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REPORT ON THE INDUCED POLARIZATION AND RESISTIVITY SURVEY ON THE WHIPSAW CLAIM GROUP, PRINCETON AREA, SIMILKAMEEN MINING DIVISION, B. C. FOR DOME EXPLORATION (CANADA) LIMITED

Optioned to Ameto Porcupine Mines Ltd from Texas Gulf Sulfur

BY

PHILIP G. HALLOF, PH. D.

NAME AND LOCATION OF PROPERTY:

WHIPSAW CLAIM GROUP, PRINCETON AREA,
SIMILKAMEEN MINING DIVISION, B. C. 49°N - 121°W

DATE STARTED - AUGUST 6, 1963

DATE COMPLETED - AUGUST 27, 1963

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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 graphite too, in effect is like a sulphide.

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

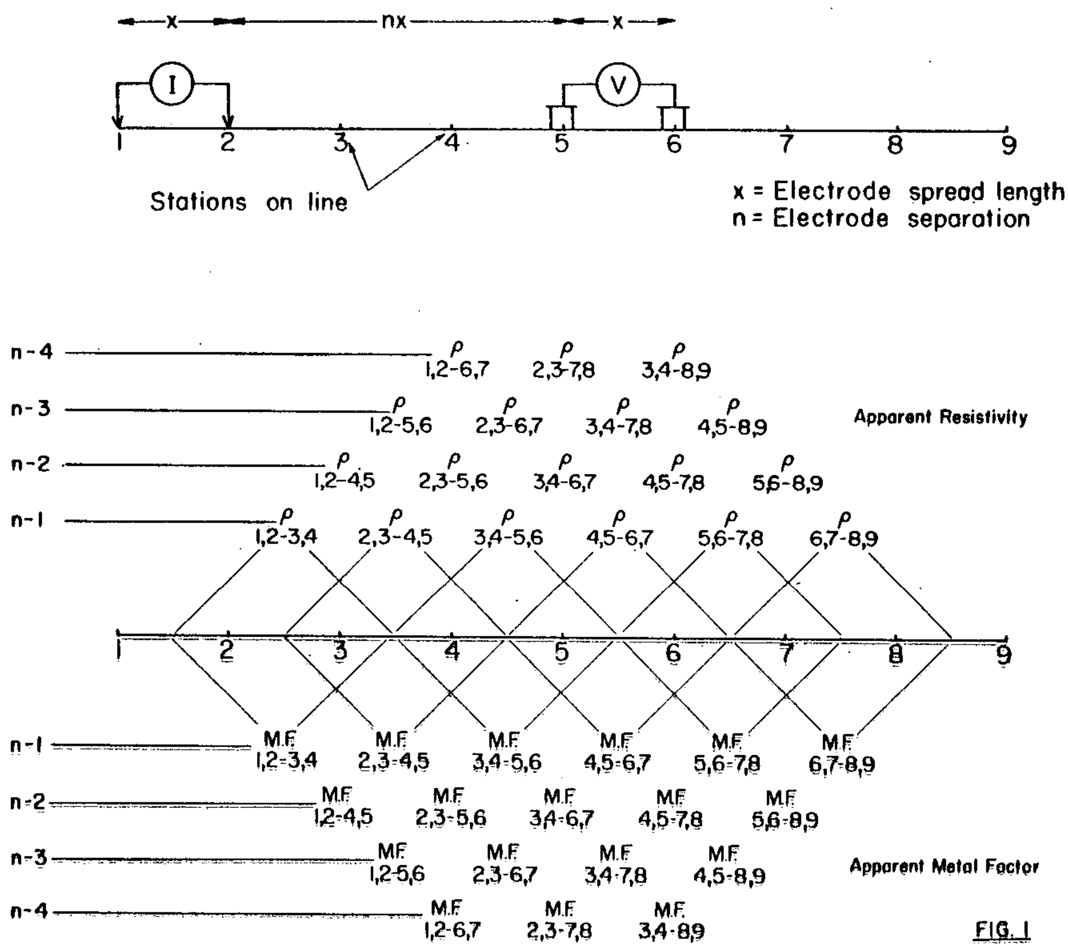

FIG. I

McPHAR GEOPHYSICS LIMITED

REPORT ON THE
INDUCED POLARIZATION
AND RESISTIVITY SURVEY
ON THE WHIPSAW CLAIM GROUP,
PRINCETON AREA,
SIMILKAMEEN MINING DIVISION, B.C.
FOR
DOME EXPLORATION (CANADA) LIMITED

1. INTRODUCTION

At the request of Dr. P. W. Richardson, geologist for the Company, an induced polarization and resistivity survey has been carried out on the Whipsaw Claim Group near Princeton, British Columbia. The property is located in the Similkameen Mining Division and is located in the southeast quadrant of the one degree quadrilateral whose southeast corner is at 49°N-121°W.

A previous report dated July 11, 1960 and entitled, "Report on the Geophysical Investigations of the Whipsaw Property, British Columbia for Texas Gulf Sulphur Co. Ltd.", describes the previous work done in the area. This preliminary survey was undertaken in an attempt to locate metallic mineralization that might be the source of the strong geochemical (copper) anomaly located on the property. A strong I. P. and E. M. anomaly indicated by this work was tested by two drill holes, and disseminated pyrite with some copper was intersected.

Subsequent study of the results indicated that the holes did not test the best part of the anomaly, and detailed geochemical investigations by the staff of Dome Explorations (Canada) Ltd. successfully located the source area of the high copper content of the soil. The I. P. measurements made during 1963 were planned to give detailed information concerning the sub-surface metallic mineralization in order to locate several drill holes that would determine the nature of the mineralization causing the strong I. P. anomaly in the vicinity of the source area of the copper in the soil.

