NOTES ON THE THEORY, METHOD OF FIELD OPERATION

AND PRESENTATION OF DATA

FOR THE INDUCED POLARIZATION METHOD

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

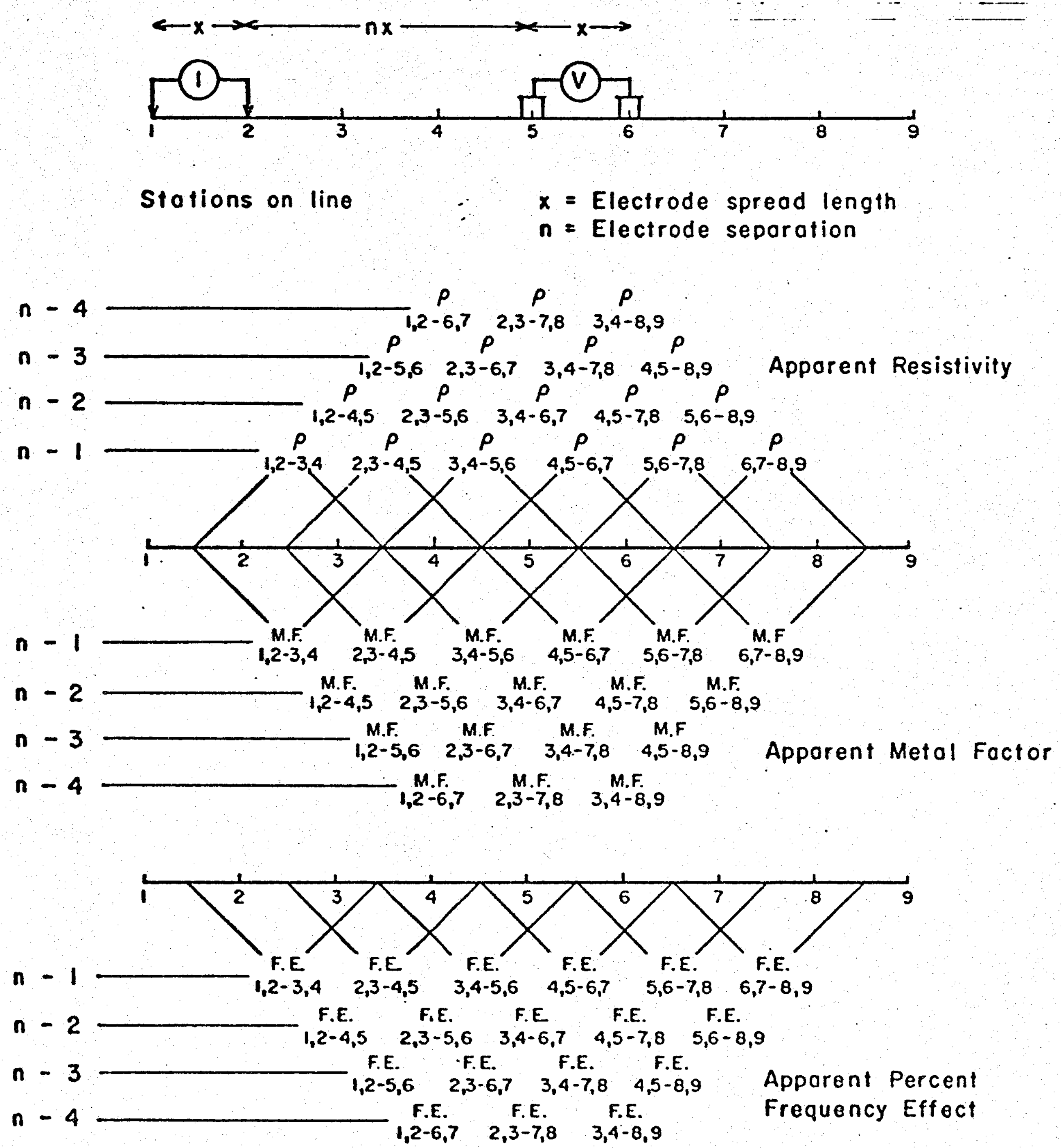


Fig. A

3384

REPORT ON THE

INDUCED POLARIZATION

AND

RESISTIVITY SURVEY

ON THE CHUCHI MINERAL CLAIMS

CHUCHI LAKE, B. C.

OMINECA MINING DIVISION

124° 43' W 55° 13' N

93 N/2E

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

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

Vancouver, B.C.
October 1971

CONTENTS

REPORT ON THE
INDUCED POLARIZATION
AND
RESISTIVITY SURVEY
ON THE CHUCHI MINERAL CLAIMS
CHUCHI LAKE, B. C.
OMINECA MINING DIVISION

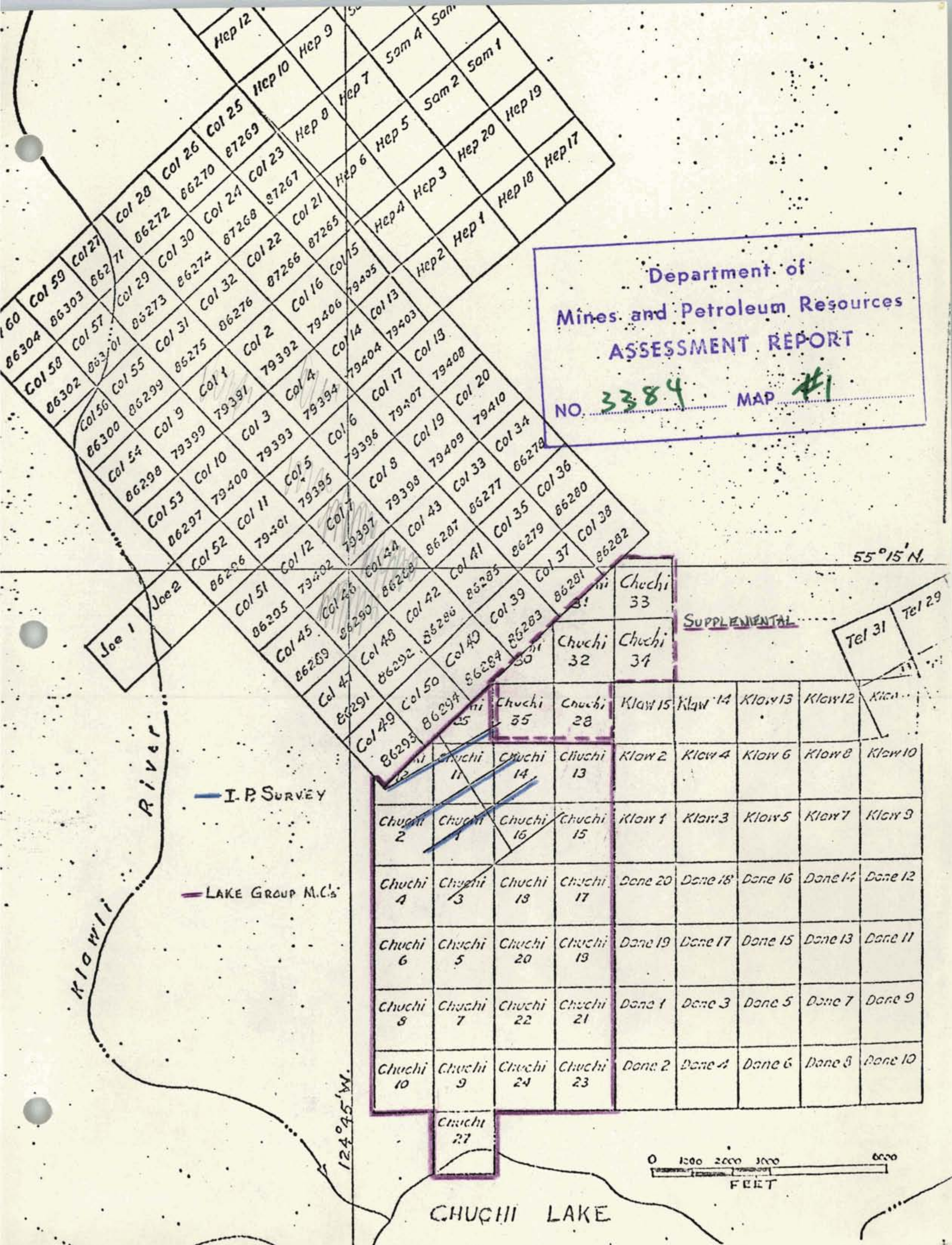
1. INTRODUCTION

The I.P. and resistivity survey was carried out by Falconbridge's crew of two operators, P. Smith and R. Leclerc, with the assistance of helpers R. Smith and R. McGuire, during the period from September 24th to 27th. G. Thomassen and L. McLeod were also required as assistants during this period for the preparation of contact holes.

This report covers the data obtained on the three most easterly traverses of an extensive grid.

