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A REPORT ON GEOPHYSICAL SURVEYS IN THE

SELINA-SPICER AREA, 1980-81

(E.L. 9/66)

for

MT. LYELL MINING & RAILWAY CO. LTD.

by

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SUMMARY

IP and magnetic surveys were carried out on the Selina, Rolleston and Spicer grids in the 1980-81 field season.

A gradient IP survey covered all except the southwestern corner of the Selina grid. The survey discovered a narrow, elongate pyrite zone in the centre of the grid from lines 136N to 184N, open to the north. The zone, referrred to as the eastern pyrite zone in this report and labelled S2, was further defined by two dipole-dipole surveys (lines 184N and 144N). A third comparative dipole-dipole survey was conducted over the well explored western pyrite zone, S1.

Other chargeability anomalies arising from the gradient survey were: the northern limits of S1 - this appears to split into two, S1(nw) and S1(ne) a single line anomaly on line 128N, east of S1 (labelled S3) and a possible northern extension of the zone into the (?unprospective) Jukes Conglomerate, S3(n).

Drill holes are planned on line 184N into S2 and into a geochemical target, south of S2 on line 128N. The geochemical anomaly gave no gradient IP response, but a dipole-dipole survey is recommended over the proposed drill target. EM surveys are also recommended on a number of lines on Selina, to check the ground response of various Dighem anomalies and anomalies from a reinterpretation of that survey (some of which are coincident with IP anomalies). Details of these recommendations are given at the end of this summary.

Dipole-dipole surveys were carried out on lines 40N, 48N and 56N on the Rolleston grid. These were designed to further investigate the CGG anomaly 'A2', centred over old workings on line 48N. The surveys were 100ft and 200ft dipole spacings on each line, read to n=4. No significant anomalies were found except on line 56N where a small section had been read to n=6; this was quite anomalous. Depending on the results of computer

modelling of the pyrite mineralisation to the west (CGG anomaly A1), a 300ft dipole-dipole IP survey (to n=6) and/or a (time domain) EM survey are recommended on this line and the next line to the north. The desired coverage is listed at the end of this summary.

The area of prospective volcanics between Lakes Dora and Spicer had not been previously mapped in any detail, nor had any geophysical surveys been carried out. A grid was surveyed to continue from the Dora grid to the northern end of Lake Spicer (where the prospective zone had narrowed to a little over 200m). Lines were spaced 200m apart and pegged at 20m intervals. Gradient array IP and magnetic surveys were carried out over the grid. The IP defined a central zone, labelled Sp1, in the northern half of the grid with higher chargeabilities coincident with geochemical anomalies and old workings. Other anomalies of smaller area were also defined over the volcanics. A strong anomaly was defined in the Owen Conglomerate, which extended over the length of the grid, on the western boundary. The response is thought to be due to a haematite sandstone unit within the conglomerate. Anomalies were also obtained over black shales on the eastern side of the grid. Magnetic anomalies were apparently confined to the volcanics; though not coincident with the chargeability anomalies, there is considerable overlap between Sp1 and magnetic responses.

The gradient IP responses over Sp1 were not high and a dipole-dipole survey (with a 40m dipole spacing) on line 192S confirmed the lack of economic mineralisation (to its depth of penetration). Deeper looking exploration is recommended over this well-defined zone of old workings, (weak) geochemical anomalies and low gradient chargeabilities. A series of broadly spaced surveys from the northern end of Lake Dora to the middle of the Spicer grid is recommended. Depending on these results, infill surveys will be needed. Several lakes would interfere with an IP survey and a Sirotem survey is recommended. The survey

would also help to evaluate the usefulness of the transient EM technique for (deep-looking) west coast exploration.

RECOMMENDATIONS FOR FURTHER GEOPHYSICAL WORK IN THE SELINA-SPICER AREAS

Selina

A ground EM survey (probably Max-Min) is recommended on the following grid lines between the intervals listed.

Line	Coverage		
184N	0	to	600mE
160N	3000'W	to	1600mE
152N	3500'W	to	1200mE
148N	3500'W	to	2000'W
144N	3500'W	to	400mE
136N	3500"W	to	400mE
128N	2300"W	to	400mE
120N	3500'W	to	800mE
112N	3500'W	to	800mE

A dipole-dipole survey (with a 40m dipole spacing and read to n=6) is recommended on line 128N, with data coverage (at n=4) 20E to 240E.

A gradient array IP survey is planned over an area north of the existing grid to define the northern extension of S2.

Rolleston

Computer modelling of the IP effect of CGG anomaly A1 is recommended for comparison with field results from line 56N. Assuming a second polarisable body to the east seems possible, the following surveys should be carried out:
Dipole-dipole IP surveys, using a 300ft dipole, with overlapping spreads to obtain a 150ft station spacing and read to n=6 on lines 56N and 64N: extreme data points (at n=4) are 1800'W and 1650'E. An EM survey, preferably time domain for better penetration, is also (or alternatively) recommended over this coverage.

Spicer

A series of transient EM (Sirotem) traverses are recommended to investigate, at depth, the line of old workings on the Dora-

Spicer grids. The widespaced lines are a regional evaluation of the zone.

Line	Coverage
120S	900mW (3000'W) to 300mE (1000'E)
132S	900mW (3000'W) to 300mE (1000'E)
152S	1400mE to 2350mE
168S	1750mE to 2400mE
184S	1800mE to 2500mE

INTRODUCTION

The narrow belt of Mt. Read Volcanics to the east of Mt. Tyndall (see Figure 1) was largely covered by IP and magnetics in the early 1970's. The areas not covered included the interval between Lake Dora and Lake Spicer, and the eastern and north-western portions of the Selina grid (this last area had been covered by magnetics). The IP and magnetic coverage of these areas was completed in the 1980/81 field season.

This report describes and interprets the surveys over those two areas, plus some follow-up IP on the Rolleston grid. Other material, from earlier surveys has been included where appropriate.

The remaining areas of prospective rocks in the Selina-Spicer belt are a very small area west of Lake Spicer and the areas north of the Selina grid. Most, if not all, of this latter area will be investigated in the coming field season.

A summary of all the geophysics in the Selina-Spicer belt up to the beginning of the 1980/81 field season is given in Bishop (1980).

SELINA

The Selina grid as shown in this report extends from 96N to 184N (in Bishop (1980) the grid, taken from the old 1:6,000 maps extended from 80N to 184N). The grid will be extended further to the north in the 1981/82 field season.

When the grid was prepared for the 1980/81 season only the western half was recoverable (pegged at 100ft intervals). The eastern half was recut and pegged at 20m intervals. Thus surveys over the western half of the grid have been conducted in imperial units, while those over the eastern half are in metric units. The nominal line spacing is 800ft.

Geology

The geology map of Selina (Figure 2) has been recently modified by Hutton (Mt. Lyell Geologist responsible for this area). Compared with Figure 2 in Bishop (1980), the chert in the NW quadrant has been reinterpreted as a fine-grained volcanic rock (ashfall?), conformable with the rest of the volcanic sequence. The eastern side of the grid, previously separated into three units of Lower Cambrian plus the Pre-Cambrian has been simplified. (That this representation was likely to be in error was evident in the Dighem survey where a strong linear lithological response, which extended N-S across the grid, was at a definite angle to the indicated strike of these units.) In Figure 2, the Lower Cambrian is undifferentiated and the mapping does not extend as far as the Pre-Cambrian. Both sequences are considered unprospective.

The southern boundary of the Jukes Formation (Tyndall Group) has been slightly changed (moved northwards). The exact boundary is still uncertain, and is of importance because of a geochemical anomaly (due to be drilled) which lies within the original Jukes boundary. A number of faults have been identified and an area of glacial moraine has been mapped on, and north of, the eastern end of line 184N. Thus the Selina grid consists of the Central Belt of the Mt. Read Volcanics through the middle of the grid, with Lower Cambrian Sediments (consisting of quartz sandstone, black shale and conglomerate) forming the eastern boundary: the western boundary is the Ordovician Owen Conglomerate, although the contact is partially obscured by glacial moraine. The central northern part of the grid consists of the Jukes Formation; the structural relationship of this last rock-type with respect to the volcanics has not yet been established.

Before the 1981 IP survey, the main mineralised area on Selina was the 'western pyrite zone', a body over 365m long and up to 150m wide but which appears to decrease to the north and split into several lenses (Hutton, 1981): it effectively outcrops. It has been drilled by four holes (plus another three on the

body's extension onto the Rolleston grid). The four holes assayed 6.2% to 12.8% pyrite. Mineralisation is disseminated but with small veins, giving it enough conductivity to react to electromagnetic surveys (Bishop, 1981a). The IP survey described below has revealed the existence of an 'eastern pyrite zone', a narrow elongate body extending from line 136N, 200mE to 184N, 450mE. Massive sulphide (pyrite) has been found outcropping on some lines: so far no base metals have been found. (This body was referred to as the 'central pyrite body' in Bishop (1981a), since that report refers to the electromagnetic responses of an 'eastern conductive body' namely black shales within the Lower Cambrian.)

Geophysical Surveys:

The following geophysical surveys were conducted on the Selina grid in the 1980/81 field season.

Induced Polarisation	-	Scintrex gradient array survey over most of the grid.
	-	Scintrex dipole-dipole surveys on lines 184N, 144N and 120N.
Electromagnetics	-	Geoterrex Max-Min survey on line 128N.

Induced Polarisation:

The coverage of the gradient and dipole-dipole surveys on the Selina grid is shown in Figure 3. The coverage of the 1970/71 CGG pole-dipole survey is also indicated.

Gradient Array IP:

A gradient array IP survey was carried out by Scintrex in March-April, 1981. The survey details are given in Table 1. The survey covered all of the Selina grid, except for the western ends of line 96N and 104N (these were among the sections of lines surveyed in the 1970/71 CGG pole-dipole survey).

For the reasons noted above, the gradient array IP over the western half of the grid used a station and dipole spacing of 100ft, while 20m was used for the eastern side of the baseline. The chargeability and resistivity results have been plotted as contours at 1:5,000 (Figures 4 and 5 respectively). They are also being plotted on composite profiles at 1:2,000, but these were not complete at the writing of this report.

The survey re-defined the Selina western pyrite body (detected by the earlier pole-dipole survey) with high chargeabilities (80+ mv/v) and a relatively low resistivity (<500 ohm-m), but the main feature of interest was the discovery of a long narrow highly chargeable zone east of the baseline. This zone extended from line 136N, 190mE to 184N, 450mE, where the highest values were recorded (>90 mv/v). The zone is narrow (mostly less than 40m at 40+ mv/v) and does not show up as a resistivity low. Massive pyrite outcrops on some lines and a drill hole is planned on the northernmost line, 184N.

A small isolated 50+ mv/v anomaly was defined on line 128N at 900'W (the pole-dipole survey on this line had extended eastwards to only 1000'W). In the north-eastern corner high chargeabilities (30+ mv/v) were recorded on the eastern ends of lines 152N to 184N (apparently caused by Lower Cambrian black shales).

The chargeability and resistivity results from the gradient array IP survey have been contoured by Hutton and are shown in Figures 4 and 5 respectively. The chargeabilities have been contoured at 10 mv/v intervals and a certain amount of extrapolation has been used to show the 'folded' contours on the map. Figure 4 shows several strong chargeability anomalies:

the western pyrite body	S1
the eastern pyrite body	S2
the 'isolated' anomaly at 128N, 900'W	S3
a weaker, elongate anomaly north of S3 (highest values on lines 152N to 168N)	S3(n)
the black shales on the NE edge of the grid	S4
the northern Jukes Conglomerate anomaly	S5

(Anomalies indicated in Figure 11.)

The resistivity map is shown in Figure 5 with contours at 500, 1000, 2000, 5000 and 10,000 ohm-m. Of the above chargeability anomalies, only the western pyrite body (S1) and the black shales (S4) have well developed resistivity lows (500 ohm-m in a background of around 5000 ohm-m). S2 shows a very weak resistivity trend which partly corresponds with the chargeability anomaly, and similarly for S3 and S3(n). The resistivity anomaly on the eastern edge of the grid is more extensive than the chargeability response, and a low (<1000 ohm-m) extends to the southern limit of the grid. (Electric soundings by CGG in 1970/70 (Omnes, 1971) showed that the Lower Cambrian Sediments had lower resistivities than the volcanics.

Dipole-Dipole Array IP:

Three spreads of dipole-dipole IP were carried out on the Selina Grid. Details are given in Table 2. Two of the spreads were over the eastern pyrite zone; the third, for comparative purposes, was over the western pyrite zone.

The survey on 184N (Figure 7) shows a central zone of very high chargeabilities (>100 mv/v) in a background of 10-20 mv/v. The resistivity anomaly is not well developed; a moderate low of 1000-1500 ohm-m is open to depth in a background of 3000 to 6000+ ohm-m.

The chargeability results over 144N (Figure 8), show the classic 'trouser-leg' pattern, with a maximum value of 120 mv/v at n=1, in a background of about 3 mv/v on the eastern side, and about 30 mv/v on the western side. The resistivity anomaly is much better developed here than on 184N, an anomalous area of 300 ohm-m being defined with a minimum value of 118 ohm-m: background is 3,000 ohm-m $\pm$ 1,500 ohm-m.

The chargeability pseudo-sections of the surveys over 184N and 144N are adequately modelled by fitting to type-curves, i.e. the results are closed representations of responses from idealised bodies (see Appendix 1). On line 144N the causative body approximates an outcropping 'dyke', about one dipole spacing wide (40m). The body is vertical and 'infinitely' deep and long (Figure A1). On line 184N, the body is no longer outcropping (depth of burial, 1/3 of a dipole spacing, i.e. 13m) and is narrower (again 13m) (Figure A2).

The survey over S1 on 120N also shows a very strong anomaly (Figure 10): the chargeability is broadly 'trouser-legged' with a maximum value of 95 mv/v at n=4, on one 'leg' of the anomaly. The resistivity anomaly is also clear with a zone of $<$200 ohm-m in a background of about 3,000 ohm-m. The extreme data points of this survey are the shallowest values rather than the deepest, i.e. for the transmitting electrodes used, the receiving dipoles could (and should) have extended further to the east and west. This would have completed the anomalous region at depth to the west and given a better idea of background conditions (as well as covering adjacent ground for comparatively little extra effort).

Magnetics

A magnetic survey of the Selina Grid was carried out in 1970/71 with a McPhar M700 fluxgate magnetometer. This data was contoured at 250 and 500γ intervals and presented at 1:6,000 in the CGG report (Omnes, 1971). This map is complex owing to several

areas of strong responses and rapid changes due to surface magnetite. Figure 6 is a contour map of the smoothed magnetics (produced by hand-smoothing the profiles), contoured at 200 γ. This rather coarse interval gives a similar map to the Dighem aeromagnetic map and shows the broad (and strong) magnetic features. (Bishop (1980) shows the Dighem magnetics and the smoothed ground magnetics at a 100 γ contour interval both at 1:20,000). The magnetics (at 1:5,000) have been included here to integrate with the IP in the interpretation. Bishop (1980) notes that a later, proton precession magnetometer survey over part of the grid produced similar results to the fluxgate magnetometer, and thus, given the large anomalies on the grid, this old, vertical field, survey is quite adequate. The data cannot be immediately integrated with total field surveys, but the results are comparable: vertical field anomalies should be about 95% of total field anomalies (the magnetic field inclination is about -72°; $\cos(90^{\circ}-72^{\circ}) = .95$).

Electromagnetics

A Dighem survey (a helicopter borne EM and magnetic survey method) carried out in March, 1980 covered most of the grid. Very few interesting anomalies were detected and a reinterpretation was carried out (Bishop, 1981a). Both the original anomalies and those from the reinterpretation have been plotted onto the chargeability and resistivity contour maps (Figures 4 and 5). These are discussed in the Interpretation.

A ground EM survey was conducted over the section of line 128N which crosses S1. The survey used a Max-Min, Horizontal-Loop EM system and was done to compare the ground response of the body with the nearby Dighem response. A coil separation of 150m was used and a profile of the best response (at the highest frequency, 3,555 Hz) is shown in Figure 9. The results of this survey are discussed more fully in Bishop (1981b).

Gravity

A gravity profile was surveyed over the western pyrite body in March, 1980 as part of a test program for the effectiveness of the gravity method in Mt. Lyell's exploration areas (Street, 1980). The results, shown in Figure 10, show a definite anomaly over S1, although the survey should have been extended further to the east and west to define a background level.

Interpretation

The chargeability contours from the gradient IP survey over Selina best define the known mineralisation, and hence may be expected to best locate any other occurrences or extensions of mineralisation.

The western pyrite zone, S1, has been drilled on lines 112N (LS7), 120N (LS4), 128N (LS5) and 136N (LS6). Although there are no associated base metals, the deposit does have significant silver values, the highest of which were in the northernmost drill hole. (A full physical and chemical description of S1 is given by Hutton, 1981.) The chargeability contours suggest that the mineralisation probably splits at 136N (confirmed by the drilling) and extends at least to line 152N. The western limb of this northern extension of S1 (labelled S1(nw)) has a Mitre EM anomaly (i.e. an anomaly arising from the reinterpretation of the Dighem survey) close to it (anomaly 148m, see Figure 4). On the resistivity map, Figure 5, anomaly '148m' is on the edge of a <2,000 ohm-m area, open to the west. This area is covered by moraine and this may well be the cause of the EM anomaly, nevertheless, line 148N is recommended for a ground EM survey. The eastern limits of the northern extension of S1 (labelled S1(ne)) may continue under the Jukes Conglomerate. Such an overburden would cause the observed reduction in chargeability. Again a ground EM

survey may provide complementary evidence to help determine the northerly extent of the mineralisation. The desired coverage for these surveys is given in the Recommendations.

The eastern pyrite zone (S2) is also a zone over which EM surveys are recommended; in this case partly to determine the parameters of a body not detected by Dighem. Although there is no distinct (gradient array) resistivity low associated with S2, a reinterpretation of the Dighem survey picked two anomalies over the mineralisation (see Figure 4). The dipole-dipole survey on line 144N has a distinct resistivity anomaly corresponding to S2, with a minimum value(s) to background ratio of about 1:20. The resistivity 'low' on the gradient survey is best developed on line 144N but is very weak. With a ratio of 1:3 , the gradient array has not defined the resistive parameters of the zone nearly as well as the dipole-dipole survey.

Eight Dighem lines crossed S2, but only two gave (reinterpretation) anomalies. One reason for the lack of anomalies on the other lines, is that a magnetic zone over the conglomerate-volcanics contact swamped the very subtle responses (the magnetic anomalies are discussed below). Also, the dipole-dipole survey on line 184N, with a much weaker resistivity anomaly than that on line 144N, indicates that the resistivity varies along the strike of S2 and, at best, is only just an (airborne) EM target. Ground EM surveys are recommended to determine how good a target is this type of mineralisation. (EM surveys are faster than IP surveys to execute, are capable of much higher target resolution and can be interpreted quantitatively.)

No base metals have been seen in the outcrops of S2, and soil geochemical samples give only low copper anomalies (maximum 140 ppm). There are however good lead and zinc anomalies on strike to the south of the strongly anomalous chargeability zone (see Figure 9). The chargeability response over these

geochemical anomalies is above background (between 20 and 30 mv/v), but is insignificant compared with other anomalies on the map (Figure 4). In laboratory measurements sphalerite is not conductive and does not give an IP effect. However in the field, zinc mineralisation nearly always has other associated sulphides and an effect is observed, e.g. at Que River, the Pb-Zn lens (containing 90% of the mineralisation) gave a very large IP effect, (peak response equivalent to well over 100 mv/v, Webster and Skey, 1977, figs. 33.22a and b). A drill hole is planned for line 128N to test the geochemical anomaly and a dipole-dipole IP survey is recommended to see if there is any response to the zone, and if so, to better define the drill target. A drill hole is also planned on line 184N (already surveyed with dipole-dipole IP). The extension of S2 north of 184N will be investigated with IP and EM in the 1981/82 field season.

