3266

REPORT ON THE RECONNAISSANCE INDUCED POLARIZATION AND RESISTIVITY SURVEY ON THE PINE NO. 6 AND 7 GROUPS THUTADE LAKE AREA OMINECA MINING DIVISION, BRITISH COLUMBIA

FOR

KENNCO EXPLORATIONS(WESTERN) LIMITED

BY

MARION A. GOUDIE, B.Sc.

AND

ASHTON W. MULLAN, B.Sc. P.Eng.

NAME AND LOCATION OF PROPERTY:

PINE NO. 6 AND NO. 7 GROUPS, THUTADE LAKE AREA

OMINECA MINING DIVISION, B.C. 57°N, 126°W - SW

DATE STARTED: JUNE 19, 1971

DATE FINISHED: JULY 9, 1971

TABLE OF CONTENTS

McPHAR GEOPHYSICS

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

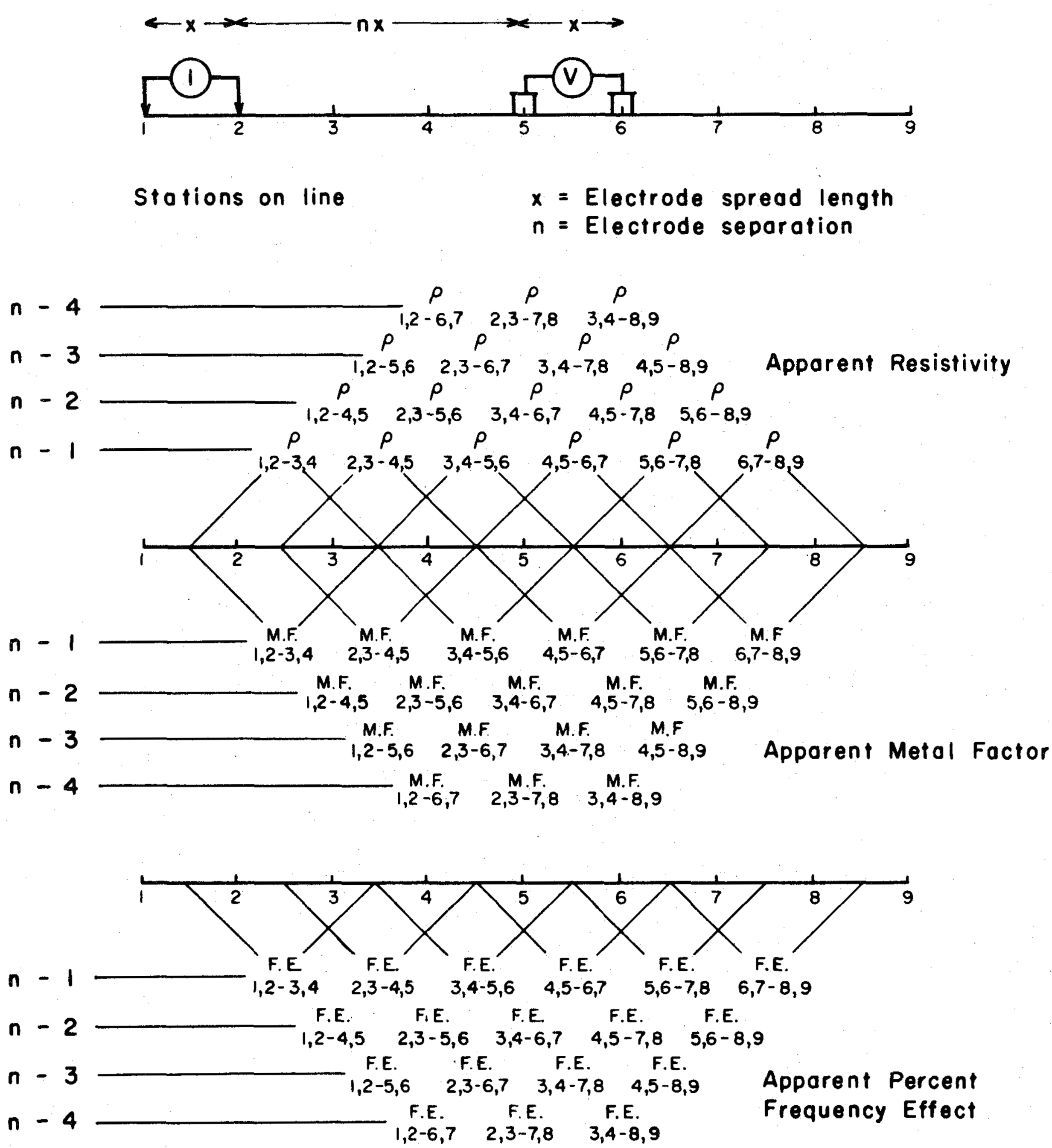


Fig. A

McPHAR GEOPHYSICS LIMITED

REPORT ON THE RECONNAISSANCE INDUCED POLARIZATION AND RESISTIVITY SURVEY ON THE PINE NO. 6 AND 7 GROUPS THUTADE LAKE AREA OMINECA MINING DIVISION, BRITISH COLUMBIA FOR KENNCO EXPLORATIONS (WESTERN) LIMITED

---

1. INTRODUCTION

At the request of Mr. R. W. Stevenson, Project Manager for the company, an Induced Polarization and Resistivity Survey has been completed on the Pine No. 6 and Pine No. 7 Groups, Thutade Lake Area, British Columbia, for Kennco Explorations (Western) Limited. The survey grid is situated in the southwest quadrant of the 1° quadrilateral whose southeast corner is located at 57° north and 126° west.

The country rocks in the area are Takla volcanics intruded by intermediate to acid intrusives. Minor amounts of disseminated sulphides occur in parts of the intrusive with somewhat greater amounts in the volcanics. The purpose of the IP survey was to explore the extent and continuity of these sulphide zones.

The survey was carried out in July, 1971, using a McPhar P654 high power variable frequency IP unit operating at 0.3 and 5 cps over the following claims:

Pine Group No. 6

37, 39, 38, 40, 42, 131, 33, 35, 34, 36

Pine Group No. 7

73, 75, 77, 79, 142 fr., 13, 15

These claims are assumed to be owned or held under option by Kennco Explorations (Western) Limited.

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	Dwg. No.
3W	200 feet	IP 5819-1
10E	200 feet	IP 5819-2
18E	200 feet	IP 5819-3
26E	200 feet	IP 5819-4
4S	200 feet	IP 5819-5
12S	200 feet	IP 5819-6
20S	200 feet	IP 5819-7
8 SE	200 feet	IP 5819-8

Also enclosed with this report is Dwg. I.P.P. 4804, a plan map of the Pine No.6 and 7 Grids at a scale of 1" = 400'. The definite, probable and possible Induced Polarization anomalies are indicated by bars, in the manner shown on the legend, on this plan map as well as on the data plots. These bars represent the surface projection of the anomalous zones as interpreted from the location of the transmitter and receiver electrodes when the anomalous values were measured.

Since the Induced Polarization measurement is essentially an averaging process, as are all potential methods, it is frequently difficult to exactly pinpoint the source of an anomaly. Certainly, no anomaly can be located with more accuracy than the electrode interval length; i.e. when using 200' electrode intervals the position of a narrow sulphide body can only be determined to lie between two stations 200' apart. In order to definitely locate, and fully evaluate, a narrow, shallow source it is necessary to use shorter electrode intervals. In order to locate sources at some depth, larger electrode intervals must be used, with a corresponding increase 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 material.

The geological information has been made available by the staff of Kennco Explorations (Western) Limited.

3. DISCUSSION OF RESULTS

The survey lines are too widely-spaced to be able to correlate narrow anomalies with any assurance; however, broad zones of anomalous readings in the west-central part of the grid have been tentatively correlated. The IP results are discussed on a line-by-line basis.

Line 3W

A broad, definite to probable anomaly was located from 15N to 22N.

The pattern of the anomaly suggests a source dipping to the north. The Model Study Case III-0.5-BU-50-a60° shows a similar pattern, but with a reverse dip. The top of the source lies at a depth of less than 100' and the anomaly would be better located and defined if detailed with shorter electrode intervals.

Line 10E

A definite, shallow anomaly extends from 39N to 43N. The anomaly is sharply defined and shows the classic pattern of a flat-lying source, as illustrated in Case IVb-0.33-EU-250-a. The top of the source lies at a depth of less than 100' and the anomaly should be detailed with shorter electrode intervals for better definition.

Line 18E

A probable, shallow anomaly extends from 34N to 38N. The top of the source lies at a depth of less than 100' and detail with shorter electrode intervals should better define and evaluate the anomaly.

A second weak anomaly was located from 42N to 44N. The anomaly appears to be of minor importance, but this could best be determined by a knowledge of the geology and the kind of mineralization present, e.g., the presence of molybdenite would make a difference.

Line 26E

An anomaly from 31N to 50N is variable in magnitude and is typical of disseminated mineralization.

