Misc Reports

(6)

HUDSON BAY WESTERN LOWLANDS

NELSON PROJECT

RES. 10 & 21 MINING RECORDING

REPORT ON MAGNETIC AND TURAM ELECTROMAGNETIC SURVEYS, LOWER NELSON PROJECT, MANITOBA

GENERAL

From August to December 1961 we carried out magnetic and Turam electromagnetic surveys on the Lower Nelson Project for Kennco Explorations, (Canada) Limited.

The survey covered nine grids which were located in the vicinity of Weir River at Mile 384 on the Hudson Bay Railway in Manitoba.

Grids 1, 2, 2A, 6 and 7 were directly accessible from the railway. Access to Grids 8 to 12 was made by aircraft from Ilford.

The magnetometer surveys showed in general relatively low magnetic relief throughout the investigated areas. Local anomalies indicated depths in excess of 250 feet.

The electromagnetic surveys showed in most areas relatively strong field distortions caused by the overlying formations with no definite conductors located in the Precambrian basement rocks.

METHODS

The magnetic surveys were carried out with two ABEM MZ-4 and one Askania Gfz magnetometers. Both models are of the torsion type measuring variations of the vertical magnetic field with an overall accuracy of 3 gammas. Diurnal corrections were made by remeasurement of predetermined base stations at regular intervals and on some grids, one instrument was used to record the continuous diurnal variations.

The electromagnetic survey was carried out with the Turam method, an inductive method whereby the ground is energized by means of an alternating current fed to a closed loop of insulated wire, laid out on the ground. The primary field induces eddying currents in conductors in the subsurface, which in their turn create secondary electromagnetic fields. By means of two coils connected to a compensator, field strength ratios and phase differences between points on traverses perpendicular to a loop side are measured. The presence of conductors will be characterized by abnormal field strength ratios and phase differences.

The relative amplitudes of these two parameters are a measure for the conductivity of the conducting bodies, i.e. a good conductor will mainly affect the field strength and to a lesser degree the phase displacement, whereas a poor conductor may cause considerable phase displacement without greatly affecting the field strength.

A coil spacing of 100 feet and a frequency of 660 c.p.s. was used throughout the surveys.

RESULTS

Grid No. 1

Magnetometer Map 60-38
Turam Map 61-55

Magnetometer Survey

Most of this grid had been previously surveyed. Lines 4E and 8E were surveyed in September 1961 which only extended the indicated magnetic pattern.

Turam Survey

The portion of the grid between 15S and 26S was covered by the electromagnetic survey. The results show relatively strong field damping. Local steep gradients indicate that this distortion originates in a near-surface layer. The anomaly on Lines 16W and 20W at approximately 26 + 50 S, could possibly be caused by a source at more than a 300 foot depth, but considering the overall high background the indication is indefinite. There is no apparent correlation between this anomaly and the magnetic pattern.

Grid No.2

Magnetometer Map 61-48
Turam Map 61-49

Magnetometer Survey

A broad anomaly about 8,000 feet in diameter was indicated in the centre of the grid.

The most pronounced local anomalies are indicated on Line 124E at 12S and 29S. The depths appear to be between 400 and 450 feet. Other local anomalies show depths in excess of these.

Turam Survey

The results show a fair amount of distortion of the electromagnetic field. The sharpness of the gradients indicate that most of the disturbances are caused by sources of less than 200 foot depths. The overall pattern is irregular. In some places; e.g. L8W at 36N, L24W at 16N, L8W at 12S, L0 at 18N, anomalies occur which could possibly be due to deeper sources. As none of these anomalies appear to extend to adjacent lines it is more likely that they are caused by several near-surface sources.

The anomaly at 24W - 16N roughly coincides with a magnetic high, the latter however, indicates a considerable larger depth.

Grid No. 2A

Magnetometer Map 61-47
Turam Maps 61-49a,b

Magnetometer Survey

This grid shows relatively low magnetic relief with a strike direction perpendicular to the lines.

Turam Survey

The results show irregular disturbances from near surface sources. Two anomalies, 80W - 95S, 144W - 95S, appear to be of more interest and were measured in detail. Both are of medium to poor conductivity. The anomaly at 144W -95S appears to correlate with a small magnetic anomaly which is part of a broader gradient. One explanation would be that the conductive zone coincides with a contact between two formations of different magnetite content.

Grid No. 6

Magnetometer Map 61-43
Turam Map 61-54

Magnetometer Survey

Two large east-west striking anomalies of relatively high intensity were outlined at the two extremities of the grid near the base line. They have apparent depths in the order of 350 to 450 feet.

Turam Survey

Most of the area shows overburden disturbances, parts of which are strong enough to mask deeper anomalies. North of the 40N base line, on lines 180E, 188E and 196E there appears to be a double conductor which was measured in detail. The results show a general steepening of the gradients and some irregular horizontal shifts of the current axes, which strongly suggest current flow in the overburden.

Grid No. 7

Magnetometer Map 61-42
Turam Map 61-53

Magnetometer Survey

Two well defined anomalies, roughly circular in shape, were located near the base line. The most westerly anomaly has an apparent depth of about 300 feet, while the other anomaly is apparently deeper.

