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NOTES ON THE THEORY, METHOD OF FIELD OPERATION

AND PRESENTATION OF DATA

FOR THE INDUCED POLARIZATION METHOD

INTERIM

REPORT ON THE

INDUCED POLARIZATION

AND

RESISTIVITY SURVEY

ON THE BORY MINERAL CLAIMS

MURPHY LAKE, B.C.

CARIBOO MINING DISTRICT

Vancouver, B.C.

August 31, 1971

D. B. Sutherland,
P.Eng.(Ontario)

D. H. Brown,
P.Eng.(B.C.)

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INTERIM

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1. INTRODUCTION

The I.P. and resistivity survey was carried out using Falconbridge's crew of two operators, M. and J. Menard, with the assistance of two helpers, R. Smith and B. Trenholm during two separate periods: the first from June 27 to July 26 and the second from August 1 to August 11.

This report covers only the data obtained in the above two field periods. The survey was incomplete on August 11 and is still incomplete as of the date of this report. However, the field survey program has been continuous since August 1 and is not expected to be completed until early September 1971. It should be noted that there are several gaps in the I.P. coverage of the 800-foot grid; these will be filled prior to the completion of the survey.

The survey area is situated near Murphy Lake which lies approximately 18 miles north of Lac la Hache, B.C. The property is centered near 52°05' N., 121°20' E. (see figure 1).

According to the Geological Survey of Canada map 3-1961 (Geology - Quesnel Lake, West Half), the survey area is underlain by quartz monzonite and granodiorite of Jurassic and/or Cretaceous age and by Triassic volcanic rocks. Economic mineralization is known to occur in rocks of these ages and compositions both to the north and to the south of this property.

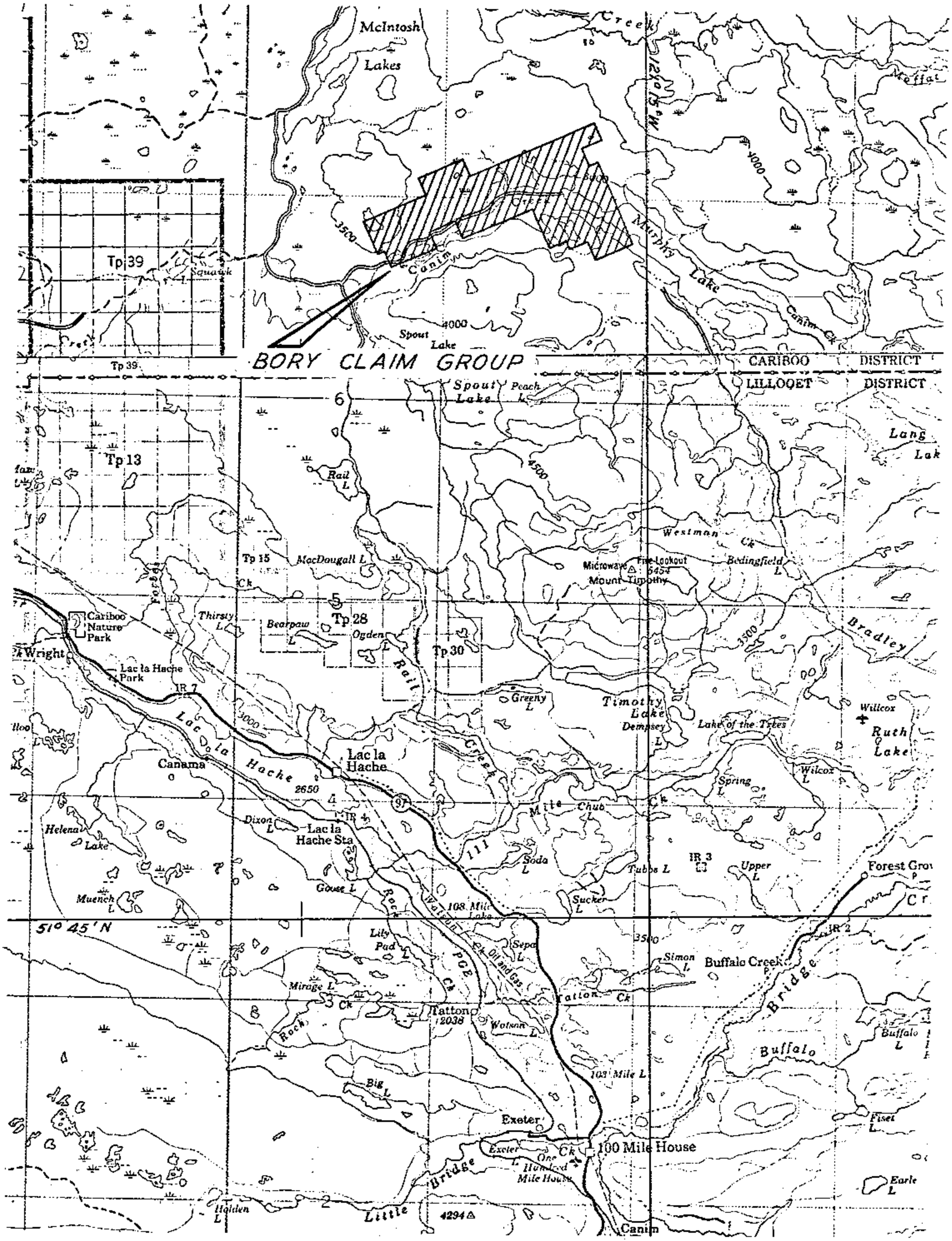


Figure 1. Location Map of Bory Claims,
Cariboo Mining District
Scale: 1/250,000

The gridded area over which the geophysical surveys have been run is mantled by glacial till, and outcrops are extremely rare. However, outcrops to the south and west of the gridded area indicate that the geologic interpretation made by the Geological Survey of Canada is essentially correct and therefore a potential does exist for economic mineralization.

The purpose of the induced polarization and resistivity survey was to locate any anomalous effect that might be indicative of "metallic" mineralization.

A McPhar P660 variable frequency unit operating at 0.3 and 5.0 Hz was used. Part of the lines were covered with dipole-dipole 300-foot electrode intervals to n = 3 or n = 4 and part with 200-foot electrode intervals to n = 3 or 4.

2. PRESENTATION OF RESULTS

Line	Electrode Interval	Drawing No.
168 W	300 feet	B 168 W
160 W	" "	B 160 W
152 W	" "	B 152 W
144 W	" "	B 144 W
136 W	" "	B 136 W
128 W	" "	B 128 W
120 W	" "	B 120 W
112 W	" "	B 112 W
104 W	" "	B 104 W
96 W	200 feet	B 96 W

Line	Electrode Interval	Drawing No.
88 W	200 feet	B 88 W
82 W	" "	B 82 W
76 W	300 feet	B 76 W
70 W	" "	B 70 W
-------	-------	-------
40 W	300 feet	B 40 W
32 W	" "	B 32 W
24 W (part)	" " (to be extended)	B 24 W
16 W	" "	B 16 W
8 W	" "	B 8 W
0+00	" "	0+00
8 E	" "	B 8 E
16 E	200 feet	B 16 E
24 E	" "	B 24 E
32 E	" "	B 32 E
40 E	" "	B 40 E
48 E	" "	B 48 E

Enclosed with this report are Figures 2-E and 2-W, plan maps of the Bory mineral claims grid at a scale of 1" = 600'. The definite, probable and possible 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 measurements are essentially an averaging process as are all potential methods, it is frequently difficult to exactly pinpoint the source of the anomaly. Certainly, no anomaly can be located with more accuracy than the spread length; i.e. when using 300-foot spread, the position of a narrow sulphide body can only be determined to lie between two stations 300 feet apart in order to locate sources 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.

3. DISCUSSION OF RESULTS

Since only part of the area had been surveyed on August 11th, 1971 a complete analysis of the data cannot be made. However, on the basis of available information the following interpretation appears warranted.

Widespread but weak I.P. responses extend over almost the entire length of all of the traverse lines and "metallic" mineralization appears to be ubiquitous. However, a careful study of the data shows that the broad, weakly anomalous responses are flanked on both the north and south by lower metal factor values and much higher resistivities.

The broad I.P. responses encountered on nearly all of the traverses suggest wide zones of "metallic" material such as disseminated sulphides, magnetite or graphite. Metal factor values are generally in the order of 30 to 50 in these broad responses, and because of the extent of the anomalies the observed "apparent metal factor" may be very close to the "true metal factor" and could be caused by less than one percent metallics.

Superimposed on the broad, weak responses are stronger more definite I.P. anomalies, many of which appear to correlate from line to line. On the basis of available data, these have been grouped into twelve anomalous zones which have been lettered alphabetically, Zones A to L inclusive, and are discussed in the following:-

Zone A

Nearly all of the responses in Zone A suggest narrow sources (i.e. less than the 300-foot dipole length) that are relatively shallow. The anomalies on 168 W. and 144 W. are of particular interest and may be due to narrow sources of much higher metallic content that lie within the broad zone of weak metallics.

Zone B

Zone B occurs on the northern end of 112 W., 120 W., and 124 W. The surveying should be extended northward to assess the importance of this zone of moderate metal factor values.

Zone C

This zone has been interpreted as a feature that is sub-parallel to Zone A. The I.P. response is variable along its length but the anomalies on 96 W. and 128 W. warrant a first priority classification. On 128 W. the contour patterns suggest a narrow, shallow source of higher metallic content but detailed surveying with shorter dipoles would be required to confirm this interpretation.

Zone D

Zone D appears to strike grid E.-W. and displays variable depth and metallic content along its length. Most of the individual I.P. responses suggest shallow sources of increased metallic content (but probably less than 3 percent total sulphides) over widths in excess of 300 feet.

On the basis of the indicated apparent metallic content, Zone D is considered to be a second priority target.

Zone E, F, G, H and I

These five zones have been interpreted from the data on the longer lines north of Two Mile Lake. It should be noted that no data is presently available for 64 W., 56 W., 48 W. and the north part of 24 W.

The strongest I.P. effects encountered to date occur on 24 W. near 30 N. This definite anomaly is presently considered as a first priority target but its importance could be reduced if the extended surveying reveals a broad, continuous response.

All of these zones appear to be either located at a depth of 200 to 500 feet or to improve markedly with depth and consideration should be given deeper exploration in the central portion of the grid.

