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A REPORT ON

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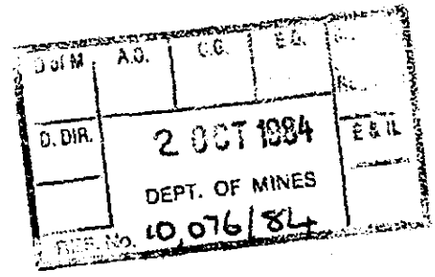
AND TOTAL FIELD MAGNETOMETER SURVEYS

OVER THE BEATRICE GRID, EL 10/69

NEAR QUEENSTOWN, WEST COAST TASMANIA

ON BEHALF OF

THE MOUNT LYELL MINING AND RAILWAY COMPANY LTD.



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A REPORT ON

GRADIENT ARRAY RECONNAISSANCE ELECTRICAL INDUCED POLARIZATION AND TOTAL FIELD MAGNETOMETER SURVEYS OVER THE BEATRICE GRID, EL 10/69 NEAR QUEENSTOWN, WEST COAST TASMANIA

ON BEHALF OF

THE MOUNT LYELL MINING AND RAILWAY COMPANY LTD.

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APRIL, 1977

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SCINTREX PTY. LTD.
GEOPHYSICAL CONSULTANTS AND CONTRACTORS

SUMMARY

The 38 kilometres within the Beatrice grid area were completed by a two, and at times, three, operator crew in 12 production days. The 10/15KW transmitter proved highly cost effective in the remoter sections of the grid area.

A physical property map has been constructed from the apparent resistivity and apparent chargeability gradient array data, together with the total magetic field survey data which was also acquired. The characteristic physical property units, together with their sharp boundaries, will materially assist in the construction of an accurate geological map of the area.

Some six areas of anomalous electrical induced polarization were located, within which some ten induced polarization anomalies were located, while outside these areas, sixteen individual anomalies were located. Of the above, some eight are considered of up to primary interest.

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A REPORT ON

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INTRODUCTION

At the request of Mr. K. Reid, Chief Geologist for the Mount Lyell Mining and Railway Company Ltd., Scintrex Pty. Ltd. executed electrical induced polarization surveys over the Beatrice grid, EL 10/69, near Queenstown West Coast Tasmania.

The overall party leader was Scintrex senior operator, Mr. R. Lindberg who was assisted by second operator Mr. N. Montgomery BSc., and for the latter portion of the survey, by senior operators Mr. B. Ekstrom and Mr. G. Street BSc. Additional field hands O. Saeck, G. Price and J. Spring were also provided by Scintrex. On site geological direction was undertaken by Mr. P. Brophy, Senior Exploration Geologist for Mt. Lyell, while Mr. A.W. Howland-Rose provided geophysical supervision.

Approximately 38 kilometres of gradient array induced polarization was surveyed at 30 metre stations in 12 production days between 10th January and 3rd February, 1977. During the period, one day was lost to instrument breakdown and seven days to bad weather.

At times, up to three reading crews were employed.

A proton precession magnetometer survey was conducted using two Scintrex MP-2 total field proton precession magnetometers. Some sections were surveyed during the course of the induced polarization survey, the remainder was completed by Scintrex operator, J. Spring after completion of the EIP survey. This work was completed on 16th February, 1977.

METHOD AND EQUIPMENT

Due to the extreme terrain and inaccessibility of the most northerly half of the grid, a 10/15KW generator was employed to energise current dipoles of from 1600 metres to 4000 metres. The generator was up to 5 kilometres from the electrode positions. The large current dipole enabled the area to be covered in an efficient manner. The resultant primary (resistivity) and secondary (chargeability) equipotential field were surveyed using Scintrex IPR-7 induced polarization receivers.

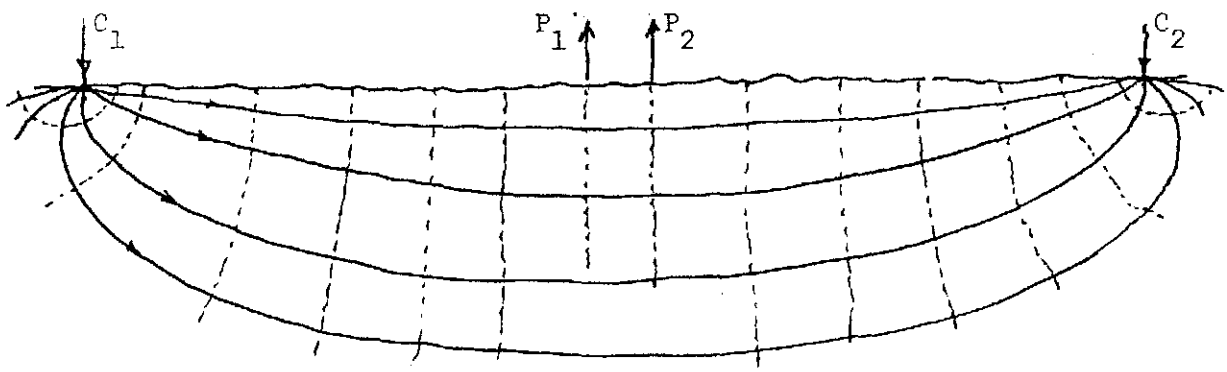
A very simple explanation of the parameters measured in the gradient survey follows. This description is designed specifically for the geologist in order to give a *visual picture* of the parameters measured.

In the case of the gradient array, the potential dipole records the electrical properties of the material defined by the two

ELECTRICAL PARAMETERS MEASURED

(A) RESISTIVITY MEASUREMENT

(taken during current 'on' time)



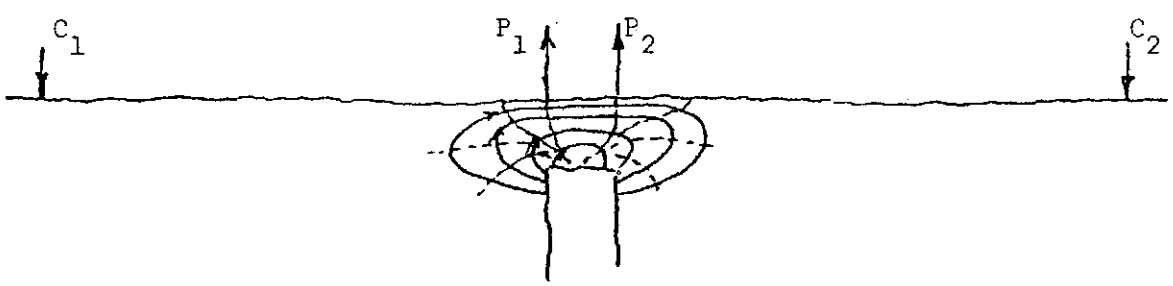
MEASUREMENT REPRESENTS:

ease with which primary current moves through ground

primary current flow
primary equipotential surface

(B) CHARGEABILITY (IP) MEASUREMENT

(taken during current 'off' time)



MEASUREMENT REPRESENTS:

discharge of stored energy

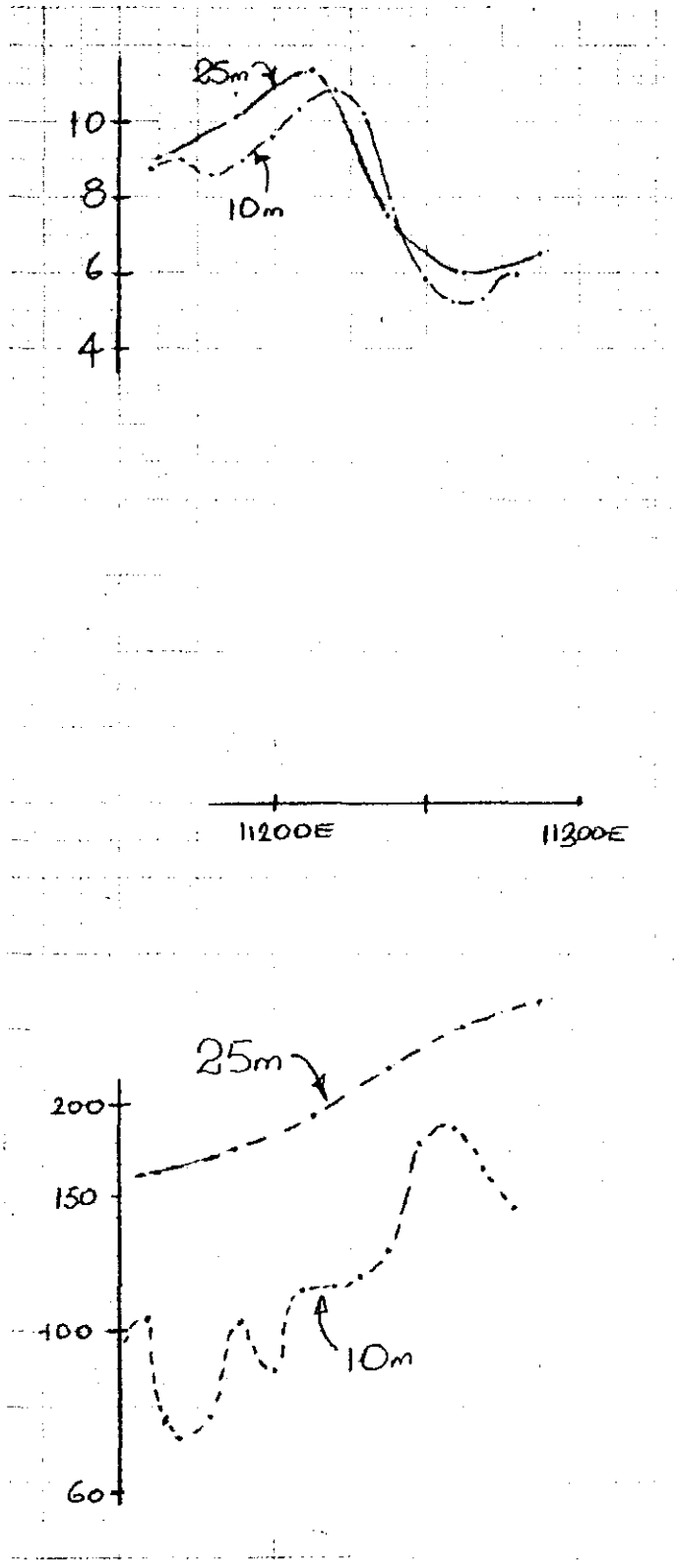
secondary current flow
secondary equipotential surface

FIGURE 1

equipotential *surfaces* tapped by the potential electrodes. This is diagramatically illustrated in Figure 1(A). This diagram represents a *section*, however, it should be realised that the apparent resistivity measurements also record information *sideways* For a three dimensional picture of the volume sampled, rotate the section *into* and *out of* the plane of the paper by 90°. Within the centre section of the array the data represents the characteristics of the rock units *immediately below* and *immediately at right angles* to the survey line. The degree of *resolution* depends on the potential *dipole width*, the smaller the dipole the greater the resolution. Diagram 2 (the resistivity data) demonstrates the much improved resolution for a 10 metre dipole over that obtained from a 25 metre dipole over a sulphide occurrence whose characteristics will be similar to the target mineralisation. It is important to remember when examining the data that only the *gross* properties are "seen". The potential dipole cannot resolve units whose effective width is less than half the size of that dipole.

