

A FURTHER INTERPRETATION OF
INDUCED POLARIZATION
AND
RESISTIVITY SURVEYS

MT. TYNDALL AREA, TASMANIA

FOR

THE CONSOLIDATED SYNDICATE

by

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SUMMARY

A further interpretation of two previously conducted surveys in the Mt. Tyndall area provided a large amount of data along line but poor correlation across the lines due to the large distance between the lines.

For complete geophysical correlation, the three zones of interest require additional lines between the existing ones. As the depth to the top of the response is not considered critical, a rapid coverage array such as the gradient array would be sufficient provided that it is strictly supervised.

TABLE OF CONTENTS

	<u>PAGE</u>
SUMMARY	
INTRODUCTION	1 - 2
GEOLOGY	3
PRESENTATION OF RESULTS	3
DISCUSSION OF RESULTS	3 - 27
CONCLUSIONS AND RECOMMENDATIONS	28 - 29

Maps:

1. MT Tyndall area.
2. mt Tyndall area.

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INTRODUCTION

At the initial request of Mr. G. Reynolds of Consolidated Goldfields and following further and detailed discussions with Mr. K.O. Reid of the Mount Lyell Mining and Railway Company Limited, the author was commissioned to review all geophysical data collected on the Syndicate lease, and where necessary, provide a more detailed interpretation. Geophysical contracts include McPhar Geophysics, Compagnie Generale de Geophysique (C.G.G.) and Scintrex (formerly Seigel Associates). Previous work executed by Rio Tinto Southern Pty. Ltd. was also available.

The main purpose of this review is threefold:

- I Up grade all geophysical interpretations - especially the weak interpretations of earlier surveys.
- II Integrate all the data from the various surveys.
- III Interpret and integrate the magnetic data.

This report consists of a review of the McPhar data plus the magnetic data collected from the coinciding traverses.

The interpretation of the McPhar data was slowed down because the percent frequency effects had to be calculated before a complete interpretation could be conducted. The metal factor as presented by McPhar is calculated as follows:

$$M.C.F. = \frac{P.F.E. \times 1000}{Ra/2\pi} \quad \text{where } Ra = \text{apparent Resistivity}$$

Hence, the metal factor is not a pure representation of the IP effect since the apparent resistivity is included in the calculation. All available theoretical model studies for interpretation usually utilize only the resistivity results and the Percent Frequency Effect.

The following relationship should also be noted at this time:

$$\frac{Ra}{2\pi} \text{ in ohm-feet} \times 1.96 = Ra \text{ in ohm-metres}$$

This calculation provides for conversion of resistivity values throughout the entire lease.

The dipole-dipole or double dipole array is universally favoured by contractors utilizing frequency domain equipment. Its strongest feature is the good amplitude of the response obtained. One of its weaker points is its poor resolution. The positioning of a narrow response can be as accurate as $\frac{1}{2}$ the dipole length providing excellent data is available. However, one dipole length is the normally quoted figure. Therefore, in order to accurately position a zone of response, a short dipole length (50ft) must be used. This does not always resolve the problem as depth of penetration depends on large dipole lengths.

Dipole-dipole data is severely affected by the presence of a conductive surface layer. "Masking" occurs and if the resistivity contrast is strong enough, a zone of IP response may be undetected when this array is utilized.

GEOLOGY

Considering the geology is well known and adequately described in several geological reports, it is sufficient to say that the majority of the area is underlain by Cambrian volcanics of the Mt. Read group; and the extreme eastern portion of the survey is underlain by the Mt. Owen Conglomerates. The entire area is covered by glacial till of varying thickness.

PRESENTATION OF RESULTS

The results are presented in the following forms:

McPhar pseudo cross-sections at 1" = 300' for apparent resistivity and Metal Conduction factor.

Mt. Lyell Mining and Railway Co. Contour Maps of PFE and Resistivity (n = 1) at 1:6000 (1" = 500').

Mt. Lyell Mining and Railway Co. profiles of geochemistry, magnetics, terrain, and McPhar pseudo cross-sections at 1" = 500'.

Mt. Lyell Mining and Railway Co. recalculated PFE values in pseudo cross-section.

Regenerated magnetic profiles of zones of interest only. 1" = 100'.

The interpreted results were plotted on a plan map of 1" = 500' (1:6000).

DISCUSSION OF RESULTS

Line 2 - East

This traverse is essentially outside of the Syndicate lease but is located on ground now held by Mt. Lyell Mining and Railway Company Limited. No magnetics and no geochemical results are available.

The IP results indicate a moderately strong response between 12E and 15E, which is expected to be exposed at the surface.

006

Data is incomplete to the west thus preventing a complete interpretation. If a response had been recorded at approx. 9E, then the response would definitely extend to surface, be relatively narrow as compared to the dipole spacing of 300 ft., and be situated at approx. 9E. This would compare favourably with the results obtained from 4 and Line 6.

A weak IP response was recorded from 39E to 42E. A surface expression or near surface expression is expected. Another surface expression is located at approx. 59-62E. It is more confined than the previous one mentioned. Further detail work is required. The response analysed at 33E is believed to be a false anomaly.

Line 4 - East

A strong IP response was recorded between 7E and 11E. It is expected that this response has a minimal depth of burial. The exceptionally strong IP response at $n = 4$ indicates that the geometry of the array was nearly perfect and an excellent source is expected at depth.

Another strong zone was recorded between 51E and approximately 58E. Further work with a 200 ft. dipole indicates that the source is located between 52E and 57E. Both spacings indicate that the response extends to depth.

The 100 ft. dipole data is indicative of zone of response 3-4 times wider than the dipole spacing. Also it would indicate a minimal depth of burial.

A possible zone of response is indicated approx. 75E by the 300 ft. dipole data. Further detailing with a 100 ft. dipole produced abortive results as readings were not obtained across the zone of interest. An anomalous zone could exist but there exists only three anomalous readings plus an unusual number of aborted readings, across the zone of interest. Further work is required.

Line 6 - East

Two very strong anomalous zones were recorded on this traverse. At 2W to 4E, an exceptionally strong response was recorded on the 200 ft. dipole. The 300 ft. dipole reveals that the response occurs at 300 ft. subsurface or less whereas analysis

007

of the 200 ft. dipole data suggests that the response is 200 - 400 ft. subsurface. It also clearly indicates that a surface expression can be expected. The incomplete magnetic data reveals a non magnetic environment, differing considerably from the strong response occurring on the western portion of the grid.

