LYELL E.Z. EXPLORATIONS

Queenstown

Report on

MOORES VALLEY

INDUCED POLARISATION

Report No. G.P. 24

April '59

31st March, 1959.

Report on the Induced Polarization Survey in Moore's Valley

1. Introduction

The term "Induced Polarization", when used in connection with geophysical prospecting, refers to the "blocking" action or polarization that takes place at metallic-ionic solution interfaces when electrical current is passed through a system that conducts both by electrons in solids and ions in solutions. This effect has been studied by electro-chemists in simple cases and is known as the "over voltage" phenomenon. As a result of this effect, there is a voltage drop in such a system at each interface through which current is passing. This voltage drop is over and above the ohmic losses in the solution and the solid.

The exact mechanics of this polarization are very complex and not completely known. However, the result of the effect is that such a system, one that has both ionic and electronic conduction, has a bulk impedance that decreases with an increase in the frequency of the current being used to measure the impedance. Stating it simply, the result is that the resistivity of a block of rock that contains metallic minerals will decrease as the frequency of the applied current is increased.

In the method of application used by McPhar Geophysics Ltd., the apparent resistivity of the area under investigation is determined at two frequencies; a change indicates the presence of metallic minerals. The "Metal Factor" or M.F. is a measure of the amount of change that takes place in the apparent resistivity when the applied current is changed from d.c. to low frequency a.c.

The measurements are made, both I.P. and resistivity, in a way which we think helps to separate vertical and lateral variations in the electrical properties of the ground. Current is applied to the ground through two electrodes (X) distance apart. The potential differences between two other, in-line, electrodes also (X) distance apart is measured. The distance between the nearest potential and current electrodes is increased in multiples of (X) feet and the measurement repeated. In this way only one set of electrodes, the transmitter or the receiver, is moved at a time.

The results of these measurements are shown on two-dimensional plots that aid in the interpretation and in locating the source of the anomalous effects. Each value is plotted using as co-ordinates the separation between the sending and receiving electrodes and the location of the center point of the electrode configuration. The apparent resistivities are plotted above the datum line and the apparent metal factors below. These plots are then contoured and studied as aids in interpretation. They are not cross-sections of the properties of the ground. However, because the separation between the electrodes is one factor that controls the depth of exploration, it can be said that distance from the datum line does indicate the relative depth to which the ground has influenced the measurement. From experience, and a certain amount of theoretical and laboratory model work, it is possible to recognise the patterns that result from several simple geometrical configurations. The results from vertical, horizontal and dipping tabular bodies are, for instance, usually easily recognisable.

2. Discussion of Results

The bedrock geology in Moore's Valley is obscured by a blanket of Tertiary sediments believed to be several hundreds of feet thick. However, the rock types present and the inferred presence of the Lyell Shear create the same geologic picture which controls the major mineral deposits of the West Coast of Tasmania. Because of the lack of detailed geologic information, exploration in Moore's Valley can best be carried out using geophysical methods.

Since the airborne electromagnetic survey had failed to yield any results, undoubtedly due to the depth of cover, the new AFMAG equipment was to be used for the reconnaissance survey. However, as explained in a separate report, low field strength seriously curtailed the amount of satisfactory work that could be done with the AFMAG unit. Enough work was done on the southern part of the grid in Moore's Valley to establish the presence of a conductor crossing the baseline at approximately station 11N. Induced polarization and resistivity measurements were made on a detailed grid in the neighbourhood of the conductor to confirm its size and attitude and to detect the presence of metallic minerals associated with the conducting features.

The following lines on the grid have been covered by the I.P. survey:

375004

Baseline 1	800' spreads	100N to 52S
Baseline L	400' spreads	40N to 40S
Baseline 1	200' spreads	22N to 6S
Line 12+00 N	400' spreads	20E to 20W
Line 10+00 W	400' spreads	40N to 16S
Line 5+00 W	400' spreads	40N to 16S
Line 5+00 E	400' spreads	40N to 40S
Line 10+00 E	400' spreads	40N to 40S
Line 15+00 E	400' spreads	40N to 18S

Also included in the results is the data from Line 44+00 N. This line was done near the camp as training for the crew and shows the resistivities to be expected in normal areas of Moore's Valley.

The results along each line, and their interpretation will be discussed separately. The solid bar under the datum line on the plots of the results indicates the interpreted surface projection of the anomalous zone. Where the bar is broken, the indicated anomaly is of a smaller magnitude or less certain location. All of the anomalous indications have been put on the accompanying plan map. They can be correlated to give an estimation of the location and size of the geologic feature causing the anomaly.

Line 44+00 N - 400' Spreads

The results along this line show uniformly low metal factors and high resistivities. The resistivities seem in general to decrease slightly for the increased separations indicating lower resistivities at depth. This is probably a result of increased water content in the Tertiary sediments at depth.

Baseline 1 - 800' Spreads

In order to locate the AFMAG anomaly more closely in terms of resistivities, the baseline was covered in a reconnaissance fashion using 800' spreads. The results show a distinct resistivity low that must be quite long since its effects can be seen at some distance. The resistivity anomaly seems to center at about 8N. The shape of the resistivity contours could indicate, among other things, that the feature crosses the baseline at some angle less than 90°.

There is a moderately high I.P. anomaly associated with the resistivity low although it seems to be centered slightly further north. The presence of the induced polarization anomaly indicates the presence of metallic minerals; however, the apparent metal factors do not seem to be large enough to suggest that the entire source of the resistivity anomaly is sulphide mineralization. It seems more likely that some ionic conduction has contributed in part to the resistivity anomaly.

The shape and distribution of the metal factor contours suggest some features of the source. The statements are though, as are those of the previous paragraph, based on a limited amount of experience and should not be accepted as iron clad facts. The actual location is shown the best. The anomaly is centred at station 12N. Since the first separation readings are anomalous, the top of the source must be shallow, at least when measured using 800' spreads. This probably means that depths measured in a few hundreds of feet must be considered. Some depth extent is indicated by the fact that the valuescontinue to increase as the receiver is moved further away. Finally, the assymetry in the contours would indicate, if anything, a southerly dip for the source.

The complete picture of the anomaly was not obtained due to extremely rough terrain and the fact that more data was gathered at different spreads. However, a few values measured at the extreme southern end of the baseline indicate that a return is made to normal conditions. As a matter of fact, the higher resistivities on the south may indicate the presence of a different rock type.

Baseline 1 - 200' Spreads

Since the presence of the Tertiary sediments assured that any interesting anomaly would not extend to the surface, the baseline was surveyed with 200' spreads in order to determine the depth to the top of the anomalous material. The results show that the anomalous values were not measured until the second or third separation. This places the top of the source at close to one or two electrode separations (200'-400'). The shallowest part is apparently at 10M-12N which correlates very well with the AFMAG crossover. As with the 800' spreads, it would seem that the resistivity anomaly is centered somewhat south of the induced polarization anomaly.