The curves in the chargeability contours south of S2 (Figure 4) were drawn by Hutton on the basis of an approximate east-west foliation in the rocks in this region and because he thought that a synclinal structure was likely beneath the Jukes Conglomerate. Also, Hutton felt that this resulted in the simplest contour pattern (Hutton, pers. commun.). This interpretation implies that S2 correlates across the syncline to anomalies S3 and S3(n).

A Dighem reinterpretation (Mitre) anomaly was picked very close to S3 (see Figure 4); as with S2, the gradient IP has only poorly defined a resistivity low. Assuming that the EM anomaly is genuine (and it is recommended that it be tested by a ground EM survey along line 128N) then such a poor Dighem response implies either a poorly conducting body of sulphides (a large volume would be needed to obtain a response) or a very small mass of highly conductive material. Alternatively the body could be at depth. The IP results apparently do not conform to either interpretation (although there is 500m be-

tween lines 120N and 136N). Assuming a horizontal, chargeable cylinder, the depth to the centre for the anomaly at 128N, 900'W is 75m*.

The system recommended for these ground EM surveys is the Max-Min equipment, a five frequency horizontal-loop method (see Bishop, 1981b). This method will readily detect 'genuine' airborne EM anomalies (given the correct location) as well as possibly being able to provide a quantitative interpretation.

The role of magnetics on the Selina Grid is not at all clear. There are two large anomalies in the north west corner of the grid; one is over the north eastern contact between the Tyndall Group (Jukes Conglomerate) and the volcanics, the other is over the south western contact of these two rock-types. Haematite and magnetite veins have been mapped within the Jukes, but these deep-seated anomalies appear to underlie the contact rather than the conglomerate itself. S2 parallels the NE anomaly and its elongate extension, on the eastern side. West of S2 on line 128N, the magnetic anomaly directly overlies the geochemical Pb, Zn anomalies (Figure 9). There is no magnetic anomaly (smoothed or unsmoothed) associated with S3 or S3(n) within the Jukes Conglomerate. There are isolated magnetic anomalies on the eastern side of the grid, which roughly align to the NNE geologic strike (see Figure 6), but there is no resistivity or IP contrast associated with these anomalies. The association of the various anomalies can be seen in the anomaly compilation map (Figure 11) which shows the main magnetic resistivity, chargeability and geochemical responses.

Despite the fact that several of the chargeability anomalies are shown as overlying the Jukes Conglomerate (thought of as an unprospective rock-type), these zones should be investigated and their causes ascertained. For example it would not, from the

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*depth to centre of a long chargeable, horizontal cylinder is $2x_{\frac{1}{2}}$, where $x_{\frac{1}{2}}$ = half the width of the anomaly at half its height.

lack of correspondence with the magnetics, appear to be magnetite. One possible source is haematite (of low susceptibility), but at least one laboratory test has shown a zero IP effect for this mineral (Telford, et al, 1976). The final assessment of this area should include laboratory measurements to verify that all the sources of the IP anomalies are accounted for. Also recommended are further (ground) EM profiles to test the various Mitre anomalies. The desired coverage is listed under Recommendations.

Before the area can be declared 'fully explored', there must be a better integration of geophysics and geology: an understanding of the relationships of the various rock types to the geophysical contrasts. The following questions should be answered.

Does the western pyrite zone S1, split? If so, S1(nw) may be under moraine and hence the chargeability is subdued and the geochemistry nullified. Alternatively the moraine itself could be largely responsible for the 30+ mv/v response. A split also suggests that S1(nw) may be on a different stratigraphic horizon from S1 (and S1(ne)) and hence the possibility of better base-metal or silver values.

Does S1(ne) continue under the Jukes Conglomerate? A large thickness of this rock-type would again serve to diminish the IP effect. S3(n) (line 152N and 160N at 900'W) in the Jukes Conglomerate may be a near surface continuation of S1, although it is aligned along strike from S3 (an anomaly within the volcanics).

What is the cause of S5, the chargeability anomaly which, like S3(n), is within the Jukes Conglomerate? Like S3(n), there is no corresponding magnetic anomaly and haematite may be the cause of the anomaly: again, this should be verified with laboratory measurements.

ROLLESTON

The Rolleston Grid is a southern continuation of the Selina Grid and the geology is considered to be broadly similar, however it is mostly covered by glacial moraine. A more detailed summary is given in Bishop (1980). The change from 1:6,000 to 1:5,000 scale maps has changed the boundary lines defining the grids (i.e. Spicer, Dora, Rolleston and Selina Grids). Rolleston's Grid is now defined by line 56S in the south and 80N in the north.

Bishop (1980) noted that despite unpromising geochemical assays from two costeans, the CGG anomaly A2 was the most promising geophysical anomaly on the grid. The dipole-dipole IP survey over this anomaly is described below.

Geophysical Surveys

The following geophysical surveys were conducted on the Rolleston Grid in the 1980/81 field season.

Induced Polarisation - Scintrex dipole-dipole surveys on lines 40N, 48N and 56N.

Induced Polaristation - Dipole-dipole array

Dipole-dipole surveys were carried out to better define the chargeability/magnetic anomaly designated A2 in the CGG 1969/70 report (Omnes, 1970). In that report, A2 was defined by the n=5 pole-dipole 10ms contour from line 32N to 48N (which actually reached 56N). The n=4 pole-dipole results showed a 20ms closure on lines 56N and 64N (Bishop, 1980, figure 11). A magnetic anomaly is centred on line 48N coincident with the IP, and high values extend to the north. Thus CGG's anomaly A2 covers lines 32N to 56N or 64N, a few hundred feet east of the baseline.

Bishop (1980) thought that the southerly part of the anomaly might be covered by moraine, which could 'significantly

reduce the IP values'. Two costeans had previously been made over the anomaly on 48N and between 48N and 40N: analyses of five samples from the costeans had given maximum values of 180 ppm Cu, 650 ppm Pb, 270 ppm Zn and 0.4% S (Reid et al, 1980). Bishop (1980) recommended dipole-dipole IP and electrical soundings to determine the thickness of glacial moraine.

Dipole-dipole surveys were carried out on lines 40N, 48N and 56N; survey details are given in Table 3. On all three lines the coverage to the west was far enough to include the CGG's anomaly A1, a possible southern extension of the Selina western pyrite zone S1, discussed above. Three drill holes have been sited on A1 (lines 48N (LS3), 64N (LS2) and 72N (LS1)) and thus good 'control' was available for the survey.

100 ft and 200 ft dipole surveys were conducted on each line. The results for each line have been combined and are presented in Figures 12, 13 and 14. Before discussing the results of the surveys, it may be worth noting that they do not appear to have been conducted very efficiently; several areas have been reflected twice, for no apparent reason, and many areas have been repeated once. While some repetition is needed to verify the operation of the survey, large scale repetition becomes unnecessarily expensive. Further, the logistics of obtaining the data (as recorded on the cards) does not appear to have been done as efficiently as possible. Finally, as is shown below, the most interesting anomaly was not adequately covered. Clearly more supervision of the contracting crews is required.

Interpretation

On lines 40N and 48N, both surveys (100 ft dipole and 200 ft dipole) were read to n=4. On the former line, a broad

chargeability high, open to depth was defined, with a corresponding (weak) resistivity low (<500 ohm-m) beneath the southern extension of anomaly A1 (about 1100ft W). On the eastern side, a chargeability high occurs beneath 500'E. Maximum values (40+ mv/v) occur at n=1 on the 100 ft dipole survey. The anomaly is broad, there is no corresponding resistivity low and a shallow disseminated source is suggested for anomaly A2 (Figure 12). On line 48N, anomaly A1 is more distinct with higher values (35+ mv/v). Anomaly A2 has diminished and again a weak shallow source is suggested (Figure 13). The IP results from neither of the lines warrant, by themselves, further action. However the results from line 56N are quite different.

Part of the 200 ft dipole survey was read to n=6, and strongly anomalous results were measured in this section. Anomaly A1 is well defined on line 56N: 65+ mv/v values below 600'W with a 'trouser-leg' shape to the chargeability pseudo-section and a corresponding resistivity low. The A2 anomaly is more weakly developed than on line 48N, though chargeability values are about the same. There is no associated resistivity anomaly. The source is probably a little deeper on 56N than on 48N.

At n=5 and 6 below 00, chargeabilities of 55+ mv/v were recorded (a maximum of 74 mv/v). This anomaly is at the bottom of the eastern 'trouser-leg' of the A1 anomaly (Figure 14), and it possibly is a result of (additive) interference from A1 and a body further to the east - not the shallow response, A2, of the previous two lines (this is too weak to give such high values at depth). The apparently 'noisy' source should be further explored. (It is emphasised that had the survey only gone to n=4 as did the other two surveys, the pseudo-sections would have been interpreted as showing only the anomaly A1.)

Two approaches are recommended for further work on this Rolleston area: since holes have been drilled into A1 at 48N and 64N, a good estimate can be made of the cross-section at 56N. The IP response of this model should be found (from routine computer programs and/or type curves) and this should be subtracted from the field results; a sizeable residual is expected. If this is not the case then the second step, IP, need not be undertaken.

In the event that there is a sizeable residual, a larger dipole-dipole survey is recommended using, e.g. a 300 ft dipole spacing. Line 64N should also be surveyed with this deep-looking IP. Details of the suggested surveys are given in the Recommendations. (It is unlikely that the residual data could be meaningfully modelled because of too few anomalous data points, even though these points have substantial values.) An EM method, with its better resolution of conductive bodies, should also be tried. If the Sirotem or similar method is tried out by Mt. Lyell this should be used because of its better penetration, otherwise the Max-Min system would do.

SPICER

The IP and magnetics coverage of the early 1970's had ended (to the south) at about the middle of Lake Dora, on line 144S. There are many old workings both north and south of Lake Dora (at one stage it was thought that mineral discoveries had been made "that almost equal Mt. Lyell", Blainey, 1978), and thus prospective rocks were known to continue south of the Dora Grid. Rio Tinto had done some geophysical work around Lake Dora in the late 1950's (Boniwell, 1958), but south of this, no geophysical techniques had been used.

The gridded area from the middle of Lake Dora to the northern tip of Lake Spicer, has been termed the Spicer Grid: the boundaries are lines 248S and 152S. The baseline runs up

the eastern edge of the grid and is designated 3000(m)E. The lines are 200m apart, but the numbering continues south from the Dora Grid (i.e. at 800 ft intervals). The lines are pegged with a 20m spacing.

Geology

The geology is shown in Figure 15 and is described by Hutton (1981b). A summary is given here.

The Central Sequence volcanics occupy the northern part of the grid and extend south to line 200S, forming a wedge between two zones of Dora Conglomerate which is interpreted to be an "epiclastic lateral equivalent to the volcanics" (Hutton, 1981b). The conglomerate also wedges out to the south with lower Cambrian sediments to the east and the Owen Conglomerate to the west. There is a thin intervening ribbon of tuff between the conglomerate and sediments on the eastern contact, and a thinner ribbon (average about 30m) of Tyndall Group rocks on the western contact. On the southernmost line (248S), the surface width of the Dora conglomerate and tuffs total about 230m.

There are several old workings in the Spicer Grid area with the more significant ones located within a narrow zone approximately along the N-S axis of the wedge of Central Sequence volcanics. (NB: Several adits were started in Dora Conglomerate, but the targets were likely mineralisation in the volcanics.) "The mineralisation consists of disseminated and veinlet pyrite throughout the zone, with patches of magnetite-haematite, galena-sphalerite and chalcopyrite" (Hutton, 1981b).

Geophysical Surveys

The following geophysical surveys were conducted over the Spicer Grid in the 1980/81 field season.

Induced Polarisation	-	Scintrex gradient array survey over whole of grid.
	-	Scintrex dipole-dipole survey on line 192S.
Magnetics	-	Scintrex survey over whole of grid (using Geometrics proton precession magnetometer).

Induced Polarisation

The coverage of the gradient array and dipole-dipole IP surveys on the Spicer Grid is shown in Figure 16.

Gradient Array IP:

A gradient array IP survey was carried out by Scintrex in December, 1980 - January, 1981. The survey was done using a 20m dipole (and station) spacing in three blocks. Details of the coverage are given in Table 4.

Contour maps of the chargeability and resistivity have been prepared by Hutton. The chargeability has been contoured at 10 mv/v intervals (Figure 17) and the resistivity at 500, 1000, 2000, 5000 and 10,000 ohm-m (Figure 18). Both maps are at 1:5,000. The results have also been plotted onto composite profiles at 1:2,000 (not presented in this report).

Most of the Spicer Grid recorded a chargeability of between 10 and 20 mv/v; only two small zones measured less than 10 mv/v, or greater than 40 mv/v. Figure 17 shows the following chargeability anomalies:

a central zone, 30+ mv/v	Sp1
several NW zones, 20+ mv/v	Sp2, Sp3, Sp3(s)
a western zone covering the N-S extent of the Grid, mostly 30+ mv/v	Sp4 & Sp4(n)
isolated anomalies in the SE quarter up to 50+ mv/v	Sp5 & Sp5(n)
NE corner of grid, 20+ mv/v	Sp6

Sp1 is a narrow elongate chargeable zone within the Central Volcanic Sequence, coincident with a large number of geochemical anomalies. It embraces most of the old workings and prospects on the grid. The north-south extent of the zone is over 1,200m, from line 200S to 152S and it probably continues north at least to the Dora Grid line 144S. Sp1 is discussed in more detail in the Interpretation.

Sp2, Sp3 and Sp3(s) are partly within the Central Volcanic Sequence, but also overlie the Dora Conglomerate. These anomalies are situated on the western half of lines 184S and 176S which are due to be mapped in detail in the next field season. The zones are similar to, but probably less interesting than, Sp1. A narrow elongate zone Sp4 and Sp4(n), of high chargeabilities (30+ mv/v) was recorded on the western edge of the grid from the southernmost line (248S) to nearly 184S; at the 20+ mv/v level, it continued to 152S. High resistivities were associated with this zone. The geology (Figure 15) shows it to be within the Owen Conglomerate and in the compilation map, Figure 21 (also drawn by Hutton), it has been labelled the "Owen Conglomerate Haematite Sandstone Unit". Platy Haematite in the sandstone is suggested as the cause of the IP effect by Hutton (1981b). The possible IP effect from haematite

was discussed in the Selina section where it was stated that at least one test had produced no effect (Telford et al, 1976, p 713). Another writer (Parkhomenko, 1971) states haematite (and sphalerite) is among that group of minerals "which may have a profound effect on induced polarisation when they contain semi-conducting impurities". (Unfortunately the amount of information on IP effects in ores, rocks and minerals is sparse and poor.) Given the variable conductivity of haematite (3.5×10^{-3} - 10^{7}ohm-m, Telford, et al P 452), one can expect variable IP responses from haematite-bearing rocks. It would be most useful for exploration in the area if laboratory tests of IP and resistivity were made of this rock-type and others suspected of causing IP effects (e.g. the Jukes Conglomerate on Selina, as previously mentioned).

IP effects have occurred over Lower Cambrian black shales in the north east corner of the grid (Sp6) and in two other isolated areas (Sp5 and Sp5(n)), see Figure 21. Rather surprisingly, these do not show up as low resistivity zones, but this may be due to a lack of response of the gradient array to narrow, less resistive zones, as previously suggested.

The only area of low resistivity (<500 ohm-m) is in the far north west corner of the grid over swampy ground with a cover of glacial moraine (Figure 18). The area is a possible southern extension of a Rio Tinto Turam anomaly. This EM anomaly was followed up by a gravity survey, which showed a slight low over the area, thus effectively eliminating the possibility of a large massive sulphide deposit. The cause of the Turam anomaly (and the resistivity low on the Spicer grid) is likely to be within the moraine/swamp. A Max-Min EM survey is planned over the area to confirm this interpretation.

Dipole-dipole array IP:

A dipole-dipole survey was carried out by Scintrex in April, 1981, over part of line 192S; dipole spacing was 40m, with a station spacing of 20m (i.e. two overlapping surveys offset by half a dipole). The coverage is listed in Table 5; the chargeability and resistivity pseudo-sections are given in Figure 20. The survey is over Sp1 however this zone has stronger responses on the lines to the north (see Figure 22, stacked chargeability profiles of Sp1). The anomaly was sited on this line "to evaluate small gradient array IP anomalies at 2330E and 2230E as well as mineralisation found in a mine dump 80m north of 2360E" (Hutton, 1981b). No significant anomalies were found.

Magnetics

A magnetic survey of the Spicer Grid was carried out by Scintrex operators in Feb. 1981: a Geometrics proton precession magnetometer was used. Station spacing was nominally 10m, but this was decreased to 5m in areas of steep magnetic gradient and increased to 20m in areas of little variation. The line coverage is listed in Table 6.
A base station magnetometer at the Rolleston camp was used to monitor the diurnal variation. The data from the base magnetometer was not attached to the field data cards, and thus the data could not be checked for accuracy, magnetic storms etc.. (All data, graphs, notes etc., must be checked before contract crews leave the area.)

The magnetic contour map was prepared by Hutton who hand-smoothed the profiles and took 200γ contour intervals to draw the map (Figure 19). Despite the smoothing, the map shows considerable variation over the grid: the Owen Conglomerate to the west is magnetically 'quiet' (including the strata containing the (?)polarisable haematite) as are (probably) the Lower Cambrian Sediments to the east (see comments below). There is a very strong response in the

north western corner of the grid (over 1500γ): this anomaly, as defined in a late 1950's aeromagnetic survey, first brought Rio Tinto's attention to the area. However their ground follow up found it to be a series of narrow, discrete anomalies (Boniwell, 1958), (as has Mt. Lyell's survey). Two of these elongate anomalies overlie, for at least part of their length, the chargeability zone Sp1 and others occur within the Central Volcanics.

The anomaly at the southern end of Lake Dora, apparently within the Dora Conglomerate, may be associated with the contact with the volcanics to the east; otherwise there are no well-developed anomalies (i.e. >200γ) in the Dora Conglomerate.

The narrow ribbons of Central Volcanics east of the Dora Conglomerate can be traced from the magnetics. From the southern most line, in lithic crystal tuffs, the magnetic trend goes north to 232S, where it 'jumps' a fault to the crystal-vitric tuffs. The zone continues north to line 192S where it overlies the volcanic- sediment contact. On line 184S, it is wholly within the sediments. The geological boundary here is dotted (Figure 15) and it appears that it should be placed further to the east on lines 192S to 168S. Hutton (pers. commun.) has stated that the dotted line is the easternmost boundary of the volcanics, based upon the westernmost outcrops of the sandstone. Hence the anomalies appear not to be correlatable with the volcanics and are unexplained.

The strong magnetic anomalies on Spicer have dictated the coarse contour interval of 200γ and thus smaller trends, evident on the unsmoothed profiles, are not observed on Figure 15; they can however be inspected from the composite profiles (Hutton, 1981b).

Interpretation

As mentioned above, Sp1 is the most interesting zone defined by the 20 mv/v contour; it encompasses many of the geochemical anomalies and most of the old workings. It extends from line 200S, 2420E to 152S, 2000E, where it is still open to the north. There is no corresponding low resistivity zone, in fact the northern part of the anomaly is 10,000+ ohm-m. But as discussed in the previous section, there are a series of magnetic anomalies which subparallel the 'central' anomaly.