The criteria affecting the chargeability reading are somewhat different. In Diagram 1(B) the decay of a chargeable section is shown. The passage of current during the *current-on* phase, during which the resistivity measurement was taken, carried some energy to be stored in the rocks (and sulphides, etc.), through which it passed. On cessation of this imposed current flow, the energy so stored will discharge (IP). It will set up its own

IMPORTANCE OF RESOLUTION



CHARGEABILITY
(milliseconds)

RESISTIVITY
(ohm-metres)

FIGURE 2

equipotential field as shown in Figure 1(B) which will be detected by the same two potentials which measured the resistivity. It should be noted that any chargeable source will have a width *greater than* the source due to the curvilinear nature of the discharge of the stored energy. It should be further noted that the volume defined by the *secondary potential field* caused by this discharge *is not necessarily identical* to that defined by the primary equipotential field. Figure 2 shows the differences in resolution *for chargeability* (top profile) over a known sulphide occurrence. The *form* is similar, but the positional information is far superior due to the more frequent reading interval.

This array has operational attributes which result in rapid coverage and excellent positional information. However, depth information is not well defined, it being possible only to assess "maximum depths".

With regard to the interpretation of the gradient array data, the following comments may prove to be of assistance.

In the gradient array the source of the reading lies between the two equipotential surfaces tapped by the two potential pots employed. For the most part then, when working in the centre section of a gradient array, the source will be "immediately below" the potential dipole used. The reliability therefore of

positional information with gradient array is excellent, however, the depth at which the response occurs is difficult to assess with accuracy. The *maximum depth* can be estimated from a consideration of the profile shape, but the accuracy of this approach will depend on a minimal potential dipole length, and of course sharp boundaries to the body. The *resolution* therefore is not better than half of that dipole. Therefore maximum depths of 10 metres may in fact either outcrop or sub-outcrop when a 20 metre potential dipole is used. Some moving source array would be required to obtain an *accurate depth estimate.*

Similarly the width of bodies is not easy to determine for zones having a width less than half the dipole spacings used. Thus, estimated maximum widths are educated guesses at best for narrow zones. However, wider bodies can be resolved more accurately.

The *attitude* of a chargeable zone can really only be gauged with any precision in the centre of the gradient array, and of course where the body has strongly contrasting chargeability and apparent resistivity to that of the enclosing rock units.

All field measurements were taken between slope distances along lines. This will, in steep areas, produce errors in the calculated apparent resistivity data. However, these errors will be arithmetic, and as signficant changes in resistivity are logarithmic, this source of error is not

significant. In assessing the position of the source in areas of extreme terrain, it does not lie vertically below the plotted position, but *normal to the "local slope"*. All positions in the text refer to source positions normal to the local slope.

Each current dipole block should be considered separately. As would be expected, the continuity along strike is generally good, especially in the chargeability data. However, *"end-on"* current dipole blocks cannot be expected to give identical data due to the different base levels of the current dipoles, and in zones close to the current poles, the data will not sample identical volumes on the overlap between current dipoles. This phenomenon will result in more extreme divergence of data as the current dipole is approached. However, these factors are entirely predictable.

DATA PRESENTATION

The contour interpretations of the apparent chargeability in milliseconds, apparent resistivity in ohm-metres, and the total magnetic field in gammas, are presented at the scale of 1:6000 (metric) on Plates 2, 3 and 4 respectively. The data profiles are presented on the six sheets of Plate 1 at the horizontal scale of 1:3000 and vertical scales of 1 centimetre = 2 milliseconds, 10 centimetre log scale for resistivity, and 5 centimetres = 200 gammas for total magnetic field. Plate 5 displays the physical properties as interpreted from the three parameters of chargeability, resistivity and total magnetic field.

DISCUSSION OF THE RESULTS

Each of the contour interpretations of apparent chargeability, apparent resistivity and total magnetic field are discussed in general terms, after which the physical property interpretation plan is then reviewed. The six major areas of induced polarization are then discussed in some detail.

THE CONTOUR INTERPRETATIONS

The method used to compile the contour interpretations was to first bias the major features of each of the three properties available, and then in turn bias those sections of each parameter which showed no clear trend by the strike implied by the most dominant parameter. It should be noted that no geological information whatsoever was used in the establishment of the trends and boundaries in these interpretations.

Each separate gradient block (the area mapped between each separate current dipole) is contoured individually for chargeability and resistivity, and the boundaries of each block are shown clearly on the plates.

The major features of each of the three physical properties studied above were then compiled on Plate 5. The various "physical property zones" represent distinct geological units, and therefore the resultant compilation of physical properties is representative of the underlying geology. The contrasts

noted on the Beatrice grid were significant and generally quite sharp, thus the *changes* in physical properties are considered to mark major changes in geology. It should be noted that not all major geologic changes will necessarily be shown up as physical property changes, particularly in the acid intermediate area where marked changes in rock type may still have similar resistivity contrasts and only small changes in mafic mineral content and magnetite content.

The Apparent Chargeability Contour Plan (Plate 2)

The general trend of the chargeability response throughout the area is grid north south in the centre, grid north-north-west/south-south-east in the west and grid north-north-east/south-south-west in the east. These strike directions are conformable for all three physical properties.

The background over the whole area can be considered to be 12½ ±2½ milliseconds with anomalous areas rising to twice to three times this background.

Over a number of zones, distinct areas of anomalously low (5 ± 2½ milliseconds) induced polarization background were recorded. These areas, in general, coincide with areas of high (above 5000 ohm-metres) resistivity.

Some five separate and distinct areas labelled C1 - C5 on Plates

2 and 5 have been defined. Also a zone of special interest in the extreme north-west of the grid labelled C6 is discussed in detail.

The correlations noted with the other two physical properties were....(i) The chargeable areas are generally mutually exclusive to the areas of higher magnetic variation, and....(ii) are generally mutually exclusive to the areas of highest resistivity, however, the *lowest* resistivities do not in general have accompanying higher chargeabilities in this area.

The Apparent Resistivity Contour Plan (Plate 3)

The main grain of the underlying geological units as inferred from the apparent resistivity data *varies about* grid north south.

The variation in apparent resistivity recorded over the grid area ranged from below 30 ohm-metres to in excess of 20,000 ohm-metres. However, the background for the area as a whole can be considered to be of the order of 2000 to 3000 ohm-metres.

Both the chargeable and magnetically active areas are confined, in general, to the moderately resistive areas between 1500 and 5000 ohm-metres, while the very highest resistivities (7000 to 20,000 ohm-metres) are in general coincident with some of the lowest chargeability recorded in the area. These zones are considered to be acid volcanic or quartz rich sediments (e.g.

Owen Congolmerates?) which are probably silicified, and devoid of mafic, chargeable mineral constituents.

Total Magnetic Field Contour Plan (Plate 4)

The magnetic field background observed in the area can be considered to be in the range 62,600 ± 50 gammas. A range of values about 1000 gammas *above* and 300 gammas *below* this level were recorded in the area. The strike of the underlying geological units is inferred to be very similar to that gauged from the chargeability data, namely, generally north-north-west/south-south-east in the west, grid north-south in the centre, and grid north-north-east/south-south-west in the eastern section.

In general, the most magnetically active areas are underlain by moderate apparent resistivities (1500 to 3000 ohm-metres), while the most conductive *and* most resistive sections lie within 50 gammas of the assessed background.

Some four zones, designated M1 to M4, have been defined on Plates 4 and 5, within which the majority of most significant magnetic events were defined. Each of these units probably represents areas of similar rock type.

THE PHYSICAL PROPERTY INTERPRETATION PLAN (Plate 5)

The general grain of the underlying geological units is grid north-south as gauged from all three physical properties, and

from the strike of the major units within those physical properties. In the extreme western and eastern sections of the grid area, the strike appears to veer west of and east of, grid north-south respectively.

One substantial area of anomalous induced polarization designated C4 occurs to the west of the baseline, with two smaller areas, C3 and zone C5, occurring to the north-east and south-west of it respectively. All three lie in areas of background magnetic field, and thus magnetite does not make a material contribution to the chargeable responses observed. In all three cases the apparent resistivity within each unit is about background (2000 to 3000 ohm-metres).

An area designated C6 in the north west of the grid area is characterised by very high chargeabilities and very low resistivities and is considered to be an area distinct from the remainder of the grid.

In the central and southern areas of the eastern third of the Beatrice grid, a large zone of higher than background induced polarization was defined. In the central section between lines 800N and 1400N, chargeabilities remain a higher than normal 17 to 20 milliseconds. This zone has been designated C1 and may represent a higher than average mafic mineral content in the underlying geological units. To the south of this unit on line 800N, 600N and 400N, chargeabilities rise significantly to over 3 times background

and resistivities fall significantly. This area has been designated zone C2 and it should be noted that it lies open to the south.

A number of distinctive zones of anomalously low induced polarization were noted over the grid, the most distinctive of which was traced along a grid north-north-west/south-south-east to north-south trend over all lines some 500 metres west of the baseline. The zone is about 250 metres wide, and has apparent resistivities of 0 to 12½ millisecond, but for the most part they range between 5 and 10 milliseconds. This zone represents an area which has minimal chargeable material, i.e. mafic minerals, magnetite, sulphides or graphite. Either these components never were present in the underlying feature, or were removed. In the northern section of this zone above line 600N, the apparent resistivities reached over 10,000 ohm-metres, which indicates extremely electrically resistive rocks, which, together with the low chargeabilities infers acid units devoid of mafic minerals and perhaps silicified. To the south of 600N the resistivities fall to 2000 to 3000 ohm-metres while on line 400N they actually reach less than 1000 ohm-metres, but with low coincident chargeabilities. It is perhaps significant that a major fault has been mapped in this vicinity. (Geological map by K. Wells dated Feb. 1975)

A second similar zone was recorded on lines 1400N to 2000N from 00 to about 400W. This zone is underlain by zero chargeabilities and extrmely high resistivities of 7000 ohm-metres+. The underlying geological units must be extremely acid in composition, and again

be low in mafic chargeable minerals.

A third area of abnormally low chargeabilities and moderate resistivities was logged in the south-western section of the area on lines 600N, 400N, 200N and 00 at approximately 1800W, 1800W, 1750W and 1650W respectively. This area varies from those described above in that it was *moderate* as opposed to *high* apparent resistivities.

A series of grid east-west dislocations are suggested as shown on Plate 5. While a number of these run along gradient boundaries, and would normally be suspect, the magnitude of the variation together with the fact that it is mirrored in the magnetic field data, clearly indicate that they are not entirely (if at all) a function of the gradient block boundaries.

The physical property map shows a great variation in a number of distinct physical property units. It is not possible to ascertain the sources of the characteristic zones defined. Further, the boundaries between the various units located are more often than not sharp and thus represent real and material geological boundaries. Thus it is concluded that the physical property interpretation plan represents some function of the underlying geology.

DESCRIPTION OF THE MAIN ZONES OF ANOMALOUS INDUCED POLARIZATION

ZONE C2.....The most southerly line on which this zone makes a material appearance is line 400N east of about 900E where background rises from about the 12½ milliseconds level to over 25 milliseconds at 1200E. Within this zone, a distinct local peak, 2.1, of 10 milliseconds above the lower western background of about 20 milliseconds was recorded. This is coincident with a fall-off in apparent resistivity to 400 ohm-metres, from a 2500 ohm-metres level to the west at 900E and 600 ohm-metres to the immediate east. As there is no associated magnetic distortion, the source is considered to be disseminated sulphides or graphite within a host less resistive than the enclosing rocks. This response is open to the south and the source has a maximum depth of about 50 metres.

To the north on line 600N, 2.1 is a material 15 milliseconds above the 10 millisecond background to the west, and is associated with a lowering of apparent resistivity to about 500 ohm-metres as against 1200 ohm-metres to the east. The maximum depth is 90 metres.