The survey area is situated about 3 miles northwest of the north end of Chuchi Lake and is centred near 124° 43' W. and 55° 13' N. (See Fig. 1)

There is no outcrop on the claims but regional mapping indicates that they lie near the eastern contact of the Hogem Batholith with the Takla Group volcanics. Copper mineralization is reported in fracture fillings in syenite from outcrops and drill holes located to the west.


55°15'N.
124°45'W.
Kiowli River
CHUCHI LAKE
I.P. SURVEY
LAKE GROUP M.C.'s
SUPPLEMENTAL
0 1000 2000 3000 6000
FEET
Hep 12
Hep 9
Hep 10
Hep 7
Hep 8
Hep 5
Hep 6
Hep 3
Hep 4
Hep 1
Hep 2
Hep 19
Hep 20
Hep 17
Hep 18
Som 4
Som 1
Som 2
Col 25 87269
Col 26 86270
Col 23 87267
Col 28 86272
Col 24 87268
Col 21 87265
Col 27 86271
Col 30 86274
Col 22 87266
Col 15 79405
Col 59 86303
Col 29 86273
Col 32 86276
Col 16 79406
Col 13 79403
Col 60 86304
Col 57 86301
Col 31 86275
Col 2 79392
Col 14 79404
Col 18 79408
Col 58 86302
Col 55 86299
Col 1 79391
Col 4 79394
Col 17 79407
Col 20 79410
Col 56 86300
Col 9 79399
Col 3 79393
Col 6 79396
Col 19 79409
Col 34 86278
Col 54 86298
Col 10 79400
Col 5 79395
Col 8 79398
Col 33 86277
Col 36 86280
Col 53 86297
Col 11 79401
Col 7 79397
Col 43 86287
Col 35 86279
Col 38 86282
Col 52 86296
Col 12 79402
Col 44 86288
Col 41 86285
Col 37 86281
Col 51 86295
Col 46 86290
Col 42 86286
Col 39 86283
Col 45 86289
Col 48 86292
Col 40 86284
Col 47 86291
Col 50 86294
Col 49 86293
Joe 1
Joe 2
Chuchi 33
Chuchi 32
Chuchi 34
Chuchi 35
Chuchi 28
Chuchi 11
Chuchi 14
Chuchi 13
Chuchi 2
Chuchi 16
Chuchi 15
Chuchi 4
Chuchi 3
Chuchi 18
Chuchi 17
Chuchi 6
Chuchi 5
Chuchi 20
Chuchi 19
Chuchi 8
Chuchi 7
Chuchi 22
Chuchi 21
Chuchi 10
Chuchi 9
Chuchi 24
Chuchi 23
Chuchi 27
Klaw 15
Klaw 14
Klow 13
Klow 12
Klow 2
Klow 4
Klow 6
Klow 8
Klow 10
Klow 1
Klow 3
Klow 5
Klow 7
Klow 9
Done 20
Done 18
Done 16
Done 14
Done 12
Done 19
Done 17
Done 15
Done 13
Done 11
Done 1
Done 3
Done 5
Done 7
Done 9
Done 2
Done 4
Done 6
Done 8
Done 10
Tel 31
Tel 29

The Chuchi Lake area itself is located at the southern end of the Hogem Batholith. This is an elongated intrusive mass trending north-northwest for at least 60 miles within the Omineca or Eastern Crystalline Belt of British Columbia. It is mapped by the Geological Survey of Canada (Armstrong, J.E., 1949, Memoir 252) as mainly granodiorite within which are small areas of syenite. This batholith is intrusive into the Triassic-Jurassic Takla Group.

The purpose of the I.P. and resistivity survey was to locate any anomalous effects that might be indicative of "metallic" mineralization.

A McPhar P660 variable frequency unit operating at 0.3 to 5.0 Hz. was used for the surveying.

2. PRESENTATION OF RESULTS

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

Line	Electrode Intervals	Drawing No.
76 E	200 feet	C 76 E
84 E	200 feet	C 84 E
92 E	200 feet	C 92 E

Enclosed with this report is Drawing I.P. 162-1-71, a plan map of the Chuchi Lake grid at a scale of 1" = 400'. 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' spread, the position of a narrow sulphide body can only be determined to lie between two stations 300' apart in order to located sources in the uncertainties of location. Therefore, while the centre 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 materials.

3. DISCUSSION OF RESULTS

Three N-E traverses, spaced at 800' intervals were surveyed.

Line 76E.

A complex response is shown by the metal factor values between 24 S. and 28 S. Weak effects near 25 S. suggest a shallow source of low metallic content that continues to depth. Stronger effects on the n = 3 and n = 4 values near 27 S. indicate an increased concentration on the south flank, at depth. The deep portion of the response is the strongest anomaly encountered on the grid and may warrant I.P. detailing with larger dipoles.

Line 84E.

There are two weak anomalies on this line.

A shallow narrow source is indicated by the contours near 27 S. However, the I.P. effects are weak and detailed surveying with shorter dipoles would be required to confirm this interpretation and further assess the importance of this indication. A broad, shallow source of low metallic content extends from 19 S. to 23 S. and appears to continue to depth.

Line 92E.

There is a moderate indication on the north end of the line and the surveying should be extended northward to complete the pattern.

The single high metal factor at 25 S. is associated with a resistivity low. Detailed surveying would be required to confirm this weak indication.

4. SUMMARY AND RECOMMENDATIONS

The I.P. survey has outlined three broad responses that may represent a single E-W trending zone of low metallic content extending from 27 S. on 76 E. to 18 S. on 92 E. The correlation is somewhat tenuous and the magnitude of the I.P. effect is not sufficiently strong to warrant an extensive follow-up program at present. However, copper mineralization is known to occur on the western extension of the grid and this anomaly should be re-assessed in the light of the results obtained in the investigations of similar I.P. responses. Additional I.P. surveying on intermediate traverses would be required to establish the continuity of the zone and detailing with larger dipoles should be carried out to evaluate the stronger, deep anomaly on Line 76 E.

With present knowledge, shallow narrow sources are of minor importance.

The above recommendations should be re-assessed when all of the data for this grid and the adjoining area to the west have been compiled and reviewed.

Respectfully submitted,

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

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

Vancouver, B.C.
October 1971

Appendix A

DOMINION OF CANADA: }
PROVINCE OF BRITISH COLUMBIA. } **In the Matter of** Geophysical Survey on Chuchi #1, 2, 3, 11, 12, 14, 15, 16, 25 mineral claims (record numbers 91882-91884, 91892, 91893, 91895-91897, 91906) of the Lake Group.
TO WIT: }

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 Lake Group mineral claims:

I.P. Survey

Miles surveyed - 2
No. of readings - 100

Personnel	Position	Dates	Days	Rate/Day	Charges	Total
P. Smith	Sr. Operator	Sept. 24-27	4	$90.00	$360.00	
J. Leclerc	Operator	" " "	4	70.00	280.00	
R. Smith	Operator-Asst.	" " "	4	35.00	140.00	
R. McGuire	Assistant	" " "	4	45.00	180.00	
G. Thomassen	"	" " "	4	45.00	180.00	
L. McLeod	"	" " "	4	35.00	140.00	$1,280.00
Note: Thomassen and McLeod required for preparation of contact holes.						
Equipment Rental			5	70.00		350.00
Transportation - Charter Helicopter - 3 hrs. @ $250.00/hour						750.00
						2,380.00

Line Cutting (Terrex Mining Services)

18,700 ft. (3.54 mi.) - July 6-11 - @ $150.00/mile	531.00	
Messing Costs - 10 man days - @ $7.00/day	70.00	
Mobilization - Helicopter - 1 hour @ $250.00/hr.	250.00	851.00

Magnetometer Survey

18,700 ft. (3.54 miles)		
Operator - M. Prevost - July 25-28 - 3½ days @ $45.00/day	157.50	
Drafting - M. Prevost - Aug. 27-28 - 1½ days @ $45.00/day	67.50	225.00
		$3,456.00

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 VANCOUVER, B. C., in the Province of British Columbia, this NOV 5 1971 day of November, A.D.

D. H. Brown

Sub - Mining Recorder

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

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

October 18, 1971

The Chief Mining Recorder
Omineca Mining Division
Smithers, B.C.

Dear Sir:

Re: Statement of Qualifications

This is to certify that the geophysical work done on the Chuchi Mineral Claims and presented in this report was done under the direction of D. B. Sutherland, B.A., M.A. (University of Toronto), P.Eng. (Ont.), and under my supervision.

The geophysical field work was performed by P. Smith, party chief, and J. Leclerc and R. Smith, geophysical operators, and were assisted by R. McGuire, G. Thomassen and L. McLeod. P. Smith has worked as a trained I.P. operator since 1961. J. Leclerc has been trained in the laboratory and in the field as a geophysical operator. R. Smith has been trained in the field as an I.P. operator and assistant. R. McGuire, G. Thomassen and L. McLeod have been trained by Falconbridge geophysical staff in the field as geophysical assistants.

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.

DHB:JR

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'.