2. PRESENTATION OF RESULTS

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

Line C-200N	200' Electrode intervals	Dwg. I. P. 2090-1
Line C	200' Electrode intervals	Dwg. I. P. 2090-2
Line B-800N	200' Electrode intervals	Dwg. I. P. 2090-3
Line B-600N	200' Electrode intervals	Dwg. I. P. 2090-4
Line B-400N	200' Electrode intervals	Dwg. I. P. 2090-5
Line B-200N	200' Electrode intervals	Dwg. I. P. 2090-6
	100' Electrode intervals	Dwg. I. P. 2090-7
Line B	200' Electrode intervals	Dwg. I. P. 2090-8
Line A-800N	200' Electrode intervals	Dwg. I. P. 2090-9

Enclosed with this report is Dwg. Misc. 2089, a plan map of the Whipsaw Grid. 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

Two of the lines surveyed during the preliminary survey were repeated during 1963 using the same electrode interval (200 feet) but shifting the electrode positions 100 feet. The results agree exactly, indicating strong, definite anomalies at depth.

Line C-200N

This line is 200' north of Line C, and the very strong anomaly located at 32W to 34W on that line, is somewhat weaker on Line C-200N.

The source is at depth on Line C-200N, and the pattern suggests that the line could be off the end of the zone of mineralization.

Line C

The results on this line are very similar to those from the previous data. There is a strong anomaly at depth at 32W to 34W, and a shallow, narrow anomaly at 36W to 38W.

Line B-800N

The two anomalies located on Line C are present on this line. The anomaly to the east is deeper and stronger than on Line C, and the shallow anomaly to the west is also of larger magnitude.

Line B-600N

The two anomalies are better separated and more definite on this line, than to the north. Both of the anomalies are of extremely large magnitude on this line.

Line B-400N

The results on this line are very similar to those on the lines to the north and south. The I. P. effects measured are very large in magnitude.

Line B-200N

The results using 200' Electrode intervals on this line are similar to those on the lines to the north. There is a strong anomaly at depth to the east (27W to 23W) and a shallow anomaly to the west (33W to 31W). The maximum I. P. effects measured are very large in magnitude.

The survey on this line was repeated using 100' electrode intervals in order to better define the shallow anomaly to the west. With the shoter spreads, the anomaly is well defined and centered at 31W to 30W. There is some depth indicated to the top of the source. There is also a broader zone of less anomalous I. P. effects west of the very strong I. P. anomaly, extending to 34W.

The 100' spread results have also outlined the upper part of the deeper anomaly to the east. The largest magnitude part of the anomaly is centered at 26W to 24W, with much lower magnitude effects extending to 21W. The results suggest a broad zone of disseminated mineralization from 21W to 34W with one spot where there is much less mineralization, and two locations where the mineralization is very concentrated.

Line B

The detailed results on this line indicate the same anomaly as the previous results, and the western extension clearly indicates the shallow anomaly. As to the north, there is a broad zone of lower magnitude anomaly.

Line A-800N

The large anomaly at depth is centered at 27W on this line, and is very definite. The shallow anomaly to the west is not separately detected, and has become part of the broad zone of less anomalous values. There is however, another anomaly of large magnitude indicated to the east. This source appears to be centered at 23W, and some depth to the top of the source is suggested. The source of this anomaly is narrower than the strong anomaly just to the west. This new anomaly to the east is at the right location to correlate with the strong, shallow, anomaly previously located at 24W to 22W on Line A.

4. CONCLUSIONS AND RECOMMENDATIONS

The two holes previously drilled on the Whipsaw Property to test the I. P. anomalies were a vertical hole at 24W on Line A and a hole drilled at -45°to the east from 26+50W on Line B. Both holes intersected disseminated pyrite with some copper. However, the position of both holes is such that they only tested the broad zone of lower magnitude I. P. effects. The mineralization intersected was just about what would be expected as the source of this broad, weaker anomaly.

Because of the very strong copper anomaly located by the geochemical survey, it is recommended that two holes be drilled to determine the nature of the mineralization causing the large magnitude I. P. anomalies. The two anomalous zones were well located by the 100 spread results on Line B-200N, and since the source for the geochemical anomaly is indicated to be at approximately 32W on Line B-200N, the following holes are recommended:

D. D. H. #1 collared at 32+50W on Line B-200N; drilled - 45°E for 450'

D. D. H. #2 collared at 23+00W on Line B-200N; drilled - 45°W for 700'

If these holes intersect mineralization of economic importance, further detailed I. P. work and drilling would be warranted.

McPHAR GEOPHYSICS LIMITED,

Philip G. Hallof,
Geophysicist.

Dated: September 6, 1963

ASSESSMENT DETAILS

PROPERTY: Whipsaw Grid		MINING DIVISION: Similkameen
SPONSOR: Dome Exploration(Canada) Ltd.		PROVINCE: British Columbia
LOCATION: Princeton, British Columbia		
TYPE OF SURVEY: Induced Polarization		
OPERATING MAN DAYS:	45.0	DATE STARTED: August 6, 1963
EQUIVALENT 8 HR. MAN DAYS:	67.5	DATE FINISHED: August 27, 1963
CONSULTING MAN DAYS:	2.0	NUMBER OF STATIONS: 177
DRAUGHTING MAN DAYS:	6.0	NUMBER OF READINGS: 888
TOTAL MAN DAYS:	75.5	MILES OF LINE SURVEYED: 5.85

CONSULTANTS:
Philip G. Hallof, 5 Minorca Place, Don Mills, Ontario.

