore fluid, degree of alteration, and mode of mineralization (disseminated, lode, vein type, etc.).

Rogers (1966), has pointed out that the resistivity of rock is only slightly influenced by changes in the sulphide content at low levels. Much of the change is due to moisture content, therefore the resistivity of rock is very dependent on fracturing, pore space and ground water rather than metallic mineral content. Alteration in combination with increased sulphide mineral content does change the resistivity value significantly.

Background resistivity in various parts of B.C. with the HEW-100 I.P. unit follows:

Area	Lithology	Background (ohm-feet)
Mamit Lake	Guichon Batholith	1600
Tonasket, Wash.	Granodiorite plug	3500
Aspen Grove	Nicola Volcanics	1000
Princeton	Princeton sediments	500

BIBLIOGRAPHY

Frequency Domain:

Wait, J.R. (1951) Editor, Overvoltage Research and Geophysical Applications. London, Pergamon Press.

Time Domain:

Brant, A.A. (1966) Examples of Induced Polarization Field Results in the Time Domain - Society of Exploration Geophysicists' Mining Geophysics, Volume I, Case Histories.

Seigel, H.O.(1966) Three Recent Irish Discovery Case Histories using Pulse Type Induced Polarization - S.E.G. Volume I, Case Histories - p.p. 341.

Rogers, G.R. Introduction to the Search for Disseminated Sulphides, S.E.G. Volume I.

DISCUSSION OF RESULTS

(a) Self Potential

The large, 600 foot "a" spacing and receiving pot separation, greatly reduces the usable value of the self potential results. Normally the first derivative of S.P. serves a useful purpose but on the Nicola Lake Mines survey the first derivative calcualtions cannot be justified.

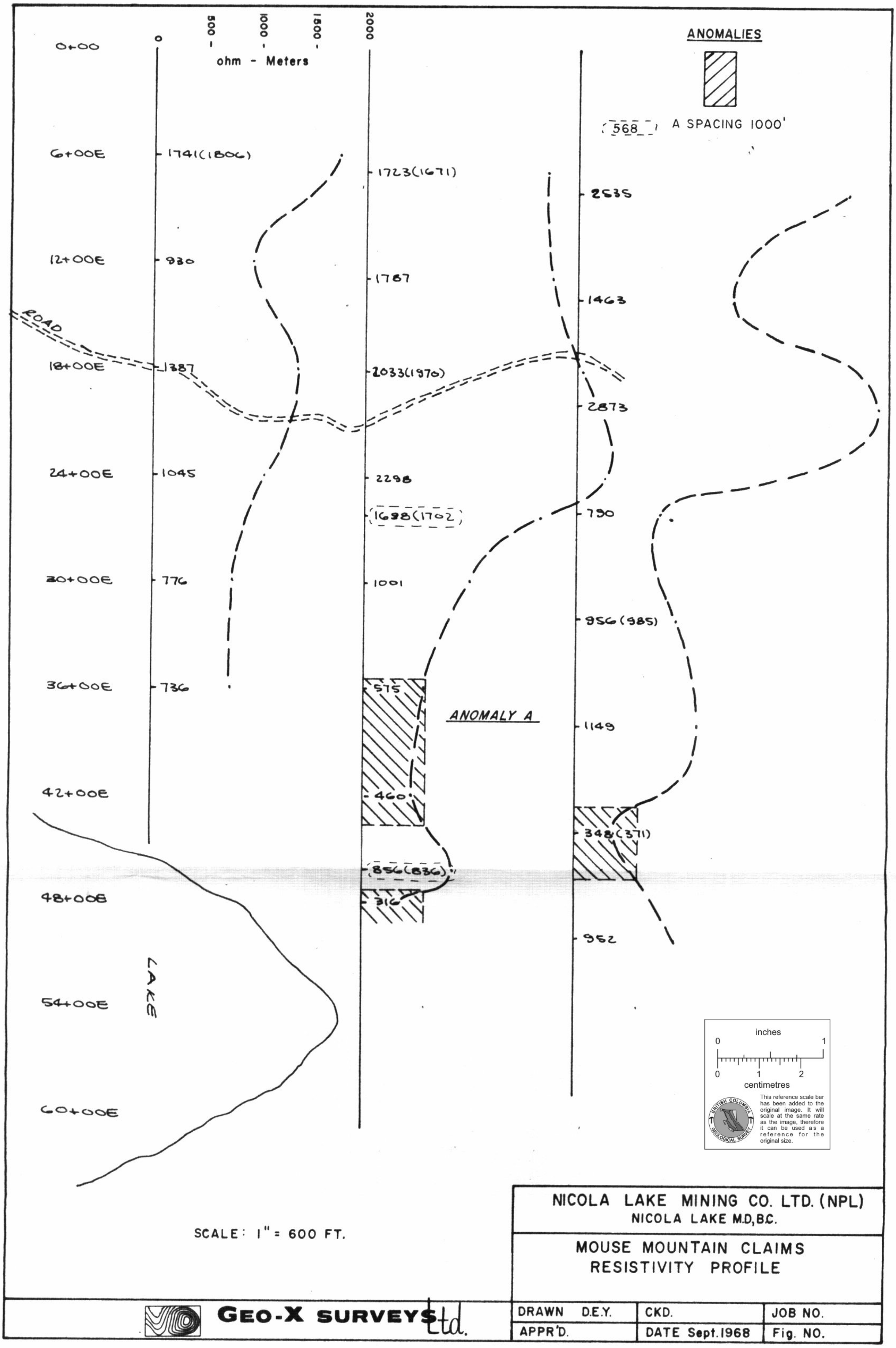
Self potential values ranged in amplitudes form +25 mv to -30mv, and these are relatively minor effects. The -30 mv difference in potential was observed on line A between stations 41+00 and 47+00.