Line 12+00 N - 400' Spreads

Since the anomalous zone crossed the baseline at about station 12N, and seemed to strike roughly parallel to it, a short survey was carried out using 400' spreads. The results do show an anomaly centered roughly at the baseline and getting smaller to the east and west. This could indicate that the source ended or perhaps that it was not striking exactly parallel to line 12+00 N and is getting further away west and east of the baseline.

Line 10+00 W - 400' Spreads

This is the western most of the north-south grid lines surveyed to outline more completely the anomalous zone. The I.P. data shows a zone at

16N-24N that appears to be at some distance from the line. South of this, extending to about 4N, is a region of somewhat lower, but still above background, values.

Either the anomalous material is at some depth under line 10W, or it is off to one side. Since it appears quite shallow on Line 5W, it seems most likely that it ends between Lines 10W and 5W and the anomaly for large separation arises from the source to the side of the line. The region of semi-anomalous values could arise from a "halo" of more disseminated material surrounding the source of the anomaly.

Line 5+00 W - 400' Spreads

The anomaly on this line appears to be due to narrow, shallow, vertical or southerly dipping source at about 12N-16N. As on line 10W, the north side of the anomaly is the sharpest with a region of lower values south of the main anomaly.

The two readings taken with the receiver at stations 8S-12S are again slightly above background and should be investigated further if the source of the main anomaly proves to be of interest.

On both of the lines west of the baseline, there are low resistivity values associated with the induced polarization anomaly. However, in both cases there are other groups of low resistivities that do not seem to be associated with high metal factors.

Baseline 1 - 400' Spreads

The baseline was surveyed using 400' spreads in order to give a more complete picture. The I.P. anomaly is located from 8N to 16N with a less definite anomaly from 4N to 8N. This corresponds well with the results using 200' and 800' spreads. The anomaly appears to be broader and perhaps a little deeper than on line 5E.

The small anomaly at 8S-12S which was not completely covered by line 5E is located more definitely by the results on the south end of the baseline. The magnitude of this anomaly is much smaller than the main zone, but it should be investigated further if the main anomaly proves to be of economic interest.

Line 5+00 E - 400' Spreads

On this line, there are again two anomalous zones. The main zone is located between 0 and 8N and the anomaly is very similar to that on L5W.

The small anomaly at 12S on L5E correlates well with small indications on lines further west. This correlation across 1000' or more gives validity to the presence of the anomaly despite its small size.

Line 10+00 E - 400' Spreads

The results on L10E do not form a clear pattern that is recognisable. It would appear that there are perhaps as many as three anomalies shown. Because of the overlap the contour pattern is always confused in such cases.

There seems to be an anomaly at the north end of the line that does not correlate on the lines further west. The high values were obtained only for large separations so the source could be at depth or perhaps some distance east of L10E.

The main zone is not as definite on this line as on those further west. It seems to be centered at about 4N, but because of the presence of the other anomalies the interpretation is uncertain.

The zone south of Anomaly A has become much more important on Line 10E. It is centered at 8S-12S and both the induced polarization and resistivity anomalies are more pronounced.

Line 15E - 400' Spreads

The largest anomaly on this line is at 8N to 16N and correlates with the northern anomaly on L10E. Its source seems to be a broad zone with some depth to the top since the first separation readings are not large.

The anomaly at the south is still apparent as it was on Line 10E. Here it extends from 10S to 6S. The main zone, Anomaly A, does not seem to extend as far as this line.

3. Conclusions

Because of the AFMAG and resistivity anomalies it is obvious that a major conductor is crossing the baseline at about 10N-12N. Its probable strike is between grid north and grid west which would mean a true strike of generally north-south.

There is a definite induced polarization anomaly associated with the feature indicating the presence of metallic minerals. The magnitude is great enough to suggest something more than just a few per cent disseminated sulphides. The true character of the anomalous material can best be obtained by drilling. Because of the extremely favourable geologic situation, this zone should be tested by drilling to see if it is economically important. If it is, there is obviously more work to be done to determine its extent, locate other similar zones, etc.

The best estimation of the location of the anomalous zone is shown on the location map. It is indicated to be at least 1500' long and 600'-800' wide. There is also some indication of a second zone further east. Most of the zone appears to be similar in nature and there is no indicated preference for the first hole. Because the drilling is going to be difficult, the location of the holes should probably be determined by topography, water, expected dip of rocks etc.

Because the induced polarization measurement is a potential measurement, it is essentially an averaging process. In the measurement, particularly for the large separations, a large block of rock affects the readings. Therefore, it is more difficult than for E.M., for instance, to locate exactly the source of an anomaly or to separate two anomalous features at depth. For this reason, it is best to look at the problem of locating the source of an I.P. anomaly as a drilling program to investigate an anomalous region. It is quite possible that several separate sources make up the anomalous zone outlined on the location map and that a single drill hole could not reveal the true nature, or even the existence, of the anomalous material. Essentially, this is a recommendation that several drill holes be used to evaluate the source of the anomaly.