FIELD TECHNICIANS:
P. Beuden, c/o Forest Ranger's School, Dorset, Ontario.

DRAUGHTSMEN:
F.R. Peer, 38 Torrens Avenue, Toronto 6, Ontario.
R. Martin, 107 Atlas Street, Toronto, Ontario.
D. Grant, 1987A Lawrence Avenue East, Scarborough, Ontario.
R. MacKenzie, 55 Shandon Drive, Scarborough, Ontario.

McPHAR GEOPHYSICS LIMITED

Philip G. Hallof,
Geophysicist.

Dated: September 6, 1963

SUMMARY OF COST

Dome Exploration (Canada) Limited

Crew

9 days Operating	@ $175.00/day	$1,575.00

Expenses

Airfare-Toronto-Vancouver-Toronto 1/2	$109.00	
Meals & Accommodation	87.29	
Travel Taxi etc.	2.50	
Telephone & Telegraph	5.55	
Supplies	9.20	
Gas	20.39	
Misc.	2.00	235.93
		$1,810.93

McPHAR GEOPHYSICS LIMITED

Philip G. Hallof

Philip G. Hallof,
Geophysicist.

Dated: September 6, 1963

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. S. 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 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, direct or indirect, in the property or securities of Dome Exploration (Canada) Limited.

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

Dated at Toronto

This 6th day of September 1963

Philip G. Hallof

Philip G. Hallof, Ph. D.

DWG. NO.-I.P.- 2090-1

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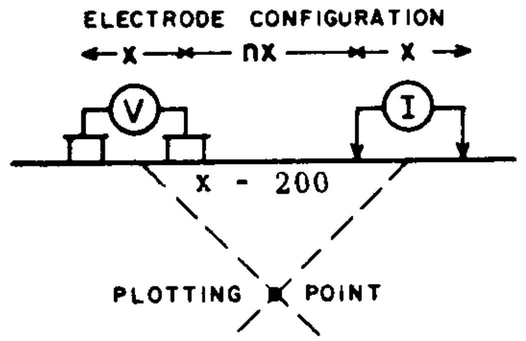
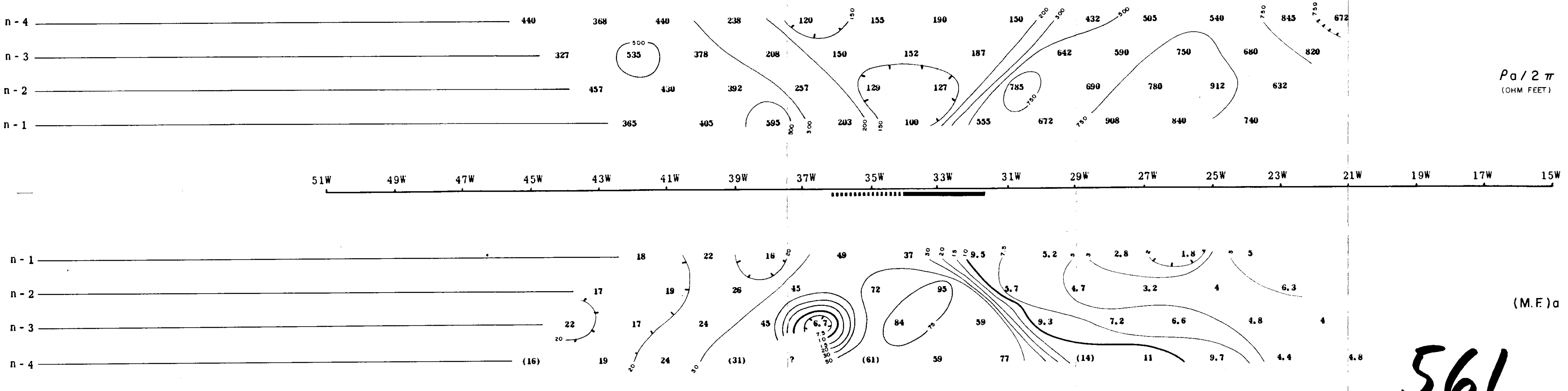
INDUCED POLARIZATION AND RESISTIVITY SURVEY



M1

LINE NO.-C-200N.



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FREQUENCY .31 - 5 C.P.S.

DATE SURVEYED AUG. 1963

APPROVED [signature]

DATE 9/3/63

DOME EXPLORATION (CANADA) LIMITED

WHIPSAW GRID — PRINCETON AREA, SIMILKAMEEN M.D.-B.C.