Zone J

All three data plots (i.e. 0, 8 E. and 16 E.) suggest sources whose strongest "metallic" concentrations are located at a depth of 150 to 300 feet. The response on 0+00, near 16 N., is particularly interesting and is regarded as a first priority target. Additional detail with shorter dipoles would be desirable prior to spotting a drill hole location on this response.

Zones K and L

Two zones of improved metallic content, Zones K and L, have been interpreted from the broad background response in the vicinity of line 32 E. Both suggest only moderate metallic content but will warrant further work if it is established that low metallic concentrations are of economic importance in this area. Second priority targets are the responses on 40 E., Zone K and 32 E., Zone L.

There are several individual and isolated anomalies not included in the above zones that may be worthy of further consideration. For example, the strong but incomplete indication on the north end of line 48 E. warrants an extension on the surveying at present. However, recommendation on this anomaly will depend largely on the results obtained on the adjacent line 56 E.

4. SUMMARY AND RECOMMENDATIONS

A total of 42 traverse lines have been cut on the Bory claims and this report covers the I.P. results on only the 26 lines that had been surveyed up to August 11, 1971. The I.P. survey and other field investigations are still in progress as of the date of this report. Consequently, a re-assessment of this report should be made when all of the other surveys have been completed and comparisons and correlations with other techniques can be studied. Suggestions and recommendations given herein should be reviewed in the light of all available data.

The completed I.P. traverses show that there are broad areas of low metallic content (probably less than one percent) that are associated with resistivities of less than 40 ohm-feet. These broad, weak responses (shown by the possible anomaly symbols) are not considered as primary drill targets in themselves but could represent a lithologic unit or rock type. Consequently, their extent may be of value in the geologic interpretation of this drift-covered area. Nevertheless, if the "metallic" mineralization consists chiefly of molybdenite, chalcocite, and bornite, parts of the broad responses could have some economic potential.

Superimposed on these broad "background" responses are indications of improved metallic concentrations as shown by the probable and definite anomaly symbols. Twelve anomalous zones, lettered alphabetically from A to L inclusive, have been interpreted on the basis of their line-to-line correlction. These have been discussed in detail in the body of the report.

With existing data the following locations are considered to warrant a first priority rating:-

Zone	A	Line 168 W and 144 W
"	C	" 128 W
"	G	" 24 W

Second priority targets are:-

Zone	C	Line 96 W
"	J	" 0+00
"	K	" 40 E
"	L	" 32 E

Zones D and I both warrant further consideration but occur on the ends of the survey data. Zones E, F, G and H trend grid E.-W. and any strike continuation on the unsurveyed lines would enhance their economic potential and their priority rating.

The above interpretation and recommendations should be reviewed and re-assessment made of all the anomalies when the I.P. survey has been completed and a study has been made of all existing geophysical, geological and geochemical data which is presently being collected and compiled.

Respectfully submitted,

REGISTERED PROFESSIONAL ENGINEER D. B. SUTHERLAND PROVINCE OF ONTARIO

D. B. Sutherland,
P.Eng.(Ontario)

D. H. Brown,
P.Eng.(B.C.)

Vancouver, B.C.

August 31, 1971

DOMINION OF CANADA:
PROVINCE OF BRITISH COLUMBIA.
TO WIT:

In the Matter of Line Cutting and Geophysical Survey on the Bory mineral claims.

I, D. H. Brown

of #504 - 1112 West Pender Street, Vancouver 1, B.C.

in the Province of British Columbia, do solemnly declare that the following work was done on the Green, Yellow, Brown, Purple and Blue groups of the Bory mineral claims.

Line Cutting (May 28 - June 24, 1971)		Charges
Contractor:	Terrex Mining Services Ltd., Box 508, Princeton, B.C.	
Work Performed:	40.2 miles of line cut and surveyed at $110.00/mile	$ 4,422.00
	5 miles tie lines at $50.00/mile	250.00
Room and Board:	4 men for 20 days, 2 men for 8 days (May 28 - June 24) at $10.00/man/day	960.00

I.P. Survey

Miles surveyed 25
No. of readings 1,739

Personnel	Position	Dates	Days	Rate/Day	
M. Menard	Party Chief	(July 1 - July 26 (Aug. 3 - Aug. 11	35	$95.00	3,325.00
J. Menard	Operator	"	"	75.00	2,625.00
R. Smith	Helper	"	"	35.00	1,225.00
B. Trenholm	Helper	"	"	35.00	1,225.00
S. Sapper	Senior Geophysicist	July 26 - 27	2	100.00	200.00
D. Sutherland	Chief Geophysicist	July 26, Aug. 25	2	150.00	300.00
Standby Time:		June 27 - 30 Aug. 1 - 2	6 days @ $80.00/day		480.00
Equipment Rental:		June 27 - July 26 Aug. 2 - 11	40 days @ $70.00/day		2,800.00
Room and Board:		6 men for 42 days @ $10.00/man/day			2,520.00
				Total	$20,332.00

This work was performed on each of the five groups of Bory claims. Of this total, $4,000 is to be applied to each of the Green, Yellow, Brown and Purple groups of 40 claims, and $3,800 is to be applied to the Blue group of 38 claims.

And I make this solemn declaration conscientiously believing it to be true, and knowing that it is of the same force and effect as if made under oath and by virtue of the "Canada Evidence Act."

Declared before me at the City of Vancouver, in the Province of British Columbia, this 1 day of September 1971, A.D.

D H Brown

Jill Turner

A Commissioner for taking Affidavits within British Columbia or
A Notary Public in and for the Province of British Columbia.
Sub-mining Recorder

Negotiable without charge at any branch of the Canadian Imperial Bank of Commerce in Canada
(For Northern Branches Excepted)

FALCONBRIDGE NICKEL MINES LIMITED

1112 WEST PENDER STREET,
VANCOUVER 1, B.C.

To
CANADIAN IMPERIAL
BANK OF COMMERCE
Hastings and Granville,
VANCOUVER, B.C.

№ 20117

DATE: JUL 09 71

AMOUNT: 1,100.00

PAY Thousand $1 100 and 00 cts

To The Order of Terrex Mining Services Limited,
Box 508,
Princeton, B.C.

FALCONBRIDGE NICKEL MINES LIMITED
Per ....
Per ....

PAID JUN 10 1971
NOT NEGOTIABLE

PLEASE DETACH BEFORE DEPOSITING CHEQUE

Negotiable without charge at any branch of the Canadian Imperial Bank of Commerce in Canada
(For Northern Branches Excepted)

FALCONBRIDGE NICKEL MINES LIMITED

1112 WEST PENDER STREET,
VANCOUVER 1, B.C.

To
CANADIAN IMPERIAL
BANK OF COMMERCE
Hastings and Granville,
VANCOUVER, B.C.

№ 20267

DATE: JUL 08 71

AMOUNT: 3,572.00

PAY Thousand $3 572 and 00 cts

To The Order of Terrex Mining Services Limited,
Box 508
Princeton, B.C.

FALCONBRIDGE NICKEL MINES LIMITED
Per ....
Per ....

PAID JUL 9 1971

NOT NEGOTIABLE

PLEASE DETACH BEFORE DEPOSITING CHEQUE

Appendix B

FALCONBRIDGE NICKEL MINES LIMITED
1112 WEST PENDER STREET
VANCOUVER 1, B. C., CANADA
TELEPHONE: 682-6242
TELEX: 04-5938

August 31, 1971

The Chief Mining Recorder
Cariboo Mining Division
Quesnel, B.C.

Dear Sir:

Re: Statement of Qualifications

This is to certify that the geophysical work done on the Bory mineral claims and presented in this report was done under the direction of D. B. Sutherland and under my supervision.

The geophysical field work was performed by M. Menard, Party Chief and J. Menard, geophysical operator who were assisted by R. Smith and B. Trenholm. M. Menard has been trained in the laboratory and in the field as a geophysical party chief and operator. J. Menard has been trained in the field as a geophysical operator. R. Smith and B. Trenholm have been trained in the field as geophysical assistants.

D. B. Sutherland, B.A., M.A., P.Eng.-Ontario (Geophysics - University of Toronto) is a qualified geophysicist with fifteen years experience in all relevant geophysical techniques.

I am a graduate in engineering geology from the University of British Columbia and a member of the Association of Professional Engineers of Ontario and British Columbia.

Yours very truly,

FALCONBRIDGE NICKEL MINES LIMITED

D H Brown

D. H. Brown, P.Eng.

APPENDIX C

THE INTERPRETATION OF INDUCED POLARIZATION ANOMALIES FROM RELATIVELY SMALL SOURCES

The induced polarization method was originally developed to detect disseminated sulphides and has proven to be very successful in the search for "porphyry copper" deposits. In recent years we have found that the IP method can also be very useful in exploring for more concentrated deposits of limited size. This type of source gives sharp IP anomalies that are often difficult to interpret.

The anomalous patterns that develop on the contoured data plots will depend on the size, depth and position of the source and the relative size of the electrode interval. The data plots are not sections showing the electrical parameters of the ground. When the electrode interval (X) is appreciably greater than the width of the source, a large volume of unmineralized rock is averaged into each measurement. This is particularly true for the large values of the electrode separation (n).

The theoretical scale model results shown in Figure 1 and Figure 2 indicate the effect of depth. If the depth to the top of the source is small compared to the electrode interval (i. e. d X) the measurement for n = 1 will be anomalous. In Figure 1 the depth is 0. 5 units (X = 1. 0 units) and the n = 1 value is definitely anomalous; the pattern on the contoured data plot is typical for a relatively shallow, narrow, near-vertical tabular source. The results in Figure 2 are for the same source with the depth increased to 1. 5 units. Here the n = 1 value is not anomalous; the larger values of (n) are anomalous but the magnitudes are much lower than for the source at less depth.

When the electrode interval is greater than the width of the source, it is not possible to determine its width or exact position between the electrodes. The true IP effect within the source is also indeterminate; the anomaly from a very narrow source with a very large true IP effect will be much the same as that from a zone with twice the width and 1/2 the true IP effect. The theoretical scale model data shown in Figure 3 and Figure 4 demonstrate this problem. The depth and position of the source are unchanged but the width and true IP effect are varied. The anomalous patterns and magnitudes are essentially the same, hence the data are insufficient to evaluate the source completely.