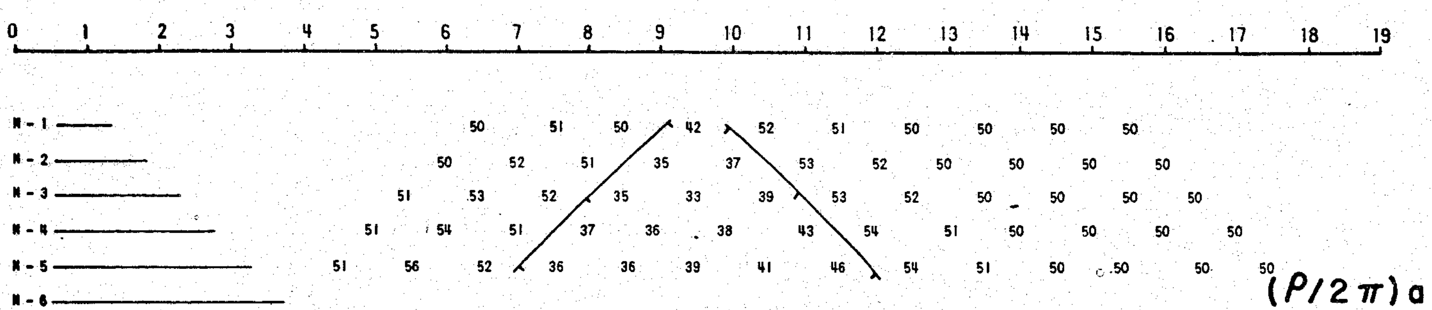
Line 85E

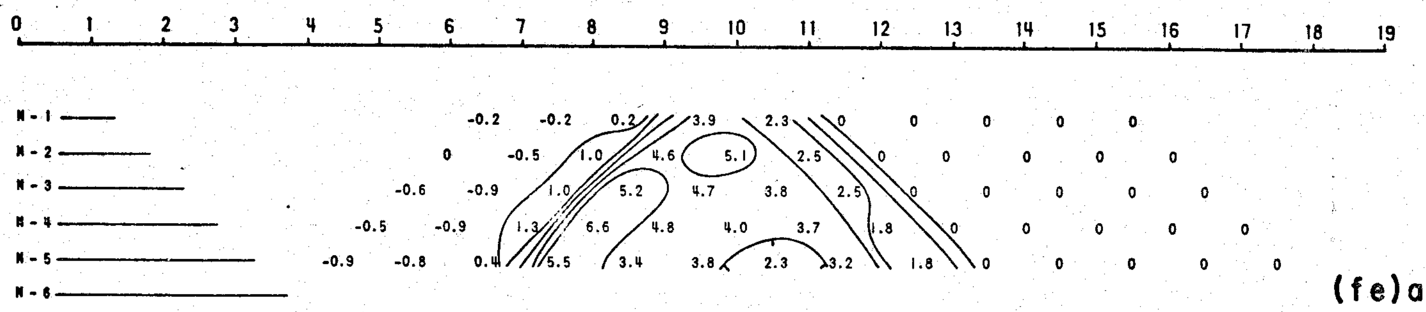
No anomalies were located.

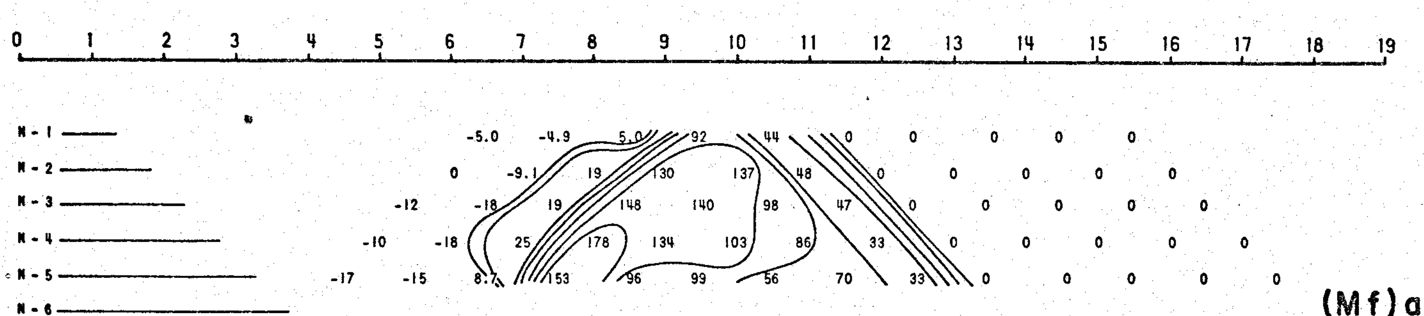
McPHAR GEOPHYSICS LIMITED

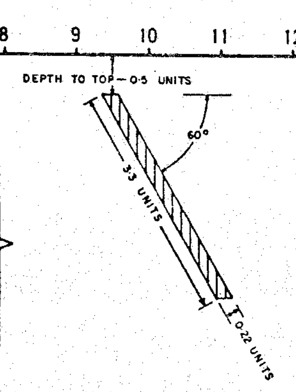
Theoretical Induced Polarization and Resistivity Studies