It is interesting to note that this mineralised zone continues along strike to the Dora grid, but here the 1969/70 pole-dipole survey did not define the zone. One difference between the two grids is that the mineralised occurrences on the Dora grid are all pyrite, chalcopyrite, while those of the Spicer grid include lead and zinc prospects. Although suggesting a zoning (and hence possible sites for further exploration?), it is difficult to see how this would effect the geophysics and perhaps a modern survey should be carried out on the Dora grid. This is further discussed in the next section.

The gradient IP survey on the Spicer grid has defined a zone of mineralisation with the low values suggesting only sub-economic sulphides. The dipole-dipole survey used to better define the gradient array anomaly and to provide some depth discrimination, confirmed this. Although the dipole-dipole survey was over one of the poorer parts of the anomalous zone (see Figure 22), it is doubtful whether the improvement in the gradient anomalies to the north, is indicative of substantially greater amounts of sulphide. However a deeper-looking survey over this zone is discussed in the next section.

The high IP response within the Owen Conglomerate was an unexpected result of the survey. Laboratory measurements of IP and resistivity of (fresh) samples together with petrographic descriptions will aid the interpretation of IP surveys

elsewhere on Mt. Lyell's exploration and mining leases, since the boundaries of the Owen Conglomerate are not always outcropping and planar unconformities.

In the Conclusions I suggest that deeper-looking exploration is worthwhile on Spicer and further to the north, on Dora. Any such search for deeper mineralisation will require a better knowledge of the structure of the area from Selina to Spicer. The inclusion of a belt of volcanics between Owen Conglomerate south of Lake Rolleston points to a complicated structure, at lease in part. The geophysics on Spicer can be readily fitted into the geology and may assist it (e.g. the magnetic boundaries to the east and west). The magnetics may also reflect some faults on the grid e.g. the western anomaly on lines 200S - 208S, with a probablr SE extension to line 216S, suggests a NW-SE trending fault. Similarly the two intense magnetic highs in the NW corner of the grid may indicate faulting in a similar direction.

CONCLUSIONS

There are several areas of interest on the Selina Grid and these include: (1) the geochemical anomaly (with no geophysical response) planned to be drilled by LS9 from line 128N, 200mE, facing west.

(2) S2, the eastern pyrite zone, still open to the north, and due to be drilled by LS8 from line 184N, 640mE, facing west (hopefully this hole is designed to intersect the contact between the volcanics and the Jukes Conglomerate.

(3) S3, and its northern extension S3(n). These anomalies appear to have shallow sources, in which case the latter is within the Jukes - and hence is unlikely to be economic mineralisation: for the former, only a small source appears likely. Nevertheless, the cause of S3(n) and the size of S3 should be established. Laboratory tests should determine the former and an EM survey (possibly needing intermediate grid lines, should help determine the latter.

(4) S1(ne) and S1(nw), the northern extension of the western pyrite zone. These may be of interest if either silver or base-metal values improve along strike. The strike of the chargeability anomaly over the main body (S1(ne)) suggests that it may go deeper and beneath the Jukes Conglomerate. The smaller 'detached limb' S1(nw) has a much lower amplitude than S1, and one can postulate various reasons for this (favourable and unfavourable) apart from merely less pyrite (which is perhaps the most likely). For example, the area over S1(nw) is largely moraine covered and if of appreciable thickness, may reduce the response; alternatively moraine may add to or even cause the response. Another interpretation is that S1(nw) is stratigraphically above S1 and hence more likely(?) to be other than a barren pyrite body.

To be integrated with these IP responses are the magnetic anomalies. The northern extension of S1 coincides with part of the western magnetic anomaly. No other chargeability anomaly coincides with the magnetics, but they are commonly adjacent, and parallel to each other. Magnetite does not appear to be causing (relatively) much of an IP response. As stated previously, the two large magnetic anomalies in the north-western third of the grid (the only anomalies of immediate interest) do not lie within the Jukes Conglomerate but under the contracts; one on the SW corner, the other on the NE edge. Bishop (1980) using the Dighem aeromagnetic results (which are a little different) used a sphere to model the response of the western anomaly: a depth to centre of

275m below line 152N, 2300mW was obtained. For the high susceptibility value of .01, a radius of 200m was obtained (Bishop, 1980, Fig. A1).

The Rolleston dipole-dipole IP survey reduced the interest in the CGG anomaly A2, but the results at depth on line 56N are very interesting. The coverage at depth is poor, but it seems that the response of anomaly A1 (to the west) has combined with the response of a body to the east - presumably at depth, since the eastern half of the pseudo-section shows no likely soucre.

It is not clear why the dipole-dipole surveys were not read to n=6 (current too weak and noisy due to dry ground conditions?); the data cards show no sign of a series of attempted readings to this depth. There are some 'no readings' at n=6 and at n=4 on S6N, with one or two at n=4 on the other two lines. (Once a decision has been made to carry out a survey, every effort should be made to maximise the amount of information that can be obtained from the survey.) Following computer modelling, deeper dipole-dipole surveys are recommended on the Rolleston Grid; the desired coverage is listed in the next section.

The gradient survey over Spicer has undoubtedly defined the zone of mineralisation, i.e. the main area of interest. And from these results it seems most unlikely that an economic body of sulphides lies close to the surface at Spicer. However, I believe that the surveys so far say little about the likelihood of a body at depth. The dipole-dipole survey on line 192S used a 40m spacing and was read to n=6, thus a depth of no more than 100m was being tested by the IP. The gradient anomaly over Sp1 on 192S was not very good and though one would expect better dipole-dipole results on other lines, e.g. 176S, the results would probably still only indicate sub-economic, near surface mineralisation.

The numerous small workings in the zone (?and the weak geochemical anomalies) make the effort of further, deeper exploration seem worthwhile. The other chargeability anomalies in the volcanics, e.g. Sp2 and Sp3, presumably have a similar cause, i.e. zones of disseminated and veinlet mineralisation as seen in the old workings. These smaller zones are also associated with one or two base-metal anomalies. Sp3(s) is the only labelled zone within the Dora Conglomerate; it is not considered significant.

It seems likely that the narrow zone of old workings and geochemical anomalies on the Spicer Grid is a continuation of the zone of old workings west of Lake Dora (i.e. further to the north on the Dora Grid). However the Dora Grid did not show up in the 1969/70 IP survey except for the southernmost line, 144S. The zone from line 114S on the Dora Grid (an arbitrary limit) to line 200S on the Spicer Grid, is over 2000m long. I suggest that deeper exploration on such a well-defined zone would be worthwhile. A program similar to the following could be used: a series of broadly spaced dipole-dipole surveys, say at 600m and using a 100m dipole spacing would be used to test for the continuation and volume of mineralisation at depth. Given some encouragement from this 'regional' survey, a series of shorter surveys (probably using the same dipole interval) would be placed at closer intervals (?150m-200m) over the strike as defined by the regional survey. A trend may even be apparent from this latter survey which would suggest where to concentrate the more detailed (but still deep-looking) survey.

Alternatively (or in conjunction), a transient EM method could be tried. Since this method (in the single loop mode) measures beneath the loop, this would minimise the problem of the lakes in the vicinity of the prospective zone. Also, since this is relatively open and accessible country, it would be a good place, geographically, to test state-of-the-art transient EM methods on Mt. Lyell's leases. I suggest that the Sirotem method be tried using 100m square loops

(i.e. intermediate lines would have to be surveyed).

RECOMMENDATIONS

A ground EM survey is recommended on the Selina Grid over S1, S1(nw), S1(ne), S2, S3 and S3(n). These surveys are recommended for several reasons: to determine the ground EM response over such bodies as the western and eastern pyrite zones, and the reinterpreted Dighem responses over S1, S1(nw), S2, S3 and elsewhere. A Max-Min survey has already been conducted over S1 on line 128N and a good response was obtained in the high frequencies. Surveys are recommended on the following lines (it is understood that surveys are also planned over the geochemical zone, south of S2).

Proposed EM Coverage - Selina

Line	Coverage	Targets
184N	0 to 600mE	S2
160N	3000'W to 1600mE	160m[1], S2, black shales
152N	3500'W to 1200mE	S1(nw), 152m, S2, 160o
148N	3500'W to 2000'W	S1(nw), 148m
144N	3500'W to 400mE	S1(nw), S1(ne), S2
136N	3500'W to 400mE	S1, S2, 148n
128N	2300'W to 400mE	S1 (128A)[2], S3 (136m) LS9
120N	3500'W to 800mE	S1 (120m), 128N
112N	3500'W to 800mE	112A, 112m, 112n, 120n

[1] Mitre anomalies m, n, o, etc (i.e. anomaly arising from Dighem reinterpretation).

[2] Dighem anomalies A, B, C, etc..

This rather extensive coverage is designed to test many of

the Mitre anomalies. Those which do not also have coincident IP anomalies are unlikely to prove prospective, however for a better evaluation of the Dighem method, the Mitre anomalies should be investigated.

Much of this ground is steep and heavily timbered; it may therefore not be possible to use the Max-Min system which requires a known slope between the transmitter and receiver and a constant separation (or preferably a constant horizontal interval). Ideally the sections of the lines listed above should be repegged at equal horizontal intervals, or alternatively a different method could be used. However meaningful results were obtained on line 128N between 4400'W & 2100'W, and if the rest of the grid is comparable to this, then Max-Min should be useable.

A drill hole, LS9 on line 128N, 200mE is planned to explore the Pb-Zn anomaly south of S2. There is no gradient IP response over this area, but a dipole-dipole array survey is recommended:

Dipole-dipole survey on line 128N, Selina
Dipole spacing 40m (reading to n=6)
Data coverage (at n=4) 20mE to 240mE
7 transmitting electrodes: 60mE to 200mE.

The most appropriate techniques for further exploration will depend upon the EM results and the proposed drilling. But it is strongly recommended that the two drill holes be kept open with the use of perfcrated plastic pipe, thus allowing down-hole geophysical exploration for an indefinite future period.

Further IP surveys are recommended on the Rolleston Grid. The dipole-dipole surveys on line 56N recorded high values at n=5 and 6, values possibly not solely from the known pyrite body (CGG anomaly A1), but caused by interference effects from A1 and another body at depth to the east of A1. A 300ft

dipole-dipole survey is recommended on lines 56N and 64N, with a station spacing of 150 ft (i.e. two spreads offset by 150 ft) and read to n=6. A similar survey should be carried out on line 64N. The surveys should have the same n=1 coverage as the 100 ft dipole survey on 56N, but this should increase with increasing N (rather than decrease as in the 100 ft and 200 ft surveys). Survey details are given in Appendix 2, but in summary, it is recommended that on the Rolleston Grid, the following surveys are made on lines 56N and 64N:

> Dipole-dipole IP, using 300 ft dipoles, with offset spreads giving a 150ft station spacing. Readings to n=6, extreme data points (at n=4) are 1800'W and 1650'E.

and/or

> An EM survey (preferably time domain) on these two lines, with the same coverage.

A similar deep-looking IP survey could also be justified for the Spicer Grid. The gradient IP has revealed a chargeable zone which is coincident with geochemical anomalies and old workings. However the low values suggest that there is no economic mineralisation near the surface. This was confirmed by a follow up 40m dipole-dipole survey on 192S (over one of the weaker gradient anomalies). This survey read to n=6, covers perhaps the top 100m. Given the long line of mineralisation on the Dora and Spicer Grids, the (weak) geochemical anomalies, and the weak gradient response (and influenced to some extent by the chargeability anomaly at depth on the Rolleston Grid), a series of deep-looking dipole-dipole IP surveys would seem worthwhile. Unfortunately the lakes would seriously hamper such surveys and thus Sirotem transient EM surveys, using 100m square loops are recommended on the following lines. These surveys are also suggested to assist in evaluating the system's usefulness in aiding exploration on Mt. Lyell's leases.

Spicer - Dora Sirotem Surveys

100m x 100m 'single' loop survey.
Proposed line defined by the northern edge of the loop. Coverage by centre of the loop.

Line	Coverage
120S	900mW (3000'W) to (300mE) 1000'E
132S (surveyed so that the southern edge of the loop clears Faulds tarn)	900mW (3000'W) to 300mE (1000'E)
152S	1400mE to 2,350mE
168S	1750mE to 2,400mE
184S	1800mE to 2,500mE

Station spacing would be 25m over the prospective zone and 50m or 100m on the edges of the profiles. (This proposed survey would also investigate the Rio Tinto Turam anomaly west of Lake Dora.)

It is also recommended that laboratory IP measurements be made of samples of Owen Conglomerate and Jukes Conglomerate. The samples should be collected from areas where haematite in the rocks is thought to cause the recorded chargeability anomalies.

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APPENDIX 1.

The dipole-dipole results over line 144N, Selina were matched to type curve 'VC-3' (Geoscience Inc.). The model is a vertical infinite dyke, one dipole spacing wide with an IP effect of 25%. The results (Figure A2) have been changed to chargeabilities by multiplying by 5 (a very approximate transformation).

The results over line 184N have been matched to type curve FB-3 (Geoscience Inc.). The model here is a finite vertical 2-dimensional dyke (2 dipole spacings deep, i.e. 80m) and buried 1/3 of a spacing (13m). It is also 13m wide (Figure A2).

APPENDIX 2.

When a survey is planned, it is good practice for the client to work out the precise details of the surveys and to give this to the contractor. The client then gets the coverage he wanted and there are no subsequent recriminations. (However the survey when being executed, must be flexible enough to cope with anomalies near ends of spreads etc). The details for the proposed coverage of lines 56N and 64N on the Rolleston Grid are as follows. (It is described as if the data were obtained by doing two surveys, the second offset 150ft from the first, and this may well be the best way to execute it.)

Survey 1 (Lines 56N and 64N, Rolleston)

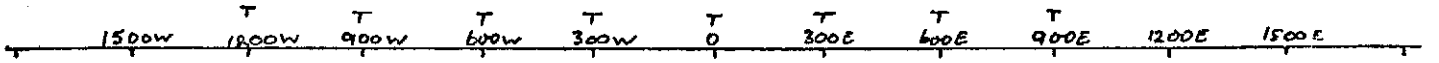
8 transmitting electrodes at:-
1200W, 900W, 600W, 300W, 0, 300E, 600E, 900E.

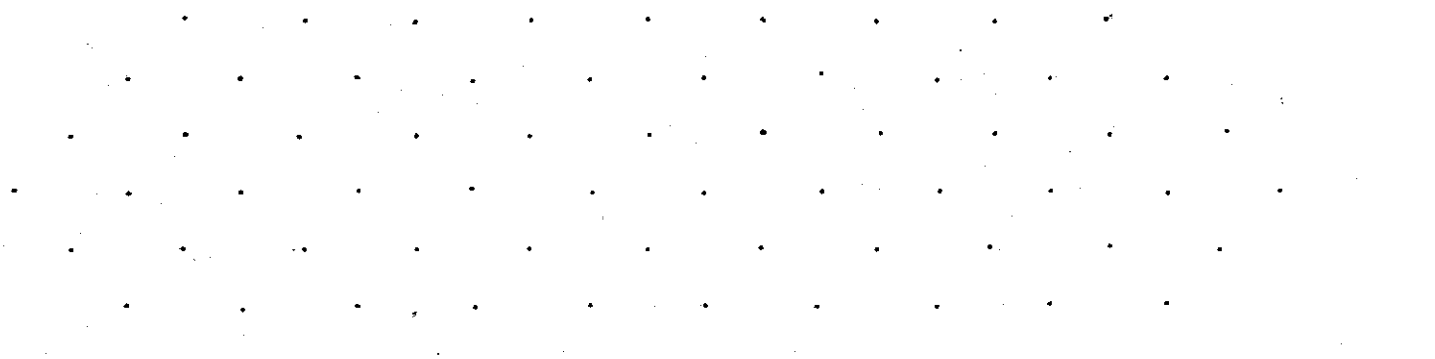
extreme western receiving dipole 2700W - 2400W

extreme eastern receiving dipole 2100E - 2400E

(These parameters give the pseudo-section a shape shown below. The 'missing' end points can be read if necessary.

Continuous coverage is obtained to n=6, i.e. no data gaps.)





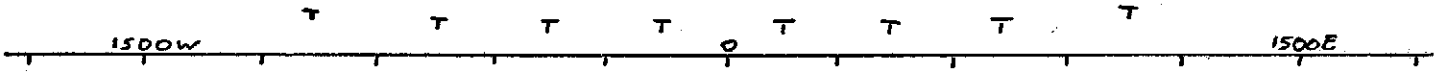
Survey 2 (Line 56N and 64N, Rolleston)

8 transmitting stations at:-

1050W, 750W, 450W, 150W, 150E, 750E, 1050E.

extreme western receiving dipole 2550W - 2250W

extreme eastern receiving dipole 2250E - 2550E.



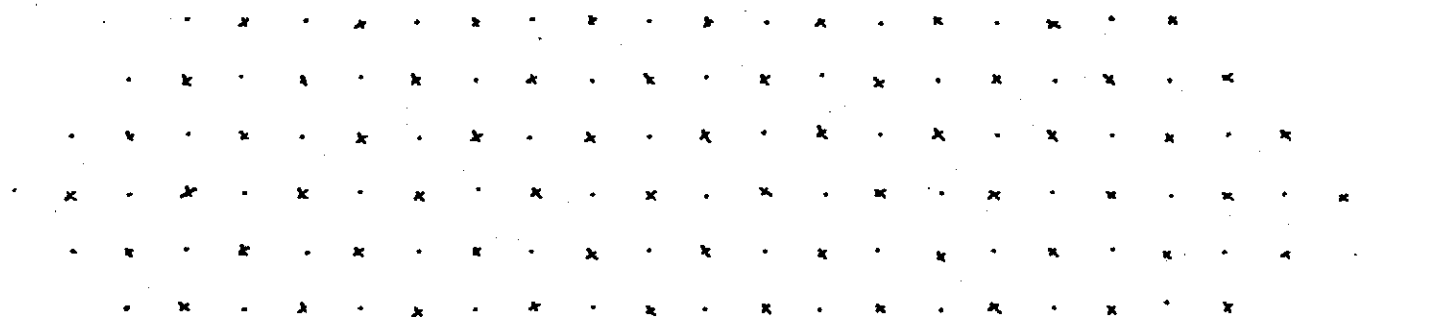


TABLE 1 - SELINA GRADIENT ARRAY IP COVERAGE

Surveyed by: Scintrex
Date: March-April, 1981
Dipole: 100ft (30.5m) west of the baseline.
20m east of the baseline.
IP receiver: IPR-8

Line	Current Electrode positions (AMG) Coverage			
	5,364,025N 384,770E - 5,364,225N 386,570E (Array 1)		5,363,975N 385,500E - 5,364,495N 387,575E (Array 4)	
184N	1500ftW	400mE	100	1600mE
176N	1900ftW	400mE	00	1560mE
168N	2600ftW	400mE	00	1560mE
160N	3100ftW	700'W	00	1500mE
	5,363,020N 384,725E - 5,363,480N 386,785E (Array 2)		5,362,930N 385,715E - 5,363,470N 387,450E (Array 5)	
160N	3100ftW	400mE		
152N	3000ftW	400mE	00	1380mE
148N	3500ftW	2000'W		
144N	3500ftW	400mE	00	1200mE
136N	3500ftW	400mE	00	1020mE
		5,362,370N 384,960E - 5,362,810N 387,015E (Array 3)		
136N	3500ftW	00	00	1020mE
128N	3500ftW	400mE	00	900mE
		5,362,465N 385,530E - 5,363,090N 388,000E (Array 6)		
120N	3500ftW	400mE	00	920mE
112N	3500ftW	400mE	00	800mE
104N			00	780mE
96N			00	600mE

Note: Grid in imperial units west of the baseline, in metric units east of the baseline

TABLE 2 - SELINA DIPOLE-DIPOLE IP COVERAGE

Surveyed by: Scintrex
Date: April, 1980
IP receiver: IPR-8

Line	Coverage	Dipole Spacing
184N	120mE - 720mE	40m (read to n=6)
144N	60mE - 540mE	40m (read to n=6)
120N	3600'W - 1600'W	200ft (read to n=6)

TABLE 3 - ROLLESTON DIPOLE-DIPOLE IP COVERAGE

Surveyed by: Scintrex
Date: January - February, 1981
IP receiver: IPR-8

Line	Coverage	Dipole Spacing
56N	1150'W - 1350'E	100ft
56N	1000'W - 1200'E	200ft
48N	1250'W - 1350'E	100ft
48N	1100'W - 1200'E	200ft
40N	1650'W - 1250'E	100ft
40N	1900'W - 1100'E	200ft

TABLE 4 - SPICER GRADIENT IP COVERAGE

Survey by: Scintrex
Date: Dec., 1980 - Jan., 1981
Dipole spacing: 20m
IP Receiver: IPR-8

Line	Current Electrode position (AMG) Coverage	
	5,353,815N 386,540E -	5,354,310N 389,160E
	(Array 1)	
152S	1120mE	3000mE
160S	1300mE	3000mE
168S	1720mE	3000mE
176S	1800mE	3000mE
184S	1820mE	3000mE
	5,353,130N 387,035E -	5,353,500N 389,200E
	(Array 2)	
184S	1820mE	3000mE
192S	1880mE	3000mE
200S	1920mE	3000mE
208S	2000mE	3000mE
216S	1960mE	3000mE
	5,352,300N 387,455E -	5,352,690N 389,420E
	(Array 3)	
216S	1960mE	3000mE
224S	2040mE	3000mE
232S	2080mE	3000mE
240S	2260mE	3000mE
248S	2300mE	3000mE

TABLE 5 - SPICER DIPOLE-DIPOLE IP COVERAGE

Survey by: Scintrex
Date: April, 1981
Dipole Spacing: 40m
IP Receiver: IPR-8

Line	Coverage
192S	2060E - 2540E

(Read to n=6, coverage obtained by two surveys, offset by 20m, i.e. data points spaced 20m apart.)