The normal practise is to indicate the IP anomalies by solid, broken, or dashed bars, depending upon their degree of distinctiveness. 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. As illustrated in Figure 1, Figure 2, Figure 3 and Figure 4, no anomaly can be located with more accuracy than the spread length. While the centre of the solid bar indicating the anomaly corresponds fairly well with the source, the length of the bar should not be taken to represent the exact edges of the anomalous material.

If the source is shallow, the anomaly can be better evaluated using a shorter electrode interval. When the electrode interval used approaches the width of the source, the apparent effects measured will be nearly equal to the true effects within the source. When there is some depth to the top of the source, it is not possible to use electrode intervals that are much less than the depth to the source. In this situation, one must realize that a definite ambiguity exists regarding the width of the source and the IP effect within the source.

Our experience has confirmed the desirability of doing detail. When a reconnaissance IP survey using a relatively large electrode interval indicates the presence of a narrow, shallow source, detail with shorter electrode intervals is necessary in order to better locate, and evaluate, the source. The data of most usefulness is obtained when the maximum apparent IP effect is measured for n = 2 or n = 3. For instance, an anomaly originally located using X = 300' may be checked with X = 200' and then X = 100'. The data with X = 100' will be quite different from the original reconnaissance results with X = 300'.

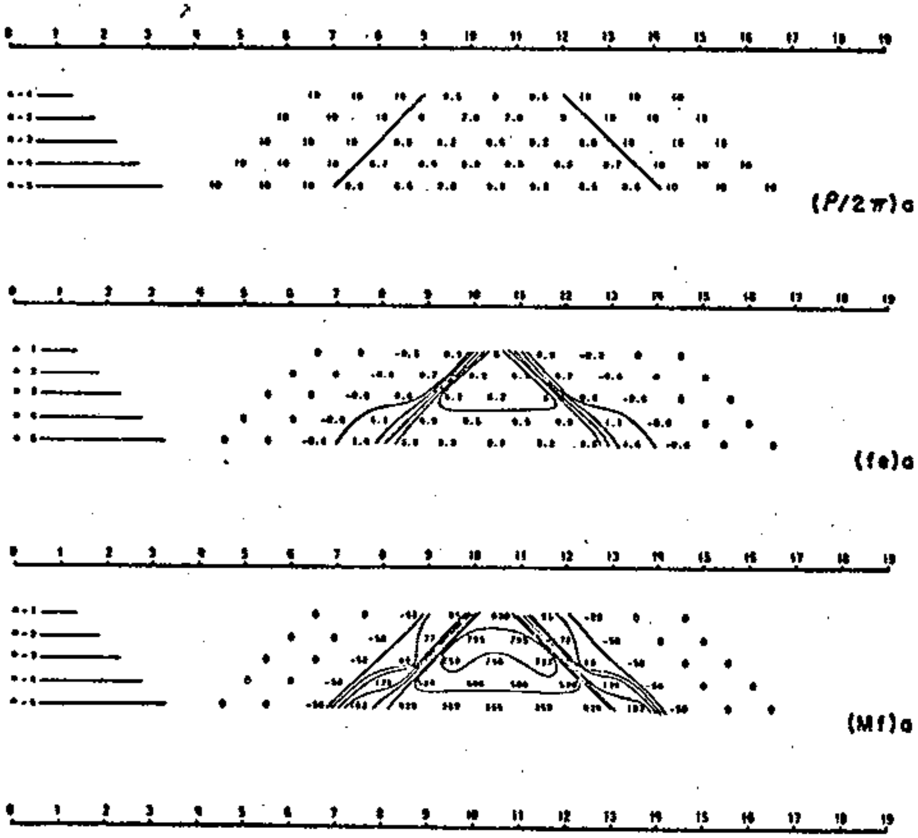
The data shown in Figure 5 and Figure 6 are field results from a greenstone area in Quebec. The expected sources were narrow (less than 30' in width) zones of massive, high-grade, zinc-silver ore. An electrode interval of 200' was used for the reconnaissance survey in order to keep the rate of progress at an acceptable level. The anomalies located were low in magnitude.

The very weak, shallow anomaly shown in Figure 5 is typical of those located by the X = 200' reconnaissance survey. Several anomalies of this type were detailed using shorter electrode intervals. In most cases the detail measurements suggested broad zones of very weak mineralization. However, in the case of the source at 20N to 22N, the measurements with shorter electrode intervals confirmed the presence of a strong, narrow source. The X = 50' results are shown in Figure 6. Subsequent drilling has shown the source to be 12.5' of massive sulphide mineralization containing significant zinc and silver values.

The change in the anomaly that results when the electrode interval is reduced is not unusual. The X = 50' data more accurately locates the narrow source, and permits the geophysicist to make a better evaluation of its importance. The completion of this type of detail is very important, in order to get the maximum usefulness from a reconnaissance IP survey.

Theoretical Induced Polarization and Resistivity Studies

Scale Model Cases



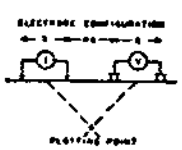
$(\rho/2\pi)_1 = 10$

$(Mf)_1 = 0$

$(\rho/2\pi)_2 = 2.51$

$(Mf)_2 = 10000$

$(fe)_2 = 25\%$



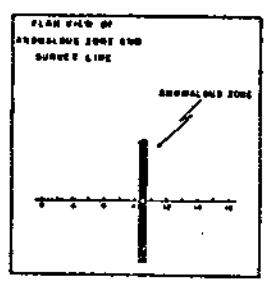
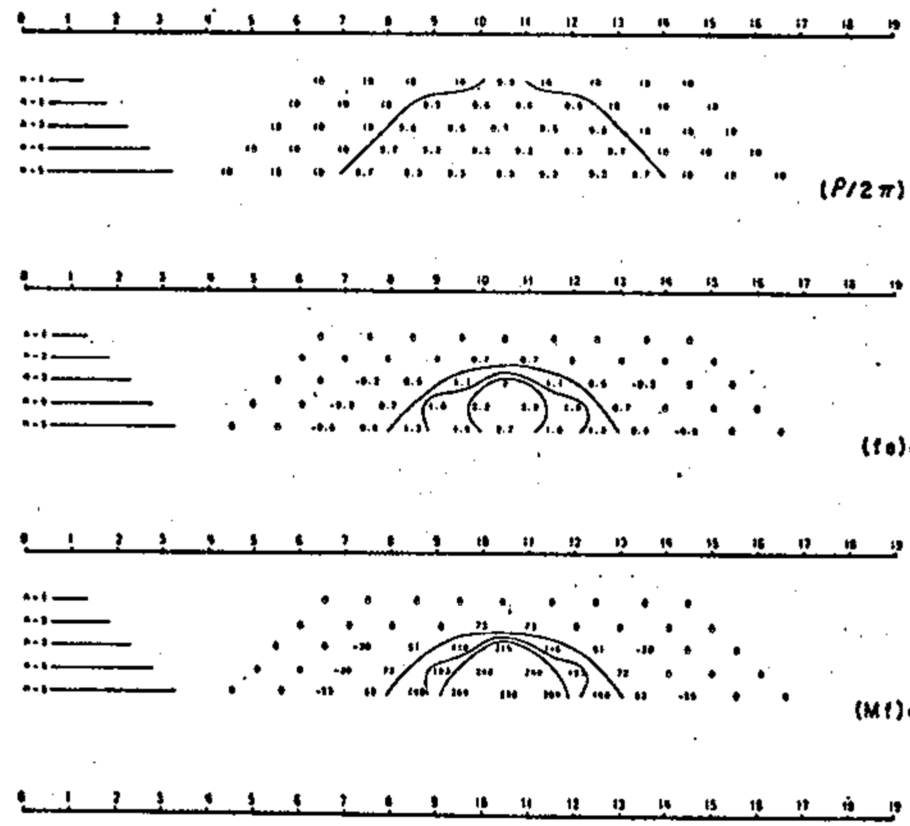


