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REPORT ON THE INDUCED POLARIZATION AND RESISTIVITY SURVEY ON THE REISETER CLAIMS OMINECA MINING DIVISION, B.C. FOR CHANNEL COPPER MINES LTD. (N.P.L.)

BY

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

AND

PHILIP G. HALLOF, Ph.D.

~~NAME AND LOCATION OF PROPERTY:~~

REISETER CLAIMS, B.C.

OMINECA MINING DIVISION, B.C. 54°57' N - 127°09' W

DATE STARTED: AUGUST 23, 1973

DATE FINISHED: SEPTEMBER 14, 1973

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REPORT ON THE INDUCED POLARIZATION AND RESISTIVITY SURVEY ON THE REISETER CLAIMS OMINECA MINING DIVISION, B.C. FOR CHANNEL COPPER MINES LTD. (N.P.L.)

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1. INTRODUCTION

An Induced Polarization and Resistivity survey has been carried out on the Reiseter Claims for Channel Copper Mines Ltd. The property is located on the east side of the Bulkley Valley, about 9 miles north of Smithers. The geographic centre of the property is located at 54°57' north latitude and 127°09' west longitude.

Access to the property is via the old Telkwa - Morice road which leaves Highway #16 on the east side of the Bulkley River at Smithers. A bush road leaves east off the main road just south of Reiseter Creek.

The geology of the Reiseter Claim area is discussed in a report prepared by Kerr, Dawson and Associates Ltd. for Channel Copper Mines Ltd., dated July 19, 1973.

Antimony, lead, zinc, copper, molybdenum and silver mineralization occurs in veinlets and fractures within a well altered sedimentary series of the Haselton Group. Acidic intrusives occur both to the north and to the southeast of the altered sediments. Two small stocks of granodiorite intrude the sediments within the IP survey grid. Based on the extensive hornfelsic alteration of the sediments, the granodiorite is postulated to occur at a shallow depth beneath a sedimentary capping.

A soil geochemical survey located a well defined molybdenum anomaly trending ENE across the survey grid. Copper values in the soil were generally low and do not correlate with the anomalous molybdenum values.

The IP survey was carried out during the period August 27 to September 14, 1973. A McPhar P-660 frequency-domain IP system operating at 0.3 and 5.0 Hz was used for the survey.

2. CLAIMS

The property consists of 24 claims described as follows:

Claim Name	Record No.	Expiry Date
Reiseter #1	64846	Nov. 12, 1975
Reiseter #2	64847	Nov. 12, 1975
Reiseter #3	13799	June 23, 1975
Reiseter #4	13800	June 23, 1975
Reiseter #5	11934	Oct. 28, 1975
Reiseter #6	11935	Oct. 28, 1975
Reiseter #7	12622	June 19, 1975
Reiseter #8	12623	June 19, 1975

Claim Name	Record No.	Expiry Date
Reiseter #9	64848	Nov. 12, 1975
Reiseter #10	64849	Nov. 12, 1975
Reiseter #11	83582	Dec. 5, 1975
Reiseter #12	83583	Dec. 5, 1975
Reiseter #13	106507	Jan. 28, 1974
Reiseter #14	106508	Jan. 28, 1974
Reiseter #15	106509	Jan. 28, 1974
Reiseter #16	106510	Jan. 28, 1974
Reiseter #17	106511	Jan. 28, 1974
Reiseter #18	106512	Jan. 28, 1974
Reiseter #19	106513	Jan. 28, 1974
Reiseter #20	106514	Jan. 28, 1974
Reiseter #21	106515	Jan. 28, 1974
Reiseter #22	106516	Jan. 28, 1974
Reiseter #23	106517	Jan. 28, 1974
Reiseter #24	106518	Jan. 28, 1974

The claims are held under an option agreement by Channel Copper Mines Ltd., N.P.L.

3. PRESENTATION OF RESULTS

The Induced Polarization and Resistivity survey results are shown on the following data plots in the manner described in the notes preceding this report.

Line	Electrode Interval	Dwg. No.
4400W	300 feet	IP 6102-1
3600W	300 feet	IP 6102-2
2800W	300 feet	IP 6102-3
2800W	100 feet	IP 6102-4
2400W	300 feet	IP 6102-5
2000W	300 feet	IP 6102-6
1600W	300 feet	IP 6102-7
1600W	100 feet	IP 6102-8
1200W	300 feet	IP 6102-9
800W	300 feet	IP 6102-10
400W	300 feet	IP 6102-11
0+00	300 feet	IP 6102-12

Also enclosed with this report is Dwg. I.P.P. 4917, a plan map of the Reiseter Claim Grid at a scale of 1" = 200'. 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 300' electrode intervals the position of a narrow sulphide body can only be determined to lie between two stations 300' apart. In order to definitely locate, and fully evaluate, a narrow, shallow source it is necessary to use shorter 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 claim and grid information shown on Dwg. I.P.P. 4917 has been taken from maps made available by the consultant to Channel Copper Mines Ltd., Dr. W.R. Bacon.

4. DISCUSSION OF RESULTS

The IP survey was conducted using the dipole-dipole electrode array, 300 foot electrode intervals and the expanding electrode technique to three separations, i.e. N = 1, 2 and 3. Lines 1600W and 2800W were later detailed with 100 foot dipoles and 4 separations, N = 1, 2, 3 and 4.

Relatively high resistivities were measured both within the IP anomalies and elsewhere on the survey grid. This would be expected with hornfelsic alteration as described in the Kerr, Dawson geological report.

An anomalous east-west striking IP zone which straddles the base-line was outlined by the survey. A description of the IP survey results on each line follows:

Line 4400W - Dwg. IP 6102-1

This line was surveyed to investigate the vicinity of an anomalous molybdenum geochemical sample at the north end of the original grid at 10N. Because of a cliff at 15N it proved impossible to obtain sufficient data to adequately explore this area. There were no anomalous effects recorded elsewhere on the line.

Line 3600W - Dwg. IP 6102-2

A probable, shallow IP anomaly was located between 0 and 3N. It may extend both north and south as shown on the plan map. The anomaly straddles a narrow vein containing pyrite and stibnite.

Line 2800W - Dwg. IP 6102-3 and 4

A well-defined IP anomaly of moderate magnitude was located between 3S and 6N, and it may extend further to the north. It appears shallow relative to the 300' dipoles. This line was subsequently detailed with 100 foot dipoles and the anomaly was much better defined.

The detail survey shows a possible IP anomaly extending south from 2S to beyond 3S. A gap in the anomaly is centred at 1+50S. A well-defined anomaly was outlined from 0 to 4N. It may continue further to the north but would be too deep for the 100 foot dipoles to detect.

Two vertical diamond drill holes are suggested to investigate this zone with the collars at 1N and 3N. The holes should be drilled to 400 feet.

Line 2400W - Dwg. IP 6102-5

A definite IP anomaly was located on this line. The pattern suggests two possible interpretations. The most likely interpretation is a dipping tabular source centred at 1+50N as shown on the IP data profile. The second possibility is for two sources. Detailing with shorter spreads would resolve these possibilities.

A possible IP anomaly from 9N to 12N is open to the north.

Line 2000W - Dwg. IP 6102-6

A moderately deep, probable IP anomaly was located between 3S and 3N and probably continues north with increasing depth to at least 9N.

Line 1600W - Dwgs. IP 6102-7 and 8

The reconnaissance 300 foot IP data located two anomalous zones. The southern anomaly is apparently south of the main east-west zone. Moderate depth to the source is indicated by the data. It may correlate with the southern portion of the anomaly on Line 1200W. It correlates with a minor increase of both copper and molybdenum values in the soil.

The northern anomaly is part of the major east-west zone. The weak IP effects appear shallow between 0 and 3N and apparently deepen to the north. Detailing with 100 foot dipoles shows a well-defined IP anomaly with moderate depth indicated to the source. The depth is estimated at 50 - 100 feet. A 400 foot vertical drill hole collared at 1N is recommended to further investigate this anomaly.

An increase in resistivities centred at 5+50S may be a reflection of the southernmost instrusive plug.

Line 1200W - Dwg. IP 6102-9

Anomalous IP effects were recorded between 9S and 6N. In detail the anomaly is probable from 9S to 6S, possible from 6S to 3S, definite from 3S to 0, probable from 0 to 3N and possible from 3N to 6N.

Line 800W - Dwg. IP 6102-10

A well-defined anomaly was located between 3S and 0. This area is underlain by outcroppings of altered granodiorite. Probable anomaly extensions at depth to 6S and 6N are suggested at both ends.

Line 400W - Dwg. IP 6102-11

An IP anomaly occurs between 9S and 9N. A definite deep source is centred at 6N; the remainder is possible to probable.

Line 0+00 - Dwg. 6102-12

The anomalous IP effects are much weaker on Line 0+00 suggesting a possible end to the E-W striking zone. A moderately deep probable anomaly is centred at 6N. It could be an " off the end effect ".

5. SUMMARY AND RECOMMENDATIONS

A well-defined anomalous zone displaying generally weak IP effects has been located roughly straddling the base line. This anomaly shows reasonable correspondence with an anomalous molybdenum geochemical zone. The low but ubiquitous pyrite content of the sedimentary rocks, as described in the Kerr-Dawson report, undoubtedly contributes to the magnitude of the IP effects. However, the IP anomaly exists as a well-defined zone within a much larger area of sediments.

Most of the IP effects appear shallow with some tendency to deepen on the flanks. With 300 foot dipoles, this would suggest depths to the source of 100 feet or less. Wherever there is some indication of depth, the letter "D" has been placed over the appropriate portion of the anomaly.

The IP anomaly, because of its correlation with both the anomalous molybdenum geochemical zone and the favourable geological environment, warrantes further investigation. Three drill holes have been recommended to test the main zone on Lines 1600W and 2800W. Any further drilling or geophysical surveying will depend largely on the results obtained from these preliminary holes.