4. Recommendations for any Further Work

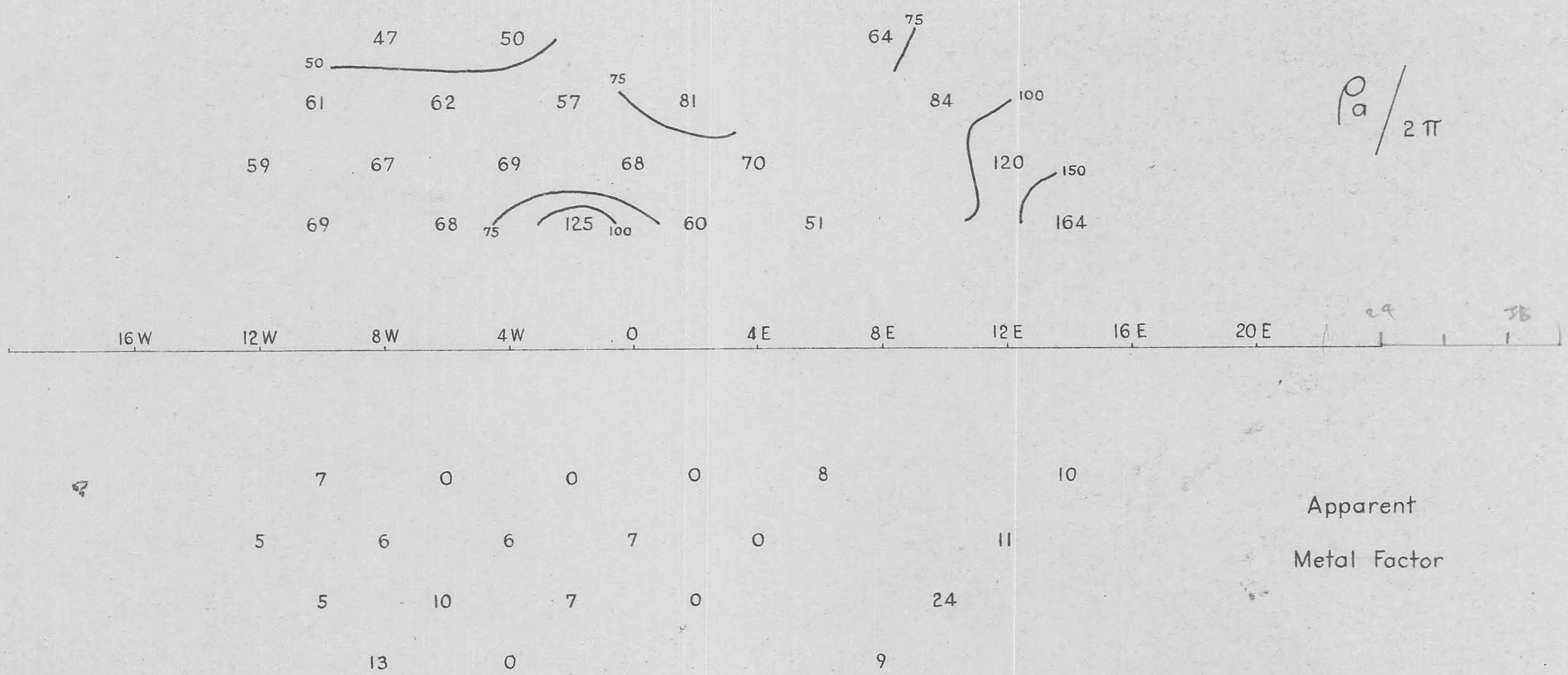
Our experience during the field season of 1959 have suggested several changes in procedure that would benefit any further induced polarization work in the area. Most of them are changes or additions to the equipment which can be made by McPhar. They range all the way from additional frequencies to be built into the equipment to the inclusion of packboard mounted water cans and probably do not have to be mentioned here.

However, several suggestions for changes could be the responsibility of LEE Explorations. The most important is probably that of very small portable radios to be used by the I.P. crew. In the event of trouble at either the transmitter or the receiver, radio contact can save a great deal of walking back and forth and hence time. Since a maximum range of 1½ to 2 miles is all that is required, the necessary equipment is quite small. Because of the diffraction effect of hills, trees, etc., a low frequency is necessary. Several transistorized units operating in the band from 7-70 megacycles have become available and weigh less than 4 lbs. This has been discussed with the management and inquiries are already underway.

The equestion of the personnel to be used in further work also arises. If a definite program is decided upon, the actual field work can be carried out by only supplying the equipment and one trained operator from Toronto. Enough spares will have to be supplied to ensure that the equipment will be kept operational. It would be best for LEE to supply someone, possible a University student, with at least an elementary knowledge of electronics and electrical equipment to help in the operation of the transmitter. From experience, it would seem that a crew of five men is required to operate efficiently. Only two need be trained, one by McPhar, and the others should be bushmen. In the normal course of operations, one man can be spared in mid-afternoon and can act as cook for the camp. In flat, open country it is possible to carry out the survey with four men with some loss of efficiency.

If, as has been indicated, it is desirable to carry out further induced polarization work in Tasmania, it would be advantageous to have the decision made as soon as practical. The more planning that can be done before the start, the better will be the results of the program.

PHILIP G. HALLOF
McPHAR GEOPHYSICS LTD.



References

LYELL E.Z. EXPLORATIONS
QUEENSTOWN

MOORES VALLEY

LINE 44 N 400 FT. SPREADS 59-267.

2324

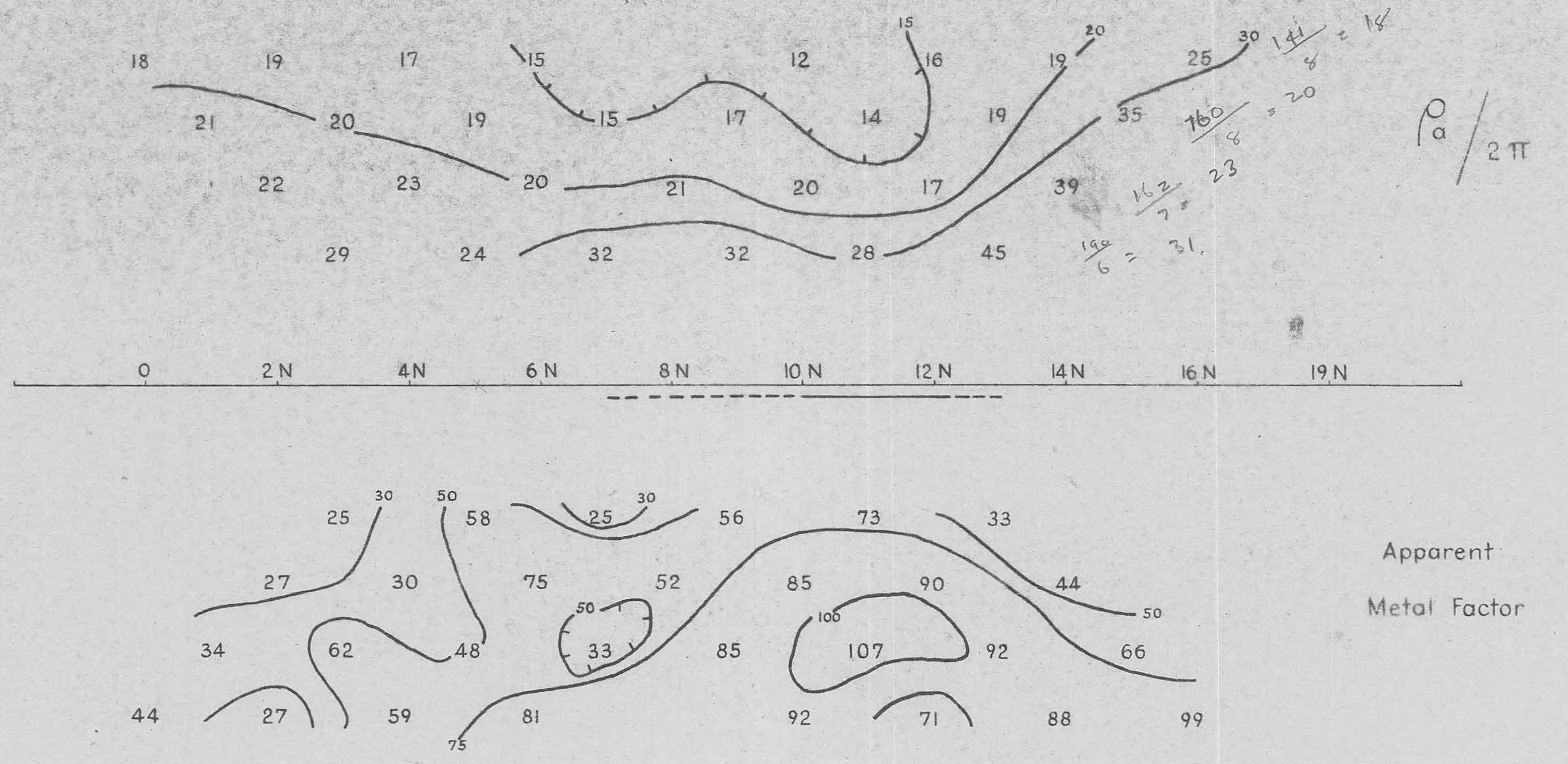
Survey			Scale
Geology			400 ft to 1 inch
Geophysics	J.S. , P.H.	Mar.'59	
Geochemistry			
Drawn	P.H.	Mar.'59	
Traced	D.S.	Mar.'59	

