1139

REPORT ON
1967 INDUCED POLARIZATION SURVEY
BARRETT PROPERTY
HOUSTON AREA, BRITISH COLUMBIA
FOR
AMAX EXPLORATION INCORPORATED

BY

D.B. SUTHERLAND, M.A.

AND

PHILIP G. HALLOF, Ph.D.

NAME AND LOCATION OF PROPERTY:

BARRETT PROPERTY, HOUSTON AREA

OMINECA MINING DIVISION, B.C. 54°N, 126°W - SE

DATE STARTED: JUNE 16, 1967

DATE COMPLETED: AUGUST 22, 1967

RPT. 1139

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McPHAR GEOPHYSICS LIMITED

REPORT ON

1967 INDUCED POLARIZATION SURVEY

BARRETT PROPERTY

HOUSTON AREA, BRITISH COLUMBIA

FOR

AMAX EXPLORATION INCORPORATED

1. INTRODUCTION

At the request of Mr. W. W. Shaw, Geophysicist for the Company, an induced polarization survey has been carried out on part of the Barrett Property, in the Houston Area of British Columbia for Amax Exploration Incorporated. The property lies in the SW quadrant of the 1° quadrilateral whose SE corner is at 54°N, 126°W in the Omineca Mining Division.

Part of the property was previously surveyed with the induced polarization method and is the subject of a McPhar report dated November 3, 1966. The 1967 IP work was laid out to extend the surveying to the west and was done in two sorties, the first in June and the second in August.

2. GEOLOGY AND PREVIOUS WORK

In addition to the IP survey, previous work includes geological mapping, geochemical sampling and magnetometer surveying.

The Smith-Barrett molybdenum prospect occurs in a quartz feldspar stock that intrudes a thick succession of Hozelton volcanics. This intrusive is situated within a broad northeast trending belt of Tertiary acid stocks extending between the Coast Range and the Omineca batholiths.

Geological mapping indicates that the quartz feldspar plug measures 4,500 by 2,500 feet. The entire mass is highly argillized and impregnated with pyrite. Quartz veining near the eastern margin and the molybdenite appears to be intimately associated with this veining.

The geochemical results are not encouraging but glacial over-burden is reported to average 6 feet in depth over the intrusive. There is little relief on the magnetic map but the contours do support the NW-SE trend along the eastern part of the plug.

3. PRESENTATION OF RESULTS

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

Line	Dipole Length	Dwg. No.
0	600 feet	IP 2709-1
10N	300 feet	IP 2709-2
15N	300 feet	IP 2709-3
15N	600 feet	IP 2709-4
20N	300 feet	IP 2709-5
20W	300 feet	IP 2709-6

Enclosed with this report is Dwg. Misc. 3126R, a revised plan map of the area at a scale of 1" = 400'. The results of both the 1966 and the 1967 surveying are shown on this plan. 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 300' spreads the position of a narrow sulphide body can only be determined to lie between two stations 300' 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.

4. DISCUSSION OF RESULTS

Pyrite mineralization is widespread in the area and some IP effects are evident on almost all of the observations made on the property. The IP anomaly symbols have been used to illustrate the relative concentration of the widespread metallic material.

Line 0

The 1967 surveying on this line was carried out with a dipole interval of 600 feet. These results confirm the strong source between 5W and 12W and suggest that its strongest portion lies within a few hundred feet of the surface.

Between 36W and 42W the 1967 results suggest a complex source with as much as 300 feet to the top of its strongest portion near 40W and an indication that it improves with depth near 30W. These results are consistent with those obtained using a 300 foot electrode interval in 1966.

Line 10N

A 300 dipole interval has been used to extend this line to the west. The deep source of moderate metallic content that was previously traced from 12W to 24W appears to extend to about 42W.

Stronger IP effects, suggesting more concentrated metallics, at shallow depth extend from 46W to 50W. There is a definite increase in the metal factor values near 45W which suggest that the source plunges and improves to the east.

The contours near 54W may mark the western edge of the broad mineralized zone that extends at least as far east as the base line.

Line 15N

The 1967 data with 300 foot spreads show two concentrated portions on the western extension of Line 15N.

The first is centered near 34W and the contours suggest a depth of 100 to 200 feet to the top of its strongest portion.

A second deep source occurs between 40W and 46W. Here the indicated depth to the concentrated portion is between 300 and 400 feet. This estimate is confirmed by the 600 foot data which shows a depth of a half to one unit (i. e. 300 to 600 feet).