Collar locations are as follows:

Drill Hole #1 - collar located at 1+00N, Line 1600W
drill vertical hole to 400 foot depth

Drill Hole #2 - collar located at 1+00N, Line 2800W
drill vertical hole to 400 foot depth

Drill Hole #3 - collar located at 3+00N, Line 2800W
drill vertical hole to 400 foot depth.

McPHAR GEOPHYSICS COMPANY

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
A. W. MULLAN

Ashton W. Mullan,
Geologist

Philip G. Hallof,
Geophysicist

Dated: November 1, 1973

ASSESSMENT DETAILS

PROPERTY: Reiseter Claims

MINING DIVISION: Omineca

SPONSOR: Channel Copper Mines Ltd. (N.P.L.)

PROVINCE: British Columbia

LOCATION: Smithers Area

TYPE OF SURVEY: Induced Polarization

OPERATING MAN DAYS:	24	DATE STARTED:	August 23, 1973
EQUIVALENT 8 HR. MAN DAYS:	36	DATE FINISHED:	September 14, 1973
CONSULTING MAN DAYS:	3	NUMBER OF STATIONS:	126
DRAUGHTING MAN DAYS:	5	NUMBER OF READINGS:	843
TOTAL MAN DAYS:	44	MILES OF LINE SURVEYED:	5.56

CONSULTANTS:

Ashton W. Mullan, 1440 Sandhurst Place, West Vancouver, B.C.
Philip G. Hallof, 15 Barnwood Court, Don Mills, Ontario.

FIELD TECHNICIANS:

A. Wilcox, R.R.#3, 12761 Sodom Road, Niagara Falls, Ontario.
K. Hoeberg, 602 Windsor Street, Kamloops, B.C.
Plus Extra Labour:
R. Bateson, R.R.#1, Smithers, B.C.
M. Johnson, Box 2782, Smithers, B.C.

DRAUGHTSMEN:

B. Boden, 103 Petworth Crescent, Agincourt, Ontario.
V. Young, 64 Highcourt Crescent, Scarborough, Ontario.

McPHAR GEOPHYSICS COMPANY

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

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
A. W. MULLAN

Dated: November 1, 1973

STATEMENT OF COST

Channel Copper Mines Ltd. (N.P.L.)
Reiseter Claims

Crews:- A. Wilcox - K. Hoeberg

5.56 line miles surveyed	$3,295.00
1 day line cutting	420.00
	$3,715.00

Breakdown of above:

5 days Operating		@ $300.78/day	$1,503.90
1 day Operating detail		@ $420.00/day	420.00
1 day line cutting		@ $420.00/day	420.00
2 days Preparation)			
1½ days Bad Weather)	4½ days	@ $100.00/day	450.00
1 day Standby)			
½ day Breakdown			N.C.

Expenses

Fares		35.33	
Vehicle expense		27.29	
Supplies		58.93	
Telephone & Telegraph		3.30	
Meals & Accommodation		581.57	
		706.42	
+ 10%		70.64	
			777.06
Extra Labour	120.00		
+ 20%	24.00		
			144.00
			$3,714.96

McPHAR GEOPHYSICS COMPANY

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

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

Dated: November 1, 19 3

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 Suite 811, 837 West Hastings Street, Vancouver, B.C.

2. That I am registered as a member of the Association of Professional Engineets of the Provinces 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 Channel Copper Mines Ltd., (N.P.L.) 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 1st day of November 1973

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

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA A. W. MULLAN

CERTIFICATE

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

1. I am a geophysicist residing at 15 Barnwood Court, Don Mills, 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 am a Professional Geophysicist, registered in the Province of Ontario, the Province of British Columbia and the State of Arizona.

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 Channel Copper Mines Ltd., or any affiliate.

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

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Dated at Toronto

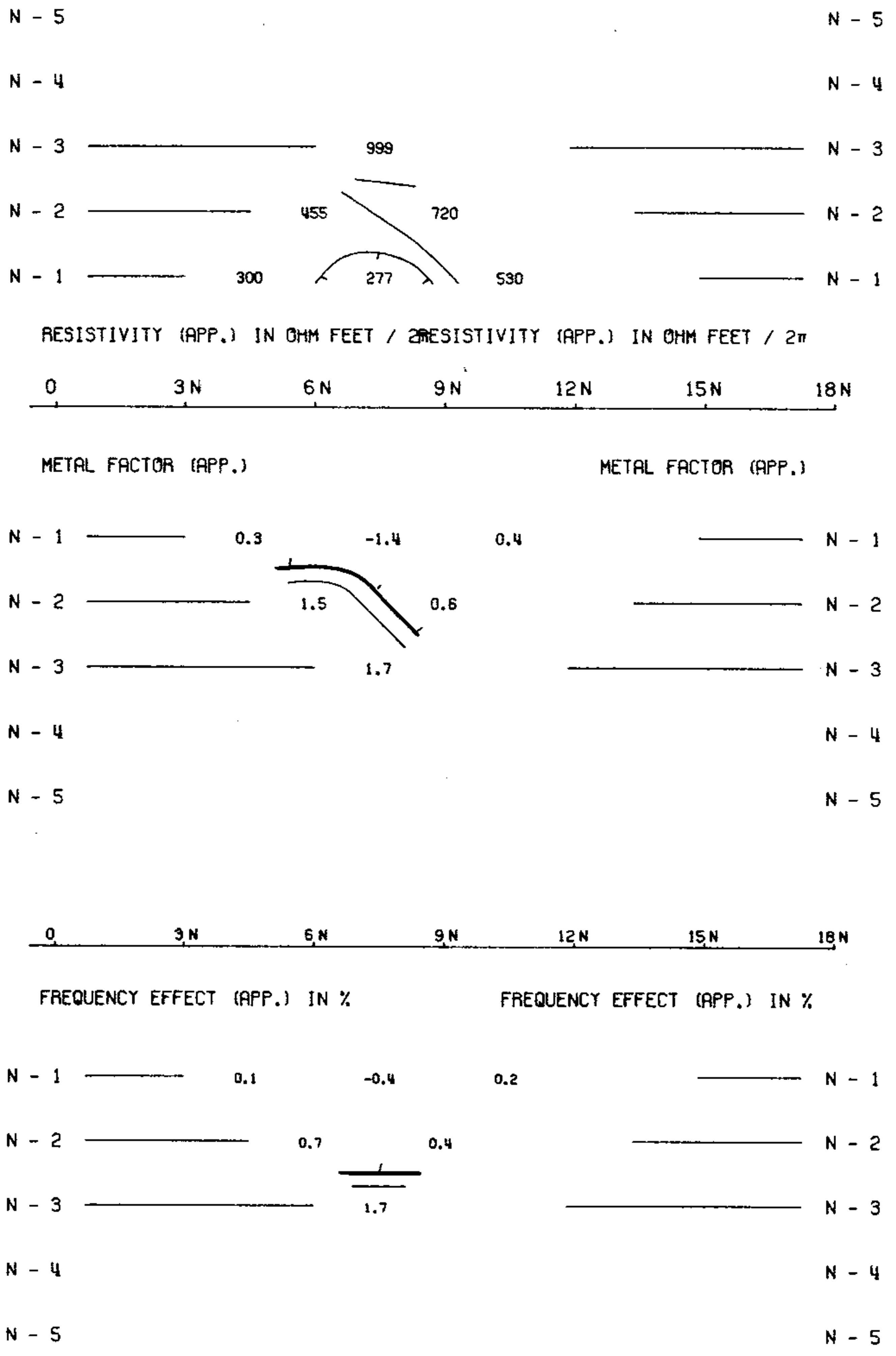
This 1st day of November 1973

Philip G. Hallof, Ph.D.

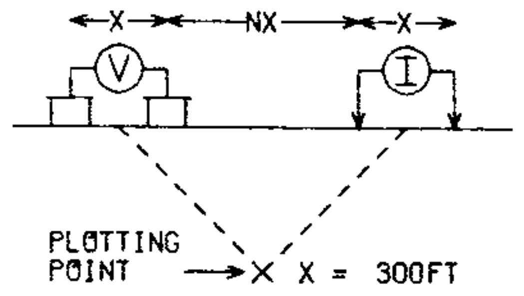
DWG. NO.- I.P.-6102-1

CHANNEL COPPER MINES LTD. (N.P.L.)

REISETER CLAIMS, OMINECA M.D., B.C.