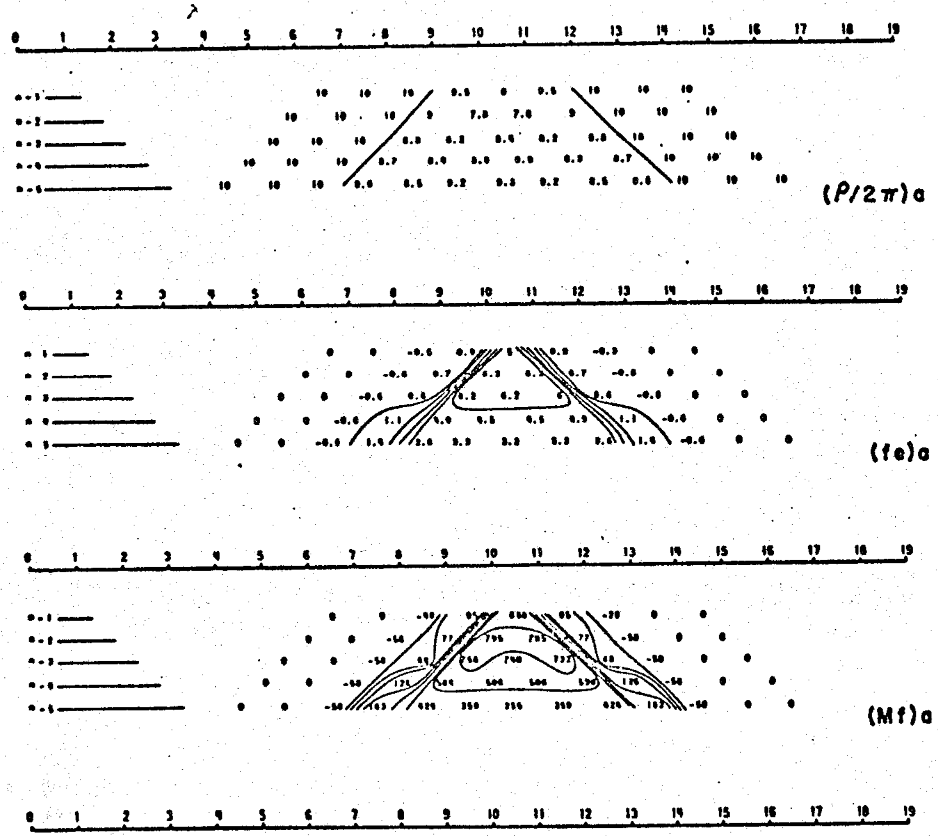
The data shown in Figure 5 and Figure 6 are field results from a greenstone area in Quebec. The expected sources were narrow (less than 30' in width) zones of massive, high-grade, zinc-silver ore. An electrode interval of 200' was used for the reconnaissance survey in order to keep the rate of progress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

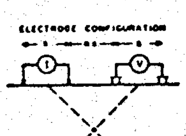
Scale Model Cases



$(\rho/2\pi)_1 = 10$ $(\rho/2\pi)_2 = 2.51$

$(Mf)_1 = 0$ $(Mf)_2 = 10000$

$(fe)_2 = 25\%$



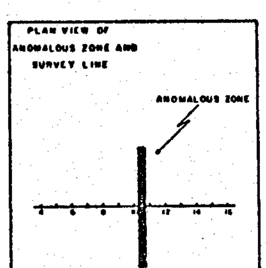
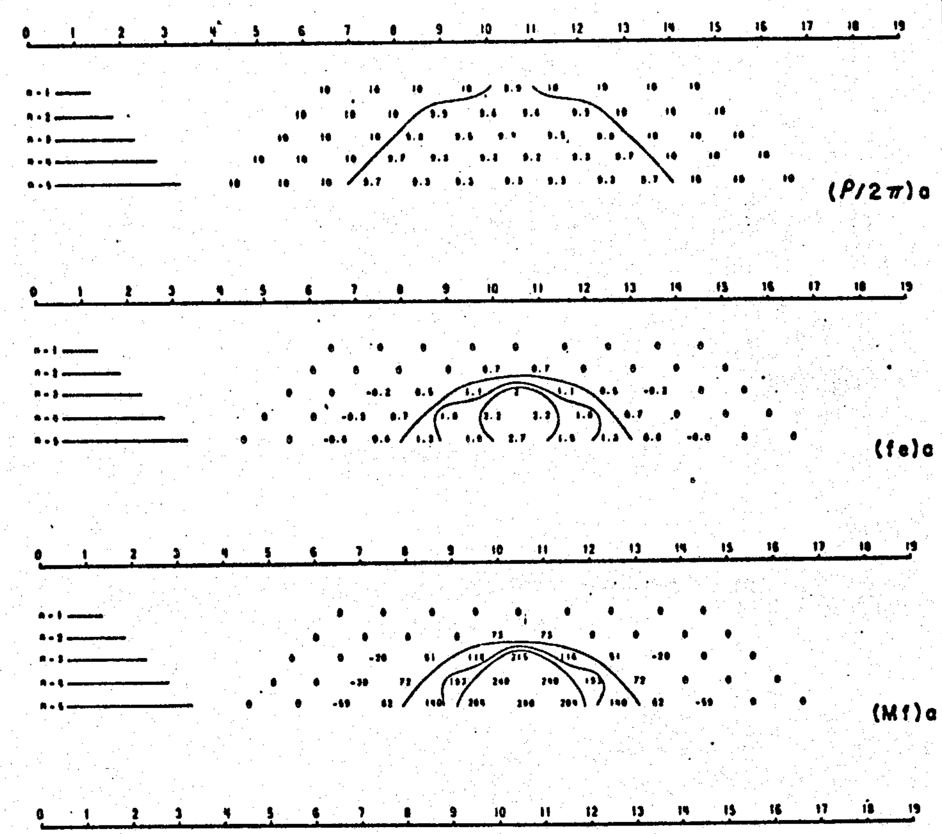