Another strong zone occurs between 44E and 47E as indicated by the 300 ft. dipole data. Analysis of the 300 ft. dipole data indicates that the top of the anomaly occurs at 300 ft. subsurface or less. The 200 ft. dipole data indicates the same (200 ft. or less) as does the 100 ft. dipole data (100 ft. of burial or less). However, the 100 ft. dipole data produced the strongest response and because of its shorter dipole length, suggests a narrower zone than the other two. The inherent lack of resolution of the double dipole array can produce a possible error in the positioning of the zone of response. However, it appears to be centred around 46E.

The resistivity results all indicate that a zone of lower resistivity is directly associated with the IP response. This would suggest a fair percentage of total sulphides (in the order of 10%) by volume.

Very weak (and incomplete) magnetic coverage across this zone eliminates the possibility of supplementary information. However, a good geochemical response is directly associated with this response at 46E. Drilling is highly recommended to test the nature of the source.

A zone of high resistivity occurs between approx. 58E and 62E with a geochemical response associated with the eastern contact. No increase in the IP response was noted.

L 6 + 200N and L 6 + 200S a = 100 ft.
L 6 + 400N and L 6 + 400S a = 200 ft.

The detailed work of two anomalous zones on line 6N consisted of 200 ft. dipoles at 6 + 400N and 6+ 400S across the zone at OE/W and 100 ft. dipoles across the zone at 48E on lines 6 + 200N and 6 + 200S.

Line 6 + 400S is incomplete as the data does not cover the anomalous zone. The data from line 6 + 400N indicate that

the source of the response is buried by less than 100 ft. of cover and it could possibly be exposed. The IP response is coincident with a zone of low resistivity.

Both lines 6 + 200S and 6 + 200N could have been extended eastward for proper coverage. The geology varies somewhat in that on 6 + 200S (46-47) the IP response lies immediately to the west of a zone of low resistivity whereas 6 + 200N (48E) indicates a more homogenous environment of essentially low resistivity with perhaps the IP response located within the zone of lower resistivity.

Line 8 - East

The IP results on this traverse are somewhat confusing as the 300 ft. dipole results and the 200 ft. dipole results do not correlate west of the road (OE/W). The 300 ft. dipole results indicate a zone of response between 3W and 9W. The 200 ft. dipole data was collected twice: one set up using even numbered stations and the other using odd numbered stations. The "odd numbered" set up clearly indicates the zone of response between 3W and 3E, whereas the "even numbered" set up, although incomplete, indicates that the response exists west of 1W. This discrepancy is due to the geometry of the set up, i.e. different spacings at different locations yield different patterns.

A detail spread of a 100 ft. dipoles centred at 20E produced no significant responses. Similarly, the 100 ft. detail spreads from 45E to 55E produced only a weak reflection of the power lines.

No really significant resistivity patterns are present. A weak low resistivity zone is associated with the IP response immediately west of the road and the geochemical response immediately east of the road is associated with a contact. No interesting magnetic features are associated with the IP results.

Line 10N - East

Only one significant zone of response was recorded on this traverse. The interpreted location between 36E and 39E. The fact that only 1/2 of the "inverted chevron" is present is

009

due to the presence of a resistive rock unit to the west of the IP response. This pattern is predicted in theoretical work. Both the 200 ft. and 300 ft. dipoles indicate a near surface response whereas the 100 ft. dipole data indicates a depth of burial of approximately 50 ft. This data also suggests a narrow zone (less than 50 ft.) centred at 37 + 50E. Resistivity results indicate a zone of low resistivity associated with the IP. The magnetics indicate a magnetic low at 39E and generally lower magnetic character at 37 + 50E than the surrounding material. It is most likely that sulphides are not the source of response. Favourable lead and copper geochemistry is associated with the eastern contact of the zone of low resistivity.

L 10 + 200S)
) a = 100 ft.
 L 10 + 200N)

Results from these two lines plus line 10N, indicate an apparent plunge to the south of the zone of response. Analysis of the data definitely support this idea as the depth to the top of the response (calculated) on line 10 + 200S is 100 ft. (58E) whereas on line 10N the calculated depth is 50 ft. (37 and 50E) and the results indicate that on line 10 + 200N the zone is less than 25 ft. from the surface at 36 + 50E.

Line 12N - East

One significant zone of IP response was indicated on this traverse at approximately 20E to 26E (300 ft. dipoles) to 22-24 + 50E for the 100 ft. dipoles. The zone of IP response has a zone of low resistivity associated with it. Other than a narrow magnetic response at 26E, there is no magnetics associated with the IP response.

The IP results indicate a wide zone as indicated by the response at all three spacings. However, the 100 ft. dipole data differs enough from theoretical modeling to suggest two narrow zones, both extending to surface. The centres of these two zones would be at approx. 21 + 50E and 24 + 50E.

The magnetic response at 26E was analysed in an attempt to provide further information. A body 50 ft. thick centred at 26E, the top of which is 50 ft. subsurface being indicated.

The body dips 70° to the west and has an average susceptibility of 1280 c.g.s. units. The model employed in the theoretical calculations was a thick dike (width equal to or greater than the depth of burial) having infinite strike (greater than 10 times the width) and infinite depth. No terrain correction was applied.

The resistivity results on line 10 + 200S indicate a resistive layer over the IP response. The calculated thickness is 100 ft. However, this environment does not exist on line 10N where the resistivity contrast is essentially 0.5 as is the contrast on line 10 + 200N. It is believed that the nature of the IP response also produces a zone of low resistivity. Graphitic sediments could be the nature of the response.

Line 12 + 300S)		12 + 200S)
) a = 200 ft.) a = 100 ft.
12 + 300N)		12 + 200N)

Continued on page 11

Line 14N - East

The Metallic Conduction Factor indicates a possible surface effect between 12E and 15E, but the percent frequency effect results indicate no significant IP response. A magnetic response at 11E was analysed and the following results were obtained:

- centre of body - 11 + 20E
- thickness of body - 75 ft.
- depth of burial - 75 ft.
- (depth to the top)
- dip - 70° W
- volume susceptibility - 2469 c.g.s. units ($\times 10^{-6}$)

This compares favourably to the magnetic results obtained on line 12N.

Line 14 + 300S a = 300 ft.

A very weak IP response was recorded between 7 and 11E. Due to the geometry of this spread, it is reflected at $n = 4$. This generally agrees with the data from 14N. It is expected that a 100 ft. dipole spread across 7-11E would properly reveal a narrow zone which is thought to exist.