Now, on this line zone C2 marks a sharp contact with the very much lower background induced polarization level of about 10 milliseconds at 1030E. The resistivity varies between 1000 and 800 ohm-metres from this contact to 1650E where it falls to 400 ohm-metres as 2.3 is approached.

Within this high background a broad peak of about 10 milliseconds was defined centred at 1440E, 2.2, where a minor reduction in the apparent resistivity was noted. The maximum depth to source is difficult to gauge for this wide, diffuse anomaly, but 50 metres is considered maximum. This anomaly is not seen to the north, and is open to the east. The source is considered to be disseminated sulphides (or perhaps graphite) within an essentially resistive host.

2.3...At 1680E, 1725E and 1770E a series of higher (6 to 8 milliseconds) induced polarization values are considered to come from sources no deeper than 30 metres below surface. This anomaly is open to the south, and is not seen to the north.

Zone C2 reaches its maximum development on line 600N where the background level along the line is about 25 milliseconds. To the south it falls off somewhat to 20 to 25 milliseconds on line 400N and is open on line 200N. To the north on line 800N the background is about 20 to 22 milliseconds, while on line 1000N the level is between 15 and 20 milliseconds.

2.4...On the edge of C2 at 915E on line 200N, a very significant response of 14 milliseconds above the very low 10 milliseconds background was noted. The *profile form suggests* a west dip.

Now, a material fall-off in resistivity was noted from 5000 ohm-metres at about 850E to 500 ohm-metres at 950E. It could be that

this resistivity is the weathered near surface manifestation of the anomaly referred to above. If not, this chargeable zone lies on or in close proximity to a major rock type change. The maximum depth to source is estimated at 30 metres.

IN SUMMARY..... zone C2 consists of background chargeabilities above 20 milliseconds rising to 30 milliseconds east of about 1050E on line 600N, falling off to north and south. The anomalous chargeabilities (2.1 to 2.3) may represent formational variations within a geologic unit which is intrinsically chargeable itself. The magnetic field within this unit is not distorted, being about background, inferring that material quantities of magnetite (or pyrrhotite) are not present. Thus the source of the higher chargeabilities are probably due to disseminated sulphides (or perhaps graphite) with or without other mafic minerals.

Of the anomalies located, 2.4 is considered of the greatest interest.

ZONE C1.....Slightly higher induced polarization values of the order of 20 milliseconds were recorded on lines 1000N, 1200N and 1400N. This higher background is probably due to an increase in chargeability background within a geologic unit rather than any anomalous sulphide source as such. Unlike Zone C2 to the south, the magnetic field is often considerably distorted within this zone, with very small (say 2 to 4 millisecond) increases in chargeability being seen to be coincident with increases in magnetic field. This infers that these minor chargeability responses could

be due to magnetite, or magnetite occurring with and proportional to, graphite or sulphides. The high 1500 to 2500 ohm-metre resistivities infer the chargeable source to be in disseminated form within a resistive rock type.

IN SUMMARY..... there are no geophysically significant anomalies defined within Zone C1. The increased background is considered to be due to an increase in mafic minerals and or sulphide and graphite in low percentages. This zone is not considered of great economic interest at this stage.

ZONE C3.....A most significant series of induced polarization anomalies was recorded in Zone C3 on lines 2000N, 1800N and 1600N. The major responses were recorded on line 1800N, with much smaller responses from the same source on the lines 200 metres to the north and south.

Anomaly 3.1 - A 20 millisecond response superimposed on a near zero background at 645W on line 1800N is coincident with a fall-off in apparent resistivity from over 4000 ohm-metres to the west to 2000 ohm-metres. The maximum depth to source is estimated to be of the order of 90 metres. As there is no distortion in the magnetic field, magnetite is not contained within the causative material, which is considered therefore to be either sulphides or graphite.

To the north, anomaly 3.1 is *probably* seen as an end-effect at

630W, while this response was not seen at all on line 1600N.

Anomaly 3.2, the most significant of the three responses within zone C3, was located at 525W on line 1800N where a 38 millisecond response, again on a near zero background, was recorded coincident with a material resistivity fall of 75% to 1000 ohm-metres. The maximum depth to source is considered of the order of 70 metres. As there is no magnetic correlation, magnetite is not present within the source.

This response can be traced to line 2000N where a 7½ millisecond response was superimposed on a 7½ millisecond background at 585W. On this line, however, the resistivities remain at a high 2500 ohm-metres. To the south the anomaly is again seen as a 10 millisecond response superimposed on a low background of 4 milliseconds and coincident lowering in apparent resistivity to 2000 ohm-metres as against 3500 ohm-metres to the immediate east and west.

This response on line 1800N is considered of major importance and could be due to more electrically continuous sulphides (although still not conductive) within a more disseminated halo *along strike* and *across strike*.

Anomaly 3.3 - An extremely sharp 28 milliseconds anomaly situated at about 400W on line 1800N lies within 3500 ohm-metre resistivities.

The source is sharp sided and shallow, being perhaps less than 30 metres. The source is disseminated sulphides (or graphite) within a host which shows no contrast with the enclosing rock types.

IN SUMMARY..... Zone C3 contains three induced polarization responses all of which reach their maximum development on line 1800N, but show some evidence of extending 200 metres north or south. Anomalies 3.1 and 3.3 are considered to be due wholly to disseminated sulphide mineralisation, while anomaly 3.2 may in part be due to more electrically continuous material. Careful follow-up of anomalies 3.1 and 3.3 on a secondary basis is recommended, and anomaly 3.2 on a primary basis.

ZONE C4.....This zone of anomalous induced polarization reaches its maximum recorded development on line 1400N, where 27 to 33 millisecond induced polarization responses were recorded over the entire width between 900W and 1560W. It should be noted that the anomaly is open along strike and on its western flank on the lines above 1400N.

Anomaly 4.1 - The most significant response within zone C4 was recorded on line 1400N at 1020W where a response of over 30 milliseconds above the 5 to 7 millisecond background to the east (but only 8 milliseconds above the background within zone 4)was noted. The apparent resistivity fell a massive 85% to 1500 ohm-metres over this anomaly and there was a *fall* in the magnetic field of about 200 gamma. The maximum depth to source is considered to be about 90 to 100 metres.

To the north, this response correlates with two 27 millisecond responses at 945W and 1005W, both of which show declines in apparent resistivity to about the 1000 to 1100 ohm-metres level as against 3000 ohm-metres to the immediate east.

On line 1800N this anomaly was located on the extreme western ends and it is open to the north and west. On this line it reaches over 30 milliseconds and is associated with a decline in apparent resistivity to about 2000 ohm-metres.

South of line 1400N the anomaly is seen distinctly on line 1200N where twin peaks of 33 milliseconds on a 7 millisecond background were observed centred at 855W and 930W. Only slight decreases in the high apparent resistivities of 3000 ohm-metres were observed. The maximum depths to source are considered to be of the order of 45 to 60 metres in this case.

The material induced polarization response continues across line 1000N at 735W where a 30 millisecond anomaly was recorded on a near zero background and a minor resistivity low within 4000 to 5000 ohm-metre apparent resistivities. The anomaly lies within an overall magnetic low of about 60 to 70 gammas below background. The maximum depth to source is estimated at 60 metres.

On line 800N at 630W the anomaly is much reduced in amplitude at 10 milliseconds above the 7 millisecond background, while the source

is located within material having an apparent resistivity of over 8000 ohm-metres. The source must therefore be disseminated sulphides (or graphite). The maximum depth indicated is about 60 metres.

The western boundary of Zone C4 is marked by a series of induced polarization maxima, west of which the chargeability decreases rapidly to low backgrounds of 10 milliseconds. On line 1400N at 1470W a 20 millisecond above 10 millisecond background anomaly was observed associated with 1500 ohm-metre resistivities. This anomaly cannot be traced south, but *may* correlate with 1155W (see below).

A small induced polarization anomaly of *about* 10 milliseconds above background at 1155W on line 1200N is worthy of note because it is accompanied by a +1000 gamma coincidental distortion in the local magnetic field. Thus, in this case the source may well be at least in part magnetite or pyrrhotite.

IN SUMMARY..... It is concluded that Zone C4 should be investigated AS A WHOLE rather than by individual induced polarization anomalies within the zone. The zone is considered to be generally disseminated chargeable material either sulphides or graphite of the order of 1% by volume. The lack of appreciable distortion in the magnetic field clearly infers that magnetite plays no material part in the source material.

The only significant response worthy of SEPARATE investigation was Zone 4.1

This anomaly has a strike length of over 1200 metres and is open to the north. On line 1400N and 1600N the anomaly is associated with lower than background apparent resistivities which infer the host to be less resistive than the enclosing rocks on those lines. On almost every line, the response lies within a magnetic low which ranges in amplitude from a few gammas to over 200 gammas. The significance of this feature is not known. The source is considered to be essentially disseminated, or if massive, electrically discontinuous sulphides and/or graphite. This response should be followed up as a primary target, especially on lines 1400N and 1600N.

ZONE C5.....This zone makes its isolated appearance on only two lines, 400N and 600N at 1590W and 1530W respectively. In both cases the amplitude is about 15 milliseconds above the 5 to 10 millisecond background. The apparent resistivity background remains a high 2500 ohm-metres in both cases. Also in both cases the magnetic field rises rapidly to the immediate east of the responses on both lines.

On line 400N the maximum depth to the source is 60 metres, while there is a coincidental *decrease* in the magnetic field of about 20 gammas. On line 600N the depth is more difficult to assess, but is estimated to be no greater than 80 to 90 metres.

IN SUMMARY..... The source of this response is again considered to be disseminated sulphides within a resistive host. The priority from a

geophysical point of view is considered to be secondary or perhaps primary in the case of line 400N.

ZONE C6.....On the extreme western ends of lines 1000N and 1200N an apparent resistivity-apparent chargeability regime not seen elsewhere in the grid area has been defined. West of 1815W on line 1000N and 1800W on line 1200N, resistivities fall rapidly from over 5000 ohm-metres to less than 500 ohm-metres, and on occasions less than 100 ohm-metres.

On line 1200N material apparent resistivity lows of less than 300 ohm-metres were recorded at 1830W, 1905W, 1965W and 2085W, and were coincident with chargeability highs of between 10 and 15 milliseconds above background. The "background resistivity" for this section can be considered to be about 1500 ohm-metres. The cause of this phenomenon is a series of relatively narrow (i.e. less than the potential dipole used) conductive and chargeable sources with a resistive and less chargeable source between. This could be a series of "massive" sulphides or "massive" graphite zones interspersed with resistive narrow material.

On line 1000N the apparent resistivities show a similar effect but the chargeabilities become difficult to measure due to the low Vp. Towards the end of the line resistivities fall to over 30 ohm-metres.

Distinct resistivity lows were defined at 1830W, 1860W, 1905W

1995W and 2085W, however, the chargeability as discussed above, was difficult to measure, so no meaningful data was able to be acquired.

On both lines the maximum depths to source for each of the responses is considered to be of the order of 30 metres or less.

On line 800N between 1620W and 1865W, a rapid fall-off in apparent resistivity was logged. Immediately to the east and west of the above boundaries respectively, apparent resistivities were a high 5000 ohm-metres while within the centre they fall to between 2000 and 1000 ohm-metres, and at 1785W they were as low as 250 ohm-metres. Due to the low Vp, the chargeability was difficult to record. However, at 1860W and 1635W narrow lows are associated with increases in chargeability which are superimposed on a low background. Both responses are considered to be significant.