(b) Resistivity

The arithmetic means of 26 apparent resistivity values is 1273 ohm-meters. The standard deviation is 660 ohm-meters. Values falling below the arithmetic mean minus one standard deviation (viz 600 ohm-meters) may be considered anomalous. Resistivities ranged from a low of 316 to a high of 2535 ohm-meters.

Four resistivity values are anomalously low (i.e. relatively high bedrock conductivity) and two of these are juxaposed on line B at 36 and 42+00.

The three resistivity profiles are remarkably analogous (see map), suggesting that a resistivity plan may serve as a useful guide to lithology.



ANOMALIES
568 A SPACING 1000'
ohm - Meters
0
500
1000
1500
2000
0+00
6+00E
12+00E
18+00E
24+00E
30+00E
36+00E
42+00E
48+00E
54+00E
60+00E
1741(1806)
930
1387
1045
776
736
1723(1671)
1767
2033(1970)
2298
1698(1702)
1001
575
460
856(836)
316
2535
1463
2873
790
856(985)
1149
348(371)
952
ROAD
LAKE
ANOMALY A
SCALE: 1" = 600 FT.
NICOLA LAKE MINING CO. LTD. (NPL)
NICOLA LAKE M.D, B.C.
MOUSE MOUNTAIN CLAIMS
RESISTIVITY PROFILE
GEO-X SURVEYS Ltd.
DRAWN D.E.Y.
CKD.
JOB NO.
APPR'D.
DATE Sept. 1968
Fig. NO.
inches
centimetres
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.