011

Line 16N - East

The 300 ft. dipole results indicate a wide zone of weak response from approximately 1E to 8E and having a minimum depth of burial.

The 200 ft. dipole results clearly indicate the possibility of two zones; the first from 2E to 4E and buried at a depth of approximately 100 ft. and a deeper zone of response from 6E to 8E.

The 100 ft. dipole results clearly indicate two distinct zones of response; the first is a narrow zone, probably coming to surface and located between 3E and 4E.

The deeper zone centred at 7E was analysed and the following results were obtained:

depth to the top of the zone	50-100 ft.
calculated P _{fe} of response	10%
calculated resistivity	2-10 ohm-m

The resistivity results provided excellent correlation with a model having a resistivity of 1 at a depth of 100 ft. The IP results clearly indicate a depth of 50 ft. and indicate a lesser resistivity contrast (.1 rather than .01). To force a resistivity fit, the response would have a resistivity of 5 but the theoretical curve as compared to that obtained from field results provides a poor correlation. The magnetic results are very low in amplitude and do not offer any assistance. A 100 ft. dipole spread centred at 25 + 50E is of apparent value.

Line 16 + 200S)) a = 100 ft. (3W-10E)
))	
16 + 200N)	

These two detail lines confirm the interpretation of line 16N in that two zones are indicated. At 4 + 50E/16 + 200S, the most westerly zone would appear to be exposed at the surface. The eastern zone at 7E (16 + 200S) is at considerable depth probably 100 ft. or greater. (16N/7E calculated to be 50-100 ft.) The resistivity results indicate a contact at 4E with the more resistive material located to the west. Line 16 + 200N presents quite a different situation. The resistivity results clearly

indicate a resistive zone west of 1W and also a resistive surface layer east to 6E. The IP zone extending to the surface at 6 + 50E (16 + 200N) is associated with a contact at 6E as indicated by the resistivity interface (10W to E). The IP results also suggest that in the area of the high resistivity on the surface there could exist a layering effect. Another explanation would be adverse coupling effects. The response at 1E (n = 4) is directly associated with a low resistivity response. It is difficult to determine whether this is a lateral effect or a genuine response. Adverse coupling effects are suspected for the general area of high surface resistivity.

Extra detail work at approx. 20-25E with a = 100ft. on lines 16 + 200S, 16 + 100S, 16, 16 + 100N and 16 + 200N over a Metal Conduction Factor response proved to be of little value as far as the percent frequency effect is concerned. Background responses were recorded throughout. The resistivity results clearly indicate a zone of low resistivity within the 5 spreads. These low resistivity values are the cause of the metallic conduction factor anomalies.

Line 18N - East

A definite change in the geology is expected as the magnetics show a marked change in the amplitude and frequency of responses. There is no magnetic resemblance to line 16N. The resistivity results correlate well with the magnetic results in that contacts at 12E and at approx. 2E are well defined by both parameters with better resolution achieved by the magnetic method. The resistivity results also indicate a rock unit of low electrical resistivity between approx. 2E and approx. 5W.

The IP results do not present a clear picture as each spacing couples best with the different zones. The 300 ft. dipole data indicates a well defined zone between 2E and 2W located in a zone of low resistivity and immediately west of a contact of a zone of high resistivity. The data would suggest that the top of the zone is less than 300 ft. subsurface. The 200 ft. dipole data does not indicate as strong a source as the 300 ft. data, but it suggests a depth of burial of 100 ft.

The data obtained from the 100 ft. dipole spreads does not

013

correlate with the 200 ft. dipole data or the 300 ft. dipole data. It indicates a narrow zone of response at approx. 3W. The zone at approx. OE/W is not definite and the 100 ft. spacing is insufficient for adequate penetration.

Line 18 + 200S/3W (a = 100 ft.) indicates a moderate response with resistive material located immediately to the east. The IP response does have a moderately weak zone of low resistivity associated directly with it. The depth of burial is expected to be 50-100 ft. Line 18 + 200N suggests a depth of burial exceeding 100 ft. at 2W. It would appear that the response is more closely associated with the contact of the higher resistivity unit to the east than the previous lines (18W 18 + 200S).

Line 12N: continued.

It would appear that these detail lines were laid out according M.C.F. values as only 12 + 300S could be considered complete. Magnetic results have been obtained from 12 + 200N and 12 + 200S but correlation across the three lines is not as easy as expected. The magnetic results would indicate a considerable amount of metamorphism which is not indicated by the geology.

Line 12 + 300S (a = 200 ft.) indicates the zone of response to be centred at 23E and it is expected to be exposed at the surface. Line 12 + 200S (a = 100 ft.) presents an interpretation problem in that the data is incomplete at the west end of the spread. However, a wide zone from 21E to 24E could be possible. Also, it would have a minimum depth of burial. As previously mentioned, line 12 (a = 100 ft.) indicates a zone from 22E to 24 + 50E. Line 12 + 200N is definitely incomplete as a wide, very shallow zone of response is indicated from 24E to at least 20 + 50E. Also, there is the possibility of a deeper zone existing at approx. 22E.

An analysis of 12 + 200N at 22E revealed an IP response buried at a depth of 200 ft. A resistivity interface also occurs at this depth with the deeper layer having a resistivity of 0.5 that of the surface layer (100 ohm-metres for the deep zone). The calculated PFE for the deep zone was an unusually high 65%. Line 12 + 300N appears incomplete, but a narrow zone is indicated at 21E.

The results would indicate that the 100 ft. dipole couples best with this zone as much higher responses are usually

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recorded. This usually indicates the presence of a narrow zone. However, model studies suggest a much wider (2 times that of the dipole spacing or 200 ft.) zone of response at the surface. Drilling of this zone would answer this discrepancy.

Line 20N

	a = 300, 100 ft.
20 + 200S	a = 100 ft.
20 + 200N	a = 100 ft.

As mentioned on line 18, the magnetics show a marked departure from the previous lines. This is even more pronounced here as the magnetic response becomes highly irregular. A very strong (and shallow) magnetic interface is crossed at 6W. Up to 10% magnetite could be expected and remnant magnetism may be present.

The 300 ft. dipole results indicate a weak surface response at 10W-14W that occurs less than 150 ft. subsurface. It essentially occurs within a broad zone exhibiting a lower resistivity than the material east of 6W and west of 21W. The magnetic interface appears to be associated with the western contact of a zone of high resistivity located between 3W and 6W.