As on Line 10N, the broad source may terminate in the vicinity of 51W to 54W.

Line 20N

The IP effects on the western extension of this line are generally weaker than on the lines to the south.

Moderate indications of shallow sources extend from 33W to 36W and from 39W to 35W. These two sources may be connected at depth.

Weaker IP effects suggest area of lower metallic content both east and west.

Line 20W

This long traverse runs north-south and crosses all of the east-west lines that were surveyed in 1966. There is some anomalous IP response over the entire length of the line.

Three significantly stronger portions have been shown as definite anomalies. All of these are relatively shallow sources that appear to improve with depth.

The single high value near 25N may represent a narrow source of high metallic content but detailing with shorter electrodes would be required to confirm this interpretation.

5. SUMMARY AND RECOMMENDATIONS

Previous IP work had outlined a broad variable anomaly that covered the quartz porphyry stock and indicated that the mineralization continued farther west. The 1967 IP surveying shows that the anomalous material extends at least as far as 50W, north of Line 0. The results over this northwest portion are similar to those found over the plug itself. That is, they indicate a broad area of widespread mineralization that varies in concentration and depth of burial. Stronger IP effects in the vicinity of 34W and 45W on Line 10N. Line 15N and Line 20N suggest two bands of more concentrated metallics that trend N-S, but the character of the responses varies from line to line.

One long traverse, Line 20W, was run N-S through the area. It appears to be anomalous over its entire length (i. e. from 27S to 33N) and additional surveying both north and south would be required to determine the extent of the broad anomalous area.

The results obtained using 600 foot spreads on Line 0 and Line 15N confirm the anomalies and depth estimates obtained with the 300 foot data. Furthermore, they indicate that the strongest anomaly, centered near 7W on Line 0 lying within the plug, does not increase with depth. However, the anomalies near 38W on Line 0 and 45W on Line 15N, lie to the west of the mapped intrusive, and appear to improve with depth on the 600 foot data.

To summarize, the IP results to date have indicated an extensive area of widespread metallic material that varies appreciably in concentration and depth of burial. The east and west boundaries have been interpreted on several lines but the north and south limits have not been firmly established.

The resistivity values are unusually low and suggest a high degree of alteration and/or pyritization. There are many definite indications of increased metallic content and these appear to be aligned into N-S trending zones that occur both within the intrusive and to the west. There are also more concentrated sources to the south and west of the intrusive plug which may represent a pyritic halo surrounding it but additional data would be required to establish this continuity.

Most of the more concentrated sources appear to be located at some depth. This could be due to either overburden thickness or leaching. The most concentrated sources on the area surveyed occur near the following localities:- 8W on Line 0, 9W on Line 5S, 10W on Line 10N, 47W on Line 10N and 35W on Line 15N.

The area definitely warrants further investigations and drilling. However, since molybdenum deposits can occur either within zones of high metallic content or on the edges of pyritized areas, the details of the follow-up program will be finalized by Mr. W. W. Shaw who is in close liaison with the regional geologists.

McPHAR GEOPHYSICS LIMITED

D. B. Sutherland,
Geophysicist.

Philip G. Hallof,
Geophysicist.

Dated: September 6, 1967

ASSESSMENT DETAILS

PROPERTY: Barrett Project		MINING DIVISION: Omineca
SPONSOR: Amax Exploration Inc.		PROVINCE: British Columbia
LOCATION: Houston Area		
TYPE OF SURVEY: Induced Polarization		
OPERATING MAN DAYS:	27.5	DATE STARTED: June 16, 1967
EQUIVALENT 8 HR. MAN DAYS:	41.25	DATE FINISHED: August 22, 1967
CONSULTING MAN DAYS:	2	NUMBER OF STATIONS: 85
DRAUGHTING MAN DAYS:	3.5	NUMBER OF READINGS: 366
TOTAL MAN DAYS:	46.75	MILES OF LINE SURVEYED: 6.7

CONSULTANTS:

D.B. Sutherland, Apt. 2518, 47 Thorncliffe Park Drive, Toronto 17, Ontario.
P.G. Hallof, 5 Minorca Place, Don Mills, Ontario.

FIELD TECHNICIANS:

G. Trefananko, 651 Sheppard Avenue West, Toronto, Ontario.
T. Yeo, Box 355, Ft. Saskatchewan, Alberta.
3 helpers - supplied by client.

McPHAR GEOPHYSICS LIMITED

Dated: August 30, 1967

D.B. Sutherland,
Geophysicist.