FIG 1

CASE II-0.5-BU-10-a

Theoretical Induced Polarization and Resistivity Studies

Scale Model Cases



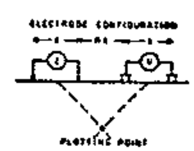
$(\rho/2\pi)_1 = 10$

$(Mf)_1 = 0$

$(\rho/2\pi)_2 = 2.6$

$(Mf)_2 = 9250$

$(fe)_2 = 24\%$



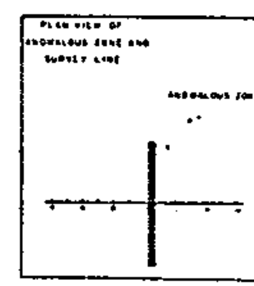


FIG 2

CASE II-1.5-BU-10-a

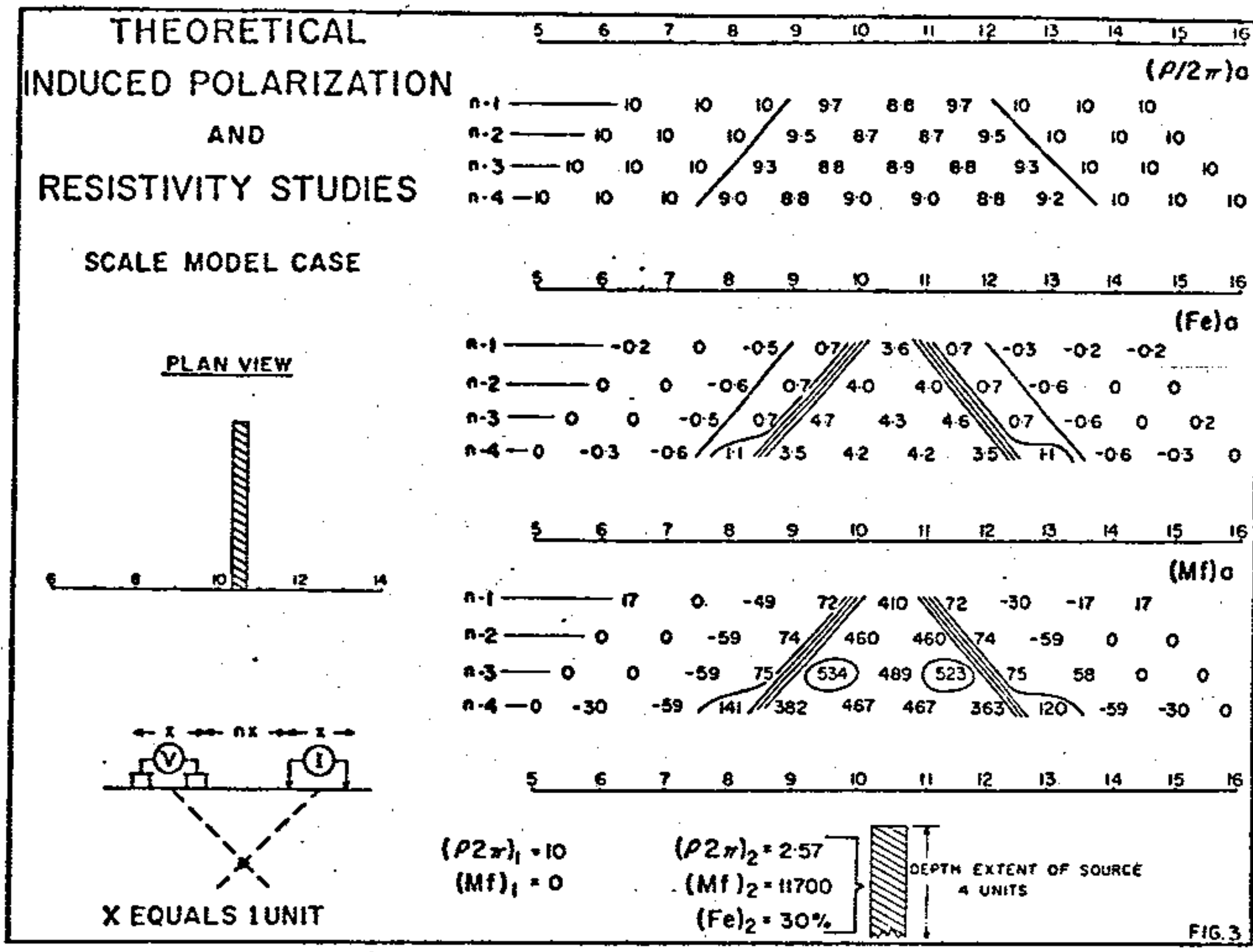

THEORETICAL
INDUCED POLARIZATION
AND
RESISTIVITY STUDIES
SCALE MODEL CASE
PLAN VIEW
X EQUALS 1 UNIT
(ρ/2π)a
n-1 10 10 10 9.7 8.8 9.7 10 10 10
n-2 10 10 10 9.5 8.7 8.7 9.5 10 10 10
n-3 10 10 10 9.3 8.8 8.9 8.8 9.3 10 10 10
n-4 10 10 10 9.0 8.8 9.0 9.0 8.8 9.2 10 10 10
(Fe)a
n-1 -0.2 0 -0.5 0.7 3.6 0.7 -0.3 -0.2 -0.2
n-2 0 0 -0.6 0.7 4.0 4.0 0.7 -0.6 0 0
n-3 0 0 -0.5 0.7 4.7 4.3 4.6 0.7 -0.6 0 0.2
n-4 0 -0.3 -0.6 1.1 3.5 4.2 4.2 3.5 1.1 -0.6 -0.3 0
(Mf)a
n-1 17 0 -49 72 410 72 -30 -17 17
n-2 0 0 -59 74 460 460 74 -59 0 0
n-3 0 0 -59 75 534 489 523 75 58 0 0
n-4 0 -30 -59 141 382 467 467 363 120 -59 -30 0
(ρ2π)1 = 10
(Mf)1 = 0
(ρ2π)2 = 2.57
(Mf)2 = 11700
(Fe)2 = 30%
DEPTH EXTENT OF SOURCE 4 UNITS

FIG. 3

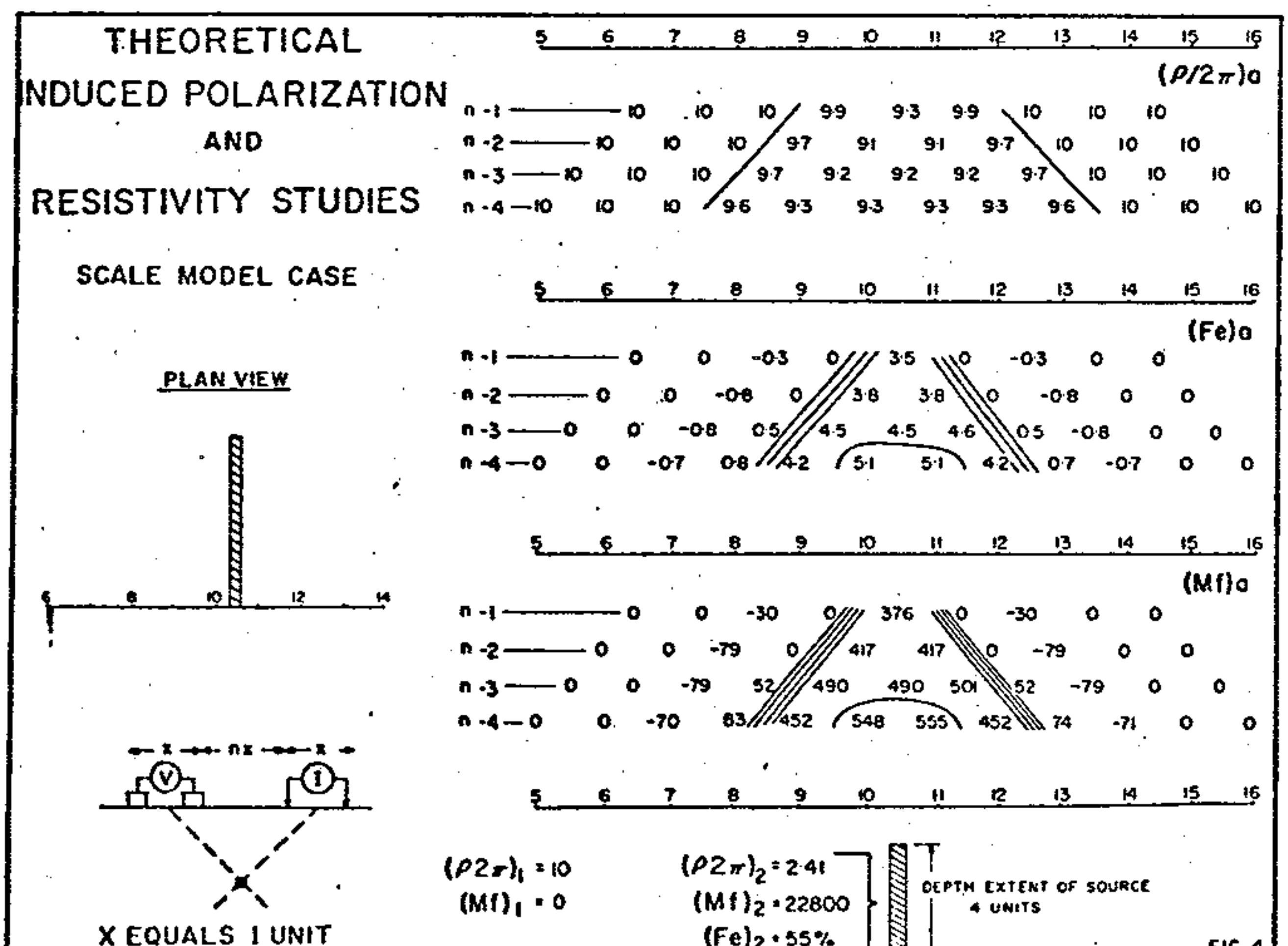

THEORETICAL
INDUCED POLARIZATION
AND
RESISTIVITY STUDIES
SCALE MODEL CASE
PLAN VIEW
X EQUALS 1 UNIT
(ρ/2π)a
n-1 10 10 10 9.9 9.3 9.9 10 10 10
n-2 10 10 10 9.7 9.1 9.1 9.7 10 10 10
n-3 10 10 10 9.7 9.2 9.2 9.2 9.7 10 10 10
n-4 10 10 10 9.6 9.3 9.3 9.3 9.3 9.6 10 10 10
(Fe)a
n-1 0 0 -0.3 0 3.5 0 -0.3 0 0
n-2 0 0 -0.8 0 3.8 3.8 0 -0.8 0 0
n-3 0 0 -0.8 0.5 4.5 4.5 4.6 0.5 -0.8 0 0
n-4 0 0 -0.7 0.8 4.2 5.1 5.1 4.2 0.7 -0.7 0 0
(Mf)a
n-1 0 0 -30 0 376 0 -30 0 0
n-2 0 0 -79 0 417 417 0 -79 0 0
n-3 0 0 -79 52 490 490 501 52 -79 0 0
n-4 0 0 -70 83 452 548 555 452 74 -71 0 0
(ρ2π)1 = 10
(Mf)1 = 0
(ρ2π)2 = 2.41
(Mf)2 = 22800
(Fe)2 = 55%
DEPTH EXTENT OF SOURCE 4 UNITS

FIG 4

INDUCED POLARIZATION AND RESISTIVITY RESULTS
BATCHELOR LAKE AREA, QUEBEC.