IN SUMMARY..... Zone C6 is considered to be a series of narrow chargeable and conductive sulphides or/and graphite interspersed with resistive material. These zones may indicate the presence of graphitic or pyritic sediments. It is strongly recommended that this area be re-surveyed with gradient dipoles specifically designed to delineate and trace the extent of these zones, providing always that ground follow-up confirms their potential economic interest. Based on the limited evidence, this area IS worthy of further follow-up.

INDUCED POLARIZATION ANOMALIES OUTSIDE THE SIX MAIN ZONES

ANOMALIES A1 & A2.....On line 1800N an isolated response of about 8 milliseconds above the 12 millisecond background was recorded centred at 1875W, with a smaller related response of about 4 milliseconds at 1935E. These responses were associated with a broad fall of about 15% in apparent resistivity to about 2500 ohm-metres. A magnetic field increase of about 80 gammas was noted over the smaller response. The maximum depths to source are about 30 metres.

Of secondary to tertiary interest.

ANOMALIES A3 & A4.....Two similar broad responses of about 6 milliseconds superimposed on a 7 millisecond background were recorded on line 1800N at 060E and 165E. Each is related to a narrow marked decrease in resistivity of 30% to 40% to 5000 ohm-metres. The most westerly response is related to a 60 gamma increase in magnetic field while the latter has a 2000 gamma increase.

A3 is considered to be due to disseminated sulphide with some magnetite being present, while A4 may contain more substantial quantities of magnetite. The maximum depth to source is 50 to 60 metres in both cases.

Of secondary to tertiary interest only.

ANOMALY A5..... A significant 12 millisecond response superimposed on an 8 millisecond background was recorded at 240E within resistivities of 2000 ohm-metres on line 1600N. A rapid increase in magnetic field by 1000 gammas over this section infers the source to contain magnetite although disseminated sulphides must also be present. The maximum depth is considered to be about 45 metres.

This disseminated sulphide and magnetite source is considered of secondary merit.

ANOMALY A6.....1600N/645E. A sharp 8 milliseconds response on a 10 millisecond background showing a 25% *increase* in apparent resistivity is also associated with a 700 gamma increase in the magnetic background. The maximum depth is considered to be about 60 metres.

The source is considered to be relatively minor disseminated sulphides and magnetite and as such is of marginal interest.

ANOMALY A7.....1600N/705E. A very similar response of 7 milliseconds on a 10 millisecond background, again showing a minor increase in apparent resistivity to 5000 ohm-metres is accompanied by a 700 gamma increase in the magnetic field.

The source is of tertiary interest only and is considered to be due to disseminated magnetite and sulphides.

ANOMALY A8.....1600N/150E. A minor 6 milliseconds response superimposed on a 7 millisecond background and showing a 45% decrease in apparent resistivity to 2300 ohm-metres is considered to be due to a disseminated sulpide source within a slightly less resistive host. The maximum depth is about 30 metres.

Of tertiary interest at best.

ANOMALY A9.....At 330E on line 1400N a 70% to 50% fall in resistivity to 900 ohm-metres is accompanied by a material 14 millisecond increase in chargeability and a 300 gamma rise in the magnetic field. The maximum depth to source is estimated at 60 metres.

The disseminated sulphide with magnetite source is considered of primary to secondary interest, and MAY contain "massive" sections. This response should be carefully followed up.

ANOMALY A10.....At 450E on line 1600N, a broad significant induced polarization anomaly of 10 milliseconds above the 7 millisecond background was associated with a 700 gamma increase in the magnetic field. This response is similar to A9 but is associated with an increase in the apparent resistivity to 5000 ohm-metres.

This disseminated sulphide and magnetite source is considered of secondary interest at best.

ANOMALIES A11 & A12.....are broad responses of about 6 milliseconds above the 7 millisecond background and were defined on line 1400N at 705E and 900E. Both are accompanied by about a 700 gamma increase in magnetic field and a 50% increase in apparent resistivity to 3000 ohm-metres. The maximum depth is estimated at 60 metres.

The disseminated sulphide and magnetite sources are considered of tertiary interest only.

ANOMALY A13.....Centred at 510W on line 1200N a 10 millisecond above 5 millisecond background response was located from a source estimated to lie at a maximum depth of about 90 metres. The extremely high 5000 ohm-metres resistivity infers a purely disseminated source.

The disseminated sulphides (or graphite) source is considered of tertiary interest at best.

ANOMALY A14.....An 8 millisecond on an 8 millisecond background response was recorded at 270E on line 1200N. An accompanying increase of 60 gammas in the magnetic field indicates the source to contain both magnetite and sulphides, while the high 2500 ohm-metres resistivity indicates it to be of disseminated form.

Of tertiary interest only.

ANOMALY A15.....A striking 10 millisecond above the low 3 to 4 millisecond background response was recorded at 540W on line 100N coincident with 8000 ohm-metres resistivity. The maximum depth to source is 30 metres.

This disseminated source is considered of tertiary interest at best.

ANOMALY A16.....A sharp single station response of 12 milliseconds on a 4 to 10 background *change* in induced polarization was defined on line 600N at 675W. A distinct increase in apparent resistivity from about the 2000 ohm-metres level to 4500 ohm-metres marks this response as having a *resistive* host. The maximum depth to source is about 45 metres.

The disseminated sulphide source is considered to be of minor interest.

ANOMALY A17.....A 12 millisecond response superimposed on a low 4 millisecond background was defined at 690E on line 600N accompanied by a 60% fall in apparent resistivity to 850 ohm-metres. A small 10 gamma increase in magnetic field was noted.

This chargeable response showing decreased resistivity within the source is considered of interest and should be accorded at least a secondary priority.

CONCLUSIONS

1 - The chargeability observed on the Beatrice grid ranges from near zero to in excess of 40 milliseconds. The area shows a number of distinct "backgrounds" dependent of course on the underlying rock types. However, overall the background can be considered to be of the order of 12½ ±2½ milliseconds.

The strike inferred is grid north-south in the centre section veering west of that in the west, and east of that in the east.

Within the grid area some five anomalous areas were defined which are designated Zones C1 to C5, all of which merit some further field investigation, although zone C1 is considered formational. In addition, a most interesting area designated Zone C6, was defined in the north-west section of the area, which shows inferred alterations of chargeable, highly conductive material with very much more resistive sections. These could be either graphite or sulphides in electrical continuity, and as such must rank as being of prime interest.

There are some areas of abnormally low chargeability of the order of 5 ±2½ milliseconds, the most prominent of which is immediately to the east and parallel to Zone C4. This unusual phenomenon may be due to a broad fault zone which has been mapped in this area (K. Wells, 1975). Other similar areas west of Zone C3 and in the extreme south-west of the area have

no known explanation at this time.

2 - The resistivity shows a vast variation from less than 30 ohm-metres to in excess of 10,000 ohm-metres. The "average" can be considered to be 2000 to 3000 ohm-metres. The strike in general conforms to that assessed from the chargeability. The very highest resistivities are more often than not associated with extremely low chargeabilities and it is suggested that this is due to the underlying rocks being highly resistive, and therefore inferred to be acid rich volcanic or sedimentary units probably silicified, and certainly low in mafic minerals.

3 - The total magnetic field map proved of great assistance in delineating distinct physical property units. The background ranged about 62,600 $\pm$50 gammas, while values of over 1000 gammas *above* and 300 gammas *below* this background were noted.

Some four zones, M1 to M4, have been defined within which the majority of the significant magnetic events occurred.

4 - The physical property interpretation is given in Plate 5. A remarkable number of quite distinct units have been defined, and are summarised on that plate.

The majority of features clearly strike about grid north-south and sharp boundaries between two or more of the physical

properties, generally mark their boundaries.

A series of east-west discontinuities cross the area. On a number of occasions these follow gradient block boundaries, and this fact would normally make them suspect. (*See section on Method and Equipment.*) However, as in this case the *characteristics* of the units north and south of the dislocation change, as well as there being very substantial changes in amplitude of *only some* of the units, these discontinuities are considered *real*. Further, the magnetic field also changes across these boundaries and this of course is not influenced in any way by the gradient block boundaries.

It is considered that the physical property map displays a function of the underlying geology with some of the major units and boundaries being clearly shown. It should be noted that not all major boundaries would be expected to be shown where the underlying geology although *geologically distinct*, is not *geophysically distinct* (e.g. Owen Conglomerates may appear like silicified highly acid hypabyssal rocks.)

5 - Some six distinct areas of high chargeability were defined - Zones C1 to C6. The merit of each warrants individual consideration, and should be assessed using any geological and/or geochemical data available.

At this stage, and using only the geophysical parameters

gathered in this survey, the order of importance is assessed by the author to be:

- of primary importance: Zones C2, C6 and C4
- of primary to secondary importance: Zones C3 and C5
- of secondary importance: Zone C1

6 - Within the above zones, some 10 individual anomalies have been defined of which about half are considered to be of primary to secondary importance. The characteristics are summarised below.

Anomaly	Zone	Line	Station	Anomaly/ Background	Resistivity Correlation	Maximum Depth	Magnetic Correlation	Priority
2.1	C2	400N	1200E	10/20	LR	50 metres	-	B/C
2.1	C2	600N	1140E	15/10	LR	90 metres	-	B
2.2	C2	600N	1440E	10/20	NC	50 metres	-	B
2.3	C2	600N	1710E	8/20	LR	30 metres	-	B
2.4	C2	200N	915E	14/10	contact	30 metres	-	B/A
3.1	C3	1800N	645W	20/0	LR	90 metres	-	B/A
3.2	C3	1800N	525W	38/0	LR	70 metres	-	A
3.3	C3	1800N	400W	28/0	NC	30 metres	-	A/B
4.1	C4	1400N	1020W	30/5	LR	100 metres	-200 gammas	A
4.1	C4	1600N	945W & 1005W	22/5	LR	60 metres	-10 gammas	A
4.1	C4	1200N	855W & 930W	33/7	NC	60 metres	-100 gammas	A/B
4.1	C4	1000N	735W	30/2	NC	60 metres	-70 gammas	A
4.1	C4	800N	630W	10/7	HR	60 metres	-50 gammas	B/C

Anomaly	Zone	Line	Station	Anomaly/ Background	Resistivity Correlation	Maximum Depth	Magnetic Correlation	Priority
4.2	C4	1400N	1470W	20/10	NC	60-90 m.	-	B
-	C5	600N	1530W	12/8	NC	90 metres	+60 gammas	B
-	C5	400N	1590W	13/12	NC	60 metres	-20 gammas	B/A
-	C6	See text for details						

NC = no change

LR = low resistivity

HR = high resistivity

7 - Outside the six main zones, some 16 individual anomalies were considered to be of some interest, of these only two were considered to be of possible primary interest. The details of these responses are given below.