Q 22 Sheet No 13

INDUCED POLARIZATION

5 cm

375010



References

LYELL E.Z. EXPLORATIONS
QUEENSTOWN

MOORES VALLEY

℄ ANOMALY "A" 200 FT SPREADS 59-267

2325

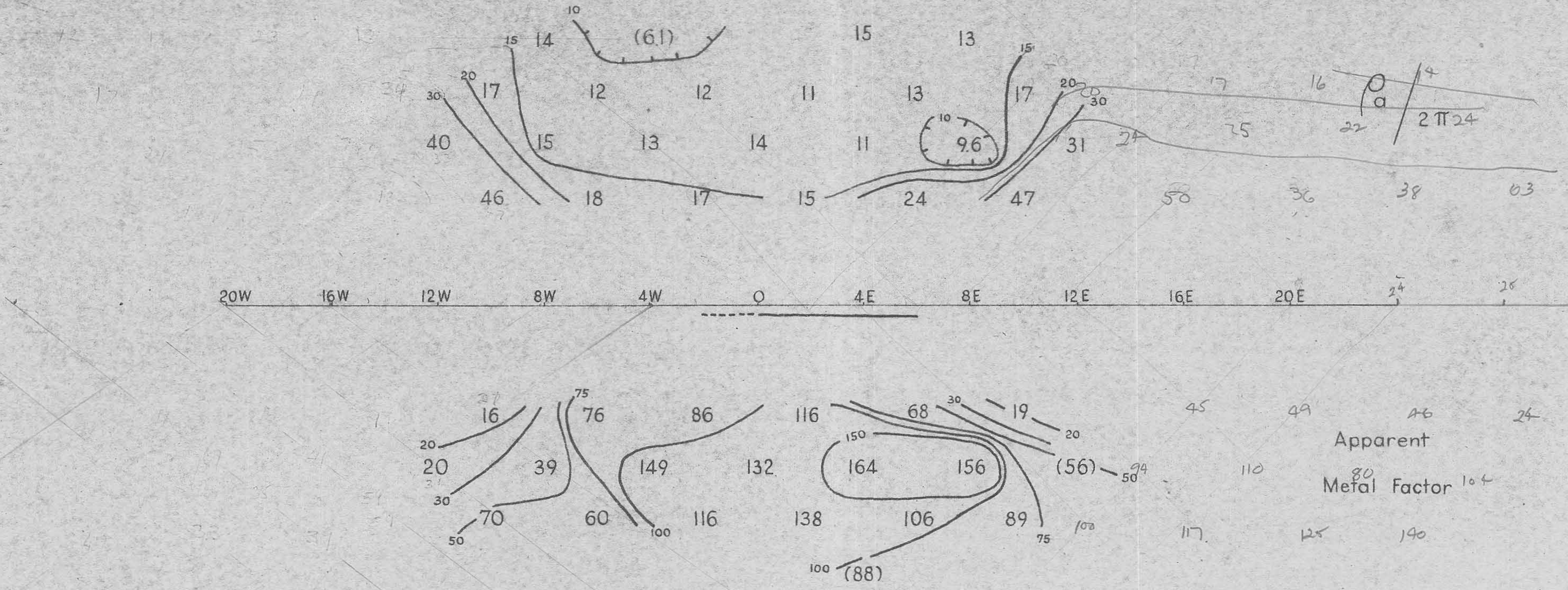
Survey			Scale
Geology			200 ft. to 1 inch
Geophysics	J.S., P.H.	Mar.'59	
Geochemistry			
Drawn	P.H.	Mar.'59	
Traced	D.S.	Mar.'59	

Q22 Sheet 13a

375011

INDUCED POLARIZATION

5 cm



5 cm

References

LYELL E.Z. EXPLORATIONS
QUEENSTOWN

859-267

MOORES VALLEY

LINE 12N ANOMALY "A" 400 FT. SPREADS

Survey			
Geology			
Geophysics	J.S., P.H.	Mar.'59	
Geochemistry			
Drawn	P.H.	Mar.'59	
Traced	D.S.	Mar.'59	