FIG 1

CASE II-0.5-BU-10-a

Theoretical Induced Polarization and Resistivity Studies

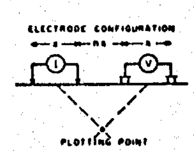
Scale Model Cases



$(\rho/2\pi)_1 = 10$ $(\rho/2\pi)_2 = 2.6$

$(Mf)_1 = 0$ $(Mf)_2 = 9250$

$(fe)_2 = 24\%$



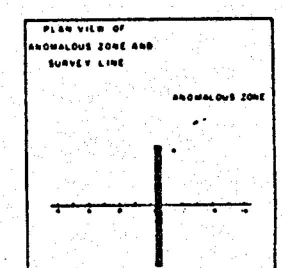


FIG 2

CASE II-1.5-BU-10-a

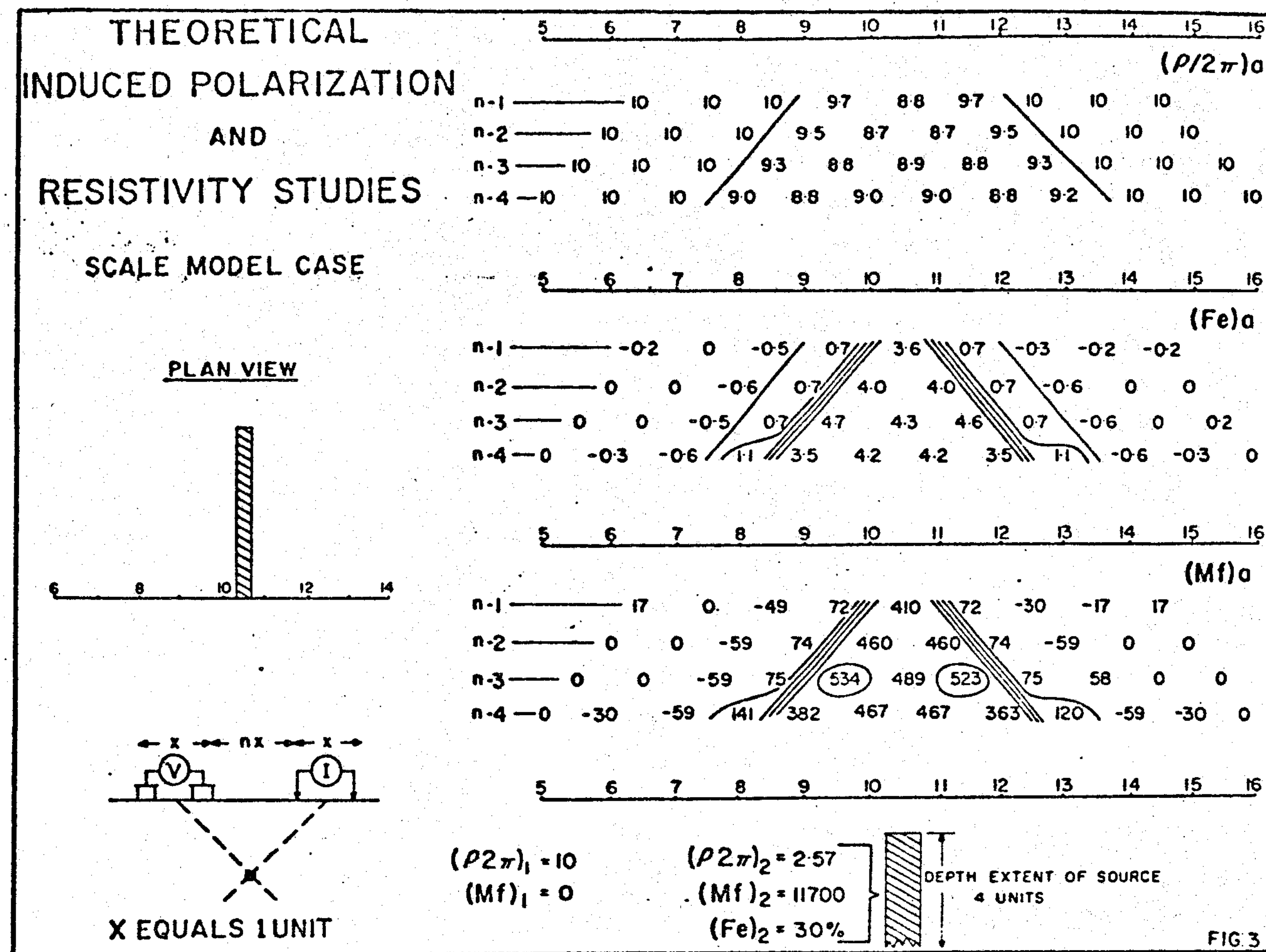

THEORETICAL
INDUCED POLARIZATION
AND
RESISTIVITY STUDIES
SCALE MODEL CASE
PLAN VIEW
6 8 10 12 14
x nx x
V I
X EQUALS 1 UNIT
5 6 7 8 9 10 11 12 13 14 15 16
(ρ/2π)a
n-1 10 10 10 9.7 8.8 9.7 10 10 10
n-2 10 10 10 9.5 8.7 8.7 9.5 10 10 10
n-3 10 10 10 9.3 8.8 8.9 8.8 9.3 10 10 10
n-4 10 10 10 9.0 8.8 9.0 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

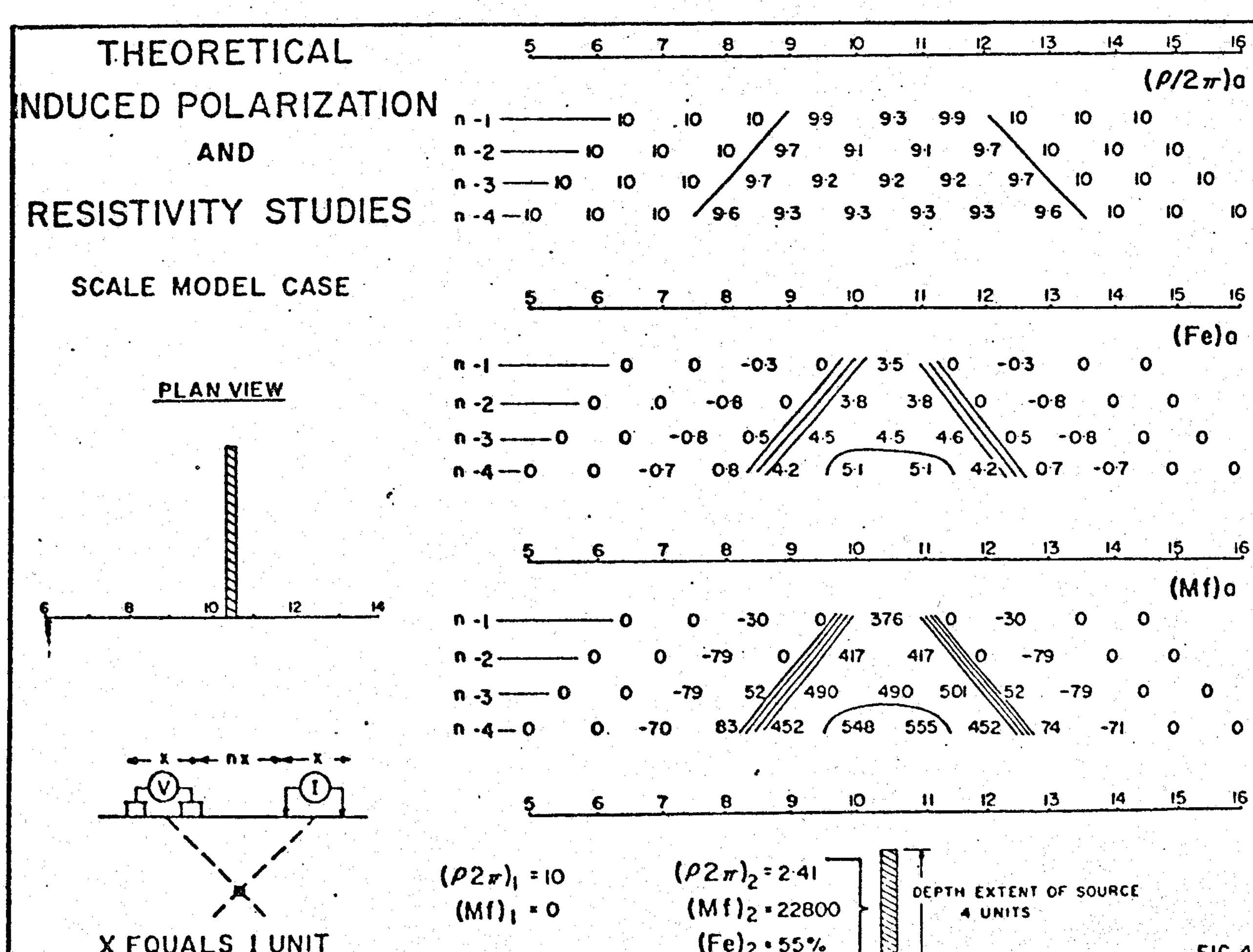

THEORETICAL
INDUCED POLARIZATION
AND
RESISTIVITY STUDIES
SCALE MODEL CASE
PLAN VIEW
6 8 10 12 14
x nx x
V I
X EQUALS 1 UNIT
5 6 7 8 9 10 11 12 13 14 15 16
(ρ/2π)a
n-1 10 10 10 9.9 9.3 9.9 10 10 10
n-2 10 10 10 9.7 9.1 9.1 9.7 10 10 10
n-3 10 10 10 9.7 9.2 9.2 9.2 9.7 10 10 10
n-4 10 10 10 9.6 9.3 9.3 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