SUMMARY OF COSTS

Houston Area - Amax Exploration Inc.

Crew

5-1/2 days	Operating	@ $195.00	1,072.50
4-1/2 days	Travel	@ $ 75.00	337.50
3 days	Standby	@ $ 75.00	225.00
			1,635.00

Estimated Expenses

Transportation	115.50	
Taxis	1.90	
Freight and Brokerage	69.50	
Meals and Accommodation	137.03	
Telephone and Telegraph	2.94	
Supplies	80.00	
		406.87
		$2,041.87

McPHAR GEOPHYSICS LIMITED

Dated: August 30, 1967

D. B. Sutherland,
Geophysicist.

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 South-western 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

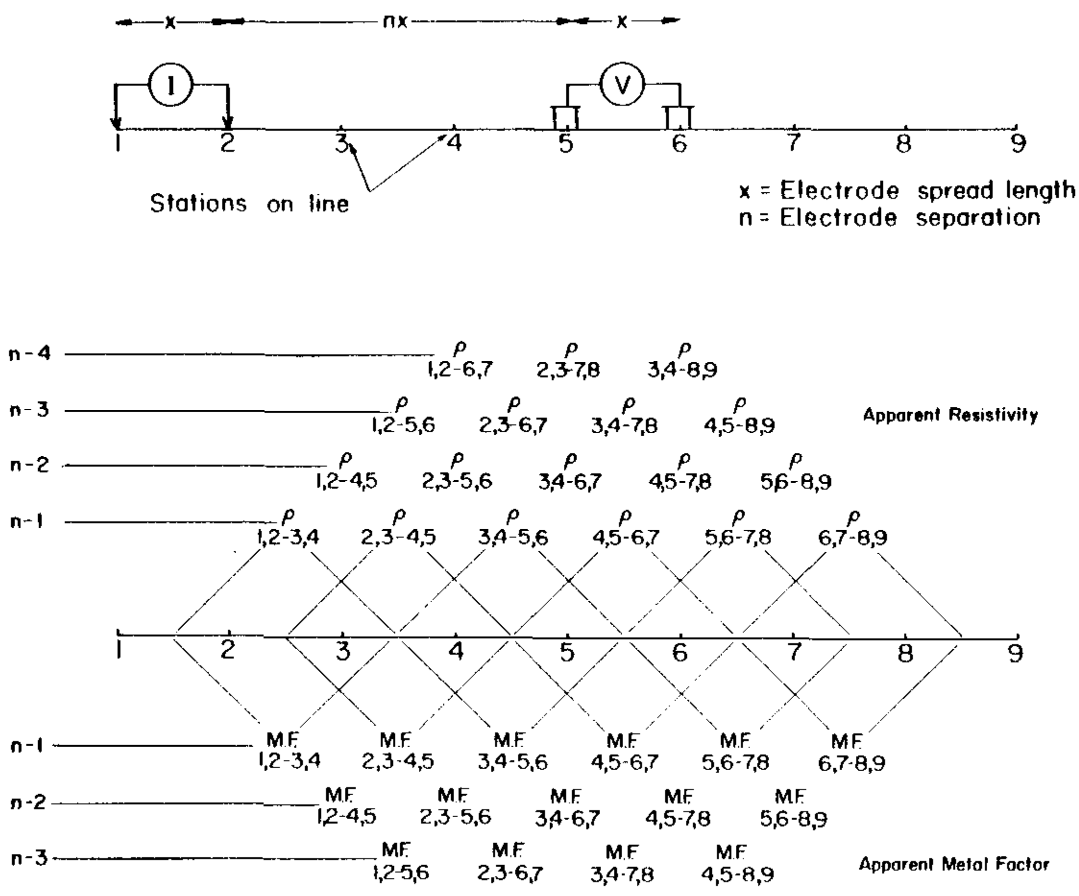

FIG. 1

CERTIFICATE

I, Don Benjamin Sutherland of the City of Toronto, Province of Ontario, do hereby certify that:

1. I am a geophysicist residing at 47 Thorncliffe Park Drive, Apartment 2518, Toronto 17, Ontario.

2. I am a graduate of the University of Toronto in Physics and Geology with the degree of Bachelor of Arts (1954); and a graduate of the University of Toronto in Physics with the degree of Master of Arts (1955).

3. I am a member of the Society of Exploration Geophysicists and a member of the European Association of Exploration Geophysicists.

4. I have been practising my profession for over eleven 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 Amax Exploration Incorporated 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 6th day of September 1967.