DISCUSSION OF RESULTS CONTINUED

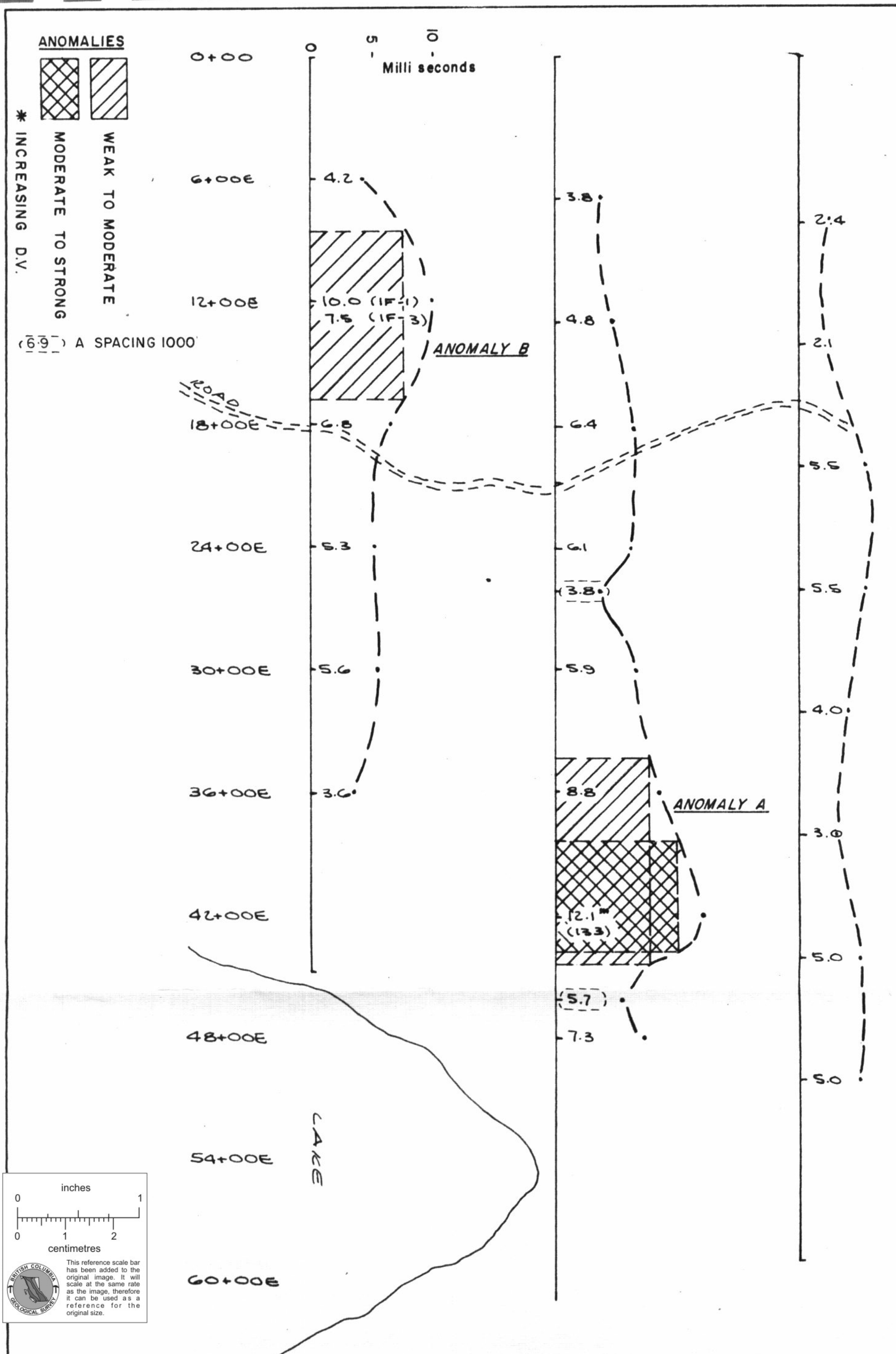
(c) Induced Polarization

The arithmetic mean of 27 normalized induced polarization values is 5.6 milliseconds. The standard deviation is 2.2 milliseconds. Response ranged from a low of 2.1 to a high of 12.1. Values greater than 7.8 milliseconds and less than 10.0 milliseconds are considered weakly to moderately anomalous; and those greater than 10.0 as moderately to strongly anomalous. Two area of weak to moderate response was encountered during the test survey, and these designated anomaly A and B respectively (see accompanying I.P. profiles). Anomaly A, ~~contoured~~ centered at 42+00 east on line B is an area approximately 500 feet long of moderate to strong I.P. response, enclosed within an area roughly 1000 feet long designated as weakly to moderately anomalous. A rather interesting feature accompanied the 12.1 millisecond I.P. at 42 on line B. The primary voltage (dV) increased noticably during pulse, and this "special effect" is often indicative of sulphide rather than membrane polarization.

Anomaly B is centered at 12+00 on line C, and consists of a single response of 10.0 milliseconds. No special effects accompanying the I.P. were reported by the instrument operator.

SUMMARY AND CONCLUSIONS

On September 5th, 6th and 7th, 1968, Geo-X Surveys Ltd., completed three induced polarization test lines over the Mouse



SCALE : 1" = 600 FT.

NICOLA LAKE MINING CO. LTD.(NPL)
NICOLA LAKE M.D., B.C.

MOUSE MOUNTAIN CLAIMS
I. P. PROFILE

GEO-X SURVEYS Ltd.