Turam Survey

The area shows some overburden distortions of relatively small amplitudes with no anomalies that could possibly be caused by deeper sources. The magnetic anomalies have no electromagnetic expression.

Grid No. 8

Magnetometer Map 61-44
Turam Map 61-50

Magnetometer Survey

The results show a long, broad magnetic zone, parrallel with the base line, extending the total length of the grid, with a relatively strong circular anomaly at the east end of the grid. It has an apparent depth in the order of 800 feet.

Turam Survey

Overburden background is relatively low over most of the area. No anomalies of interest were located.

The magnetic anomalies appear to have no electromagnetic expression.

Grid No. 9

Magnetometer Map 61-45
Turam Map 61-51

Magnetometer Survey

A large, relatively strong anomaly up to 2,500 gammas above background, was outlined. It strikes parallel with the base line and is centered just south of the 20N base line on Line 64E. It has an apparent depth of over 1000 feet.

Turam Survey

The area shows relatively low overburden background. No anomalies occur that could possibly be caused by deeper conductors.

There is no electromagnetic expression of the magnetic anomaly.

Grid No. 10

Magnetometer Map 61-46
Turam Map 61-52

Magnetometer Survey

The map shows the expression of one magnetic pole with a peak of about 400 gammas on Line 100S. It has an indicated depth of approximately 350 feet.

Turam Survey

The area is geo-electrically undisturbed, with no expression of the one magnetic anomaly.

Grid No. 11

Magnetometer Map 61-57
Turam Map 61-56

Magnetometer Survey

The results show several isolated magnetic highs up to 650 gammas above background. The pattern of the anomalies may possibly indicate that the base line is not parallel to the strike. Due to the large intervals of line-spacing, it is difficult to suggest what the actual magnetic picture may be.

Turam Survey

Most of the area has relatively low overburden distortion. One exceptionally strong anomaly for the area was located on Line 0 at 78. The depth indicated by the gradient of the curve is approximately 250 feet. However, assuming that the conductor is not more than 2000 feet long, the strength indicates a much shallower source, more likely 100 feet or less. Unless there is a reason to suspect that the Precambrian bedrock is at a depth of the same order in this part of the area, this anomaly can be discounted.

There is no apparent correlation between the electromagnetic and magnetic anomalies.

Grid No. 12

Magnetometer Map 61-59
Turam Map 61-58

Magnetometer Survey

A long, broad anomaly of relatively low intensity was outlined in the western part of the area. It appears to strike at about a 40 degree angle to the base line and has an apparent depth of about 700 feet.

Turam Survey

Disturbances from the overburden are relatively low in this area. No anomalies of interest were located.

There is no electromagnetic expression of the magnetic anomaly.

CONCLUSION

A steeply dipping tabular body of good conductivity with a strike length between 1000 and 3000 feet would cause, at a depth of 300 feet, a field strength ratio anomaly with a maximum amplitude of 5 to 12% and an anomaly width of 600 feet. In some parts of the investigated areas, where the magnetometer results indicate depths in excess of 300 feet and where the geo-electrical background is high, such anomalies, particularily from the smaller conductors, could be masked. Generally, however, the overburden distortion has an irregular pattern, which makes it less likely that a regular pattern from a deeper conductor would be entirely hidden.

This survey has not located a pattern of electromagnetic anomalies comparable to results obtained in the Thompson area where the overburden is shallower (i.e. in the order of 200 feet).

No isolated anomalies have been located which definitely indicate a conductor at a sufficient depth to be in the Precambrian basement rocks.

The few anomalies that appear to be of some interest (Grids 2 - 2A) show depths of approximately 300 feet which makes it questionable whether the sources are located in the Precambrian basement. Assuming they are, their medium to poor conductivity would exclude the possibility that they are caused by economic concentrations of sulphides.

In general, there appears to be little correlation between the magnetic and the electromagnetic results.

Respectfully submitted,

R. A. Bosschart
Consulting Geophysicist

MOREAU, WOODARD & CO. LTD.

J. A. Woodard, P. Eng.

/jw

McPHAR GEOPHYSICS LIMITED

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

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

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

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

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

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

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

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

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

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

Apropos of this, it should be stated that the induced polarization measurements indicate the total amount of metallic constituents in the rock. Thus all of the metallic minerals in the rock, such as pyrite, as well as the ore minerals chalcopyrite, chalcocite, galena, etc. are responsible for the induced polarization effect. Some oxides such as magnetite, pyrolusite, chromite, and some forms of hematite also conduct by electrons and are metallic. All of the metallic minerals in the rock will contribute to the induced polarization effect measured on the surface.