Scale-One inch = 200 Feet

ANOMALOUS ZONE

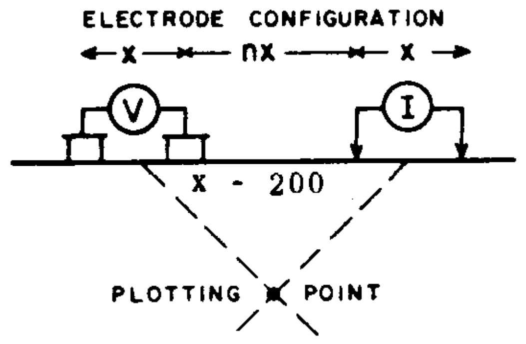
POSSIBLE ANOMALOUS ZONE

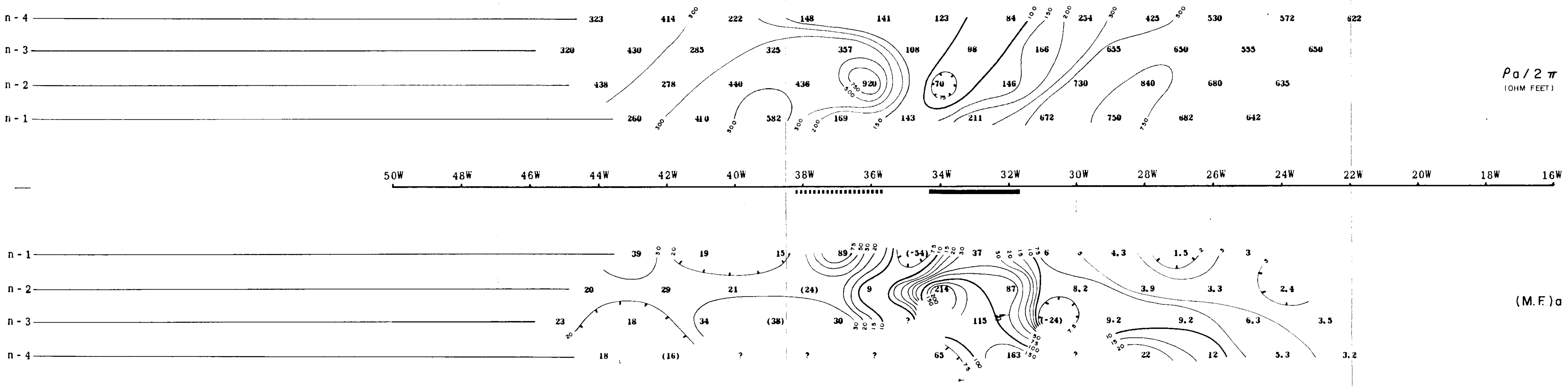
NOTE
LOGARITHMIC CONTOUR INTERVAL

DWG. NO.-I.P.-2090-2

McPHAR GEOPHYSICS LIMITED

INDUCED POLARIZATION AND RESISTIVITY SURVEY





LINE NO.-C

DOME EXPLORATION (CANADA) LIMITED

WHIPSAW GRID — PRINCETON AREA, SIMILKAMEEN M.D.-B.C.

Scale-One inch = 200 Feet

ANOMALOUS ZONE ———

POSSIBLE ANOMALOUS ZONE — — —

NOTE
LOGARITHMIC CONTOUR INTERVAL

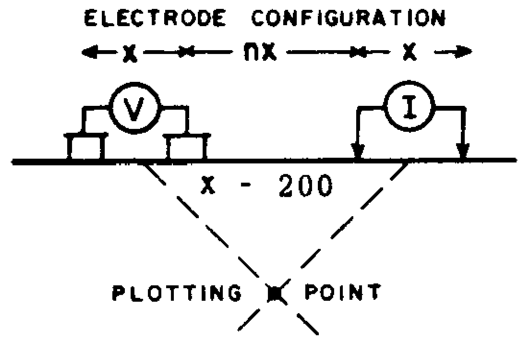
FREQUENCY .31 - 5 C.P.S.

DATE SURVEYED AUG. 1963

APPROVED PH

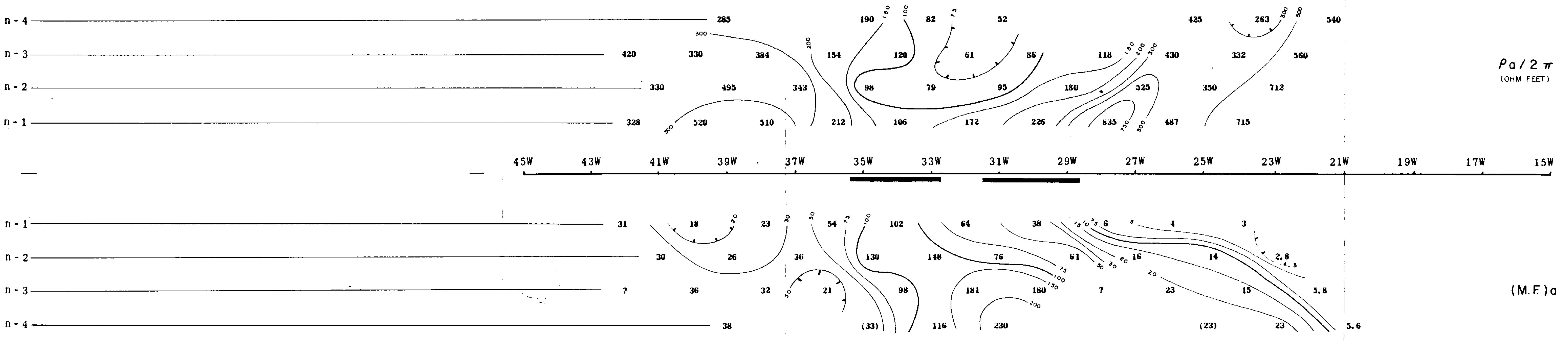
DATE 9/3/63

DWG. NO.-I.P.-2090-3



McPHAR GEOPHYSICS LIMITED

INDUCED POLARIZATION AND RESISTIVITY SURVEY



DOME EXPLORATION (CANADA) LIMITED

WHIPSAW GRID — PRINCETON AREA, SIMILKAMEEN M.D.-B.C.

Scale-One inch=200 Feet

ANOMALOUS ZONE

POSSIBLE ANOMALOUS ZONE

NOTE
LOGARITHMIC CONTOUR INTERVAL

FREQUENCY ·31 - 5 C.P.S.