LINE NO.- 4400W



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: SEP 1973

APPROVED:

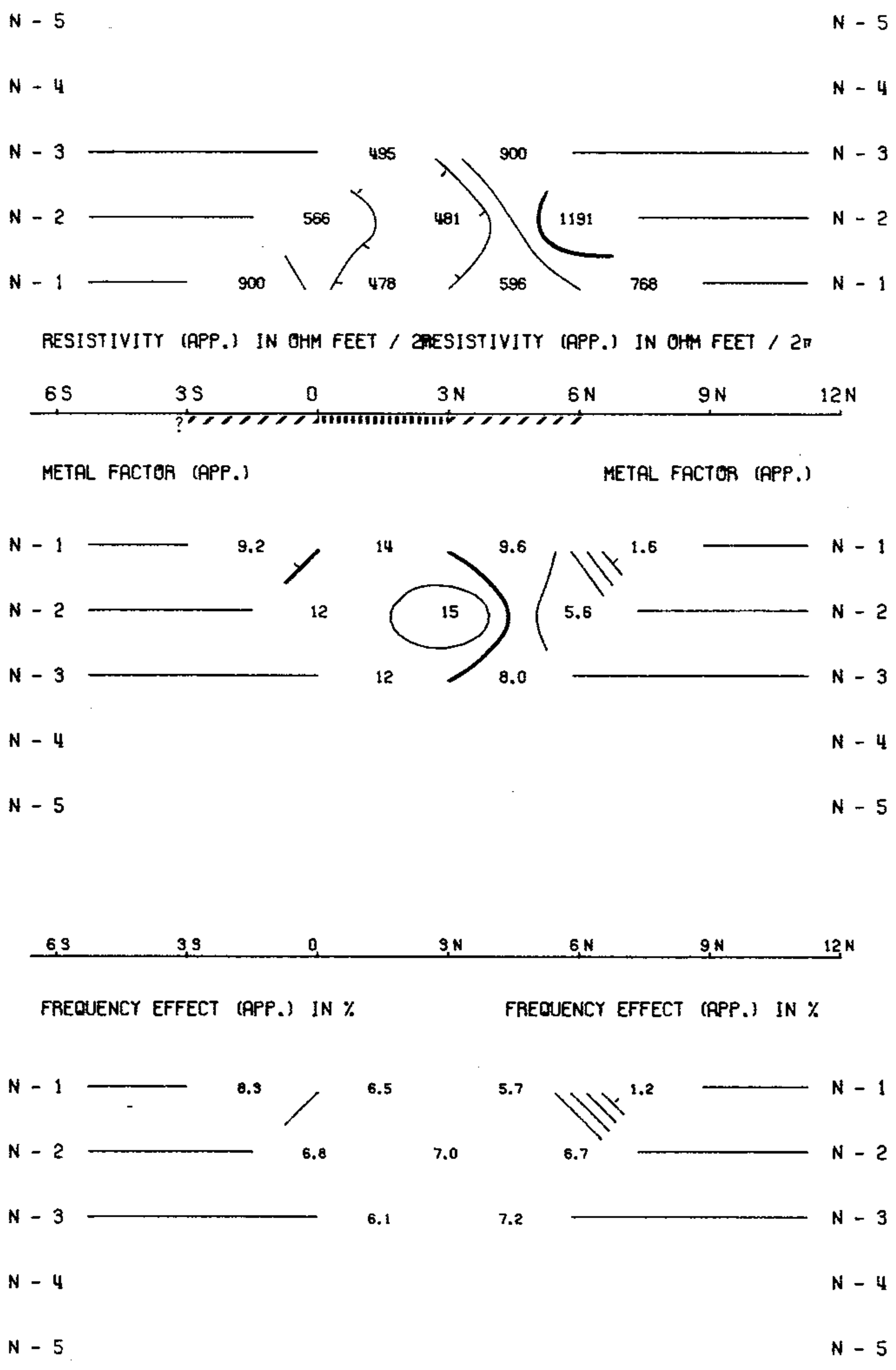
DATE:

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 BY MCPHAR COMPUTER DIVISION



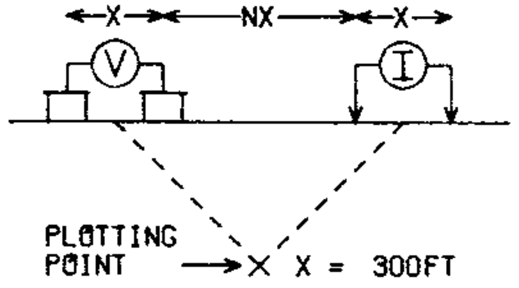
DWG. NO.- I.P.- 6102-2

CHANNEL COPPER MINES LTD. (N.P.L.)

REISETER CLAIMS, OMINECA M.D., B.C.

LINE NO.- 3600W

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: SEP 1973

APPROVED:

DATE: 11/1/73

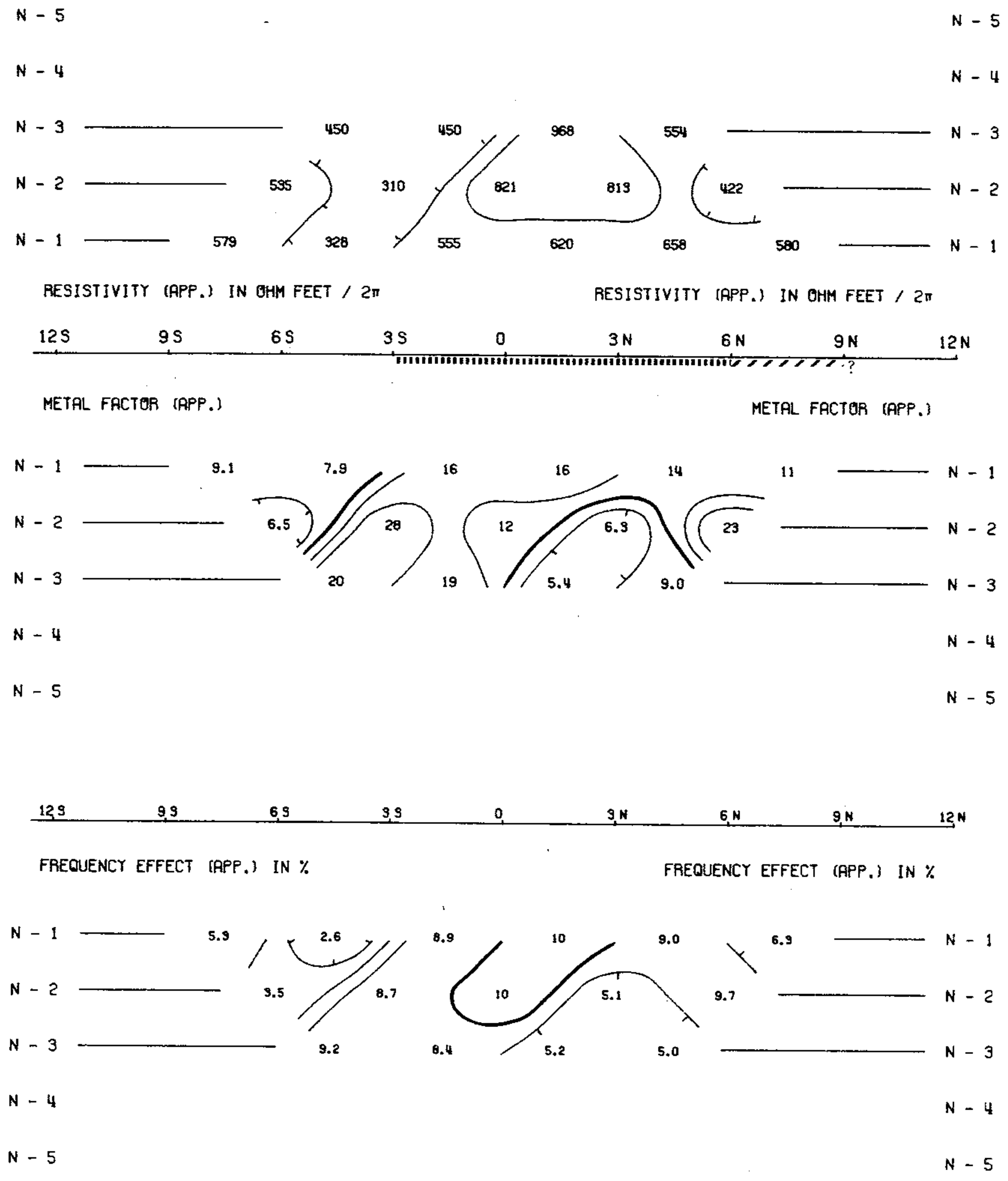
Expiry Date: February 28, 1974

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 BY MCPHAR COMPUTER DIVISION



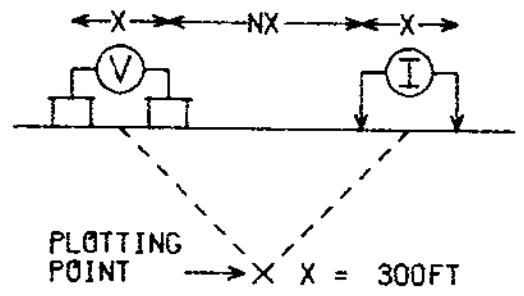
DWG. NO.- I.P.- 6102-3

CHANNEL COPPER MINES LTD. (N.P.L.)

REISETER CLAIMS, OMINECA M.D., B.C.

LINE NO.- 2800W

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: SEP 1973

APPROVED:

DATE: 11/1/73

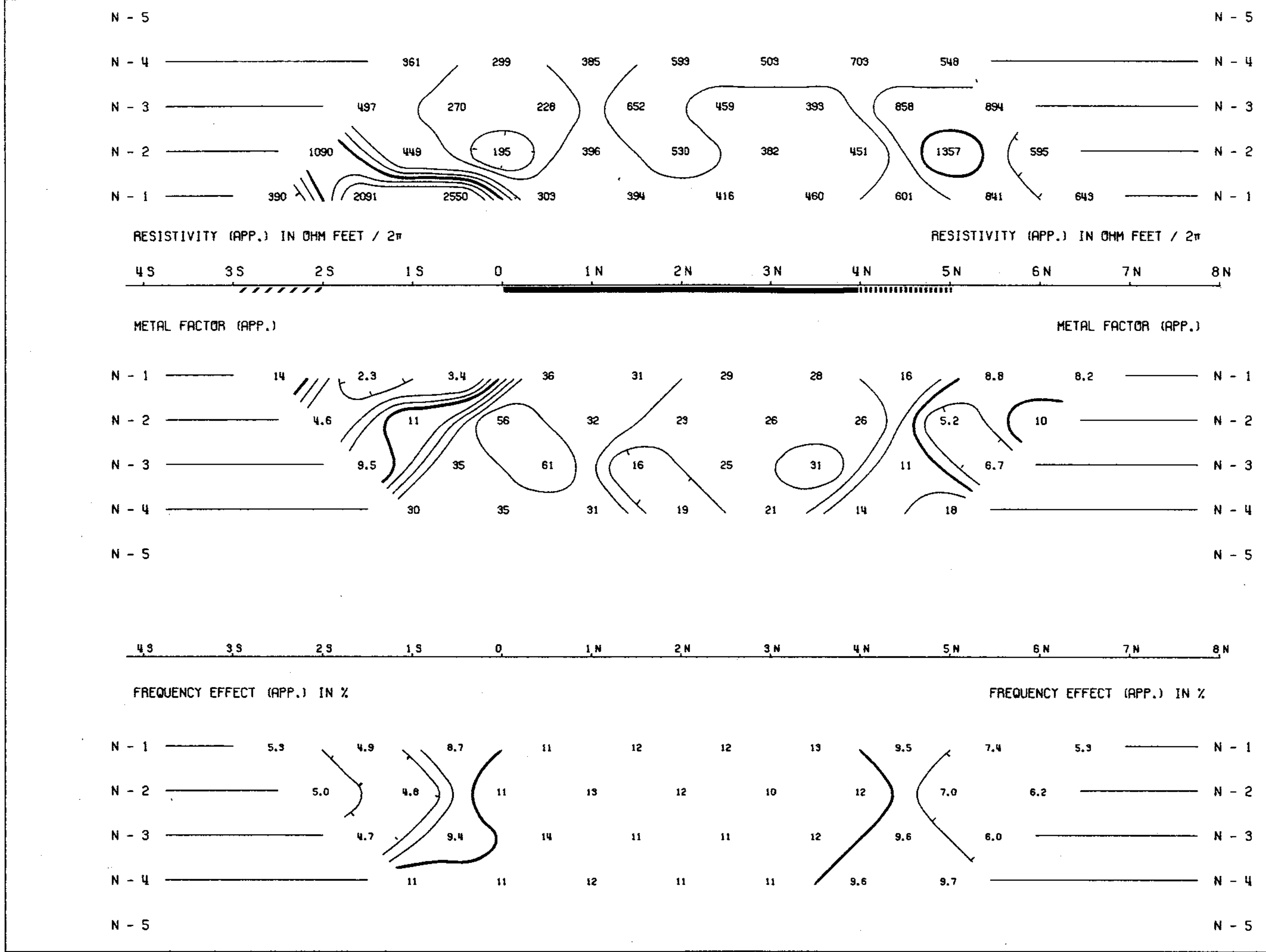
Expiry Date: February 23, 1974

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 BY MCPHAR COMPUTER DIVISION



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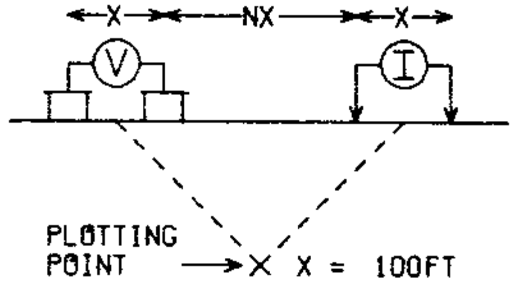
CHANNEL COPPER MINES LTD. (N.P.L.)

REISETER CLAIMS, OMINECA M.D., B.C.

LINE NO.- 2800W

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: SEP 1973

APPROVED:

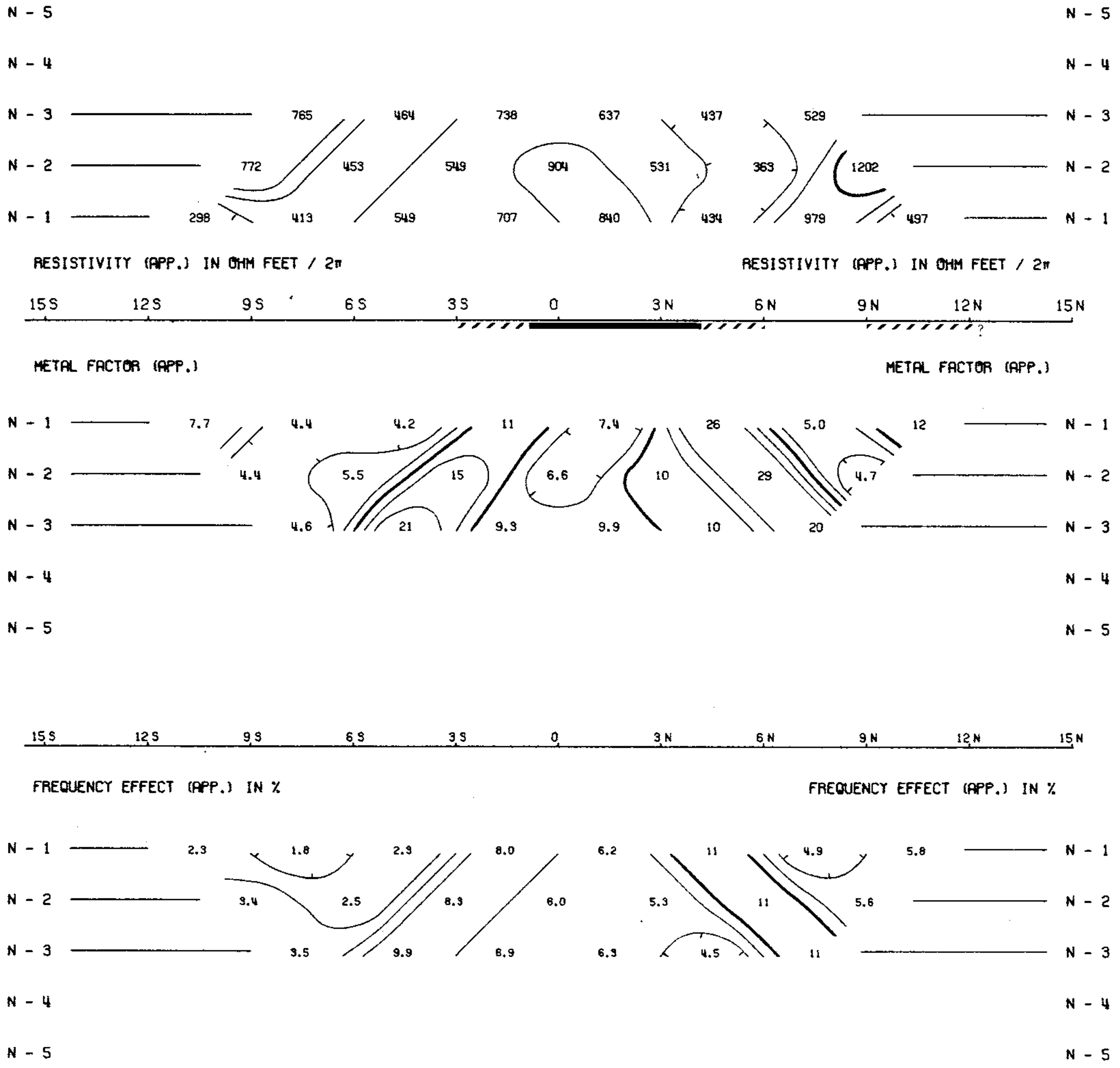
DATE:

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 BY MCPHAR COMPUTER DIVISION



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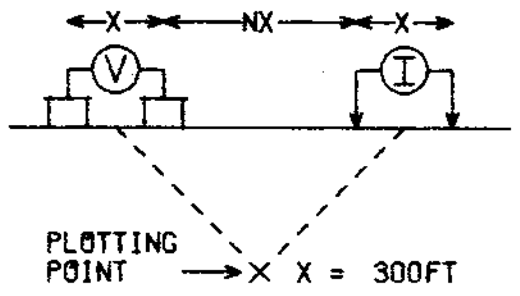
CHANNEL COPPER MINES LTD. (N.P.L.)

REISETER CLAIMS, OMINECA M.D., B.C.

LINE NO.- 2400W

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: SEP 1973

APPROVED:

DATE:

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

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

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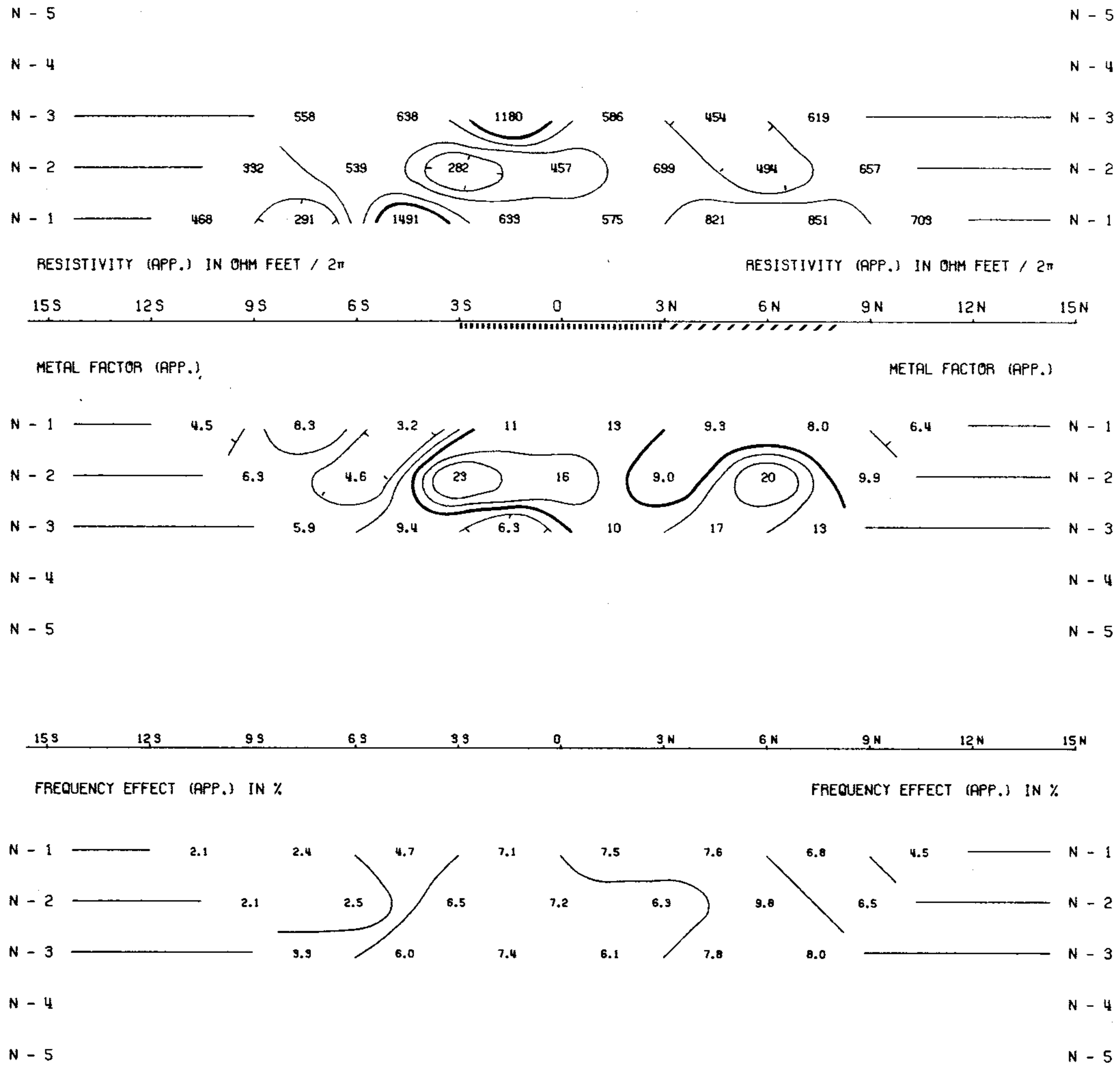