Scale Model Cases





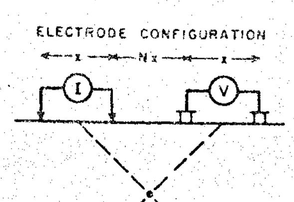


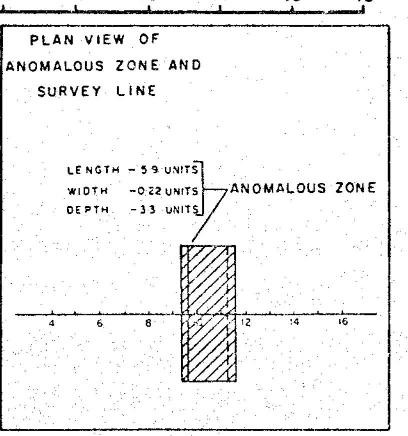


$(\rho/2\pi)_1 = 50$ $(\rho/2\pi)_2 = 2{\cdot}0$

$(Mf)_1 = 0$ $(Mf)_2 = 12{,}500$

$(fe)_2 = 25\%$



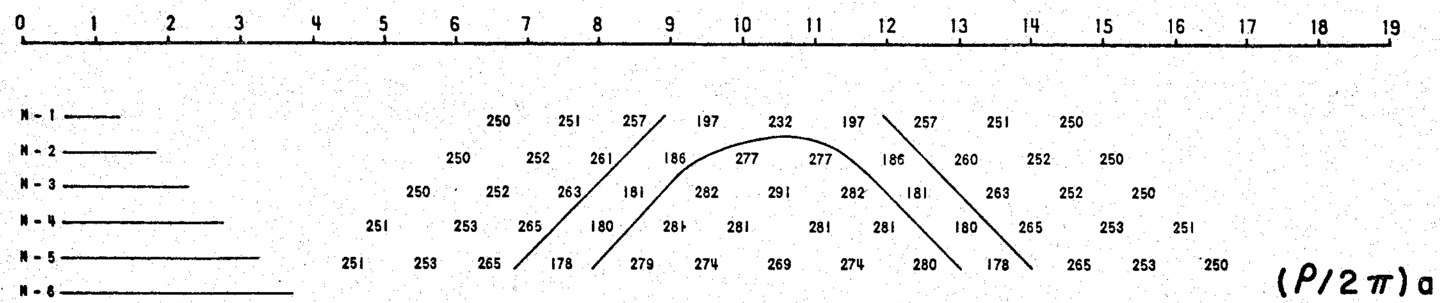


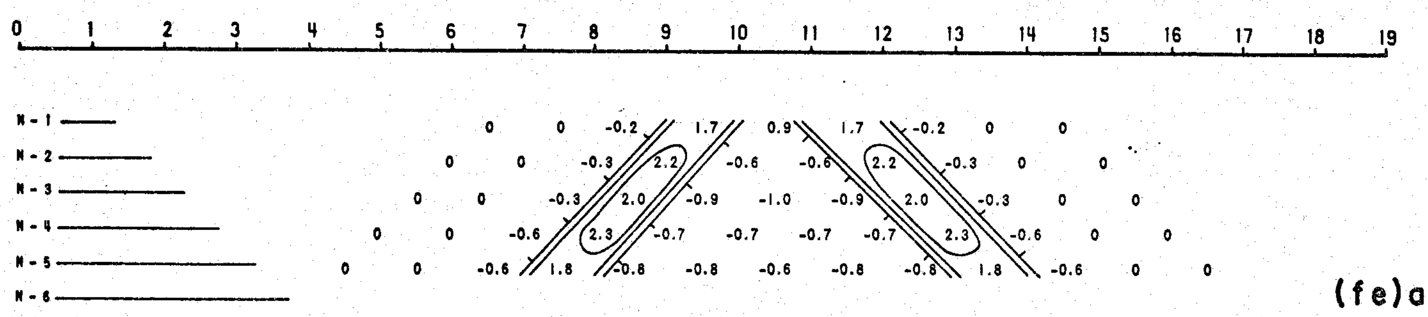
CASE III-0.5-BU-50-a60°

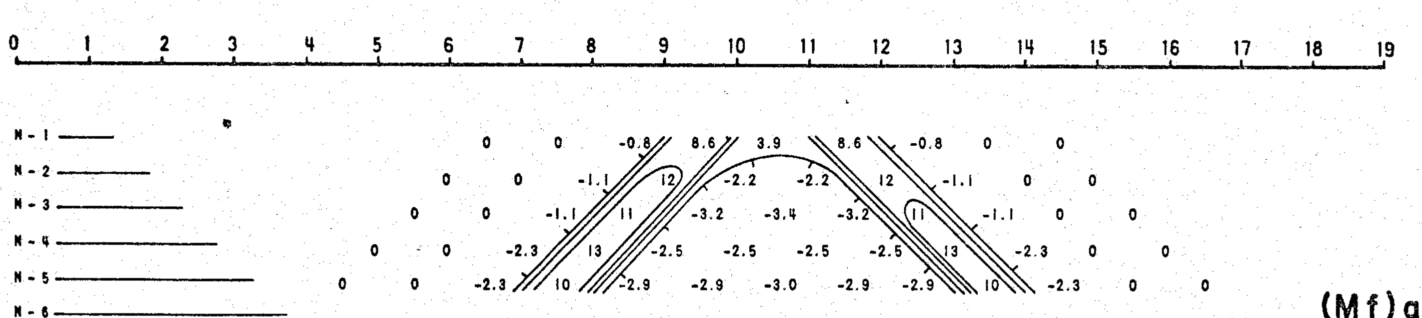
McPHAR GEOPHYSICS LIMITED

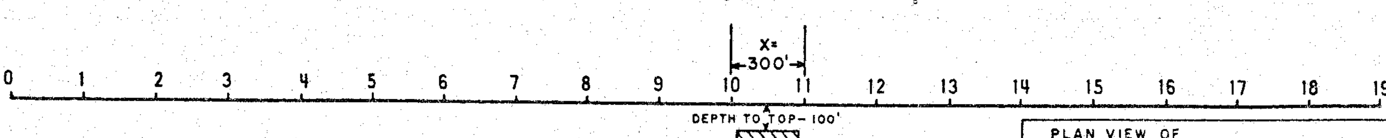
Theoretical Induced Polarization and Resistivity Studies

Scale Model Cases









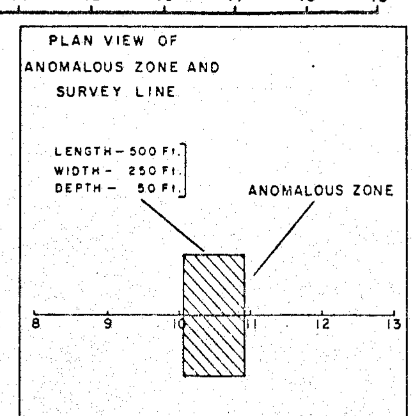
$(\rho/2\pi)_1 = 250$

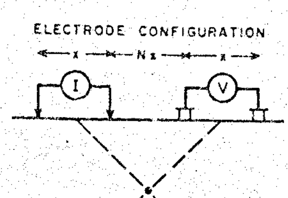
$(Mf)_1 = 0$

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

$(Mf)_2 = 2500$

$(fe)_2 = 25\%$





CASE IVb-0.33-EU-250-a

Line 4S

The complete line is anomalous, with the magnitude of the anomalous effects varying from probable to possible. The anomaly suggests disseminated mineralization with erratic concentrations of mineralization, with the top of the zone at less than 100' and with some depth indicated. The anomaly is incomplete at both ends of the line.

Line 12S

This line is very similar to Line 400S, except that there is a non-anomalous section from 00 to 6W.

Line 20S

The line is anomalous from 8W to 2E and from 6E to 16E. A strong, one-station anomaly from 6W to 8W is shallow and may indicate a strong concentration of mineralization at shallow depth (less than 100'). Detail with 100' electrode intervals might better define the source, or sources, of the anomalies.

4. CONCLUSIONS AND RECOMMENDATIONS

While the survey lines were widely spaced, strong indications of the presence of metallic mineralization in the grid area were obtained by the survey results. The anomalies on Line 3W, Line 10E and Line 18E indicate that concentrated mineralization is present to some degree across the northern portion of the grid. Line 3W should be extended north and intermediate parallel lines should be surveyed, particularly in the vicinity of the anomalies, to determine the strike extent of the mineralization indicated.

The west-central lines indicate extensive, weakly disseminated mineralization with significant sections of more concentrated mineralization.

Any further work should be done with 100' electrode intervals, as the source of the anomalies is almost everywhere, less than 100' deep. In addition, the anomalies on Line 3W, Line 10E and Line 18E should be detailed with 100' electrode intervals for better definition of the source of the anomalies.

When this recommended work is completed, it will serve as a basis for further recommendations.

McPHAR GEOPHYSICS LIMITED

Marion A. Goudie,
Geologist.

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
A. W. MULLAN

Ashton W. Mullan,
Geologist.

Dated: August 10, 1971

ASSESSMENT DETAILS

PROPERTY: Pine No. 6 And No. 7 Groups		MINING DIVISION: Omineca	
SPONSOR: Kennco Explorations (Western) Limited		PROVINCE: British Columbia	
LOCATION: Thutade Lake Area			
TYPE OF SURVEY: Induced Polarization			
OPERATING MAN DAYS:	24	DATE STARTED: June 19, 1971	
EQUIVALENT 8 HR. MAN DAYS:	36	DATE FINISHED: July 9, 1971	
CONSULTING MAN DAYS:	3	NUMBER OF STATIONS:	194
DRAUGHTING MAN DAYS:	5	NUMBER OF READINGS:	1896
TOTAL MAN DAYS:	44	MILES OF LINE SURVEYED:	7.1

CONSULTANTS:
Marion A. Goudie, 739 Military Trail, West Hill, Ontario.
Ashton W. Mullan, 1440 Sandhurst Place, West Vancouver, British Columbia

FIELD TECHNICIANS:
D. Broswick, c/o McPhar Geophysics Ltd. Suite 811, 837 West Hastings St. Vancouver, B.C.
M. McDonald, 6135 Bow Crescent, N.W. Calgary, Alberta.

DRAUGHTSMEN:
K. Kingsbury, 58 Oak Avenue, Richvale, Ontario.
B. Marr, 19 Kenewen Court, Toronto 16, Ontario.
J. Preager, 20 Esterbrooke Avenue, Apt. 705, Willowdale, Ontario.

McPHAR GEOPHYSICS LIMITED

Marion A. Goudie

Marion A. Goudie,
Geologist.

Dated: August 10, 1971

INTERIM STATEMENT OF COST

Kennco Explorations (Western) Limited
IP Survey - Pine No. 6 and No. 7 Groups

Crew (2 men) - D. Broswick - M. McDonald

8 days Operating		@ $265.00/day	$2,120.00
3 days Travel) ½ day Bad Weather) 1½ days Preparation) 3/4 day Standby)	5-3/4 days	@ $100.00/day	575.00
5-3/4 days Breakdown) 1 day Operating) ½ day Standby)	7½ days		N.C.
			$2,695.00

Expenses to Follow

McPHAR GEOPHYSICS LIMITED

Marion A. Goudie

Marion A. Goudie,
Geologist.

Dated: August 10, 1971

CERTIFICATE

I, Marion A. Goudie, of the City of Toronto, Province of Ontario, do hereby certify that:

1. I am a Geologist residing at 739 Military Trail, West Hill, Ontario.

2. I am a graduate of the University of Western Ontario with a B.Sc. Degree (1950) in Honours Geology.

3. I am a member of the Geological Society of America.

4. I have been practising my profession for 20 years.

5. I have no direct or indirect interest, nor do I expect to receive any interest directly or indirectly, in the property or securities of Kennco Explorations (Western) Limited or any affiliate.

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

7. Permission is granted to use in whole or in part for assessment and qualification requirements but not for advertising purposes.

Dated at Toronto

This 19th day of August 1971

Marion A. Goudie

Marion A. Goudie, B.Sc.

CERTIFICATE

I, Ashton W. Mullan, of the City of Vancouver, in the Province of British Columbia, hereby certify:

1. That I am a geologist and a fellow of the Geological Association of Canada with a business address at 837 West Hastings Street, Vancouver, British Columbia.

2. That I am registered as a member of the Association of Professional Engineers of the Province of Ontario and British Columbia.

3. That I hold a B.Sc. degree from McGill University.

4. That I have been practising my profession as a geologist for about twenty years.

5. I have no direct or indirect interest, nor do I expect to receive any interest directly or indirectly, in the property or securities of Kenmco Explorations (Western) Limited or any affiliate.

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

7. Permission is granted to use in whole or in part for assessment and qualification requirements but not for advertising purposes.

Dated at Vancouver

This 10th day of August 1971

A. W. Mullan, B.Sc., P.Eng.

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
A. W. MULLAN

APPENDIX A

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.