DATE SURVEYED AUG 1963

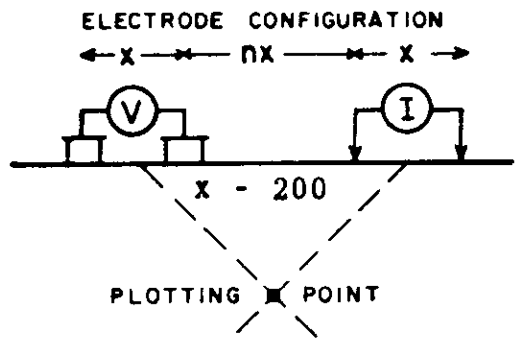
APPROVED [signature]

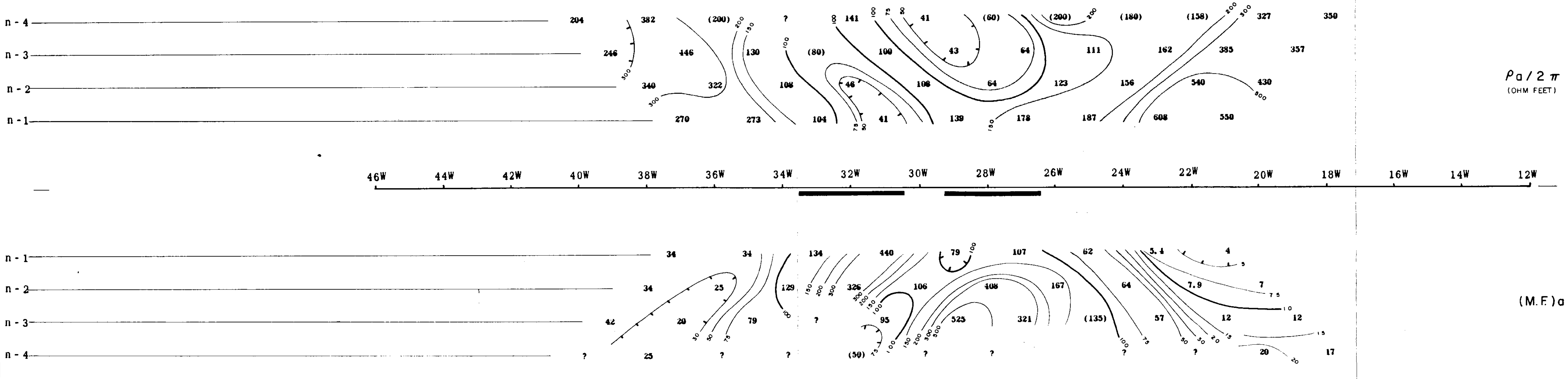
DATE 9/3/63

DWG. NO.-I.P.-2090-4

McPHAR GEOPHYSICS LIMITED

INDUCED POLARIZATION AND RESISTIVITY SURVEY





LINE NO.- B-600N

DOME EXPLORATION (CANADA) LIMITED

WHIPSAW GRID — PRINCETON AREA, SIMILKAMEEN M.D.-B.C.

Scale-One inch=200 Feet

ANOMALOUS ZONE

POSSIBLE ANOMALOUS ZONE

NOTE
LOGARITHMIC CONTOUR INTERVAL

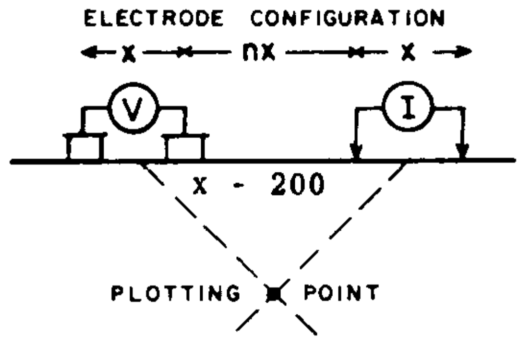
FREQUENCY .31-5 C.P.S.

DATE SURVEYED AUG 1963

APPROVED [signature]

DATE 9/3/63

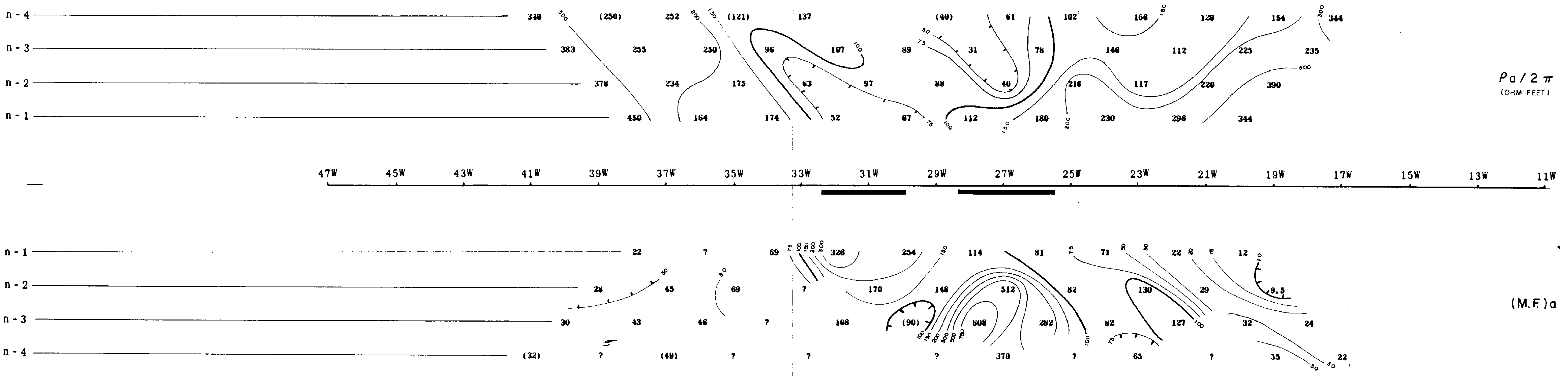
DWG. NO.-I.P.-2090-5



McPHAR GEOPHYSICS LIMITED

INDUCED POLARIZATION AND RESISTIVITY SURVEY

MS



LINE NO.- B-400N.