Don B. Sutherland, M.A.

CERTIFICATE

I, Philip George Hallof, of the City of Toronto, Province of Ontario, do hereby certify that:

1. I am a geophysicist residing at 5 Minorca Place, Don Mills, (Toronto) Ontario.

2. I am a graduate of the Massachusetts Institute of Technology with a B. Sc. Degree (1952) in Geology and Geophysics, and a Ph. D. Degree (1957) in Geophysics.

3. I am a member of the Society of Exploration Geophysicists and the European Association of the Exploration Geophysicists.

4. I have been practising my profession for ten 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 Amax Exploration Incorporated 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 6th day of September 1967.

Philip G. Hallof

Philip G. Hallof, Ph.D.

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DWG. NO.-I.P.- 2709-I

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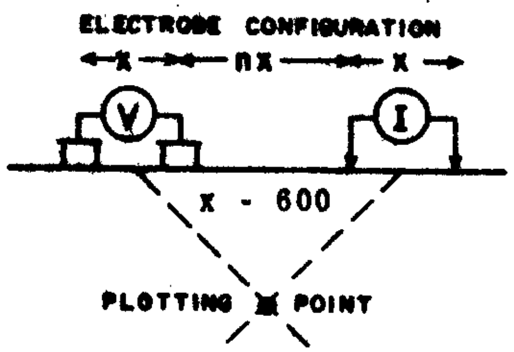
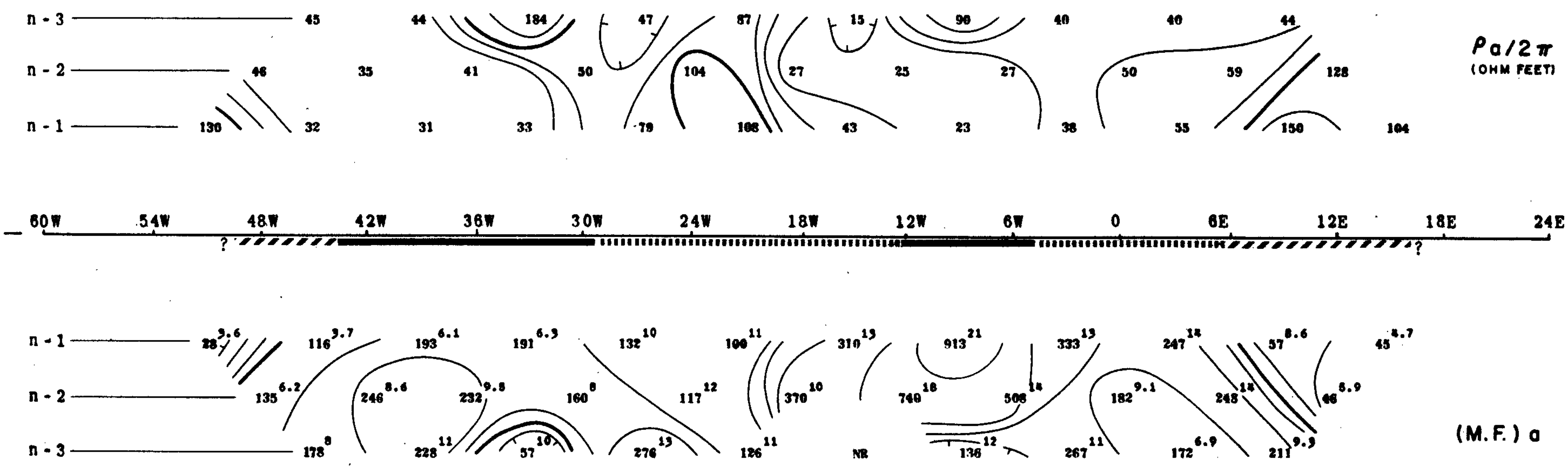
INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: CONTOURS AT LOGARITHMIC MULTIPLES OF 10-15-20-30-50-75-100





LINE NO.- 0

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

AMAX EXPLORATION, INC.

BARRETT PROPERTY, PROJECT 293, HOUSTON AREA - OMINECA M. D., B. C.

Scale - One inch = 600 Feet

NOTE: LOGARITHMIC CONTOUR INTERVAL

1139

FREQUENCY 0.31-5 C.P.S.