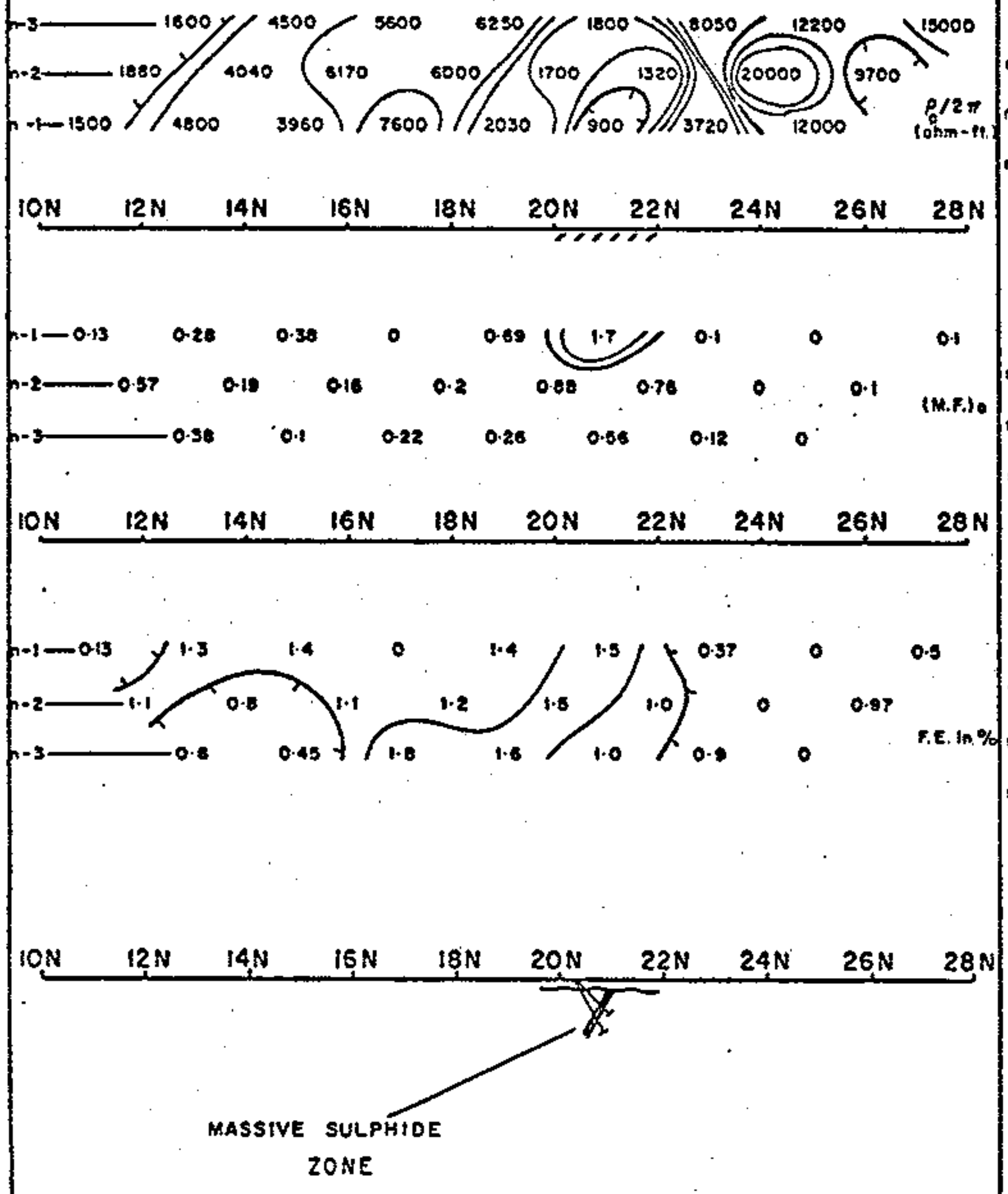


FIG. 5

INDUCED POLARIZATION AND RESISTIVITY RESULTS
BATCHELOR LAKE AREA, QUEBEC.

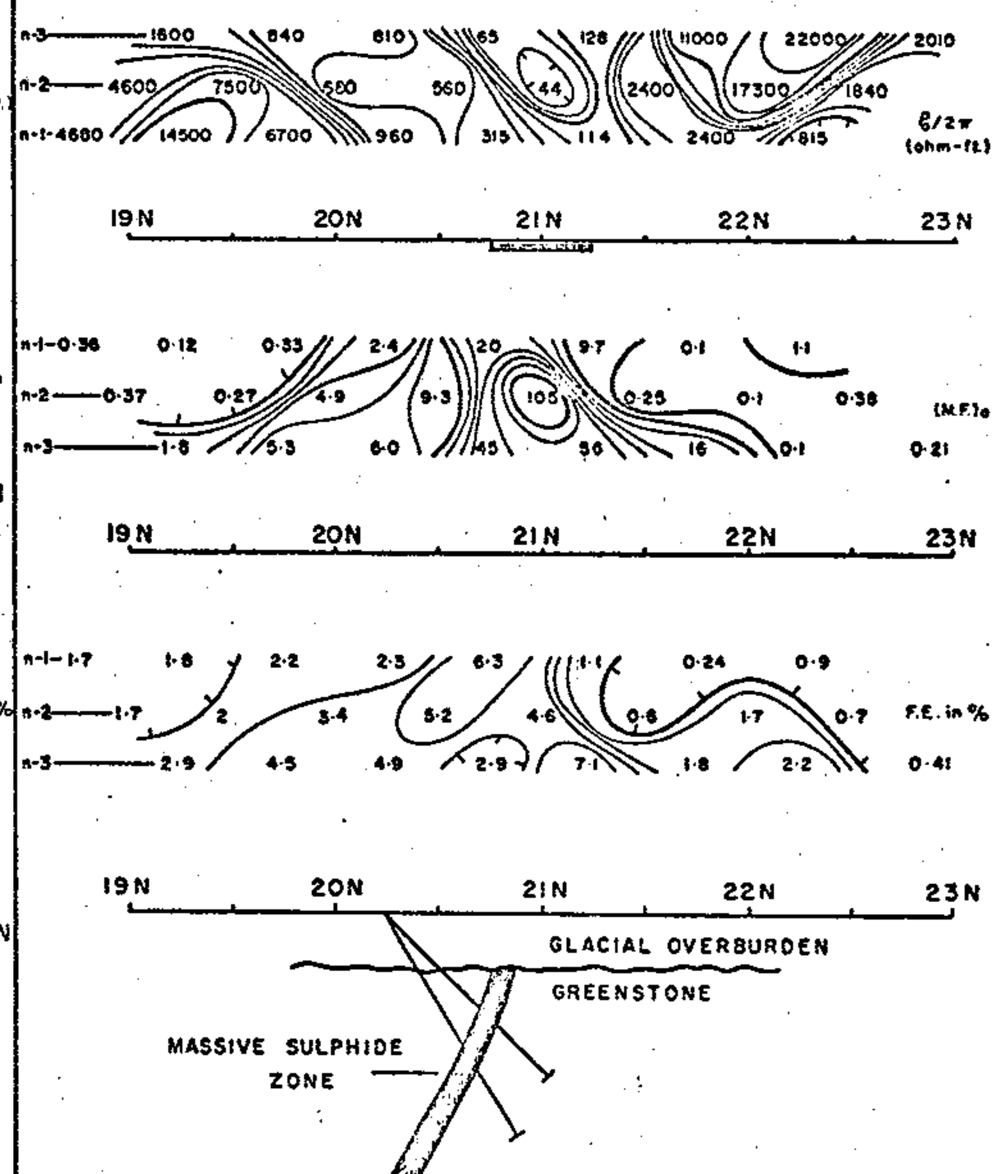


FIG. 6

APPENDIX D

EXPECTED IP ANOMALIES FROM "PORPHYRY COPPER" TYPE ZONES OF DISSEMINATED SULPHIDE MINERALIZATION

Our experience in other areas has shown that the induced polarization method can be successfully used to locate, and outline, zones of disseminated sulphide mineralization of the "porphyry copper" type. In most cases the interpretation of the IP results is simple and straightforward. The results shown in Figure 1 and Figure 2 are typical.

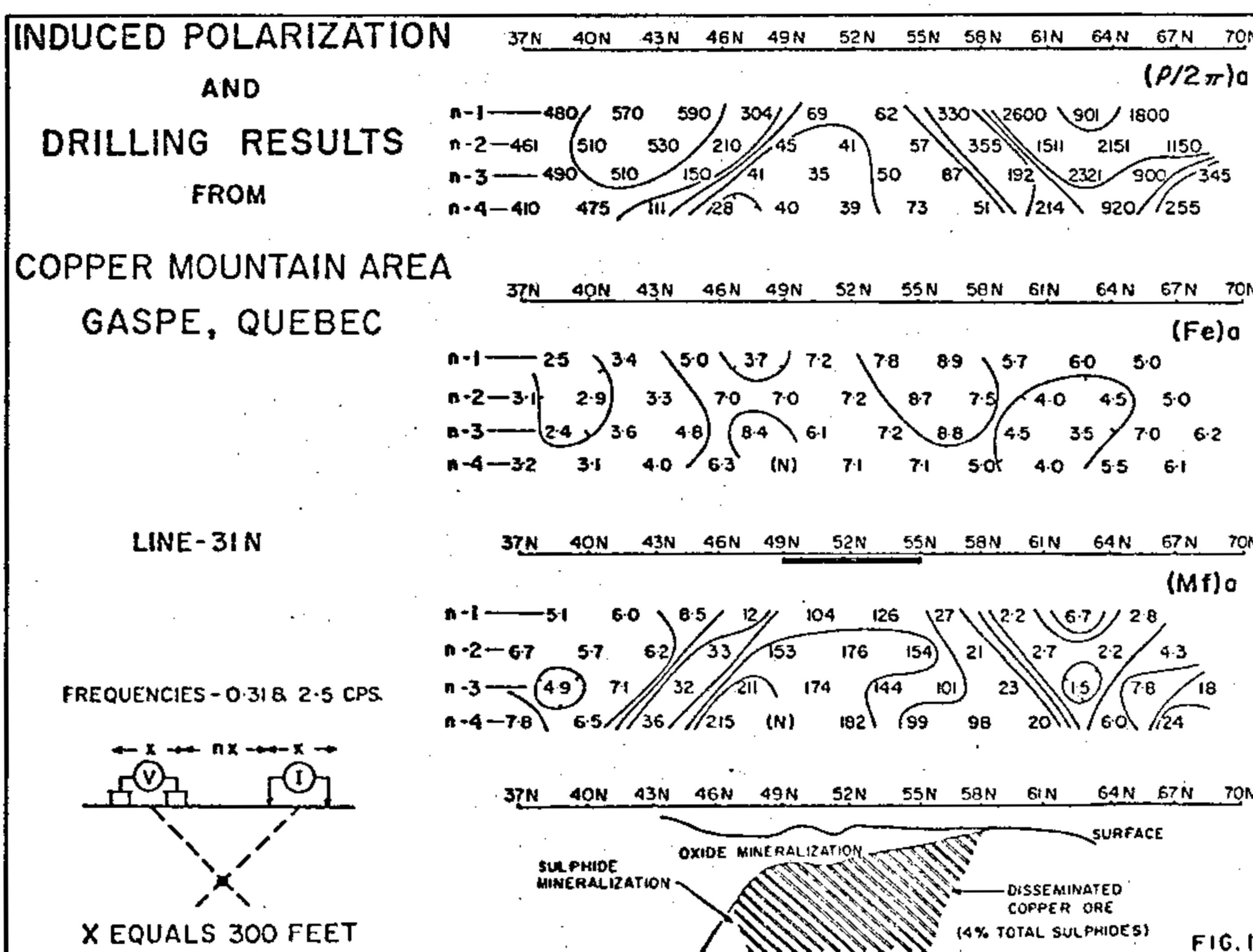


FIG. 1

The source of the moderate magnitude IP anomaly shown in Figure 1 contains approximately 4% metallic mineralization. The zone is of limited lateral extent and enough copper is present to make the mineralization "ore grade". The presence of the surface oxidation can be seen in the fact that the apparent IP effects increase for n = 2.