DOME EXPLORATION (CANADA) LIMITED

WHIPSAW GRID — PRINCETON AREA, SIMILKAMEEN M.D.-B.C.

Scale-One inch=200 Feet

ANOMALOUS ZONE
POSSIBLE ANOMALOUS ZONE
NOTE
LOGARITHMIC CONTOUR INTERVAL

FREQUENCY .31 - 5 C.P.S.
DATE SURVEYED AUG. 1963
APPROVED P.H.
DATE 9/3/63

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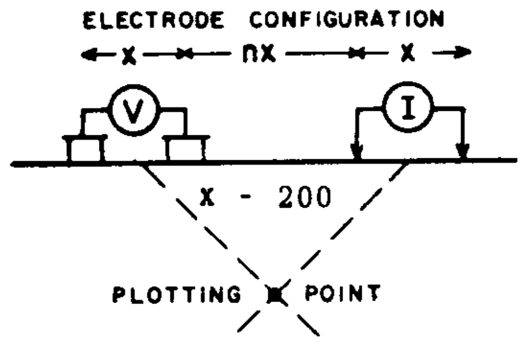
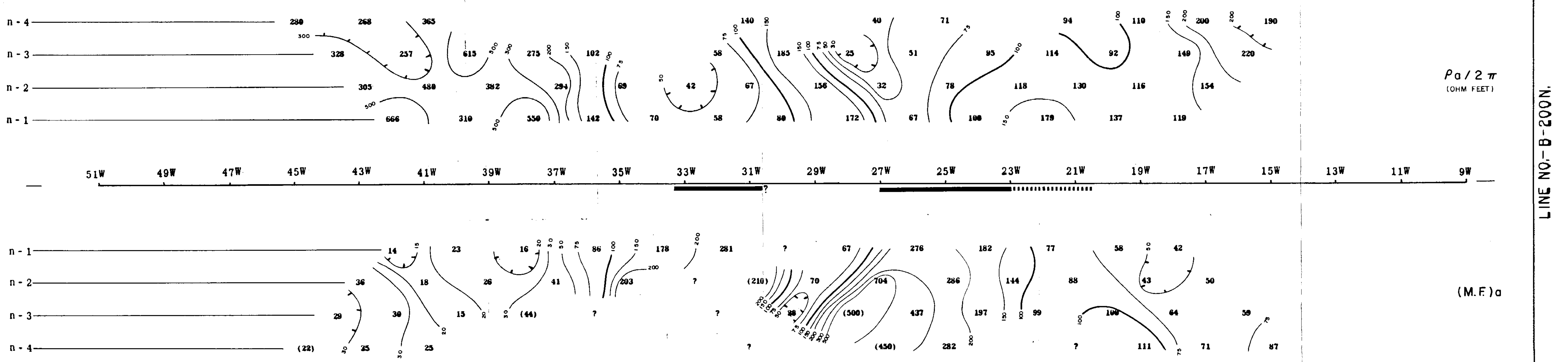
INDUCED POLARIZATION AND RESISTIVITY SURVEY





ANOMALOUS ZONE

POSSIBLE ANOMALOUS ZONE

NOTE
LOGARITHMIC CONTOUR INTERVAL

DOME EXPLORATION (CANADA) LIMITED

WHIPSAW GRID — PRINCETON AREA, SIMILKAMEEN M.D.-B.C.

Scale-One inch=200 Feet

FREQUENCY .31 - 5 C.P.S.

DATE SURVEYED AUG. 1963

APPROVED

DATE 9/3/63

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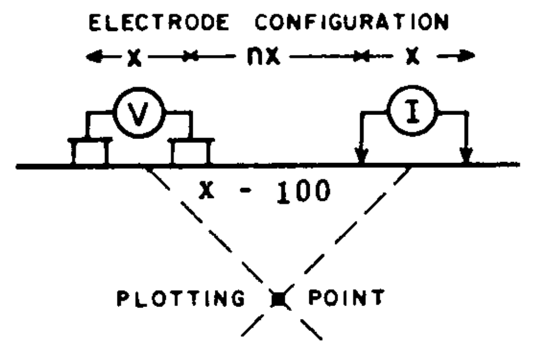


McPHAR GEOPHYSICS LIMITED

INDUCED POLARIZATION AND RESISTIVITY SURVEY

ANOMALOUS ZONE
POSSIBLE ANOMALOUS ZONE
NOTE
LOGARITHMIC CONTOUR INTERVAL

DOME EXPLORATION (CANADA) LIMITED

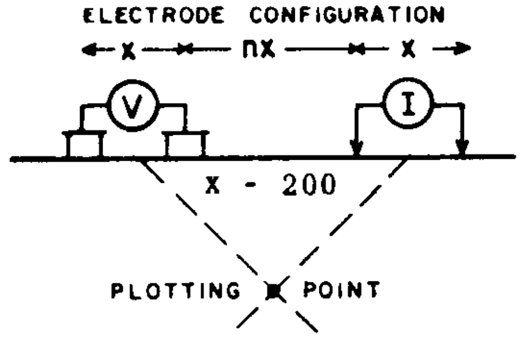
WHIPSAW GRID — PRINCETON AREA, SIMILKAMEEN M.D.-B.C.