100 ft. dipole spreads were run on 20 + 200S, 20 and 20 + 200N from approx. 25W to 13W to cover the Metal Factor response between 15 & 18W. No coverage was obtained over the P.F.E. zone at 12W. Line 20 + 200S indicates a narrow zone, probably extending to surface and located between 18W and 19W. A weak zone of lower resistivity is associated with it. An analysis of the 100 ft. dipole data at 15W/20N revealed that the IP response occurs 100 ft. subsurface whereas there is a resistivity interface at 200 ft. subsurface with the surface layer having a resistivity in the order of 1000 ohm-metres and the deeper layer having a resistivity of 200-500 ohm-metres. This zone strikes to the east of north as the peak of the response occurs at approx. 17W/20N.

The resistivity results from line 20 + 200N reveal a generally homogenous material throughout. A 100 ft. dipole spread from 8E to 14E revealed no significant IP response.

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Line 22N (E)

a = 400, 300, 200 and 100 ft.

22 + 400S, 22 + 200S, 22 + 400N and 22 + 200N; a = 100 ft.

An unusually large amount of IP + resistivity coverage was obtained in this immediate area. The magnetic response is still as active as previously noted but as the results are less spurious, individual zones can be recognised. A magnetic response at approx. 21W was analysed and the theoretical model produced suggests essentially a vertical body with a width of 65 ft. centred at 21 + 40W with a depth to the top of the body of 60 ft. The best "fit" was achieved by combining two models; the eastern contact dipping 85° to the east and the western contact dipping 85°W. The calculated susceptibility for the body was 750 c.g.s. units. This is less than expected for an andesite. As younger rocks are to the east, the magnetic results indicate that the top of the mineralised horizon has a stronger magnetic character.

The detail IP results indicate a zone of high resistivity directly associated with the magnetic response. This would indicate that either the magnetic zone is more crystalline than the surrounding rocks or that quartz is present within the magnetic zone.

In general, the IP results indicate a direct association between the zone of response and an equal zone of low resistivity. The detail data (a = 100 ft.) indicates that the zone of lower resistivity occurs at the western end of the IP response or at the bottom of the mineralised horizon.

Both the 400 and 300 ft. spreads indicate a zone of response from 20-24W and probably extending to surface. However, they also both indicate the possibility of a deep zone at approx. 18W. However, as there exists a more resistive zone from 20W eastward, this apparent response is due to a distortion of the response pattern. A zone of low resistivity possessing an IP response in contact with a zone of higher resistivity, exhibits a distorted IP pattern. The amplitude of the response at n = 4 indicates a good continuation of the zone at depth.

The 200 and 100 ft. spreads suggest a depth of burial of approximately 100 ft. for the IP response and definitely indicate a zone of at least 300 ft. wide. The abnormally high IP response at 18W, n = 4 is probably a false anomaly

as the dipole-dipole array yields false anomalies from bodies having a very high resistivity. This is due to undesirable distortions in the electrical pattern around a resistive zone.

The strike of this zone is not too well defined and it does not coincide with the magnetic results. Utilizing the 100 ft. dipole data, the IP response is located at 19-20W. 22 + 200S, 21-23W/22N (at depth) and on line 22 + 200N, it is very difficult to determine its position as there is a weak response from about 29W to about 20W.

An EM conductor obtained with the turren method by Rio Tinto during two periods of work in the 1957/58 and 1958/59 seasons is located at approximately 15W on line 22N. The EM response is strong and very narrow (probably 10 ft.). Only the 100 ft. dipole data has any chance of resolving it by the IP method. An incomplete IP response is noted at 13 + 50W on line 22 and a narrow, low resistivity zone at approx. 15W. The correlation of the data is not good as the position of the EM response is not accurately known. An IP response occurs at a depth of 100 ft. or greater on line 22 + 200S at 14 + 50W and a zone of low resistivity is directly associated with it. An IP response at 14 + 50W on line 22 + 200N but the resistivity results do not indicate any narrow zone of low resistivity associated with it. The magnetic data provides very little supplementary data in that the nearest magnetic feature of any note is at 17 + 50W. However, a minor feature of 100 gammas occurs at 14 + 50W and may be associated with the EM conductor.

Gravity data collected over the zone reveals a negative departure from the norm. Topographical results presented show a creek coincident with the gravity low and associated with the EM anomaly. A water filled shear zone would account for the EM response and the water filling the voids within the shear should effectively reduce the average density thus producing the gravity low. (See Bonivall, 1959, see Rio Tinto) The most promising gravity anomaly located at approximately 10-12E was not covered by the IP and resistivity survey.

Lines 22 + 400S and 22 + 400N (a = 100 ft.) can only be correlated with the 300 ft. dipole data from line 22N. No IP response was recorded at approx. 8W/Line 22N but both of the intermediate lines suggest a narrow, weak response at this point. A narrow zone of lower resistivity occurs at approximately 9 + 50W on line

22 + 400S whereas a zone of lower resistivity occurs at approx. 6 + 50W on line 22 + 400N. Neither zones of lower resistivity are directly associated with the IP response and different environments are suspected. Line 22 + 400S indicates an IP response at approx. 5 + 50W but as data is incomplete, it is impossible to correctly position the data.

Line 24N

a = 300 ft., 200 ft. + 100 ft.

The reconnaissance results show an IP response located between 24W and 27W and located within a zone of high resistivity flanked on the east by a zone of low resistivity.

Two sets of 200 ft. dipole data are presented - one of which is incomplete to the west but because of its additional coverage to the east, it reveals a weak, narrow response at 12W. Resistivity results indicate that the IP response is associated with a weak resistivity contrast. The 200 ft. dipole spread utilizing even numbered stations for its set-up and extending the farthest westward, indicated an IP response approximately 200 ft. wide and centred at 26W. Resistivity results indicate that this response is directly associated with a contact zone. A very weak zone is suggested at 23W and is associated with a contact environment.

The 100 ft. dipole data does not extend far enough westward to adequately test the response at 26W. However, the weak response previously noted at 23W is well defined by the 100 ft. dipole. A zone of approximately 200 ft. in width is indicated. The results also indicate that this zone extends to the surface. Resistivity results indicate that a zone of high resistivity flanks the IP response on the east.

Detail lines at 24 + 200S and 24 + 200N indicate a complicated strike of the zone. The results on 200S are not overly conclusive as a very broad, weak zone extends from 20W to 24W. Utilizing the resistivity results from 24N, the centre of the response should occur between 23 + 24W. Results from 200S do not verify this and no definite response can be determined. Line 200N is not complete to the west, but an IP response between 24W + 25W is definitely indicated. The results also indicate that a surface expression can be expected. The resistivity results clearly show a change in environment in that the IP response is located within a

018
wide zone of homogenous electrical resistivity. A narrow zone of low resistivity exists to the west of the IP response and is located at 26W-27W/200N; 25W/24N; and 25-26/200S.