Anomaly	Line	Station	Anomaly Background	Resistivity Correlation	Maximum Depth	Magnetic Correlation	Priority
A1	1800N	1875E	8/12	NC	30 metres	-	B/C
A2	1800N	1935E	4/12	NC	30 metres	+80 gammas	C
A3	1800N	060E	6/7	LR	60 metres	+60 gammas	B/C
A4	1800N	165E	6/7	LR	50 metres	+2000 gammas	B/C
A5	1600N	240E	12/8	NC	45 metres	+1000 gammas	B
A6	1600N	645E	8/10	HR	60 metres	+700 gammas	C
A7	1600N	705E	7/10	HR	60 metres	+700 gammas	C
A8	1600N	150E	6/7	LR	30 metres	-	C

Anomaly	Line	Station	Anomaly/ Background	Resistivity Correlation	Maximum Depth	Magnetic Correlation	Priority
A9	1400N	330E	14/7	LR	60 metres	+300 gammas	A/B
A10	1400N	450E	10/7	HR	90 metres	+700 gammas	B/C
A11	1400N	705E	6/7	HR	60 metres	+700 gammas	C
A12	1400N	900E	4/7	HR	60 metres	+700 gammas	C
A13	1200N	510W	10/5	NC	90 metres	-	C
A14	1200N	270E	8/8	HR	30 metres	+60 gammas	C
A15	1000N	540W	10/3	HR	30 metres	-	C
A16	600N	675W	12/6	HR	45 metres	-40 gammas	C
A17	600N	690E	12/4	LR	60 metres	+10 gammas	B/A

It should be noted that no details of individual anomalies within Zone C6 are given above. The reader should refer to the main body of the report (Page 23)

8 - The two magnetometer total magnetic field survey proved of great assistance in determining the physical property boundaries and strike directions. The ±2 gamma overall accuracy enabled accurate correlation *between* lines as well as along lines to be made.

9 - This was the first regional rapid reconnaissance survey conducted using a 15KW transmitter. This enabled 4000 metre current dipoles to be used without which the more remote parts of the grid would have taken up to three times longer to complete. The 38 kilometres of rugged inaccessible grid were

completed in 12 production days using two reading crews for the most part, with three reading crews in the latter part of the survey. Considering the difficult access to the remote lines, the productivity is considered reasonable.

The author looks forward to discussing the results in due course.

Respectfully submitted on behalf of:

SCINTREX PTY. LTD.

A.W. HOWLAND-ROSE, MSc, DIC, AMAusIMM, FGS.

GEOPHYSICIST

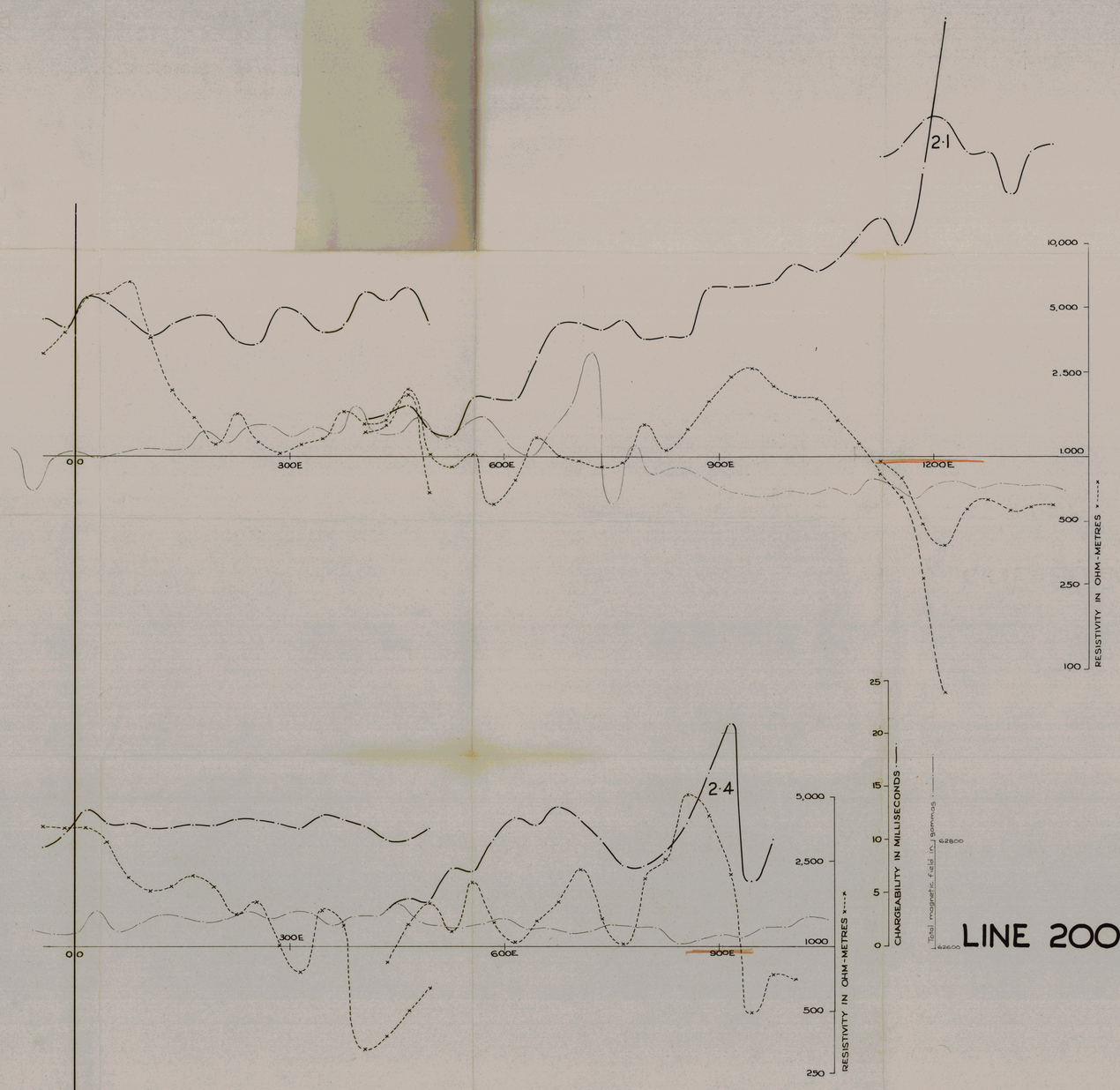
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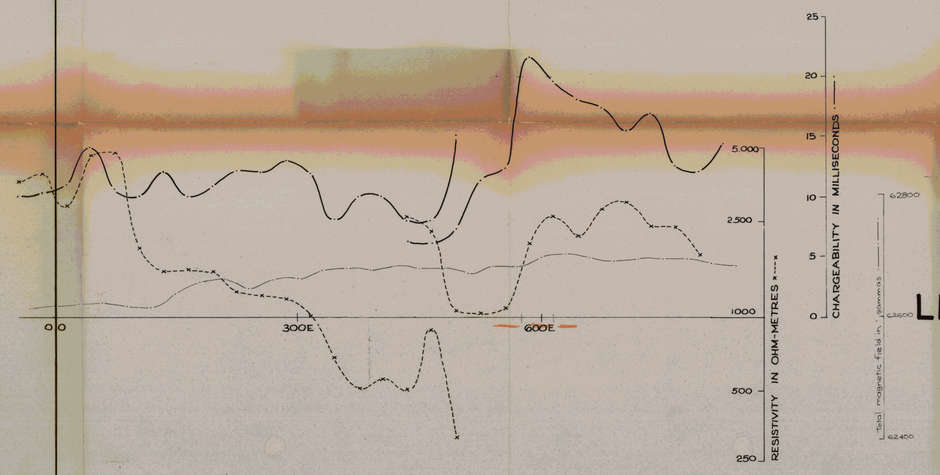
A REPORT ON GRADIENT ARRAY RECONNAISSANCE EIP AND TOTAL FIELD MAGNETOMETER SURVEYS OVER THE BEATRICE GRID, EL 10/69 NEAR QUEENSTOWN, WEST COAST TASMANIA ON BEHALF OF THE MOUNT LYELL MINING AND RAILWAY COMPANY LTD.

D.S.M.	A.D.	C.G.	E.D.	D.C.
				Pro. Geol.
D. DIR.	2 OCT 1984			E.S.R.
	DEPT. OF MINES			
REF. No. 10,076/84				



LINE 400mN

LINE 200 m N



LINE 00 m N

GEOPHYSICAL BASELINE

6	5
4	3
2	1

GEOPHYSICAL BASELINE

MOUNT LYELL MINING & RAILWAY COMPANY LTD.

BEATRICE GRID

(NR.) QUEENSTOWN - WEST COAST TASMANIA

ELECTRICAL INDUCED POLARIZATION SURVEY

GRADIENT ARRAY

DATA PROFILES

5 cm

SURVEYED & COMPILED BY

SCINTREX PTY. LTD.

FEBRUARY 1977

325044

0 150 300

SCALE : 1 cm. = 30 metres

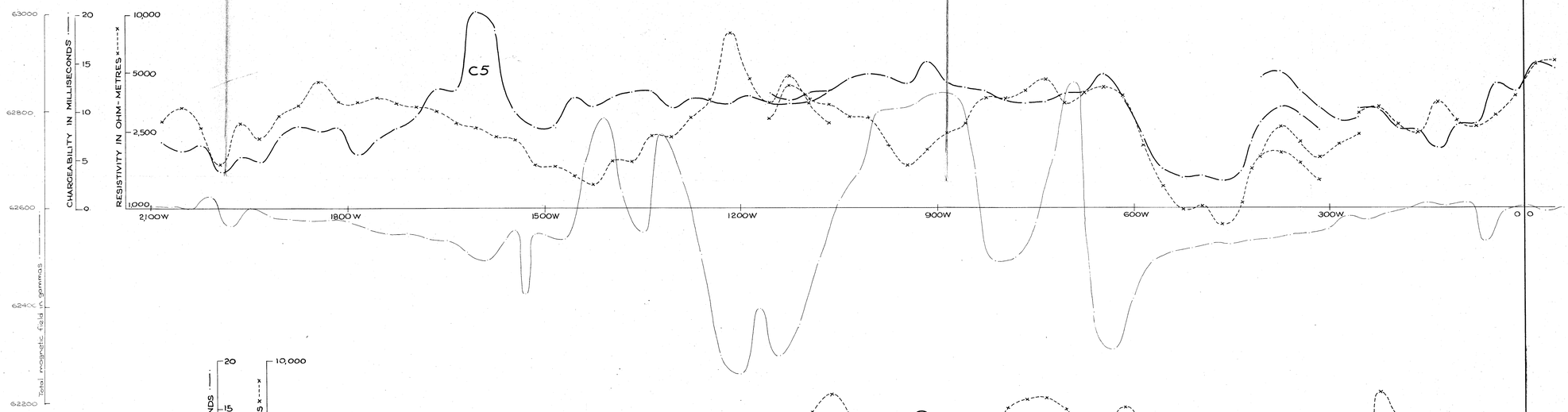
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JOB Nº TAS-035-D Sheet 1 of 6

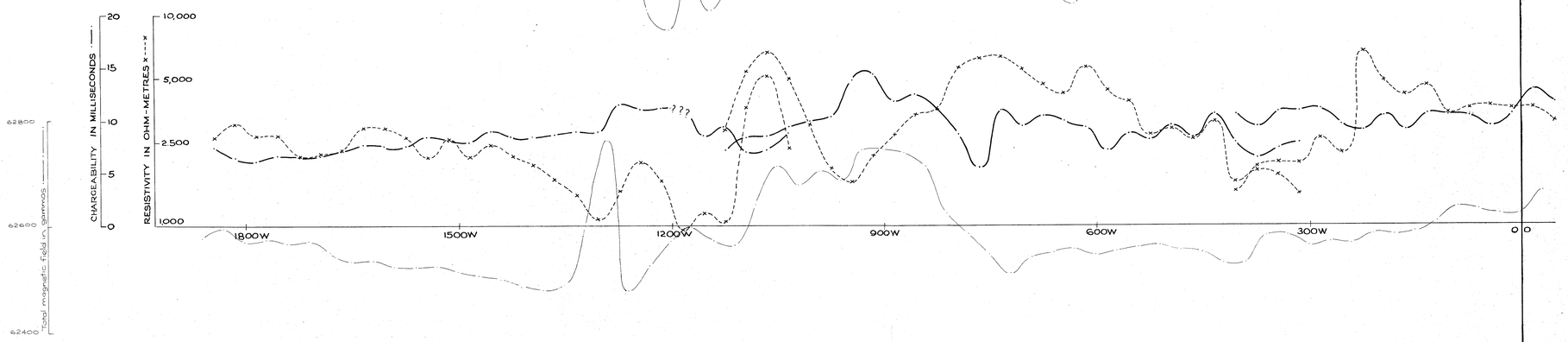
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PLATE 1.