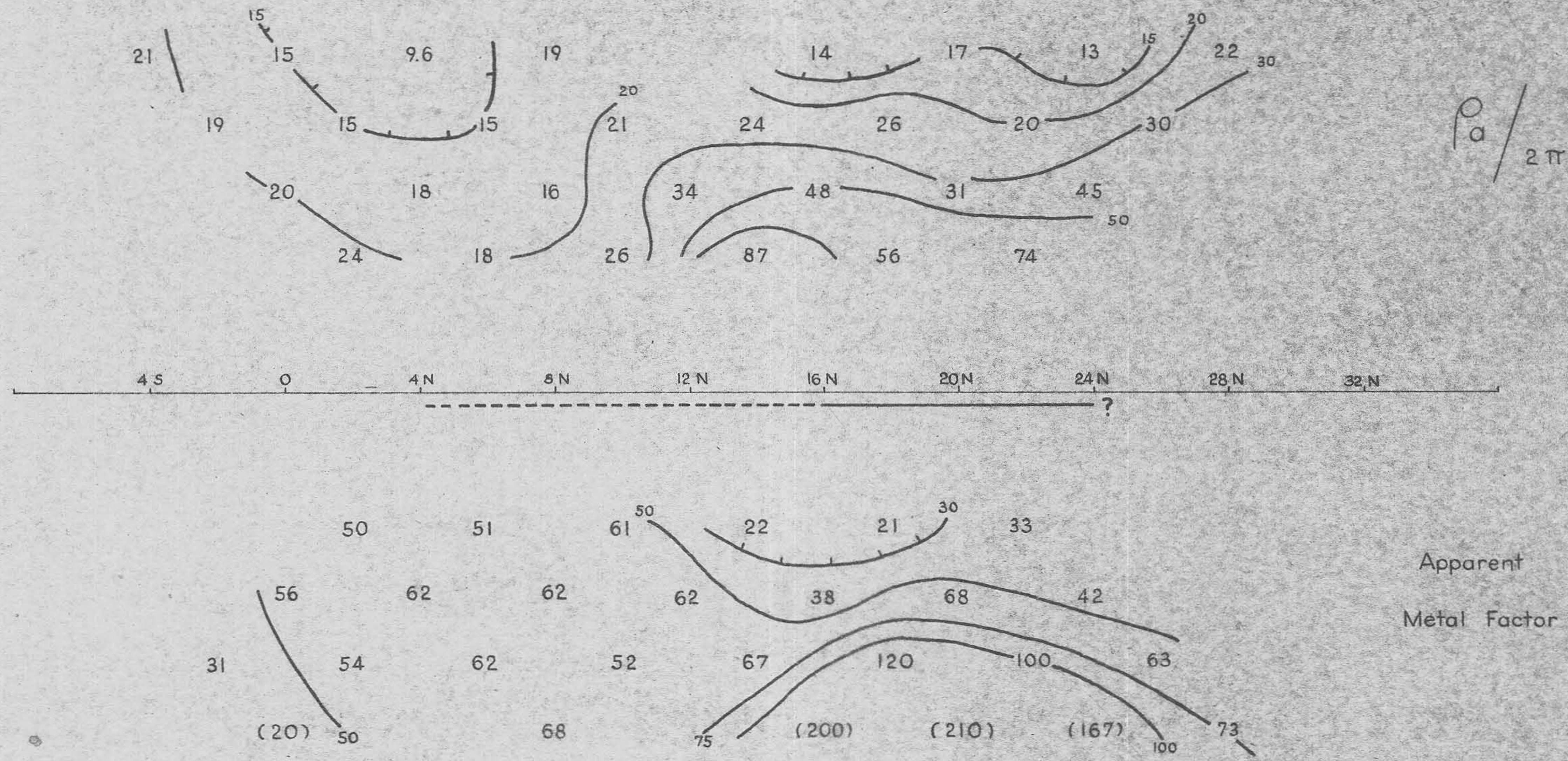
Scale: 400 ft to 1 inch

2326

Q22 Sheet No. 13b

375012

INDUCED POLARIZATION



References

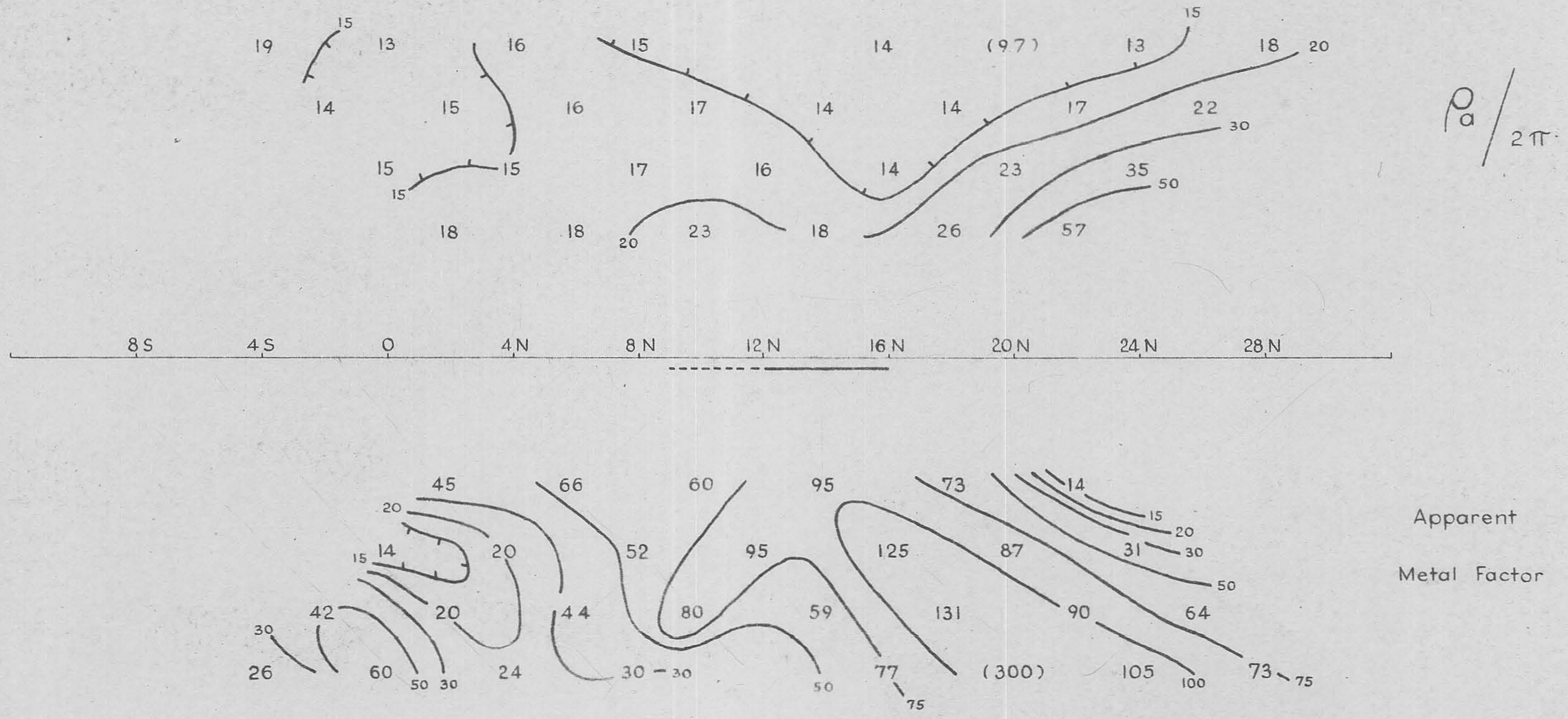
LYELL E.Z. EXPLORATIONS
QUEENSTOWN

MOORES VALLEY
LINE 10 W — 400 FT. SPREADS 59-267

			Scale	2327
Survey			400 ft. to 1 inch	Q22 Sheet No. 13c
Geology				
Geophysics	J.S., P.H.	Mar. '59		
Geochemistry				
Drawn	P.H.	Mar. '59		375013
Traced	D.S.	Mar. '59		