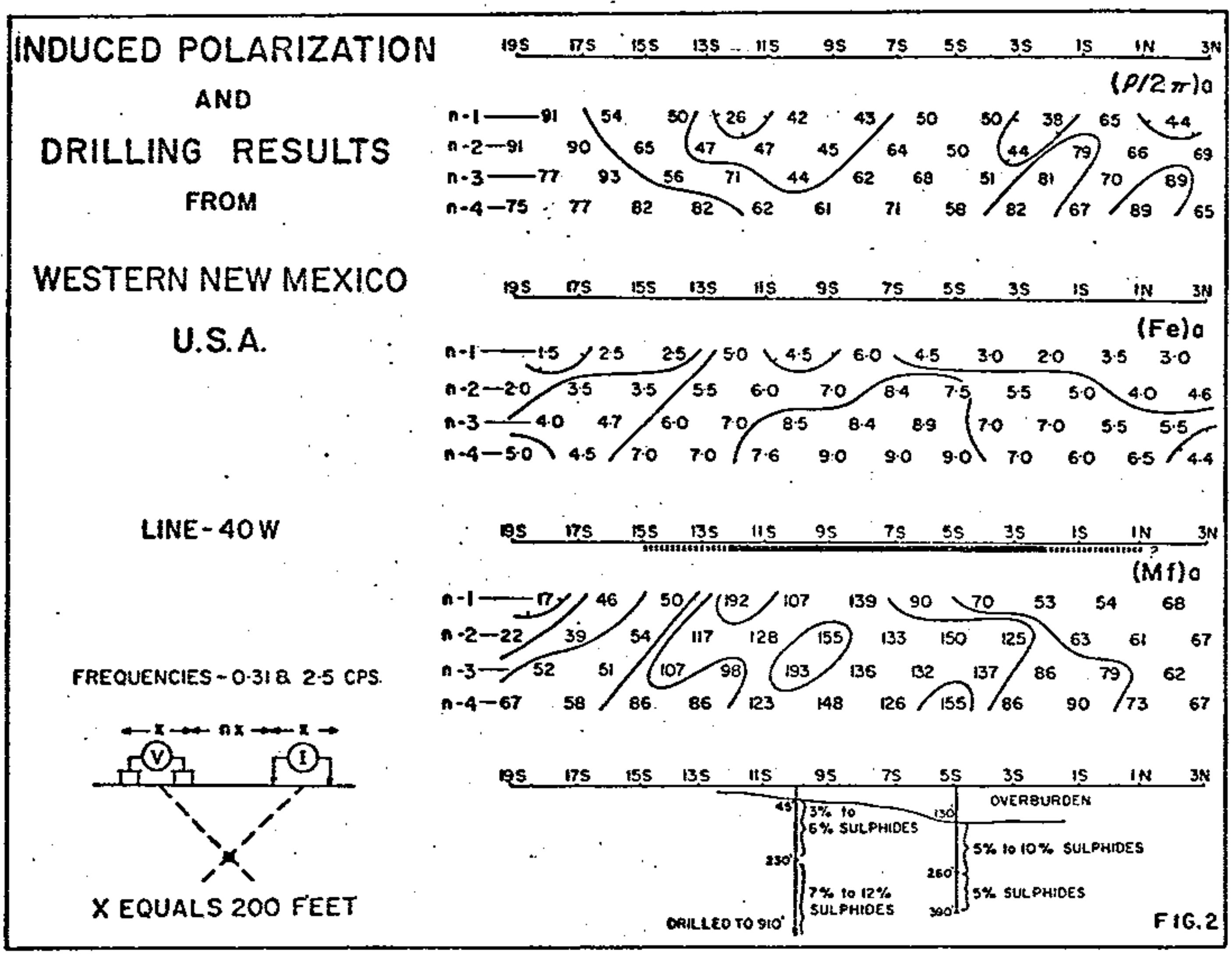


FIG. 2

The IP anomaly shown in Figure 2 has about the same magnitude as that described above. It should be noted that appreciably greater concentrations of metallic mineralization are present; further, there is little or no copper present. These results illustrate the fact that IP results can not be used to determine the exact amount of metallic mineralization present or to determine the economic importance of a mineralized zone. In some geologic situations zoning is present; the zones of mineralization of greatest economic value may contain less total metallic mineralization than other zones in the same general area.

In the proper geologic environment, the method will detect even very low concentrations of metallic mineralization. The IP results shown in Figure 3 located the ore zone at the Brenda Property near Peachland, B. C. The zone contains 1. 0 to 1. 5 per cent metallic mineralization; however, the mineralization is "ore grade" because only molybdenite and chalcopyrite are present.

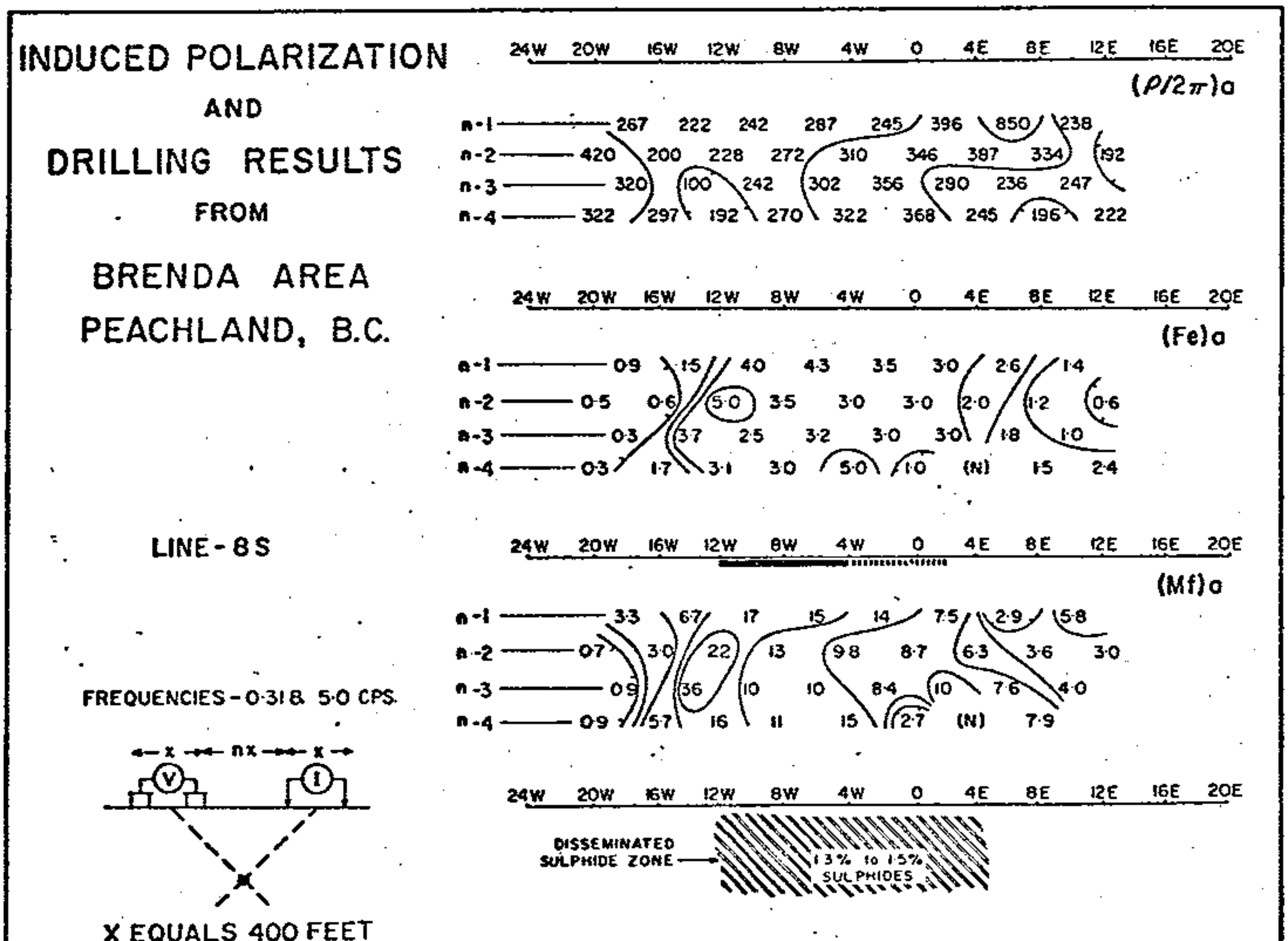


FIG.3

NOTES ON THE THEORY, METHOD OF FIELD OPERATION AND PRESENTATION OF DATA FOR THE INDUCED POLARIZATION METHOD

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 appreciably reduce the amount of 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 per cent frequency effect or F. E. are a measurement of the polarization in the rock mass. However, since the measurement of the degree of polarization is related to the apparent resistivity of the rock mass it is found that the metal factor values or M. F. are the most useful values in determining the amount of polarization present in the rock mass. The MF values are obtained by normalizing the F. E. values for varying resistivities.

The induced polarization measurement is perhaps the most powerful geophysical method for the direct detection of metallic sulphide mineralization, even when this mineralization is of very low concentration. The lower limit of volume per cent sulphide necessary to produce a recognizable IP anomaly will vary with the geometry and geologic environment of the source, and the method of executing the survey. However, sulphide mineralization of less than one per cent by volume has been detected by the IP method under proper geological conditions.

The greatest application of the IP method has been in the search for disseminated metallic sulphides of less than 20% by volume. However, it has also been used successfully in the search for massive sulphides in situations where, due to source geometry, depth of source, or low resistivity of surface layer, the EM method can not be successfully applied. The ability to differentiate ionic conductors, such as water filled shear zones, makes the IP method a useful tool in checking EM anomalies which are suspected of being due to these causes.