A magnetic model was generated for the response peaking between 25 + 26W. Results yielded a body 200 ft. wide centred at 25 + 30W with the top buried 60 below the surface. A dip of 90° provided the best results as did a volume susceptibility of 250 c.g.s. units. This body correlates very well with the interpreted location of the deep IP response as indicated by the 200 and 300 ft. dipoles.

The EM results as presented by Rio Tinto indicate that two different zones terminate in the general area of line 24 at about 15W to 20W. No 100 ft. dipole data covers the area but one of the 200 ft. dipole spreads does suggest a favourable zone of low resistivity at approx. 17W (a zone of low resistivity identifies a favourable EM target).

Line 26

This line shows no real strong IP response. However, the two zones are of interest. Between 24W and 27W, a definite weak, narrow IP response is indicated. This would appear to be complimented by an EM response as obtained by Rio Tinto. A possibility of a second EM response located at approximately 29W to 30W also exists. A zone of low resistivity occurs between 21W and 24W and may possibly lie adjacent to the IP zone. Although the results are inconclusive, it would appear that this zone between 24 + 27W extends to the surface.

A deep seated zone exists at approximately 39W-42W. An analysis of the results ($a = 300$ ft. only) did not provide a good interpretation. The resistivity results indicate a weak resistivity contrast whereas according to the best IP "fit" a contrast of -1 (ρ_2/ρ_1) could be expected. The depth of the IP response is of the order of 150-300 ft. The calculated PFE was not much greater than 4% which indicates that if a higher PFE were expected, then the width of the zone does not exceed 150 ft.

Magnetic and resistivity results indicate a zone similar to

013

one previously discussed in that the eastern portion of the IP zone has a magnetic response and the western portion exhibits a possible zone of lower resistivity.

Magnetic results also indicate a sharp, near surface response of very strong magnitude located between 12W and 15W. A combination of an edge plus a narrow, dike like body is suspected. The resistivity results do suggest a narrow, more resistive unit between 12W and 15W.

Line 29

Both the IP results and the resistivity results are not too inspiring as only weak IP responses were recorded and only a few resistivity interfaces were recorded. Two weak IP responses include one at approx. 28W and the other at approx. 34W. A zone of lower resistivity is located between the two. The 200 ft. dipole spread indicates a weak zone at 33W and the possibility of a very weak one at 29W. A definite zone of low resistivity exists between 28 and 30W.

The detail work at a = 100 ft. is incomplete as lines 28 and 28 + 200N need to be extended westward. Line 28 + 200S indicates an IP response at approximately 30W and is situated within a wide zone of low resistivity. Line 28 + 00 suggests that the IP response is located between 31W and 32W but due to the incomplete results, it is questionable. A narrow zone of very low resistivity at 29W correlates with the approximate position of the Rio Tinto EM response. This is also within a zone of lower resistivity. Line 28 + 200N indicates an IP response between 32 and 33W whereas the zone of lower resistivity is located between 29 and 32W.

No magnetic results were available for this traverse.

Line 30N

Two IP responses were recorded on this line of which the zone between 1E and 5E is of most interest. The 300 ft. dipole data indicates a zone probably exposed at the surface and a zone of low resistivity directly associated with it. The 200 ft. dipole confirms this and definitely locates the IP response and zone of low resistivity against a resistive rock unit to the east. The fact that the 100 ft. dipole data confirms this clearly indicates a narrow zone (3 + 50E to 4 + 50E) and

020

surface exposure is expected. The lack of any magnetic response suggests that this is a classical graphite response.

A second, but much weaker response occurs at approximately 30W and it is directly associated with a zone of low resistivity. Analysis of the data at 30W indicates a depth of burial of 50 ft. with the zone of response exhibiting a PFE of greater than 5%. As there exists a subtle 100 gamma change in the magnetics, black shales are not expected as the source material. There is insufficient data in the area of the Rio Tinto EM anomaly to check it by either IP or resistivity.

Line 32N

This line produced only one significant IP response and it is the northern continuation of a suspected black shale horizon. The IP response is located within a wide zone of lower resistivity and the 300 ft. dipole data locates it between 6 and 9E and in contact with a more resistive rock unit to the east. The 200 ft. dipole data positions the IP response about 200 ft. west of the resistive rock unit at 11E but indicates a low resistive unit within the IP response. The 100 ft. dipole data does not indicate the narrow zone of low resistivity within the IP response. The zone is at least 100 ft. wide, centred at 8E and buried 50-100 ft.

Line 34

Two IP responses were located on this line and neither are considered to be strong. Only 400 and 300 ft. dipole data is available, but it would appear to be a narrow zone approaching the surface at approx. 32W. It is located within a zone of moderate resistivity with no interpreted contacts close by. None of the extra detail work covers this zone.

The 200 ft. and 100 ft. dipole data covered a weak response at approx. 20W. The results would indicate a weak zone between 18 and 19W probably less than 50 ft. wide and exposed to the surface. The detail (a = 100 ft.) indicate a direct association between the IP response and a contact at 18 + 50W.

A second zone of interest occurs at approx. 9-12E. This response occurs within a zone of high resistivity (3000 ohm-metres). The 200 ft. dipole data is incomplete but it tends to place the zone

021

of response at 12E. There exists a possibility of a deep seated zone at 7E. An analysis of this possible zone reveals a depth of burial of 200 ft. and a calculated PFE of 6% or greater.

Line 36

Between 21 and 27W, the possibility of two zones of response exists. Both zones are indicated by the 300 & 200 ft. spreads whereas the detailed 100 ft. spread only indicates the zone at 23-24W which is expected to be exposed at the surface. The detail results also reveal that the IP response has a zone of low resistivity located on its eastern boundary.

The 200 ft. dipole data clearly indicates the zone at 23W and places the IP response within a general zone of low resistivity. The second zone would be located at approx. 26W utilizing data from the 200 ft. spread and at 27W from the 300 ft. data. Analysis of the 300 ft. data at 27W indicates a depth of burial of approximately 150 ft. and a calculated PFE response of 6%.