DATE SURVEYED JUNE, 1967

APPROVED

DATE 7/19/67

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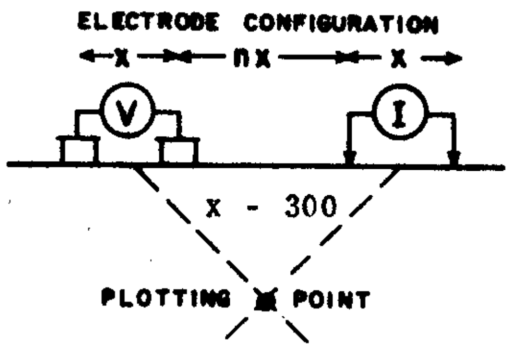
INDUCED POLARIZATION AND RESISTIVITY SURVEY



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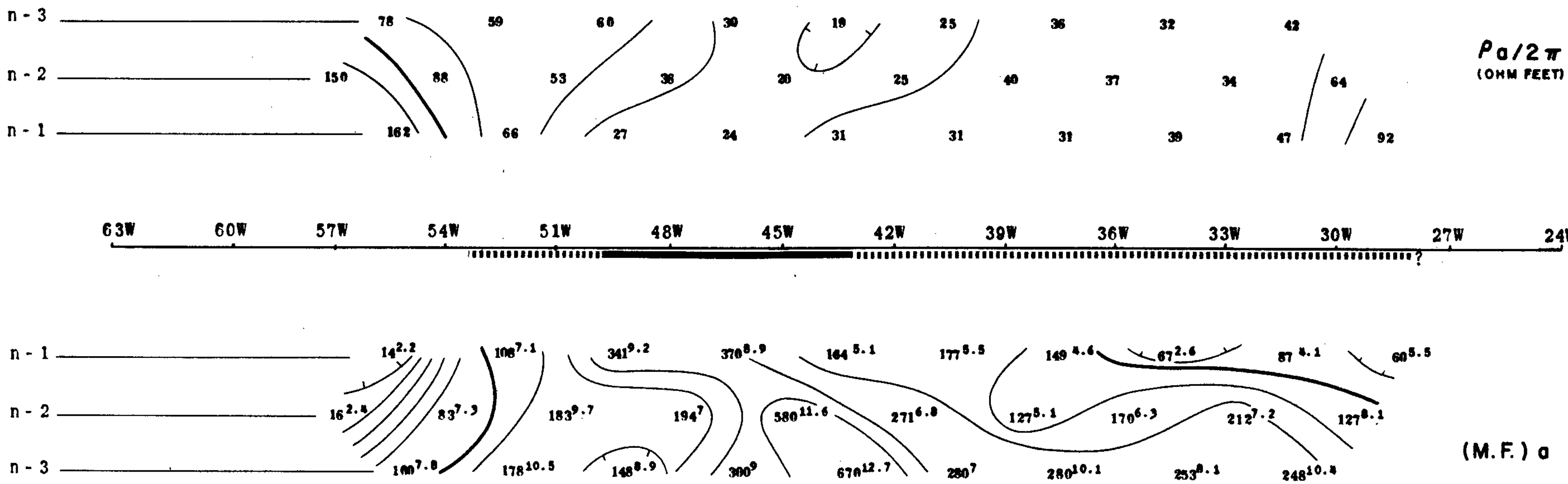

LINE NO.- 10 N

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

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AMAX EXPLORATION, INC.

BARRETT PROPERTY, PROJECT 293, HOUSTON AREA - OMINECA M. D., B. C.

Scale - One inch = 300 Feet

NOTE LOGARITHMIC CONTOUR INTERVAL

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FREQUENCY 0.31-5 C.P.S.