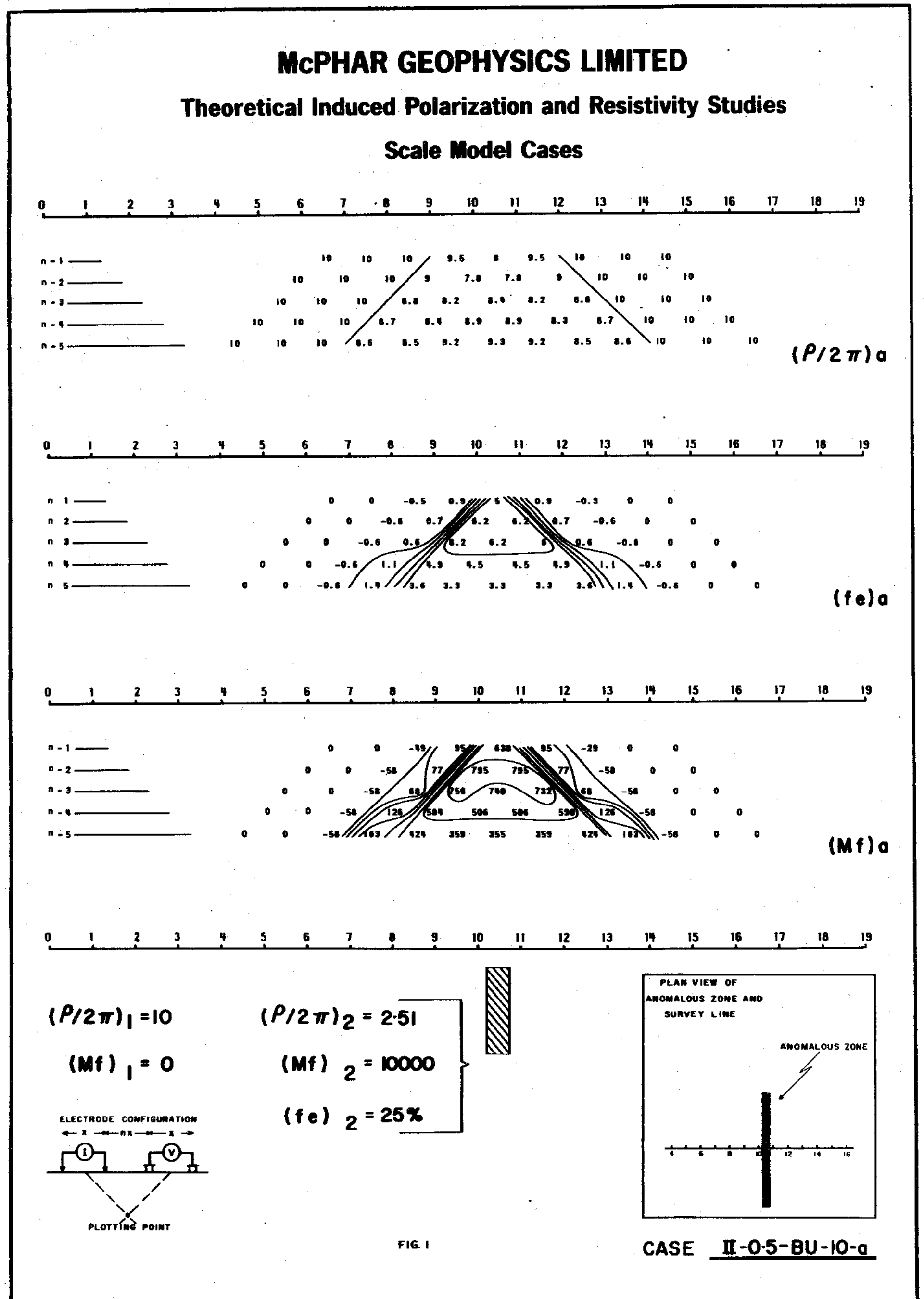
If the source is shallow, the anomaly can be better evaluated using a shorter electrode interval. When the electrode interval used approaches the width of the source, the apparent effects measured will be nearly equal to the true effects within the source. When there is some depth to the top of the source, 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.

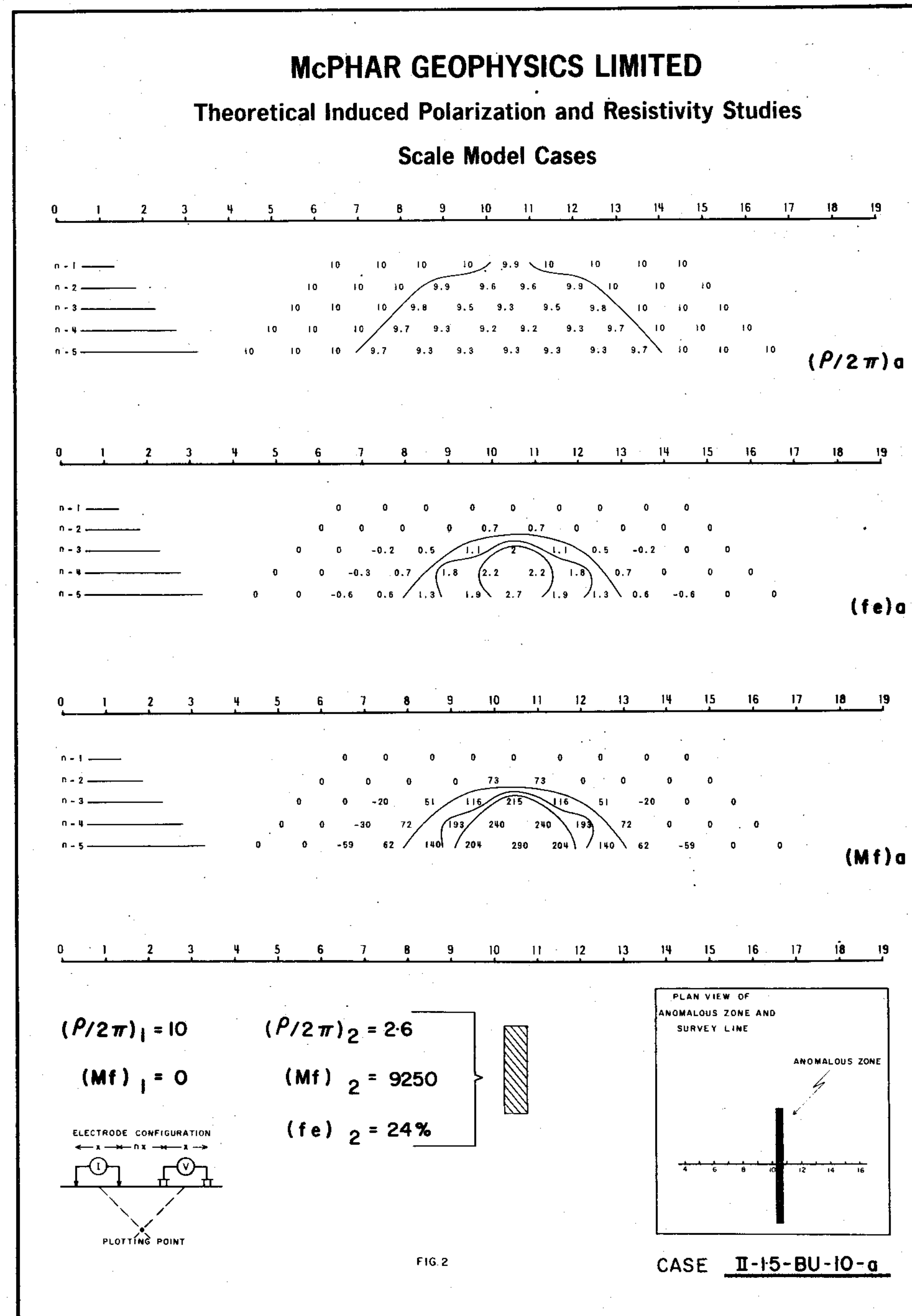
Our experience has confirmed the desirability of doing detail. When a reconnaissance IP survey using a relatively large electrode interval indicates the presence of a narrow, shallow source, detail with shorter electrode intervals is necessary in order to better locate, and evaluate, the source. The 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.


McPHAR GEOPHYSICS LIMITED
Theoretical Induced Polarization and Resistivity Studies
Scale Model Cases
(ρ/2π)a
(fe)a
(Mf)a
(ρ/2π)1 = 10
(Mf)1 = 0
(ρ/2π)2 = 2.51
(Mf)2 = 10000
(fe)2 = 25%
ELECTRODE CONFIGURATION
PLOTTING POINT
PLAN VIEW OF ANOMALOUS ZONE AND SURVEY LINE
ANOMALOUS ZONE
CASE II-0.5-BU-10-a
FIG. 1


McPHAR GEOPHYSICS LIMITED
Theoretical Induced Polarization and Resistivity Studies
Scale Model Cases
(ρ/2π)a
(fe)a
(Mf)a
(ρ/2π)1 = 10
(Mf)1 = 0
(ρ/2π)2 = 2.6
(Mf)2 = 9250
(fe)2 = 24%
ELECTRODE CONFIGURATION
PLOTTING POINT
PLAN VIEW OF ANOMALOUS ZONE AND SURVEY LINE
ANOMALOUS ZONE
CASE II-1.5-BU-10-a
FIG. 2