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

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

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

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

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

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

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

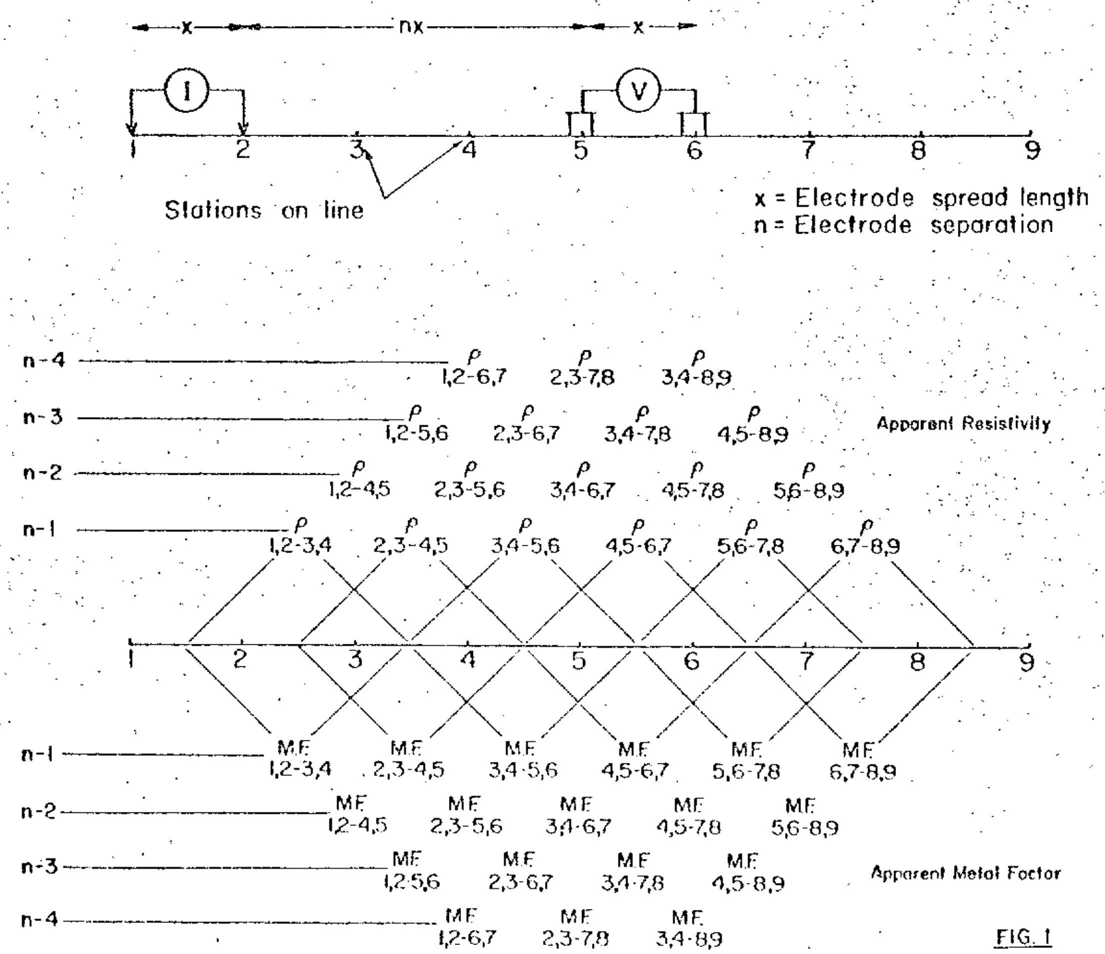

FIG. 1

McPHAR GEOPHYSICS LIMITED

REPORT ON GEOPHYSICAL INVESTIGATIONS IN THE NELSON RIVER AREA OF MANITOBA FOR KENNCO EXPLORATIONS (CANADA) LTD.

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1. INTRODUCTION

At the request of Mr. H. W. Fleming, geophysicist for the company, we have carried out Induced Polarization-Resistivity investigations on three properties in the Cross Lake Mining Division of northern Manitoba. The three areas of interest are located about 60 miles WSW of Port Nelson on Hudson Bay and some 20 miles north of the Nelson River. (See accompanying map Misc. 3367 and C.D.M. 8 mile sheet #54 SW, York Factory).

Field work was carried out in September 1962 using a McPhar Standard I.P. unit. Difficulties were encountered on Grid #7 and Grid #8, evidently because of permafrost, and the investigation had to be cancelled.

2. PRESENTATION OF RESULTS

The Induced Polarization and Resistivity results are shown on the following data plots, bound at the back of this report, in the manner outlined in the preceding notes.

Grid #2

Line 20N	400-foot Spreads	Dwg. No. I.P. 2936-1
Line O	400-foot Spreads	Dwg. No. I.P. 2936-2
Line 20S	400-foot Spreads	Dwg. No. I.P. 2936-3

Grid #7

Line 80E	400-foot Spreads	Dwg. No. I.P. 2936-4

Grid #8

Line 40E	400-foot Spreads	Dwg. No. I.P. 2936-5

Enclosed with this report is Dwg. Misc. 3367, a plan map of the area at a scale of 1" = 1/2 mile. The definite 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 measurement is essentially an averaging process, as are all potential methods, it is frequently difficult to exactly pinpoint the source of an anomaly. Certainly, no anomaly can be located with more accuracy than the spread length; i.e. when using 200' spreads the position of a narrow sulphide body can only be determined to lie between two stations 200' apart. In order to locate sources at some depth, larger spreads must be used, with a corresponding increase in the uncertainties of location. Therefore, while the center of the indicated anomaly probably corresponds fairly well with source, the length of the indicated anomaly along the line should not be taken to represent the exact edges of the anomalous material.