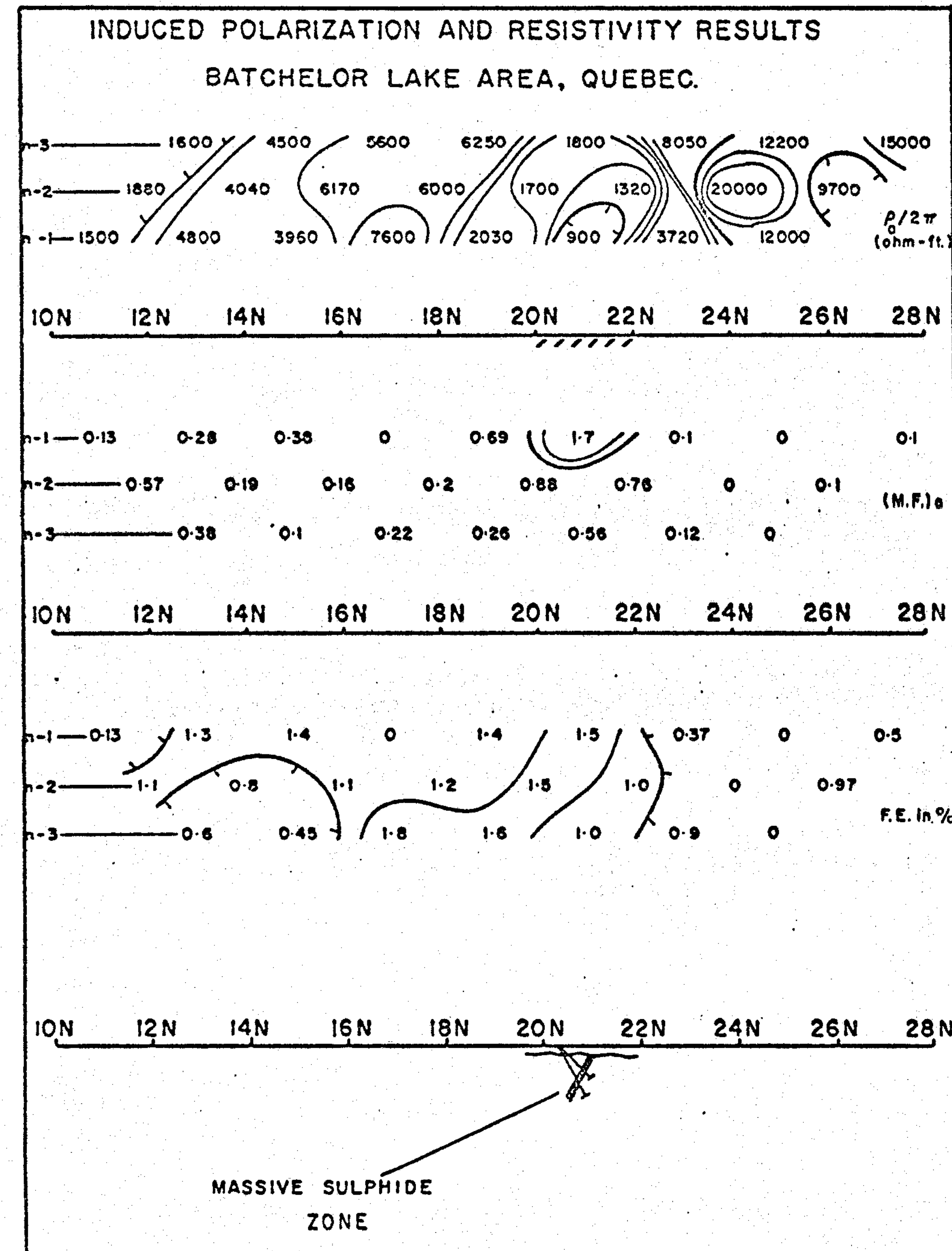

INDUCED POLARIZATION AND RESISTIVITY RESULTS
BATCHELOR LAKE AREA, QUEBEC.
n-3 1600 4500 5600 6250 1800 8050 12200 15000
n-2 1880 4040 6170 6000 1700 1320 20000 9700
n-1 1500 4800 3960 7600 2030 900 3720 12000
$\rho_a/2\pi$ (ohm-ft.)
10N 12N 14N 16N 18N 20N 22N 24N 26N 28N
n-1 0·13 0·28 0·38 0 0·69 1·7 0·1 0 0·1
n-2 0·57 0·19 0·16 0·2 0·88 0·76 0 0·1
n-3 0·38 0·1 0·22 0·26 0·56 0·12 0
(M.F.)a
10N 12N 14N 16N 18N 20N 22N 24N 26N 28N
n-1 0·13 1·3 1·4 0 1·4 1·5 0·37 0 0·5
n-2 1·1 0·8 1·1 1·2 1·5 1·0 0 0·97
n-3 0·6 0·45 1·8 1·6 1·0 0·9 0
F.E. in %
10N 12N 14N 16N 18N 20N 22N 24N 26N 28N
MASSIVE SULPHIDE
ZONE

FIG. 5

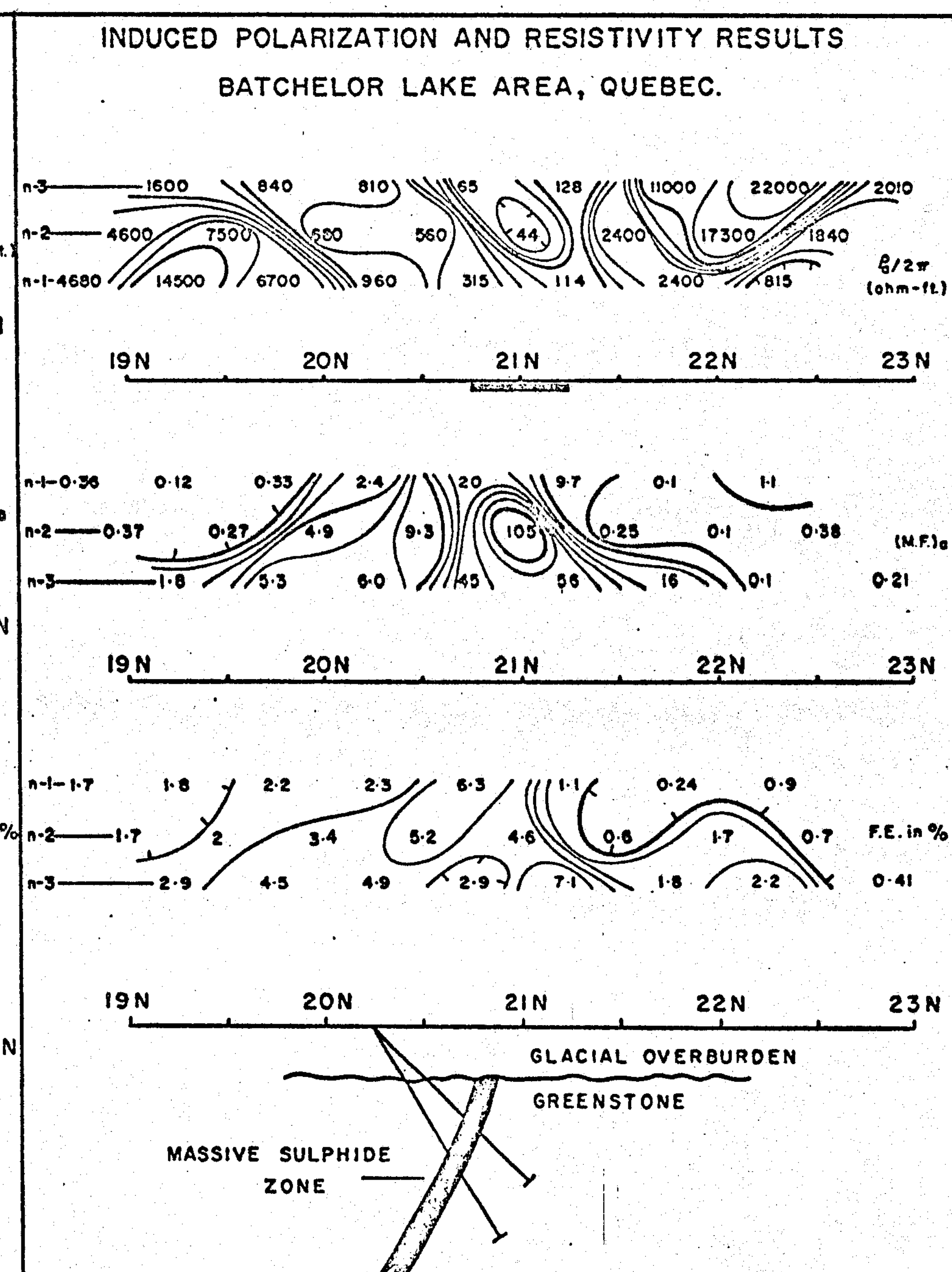

INDUCED POLARIZATION AND RESISTIVITY RESULTS
BATCHELOR LAKE AREA, QUEBEC.
n-3 1600 840 810 65 128 11000 22000 2010
n-2 4600 7500 680 560 44 2400 17300 1840
n-1 4680 14500 6700 960 315 114 2400 815
$\rho_a/2\pi$ (ohm-ft.)
19N 20N 21N 22N 23N
n-1 0·36 0·12 0·33 2·4 20 9·7 0·1 1·1
n-2 0·37 0·27 4·9 9·3 105 0·25 0·1 0·38
n-3 1·8 5·3 6·0 45 56 16 0·1 0·21
(M.F.)a
19N 20N 21N 22N 23N
n-1 1·7 1·8 2·2 2·3 6·3 1·1 0·24 0·9
n-2 1·7 2 3·4 5·2 4·6 0·6 1·7 0·7
n-3 2·9 4·5 4·9 2·9 7·1 1·8 2·2 0·41
F.E. in %
19N 20N 21N 22N 23N
GLACIAL OVERBURDEN
GREENSTONE
MASSIVE SULPHIDE
ZONE

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.