TABLE 6 - SPICER MAGNETICS COVERAGE

Station spacings are 10m; 20m in 'quiet' areas, 5m in 'active' areas.
Instrument: Geometrics proton precession magnetometer.
Contractor: Scintrex
Base Station: Rolleston camp, value not recorded.

Line	Coverage
152S	1120E - 3000E
160S	1300E - 3000E
168S	1740E - 3000E
176S	1800E - 3000E
184S	1820E - 3000E
192S	1840E - 3000E
200S	1920E - 3000E
208S	2000E - 3000E
216S	1960E - 3000E
224S	2040E - 3000E
232S	2080E - 3000E
240S	2260E - 3000E
248S	2300E - 3000E

LIST OF TABLES & FIGURES

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Table 2 Selina dipole-dipole IP coverage.
Table 3 Rolleston dipole-dipole IP coverage.
Table 4 Spicer gradient IP coverage.
Table 5 Spicer dipole-dipole IP coverage.
Table 6 Spicer magnetic coverage.

FIGURES

Figure 1 Grid location plan (1:50,000)
Figure 2 Selina Geology (1:5,000)
Figure 3 Selina IP coverage (1:5,000)
Figure 4 Selina chargeability contours & Dighem anomalies (1:5,000)
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Figure 7 Selina composite profile, line 184N (1:2,000)
Figure 8 Selina composite profile, line 144N (1:2,000)
Figure 9 Selina composite profile, line 128N (1:2,000)
Figure 10 Selina composite profile, line 120N (1:2,000)
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Figure 12 Rolleston composite profile, line 40N (1:2,000)
Figure 13 Rolleston composite profile, line 48N (1:2,000)
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Figure 19 Spicer magnetic contours (1:5,000)
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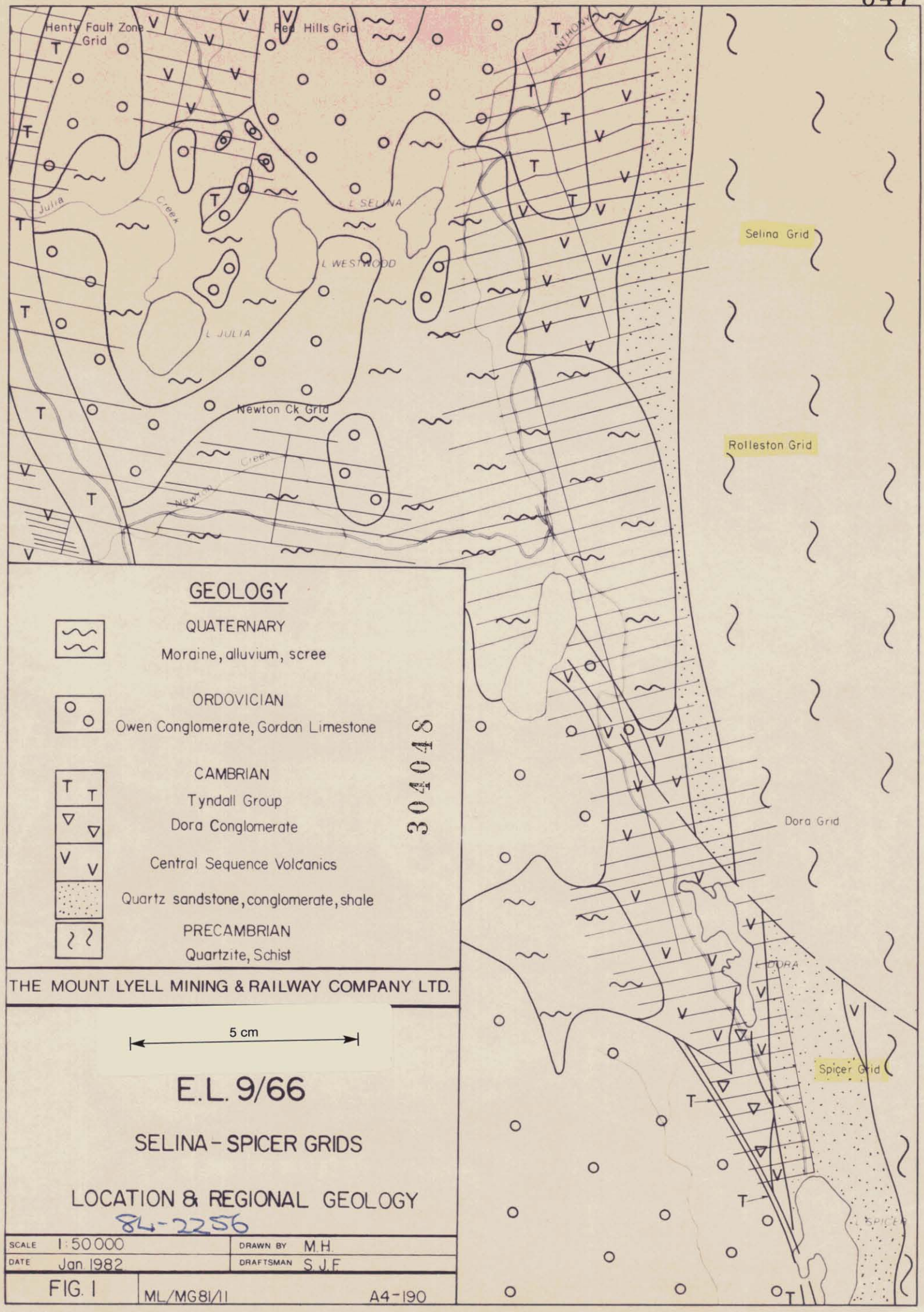
Figure 21 Spicer anomaly compilation (1:5,000)
Figure 22 Spicer chargeability profiles (1:5,000)
Figure A1 Modelling of chargeability results, dipole-

dipole survey, line 144N, Ṡelina

Figure A2 . Modelling of chargeability results, dipole-dipole survey, line 184N, Selina.



GEOLOGY

QUATERNARY
Moraine, alluvium, scree

ORDOVICIAN
Owen Conglomerate, Gordon Limestone

CAMBRIAN
Tyndall Group
Dora Conglomerate
Central Sequence Volcanics
Quartz sandstone, conglomerate, shale

PRECAMBRIAN
Quartzite, Schist

304048

THE MOUNT LYELL MINING & RAILWAY COMPANY LTD.

5 cm

E.L. 9/66

SELINA - SPICER GRIDS

LOCATION & REGIONAL GEOLOGY

84-2256

SCALE	1:50000	DRAWN BY	M.H.
DATE	Jan 1982	DRAFTSMAN	S.J.F.

FIG. 1 | ML/MG81/11 | A4-190

GEOLOGICAL LEGEND

QUATERNARY		Moraine, alluvium
ORDOVICIAN		Owen Conglomerate: Siliceous conglomerate, hematitic quartz sandstone
UPPER CAMBRIAN	T T	JUKES FORMATION: Volcaniclastic conglomerate
CAMBRIAN		CENTRAL VOLCANIC SEQUENCE: Ash fall tuffs
		Rhyolitic lavas, brecciated lavas
		Quartz-sericite-pyrite vitric tuffs, "Eastern pyrite zone"
		Quartz crystal tuffs
		Lithic tuffs
		Vitric tuffs
		Black pyritic shales (Line 168N, 420mE)
CAMBRIAN	+ +	Altered granitic intrusives
LOWER CAMBRIAN		Success Ck Group Correlate: Black shale, quartz sandstone, quartz pebble conglomerate
PRECAMBRIAN		Quartzites, quartz-mica schists.

GEOLOGICAL BOUNDARIES

Accurate

Approximate

FAULTS

Accurate

Approximate or inferred

Concealed

STRUCTURES

Bedding, with dip

Cleavage with dip

PETROLOGY

Thin section

Hand specimen

DATA SOURCES

McKibben (1971) - Field notes of outcrop mapping

McKibben, Poltock (1972) - N.E. reconnaissance field notes

Hutton (1980-81) - Outcrop mapping

Whitehead (1981) - Petrological descriptions, Amdel service report GS 831/82

Hutton (1981) - Airphoto interpretation Project F301 (1972) Runs 8 & 9

SEALED ROAD, BRIDGE

VEHICULAR TRACK

LOGGING TRACK, BULLDOZER SCAR

WALKING TRACK

RAILWAY, TRAMWAY ABANDONED

PROMINENT PEAK

TRIG STATION

BENCH MARK

SPOT ELEVATIONS

RIVER, CREEK

LAKE

SWAMP

POWER LINE & PYLONS

BUILDING

FLYING FOX

PIT

COSTEAN, TRENCH

ADIT

SHAFT (Depth metre)

OPEN CUT

ALLUVIAL WORKINGS

DUMP

DIAMOND DRILL HOLE

5 cm

100 0 100 200 300 400 500

Metres

304049

THE MOUNT LYELL MINING & RAILWAY COMPANY LTD.

E.L.9/66
SELINA GRID
INTERPRETIVE GEOLOGY
001

ML/MG 81/11 84-2256

SCALE 1:5000 DRAWN BY M.H.

DATE DRAFTSMAN

REVISIONS

FIG 2

A0-172-6

02

85 86 87 88

66 65 64 63 62 61

184N 176N 168N 160N 152N 144N 136N 128N 120N 112N 104N 96N 56N

148N

ARRAY 1 ARRAY 2 ARRAY 3 ARRAY 4 ARRAY 5 ARRAY 6

L.S.1 L.S.2 L.S.3 L.S.4 L.S.5 L.S.6 L.S.7

a=40m a=200ft

4200'W 4500'W 4600'W

POLE-DIPOLE C.G.G. 1970-71

MOUNT SELINA

MT.23

ANTHONY

536|000mN

385000mE

POLE-DIPOLE 1970-71 (C.C.G.)

SURVEY COVERAGE

GRADIENT ARRAY 1980-81 (Scintrex)

GRADIENT ARRAY COVERAGE

ARRAY 3 ARRAY NUMBERS

⊕4 ELECTRODE POSITION WITH ARRAY POSITION

DIPOLE-DIPOLE 1980-81 (Scintrex)

a=40m LIMITS TO SUBSURFACE COVERAGE
DIPOLE SPACING

SINGLE SET-UP STATION SPACING EQUALS DIPOLE SPACING. n=1-6

TWO SUPERIMPOSED SET-UPS. STATION SPACING EQUALS HALF DIPOLE SPACING n=1-6

- SEALED ROAD, BRIDGE
- VEHICULAR TRACK
- LOGGING TRACK, BULLDOZER SCAR
- WALKING TRACK
- RAILWAY, TRAMWAY ABANDONED
- PROMINENT PEAK
- TRIG STATION
- BENCH MARK
- 231 SPOT ELEVATIONS
- RIVER, CREEK
- LAKE
- SWAMP
- POWER LINE & PYLONS
- BUILDING
- FLYING FOX
- PIT
- COSTEAN, TRENCH
- ADIT
- 33 SHAFT (Depth metre)
- OPEN CUT
- ALLUVIAL WORKINGS
- DUMP
- DIAMOND DRILL HOLE

301050

5 cm

100 0 100 200 300 400 500
Metres

THE MOUNT LYELL MINING & RAILWAY COMPANY LTD.

E.L.9/66
SELINA GRID
I.P. COVERAGE
POLE-DIPOLE 1970-71
GRADIENT ARRAY 1980-81
DIPOLE-DIPOLE 1980-81

002

ML/MG 81/11

84-2256

FIG. 3

A0-172-9

SCALE 1:5000 DRAWN BY M.H.

DATE 8-2-81 DRAFTSMAN P.J.R.

REVISIONS

03

248N
240N
232N
224N
216N
208N
200N
192N
184N
176N
168N
160N
152N
144N
136N
128N
124N
120N
116N
112N
108N
104N
96N
148N
MOUNT SELINA
ANTHONY

CHARGEABILITY

Lines 192N - 248N

Survey by : Scintrex
Survey date : Nov.-Dec. 1981
Instruments : Scintrex I.P.R.-8 receivers
Dipole spacing : 20m
Station interval : 20m

Lines 96N - 184N

Survey by : Scintrex
Survey date : March-April, 1981
Instruments : Scintrex I.P.R.-8 receivers
Transmitter : Scintrex 2.5/3 kw time domain I.P. transmitter
: 20m east of base line
100 ft. west of base line, except for line 128N - 50 ft.
Station interval : As for receiver dipole
Chargeability : M 32 slice of decay curve

SEALED ROAD BRIDGE
VEHICULAR TRACK
LOGGING TRACK, BULLDOZER SCAR
WALKING TRACK
RAILWAY, TRAMWAY ABANDONED
PROMINENT PEAK
TRIG STATION
BENCH MARK
SPOT ELEVATIONS
RIVER, CREEK
LAKE
SWAMP
POWER LINE & PYLONS
BUILDING
FLYING FOX
PIT
COSTEAN, TRENCH
ADIT
SHAFT (Depth metres)
OPEN CUT
ALLUVIAL WORKINGS
DUMP

The relationship between True North, Grid North and Magnetic North at the centre of the area mapped is as follows for 1982: Grid North is 0.3° East of True North; Magnetic North is 0.3° West of True North.

Photography : Lands Department 1979-80
South West Project F817
Photogrammetry : Associated Aerial Surveys Pty Ltd 1980

Grid Lines are 1000 Metre Intervals of the Australian Map Grid, Zone 55
Grid Values are Shown in Full Only at the South West Corner of the Map
Horizontal Datum : Australian Geodetic Datum 1966
Vertical Datum : Australian Height Datum (Tasmania)
Transverse Mercator Projection

100 0 100 200 300 400 500
Metres

5 cm

304051

THE MOUNT LYELL MINING & RAILWAY COMPANY LTD.

E.L.9/66
SELINA GRID
GRADIENT ARRAY I.P.
CHARGEABILITY
1981-82

003

FIG 27.4

SCALE 1:5000 | DRAWN BY MJH
DATE DECEMBER 81 | DRAUGHTSMAN P.J.R.

REVISIONS:

A0-203-8

84-2256

63 64 65 66 67 68

385000E

004

184N
176N
168N
160N
152N
144N
136N
128N
120N
112N
104N
96N
56N
MOUNT SELINA
MT23
L.S.1
L.S.2
ANTHONY

DIGHEM, 1980 AIRBORNE ELECTROMAGNETICS

ANOMALY GRADE

6
5
4
3
2
1
X — Dighem

-1
-2
-3 — Mitre

increasing order of merit

Flight line 112A — Identifier; (1) — Grade

GRADIENT ARRAY I.P.
Survey by Scintrex Pty Ltd., 1981
Transmitter: Scintrex 2.5/3 kw time domain I.P. transmitter
Receivers: Scintrex I.P.R.-8 I.P. receivers
Receiver dipole: 20m east of base line
100ft west of baseline except for line 128N-50ft
Station interval: As for receiver dipole
Resistivity: Logarithmic contours in ohm-metres
$\oplus_6$ Electrode position with array number

ohm-metres
- >10000
- 5000-10000
- 2000-5000
- 1000-2000
- 500-1000
- < 500

- SEALED ROAD, BRIDGE
- VEHICULAR TRACK
- LOGGING TRACK, BULLDOZER SCAR
- WALKING TRACK
- RAILWAY, TRAMWAY ABANDONED
- PROMINENT PEAK
- TRIG STATION
- BENCH MARK
- SPOT ELEVATIONS
- RIVER, CREEK
- LAKE
- SWAMP
- POWER LINE & PYLONS
- BUILDING
- FLYING FOX
- PIT
- COSTEAN, TRENCH
- ADIT
- SHAFT (Depth metre)
- OPEN CUT
- ALLUVIAL WORKINGS
- DUMP
- DIAMOND DRILL HOLE

304052

5 cm

100 0 100 200 300 400 500
Metres

THE MOUNT LYELL MINING & RAILWAY COMPANY LTD.

E.L.9/66
SELINA GRID
GRADIENT ARRAY I.P. 1981
RESISTIVITY
ohm-metres
004

ML./MG 81/11 BL-2256
SCALE 1:5000 DRAWN BY: M.H.
DATE DRAFTSMAN

REVISIONS

FIG. 5
A0-172-8

005

85 86 87 88

66 65 64 63 62 61

L.S.1 L.S.2 L.S.3 L.S.4 L.S.5 L.S.6 L.S.7 L.S.8

184N 176N 168N 160N 152N 144N 136N 128N 120N 112N 104N 96N 56N

MOUNT SELINA

MT 23

ANTHONY

GROUND MAGNETICS

Raw data – Recorded in 1970–71 using McPhar M700 magnetometer, 50ft spaced readings plotted

Contours – Line profiles of raw data smoothed by hand (M. Hutton). Contours taken from smoothed profiles Contour interval 200 gammas

- SEALED ROAD, BRIDGE
- VEHICULAR TRACK
- LOGGING TRACK, BULLDOZER SCAR
- WALKING TRACK
- RAILWAY, TRAMWAY ABANDONED
- PROMINENT PEAK
- TRIG STATION
- BENCH MARK
- SPOT ELEVATIONS
- RIVER, CREEK
- LAKE
- SWAMP
- POWER LINE & PYLONS
- BUILDING
- FLYING FOX
- PIT
- COSTEAN, TRENCH
- ADIT
- SHAFT (Depth metre)
- OPEN CUT
- ALLUVIAL WORKINGS
- DUMP
- DIAMOND DRILL HOLE

5 cm

304053

100 0 100 200 300 400 500

Metres

THE MOUNT LYELL MINING & RAILWAY COMPANY LTD.