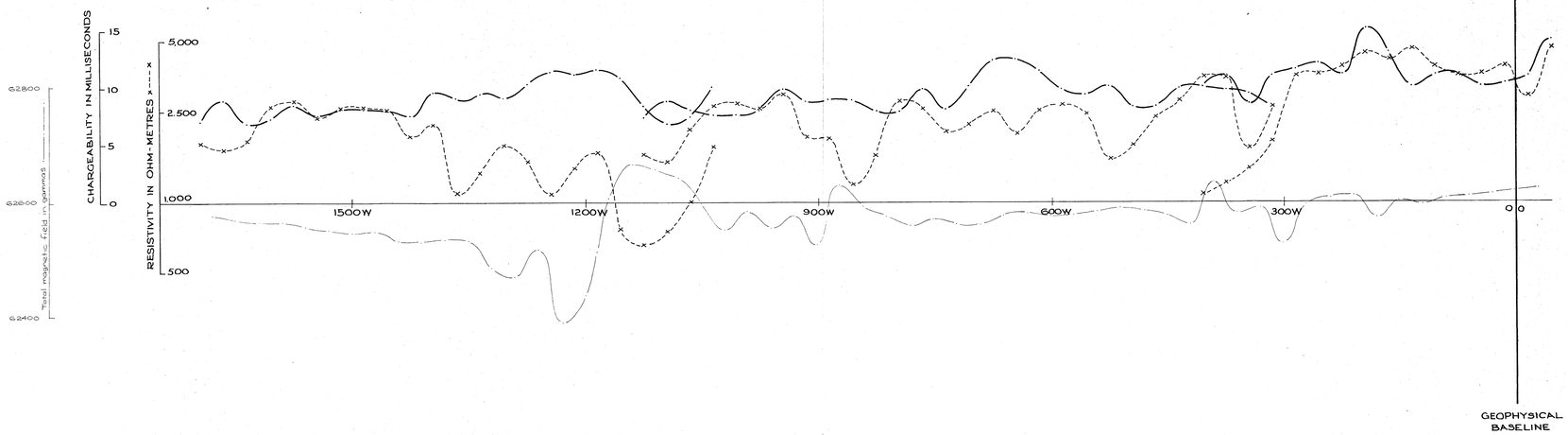
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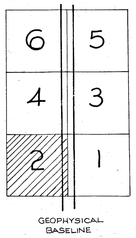


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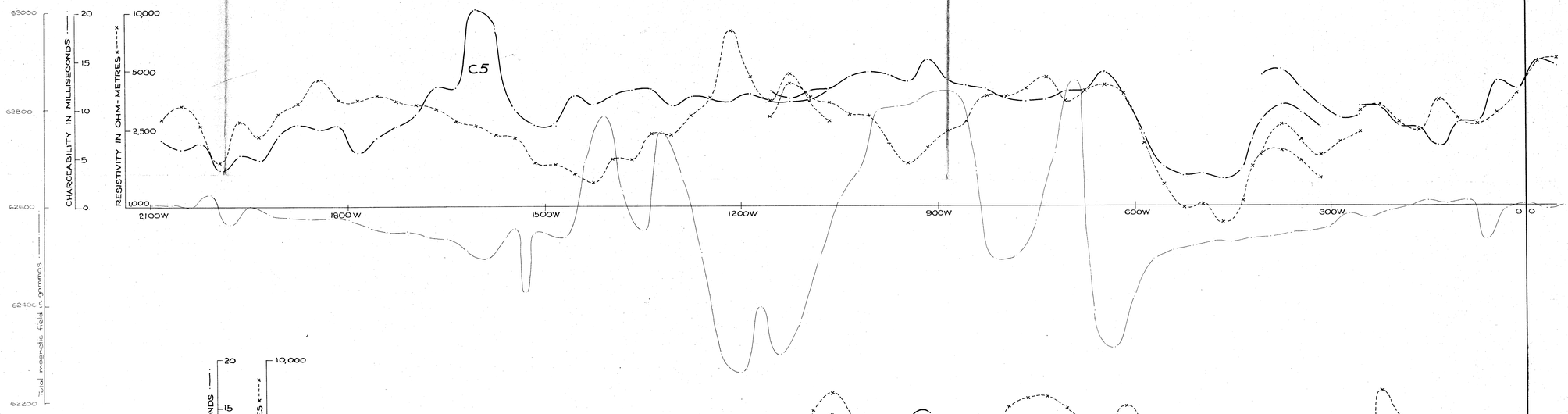




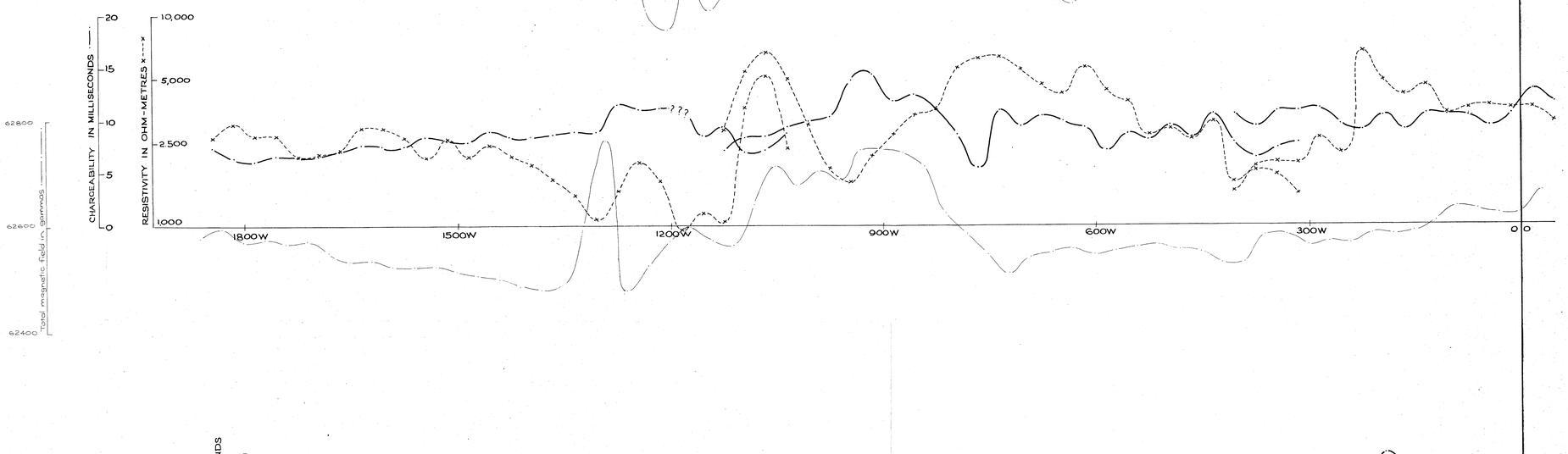
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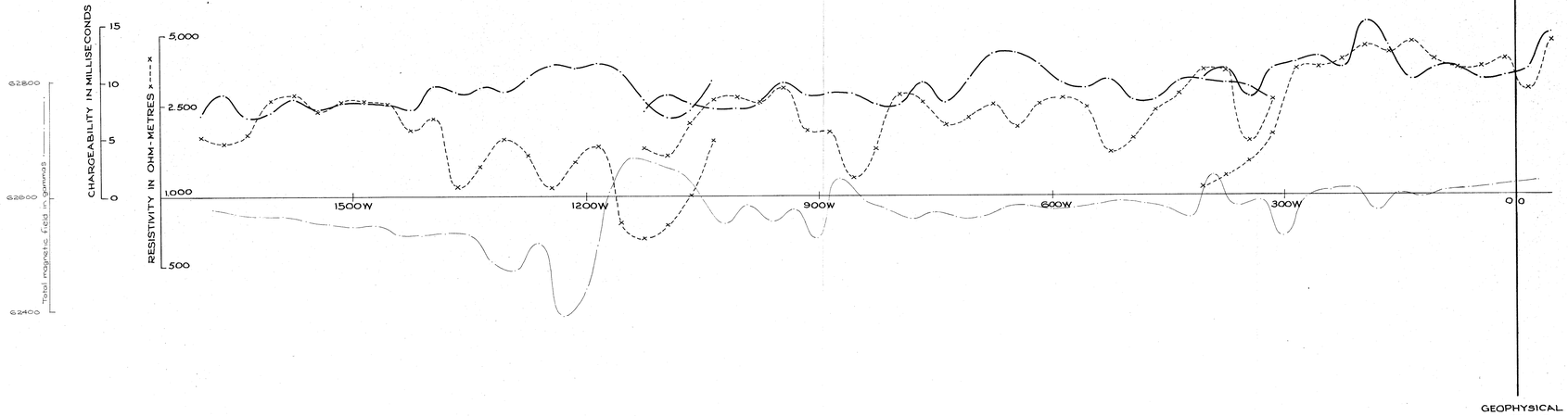
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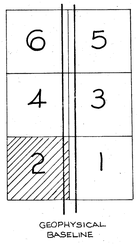