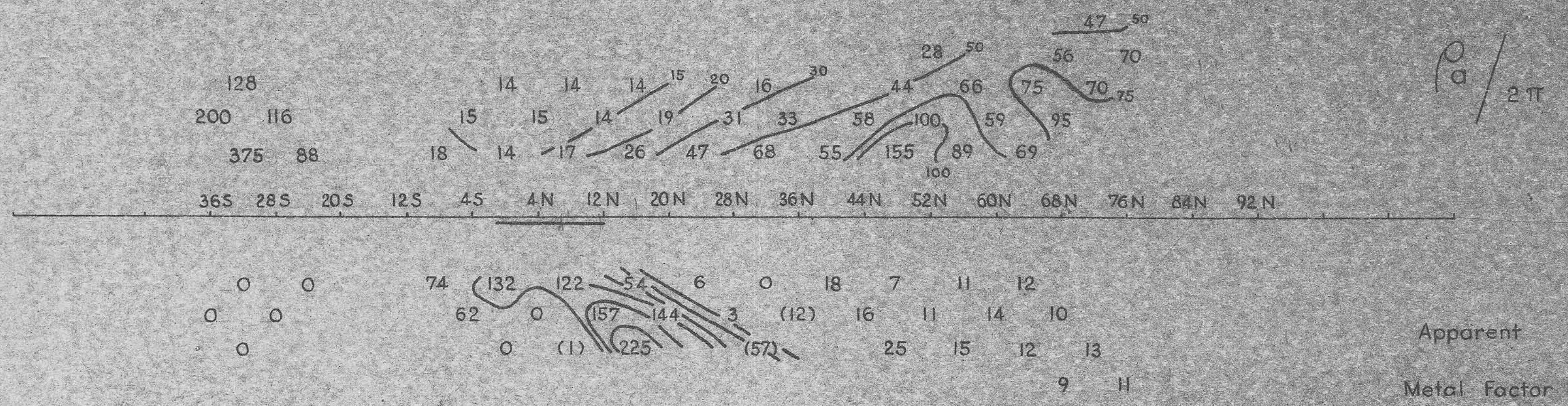
INDUCED POLARIZATION

5 cm



References	LYELL E.Z. EXPLORATIONS QUEENSTOWN				
	MOORES VALLEY LINE 5 W 400 FT. SPREADS 59-267				
	Survey			Scale	2328
	Geology			400 ft. to 1 inch	
	Geophysics	J.S., P.H.	Mar.'59		Q22 Sheet No. 13d
	Geochemistry				
INDUCED POLARIZATION	Drawn	P.H.	Mar.'59		
	Traced	D.S.	Mar.'59		375014

5 cm



References.

INDUCED POLARIZATION

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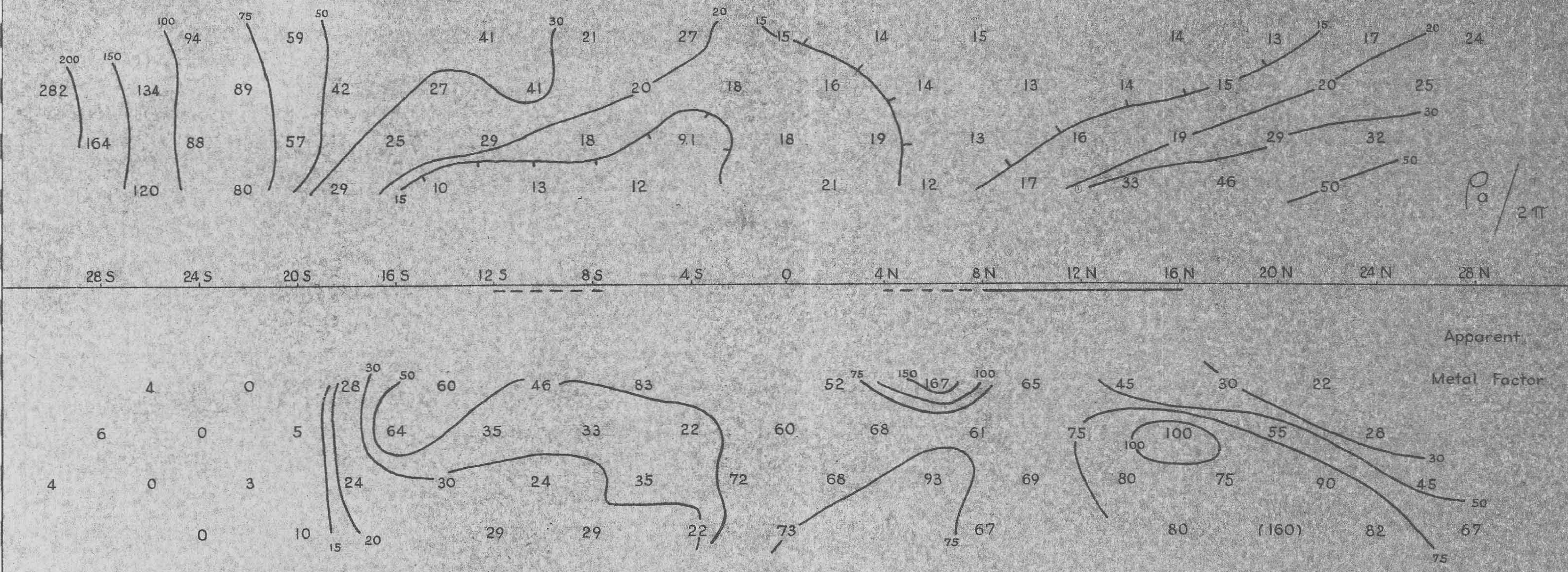
MOORES VALLEY