Scale-One inch=100 Feet

FREQUENCY .31 - 5 C.P.S.
DATE SURVEYED AUG. 1963
APPROVED P.
DATE 9/3/63

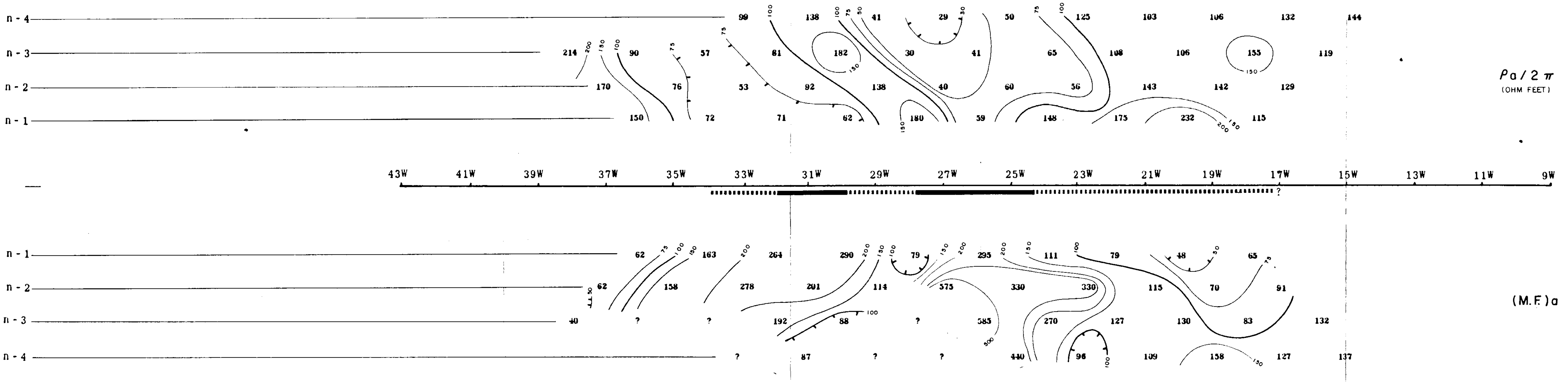
DWG. NO.-I.P.-2090-8

(M8)



McPHAR GEOPHYSICS LIMITED

INDUCED POLARIZATION AND RESISTIVITY SURVEY



LINE NO.- B

ANOMALOUS ZONE
POSSIBLE ANOMALOUS ZONE
NOTE
LOGARITHMIC CONTOUR INTERVAL

DOME EXPLORATION (CANADA) LIMITED

WHIPSAW GRID — PRINCETON AREA, SIMILKAMEEN M.D.-B.C.

Scale-One inch=200 Feet

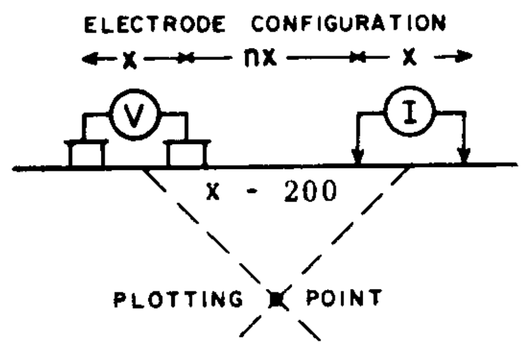
FREQUENCY .31 - 5 C.P.S.
DATE SURVEYED AUG. 1963
APPROVED [signature]
DATE 9/3/63

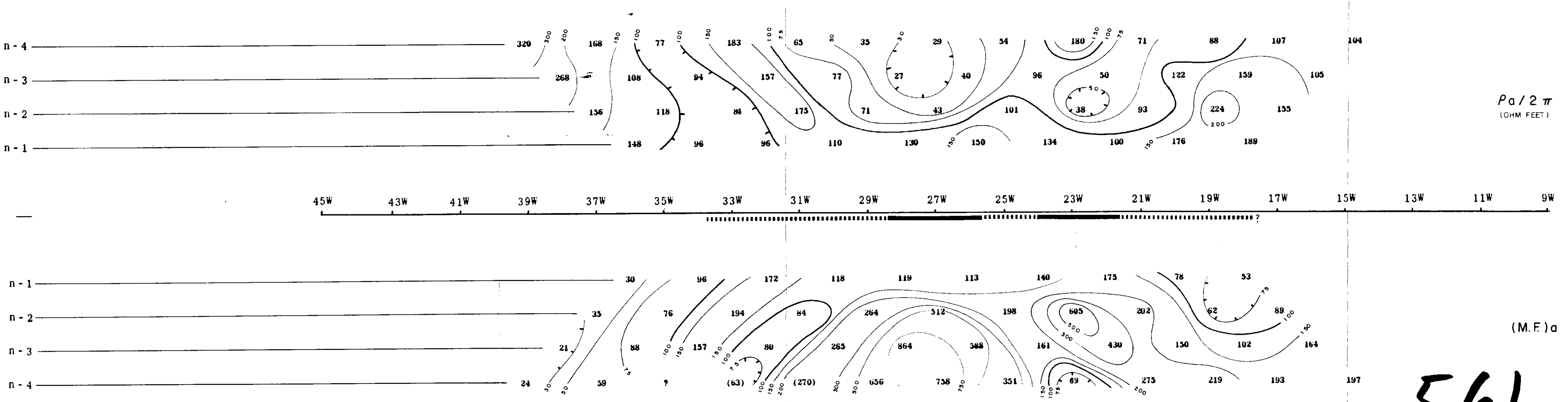
DWG. NO.-I.P.-2090-9

McPHAR GEOPHYSICS LIMITED

INDUCED POLARIZATION AND RESISTIVITY SURVEY

M9





LINE NO.- A-800 N.