The 200 ft. & 300 ft. data yield a discrepancy of position for the IP response at approximately 10E. The 300 ft. dipole data positions the IP response between 7 and 11E with a distinct zone of low resistivity from 8E to 10E. The depth of burial is expected to be less than 100 ft. The 200 ft. data positions the response between 10 and 13E and over a contact zone as indicated by the resistivity results. An exceptionally resistive rock unit is indicated by the 300 ft. data to exist east of 16E. No detail information is available for this response.

Line 38N

Two distinct zones of IP were recorded and there are also two possible zones within the western zone. A very broad, near surface zone is located between 34 and 41W. The 300 and 200 ft. data indicate that the response should be exposed at the surface but the detail data suggests 50 ft. of barren cover. The detail data would also position the zone from 38-40W. Resistivity results indicate that this zone response is located on the western edge of a resistivity low.

Another zone at 11W is of a different nature. The 200 ft.

022
data clearly indicates an IP response directly associated with a narrower zone of low resistivity. A surface expression is expected.

A deep seated (greater than 150 ft.) IP response is located at approximately 12E. The resistivity results indicate a slightly lower zone of resistivity directly associated with it. No detail results are available.

DISCUSSION OF THE RESULTSLine 2-W

The IP and magnetic results indicate a distinct change in physical properties for the material west of approximately 37E (3700E). The magnetic and IP response is relatively flat with the exception of an IP response on the surface at approximately 17 + 50E. A minor magnetic response is directly associated with it.

A broad, weak IP response is noted between approximately 38E and 42E. The magnetic data indicates vertical bodies centred at 38 + 50E and 47E suggesting the contacts of the host rock are the IP response. However, the magnetic responses could also be due to two separate bodies with the weak and near surface IP response located between them. The analysis of the magnetic response at 37 + 50E reveals a body buried at 85 ft. and having a dip of 90° . Assuming a true thickness of 100 ft. the calculated susceptibility is 1860 c.g.s. units. The analysis of the response at 47E reveals a depth of burial of 50 ft. and a dip of 90° . Assuming a thickness of 50 ft., the calculated susceptibility is 3720 c.g.s. units.

A weak surface IP response is located between 60E and 63E. It is associated with a gradual resistivity change whereas the IP response at 47E is associated with a very strong resistivity contrast. The magnetic response is directly associated with the high resistivity zone (47E) suggesting a crystalline, magnetic rock unit.

Line 4-W

A strong IP response was recorded from approximately 27E to 31E and the IP results indicate that the response is exposed at the surface or it is a near surface feature. The very strong magnetic response could indicate a 7-10% magnetite content and it is directly associated with the IP response. The geochemical response occurs on the western contact of the zone. The contact as indicated by the resistivity results is associated with the magnetic response in that the magnetics lie immediately to the west of the contact (and directly related to the IP). A possible steep dip to the east is indicated.

024

A weak surface IP response occurs between 14E and 18E. Another weak surface zone occurs between 53E and 56E. A very narrow and weak IP response occurs at approx. 61E and resistivity results indicate an association with a contact, as indicated by the magnetics (steep westerly dip?). Another weak IP response located between 67E and 71E is directly associated with a low resistivity surface feature which possibly overlies a narrow zone of low resistivity. The magnetics are homogenous over this zone thus revealing no magnetic character. However, geochemical results are associated with the western and eastern contacts of this zone and also with a westerly dipping magnetic feature at 78E. Leakage is suspected for this last case.

Line 6-W

A very strong IP response occurs from 15E to 21E and is directly associated with a strong magnetic response plus low resistivity values. Serpentine is strongly suspected as the source material. A review of the contoured magnetics reveals a NE trending fault between lines 4 & 6 offsetting the N block about 500 ft. to the west. North of this fault, all responses are directly related whereas south of the fault, this is not the case.

A narrow, weak IP response occurs at 63E and is associated with a zone of low resistivity. A very weak magnetic response was recorded associated with this zone.

Another zone of interest occurs between 76E and 80E. This zone occurs at least 100 ft. subsurface and has a narrow zone of low resistivity at its western boundary at approx. 76E to 77E. A very strong geochemical response is coincident with the IP response. A very weak magnetic response indicating an easterly dip is associated with this response.

Line 8-W

The most notable feature on this line is the highly magnetic low resistivity in IP response located between 15-18E. The data is incomplete at the western end and further work - including detail spreads, is necessary to fully evaluate this zone. Detail work is necessary to correctly position the IP and resistivity in relation to the magnetics. A shallow zone between 15 and 18E correlates with the magnetics but there

025 .
exists a second zone of response to the west of the ultra-basic rock unit and further work is required to evaluate it.

A weak IP response is located at 63E and has a magnetic response associated with it. A magnetic model that provided the best "fit" with the field data was a dike with infinite strike and depth, dipping 60W, having a thickness of 200 ft. centred at 63 + 30E, a depth of burial of 125 ft. and a calculated susceptibility of 160 c.g.s. units. This depth would compare with an estimate of the depth of burial of the IP response. Further work to the west is needed.

Line 10 (W)

The ultra-basic rock unit can still be seen in the magnetic results but there is a marked reduction of the amplitude of the response. The IP results indicate a possible isolated zone with no depth extension at 21E.

Line 12N (W)

Three zones of interest occur on this line with two of them being shallow zones; one at each end of the line (48E and 24-27W) and a deep seated zone between 12-15W.

The zone at 48E has a zone of very low resistivity directly associated with it, and surface expression is expected. The magnetic feature at 40E is probably due to a shallow westerly dipping, thin dike. It is interesting to note that the anomalous geochemical responses occur between the magnetic feature at 40E and the IP response at 48E.

The IP zone at approximately 24-27W is of moderate amplitude and the magnetic results would indicate that it occurs in a different environment than the deep zone at 12-15W. Further work is required here to properly outline and locate the zone.

The deep seated zone located at 12-15W has magnetic results indicating that the western portion of the IP response has a magnetic character. However, the magnetic response has a much shallower depth of burial than the IP response and may not be related. A steep westerly dip is suggested by the magnetics. Theoretical results of the IP response indicate that it has a depth of burial of approximately 300 ft. with

026

a calculated PFE of 10%. Resistivity modeling indicate a zone of low resistivity below approximately 500 ft. As the IP and resistivity interface do not occur simultaneously, a complex environment is suggested.

Line 14N (West)

The results from this line differ considerably than line 12 in that the expected continuation of the most western response from line 12 probably occurs west of 21W and is verified by the incomplete response due to inadequate IP coverage. The response at 12W (n = 3) is probably due to either a bad reading or an isolated body of limited size. The magnetic response at 7W arises from a very shallow, narrow dike with a steep easterly dip.