In normal field applications the IP method does not differentiate between the economically important metallic minerals such as chalcopyrite, chalcocite, molybdenite, galena, etc., and the other metallic minerals such as pyrite. The induced polarization effect is due to the total of all electronic conducting minerals in the rock mass. Other electronic conducting materials which can produce an IP response are magnetite, pyrolusite, graphite, and some forms of hematite.

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 in distance (X) apart. The potentials are measured at two other points (X) feet apart, in line with the current 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, apparent per cent frequency effect, 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. (See Figure A.) The resistivity values are plotted above the line as a mirror image of the metal factor values below. On a second line, below the metal factor values, are plotted the values of the per cent frequency effect. In some cases the values of per cent frequency effect are plotted as superscripts of the metal factor value. In this second case the frequency effect values are not contoured. 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. The 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 results, model study results and theoretical investigations. The position of the electrodes when anomalous values are measured is important 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 25 feet to 2000 feet for (X). In each case, the decision as to the distance (X) and the values of (n) to be used 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.

The diagram in Figure A demonstrates the method used in plotting the results. Each value of the apparent resistivity, apparent metal factor, and apparent per cent frequency effect 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. When the F. E. values are plotted as superscripts to the MF values the third section of data values is not presented and the F. E. values are not contoured.

The actual data plots included with the report are prepared utilizing an IBM 360/75 Computer and a Calcomp 770/763 Incremental Plotting System. The data values are calculated, plotted, and contoured according to a programme developed by McPhar Geophysics. Certain symbols have been incorporated into the programme to explain various situations in recording the data in the field.

The IP measurement is basically obtained by measuring the difference in potential or voltage (ΔV) obtained at two operating frequencies. The voltage is the product of the current through the ground and the apparent resistivity of the ground. Therefore in field situations where the current is very low due to poor electrode contact, or the apparent resistivity is very low, or a combination of the two effects; the value of (ΔV) the change in potential will be too small to be measurable. The symbol "TL" on the data plots indicates this situation.

In some situations spurious noise, either man made or natural, will render it impossible to obtain a reading. The symbol "N" on the data plots indicates a station at which it is too noisey to record a reading. If a reading can be obtained, but for reasons of noise there is some doubt as to its accuracy, the reading is bracketed in the data plot ( ).

In certain situations negative values of Apparent Frequency Effect are recorded. This may be due to the geologic environment or spurious electrical effects. The actual negative frequency effect value recorded is indicated on the data plot, however the symbol "NEG" is indicated for the corresponding value of Apparent Metal Factor. In contouring negative values the contour lines are indicated to the nearest positive value in the immediate vicinity of the negative value.

The symbol "NR" indicates that for some reason the operator did not attempt to record a reading although normal survey procedures would suggest that one was required. This may be due to inaccessible topography or other similar reasons. Any symbol other than those discussed above is unique to a particular situation and is described within the body of the report.

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

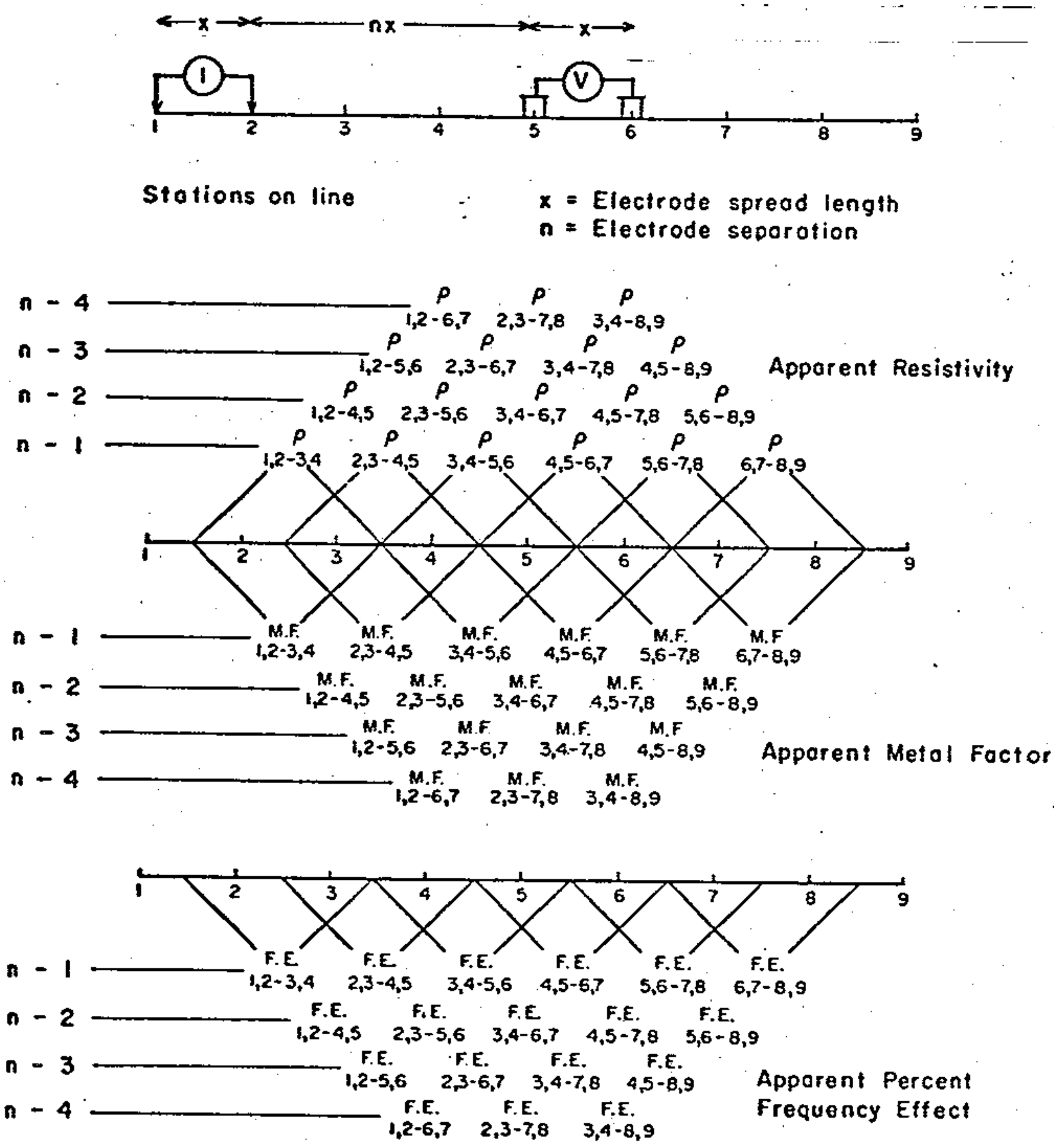


Fig. A

FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

BORY PROJECT

LINE Nº 0+00

LEGEND

UNIT USED McPHAR - P660
ARRAYS DIPOLE - DIPOLE
FREQUENCIES .3 - 5 C.P.S.
SCALE 1" = 300'
DATE 13 - 14 - 7 - 71
CREW M. MENARD

Department of Mines and Petroleum Resources
ASSESSMENT REPORT
NO. .... MAP ....

CONTOUR INTERVALS 1, 1.5, 2, 3, 5, 7.5, 10,

ANOMALY, STRONG
MODERATE
WEAK

FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

BORY PROJECT

LINE No 128 W

LEGEND

UNIT USED McPHAR P-660
ARRAYS DIPOLE-DIPOLE
FREQUENCIES .3-5 C.P.S.
SCALE 1" = 300'
DATE 6-7-7-71
CREW M. MENARD

Department of Mines and Petroleum Resources
ASSESSMENT REPORT
MAP

CONTOUR INTERVALS 1, 1.5, 2, 3, 5, 7.5, 10,
ANOMALY, STRONG
MODERATE
WEAK

FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

BORY PROJECT

LINE No 136 W

LEGEND

UNIT USED McPHAR P-660

ARRAYS DIPOLE - DIPOLE

FREQUENCIES .3-5 C.P.S.

SCALE 1" = 300'

DATE 7-8-7-71

CREW M. MENARD

Department of Mines and Petroleum Resources
ASSESSMENT REPORT
NO. ......

D H Brown

CONTOUR INTERVALS 1, 1.5, 2, 3, 5, 7.5, 10,

ANOMALY, STRONG

MODERATE

WEAK

FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

BORY PROJECT

LINE Nº 112 W

LEGEND

UNIT USED McPHAR P-660
ARRAYS DIPOLE - DIPOLE
FREQUENCIES 3-5 C.P.S.
SCALE 1" = 300'
DATE 2-7-71
CREW M. MENARD

Department of Mines and Petroleum Resources ASSESSMENT REPORT
NO. .... MAP ....

CONTOUR INTERVALS 1, 1.5, 2, 3, 5, 7.5, 10,
ANOMALY, STRONG
MODERATE
WEAK

FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

BORY PROJECT

LINE No 120 W

LEGEND

UNIT USED McPHAR P-660
ARRAYS DIPOLE - DIPOLE
FREQUENCIES .3-5 C.P.S.
SCALE 1" = 300'
DATE 6-7-71
CREW M. MENARD

Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
MAP

CONTOUR INTERVALS 1, 1.5, 2, 3, 5, 7.5, 10.

ANOMALY, STRONG
MODERATE
WEAK

FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

[illegible] PROJECT
123 - Marsh Lake

LINE No 76 W

LEGEND

UNIT USED [illegible]
ARRAYS [illegible]
FREQUENCIES [illegible]
SCALE [illegible]
DATE [illegible] - 8 - 71
CREW [illegible]

Department of
Mines and Petroleum Resources
ASSESSMENT REPORT

NO. ....

D H Brown

CONTOUR INTERVALS 1, 1·5, 2, 3, 5, 7·5, 10,

ANOMALY, STRONG ———
MODERATE — — —
WEAK · · · · · · ·

FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

BORY **PROJECT**

LINE No 104/W

LEGEND

UNIT USED McPHAR P-660

ARRAYS DIPOLE-DIPOLE

FREQUENCIES .3-5 C.P.S.

SCALE 1" = 300'

DATE 28-29-30-6-71 — 1-7-71

CREW M. MENARD

Department of Mines and Petroleum Resources ASSESSMENT REPORT

NO.