3. DISCUSSION OF RESULTS

a) Grid #2

Grid #2 is situated immediately to the southwest of Weir River Station, at Mile 373 on the Hudson Bay Line of the C.N.R. I.P. traverses were made on three lines spaced at 2000-foot intervals and running slightly south of east. A 400-foot dipole-dipole electrode array was used on all lines.

No strong anomalies suggestive of a large volume of near-surface metallic mineralization were indicated by the I.P. traverses. Weak effects were noted on each line but, with the possible exception of Line 20N, they appear to represent broad zones of low metallic content rather than concentrated sources. On all lines the apparent resistivities are low and the contour patterns more or less incomplete, suggesting that the traverses should be extended to completely outline the weakly anomalous zones and to establish the background resistivity and I.P. levels.

b) Grid #7

Grid #7 is located about 1-1/2 miles to the east of Weir River Station. An attempt was made to carry out a survey here but negative readings were obtained at some stations rendering the data unreliable and hence the investigation was cancelled. A portion of Line 80E is included to illustrate this effect.

The resistivities measured on Line 80E are low, but no lower than on Grid #2, and should not produce any great problems. The difficulty apparently arises from the presence of permafrost on Grid #7. Experience in parts of Alaska and northern Quebec has shown that at certain times of the year similar effects may occur.

This phenomenon was first noted in northern Quebec during the early spring; it was not apparent during the winter or summer, even on the same property, when ground conditions were more stable. It has also been noted that the effect is local, being present on one property and absent on another a few miles away; in addition it appears to decrease with decreasing currents. It is suggested therefore that this investigation be repeated in mid-winter or mid-summer.

c) Grid #8

This area is situated about eight miles northwest of Weir River Station. The results obtained here on Line 40E are similar to those obtained on Line 80E, Grid #7 and it is reasonable to assume that the same conditions prevail in both areas.

4. SUMMARY AND RECOMMENDATIONS

Induced Polarization investigations have been carried out in three areas near Weir River Station, northern Manitoba. Weak anomalies were obtained on Grid #2 but there are no anomalies suggestive of a shallow concentrated source of large volume. Since the strongest effects were obtained on Line 20N, the grid might be extended further north.

Spurious effects were obtained on Grids #7 and #8, similar to effects measured in other areas in the presence of permafrost at or near the freezing point. It is suggested that this work be repeated in mid-summer or mid-winter when more stable ground conditions prevail.