Another zone at 42E is associated with a resistivity contrast. The IP response would have a depth of burial of approximately 100 ft. The magnetic results indicate that this response occurs from within a general zone of magnetic activity.

Line 16N

A marked change has occurred in the geology in that the zones of low resistivity and the IP responses are very wide as compared to previous results. Also, the background has generally increased by a factor or two.

A general zone of IP response occurs between 9W and 18W. As there is no magnetic response associated with this response, a multi-banded black shale sequence is suspected.

A minor isolated response at 0 + 00 is probably due to a body of limited dimensions.

Line 18 (W)

The small, single station responses recorded east of 0 + 00 are not considered to be significant in this environment. One very weak IP response occurs between 15 and 18E. There is no complimentary magnetic or resistivity response and the same at 24-27E.

A very broad, amorphous IP zone occurs from approximately 3E

027

to approximately 24W and generally speaking, occurs in a homogenous host rock. Only two distinct zones of higher resistivity occur between 6 and 9W and also between 18 and 21W. Other than a generally low resistivity surface layer, there is only one zone of lower resistivity which occurs at 21-24W. The strongest portion of the IP response occurs between 9W & 12W. The response pattern is considered abnormal due to the adjacent zone of high resistivity. A weaker IP response occurs between 21W & 24W (directly associated with the zone of low resistivity) and it is believed to be buried at a depth of 100 ft.

Other than a strong, near surface dipole effect at 3E, the western half of the magnetic results are exceptionally uniform. An isolated surface response occurs at 13E and east of 35E, the magnetic results show considerable activity.

Line 20 (W)

A single very high IP response is questionable between 6 and 9E (n = 3). It is thought to be caused by a distortion of the electrical field due to the extreme resistivity contrasts.

An IP zone buried at approximately 100-200 ft. occurs between 12W and 15W. A reduction of resistivity occurs with depth and is associated with the IP response. Analysis of the results by theoretical modeling reveals that the IP response has a depth of burial of approximately 100 ft. whereas the resistivity interface occurs at a depth of 300 ft. and indicates that the second layer has a resistivity of 90 ohm-metres.

The zone between 6W and 10E is believed to be composed of a series of crystalline and sedimentary rock units. At approximately 2E, a narrow zone of low resistivity has a weak IP response directly associated with it.

Weak IP responses occur at approximately 21-24E, 27-30E and 33-36E are considered to be narrow and exposed at surface.

Line 22N

From 3E to 28W, the IP responses indicate the possibility of sulphides, and/or banded black shales throughout. Within

028

this broad zone are four possible targets:

Between 0 & 3E there is a narrow near surface zone of low resistivity with an IP response directly associated with it. As there is no magnetic response associated with this response, black shales should be considered as a possible source material.

Another zone of IP response occurs between 6W and 9W and it is expected to be exposed at the surface. Resistivity results indicate that this response occurs from within a wide zone of moderately low resistivity.

The zone at approximately 15W occurs below 150 ft. of cover and is in a more resistive rock unit and adjacent to a zone of low resistivity.

The zone at 24W is also buried at a depth of approximately 150 ft., is not as strong as the narrower zone at 15W and is within a resistive rock unit.

All of these responses have no magnetic character and this strongly suggests sediments.

Line 24N (West)

Four IP responses were recorded from within a zone of general response. The zone at 7E is perhaps the narrowest and the only one expected to come to surface. No distinct change in resistivity or magnetic results are noted. Another narrow zone occurs between 11W and 14W and 0-50 ft. of burial are expected. The zone at 1E is believed to be caused by a body of limited depth extent. Also, the validity of the $n = 3$ value could be questioned.

The zone at 16E occurs beneath about 100-150 of cover and a low resistivity layer is at the surface.

None of the responses exhibit any magnetic character and the IP responses could therefore be caused by black shale horizons.

Line 26N

Two general features can be said about this line. Firstly,

CONCLUSIONS AND RECOMMENDATIONS

Several zones of response were recorded, two of which require additional work and a third may require additional work.

The main zone of interest is the response known as Howards' Anomaly. This zone is located on the eastern grid from line 16N to at least 26N, a strike length $1\frac{1}{2}$ miles. It is also characterized by a distinct change in the magnetic response.

Geophysical work to date suggests either a series of an echelon features or discontinuous zone of response off-set by a series of faults. The resistivity indicates that there is usually a resistivity low directly associated with the IP response. Neither the IP results nor the resistivity results can easily be correlated across the $\frac{1}{2}$ mile separating the survey lines. The magnetic activity varies considerably throughout this zone from very strong, near surface effects, isolated zones plus one good lineation through line 22N. Previously collected Turam results do not correlate with the IP results and definitely outline an entirely different target. Also, the previously collected gravity results do not produce any supplementary results in the zone of interest. A positive gravity response at 10-12E on line 22N requires further attention.

Another zone of interest occurs from line 6N to 8N striking north from 0 + 00 on line 6N. The minimal information from this area suggests a worthy zone of interest.

Both of the above zones require a complete geophysical coverage in order that geophysical correlation may be provided.

As information on the depth of the zone is not considered as important as its exact location, both areas could be resurveyed with IP and utilizing the gradient array for rapid coverage and accurate positioning of the zone of response. Traverse lines should not exceed 600 ft. in separation and adjacent gradient blocks should have a common traverse. Magnetic data should also be collected. All work should be strictly supervised.

A third zone of interest is located on the western grid from line 4N to line 12N and is associated with a mapped gabbro intrusive. As the IP coverage to the west of this body is

there is an absence of magnetic response and secondly, the previously very wide IP response is now two wide zones.

Between 18 and 21E, a narrow zone buried 100-150' subsurface occurs within a moderately low resistivity zone.

A zone located between 3E and 6E is directly associated with a zone of low resistivity and surface exposure is expected. This zone extends with depth and is located close to a zone of high resistivity.

A zone at 12W is buried at a depth of approximately 150 ft. and is directly associated with a zone of low resistivity.

At 24W, a narrow IP response is associated with a contact environment. Its depth of burial is expected to be 100-150 ft.

A narrow, near surface IP response occurs between 24 and 27E.

Line 28N

24E to 21W is essentially a zone of polarization with the zone from 12E to 18E being exceptionally strong.