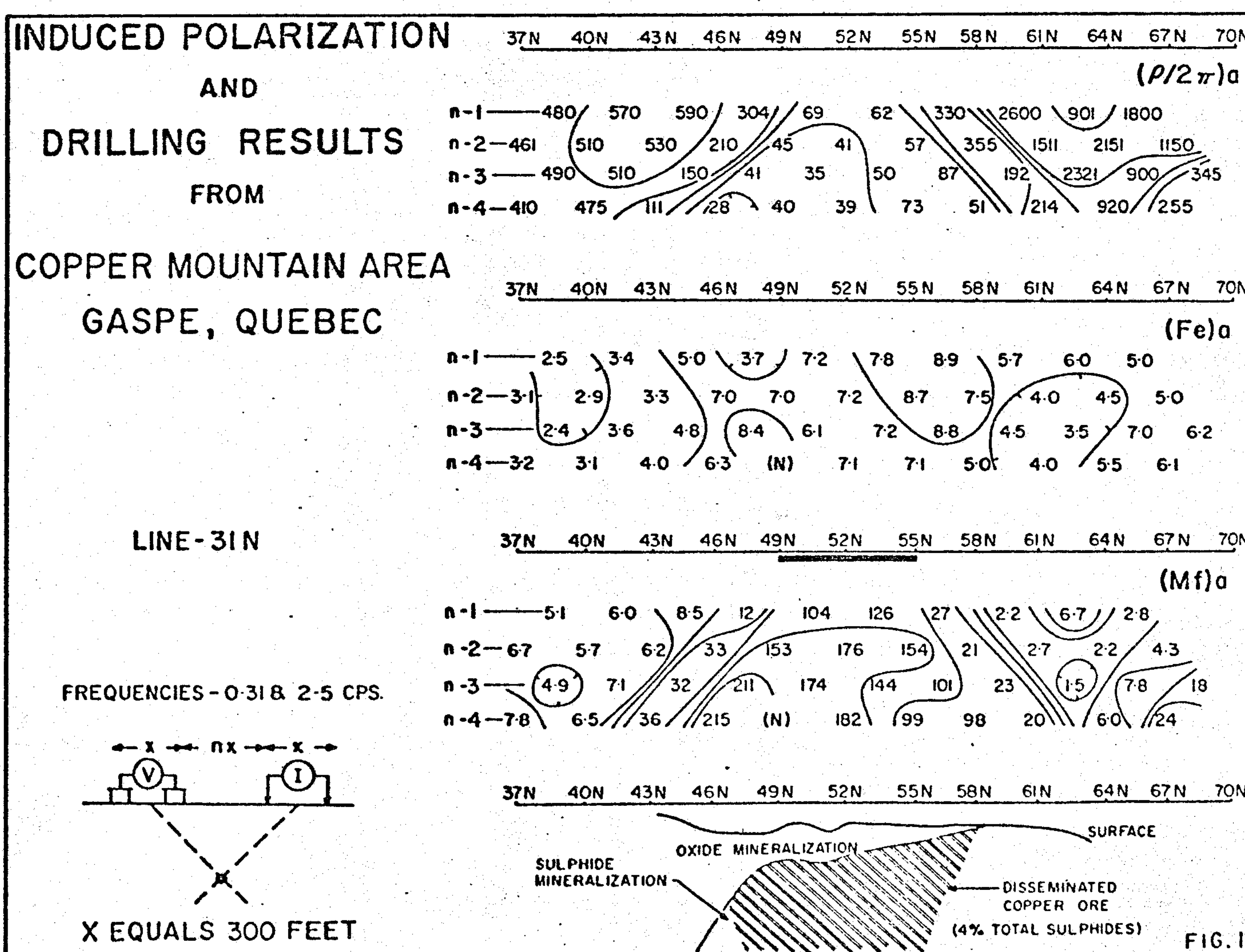


FIG. 1

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.

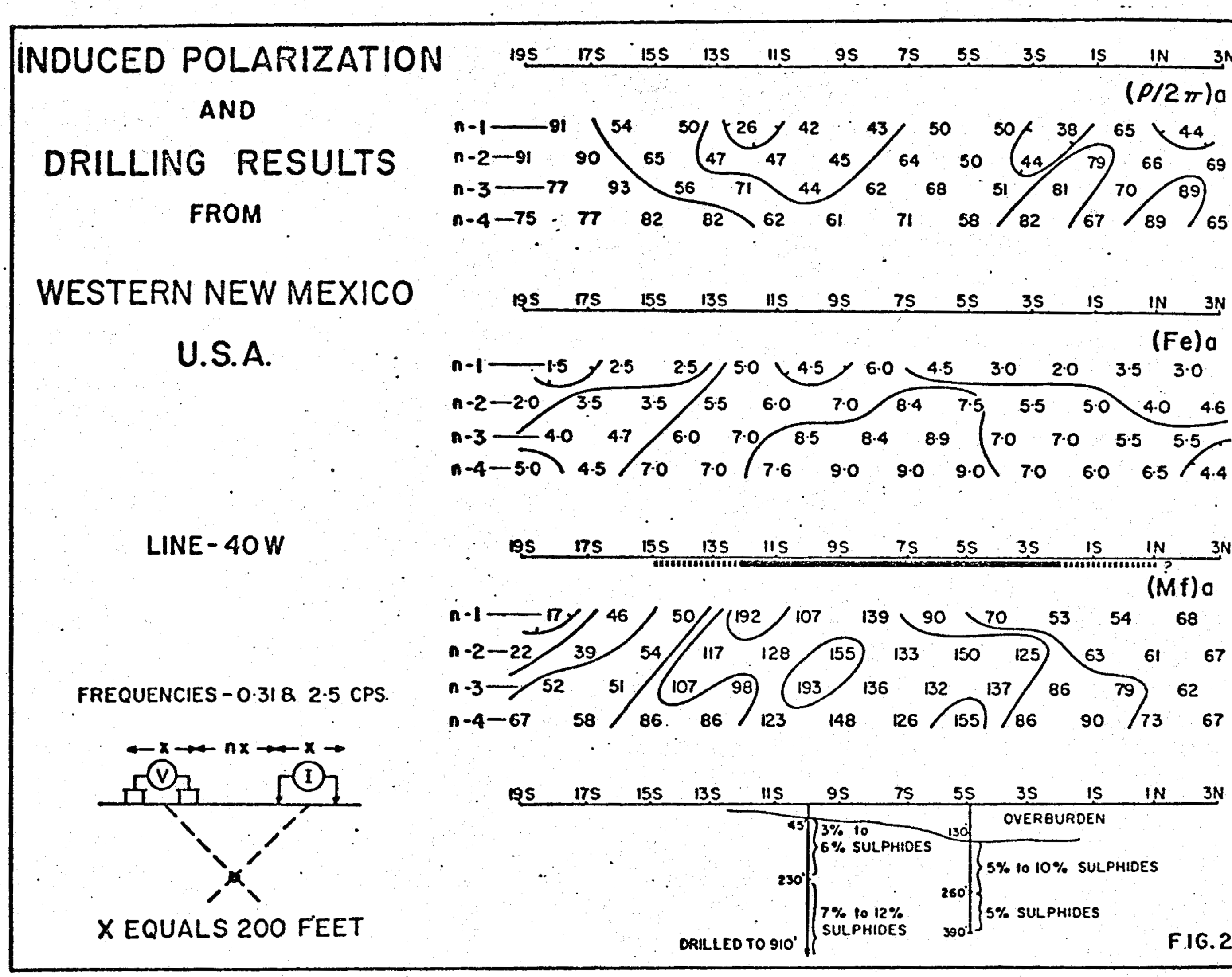


FIG. 2

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.