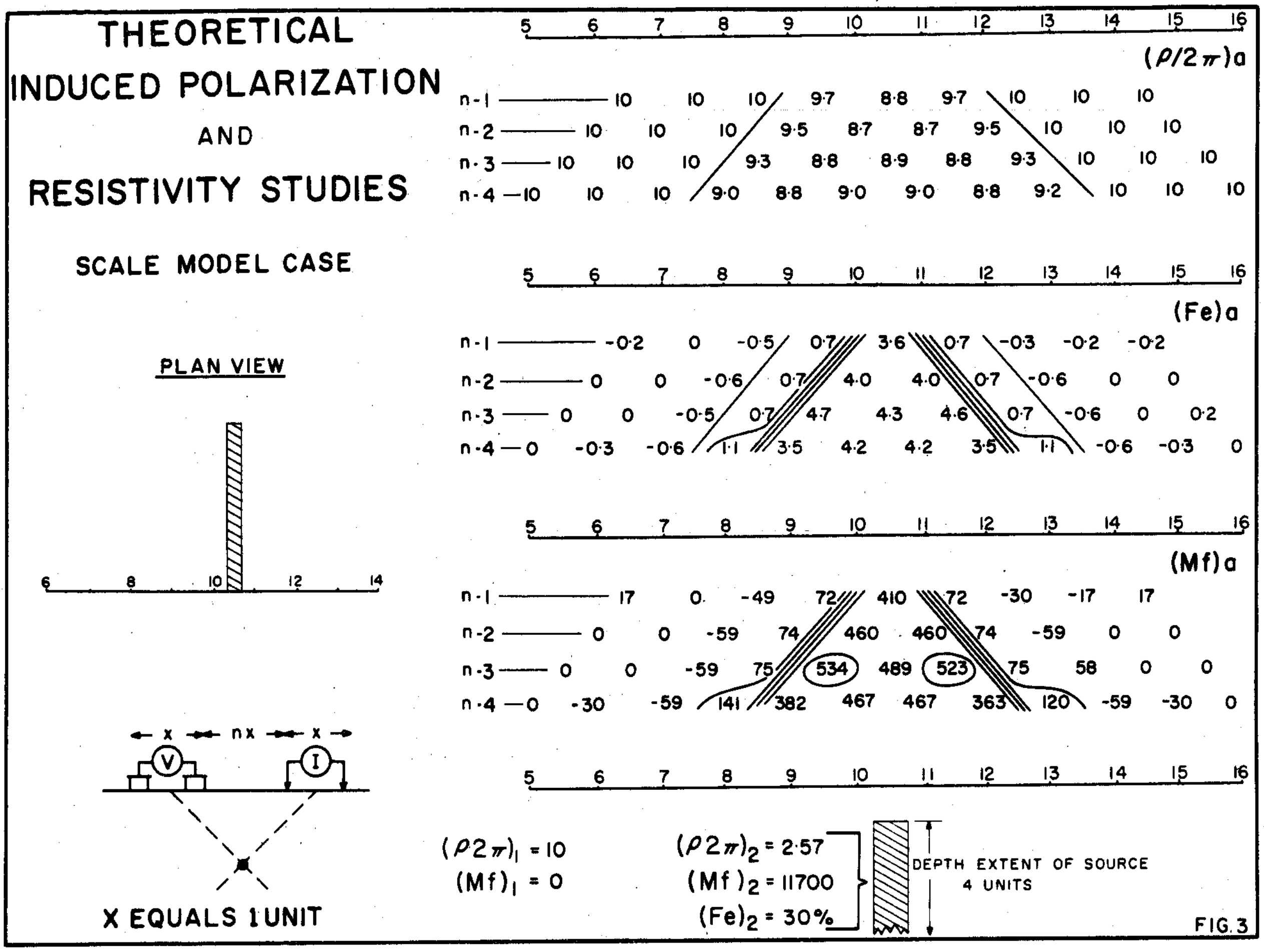

THEORETICAL
INDUCED POLARIZATION
AND
RESISTIVITY STUDIES
SCALE MODEL CASE
PLAN VIEW
6 8 10 12 14
X EQUALS 1 UNIT
x nx x
V I
5 6 7 8 9 10 11 12 13 14 15 16
(ρ/2π)a
n-1 10 10 10 9·7 8·8 9·7 10 10 10
n-2 10 10 10 9·5 8·7 8·7 9·5 10 10 10
n-3 10 10 10 9·3 8·8 8·9 8·8 9·3 10 10 10
n-4 10 10 10 9·0 8·8 9·0 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

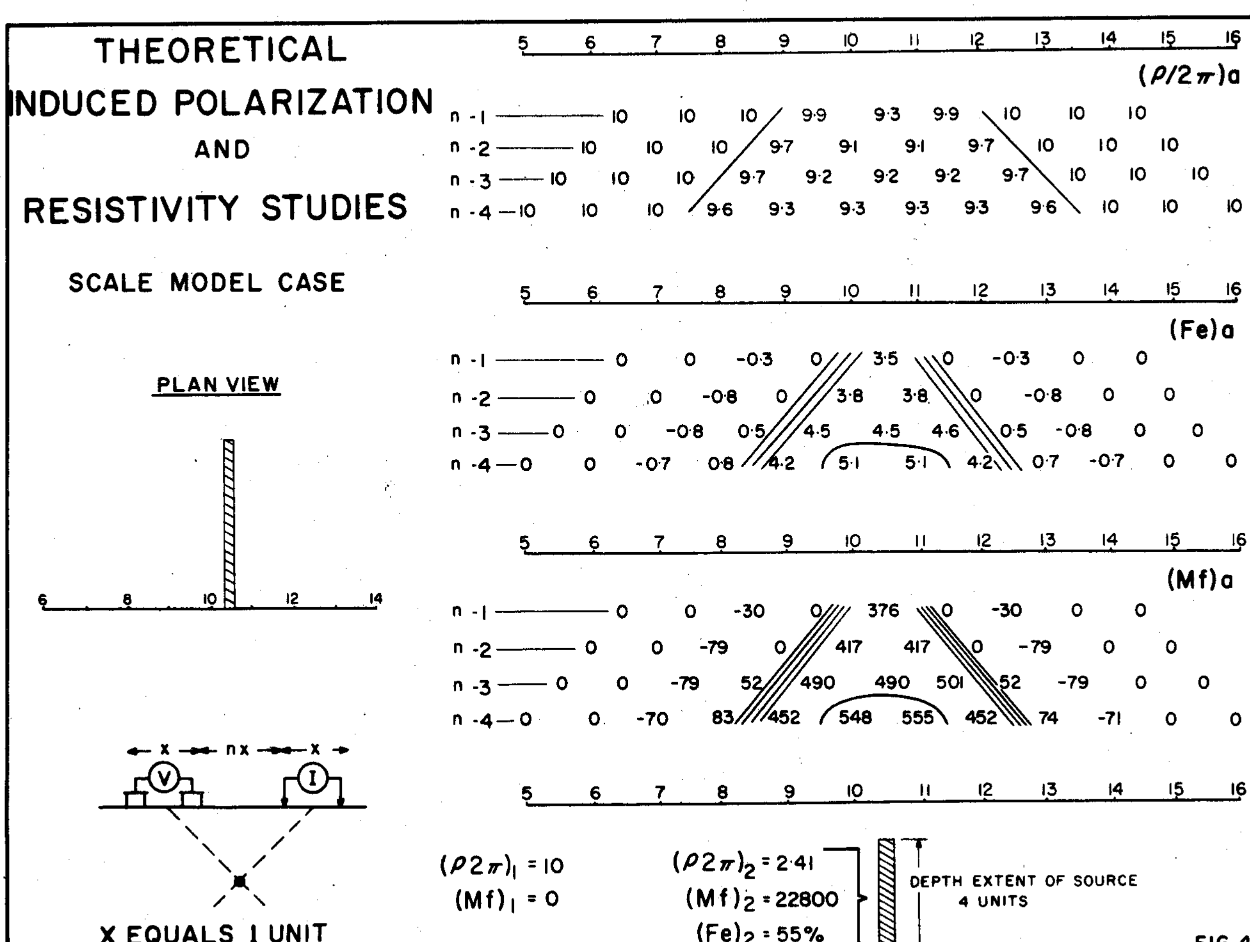

THEORETICAL
INDUCED POLARIZATION
AND
RESISTIVITY STUDIES
SCALE MODEL CASE
PLAN VIEW
6 8 10 12 14
X EQUALS 1 UNIT
x nx x
V I
5 6 7 8 9 10 11 12 13 14 15 16
(ρ/2π)a
n-1 10 10 10 9·9 9·3 9·9 10 10 10
n-2 10 10 10 9·7 9·1 9·1 9·7 10 10 10
n-3 10 10 10 9·7 9·2 9·2 9·2 9·7 10 10 10
n-4 10 10 10 9·6 9·3 9·3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