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DOME EXPLORATION (CANADA) LIMITED

WHIPSAW GRID — PRINCETON AREA, SIMILKAMEEN M.D.-B.C.

Scale-One inch = 200 Feet

ANOMALOUS ZONE

POSSIBLE ANOMALOUS ZONE

NOTE
LOGARITHMIC CONTOUR INTERVAL

FREQUENCY .31 - 5 C.P.S.

DATE SURVEYED AUG. 1963

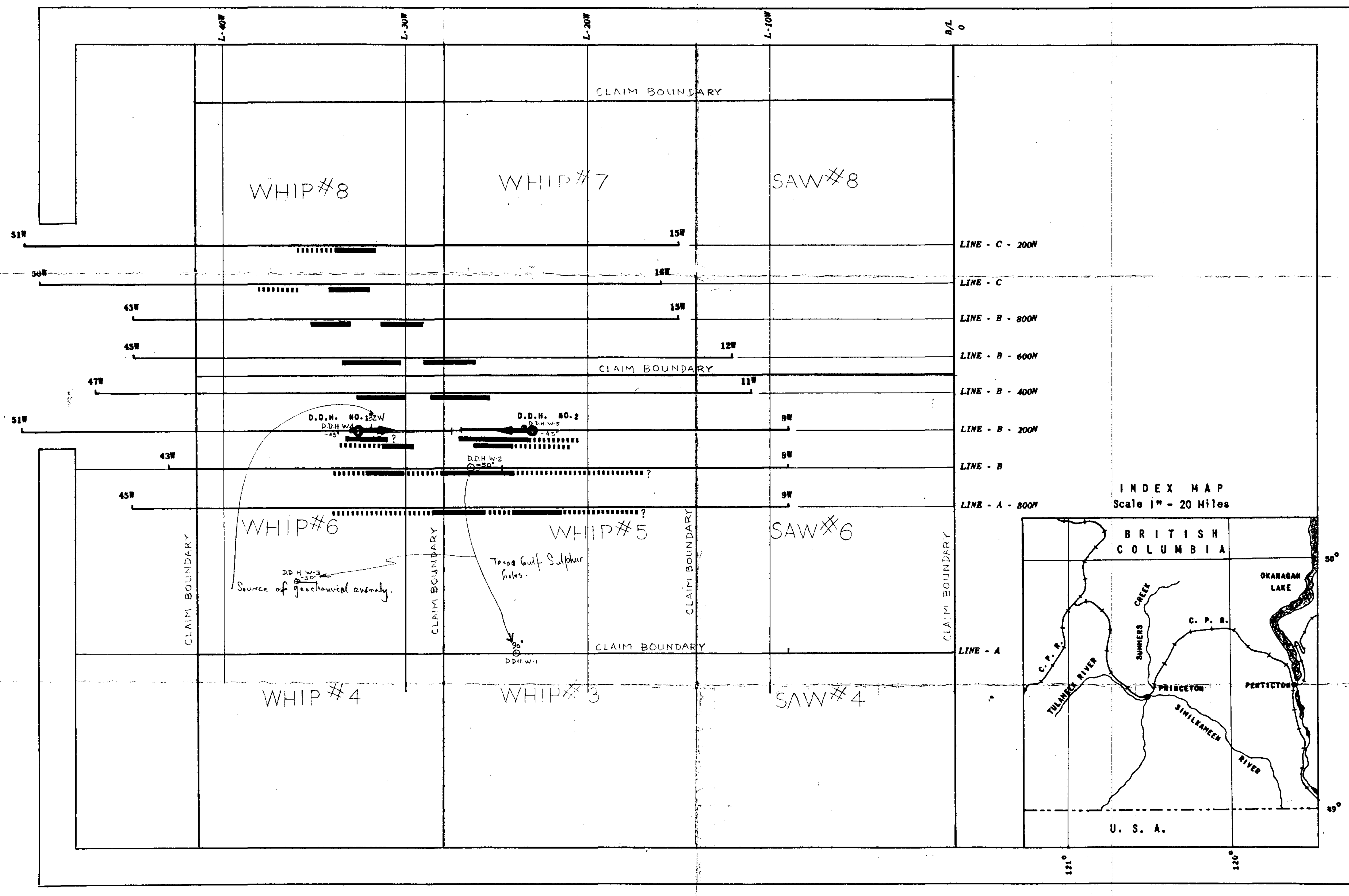
APPROVED [signature]

DATE 9/3/63

McPHAR GEOPHYSICS LIMITED

INDUCED POLARIZATION AND RESISTIVITY SURVEY

LOCATION MAP



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ANOMALOUS ZONE ▬▬▬

POSSIBLE ANOMALOUS ZONE ▪▪▪▪▪▪▪

DIAMOND DRILL HOLE

DOME EXPLORATION (CANADA) LIMITED

WHIPSAW GRID — PRINCETON AREA, SIMILKAMEEN M.D.-B.C.

SCALE

400 200 0 400 800 1200 1600 2000 FEET

One Inch = Four Hundred Feet

TO ACCOMPANY GEOPHYSICAL REPORT BY PHILIP G. HALLOF, Ph. D., ON THE WHIPSAW GRID, PRINCETON AREA, SIMILKAMEEN MINING DIVISION, BRITISH COLUMBIA.

DATED: SEPTEMBER 6th, 1963.

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