DATE SURVEYED JUNE, 1967

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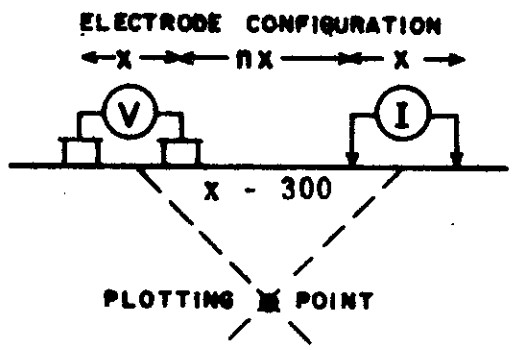
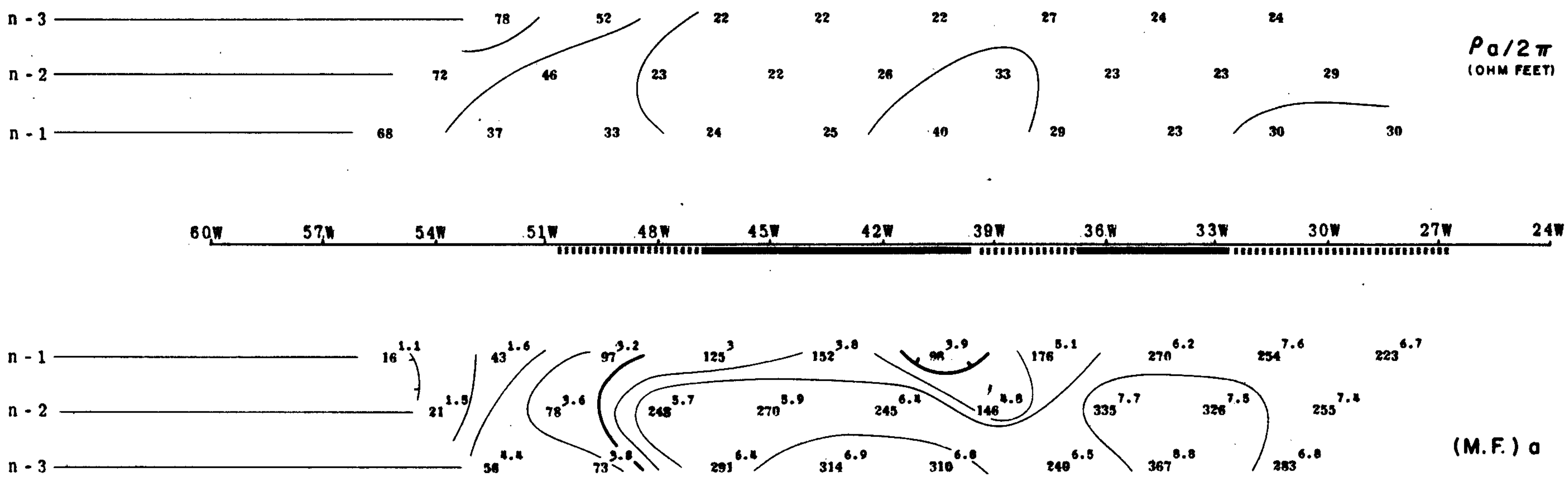
INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: CONTOURS AT LOGARITHMIC MULTIPLES OF 10-15-20-30-50-75-100





LINE NO.- 15N

SURFACE PROJECTION OF ANOMALOUS ZONES

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BARRETT PROPERTY, PROJECT 293, HOUSTON AREA - OMINECA M. D., B. C.

Scale - One inch = 300 Feet

NOTE LOGARITHMIC CONTOUR INTERVAL

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FREQUENCY 0.31-5 C.P.S.

DATE SURVEYED JUNE, 1967

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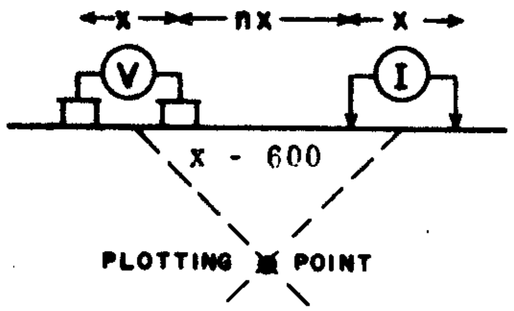
INDUCED POLARIZATION AND RESISTIVITY SURVEY