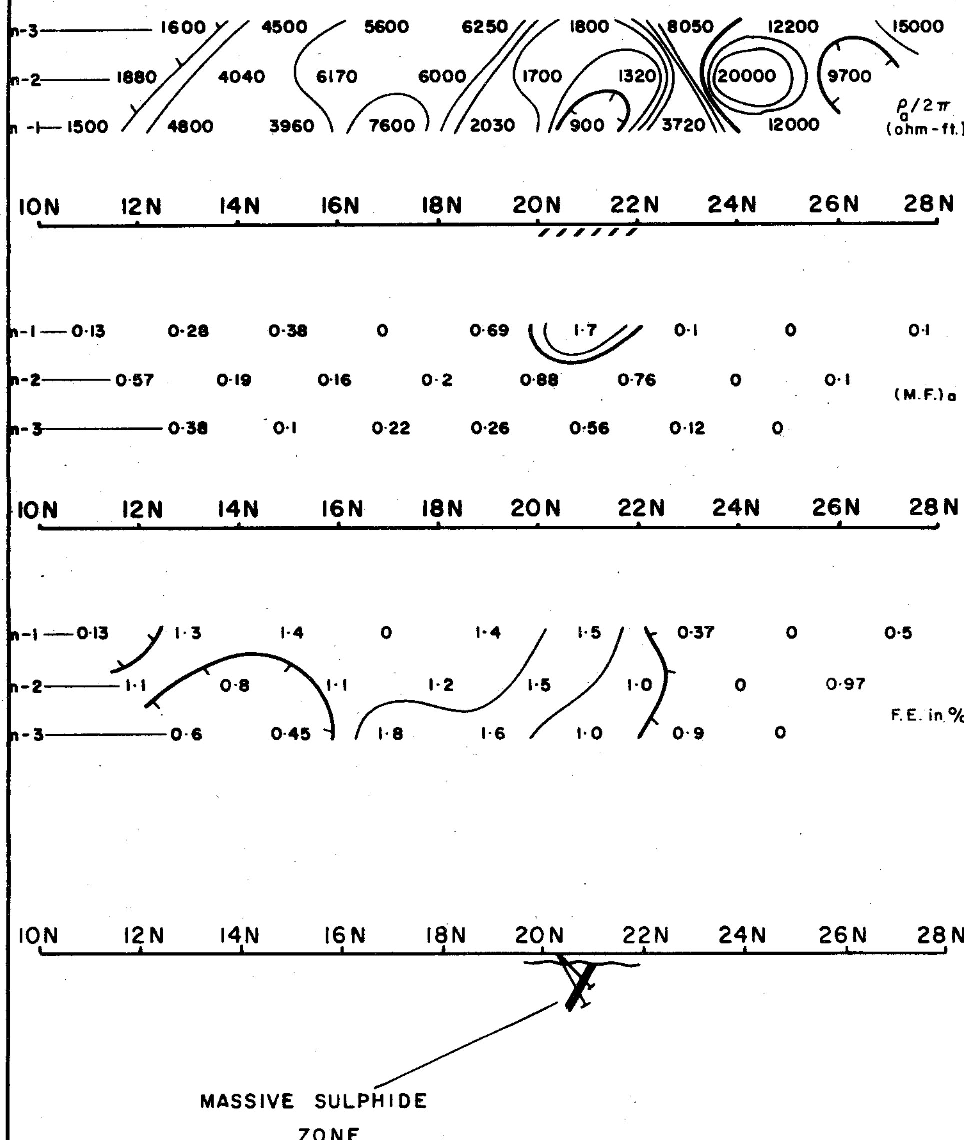


FIG. 5

INDUCED POLARIZATION AND RESISTIVITY RESULTS
BATCHELOR LAKE AREA, QUEBEC.

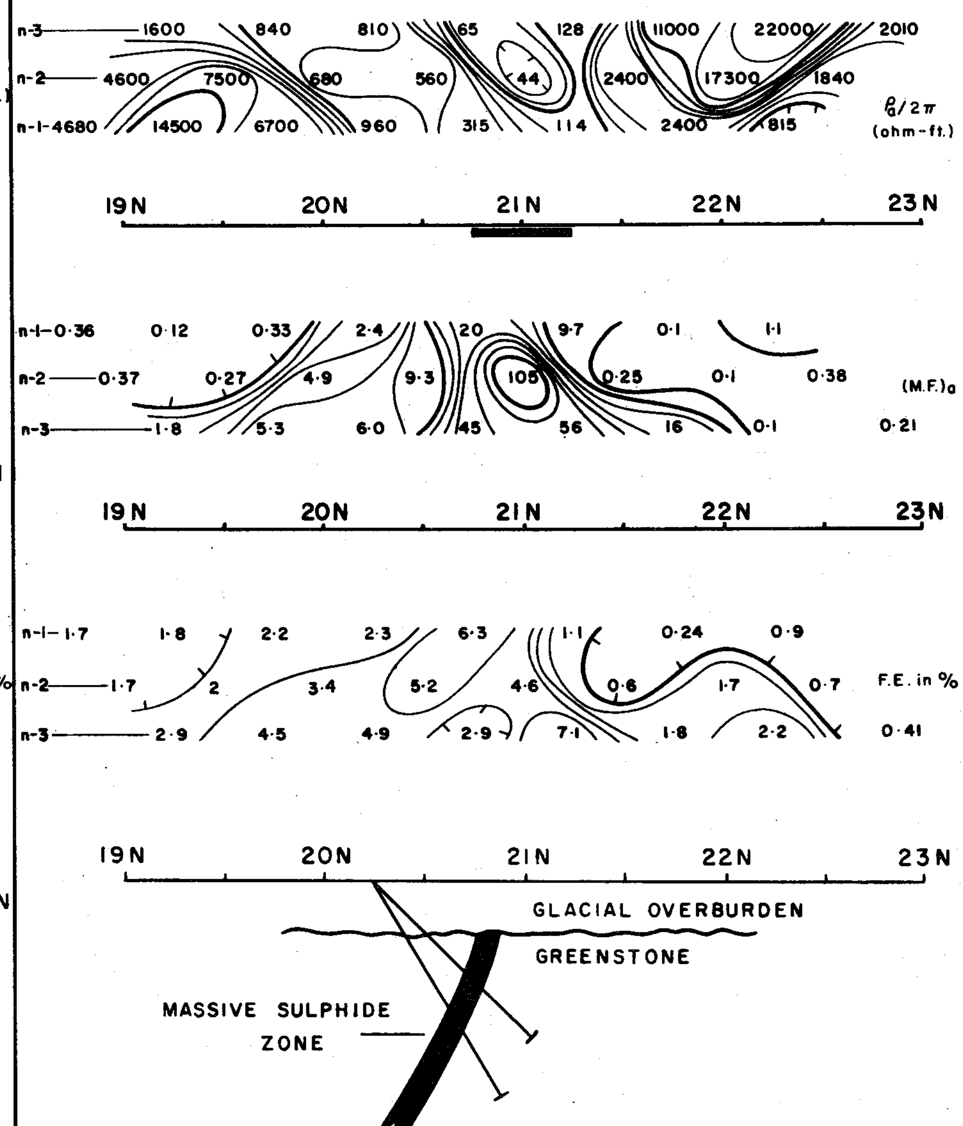


FIG. 6

APPENDIX B

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.

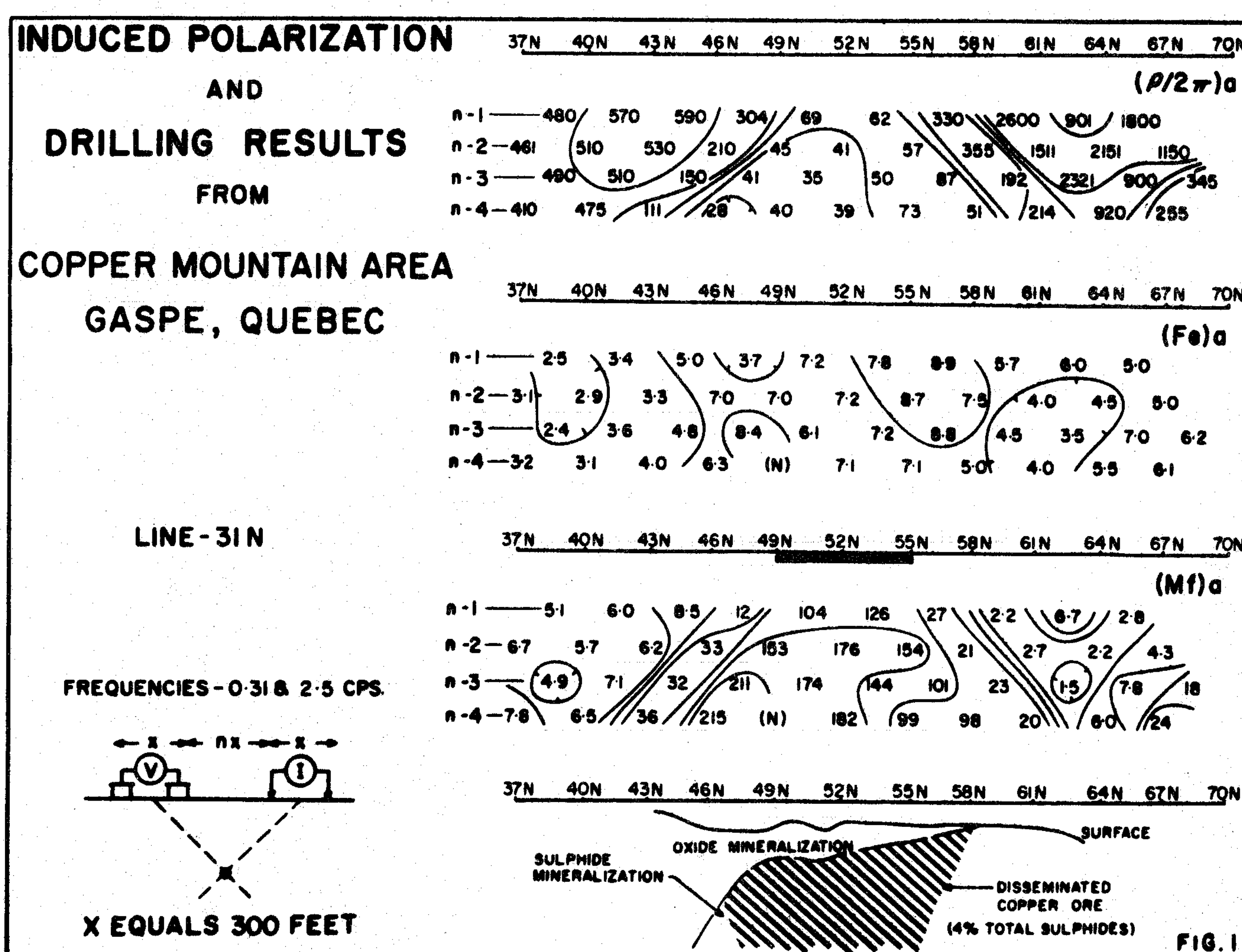


FIG. 1

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.