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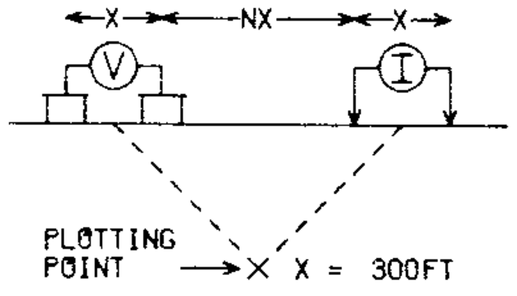
CHANNEL COPPER MINES LTD. (N.P.L.)

REISETER CLAIMS, OMINECA M.D., B.C.

LINE NO.- 2000W

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: AUG 1973

APPROVED:

DATE: 11/73

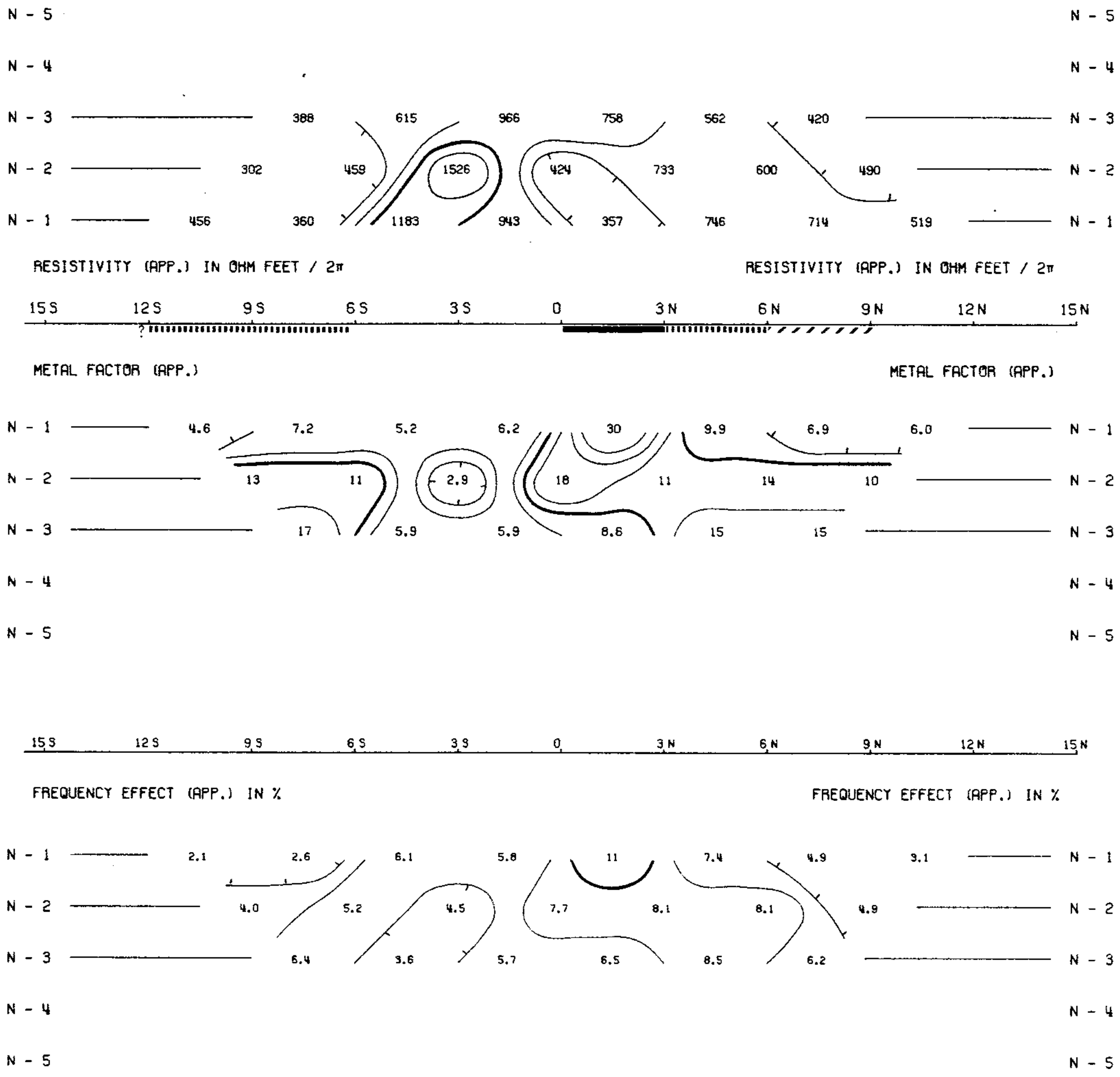
/ Date: February 25, 1974

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 BY MCPHAR COMPUTER DIVISION



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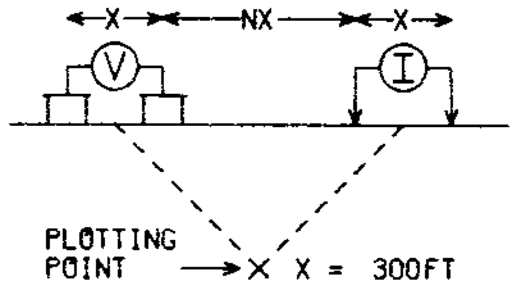
CHANNEL COPPER MINES LTD. (N.P.L.)

REISETER CLAIMS, OMINECA M.D., B.C.

LINE NO.- 1600W



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: AUG 1973

APPROVED:

DATE:

Expiry Date: February 25, 1974

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

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

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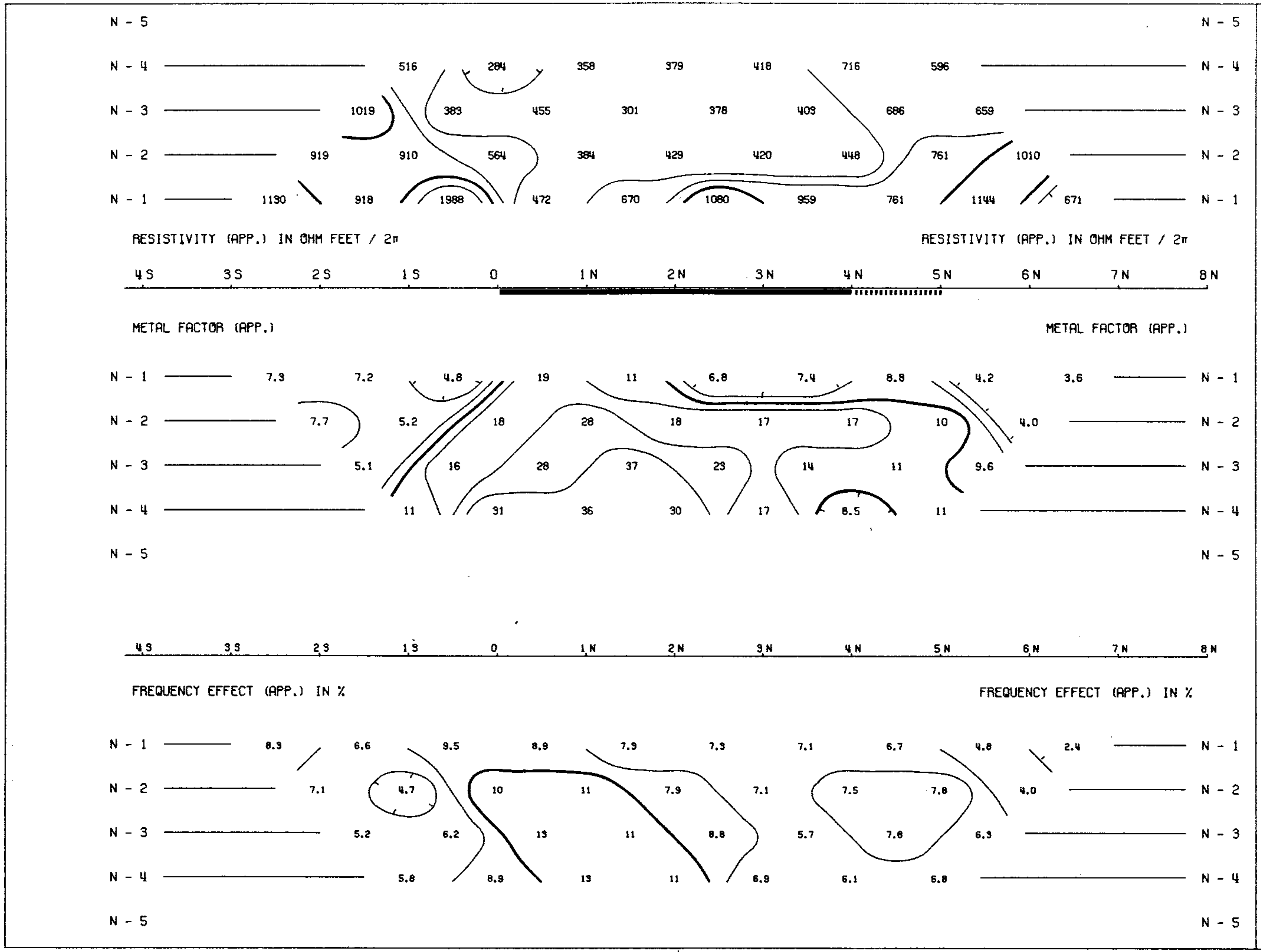