McPHAR GEOPHYSICS LIMITED

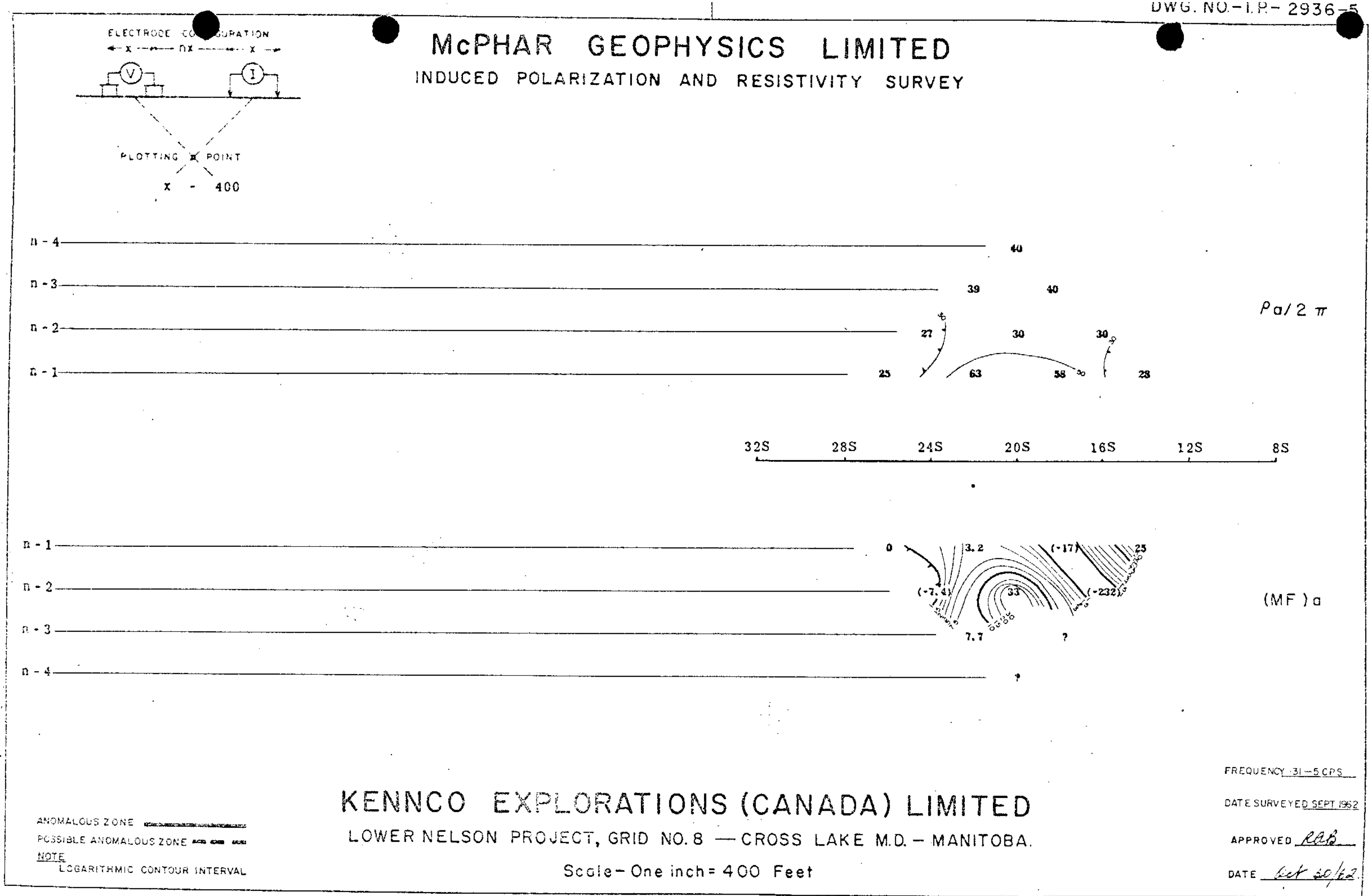
Robert A. Bell

Robert A. Bell,
Geologist.

D. B. Sutherland

D. B. Sutherland,
Geophysicist.

Dated: October 31, 1962.


DWG. NO.-I.P.-2936-5
McPHAR GEOPHYSICS LIMITED
INDUCED POLARIZATION AND RESISTIVITY SURVEY
ELECTRODE CONFIGURATION
x nx x
V
I
PLOTTING POINT
x - 400
n - 4
n - 3
n - 2
n - 1
40
39
40
27
30
30
25
63
58
28
Pa/2 π
32S
28S
24S
20S
16S
12S
8S
LINE NO. 40 E
0
3.2
(-17)
25
(-7.4)
33
(-232)
7.7
?
(MF) a
FREQUENCY .31 - 5 CPS
DATE SURVEYED SEPT 1962
APPROVED RAB
DATE Oct 30/62
KENNCO EXPLORATIONS (CANADA) LIMITED
LOWER NELSON PROJECT, GRID NO. 8 — CROSS LAKE M.D. - MANITOBA.
Scale - One inch = 400 Feet
ANOMALOUS ZONE
POSSIBLE ANOMALOUS ZONE
NOTE
LOGARITHMIC CONTOUR INTERVAL

DWG. NO.-I.P.-2936-4

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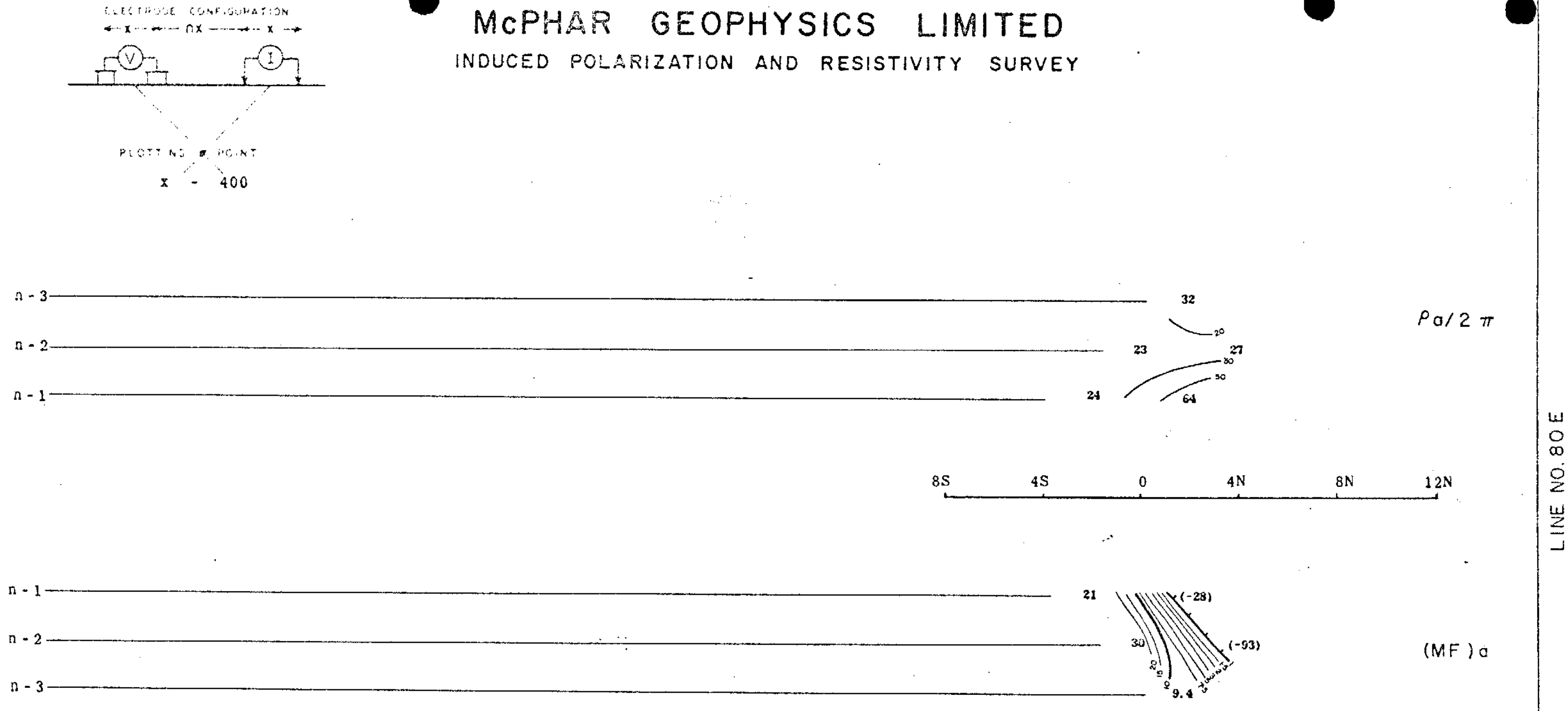
INDUCED POLARIZATION AND RESISTIVITY SURVEY