E.L.9/66
SELINA GRID
GROUND MAGNETICS
VERTICAL FIELD 1970–71
SMOOTHED CONTOURS

ML/MG 81/11 84-2256 005

SCALE 1: 5000 DRAWN BY: M.H.

DATE DRAFTSMAN

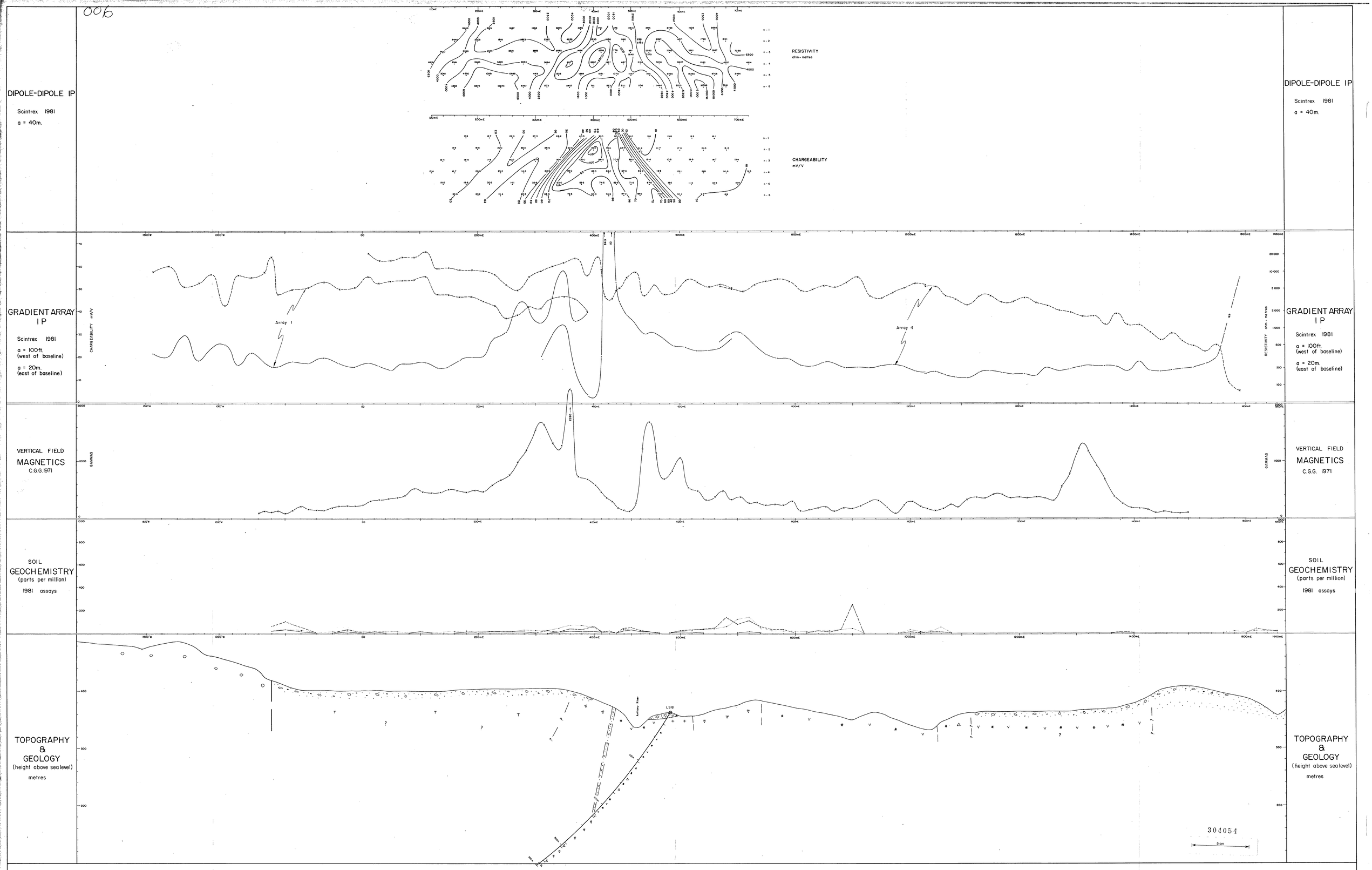
REVISIONS

FIG. 6

AO-172-3

536000mN

385000mE



GEOLOGY

QUATERNARY
Moraine, scree

ORDOVICIAN
Owen Conglomerate

CAMBRIAN
Jukes Formation

Rhyolitic lavas ± magnetite

Quartz-sericite vitric tuffs ± pyrite

Crystal vitric tuffs

Lithic - crystal tuffs

Altered granitic intrusive

LOWER CAMBRIAN
Quartz sandstone, conglomerate, shale

MAGNETICS
Coarse scale
Fine scale

GRADIENT ARRAY
Chargeability
Resistivity

GEOCHEMISTRY (ppm)
Cu
Pb
Zn
Mn
Ag > 2 ppm

THE MOUNT LYELL MINING & RAILWAY COMPANY LTD.

E.L. 9/66
SELINA GRID
LINE 184 N PROFILE

006

ML/MG81/11 84-2256

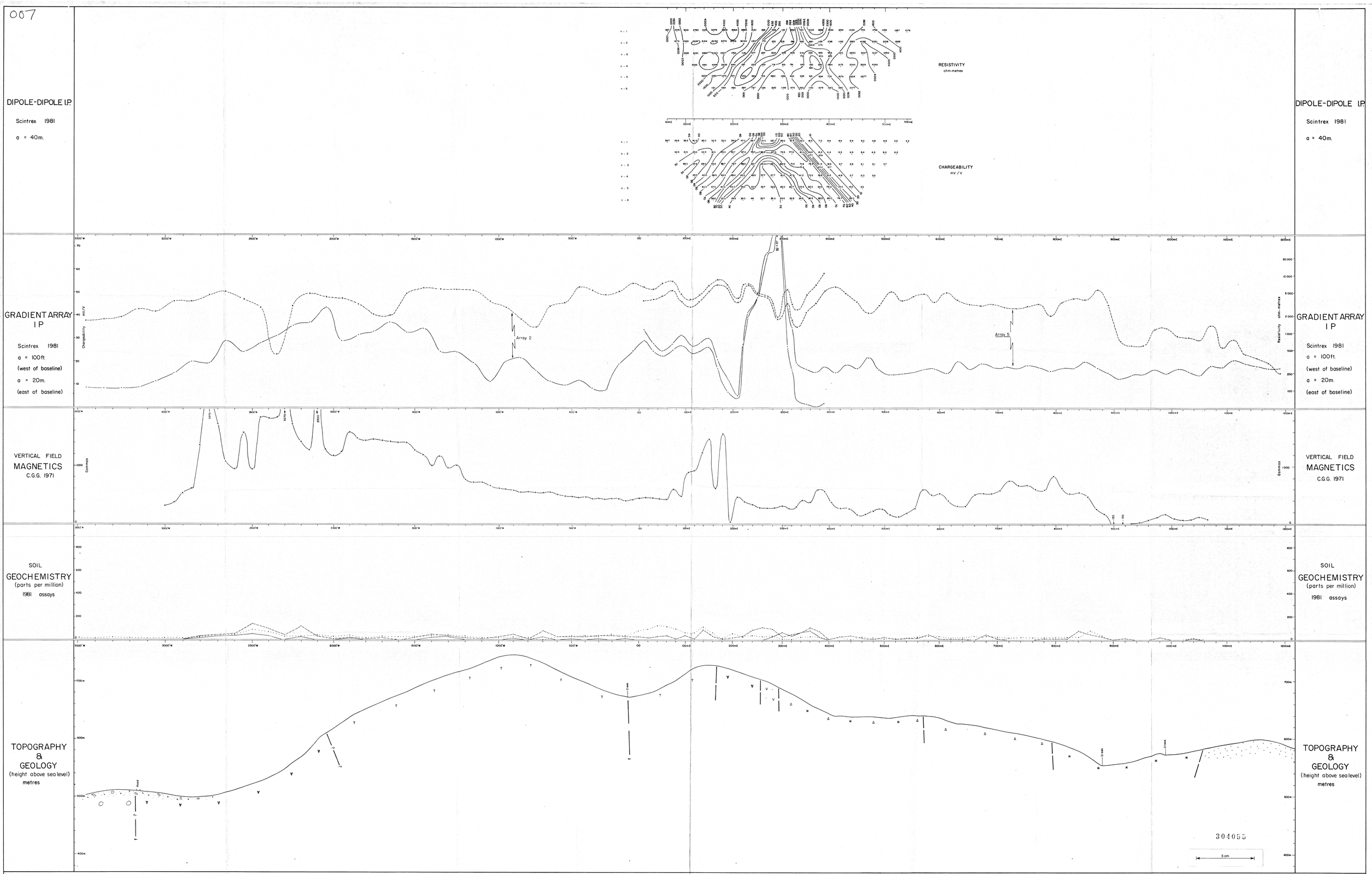
SCALE 1:2000
DATE January 1982
DRAWN BY MJH
DRAFTSMAN T.G.D.S.

REVISIONS

FIG.7

AO-182

007



GEOLOGY

QUATERNARY Moraine, scree

ORDOVICIAN Owen conglomerate

CAMBRIAN Jukes Formation

Rhyolitic lavas ± magnetite

Quartz-sericite vitric tuffs ± pyrite

Crystal - lithic tuffs

Lithic tuffs

Quartz crystal tuffs

LOWER CAMBRIAN Quartz sandstone, conglomerate, shale

MAGNETICS

Coarse scale

Fine scale

GRADIENT ARRAY

Chargeability

Resistivity

GEOCHEMISTRY (ppm)

Cu

Pb

Zn

Mn

Ag > 2 ppm

THE MOUNT LYELL MINING & RAILWAY COMPANY LTD.

E.L. 9/66

SELINA GRID 007

LINE 144 N PROFILE

ML/MG81/11 84-2256

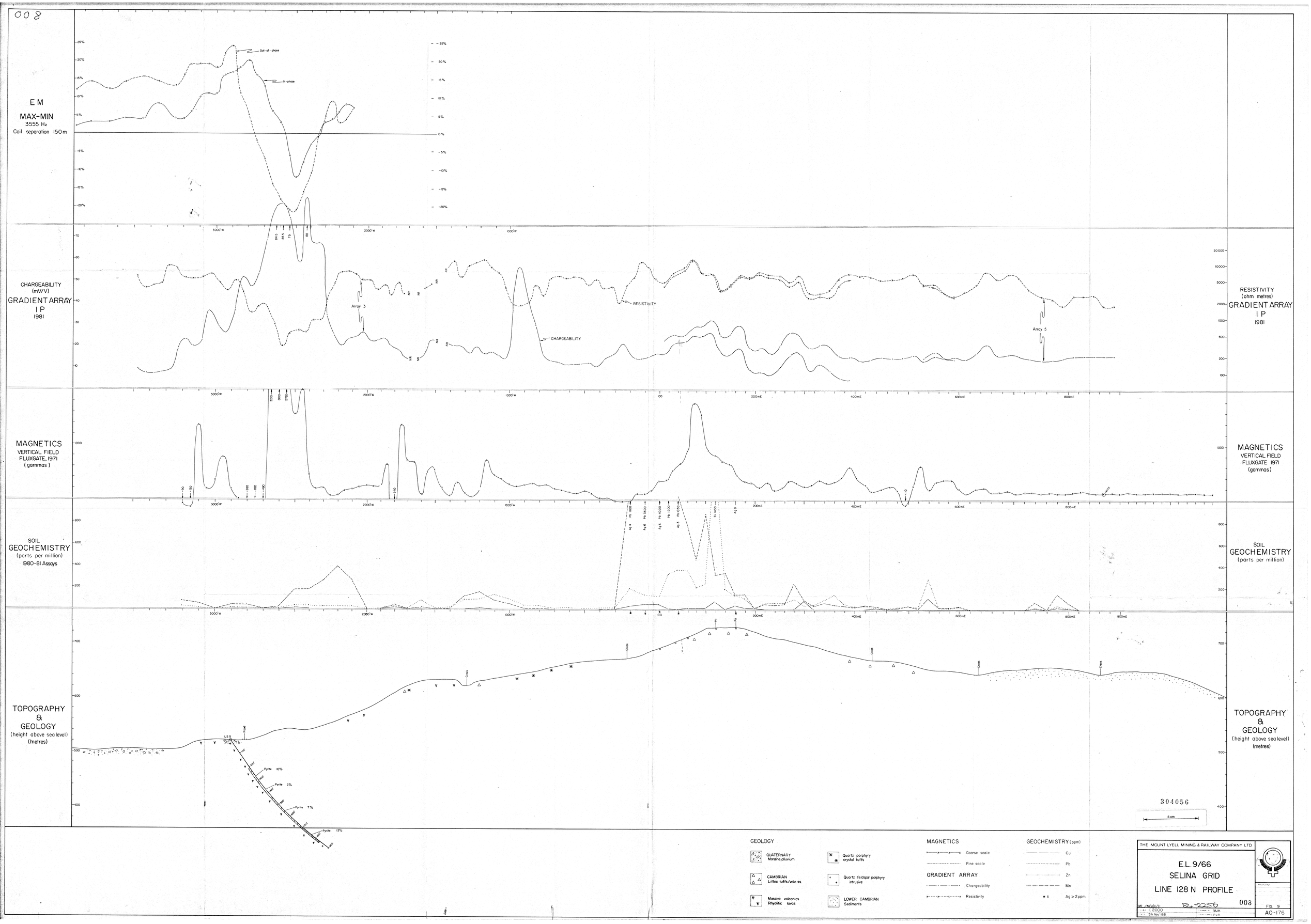
SCALE 1:2000 DRAWN BY M.H.

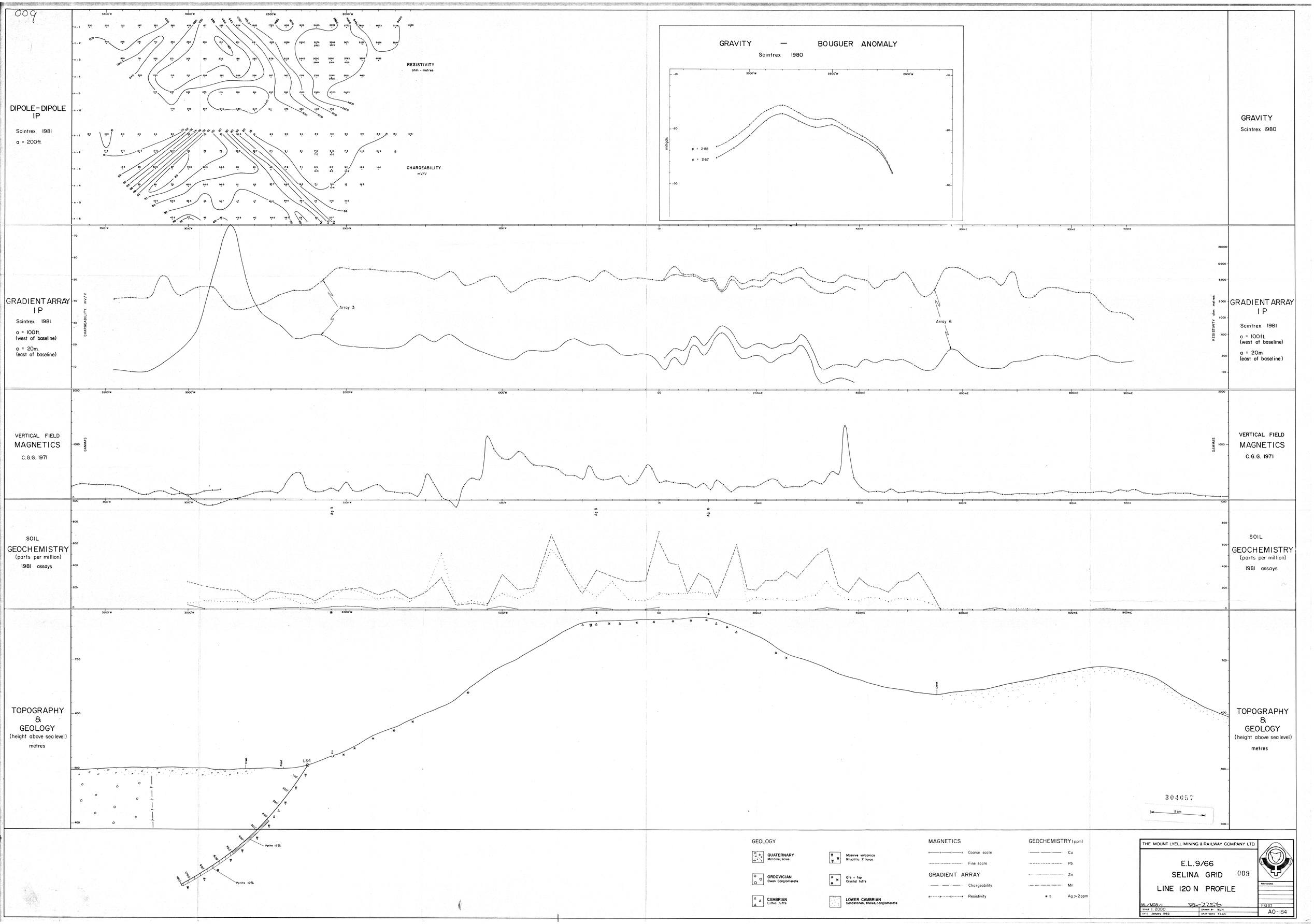
DATE January 1981 DRAFTSMAN T.G.D.S.