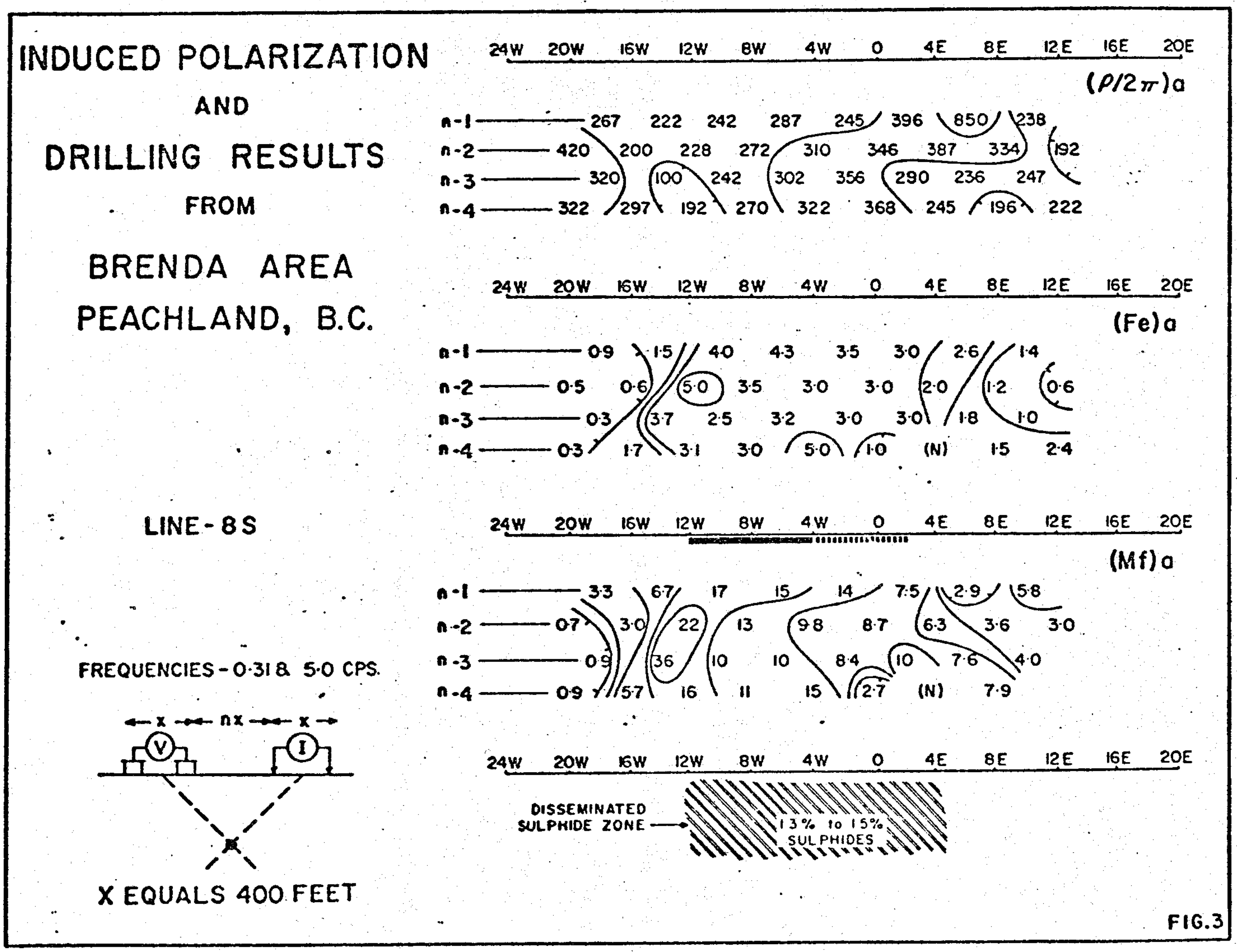
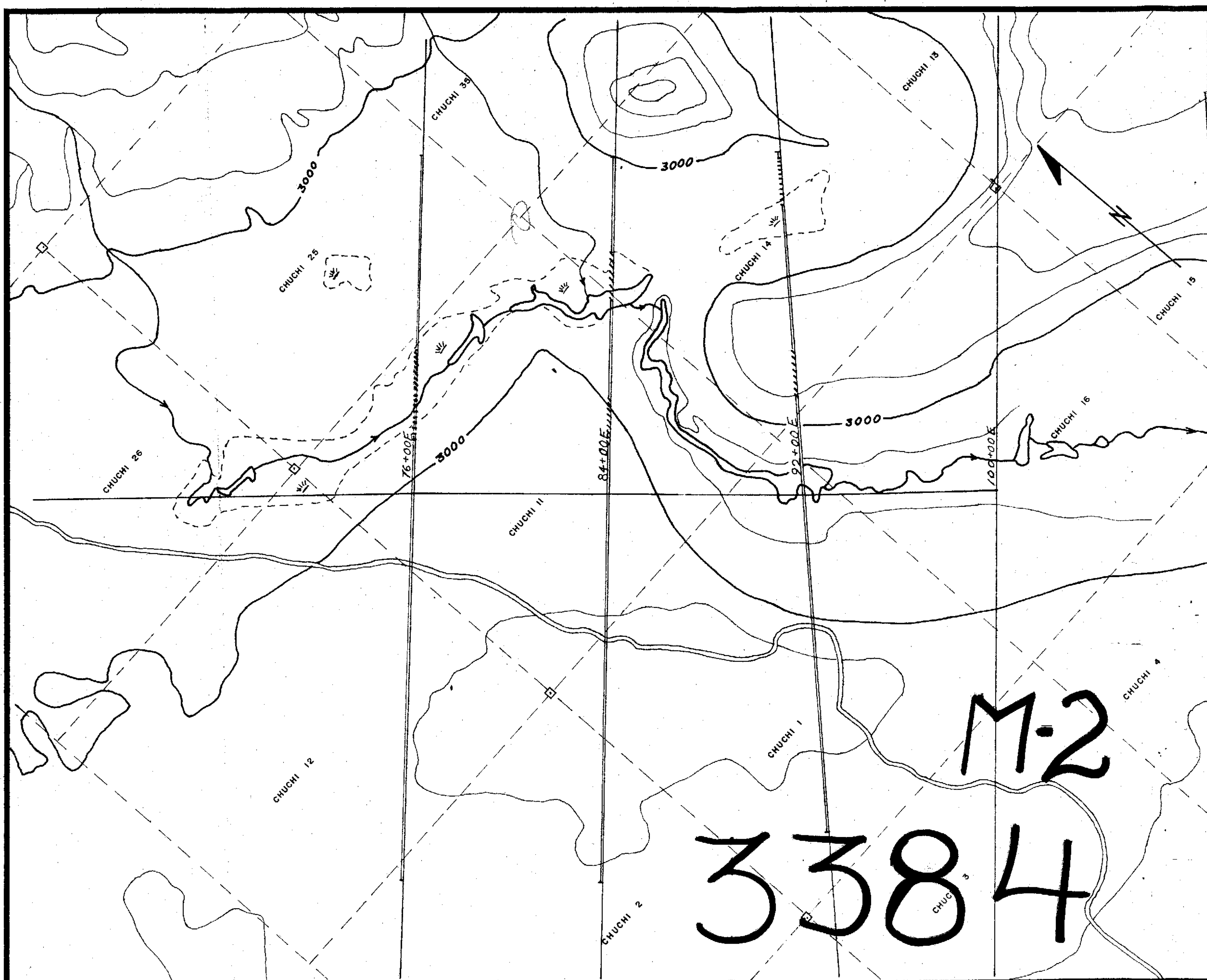


FIG.3



MAP REF. No.: IP 162-1-71

N.T.S.: 93-N-7

Department of Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 3384 MAP #2

LEGEND

DEFINITE

PROBABLE

POSSIBLE

NO ANOMALY

FALCONBRIDGE NICKEL MINES LTD.

PROPERTY: CHUCHI CLAIMS

LOCATION: CHUCHI LAKE B.C.

TYPE OF MAP: GEOPHYSICAL

BASED ON: D.H. Brown

DATE OF WORK: SEPT. 1971

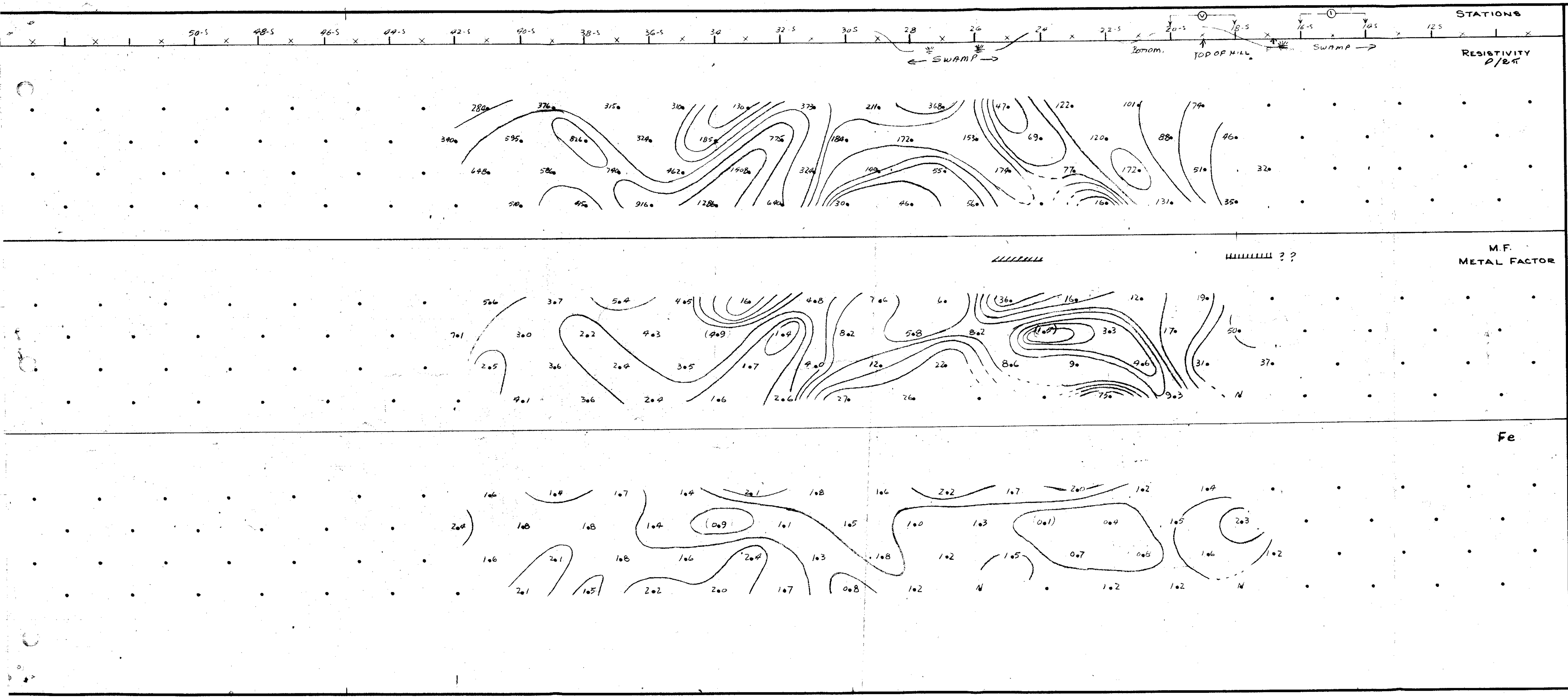
DATE:

DRAWN BY: G.T.