KENNCO EXPLORATIONS (CANADA) LIMITED

LOWER NELSON PROJECT, GRID NO. 7 — CROSS LAKE M.D. – MANITOBA.

Scale – One inch = 400 Feet

ANOMALOUS ZONE

POSSIBLE ANOMALOUS ZONE

NOTE: LOGARITHMIC CONTOUR INTERVAL

FREQUENCY .31 – 5 CPS

DATE SURVEYED SEPT. 1962

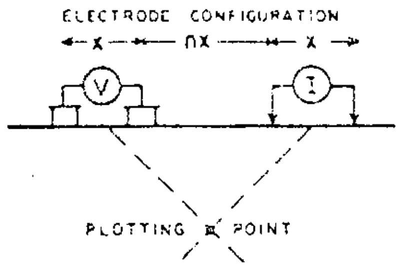
APPROVED RAB

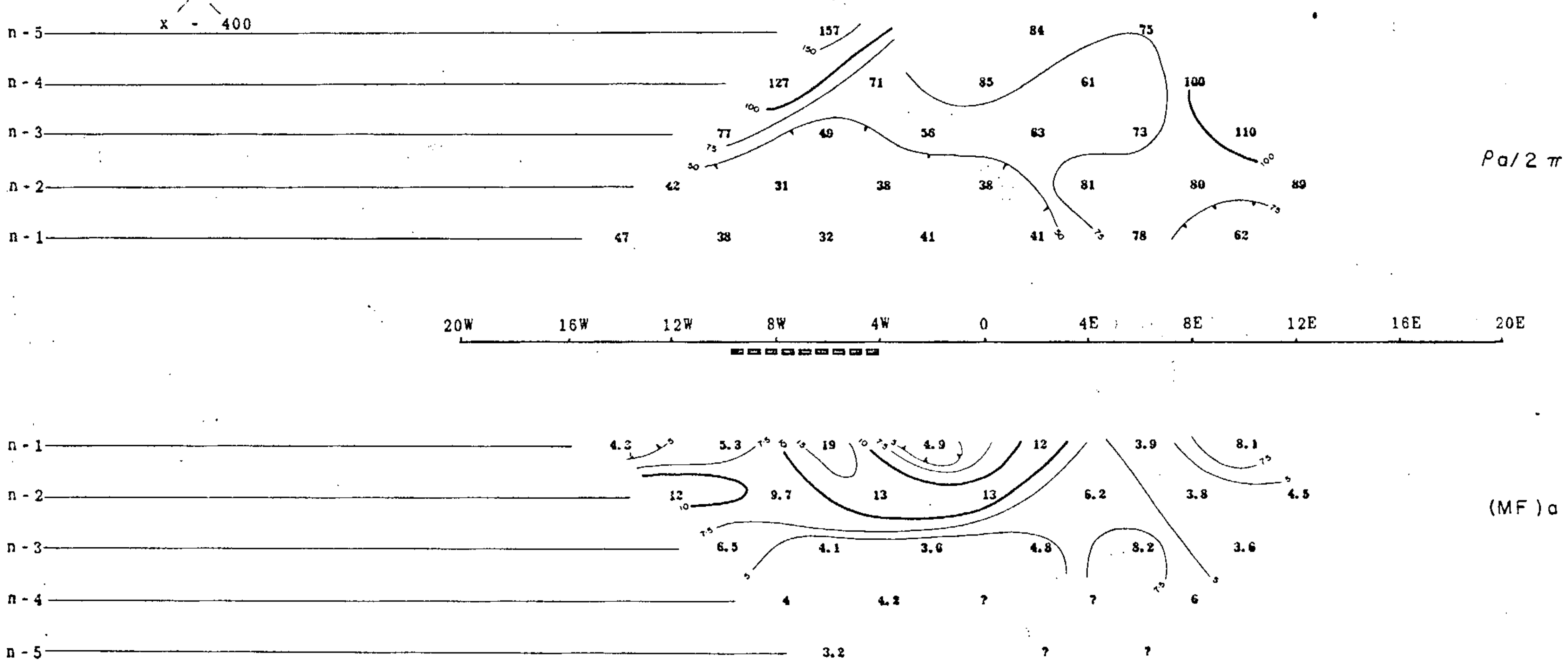
DATE Oct 30/62

DWG. NO.-I.P.-2936-3

McPHAR GEOPHYSICS LIMITED

INDUCED POLARIZATION AND RESISTIVITY SURVEY





LINE NO. 20 S

KENNCO EXPLORATIONS (CANADA) LIMITED

LOWER NELSON PROJECT, GRID NO. 2 — CROSS LAKE M.D. – MANITOBA.