REVISIONS

FIG.8

AO-183


008
EM
MAX-MIN
3555 Hz
Coil separation 150m
Out-of-phase
In-phase
CHARGEABILITY
(mV/V)
GRADIENT ARRAY
IP
1981
Array 3
RESISTIVITY
CHARGEABILITY
Array 5
RESISTIVITY
(ohm metres)
GRADIENT ARRAY
IP
1981
MAGNETICS
VERTICAL FIELD
FLUXGATE, 1971
(gammas)
MAGNETICS
VERTICAL FIELD
FLUXGATE 1971
(gammas)
SOIL
GEOCHEMISTRY
(parts per million)
1980-81 Assays
SOIL
GEOCHEMISTRY
(parts per million)
TOPOGRAPHY
&
GEOLOGY
(height above sea level)
(metres)
TOPOGRAPHY
&
GEOLOGY
(height above sea level)
(metres)
Pyrite 10%
Pyrite 2%
Pyrite 7%
Pyrite 13%
304056
5 cm
GEOLOGY
QUATERNARY
Moraine, alluvium
CAMBRIAN
Lithic tuffs/volc. ss.
Massive volcanics
Rhyolitic lavas
Quartz porphyry
crystal tuffs
Quartz feldspar porphyry
intrusive
LOWER CAMBRIAN
Sediments
MAGNETICS
Coarse scale
Fine scale
GRADIENT ARRAY
Chargeability
Resistivity
GEOCHEMISTRY (ppm)
Cu
Pb
Zn
Mn
Ag > 2ppm
THE MOUNT LYELL MINING & RAILWAY COMPANY LTD.
E.L. 9/66
SELINA GRID
LINE 128 N PROFILE
008
FIG. 9
AO-176


009
DIPOLE-DIPOLE IP
Scintrex 1981
a = 200ft.
RESISTIVITY ohm - metres
CHARGEABILITY mV/V
GRAVITY — BOUGUER ANOMALY
Scintrex 1980
GRAVITY
Scintrex 1980
GRADIENT ARRAY IP
Scintrex 1981
a = 100ft. (west of baseline)
a = 20m. (east of baseline)
Array 3
Array 6
VERTICAL FIELD MAGNETICS
C.G.G. 1971
GAMMAS
SOIL GEOCHEMISTRY
(parts per million)
1981 assays
TOPOGRAPHY & GEOLOGY
(height above sea level)
metres
LS4
Pyrite 15%
Pyrite 10%
304057
5 cm
GEOLOGY
QUATERNARY Moraine, scree
ORDOVICIAN Owen Conglomerate
CAMBRIAN Lithic tuffs
Massive volcanics Rhyolitic ? lavas
Qtz - fsp Crystal tuffs
LOWER CAMBRIAN Sandstones, shales, conglomerate
MAGNETICS
Coarse scale
Fine scale
GRADIENT ARRAY
Chargeability
Resistivity
GEOCHEMISTRY (ppm)
Cu
Pb
Zn
Mn
Ag > 2 ppm
THE MOUNT LYELL MINING & RAILWAY COMPANY LTD.
E.L. 9/66
SELINA GRID
009
LINE 120 N PROFILE
ML/MGB/11
84-2756
SCALE 1:2000
DRAWN BY M.J.H.
DATE January 1982
DRAFTSMAN T.G.D.S.
REVISIONS
FIG 10
AO-184

0010

248N
240N
232N
224N
216N
208N
200N
192N
184N
176N
168N
160N
152N
144N
136N
128N
124N
120N
116N
112N
108N
104N
96N

S1
S2
S3
S3(n)
S1(ne)
S1(nw)
S4
S5
S6

ANTHONY
LOWER CAMBRIAN
BLACK SHALES
EASTERN PYRITE ZONE
MT. SELINA ANOMALY ZONE

GRADIENT ARRAY I.P. 1980-81,81-82

Chargeability > 30mV/V
Resistivity < 2000 ohm-m
S1 Anomaly number

DRILLING
LS6 Diamond drill hole

GEOCHEMISTRY

SOIL ASSAYS 1980-81, 81-82
Cu ≥ 40 ppm
Pb ≥ 500 ppm
Zn ≥ 200 ppm
Ag ≥ 2 ppm
S6 Soil anomaly zone (Pb-Zn-Ag)

GEOPHYSICS

AIRBORNE E.M.
Dighem anomalies

GROUND MAGNETICS - FLUXGATE 1970-71
PROTON PRECESSION 1981-82
> 500 γ above background
(Fluxgate > 600 γ ; Proton precession 62 800)

SEALED ROAD, BRIDGE
VEHICULAR TRACK
LOGGING TRACK, BULLDOZER SCAR
WALKING TRACK
RAILWAY, TRAMWAY ABANDONED
PROMINENT PEAK
TRIG STATION
BENCH MARK
SPOT ELEVATIONS
RIVER, CREEK
LAKE
SWAMP
POWER LINE & PYLONS
BUILDING
FLYING FOX
PIT
COSTEAN, TRENCH
ADIT
SHAFT (Depth metres)
OPEN CUT
ALLUVIAL WORKINGS
DUMP

GN 1° 30'
GRID CONVERGENCE 1°
GRID MAGNETIC ANGLE 12°

The relationship between True North and Magnetic North is shown diagrammatically. Magnetic value 9° 0' varies for Grid. Annual change is 0° 10' West Easterly

Photography Lands Department 1979-80
South West Project F617
Photogrammetry Associated Aerial Surveys Pty. Ltd. 1980

Grid Lines are 1000 Metre Intervals of the Australian Map Grid Zone 55
Grid Values are Shown in Full Only at the South West Corner of the Map
Horizontal Datum Australian Geodetic Datum 1966
Vertical Datum Australian Height Datum (Tasmania)
Transverse Mercator Projection

100 0 100 200 300 400 500
Metres

304058

5 cm

THE MOUNT LYELL MINING & RAILWAY COMPANY LTD.

E.L. 9/66
SELINA GRID
ANOMALY COMPILATION
1980-82 010

REVISIONS

FIG. 16 11

SCALE 1: 5000 DRAWN BY M.H.
DATE DECEMBER '81 DRAFTSMAN P.J.R.
A0÷203-5

84-2256

385000E 86 87 88

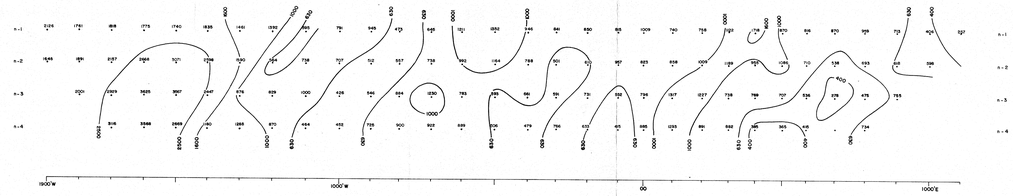
011

DIPOLE-DIPOLE IP

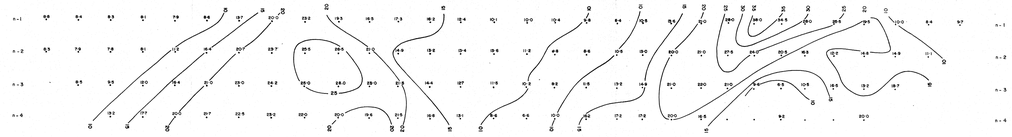
Scintrex 1981

a = 200ft.

RESISTIVITY
ohm - metres



CHARGEABILITY
mV/V



RESISTIVITY
ohm - metres

CHARGEABILITY
mV/V

DIPOLE-DIPOLE IP

Scintrex 1981

a = 200ft.

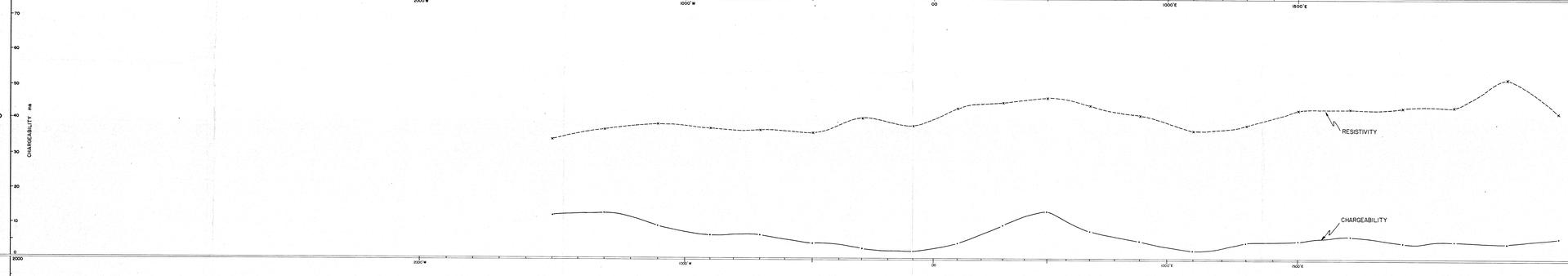
POLE-DIPOLE IP

C.G.G. 1970

Receiver 1

a = 200ft.

n = 5



POLE-DIPOLE IP

C.G.G. 1970

Receiver 1

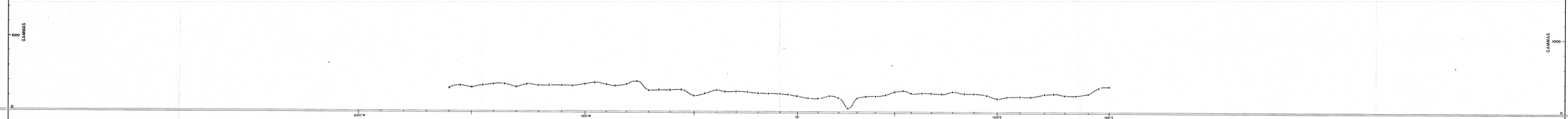
a = 200ft.

n = 5

RESISTIVITY ohm-metres
20 000
10 000
5 000
2 000
1 000
500
200
100

VERTICAL FIELD MAGNETICS

C.G.G. 1970



VERTICAL FIELD MAGNETICS

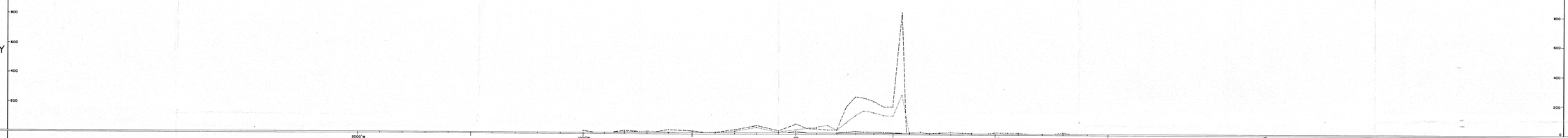
C.G.G. 1970

GAMMAS
2000
1000
0

SOIL GEOCHEMISTRY (parts per million)

1981 assays

B/C horizon



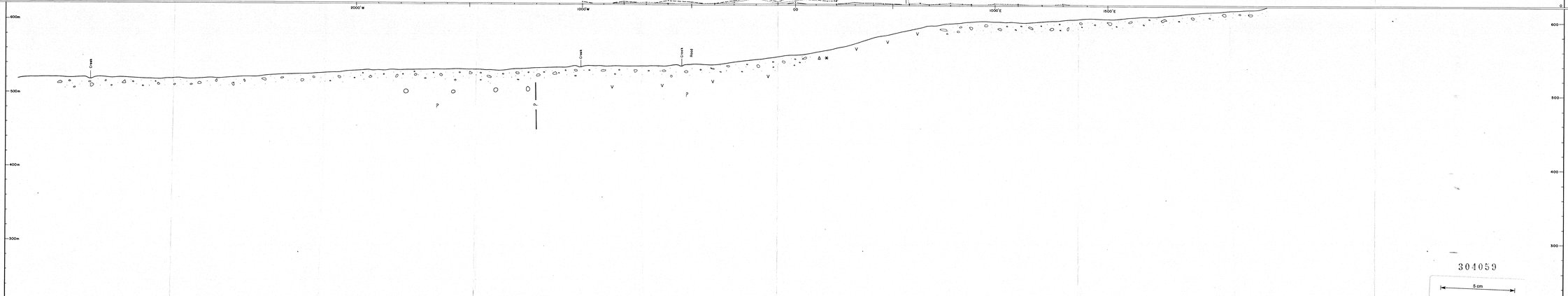
SOIL GEOCHEMISTRY (parts per million)

1981 assays

B/C horizon

800
600
400
200
0

TOPOGRAPHY & GEOLOGY (height above sea level) (metres)



TOPOGRAPHY & GEOLOGY (height above sea level) (metres)

600
500
400
300

304059

5 cm

GEOLOGY

- QUATERNARY — Moraine, scree
- ORDOVICIAN — Owen Conglomerate
- CAMBRIAN — Lithic-crystal tuff
- Undifferentiated volcanics

MAGNETICS
- Coarse scale
- Fine scale

POLE-DIPOLE
- Chargeability
- Resistivity

GEOCHEMISTRY (ppm)
- Cu
- Pb
- Zn
- Mn
- * 5 — Ag > 2ppm

THE MOUNT LYELL MINING & RAILWAY COMPANY LTD.

E.L. 9/66 011

ROLLESTON GRID

LINE 40N PROFILE

RL-2256

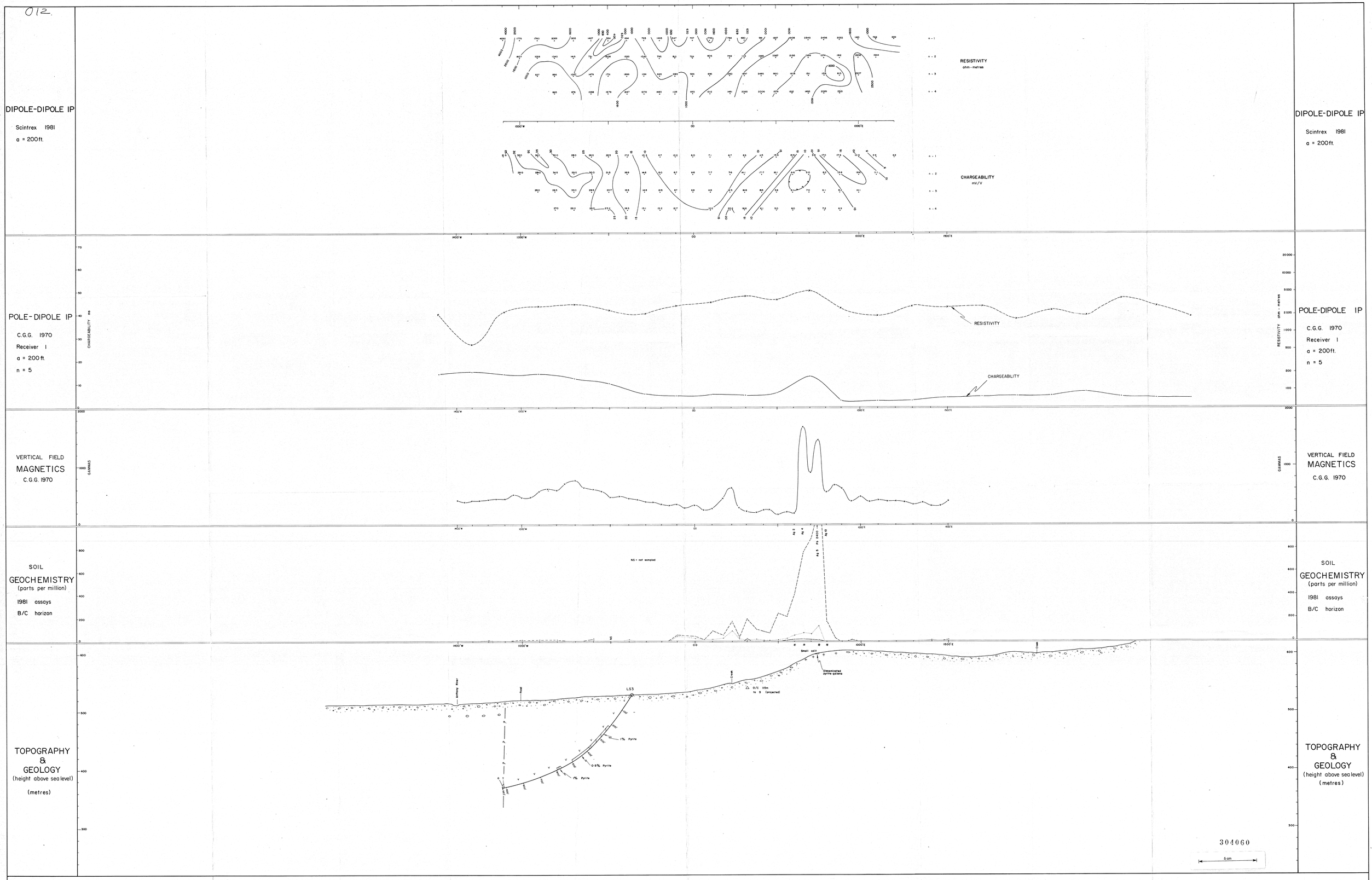
SCALE 1:2000 | DRAWN BY M.J.H.

DATE January 1982 | DRAWING No. 12

AO-185

REVISIONS

012



GEOLOGY

- QUATERNARY — Moraine, scree
- ORDOVICIAN — Owen Conglomerate
- CAMBRIAN — Jukes Formation
- Quartz-sericite schist — Undifferentiated volcanics
- Lithic tuff
- Chloritised granodiorite intrusive

MAGNETICS

- Coarse scale
- Fine scale

POLE-DIPOLE

- Chargeability
- Resistivity

GEOCHEMISTRY (ppm)

- Cu
- Pb
- Zn
- Mn
- * 5 Ag > 2 ppm

THE MOUNT LYELL MINING & RAILWAY COMPANY LTD.

E.L. 9/66
ROLLESTON GRID
LINE 48 N PROFILE

84-2256 012

SCALE 1:2000 | DRAWN BY M.J.H. | DATE January 1982 | DRAFTSMAN T.G.D.S.

REVISIONS

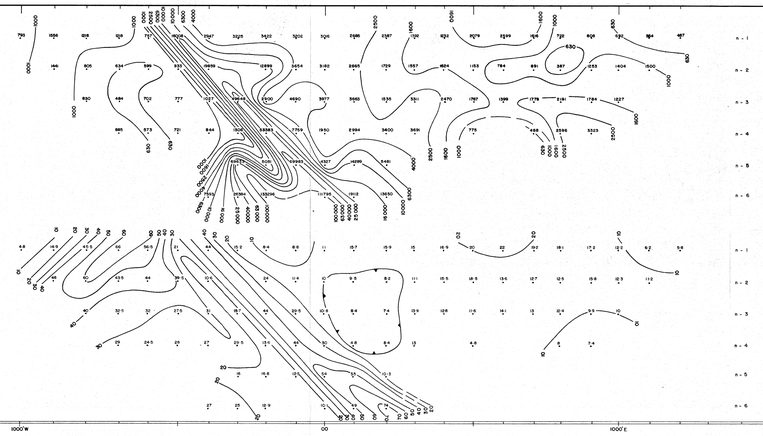
FIG. 13

A0-186

DIPOLE-DIPOLE IP

Scintrex 1981

a = 200ft.



DIPOLE-DIPOLE IP

Scintrex 1981

a = 200ft.