400 0 400 800

SCALE: 1 INCH TO 400 FEET

BCIL - 2247 - F.N.M.



FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

CHUCHI PROJECT

P.N. 162

LINE No E.

LEGEND

UNIT USED – McPHAR - P-660

ARRAYS – DIPOLE – DIPOLE

FREQUENCIES – 3 - 5 c.p.s.

SCALE – 1" = 200'

DATE – 27 Sept. 1971

CREW Opr. – J. Leclerc

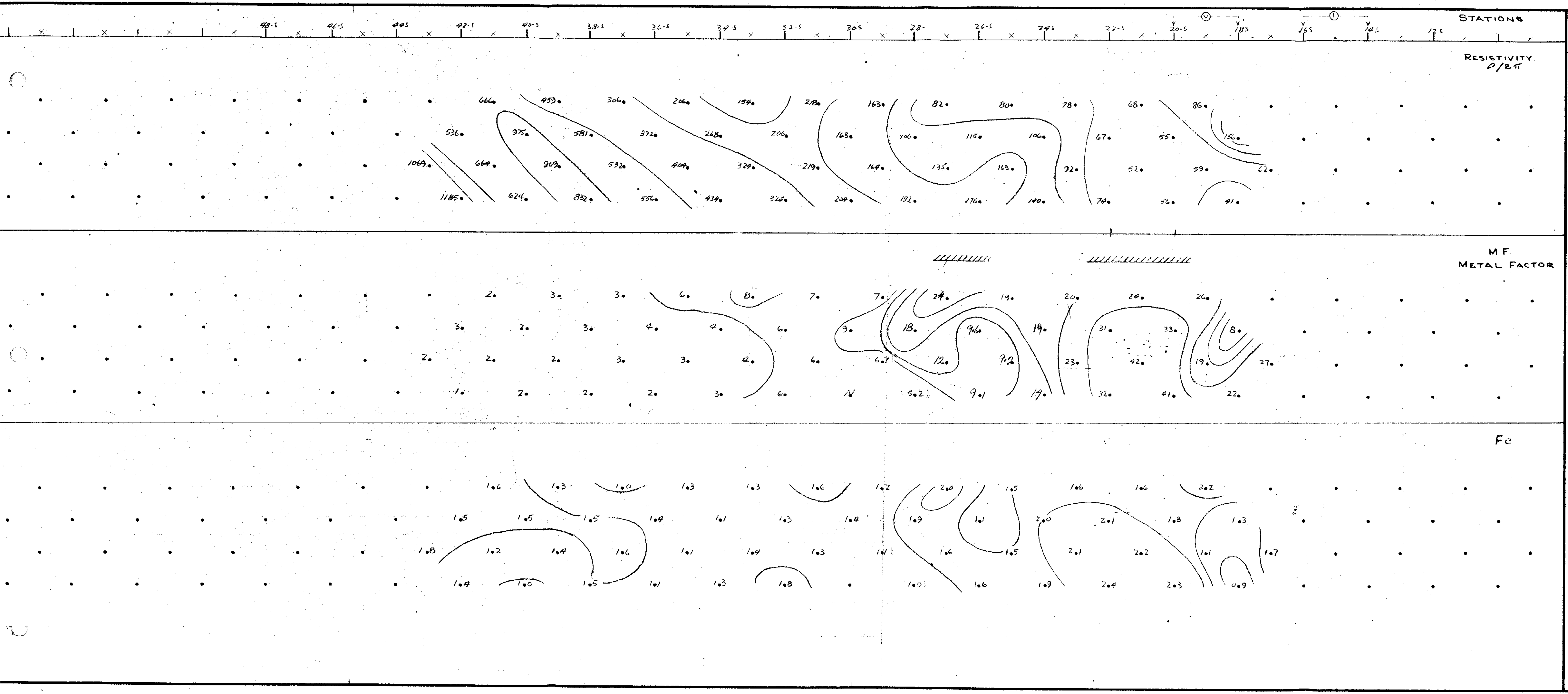
Department of Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 3384 #5

D.H. Brown

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

ANOMALY, Definite
Probable
Possible

Map IP. 162-1C-71



FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

CHUCHI PROJECT

PN. 162

LINE No 84-E

LEGEND

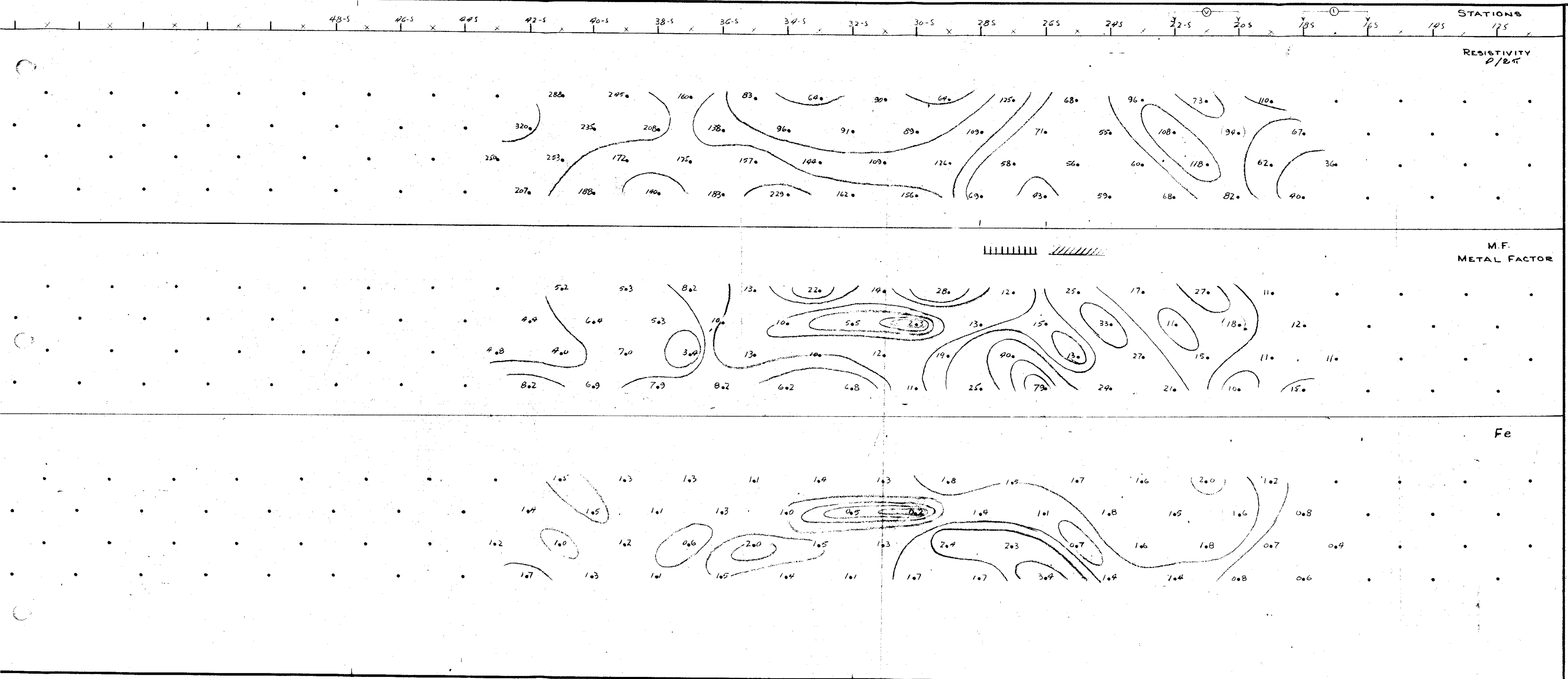
UNIT USED – McPHAR - P.660
ARRAYS – DIPOLE - DIPOLE
FREQUENCIES – 3 - .3 cps.
SCALE – 1" = 200'
DATE – 26 Sept. 1971
CREW Oper. – J. Leclerc

Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 3384 MAP #4

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

ANOMALY: Definite / Probable / Possible

Map IP. 162-1B-71



FALCONBRIDGE NICKEL MINES LIMITED

INDUCED POLARIZATION SURVEY

CHUCHI PROJECT

LINE No 76-E

LEGEND

UNIT USED - McPhar-PEGE
ARRAYS - DIPOLE - DIPOLE
FREQUENCIES 3-5 c.p.s.
SCALE - 1" = 200'
DATE - 25 Sept 1971
CREW Gpn - J. Lechic

Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 3384 MAP #3

D.H. Brown

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

ANOMALY, Definite
Probable
Possible

Map IP-162-1A-71