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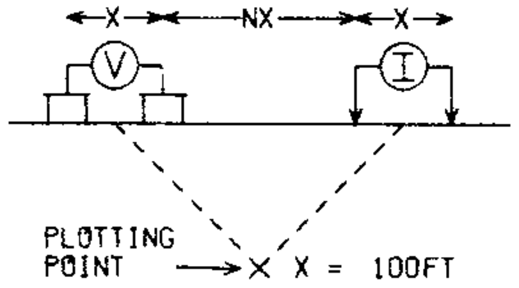
CHANNEL COPPER MINES LTD. (N.P.L.)

REISETER CLAIMS, OMINECA M.D., B.C.

LINE NO.- 1600W

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: SEP 1973

APPROVED:

DATE: 11/1/73

Expiry Date: February 25, 1974

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McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

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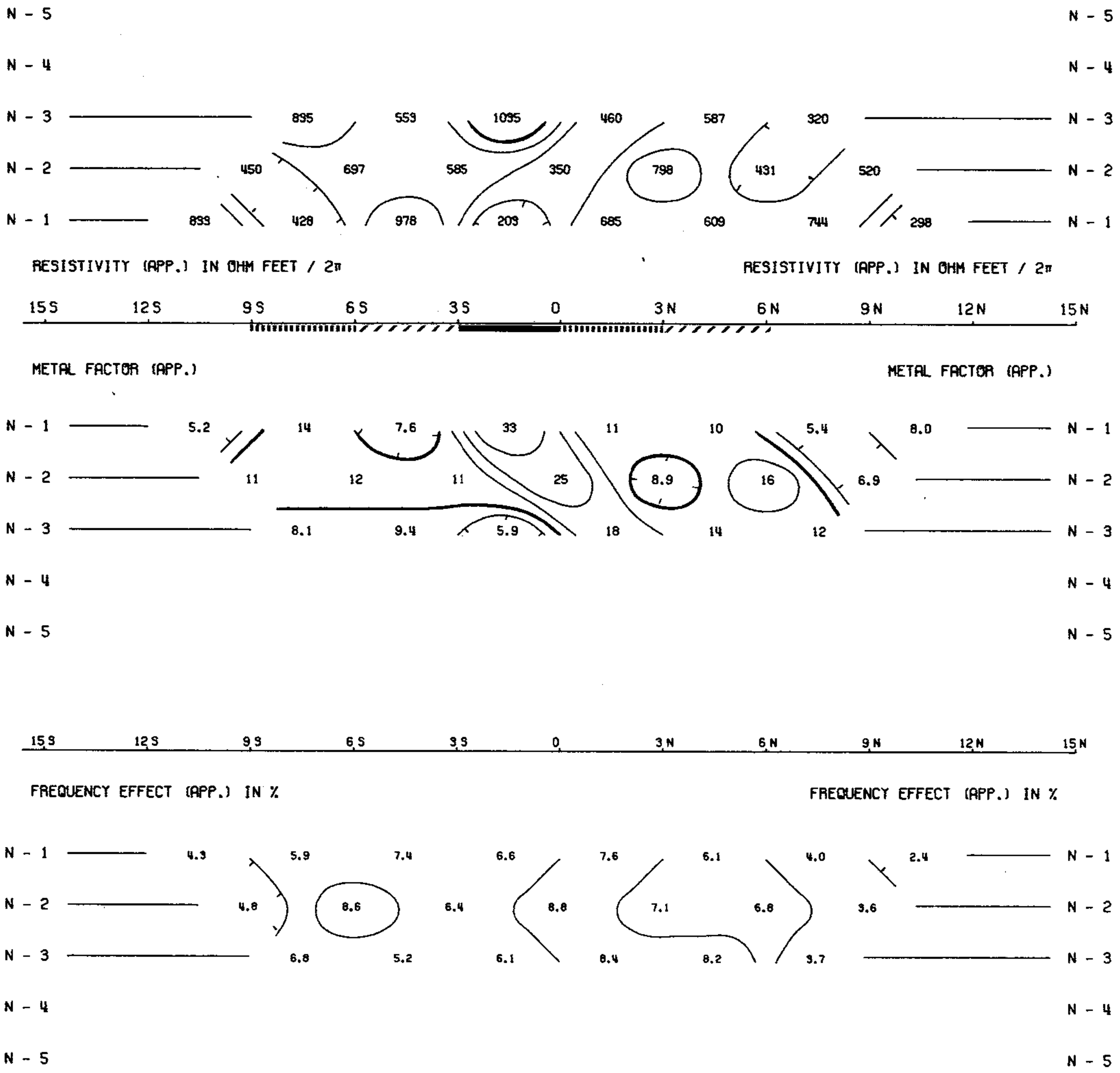


DWG. NO.- I.P.- 6102 - 9

CHANNEL COPPER MINES LTD. (N.P.L.)

REISETER CLAIMS, OMINECA M.D., B.C.

LINE NO.- 1200W

ELECTRODE CONFIGURATION

PLOTTING POINT → X X = 300FT

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: AUG 1973

APPROVED:

DATE: 11/1/73

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

Expiry Date: February 25, 1974

McPHAR GEOPHYSICS

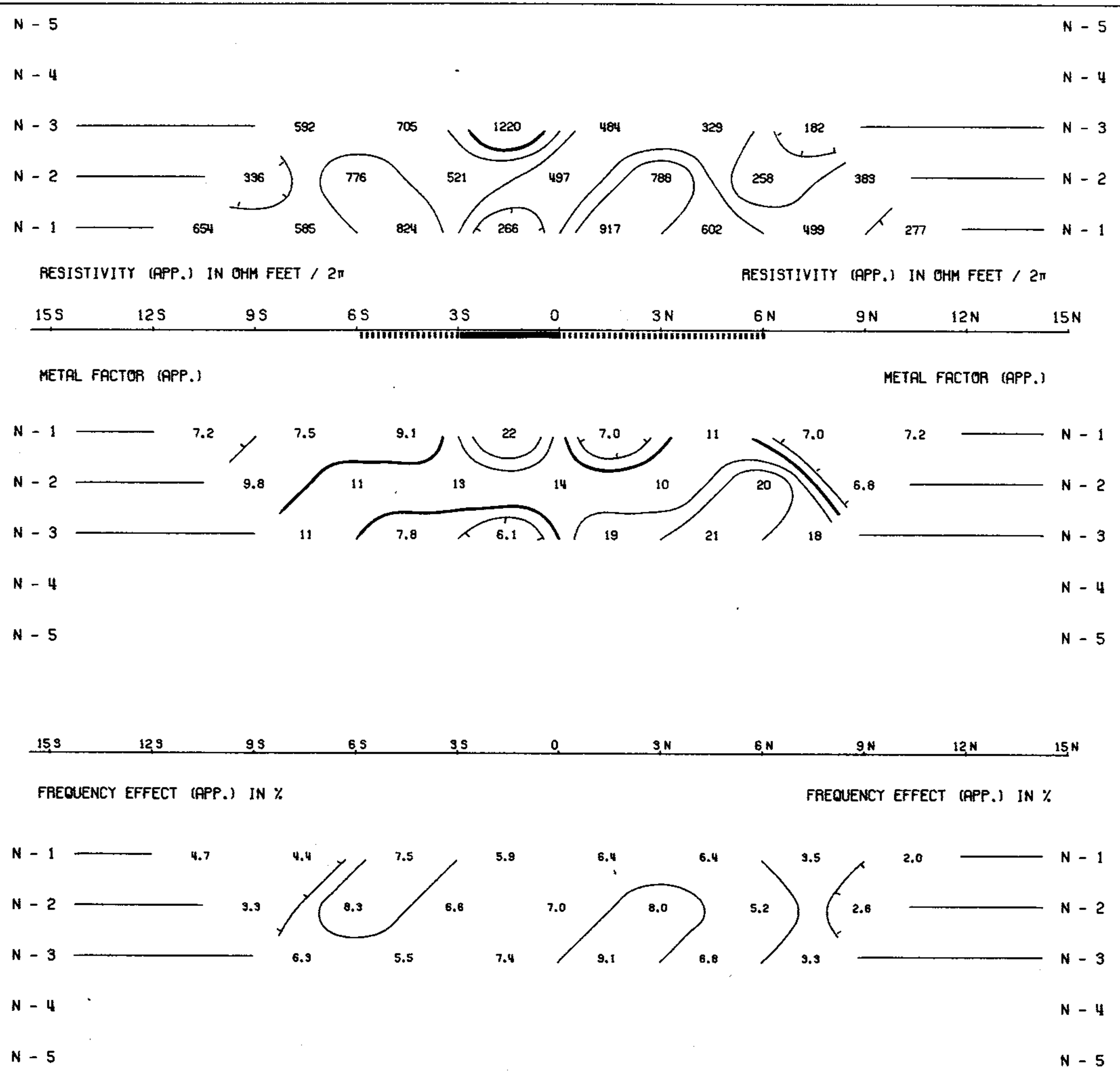
INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED BY MCPHAR COMPUTER DIVISION

DWG. NO.- I.P.- 6102-10

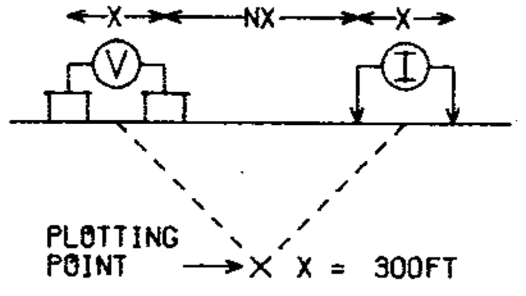
CHANNEL COPPER MINES LTD. (N.P.L.)