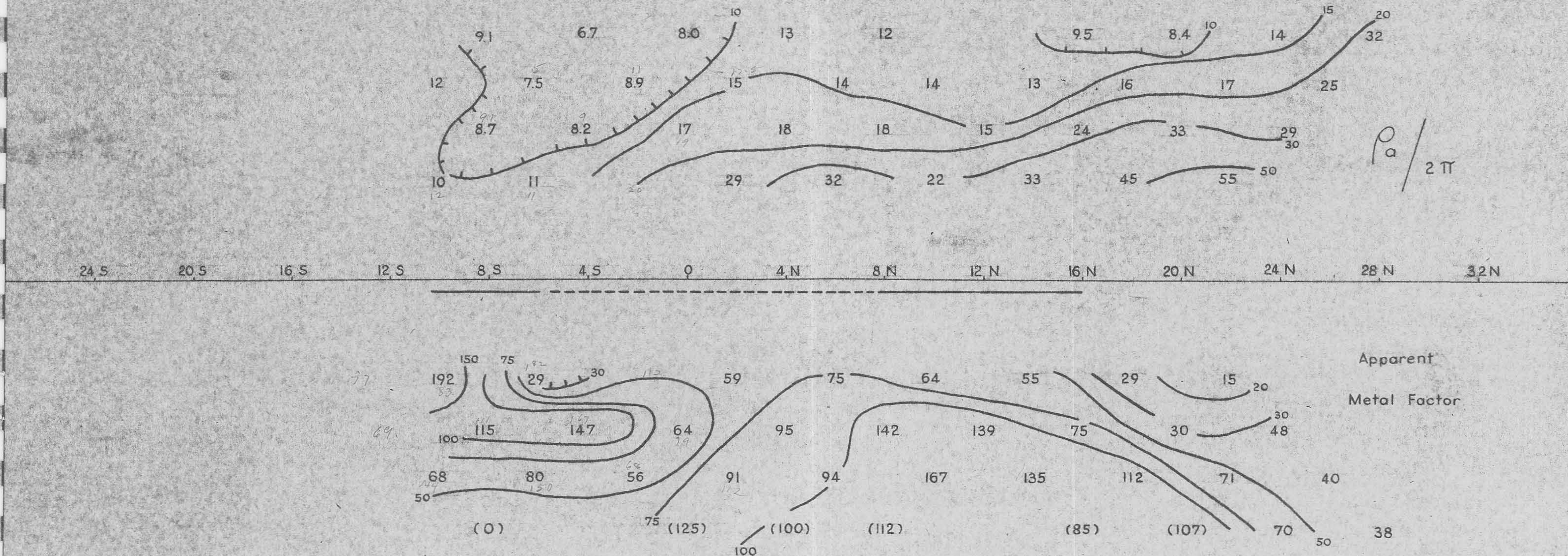
BL No. 1 — 800 FT. SPREADS — 59-267

			Scale	
Survey				2320
Geology			1600 ft to 1 inch	
Geophysics	J.S., P.H.	Mar. '59		Q 22 — Sheet No. 13e
Geochemistry				
Drawn	P.H.	Mar. '59		375015
Traced	D.S.	Mar. '59		



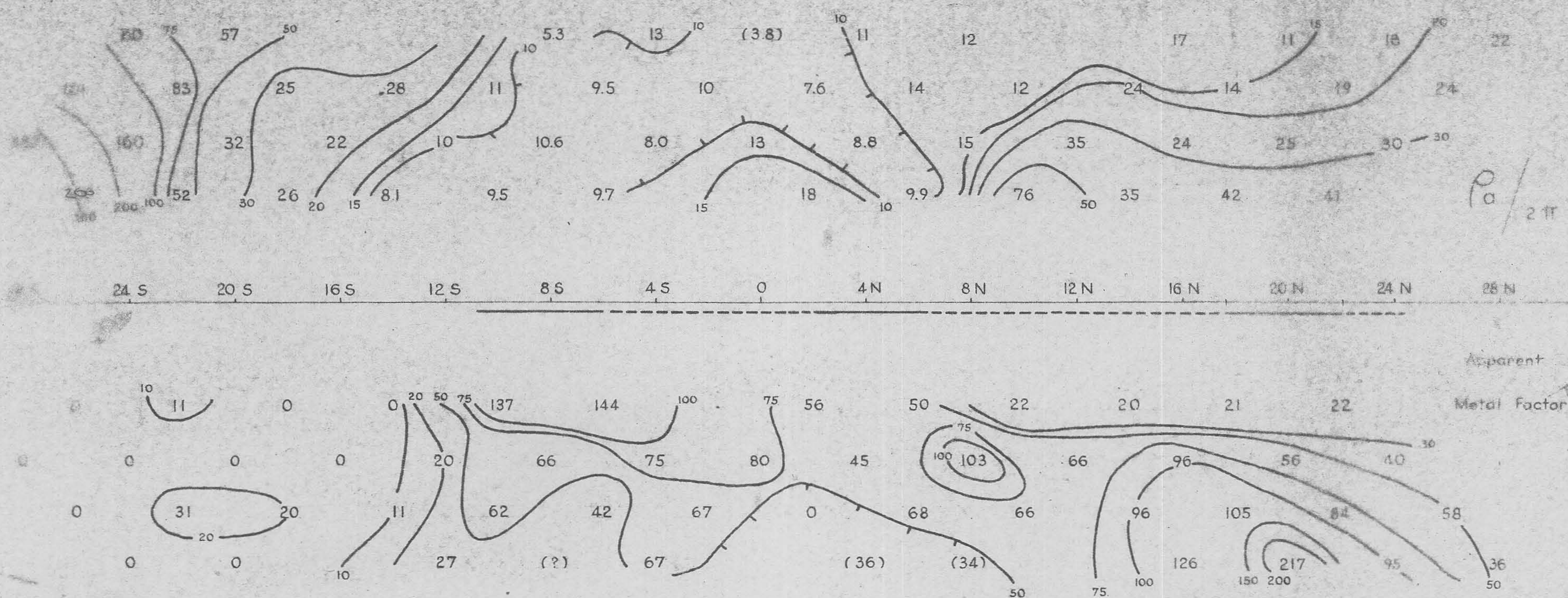
References	LYELL E.Z. EXPLORATIONS QUEENSTOWN			
	MOORES VALLEY BL Nº 1 400 FT. SPREADS 59-267			
	Survey			Scale: 400 Ft. to 1 inch
	Geology			2330
	Geophysics	J.S., P.H.	Mar. '59	Q22 Sheet No. 13f
	Geochemistry			
INDUCED POLARIZATION	Drawn	P.H.	Mar. '59	
	Traced	D.S.	Mar. '59	375016

5 cm



References	LYELL E.Z. EXPLORATIONS QUEENSTOWN			
	MOORES VALLEY LINE 15 E 400 FT. SPREADS 59-267			
	Survey			Scale	2331
	Geology			400 Ft. to 1 inch	Q22 Sheet 13g
	Geophysics	J.S., P.H	Mar.'59		
	Geochemistry				
INDUCED POLARIZATION	Drawn	P.H.	Mar.'59		
	Traced	D.S.	Mar.'59		375017