CONTOUR INTERVALS 1, 1.5, 2, 3, 5, 7.5, 10,

ANOMALY, STRONG

MODERATE

WEAK

FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

PROJECT

LINE No

LEGEND

UNIT USED

ARRAYS

FREQUENCIES

SCALE 1" = 200'

DATE

CREW

Department of Mines and Petroleum Resources
ASSESSMENT REPORT
NO. MAP

CONTOUR INTERVALS 1, 1.5, 2, 3, 5, 7.5, 10

ANOMALY STRONG
MODERATE
WEAK

FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

PROJECT

LINE No

LEGEND

UNIT USED

ARRAYS

FREQUENCIES

SCALE

DATE

CREW

Department of Mines and Petroleum Resources
ASSESSMENT REPORT
NO. .... MAP ....
D.H. Brown

CONTOUR INTERVALS 1, 1.5, 2, 3, 5, 7.5, 10,

ANOMALY: STRONG

MODERATE

WEAK

FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

PROJECT

LINE No

LEGEND

UNIT USED

ARRAYS

FREQUENCIES

SCALE

DATE

CREW

CONTOUR INTERVALS 1·5, 2, 3, 5, 7·5, 10,

ANOMALY, STRONG
MODERATE
WEAK

FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

BORY PROJECT

LINE No 70W

LEGEND

UNIT USED McPHAR - P660
ARRAYS DIPOLE - DIPOLE
FREQUENCIES 3-5 CPS
SCALE 1" = 300'
DATE 24-7-71
CREW M. MENARD

Department of Mines and Petroleum Resources
ASSESSMENT REPORT
NO. .... MAP ....

CONTOUR INTERVALS 1, 1.5, 2, 3, 5, 7.5, 10, .
ANOMALY, STRONG
MODERATE
WEAK

FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

BoRY PROJECT
123 MURPHY LAKE

LINE No 76W

LEGEND

UNIT USED McPHAR P-660
ARRAYS DIPOLE-DIPOLE
FREQUENCIES .3-5 CPS
SCALE 1" = 300'
DATE 24-25-7-71
CREW M. ALLENARD

Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. .... MAP

D. H. Brown

CONTOUR INTERVALS 1, 1.5, 2, 3, 5, 7.5, 10,

ANOMALY, STRONG
MODERATE
WEAK

FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

BORY PROJECT

LINE No 32 W

LEGEND

UNIT USED McPHAR-P660

ARRAYS DIPOLE-DIPOLE

FREQUENCIES .3-5 C.P.S.

SCALE 1" = 300'

DATE 19-20-7-71

CREW M. MENARD

Department of Mines and Petroleum Resources ASSESSMENT REPORT

NO. .... MAP ....

CONTOUR INTERVALS 1, 1.5, 2, 3, 5, 7.5, 10.

ANOMALY, STRONG

MODERATE

WEAK

FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

BORY PROJECT

LINE No 40 W

LEGEND

UNIT USED McPHAR-P660
ARRAYS DIPOLE-DIPOLE
FREQUENCIES .3-5 C.P.S.
SCALE 1" = 300'
DATE 21-7-71
CREW M. MENARD

Department of Mines and Petroleum Resources
ASSESSMENT REPORT
NO. .... MAP ....

CONTOUR INTERVALS 1, 1.5, 2, 3, 5, 7.5, 10,

ANOMALY, STRONG
MODERATE
WEAK

FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

BORY PROJECT

LINE No 8E

LEGEND

Unit used McPHAR - P660
Arrays DIPOLE - DIPOLE
Frequencies .3 - 5 C.P.S.
Scale 1" = 300'
Date 13 - 7 - 71
Crew M. MENARD

Contour intervals 1, 1.5, 2, 3, 5, 7.5, 10,
Anomaly: Strong
Moderate
Weak

FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

BORY PROJECT

LINE Nº 24 W

LEGEND

UNIT USED McPHAR-P660
ARRAYS DIPOLE - DIPOLE
FREQUENCIES .3-5 C.P.S.
SCALE 1" = 300'
DATE 19-7-71
CREW M. MENARD

Department of Mines and Petroleum Resources
ASSESSMENT REPORT
NO. .... MAP ....
D.H. Brown

CONTOUR INTERVALS 1, 1.5, 2, 3, 5, 7.5, 10,

ANOMALY; STRONG
MODERATE
WEAK

FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

PROJECT

LINE No

LEGEND

UNIT USED

ARRAYS

FREQUENCIES

SCALE 1" : 200'

DATE 7-9-9-71

CREW

Department of Mines and Petroleum Resources
ASSESSMENT REPORT
NO. .... MAP ....

CONTOUR INTERVALS 1, 1.5, 2, 3, 5, 7.5, 10,

ANOMALY, STRONG
MODERATE
WEAK

STATIONS
RESISTIVITY ρ/2π
M.F. METAL FACTOR
Fe
FALCONBRIDGE NICKEL MINES LIMITED
INDUCED POLARIZATION SURVEY
PROJECT
LINE No
LEGEND
UNIT USED
ARRAYS
FREQUENCIES
SCALE
DATE
CREW
Department of Mines and Petroleum Resources
ASSESSMENT REPORT
NO.
MAP
CONTOUR INTERVALS 1, 1.5, 2, 3, 5, 7.5, 10,
ANOMALY; STRONG
MODERATE
WEAK

FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

[illegible] PROJECT

LINE No [illegible]

LEGEND

UNIT USED [illegible]

ARRAYS [illegible]

FREQUENCIES . [illegible]

SCALE 1" = 200'

DATE [illegible]

CREW [illegible]

Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. ________ MAP ________

D. H. Brown

CONTOUR INTERVALS 1, 1.5, 2, 3, 5, 7.5, 10,

ANOMALY, STRONG ————
MODERATE — — —
WEAK . . . .

FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

PROJECT
MURPHY LAKE

LINE No

LEGEND

UNIT USED
ARRAYS
FREQUENCIES
SCALE
DATE
CREW

Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. MAP

D H Brown

CONTOUR INTERVALS 1, 1.5, 2, 3, 5, 7.5, 10,

ANOMALY, STRONG
MODERATE
WEAK

FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

PROJECT

LINE No

LEGEND

UNIT USED

ARRAYS

FREQUENCIES

SCALE 1" : 200

DATE

CREW

Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. .... MAP ....

CONTOUR INTERVALS, 1, 1.5, 2, 3, 5, 7.5, 10,

ANOMALY, STRONG
MODERATE
WEAK

FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

BORY PROJECT

LINE No 168 W

LEGEND

UNIT USED McPHAR P-660

ARRAYS DIPOLE-DIPOLE

FREQUENCIES .3-5 C.P.S.

SCALE 1" = 300'

DATE 12-7-71

CREW M. MENARD

Department of
Mines and Petroleum Resources
ASSESSMENT REPORT

NO. .... MAP ....

CONTOUR INTERVALS 1, 1.5, 2, 3, 5, 7.5, 10,

ANOMALY; STRONG
MODERATE
WEAK

FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

BORY PROJECT

LINE Nº 144 W

LEGEND

UNIT USED McPHAR P-660

ARRAYS DIPOLE-DIPOLE

FREQUENCIES .3-5 C.P.S.

SCALE 1" = 300'

DATE 8-7-71

CREW M. MENARD

Department of Mines and Petroleum Resources
ASSESSMENT REPORT
NO. .... MAP ....

CONTOUR INTERVALS 1, 1.5, 2, 3, 5, 7.5, 10,

ANOMALY, STRONG
MODERATE
WEAK

FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

BORY PROJECT

LINE No 152 W

LEGEND

UNIT USED McPHAR P-660

ARRAYS DIPOLE-DIPOLE

FREQUENCIES .3-5 C.P.S.

SCALE 1" = 300'

DATE 9-7-71

CREW M. MENARD

Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO .... MAP ....

CONTOUR INTERVALS 1, 1.5, 2, 3, 5, 7.5, 10,

ANOMALY, STRONG
MODERATE
WEAK

FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

BORY PROJECT

LINE No 160 W

LEGEND

UNIT USED McPHAR P-660
ARRAYS DIPOLE - DIPOLE
FREQUENCIES .3-5 C.P.S.
SCALE 1" = 300'
DATE 11-7-71
CREW M. MENARD

Department of
Mines and Petroleum Resources
ASSESSMENT REPORT

NO. .... MAP ....

CONTOUR INTERVALS 1, 1.5, 2, 3, 5, 7.5, 10,

ANOMALY, STRONG
MODERATE
WEAK

FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

BORY PROJECT

LINE No 8W

LEGEND

UNIT USED McPHAR - P660
ARRAYS DIPOLE - DIPOLE
FREQUENCIES .3-5 C.P.S.
SCALE 1" = 300'
DATE 14-15-7-71
CREW M. MENARD

CONTOUR INTERVALS 1, 1.5, 2, 3, 5, 7.5, 10,

ANOMALY: STRONG ———
MODERATE — — —
WEAK · · · · · · ·

FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

BORY PROJECT

LINE Nº 16W

LEGEND

UNIT USED McPHAR - P660
ARRAYS DIPOLE - DIPOLE
FREQUENCIES .3-5 CPS
SCALE 1" = 300'
DATE 16-18-7-71
CREW M. MENARD

CONTOUR INTERVALS 1, 1.5, 2, 3, 5, 7.5, 10,

ANOMALY, STRONG ———
MODERATE – – – –
WEAK ....

MAP REF. NO.: 123 M-71-1
N.T.S.: 93-A-3

MAP REF. NO.: 123 M-71-1
N.T.S.: 93-A-3

FALCONBRIDGE NICKEL MINES LIMITED

PROPERTY: BORY CLAIMS (W ½)

LOCATION: Murphy Lake, Cariboo Mining Division, B.C.

TYPE OF MAP: GEOPHYSICAL (INDUCED POLARIZATION)
Dipole - Dipole 300' - except where noted

WORKING PLACE: Murphy Lake

BASED ON: Survey by M. Menard, interpretation by D. Sutherland

DATE OF WORK: Jun 27 - July 26, Aug 1 - Aug 11, 1971

MAP REF. NO.: 123 M-71-1

FIG. NO.: 2 W

DRAWN BY: H.G.T.

DATE: August 27, 1971

N.T.S. NO.: 93-A-3