Scale – One inch = 400 Feet

ANOMALOUS ZONE

POSSIBLE ANOMALOUS ZONE

NOTE
LOGARITHMIC CONTOUR INTERVAL

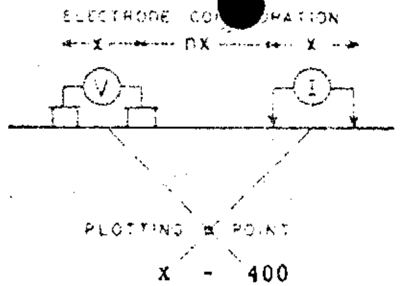
FREQUENCY .31–5 CPS

DATE SURVEYED SEPT. 1962

APPROVED RAB

DATE Oct 30/62

D.G. NO.-I.P.-2936-1



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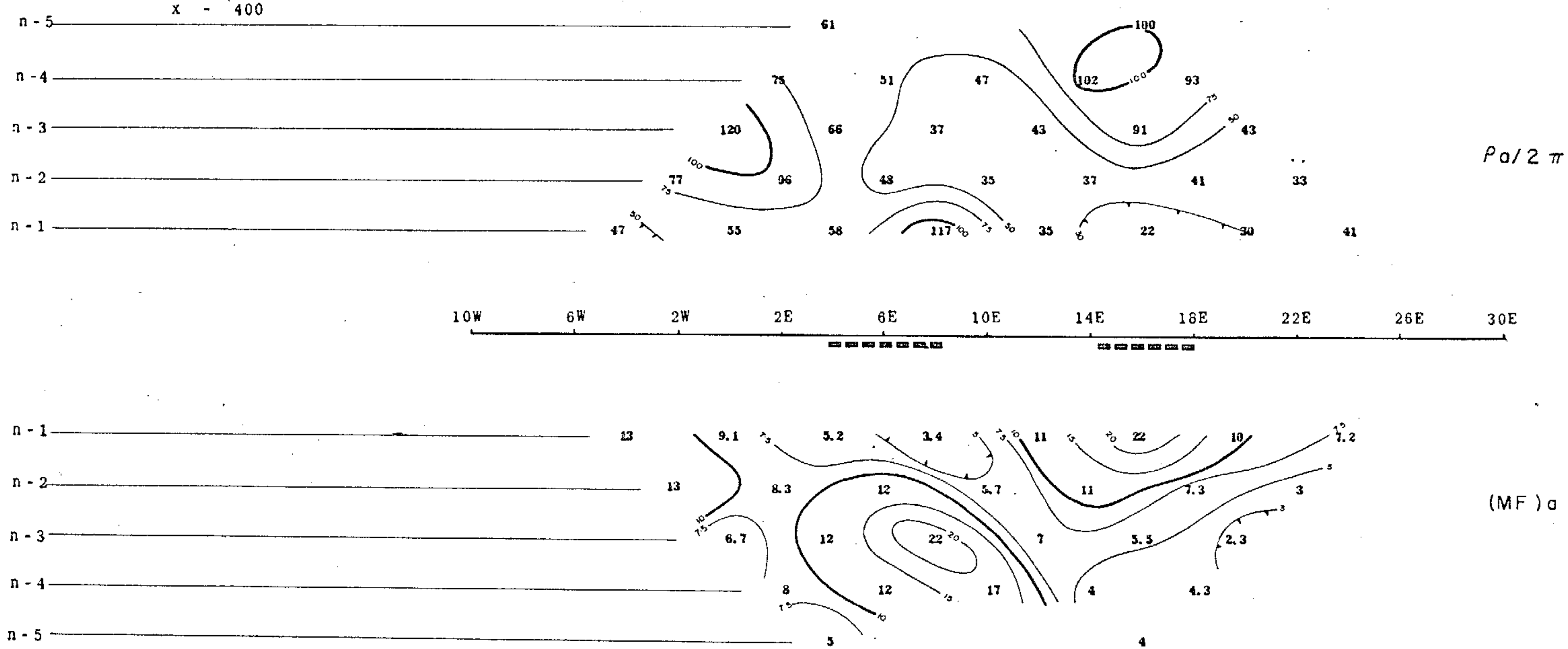
INDUCED POLARIZATION AND RESISTIVITY SURVEY



LINE NO. 20N

FREQUENCY .31 - 5 CPS

DATE SURVEYED SEPT. 1962

APPROVED RAB

DATE Oct 30/62

KENNCO EXPLORATIONS (CANADA) LIMITED

LOWER NELSON PROJECT, GRID NO. 2 — CROSS LAKE M.D. - MANITOBA.