5 cm



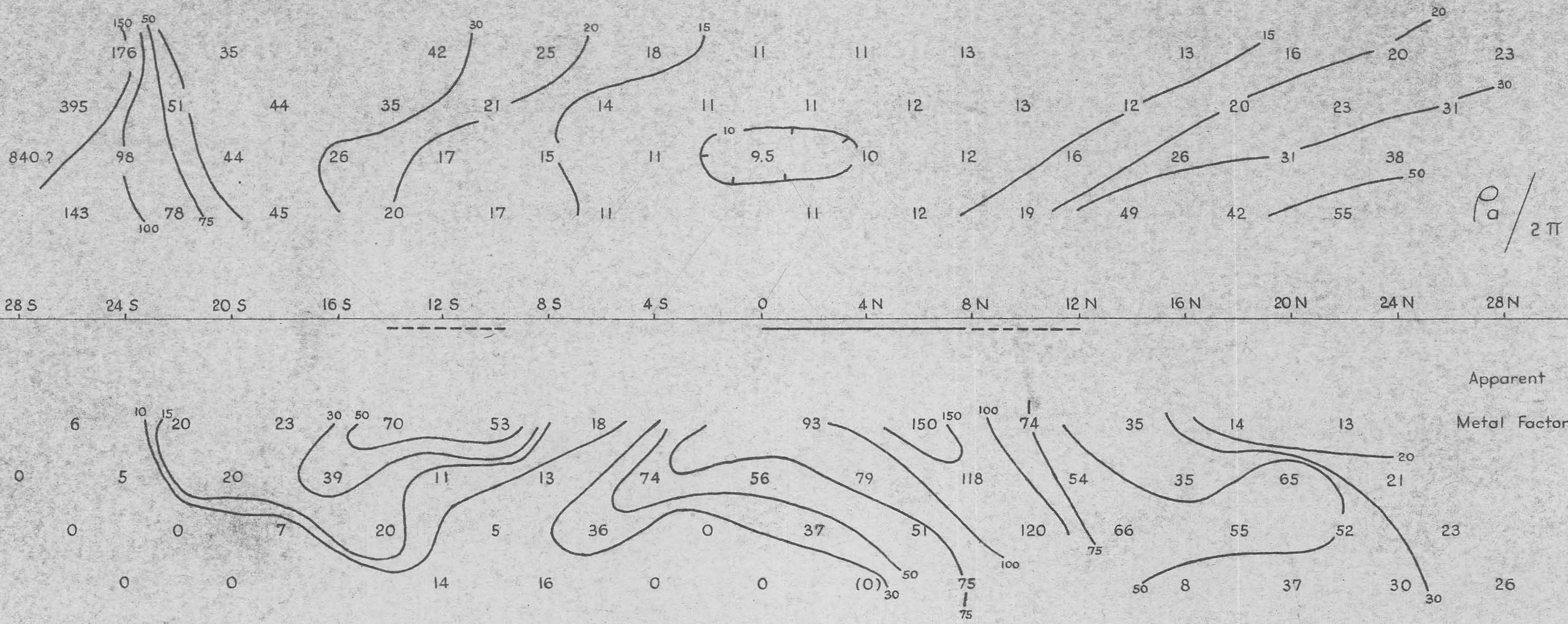
References	LYELL E.Z. EXPLORATIONS QUEENSTOWN			
	MOORES VALLEY LINE 10 E 400 FT SPREADS 59-267			
	Survey			Scale
	Geology			400 ft to 1 inch
	Geophysics	J.S., P.H.	Mar '59	
	Geochemistry			
INDUCED POLARIZATION	Drawn	P.H.	Mar '59	
	Traced	D.S.	Mar '59	

2332

Q 22 Sheet 13h

375018

5 cm



References

INDUCED POLARIZATION

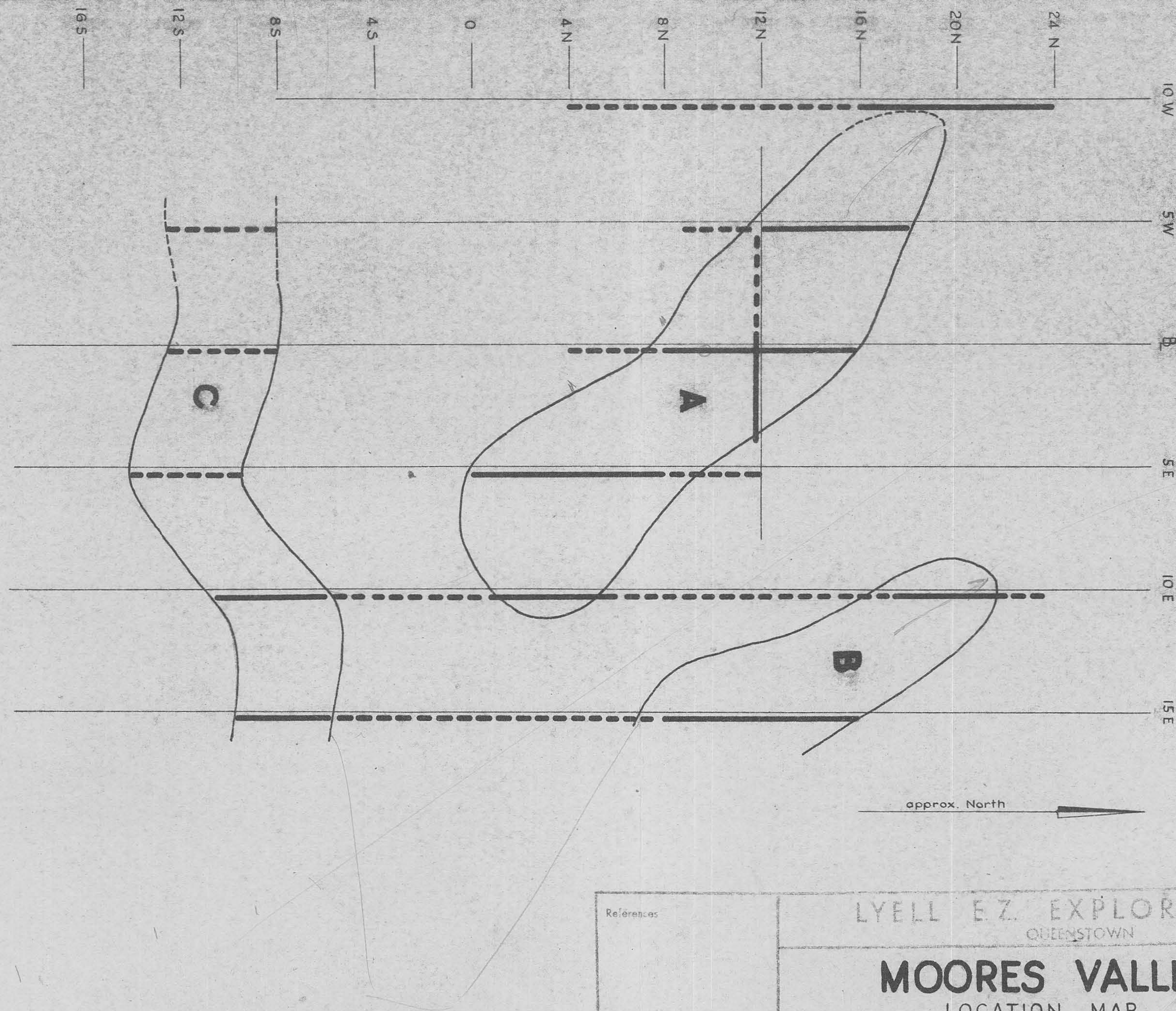
LYELL E.Z. EXPLORATIONS
QUEENSTOWN

MOORES VALLEY

LINE 5 E — 400 FT. SPREADS 59-267

			Scale	2333
Survey			400 ft. to 1 inch	Q22 Sheet No. 13i
Geology				
Geophysics	J.S., P.H.	Mar.'59		
Geochemistry				
Drawn	P.H.	Mar.'59		
Traced	D.S.	Mar.'59		375019

5 cm



References

LYELL E.Z. EXPLORATIONS
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MOORES VALLEY
LOCATION MAP

59-267.

			Scale	2334
Survey			400 ft. to 1 inch	Q 23 Sheet No
Geology				
Geophysics	P.H.	Mar.'59		
Geochemistry				
Drawn	P.H.	Mar.'59		375020
Traced	D.S.	Mar.'59		

INDUCED POLARIZATION