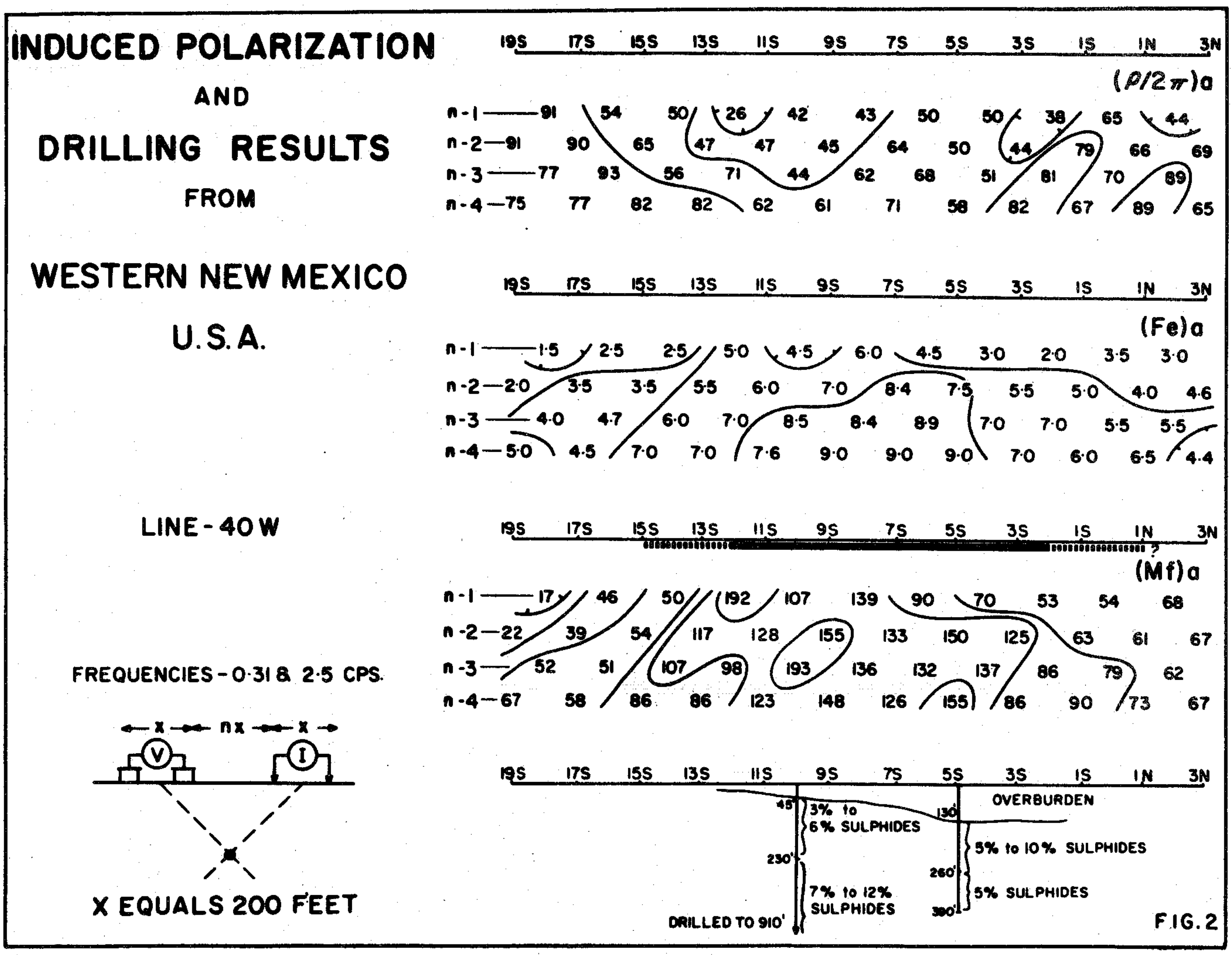


FIG. 2

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.

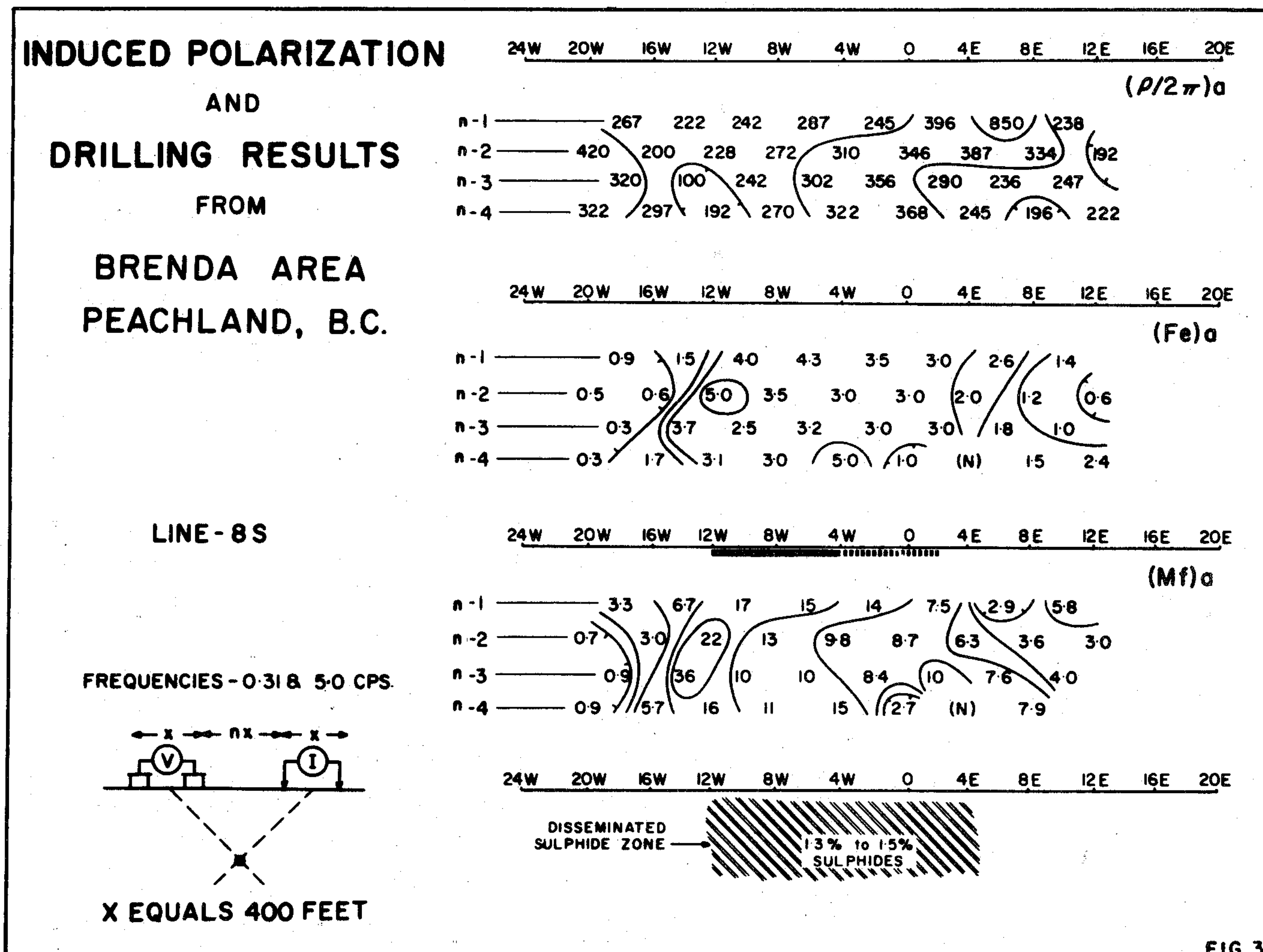


FIG. 3

3266

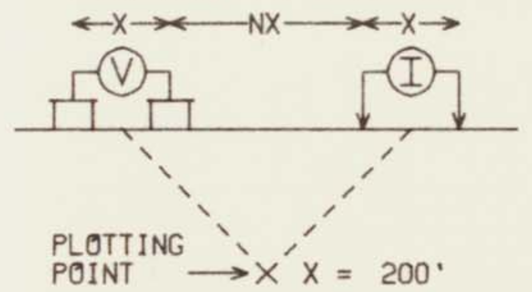
DWG. NO.- I.P.-5819-1

KENNCO EXPLORATION (WESTERN) LIMITED

PINE NO. 6&7 GROUPS, THUTADE LAKE AREA
OMINECA M.D., BRITISH COLUMBIA

LINE NO.- 3W

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: JUL 1971

APPROVED:

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

PROFESSIONAL ENGINEER, PROVINCE OF BRITISH COLUMBIA, A. W. MULLAN

1971

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED WITH AN IBM 360/65 COMPUTER AND A CALCOMP PLOTTER

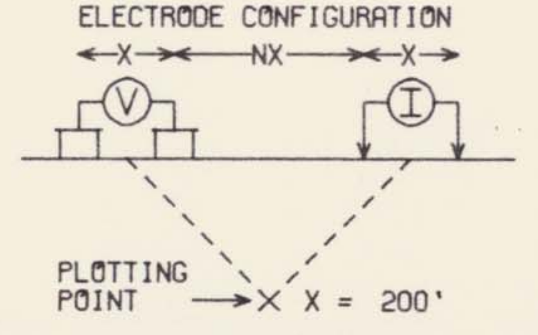
DWG. NO.- I.P.- 5819-2

KENNCO EXPLORATION (WESTERN) LIMITED

PINE NO. 6&7 GROUPS, THUTADE LAKE AREA

OMINECA M.D., BRITISH COLUMBIA

LINE NO.- 10E



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE ▬▬▬

PROBABLE ||||||||||

POSSIBLE / / / / /

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: JUL 1971

APPROVED:

DATE: Aug. 10, 1971

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA A. W. MULLAN

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED WITH AN IBM 360/65 COMPUTER AND A CALCOMP PLOTTER

DWG. NO.- I.P.-5819-3

KENNCO EXPLORATION (WESTERN) LIMITED

PINE NO. 6&7 GROUPS, THUTADE LAKE AREA

OMINECA M.D., BRITISH COLUMBIA

LINE NO.- 18E

ELECTRODE CONFIGURATION

X — NX — X

PLOTTING POINT

X = 200'

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: JUL 1971

APPROVED:

DATE: 1971

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — A. W. MULLAN

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED WITH AN IBM 360/65 COMPUTER AND A CALCOMP PLOTTER

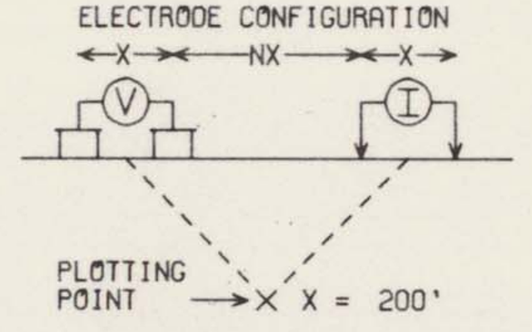
DWG. NO.- I.P.- 5819-4

KENNCO EXPLORATION (WESTERN) LIMITED

PINE NO. 6&7 GROUPS, THUTADE LAKE AREA
OMINECA M.D., BRITISH COLUMBIA

LINE NO.- 26E

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: JUL 1971

APPROVED:

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

DATE: Aug 20, 1971

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — A. W. MULLAN

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED WITH AN IBM 360/65 COMPUTER AND A CALCOMP PLOTTER

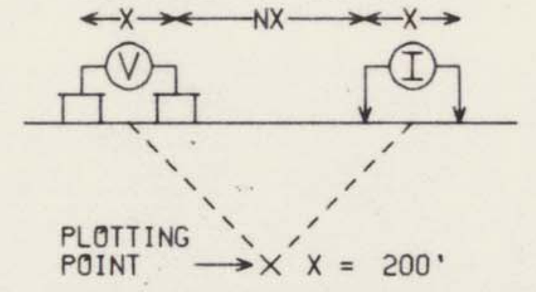
DWG. NO.- I.P.- 5819-5

KENNCO EXPLORATION (WESTERN) LIMITED

PINE NO. 6&7 GROUPS, THUTADE LAKE AREA
OMINECA M.D., BRITISH COLUMBIA

LINE NO.- 4S

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: JUL 1971

APPROVED:

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

DATE:

PROFESSIONAL ENGINEER A. W. MULLAN BRITISH COLUMBIA

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED WITH AN IBM 360/65 COMPUTER AND A CALCOMP PLOTTER

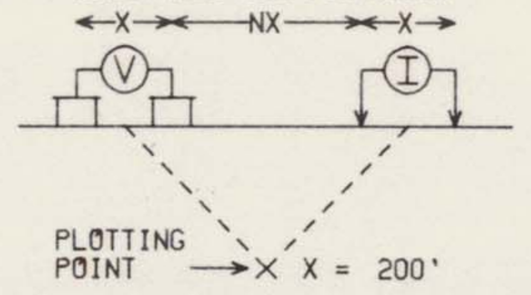
DWG. NO.- I.P.- 5819-6

KENNCO EXPLORATION (WESTERN) LIMITED

PINE NO. 6&7 GROUPS, THUTADE LAKE AREA
OMINECA M.D., BRITISH COLUMBIA

LINE NO.- 12S

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES
DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: JUL 1971

APPROVED:

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

DATE Aug 10, 1971

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — A. W. MULLAN

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED WITH AN IBM 360/65 COMPUTER AND A CALCOMP PLOTTER

DWG. NO.- I.P.-5819-7

KENNCO EXPLORATION (WESTERN) LIMITED

PINE NO. 6&7 GROUPS, THUTADE LAKE AREA
OMINECA M.D., BRITISH COLUMBIA

LINE NO.- 20S

ELECTRODE CONFIGURATION

X NX X

PLOTTING POINT X = 200'

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: JUL 1971

APPROVED:

DATE:

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

PROFESSIONAL ENGINEER, PROVINCE OF BRITISH COLUMBIA, A. W. MULLAN

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED WITH AN IBM 360/65 COMPUTER AND A CALCOMP PLOTTER

DWG. NO.- I.P.- 5819-8

KENNCO EXPLORATION (WESTERN) LIMITED

PINE NO. 6&7 GROUPS, THUTADE LAKE AREA

OMINECA M.D., BRITISH COLUMBIA

LINE NO.- 8SE

ELECTRODE CONFIGURATION

X — NX — X

PLOTTING POINT → X   X = 200'

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: JUL 1971

APPROVED:

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

DATE:

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA A. W. MULLAN

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

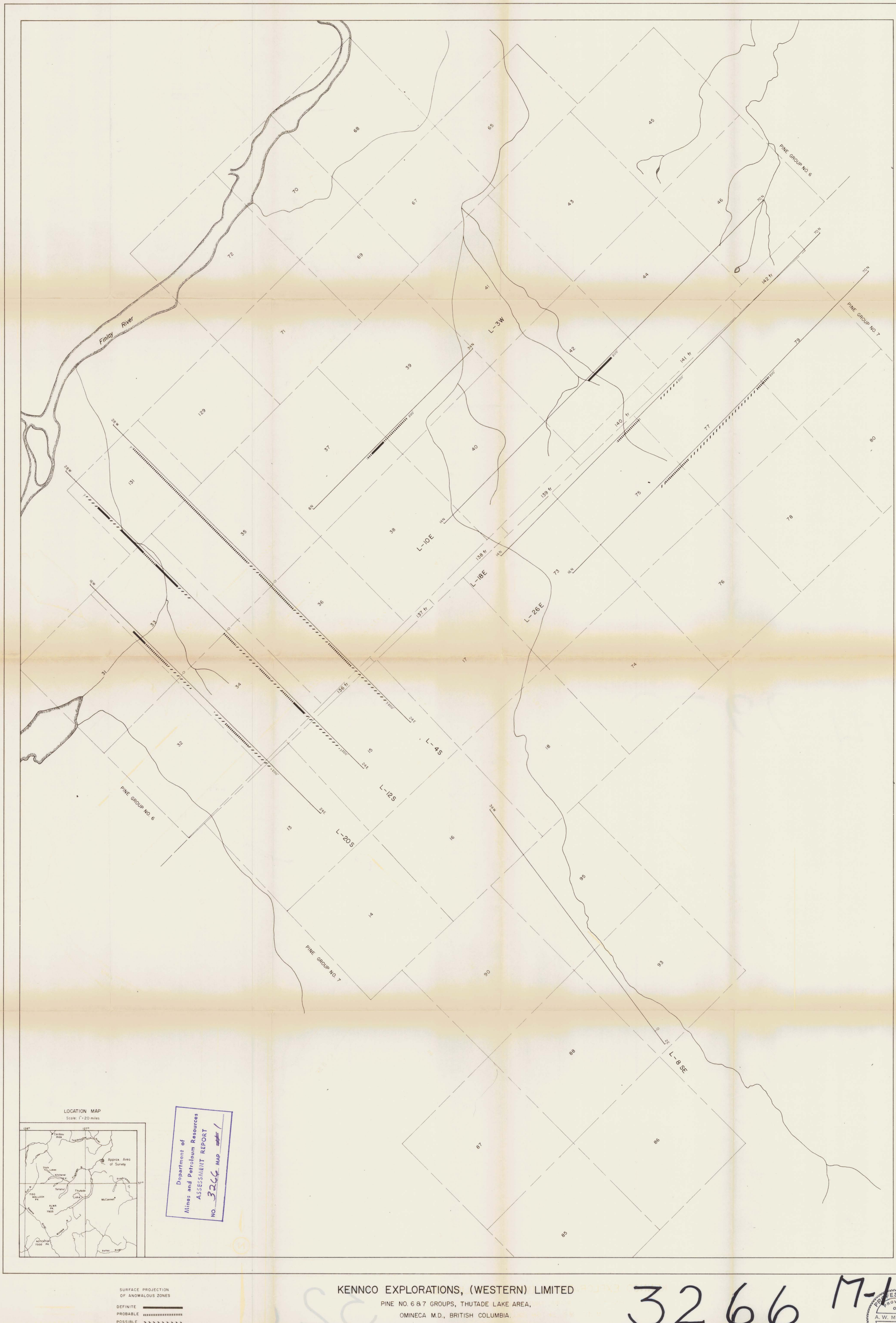
NOTE: THIS PLOT WAS PRODUCED WITH AN IBM 360/65 COMPUTER AND A CALCOMP PLOTTER

DWG. IPP-4804

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

PLAN MAP



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

Number at the end of anomaly indicates electrode interval

KENNCO EXPLORATIONS, (WESTERN) LIMITED

PINE NO. 6 & 7 GROUPS, THUTADE LAKE AREA,

OMINECA M.D., BRITISH COLUMBIA.

SCALE

ONE INCH EQUALS FOUR HUNDRED FEET

3266 M-1

DATE: JULY /1971

APPROVED: AWM Aug. 10, 1971

PROFESSIONAL ENGINEER, PROVINCE OF BRITISH COLUMBIA, A. W. MULLAN

DWG. IPP — 4804