REISETER CLAIMS, OMINECA M.D., B.C.



LINE NO.- 800W

ELECTRODE CONFIGURATION



PLOTTING POINT → X X = 300FT

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE ▬▬▬

PROBABLE ||||||||||

POSSIBLE / / / / /

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: NOV/1973

APPROVED: [signature]

DATE:

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

PROFESSIONAL ENGINEER — PROVINCE OF B.C. — PHILIP G. HALLOF

Expiry Date: February 25, 1974

McPHAR GEOPHYSICS

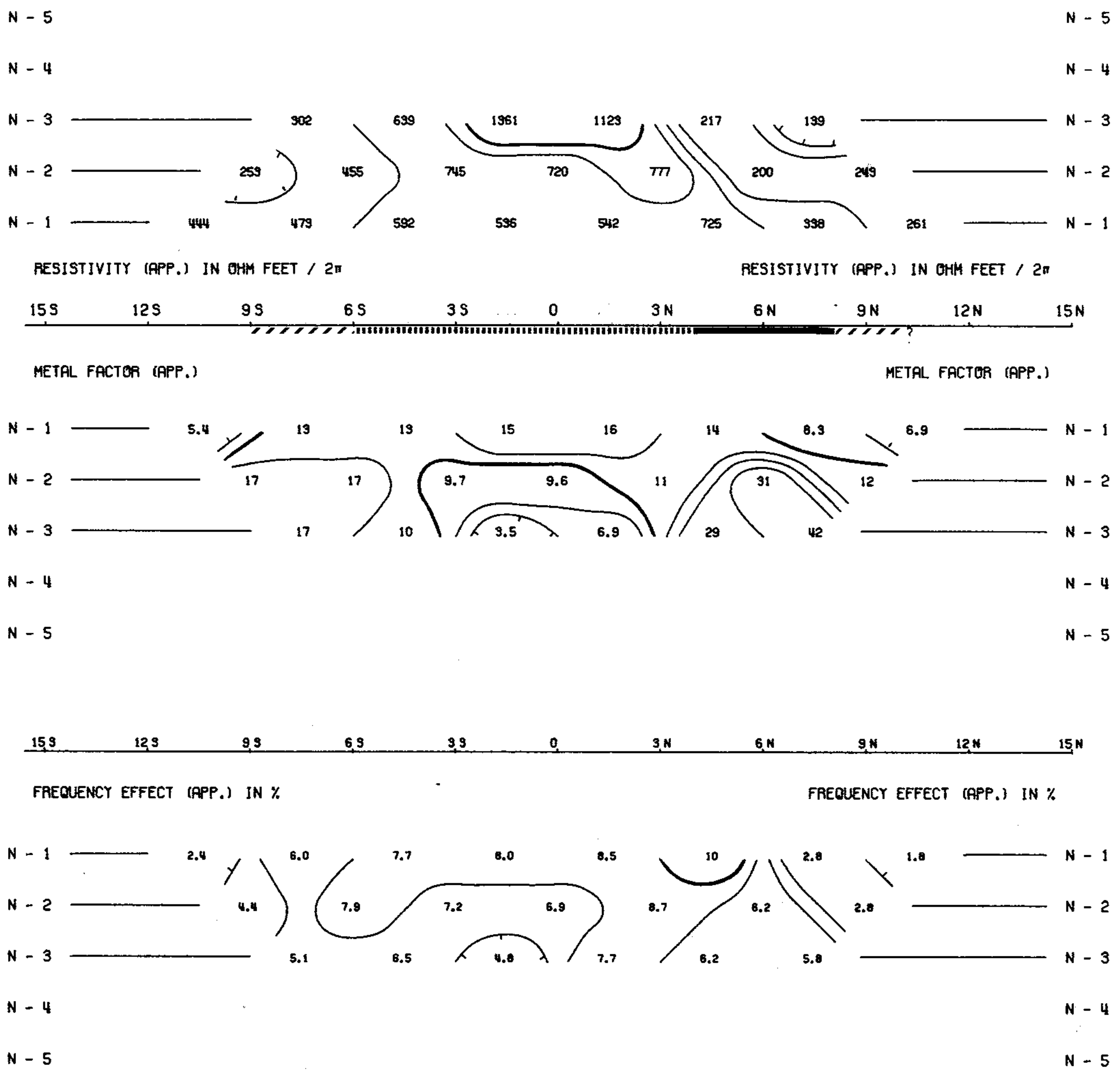
INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED BY McPHAR COMPUTER DIVISION

DWG. NO.- I.P.-6102-11

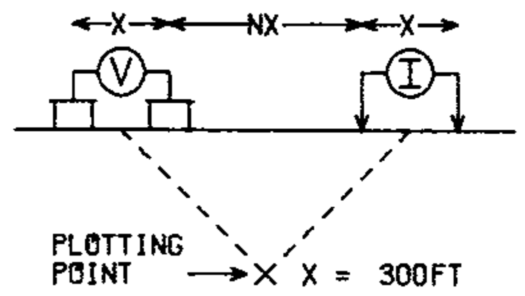
CHANNEL COPPER MINES LTD. (N.P.L.)

REISETER CLAIMS, OMINECA M.D., B.C.



LINE NO.- 400W

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: AUG. 1973

APPROVED:

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

DATE:

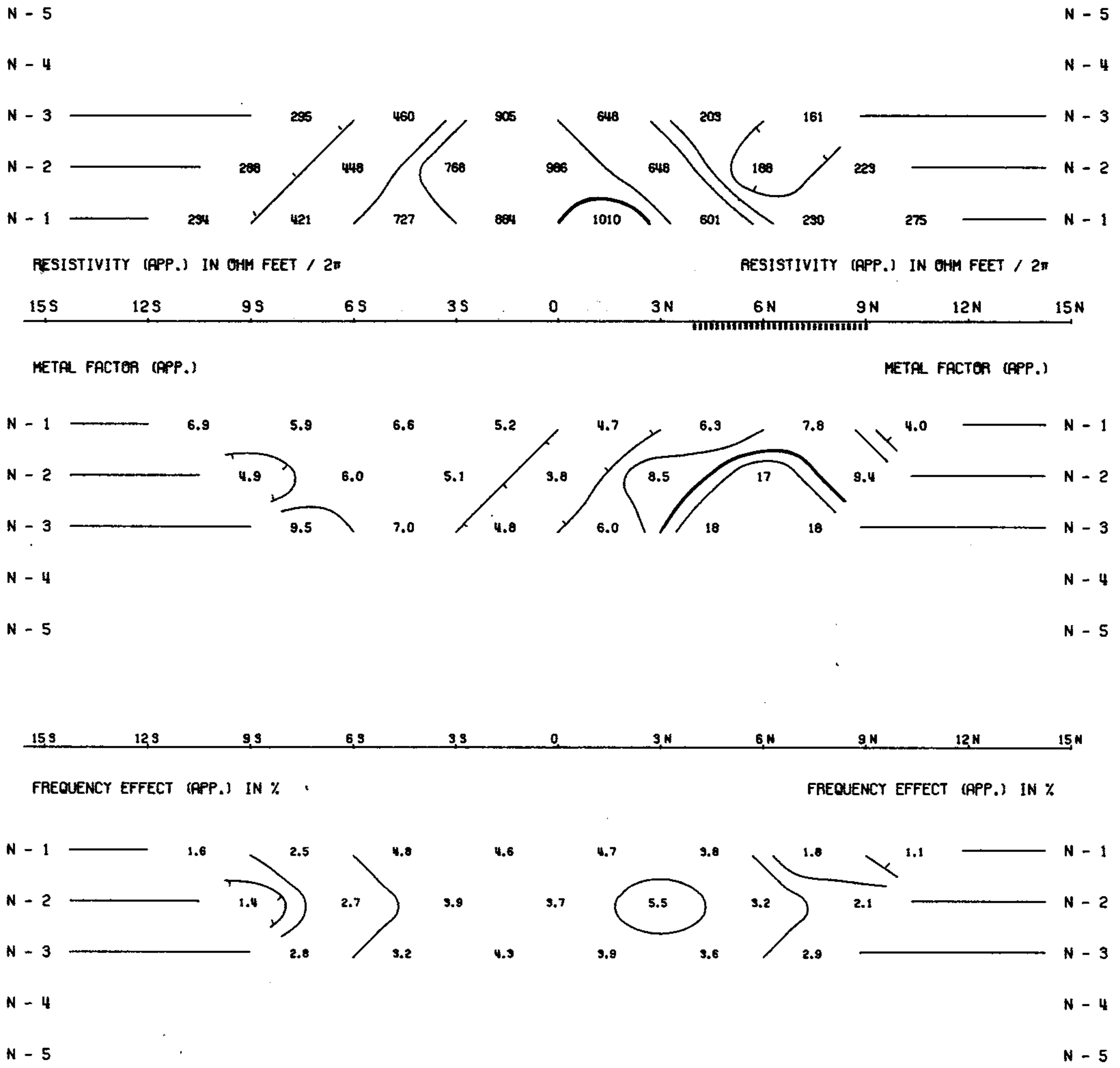
PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA PHILIP G. HALLOF

Expiry Date: February 25, 1974

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED BY MCPHAR COMPUTER DIVISION



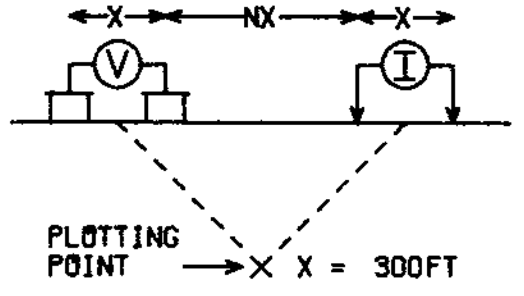
DWG. NO.- I.P.- 6102 -12

CHANNEL COPPER MINES LTD. (N.P.L.)