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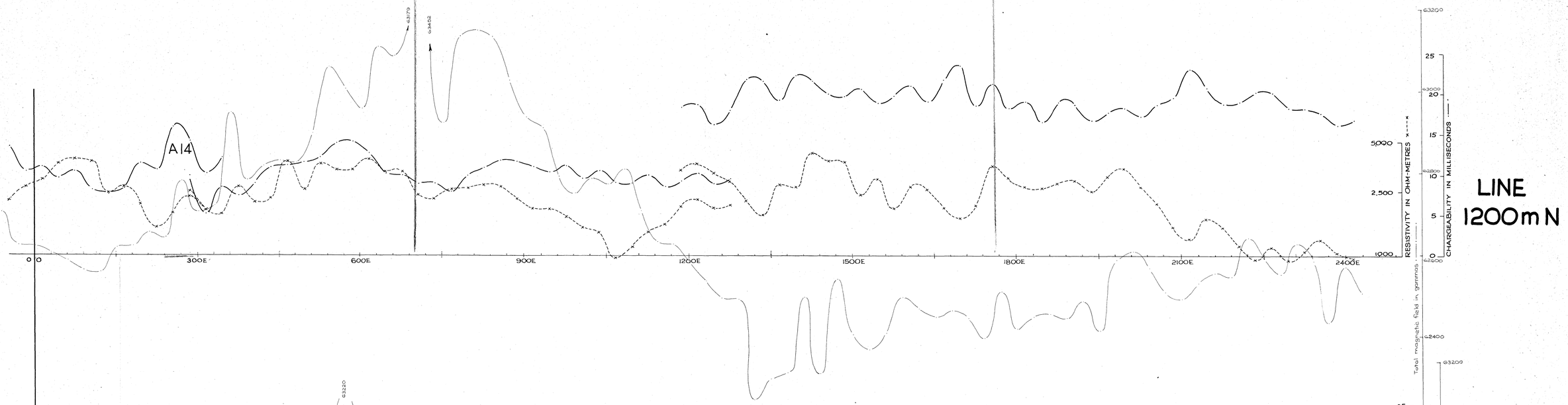
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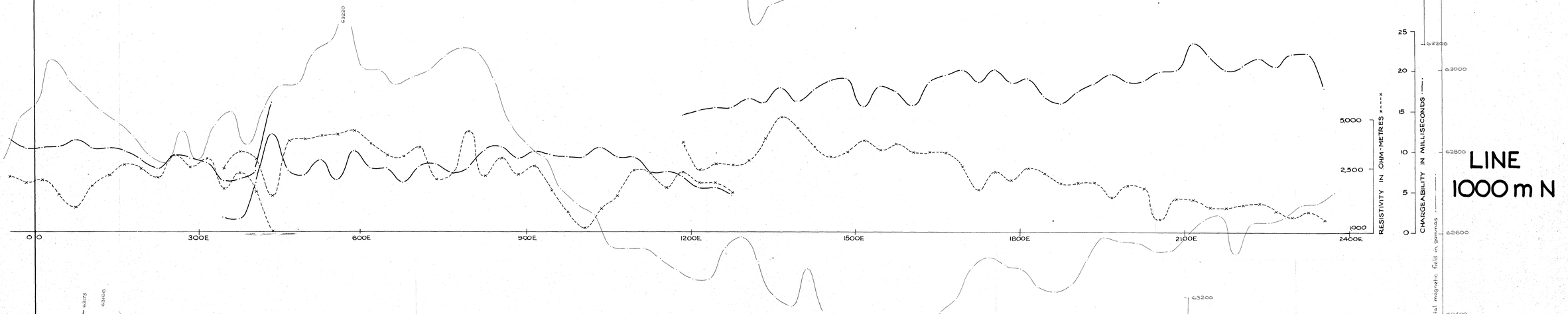
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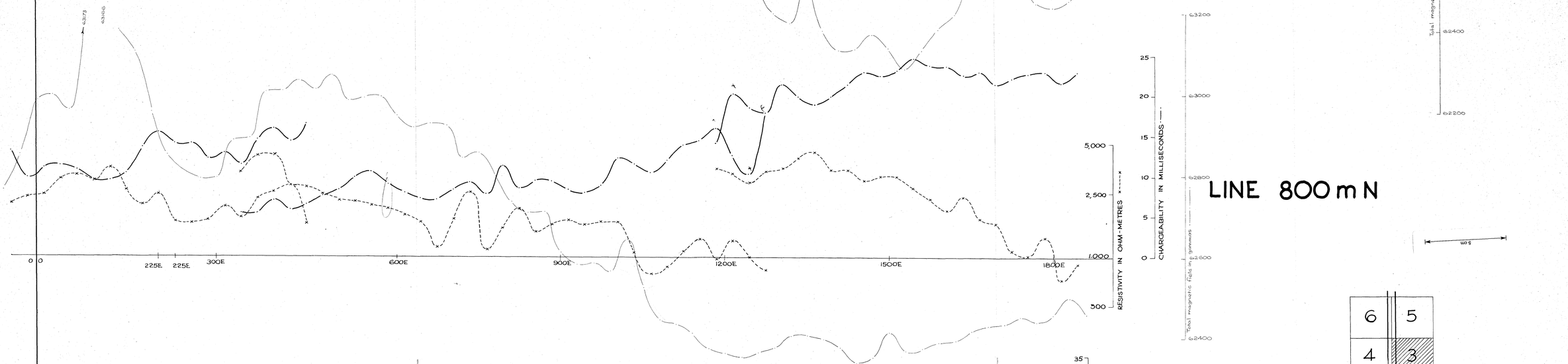
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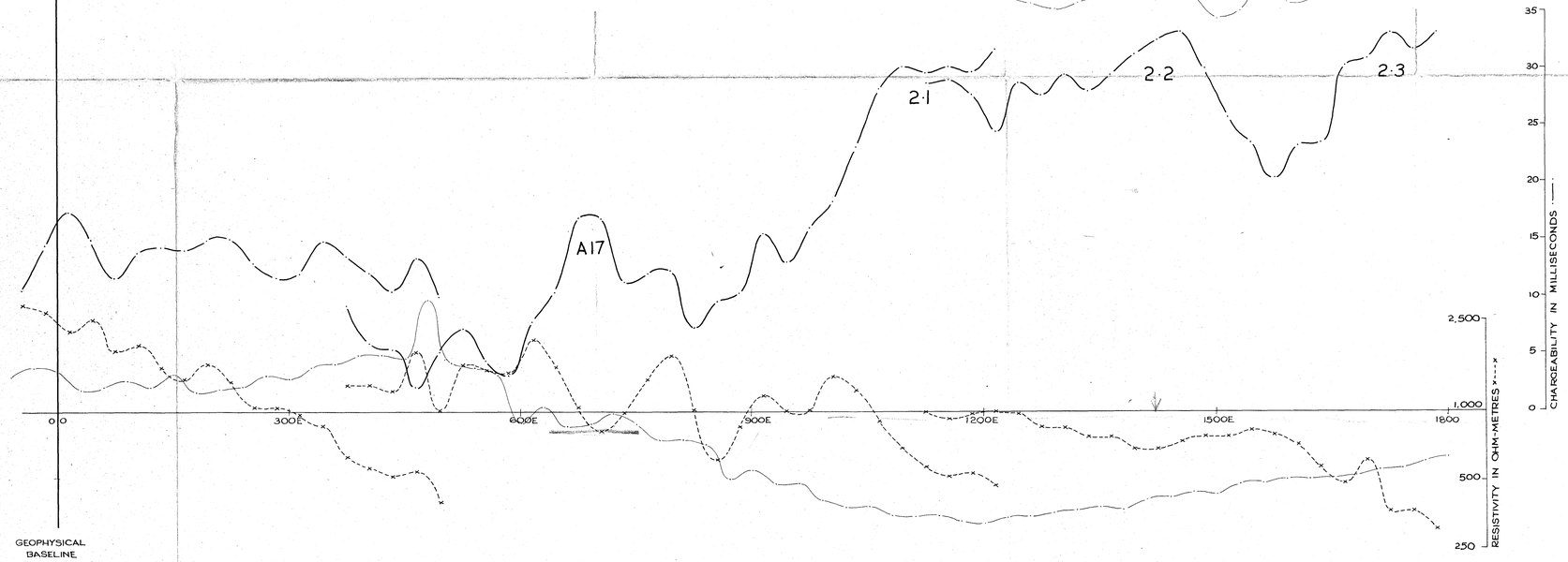
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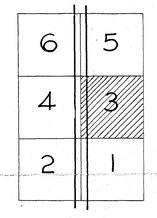


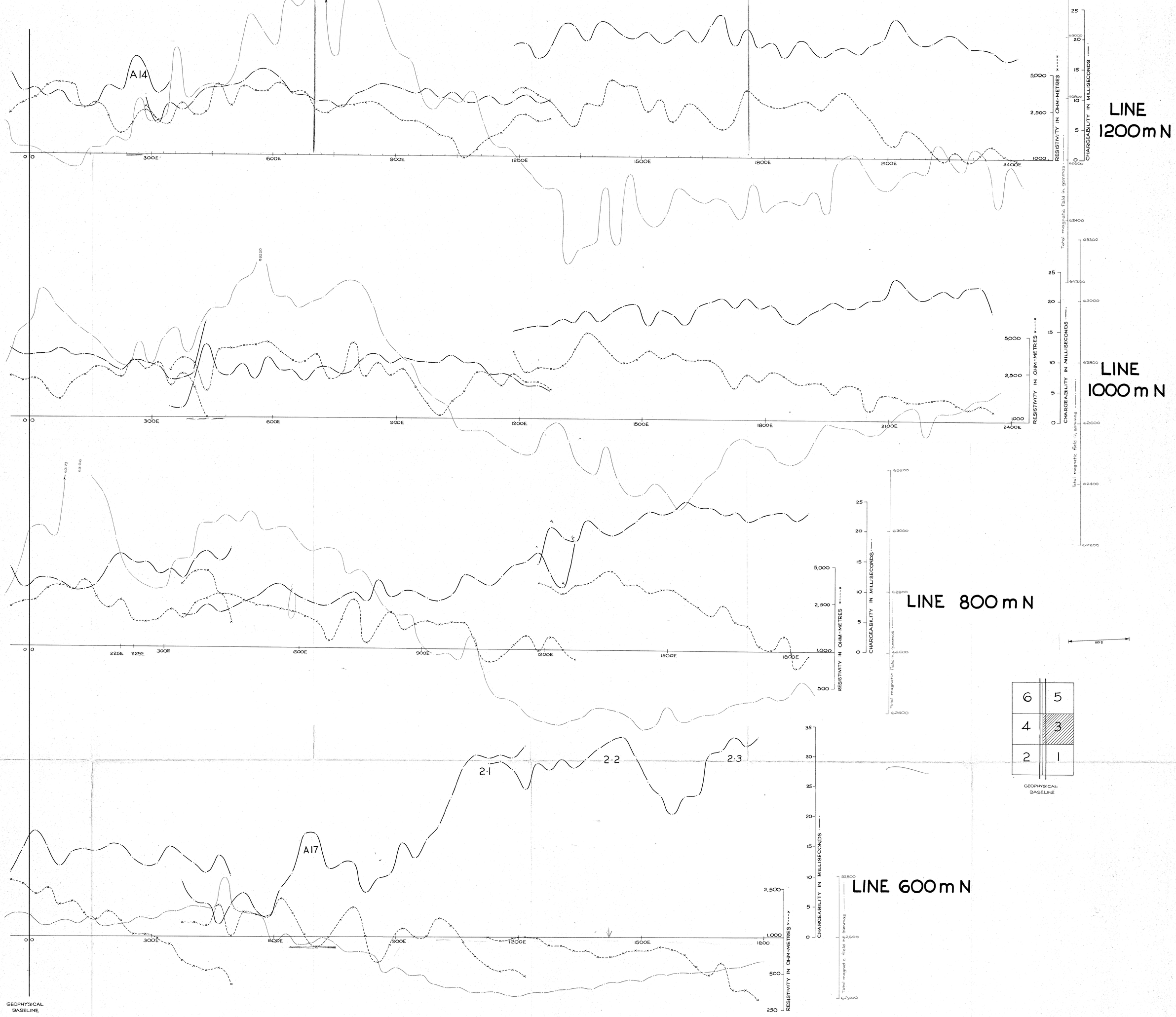
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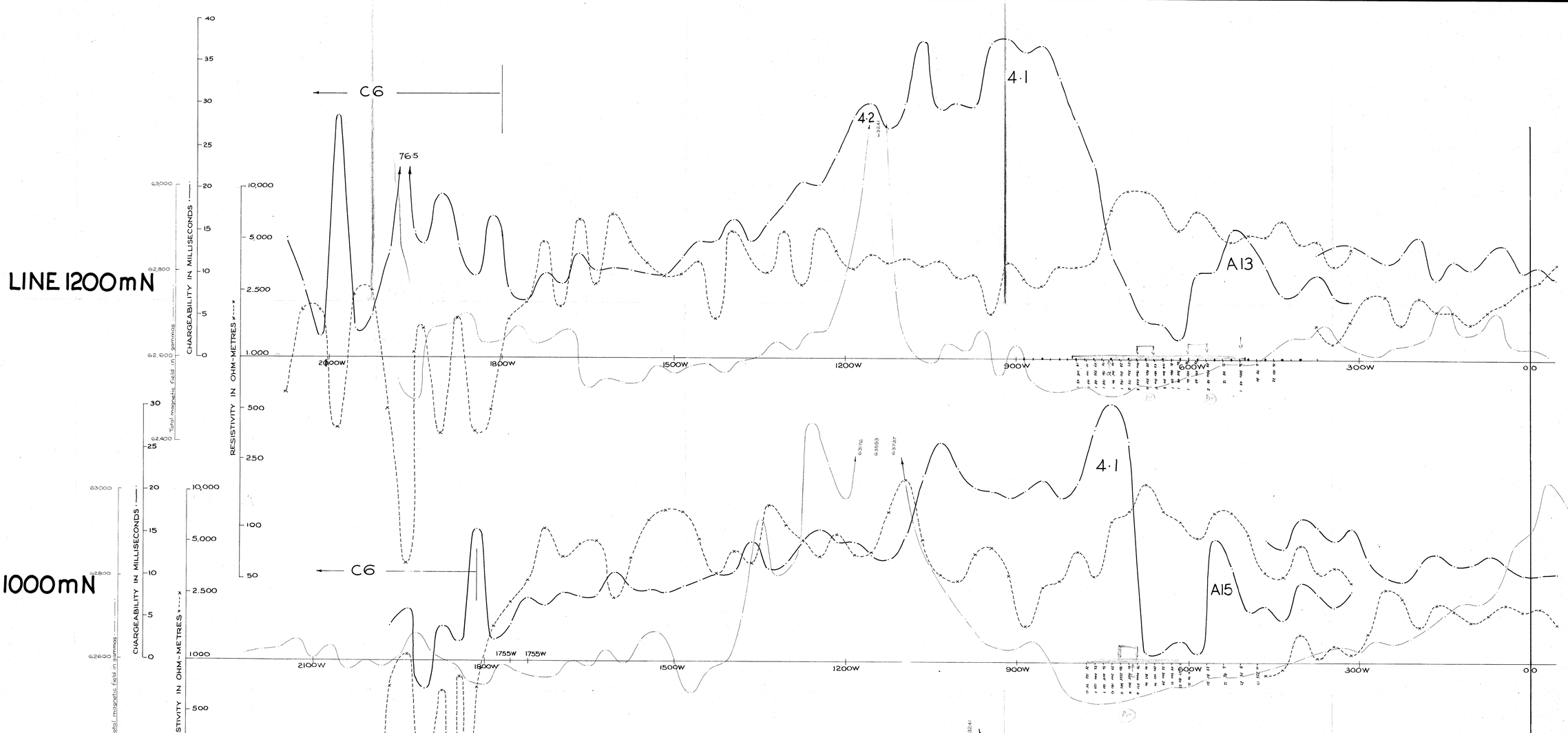