DRAWN D.E.Y.	CKD.	JOB NO.
APPR'D.	DATE: Sept. 1968	FIG. NO.

SUMMARY AND CONCLUSIONS CONTINUED

Claim Group owned by Nicola Lake Mines Limited.

A Hewitt Enterprises pulse type instrument was employed with a standard Wenner electrode array, and an "a" spacing of 600 and 1000 feet.

An anomalous induced polarization and coincident anomalous apparent resistivity anomaly was discovered on line C, and is centered at 42+00. It is designated as anomaly A. The increase in primary voltage observed during pulse is indicative of sulphides. Geologic mapping in this area shows that a limestone band underlies the anomaly, and the limestone band is considered a favorable host for sulphide mineralization in the area.

A second I.P. high, designated anomaly B, consists of a single 10.0 millisecond response, with a small negative change in resistivity.

The resistivity profiles suggest that an apparent resistivity plan may serve as a useful guide to structure and lithology.

Investigation as to the cause of anomaly A is recommended.

Respectfully submitted,

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA D. R. COCHRANE

D.R. Cochrane, P.Eng.

September 18th, 1968
Vancouver, B.C.

APPENDIX I

PERSONNEL

Name:	COCHRANE, Donald Robert
Education:	B.Sc. - University of Toronto M.Sc.(Eng.) - Queen's University
Professional Associations:	Professional Engineer of British Columbia, Ontario and Saskatchewan. Jr. member of C.I.M.M., member of G.A.C., M.A.C. Geological Engineer.
Experience:	Engaged in the profession since 1962 while employed with Noranda Exploration Co. Ltd., Quebec Cartier Mines Ltd., Meridian Exploration Syndicate. Presently employed as Engineer with Geo-X Surveys Ltd. Experience in West Indies, Latin America, South America, United States and Canada.

APPENDIX I

PERSONNEL

Name:	WILSON, Norman George Robert
Education:	Junior Matriculation equiv., Grade 13 Math.
	2nd Year National Electrical Engineering.
Experience:	12 years Royal Air Force - Radar Technician.
	6 months British Government Communications - Radio Technician.
	Presently employed by Geo-X Surveys Ltd., since October 22nd, 1967 doing Induced Polarization, Electromagnetic and Magnetometer Surveys under Professional supervision.

APPENDIX II

GENERAL SPECIFICATIONS OF THE HEWITT PULSE TYPE INDUCED POLARIZATION UNIT.

Transmitter Unit

Current pulse period (D.C. Pulse Manual initiated timer	1 - 10 seconds
Current measuring ranges	0 - 500 0 - 1000 Milliamperes 0 - 5000
Internal voltage converter 27 volt D.C. 350 watt output with belt back batteries	250 500 volts D.C. 1000 Nominal

500 watts using 27 volts aircraft batteries.

Transmitter can switch up to 3 amps at 1000 volts from generator or battery supply with resistive load. The switching is done internally in the transmitter unit. Remote control output can switch up to 10 kilowatts of power by using a separate control unit. A remote control cord is supplied with auxiliary equipment.

Receiver Unit

Self Potential Range	0 - 1000 millivolts 1 millivolt resolution
Impressed EMF Ranges	0 - 30 0 - 100 millivolts 0 - 300 0 - 1000
Input Terminals with Three Combinations	$P_1 - P_2$ $P_1 - P_0$ $P_2 - P_0$
Induced Polarization Ranges	0 - 30 0 - 60 millivolt 0 - 90 seconds
Integration Time Periods	.8 seconds 1.6 seconds

<u>Tandem Integration Time Periods</u>	1.6 seconds 3.2 seconds
<u>Input Filtering</u>	3 ranges plus 4 integration combinations
<u>Delay Time from Cessation of Current Pulse</u>	.3 seconds

(Combined Photo Electric Coupled Receiver and Transmitter)

Operation Temperature -25° F - 120° F

POWER SUPPLY

<u>Receiver Unit</u>	4 Eveready E136 Mercury Batteries 2 Eveready E134 Mercury Batteries 2 Eveready E401 Mercury Batteries
<u>Transmitter Unit</u>	Sealed Rechargeable 8 amp. hr. belt pack capable of driving the converter at 350 watts for a minimum of one day's operation before recharge.

Manufactured by Hewitt Enterprises, Box 978A, Sandy, Utah, 84070
Phone: 801 571-0157