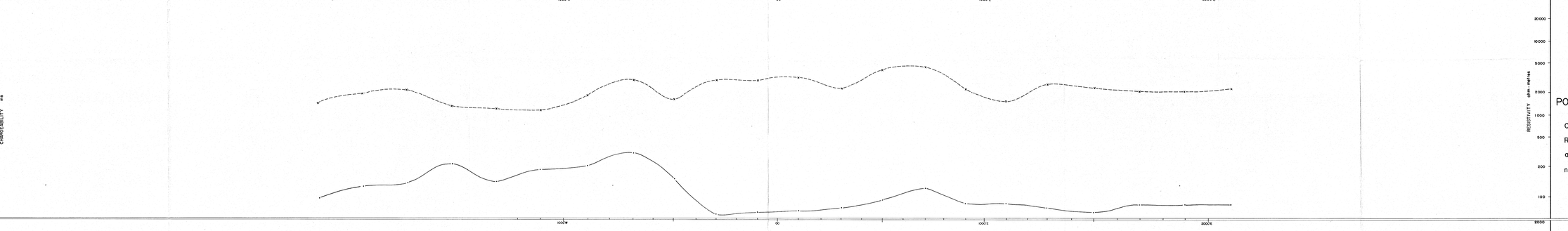
POLE-DIPOLE IP

C.G.G. 1970

Receiver 1

a = 200ft.

n = 5



POLE-DIPOLE IP

C.G.G. 1970

Receiver 1

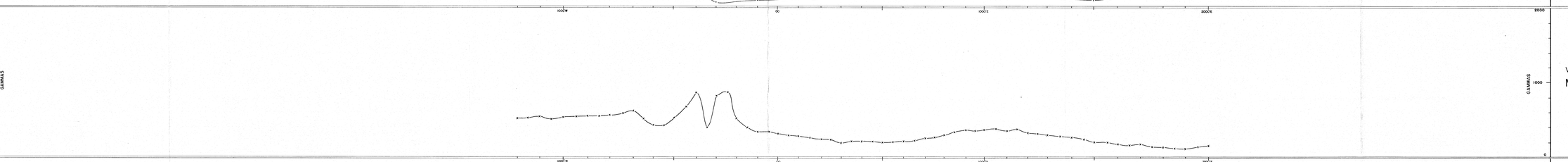
a = 200ft.

n = 5

VERTICAL FIELD

MAGNETICS

C.G.G. 1970



VERTICAL FIELD

MAGNETICS

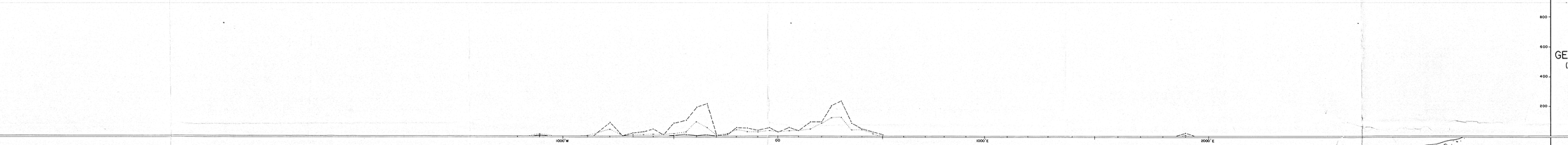
C.G.G. 1970

SOIL

GEOCHEMISTRY

(parts per million)

1981 assays



SOIL

GEOCHEMISTRY

(parts per million)

1981 assays

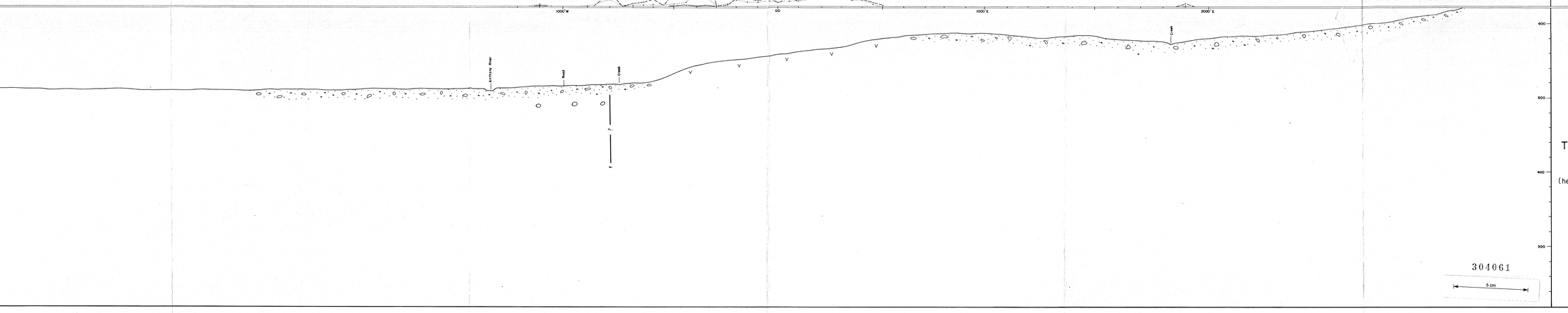
TOPOGRAPHY

&

GEOLOGY

(height above sea level)

metres



TOPOGRAPHY

&

GEOLOGY

(height above sea level)

metres

304061

5 cm

GEOLOGY

QUATERNARY
Moraine, scree

ORDOVICIAN
Owen Conglomerate

CAMBRIAN
Undifferentiated volcanics

MAGNETICS

Coarse scale

Fine scale

POLE-DIPOLE

Chargeability

Resistivity

GEOCHEMISTRY (ppm)

Cu

Pb

Zn

Mn

* 5 Ag > 2 ppm

THE MOUNT LYELL MINING & RAILWAY COMPANY LTD.

E.L. 9/66

ROLLESTON GRID

LINE 56 N PROFILE

013

RL-2256

REVISIONS

SCALE 1:2000

DATE January 1982

DRAWN BY MJH

DRAFTSMAN TGDS

FIG 14

AO-187

LAKE DORA

WL·760

WL·754

WL·745

WL·726·0

Michael Tarn

Maxfield Tarn

5355000mN

5354900mN

5353000mN

5352000mN

387000mE

388000mE

389000mE

152S

160S

168S

176S

184S

192S

200S

208S

216S

224S

232S

240E

248S

BASELINE 2000E

GEOLOGICAL BOUNDARIES

- Accurate
- Approximate / inferred
- Gradational

FAULTS

- Accurate
- Approximate / Inferred
- Concealed

STRUCTURES

- 70 Bedding, with dip
- Bedding, vertical
- 65 Cleavage, with dip
- Cleavage, vertical

QUATERNARY

- Glacial moraine, alluvium

ORDOVICIAN

- Gordon Limestone
- O Owen Conglomerate

CAMBRIAN

- T Jukes Formation
  Hematitic volcaniclastic sandstone and minor hematitic tuffs
- ▽ Dora Conglomerate
  Volcaniclastic boulder conglomerate and minor volcaniclastic sandstone

CAMBRIAN

- Quartz crystal-vitric tuffs
- Felsic lavas rhyolite-dacite
- Crystal-lithic and lithic-crystal tuffs, grading to agglomerate locally
- Quartz-feldspar crystal tuff

LOWER CAMBRIAN

- Quartz sandstone, pebble conglomerates, shales

INTRUSIVES

- Quartz-feldspar porphyry
- Feldspar-hornblende porphyry
- Coarse-grained granodiorite

Data sources : Hutton, 1981
Brophy, 1981
Airphotos: F301, Queenstown 1972
8/16-20, 9/51-59. 1:18,000

304062

THE MOUNT LYELL MINING & RAILWAY COMPANY LTD.

E.L.9/66
SPICER GRID
GEOLOGY

014

5 cm

ML/MG81/11 8L-2256

SCALE 1:5000 DRAWN BY M.H

DATE DRAFTSMAN

REVISIONS

FIG 15

A1 - 177 - 1

LAKE DORA

Michael Tarn

Maxfield Tarn

WL·760

WL·754

WL·745

WL 725·0

5355000mN

5354000mN

5353000mN

5352000mN

387000mE

388000mE

389000mE

ARRAY 1

ARRAY 2

ARRAY 3

152S

160S

168S

176S

184S

192S

200S

208S

216S

224S

232S

240E

248S

BASELINE 3000E

a = 40m

150m

20m

60m

80m

GRADIENT ARRAY
1980-81 (Scintrex)

ARRAY COVERAGE

DIPOLE-DIPOLE
1980-81 (Scintrex)

ARRAY NUMBERS

ELECTRODE POSITION WITH ARRAY POSITION

304063

5 cm

THE MOUNT LYELL MINING & RAILWAY COMPANY LTD.

E.L.9/66
SPICER GRID

I.P. COVERAGE 1980-81

015

ML/MG81/11

84-2256

SCALE 1:5000	DRAWN BY M.H.
DATE	DRAFTSMAN

REVISIONS

A1 - 177-7

LAKE DORA

Michael Tarn

Maxfield Tarn

WL·760

WL·754

WL·745

WL 726·0

Sp1

Sp2

Sp3

Sp3(s)

Sp4

Sp4(n)

Sp5

Sp5(n)

Sp6

BASELINE 3000E

152S

160S

168S

176S

184S

192S

200S

208S

216S

224S

232S

240E

248S

5355000mN

5354000mN

5353000mN

5352000mN

387000mE

388000mE

389000mE

20m

150m

60m

280m

Survey by Scintrex Pty Ltd, Dec, 1980 - Jan 1981

Transmitter: Scintrex 2·5/3 kw time domain I.P. transmitter

Receivers: Scintrex IPR-8 I.P. receivers.

Receiver dipole: 20 m

Station interval: 20 m

Chargeability: M32 slice of normalised decay curve
650-1170ms after shut off.

⊕3 Electrode position with array number

mV/V

	> 40
	30-40
	20-30
	10-20
	< 10

CONTOUR INTERVAL 10mV/V

Sp1 ANOMALY NUMBER

304064

5 cm

THE MOUNT LYELL MINING & RAILWAY COMPANY LTD.

E.L.9/66
SPICER GRID
GRADIENT ARRAY I.P.
CHARGEABILITY
1980-81 SURVEY

016

ML/MG81/11 84-2256

SCALE 1:5000 DRAWN BY M.H.

DATE DRAFTSMAN

REVISIONS

FIG. 17

A1 - 177-4

LAKE DORA

Michael Tarn

Maxfield Tarn

WL·760

WL·754

WL·745

WL·726·0

BASELINE 3000E

152S

160S

168S

176S

184S

192S

200S

208S

216S

224S

232S

240E

248S

5355000mN

5354000mN

5353000mN

5352000mN

387000mE

388000mE

389000mE

20m

50m

150m

280m

Survey by Scintrex Pty Ltd, Dec.1980 - Jan, 1981

Transmitter: Scintrex 2·5/3 kw time domain I.P. transmitter

Receivers: Scintrex IPR-8 I.P. receivers.

Receiver dipole: 20 m

Station interval: 20 m

Resistivity: Logarithmic contours in ohm-metres

$\oplus_3$ Electrode position with array number

ohm-metres

	> 10 000
	5000 - 10000
	2000 - 5000
	1000 - 2000
	500 - 1000
	< 500

304065

5 cm

THE MOUNT LYELL MINING & RAILWAY COMPANY LTD.

E.L.9/66
SPICER GRID
GRADIENT ARRAY I.P. RESISTIVITY

1980-81 SURVEY

017

ML/MG81/11

84-3256

SCALE 1: 5000 — DRAWN BY M. H.

DATE — DRAFTSMAN

REVISIONS

FIG. 18

AI - 177-5

018

LAKE DORA

Michael Tarn

Maxfield Tarn

WL·760

WL·754

WL·745

WL 726·0

BASELINE 3000E

152S
160S
168S
176S
184S
192S
200S
208S
216S
224S
232S
240E
248S

5355000mN
5354000mN
5353000mN
5352000mN

387000mE
388000mE
389000mE

Survey by Scintrex Pty Ltd. February, 1981

Magnetometers: Geometrics G816
Scintrex MP-2

Base station: Rolleston camp

Station intervals: 5m - 20m

Line profiles of corrected data smoothed by hand and contoured by M. Hutton

Gammas

	> 63800
	63400 - 63800
	63000 - 63400
	62600 - 63000
	< 62600

304066

5 cm

THE MOUNT LYELL MINING & RAILWAY COMPANY LTD.

E.L.9/66
SPICER GRID
GROUND MAGNETICS
SMOOTHED CONTOUR PLAN
1980-81 SURVEY

018

ML/MG81/11 8L-2256

SCALE 1:5000 DRAWN BY M. H.

DATE DRAFTSMAN

REVISIONS

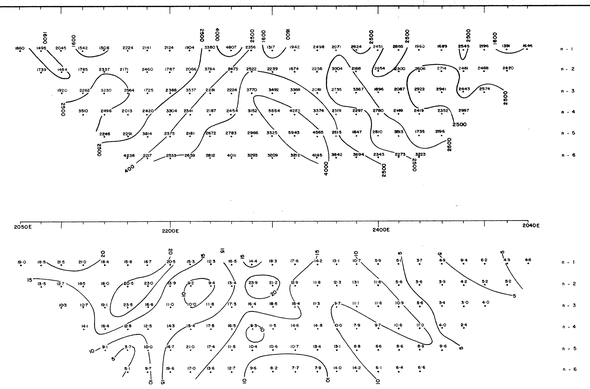
FIG. 19

A1 - 177-6

DIPOLE-DIPOLE IP

Scintrex 1981

a = 40m.



DIPOLE-DIPOLE IP

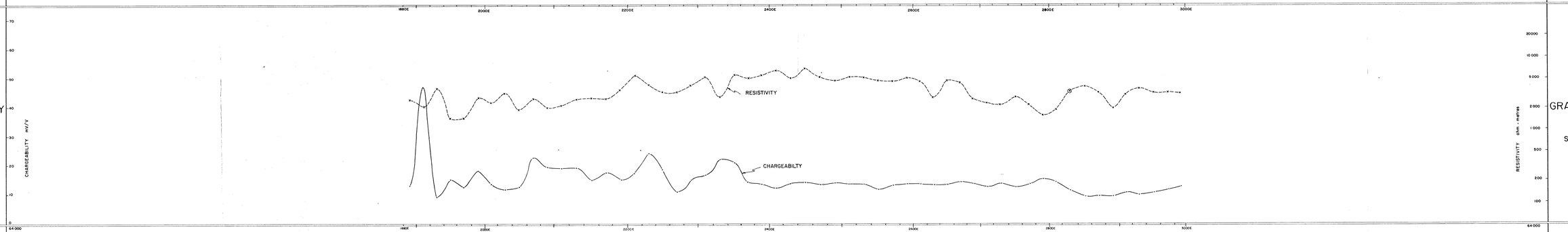
Scintrex 1981

a = 40m.

GRADIENT ARRAY IP

Scintrex 1981

a = 20m.

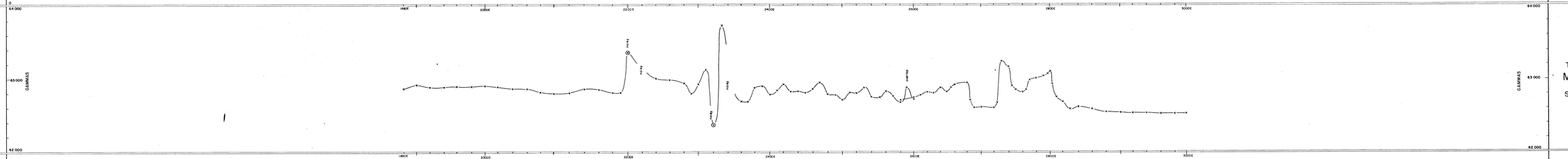


GRADIENT ARRAY IP

Scintrex 1981

TOTAL FIELD MAGNETICS

Scintrex 1981



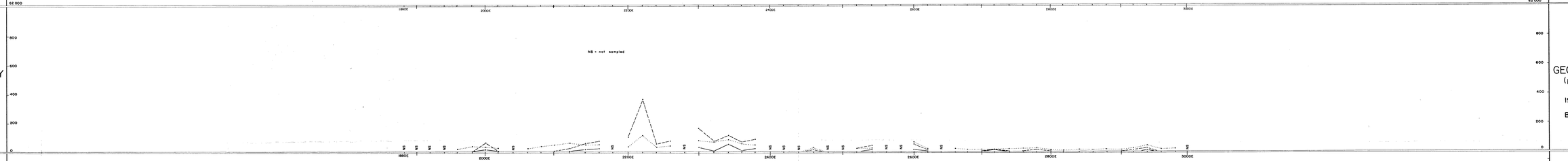
TOTAL FIELD MAGNETICS

Scintrex 1981

SOIL GEOCHEMISTRY (parts per million)

1981 assays

B/C horizon

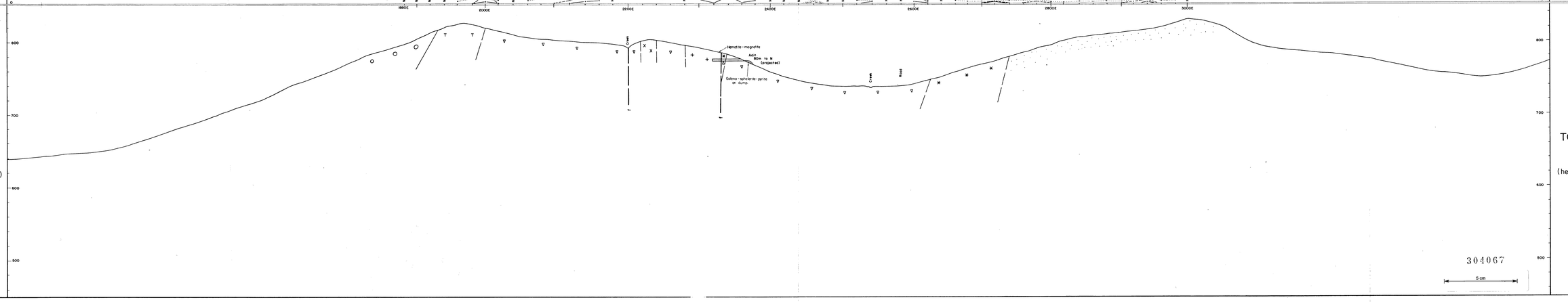


SOIL GEOCHEMISTRY (parts per million)

1981 assays

B/C horizon

TOPOGRAPHY & GEOLOGY (height above sea level) (metres)



TOPOGRAPHY & GEOLOGY (height above sea level)

304067

5 cm

CAMBRIAN INTRUSIVES

- Feldspar - hornblende porphyry
- Coarse-grained granodiorite

GEOLOGY

- ORDOVICIAN — Owen Conglomerate
- CAMBRIAN — Jukes Formation
- Dora Conglomerate
- Crystal lithic tuffs
- Quartz-feldspar crystal tuffs
- LOWER CAMBRIAN — Quartz sandstone, siltstone, shale

MAGNETICS

- Coarse scale
- Fine scale

GRADIENT ARRAY

- Chargeability
- Resistivity

GEOCHEMISTRY (ppm)

- Cu
- Pb
- Zn
- Mn
- * 5 Ag > 2ppm

THE MOUNT LYELL MINING & RAILWAY COMPANY LTD.

E.L. 9/66

SPICER GRID 013

LINE 192 S PROFILE

84-2256

SCALE 1:2000	DRAWN BY M.J.H.
DATE January 1982	DRAUGHTSMAN T.G.S.S.

REVISIONS

FIG. 20

AO-188

LAKE DORA

Michael Tarn

? Swamp

Maxfield Tarn

WL·760

WL·754

WL·745

WL 726·0

LOWER CAMBRIAN INCLUDING BLACK SHALES SEDIMENTS

OWEN CONGLOMERATE

HEMATITIC SANDSTONE UNIT

BLACK SHALES

LOWER BLACK CAMBRIAN SHALES

SP1

SP2

SP3

SP3 (S)

SP4(n)

SP5(n)

SP6

27324
27342

27329
27338

152S
160S
168S
176S
184S
192S
200S
208S
216S
224S
232S
240E
248S

5355000mN
5354000mN
5353000mN
5352000mN

387000mE
388000mE
389000mE

ROCK CHIPS

SIGNIFICANT ASSAYS

SAMPLE No.	TYPE OF SAMPLE	Cu %	Pb %	Zn %	Ag g/t
27324	Random	0·48	0·01	0·04	7
27342	Picked	0·93	0·03	0·05	7
27340	Picked	0·02	0·95	2·3	4
27329	Random	0·09	0·25	0·13	13
27338	Picked	0·20	4·0	5·7	160

GEOCHEMISTRY

SOILS - B Samples

Cu 40ppm
Pb 180ppm
Zn 90ppm

ROCK CHIP - SIGNIFICANT ASSAYS
x 27340

GEOPHYSICS

Gradient Array I.P.

Chargeability > 20 m V/V

Resistivity < 2000 ohm-m

Magnetics > 63000 γ (600 γ above background)

SP1 Anomaly number

304068

5 cm

THE MOUNT LYELL MINING & RAILWAY COMPANY LTD.