REISETER CLAIMS, OMINECA M.D., B.C.

LINE NO.- 0

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: AUG 1973

APPROVED:

DATE:

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA PHILIP G. HALLOF

Expiry Date: February 25, 1974

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 BY MCPHAR COMPUTER DIVISION

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

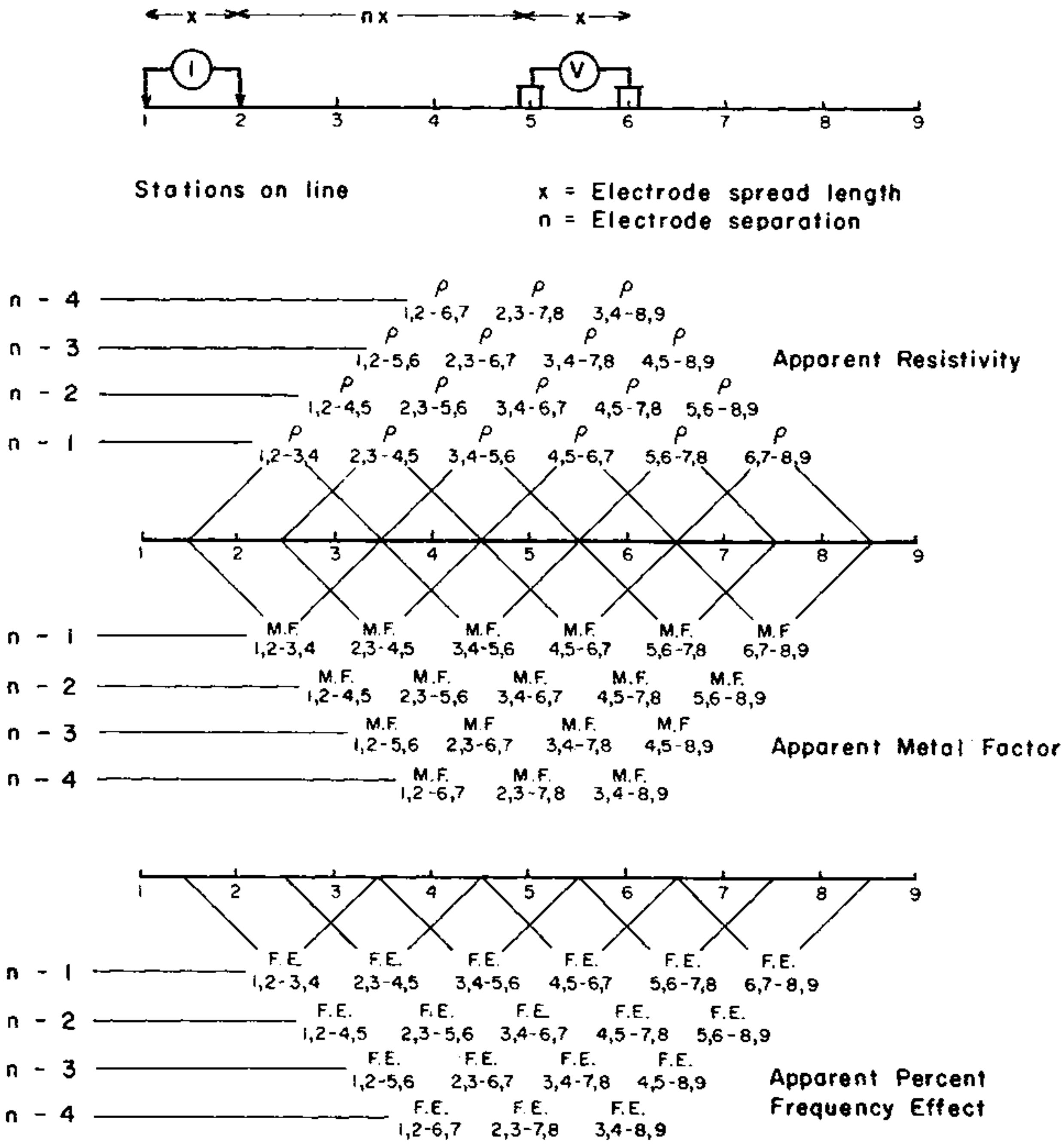
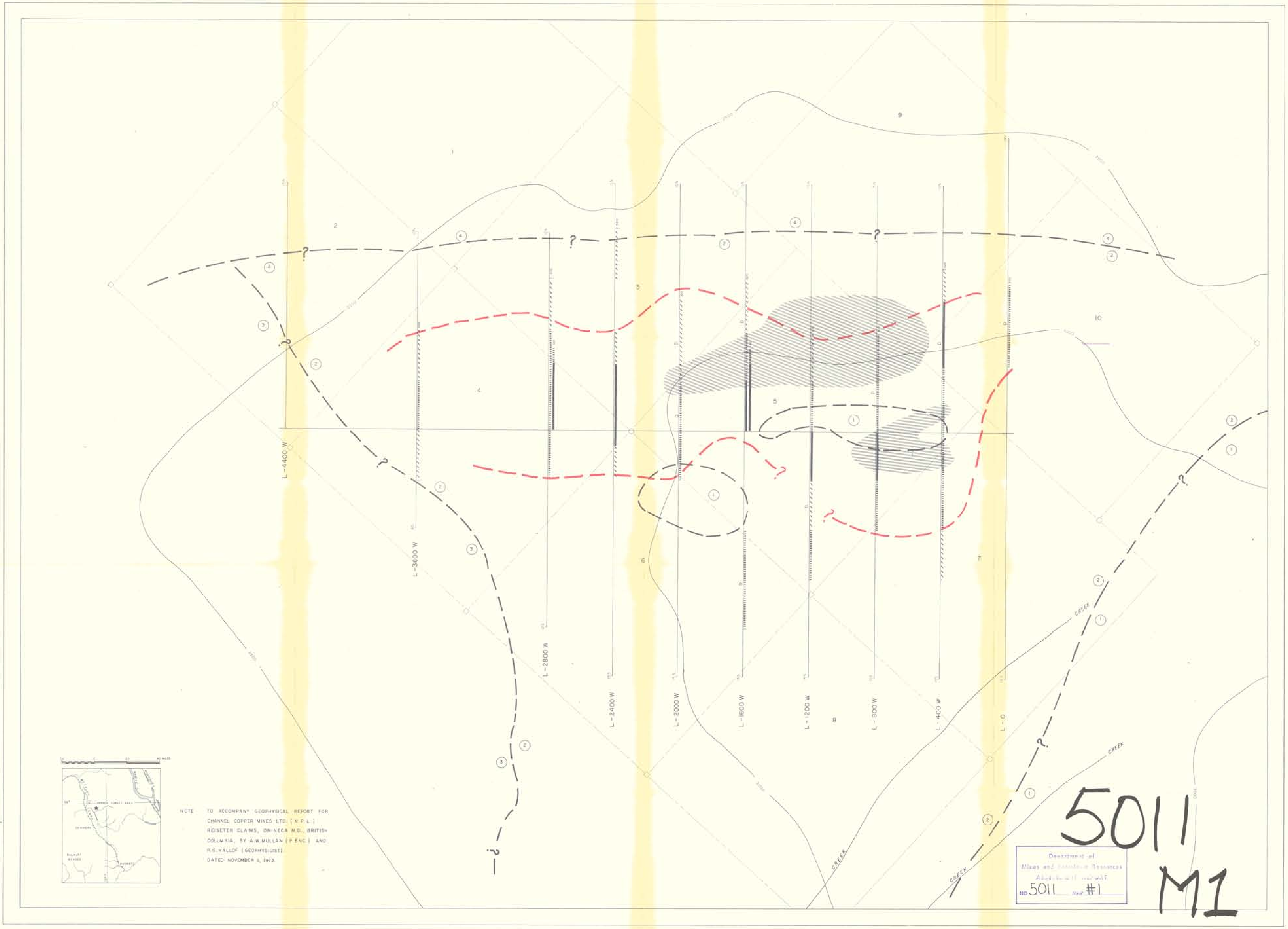


Fig. A

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

PLAN MAP



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

CHANNEL COPPER MINES LTD. (N.P.L.)

REISETER CLAIMS, OMINECA M.D.

BRITISH COLUMBIA

SCALE

ONE INCH EQUALS TWO HUNDRED FEET

IP ANOMALOUS ZONE

1. CRETACEOUS
2. HAZELTON GROUP - JURASSIC
3. TUFFACEOUS SEDIMENTS
4. VOLCANIC ROCK - ANDESITE

ROCK CONTACT

"Z" - ZONE DEPTH TO SOURCE INDICATED

DWG. IPP - 4917