ELECTRODE CONFIGURATION



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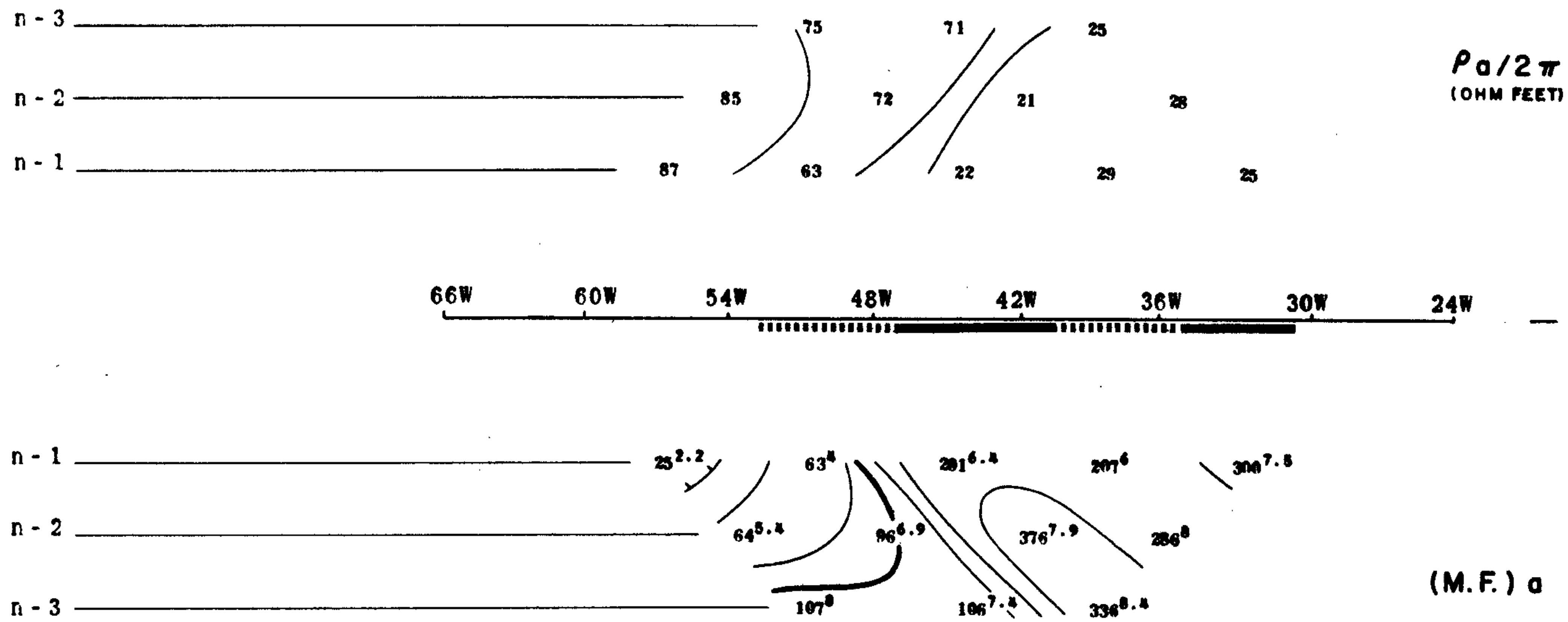

LINE NO.- 15 N

SURFACE PROJECTION OF ANOMALOUS ZONES

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BARRETT PROPERTY, PROJECT 293, HOUSTON AREA - OMINECA M. D., B. C.

Scale - One inch = 600 Feet

NOTE: LOGARITHMIC CONTOUR INTERVAL

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FREQUENCY 0.31 - 5 C.P.S.
DATE SURVEYED JUNE, 1967
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DATE 7/9/67

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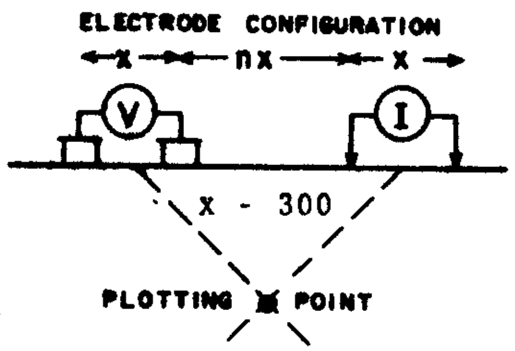
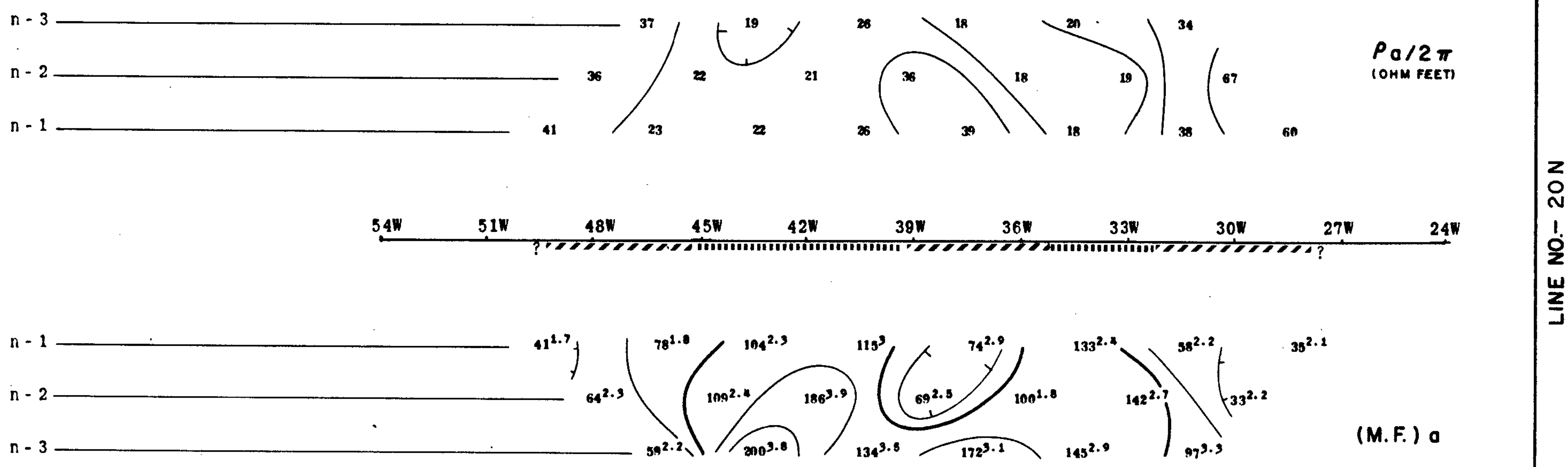
INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: CONTOURS AT LOGARITHMIC MULTIPLES OF 10-15-20-30-50-75-100





SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
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POSSIBLE

AMAX EXPLORATION, INC.

BARRETT PROPERTY, PROJECT 293, HOUSTON AREA - OMINECA M. D., B. C.

Scale – One inch = 300 Feet

NOTE: LOGARITHMIC CONTOUR INTERVAL

FREQUENCY 0.31 - 5 C. P. S.

DATE SURVEYED JUNE, 1967

APPROVED

DATE 7/9/67

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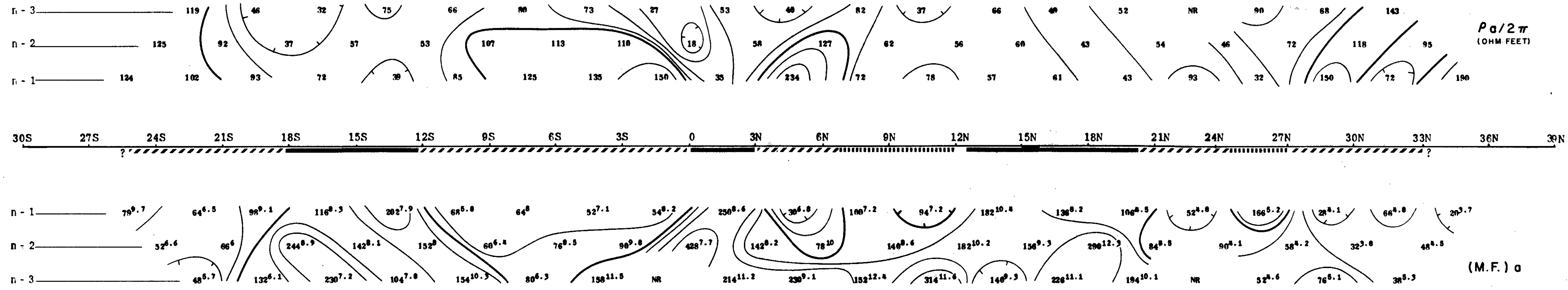
NOTE: CONTOURS AT LOGARITHMIC MULTIPLES OF 10-15-20-30-50-75-100

McPHAR GEOPHYSICS LIMITED

INDUCED POLARIZATION AND RESISTIVITY SURVEY



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

AMAX EXPLORATION, INC.

BARRETT PROPERTY, PROJECT 293, HOUSTON AREA - OMINECA M.D., B.C.

Scale-One inch= 300 Feet

NOTE LOGARITHMIC CONTOUR INTERVAL

1139

FREQUENCY 0.31-5 C.P.S.

DATE SURVEYED JUNE 1967

APPROVED

DATE

McPHAR GEOPHYSICS LIMITED

INDUCED POLARIZATION AND RESISTIVITY SURVEY

PLAN MAP

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

Number at the end of anomaly indicates spread used.

AMAX EXPLORATION, INC.

BARRETT PROPERTY, PROJECT 293, HOUSTON AREA - OMINECA M.D., B.C.

SCALE

ONE INCH EQUALS FOUR HUNDRED FEET

1966 I.P. SURVEY 30W 9E L-10N

1967 I.P. SURVEY 30W 9E L-10N

REVISED:

DATE: SEPT 1967

APPROVED:

DATE:

1139