E.L.9/66
SPICER GRID
ANOMALY COMPILATION

020

ML/MG81/11 EL-2256

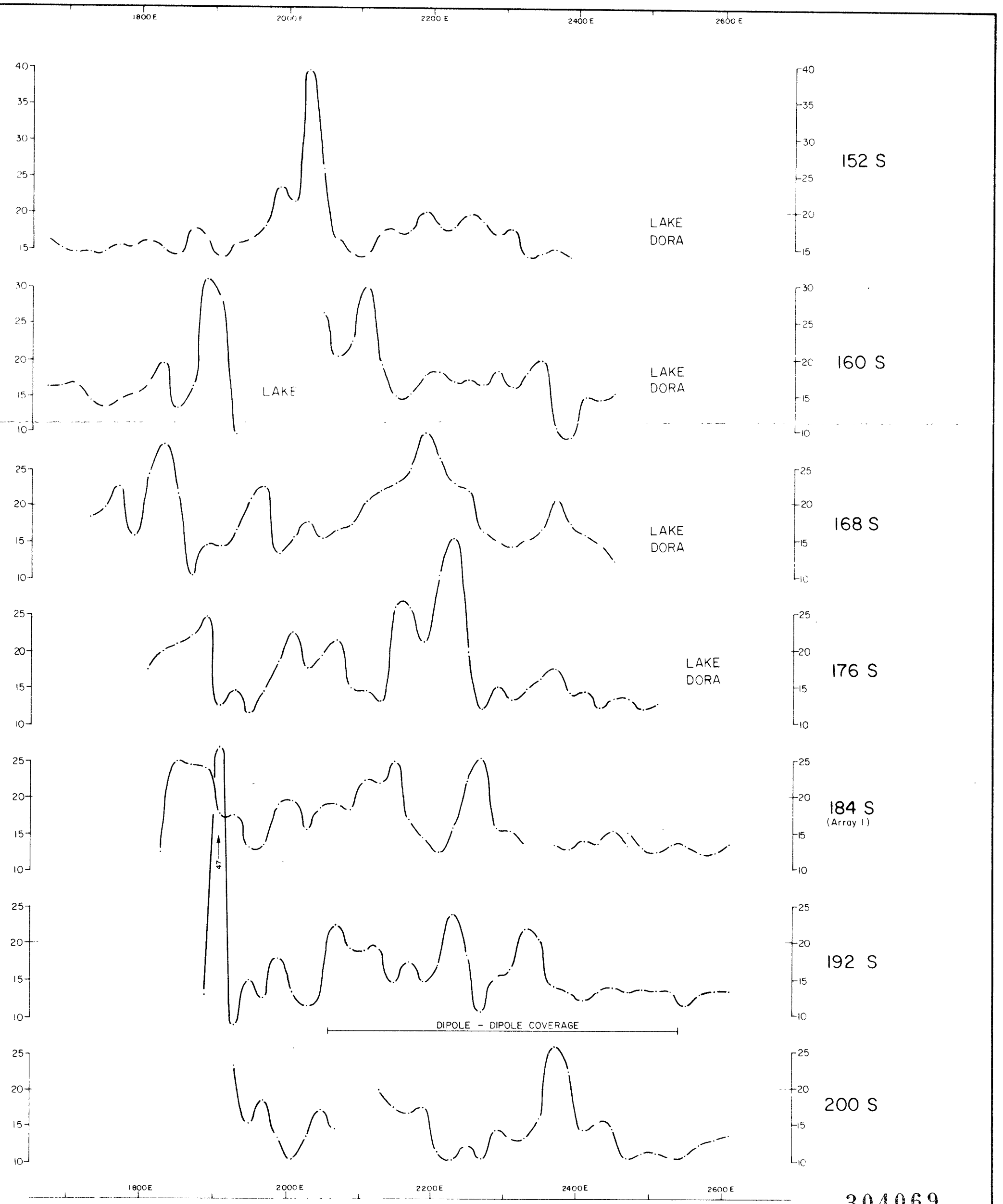
SCALE 1:5000 DRAWN BY M.H.

DATE DRAFTSMAN

REVISIONS

FIG. 21

A1-177-2



5 cm

Horizontal scale 1 5000 No slope correction

Vertical scale 1cm = 5m V/V

Survey dates 4-12-80 to 25-1-81

Survey by Scintrex Pty Ltd

Scintrex IPR-8 receivers

M32 slice of transient decay curve plotted in millivolts/volt

304069

THE MOUNT LYELL MINING & RAILWAY COMPANY LTD.

SPICER GRID
GRADIENT ARRAY
CHARGEABILITY PROFILES
LINES 152 S - 200 S

021

84-2256

SCALE 1:5000	DRAWN BY M J H
DATE 4th September 1981	DRAFTSMAN P J R

REVISIONS

FIG 22

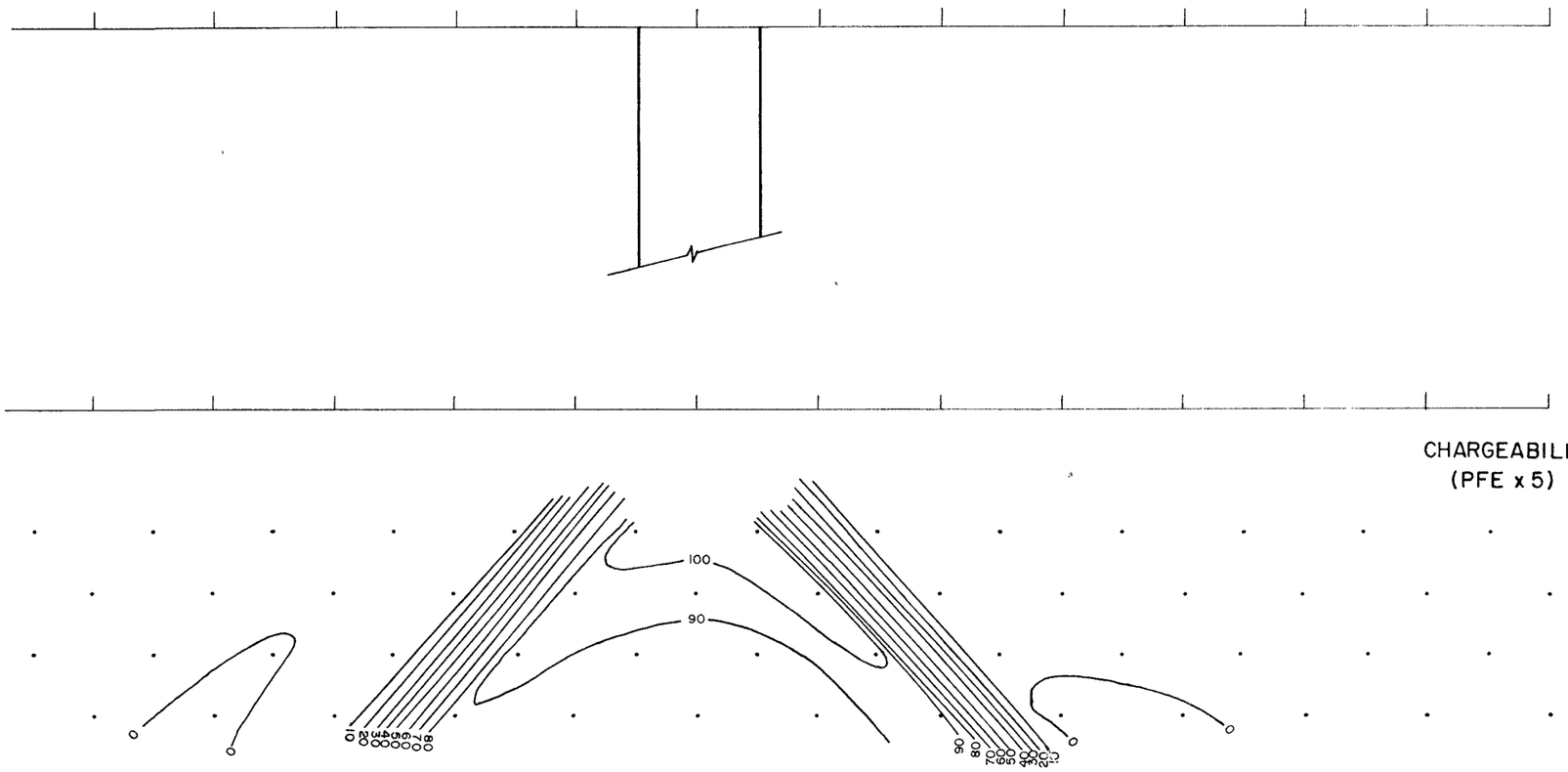
A3 - 162

Model: Infinite vertical dyke
(VC-3, Geoscience type curves)

Depth: Outcropping — Resistivity of host 100 ohm-m

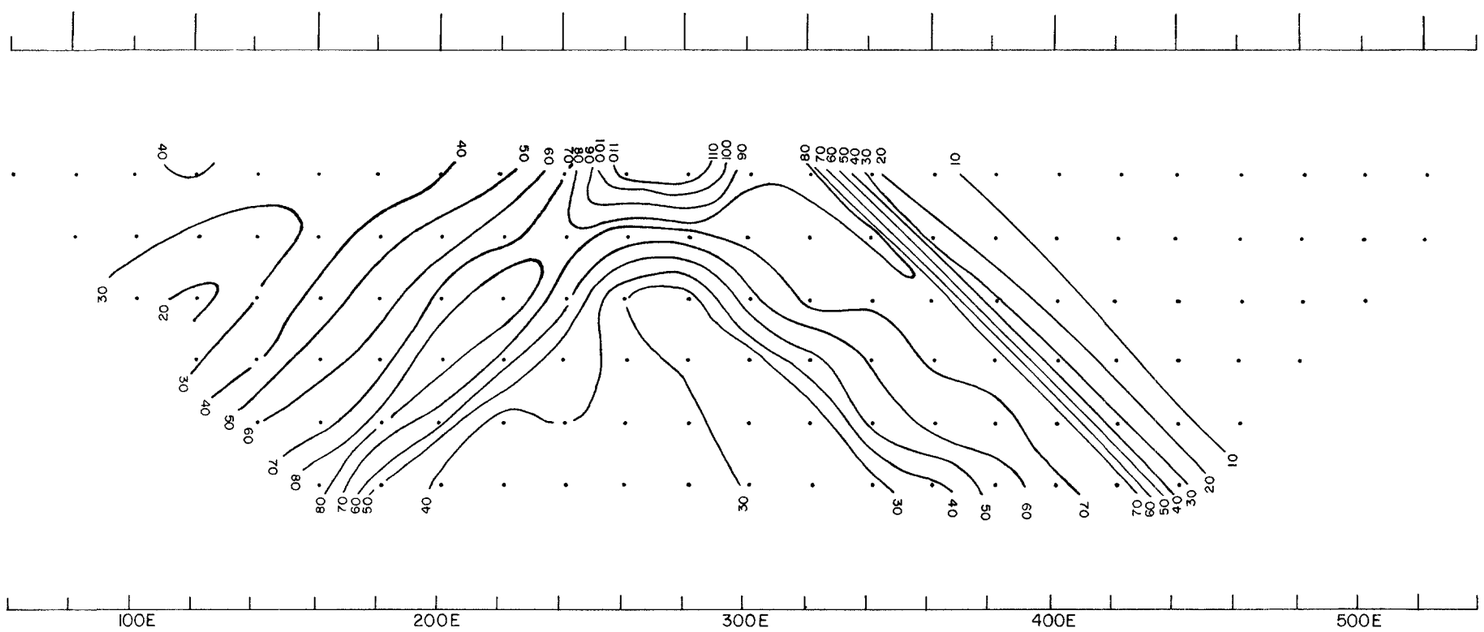
Width: 1 Dipole — Resistivity of dyke 10 ohm-m

(1 dipole = 40m) — pfe of dyke 25%



MODEL RESULTS

304070



FIELD RESULTS
(dipole spacing 40m)

5 cm

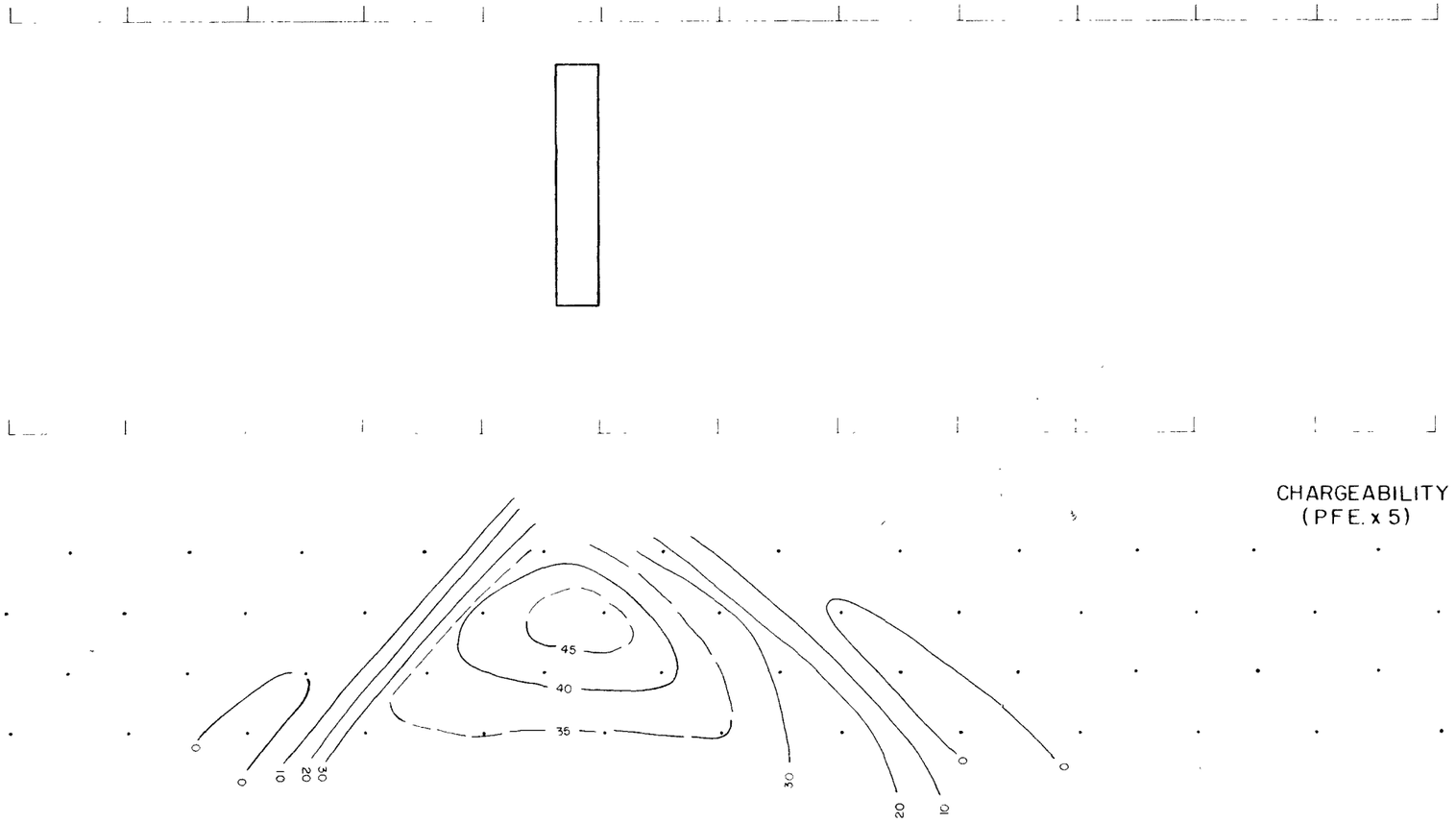
THE MOUNT LYELL MINING & RAILWAY COMPANY LTD.

MODELLING OF
CHARGEABILITY RESULTS,
DIPOLE-DIPOLE SURVEY
Line 144N, Selina

022

ref ML/MG81/11 84-2256 FIG:A1

SCALE 1 2000	DRAWN BY MITRE GEO
DATE 18th DEC 1981	DRAFTSMAN H D J A3-180



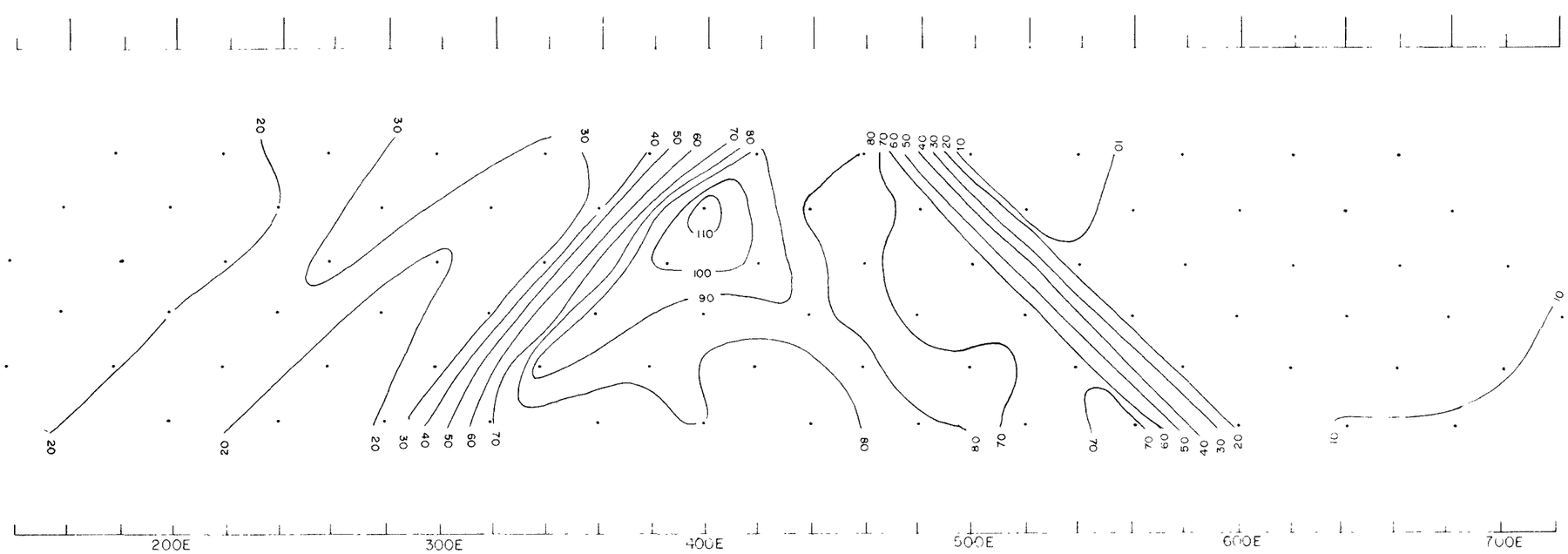
Model Infinite vertical dyke of limited depth extent
(FB-3, Geoscience type curves)

Depth = 1/3 dipole	Resistivity of host 100 ohm-m
Width = 1/3 dipole	Resistivity of dyke 10 ohm-m
Depth extent = 2 dipoles	pfe of dyke 25%

(1 dipole = 40 m)

(Lower model values indicates a more chargeable 'field' source)

MODEL RESULTS



304071

FIELD RESULTS

(dipole spacing 40 m)

5 cm

THE MOUNT LYELL MINING & RAILWAY COMPANY LTD.

MODELLING OF CHARGEABILITY RESULTS, DIPOLE-DIPOLE SURVEY Line 184 N, Selina

023

ref ML/MG81/11 84-2256 FIG A2

SCALE 1 2000	DRAWN BY MITRE GEO.
DATE 18th DEC. 1981	DRAFTSMAN H D J A3-179