12E to 18E is one of the strongest responses recorded in the entire survey. It is expected that this response will be exposed at surface. A favourable zone of low resistivity corresponds with the IP response but there is no magnetic response. This would indicate a classical black shale as the source of response. There exists the possibility of two additional zones flanking this main one. The first would exist at 6-9E and at an expected depth of 200-300 ft. whereas the second would be located between 21 and 24E and at a depth of 50-100 ft. This second zone is on a strong contact zone and may not be black shale.

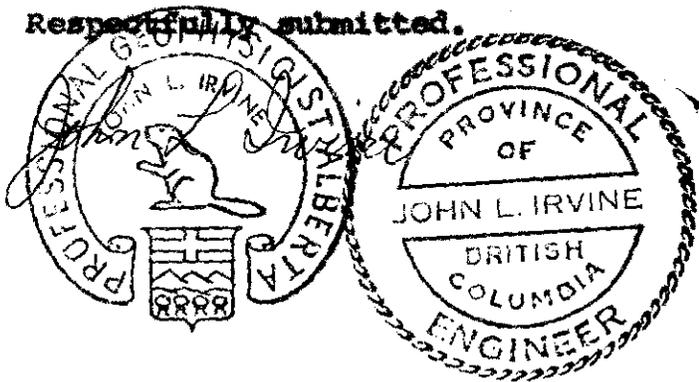
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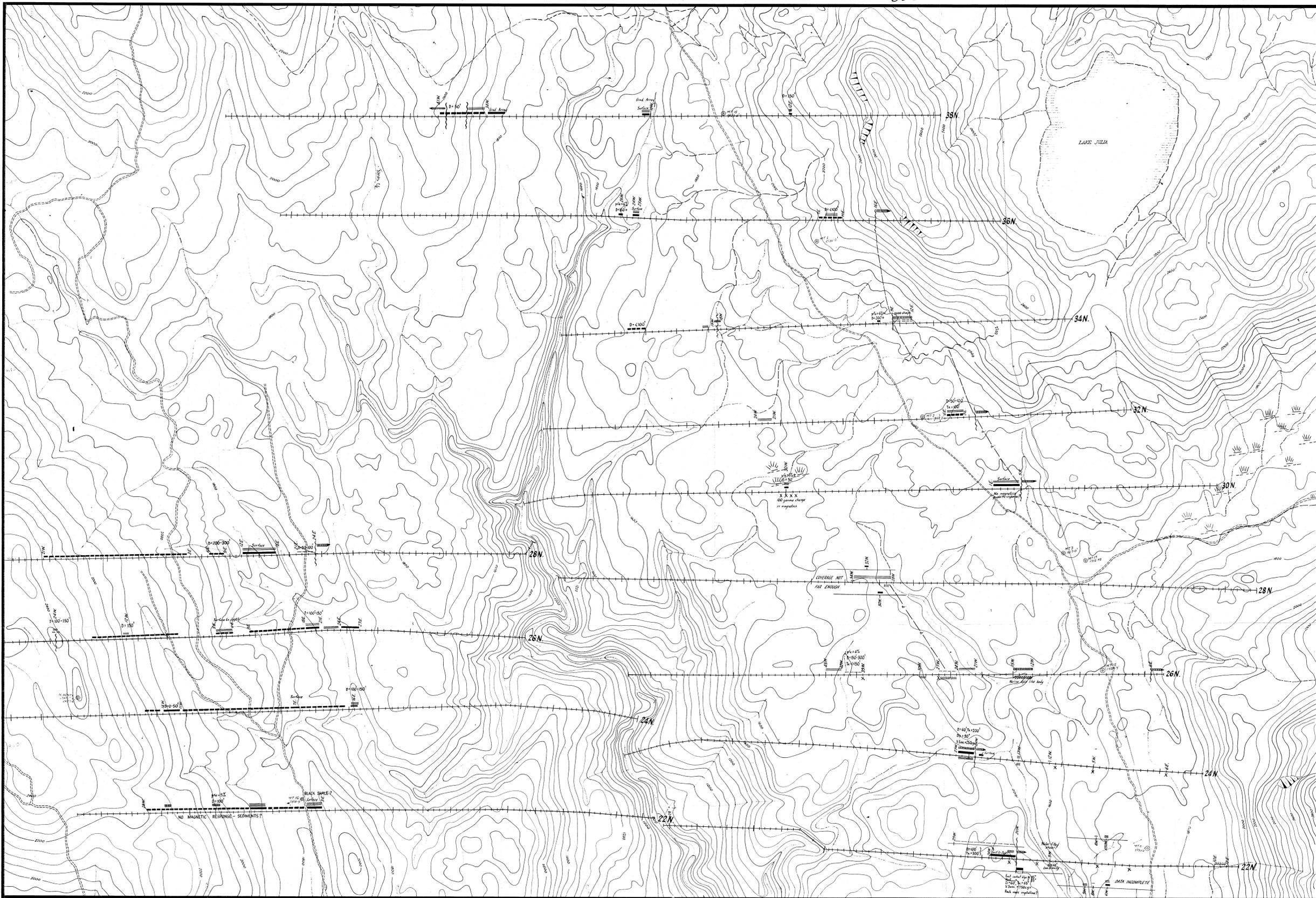
incomplete and as a possible IP zone exists to the west (line 12N), further IP work is necessary to completely outline this zone.

As further geological information becomes available, the author is willing to discuss any discrepancy that may arise.

Respectfully submitted.



Expiry Date: July 18, 1974



ANOMALIES

I.P.

- CHARGEABILITY
 - STRONG
 - MODERATE
 - WEAK
- RESISTIVITY
 - HIGH
 - LOW

MAGNETICS

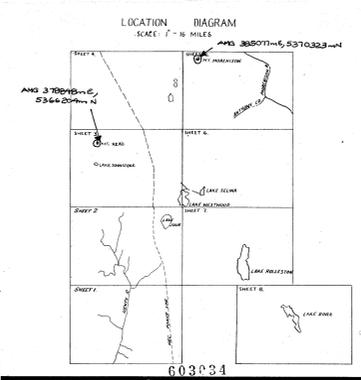
- HIGH
- LOW

GRAVITY

E.M.

GEOPHYSICAL CONTACTS

D = DEPTH
 T_k = THICKNESS
 DIP = DIP
 KSM = VOLUME SUSCEPTIBILITY (MAGNETICS)
 pfe = PERCENT FREQUENCY EFFECT (I.P.)



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THE CONSOLIDATED SYNDICATE

INTERPRETATION OF NIPPHAR DATA
 BY J. IRVINE, APRIL 1974
 MT. TYNDALL AREA
 EL. 9'66

Sheet 2

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