Scale - One inch = 400 Feet

ANOMALOUS ZONE

POSSIBLE ANOMALOUS ZONE

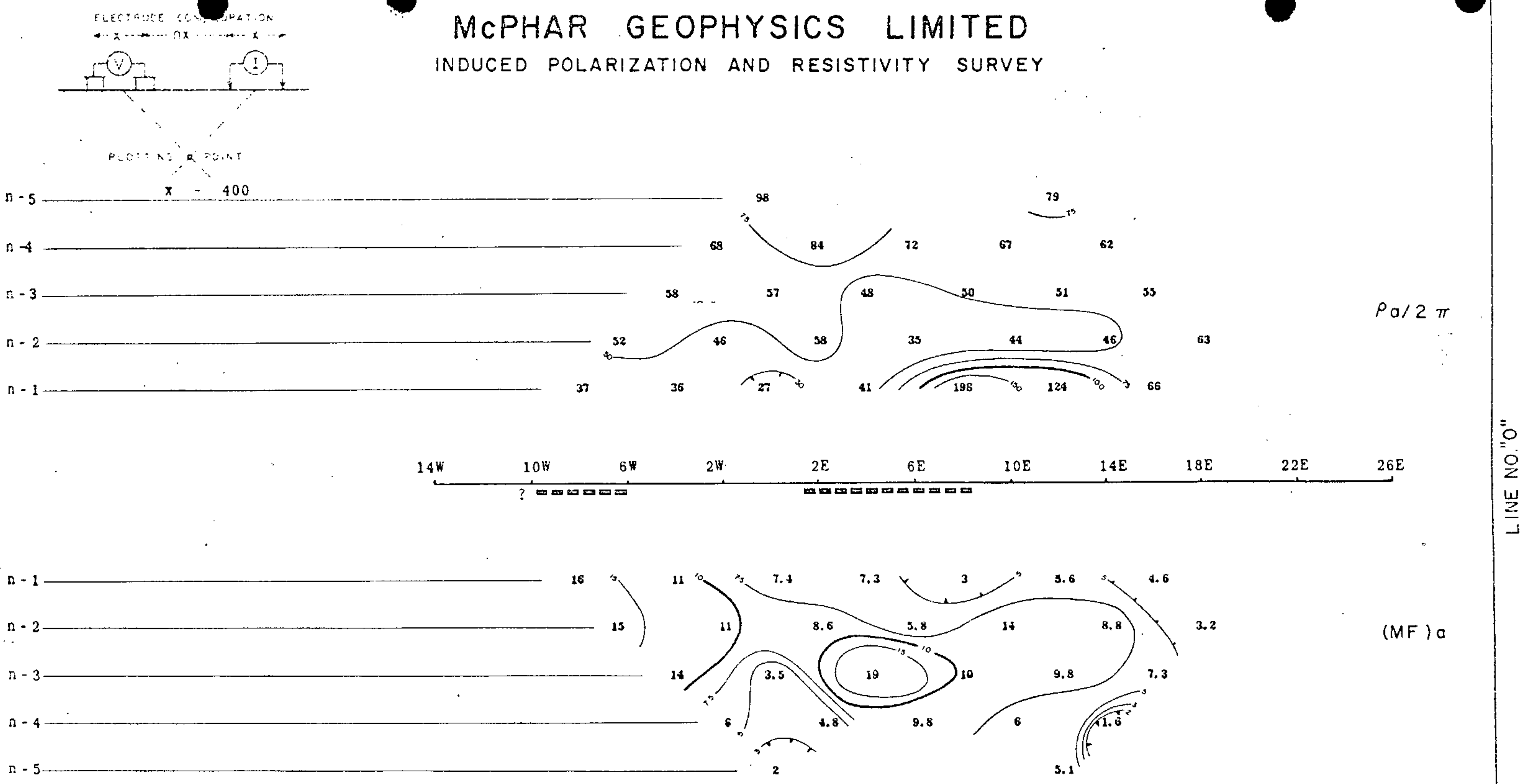
NOTE

LOGARITHMIC CONTOUR INTERVAL

DWG. NO.-I.P.-2936-2

McPHAR GEOPHYSICS LIMITED

INDUCED POLARIZATION AND RESISTIVITY SURVEY



KENNCO EXPLORATIONS (CANADA) LIMITED

LOWER NELSON PROJECT, GRID NO. 2 — CROSS LAKE M.D. – MANITOBA.

Scale – One inch = 400 Feet

ANOMALOUS ZONE
POSSIBLE ANOMALOUS ZONE
NOTE
LOGARITHMIC CONTOUR INTERVAL

FREQUENCY .31 – 5 CPS
DATE SURVEYED SEPT 1962
APPROVED RAB
DATE Oct 30/62