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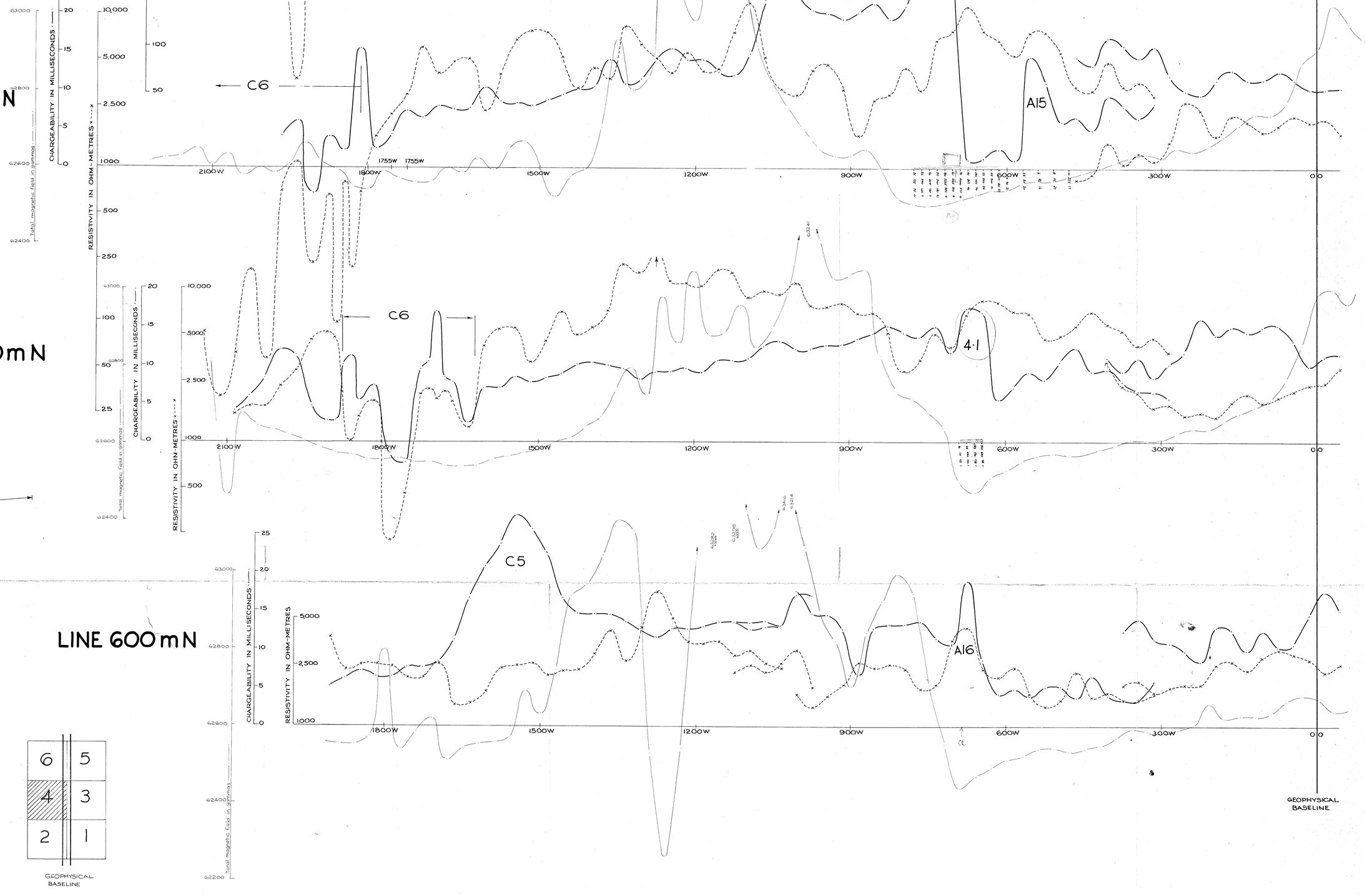
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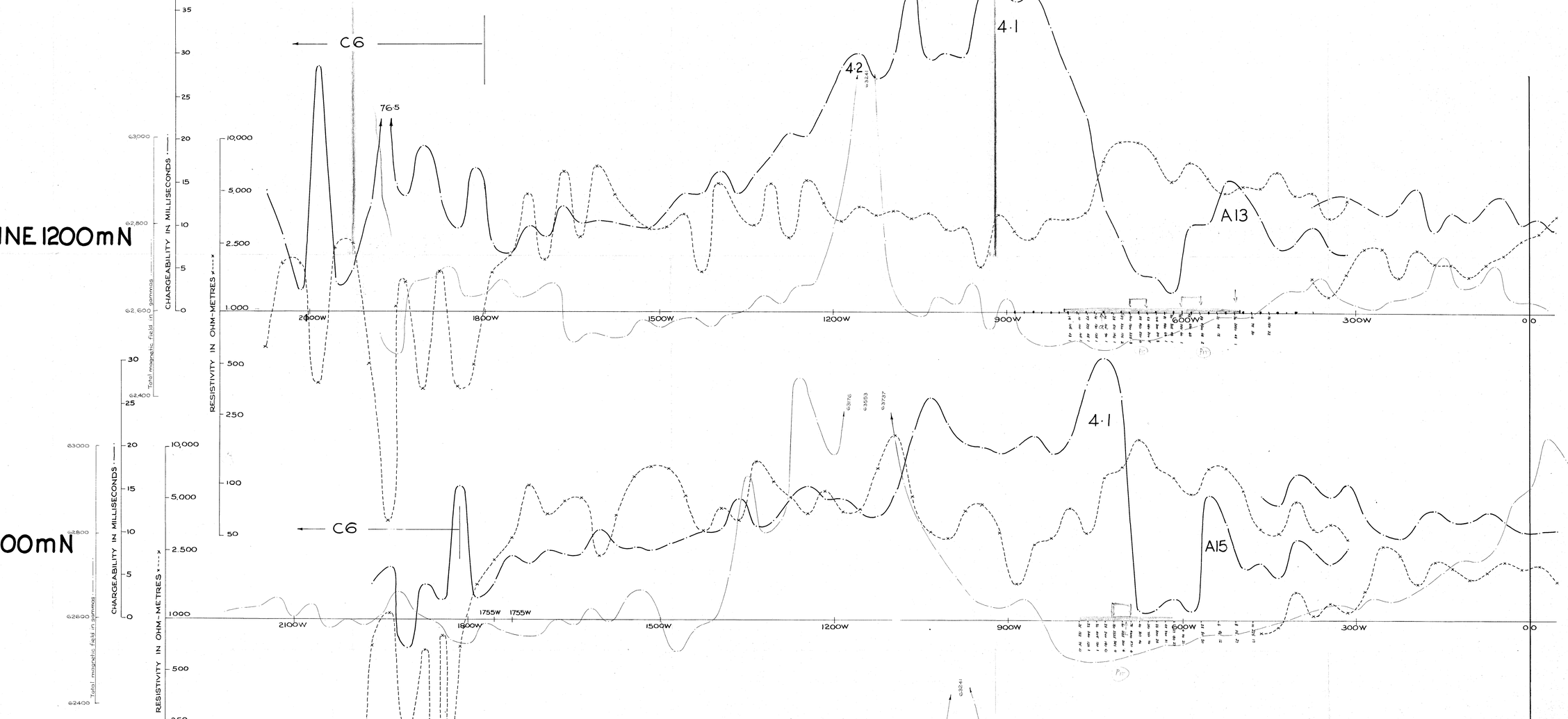
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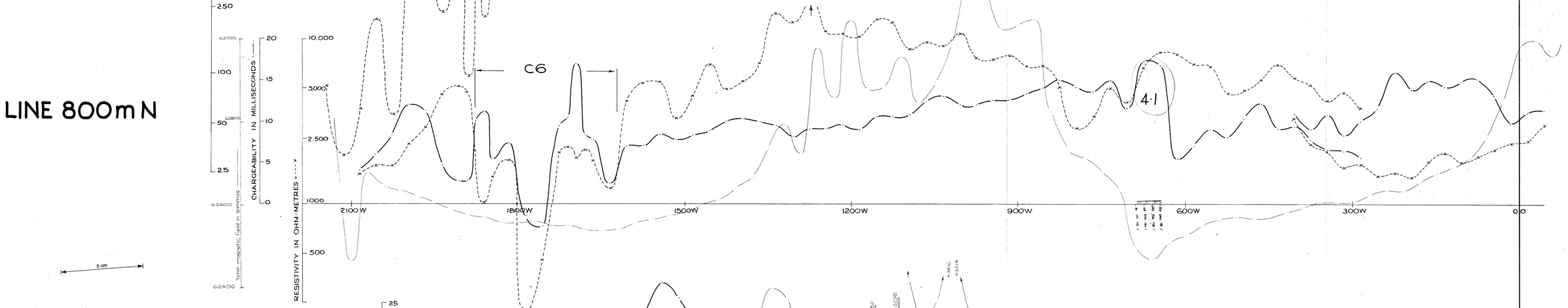
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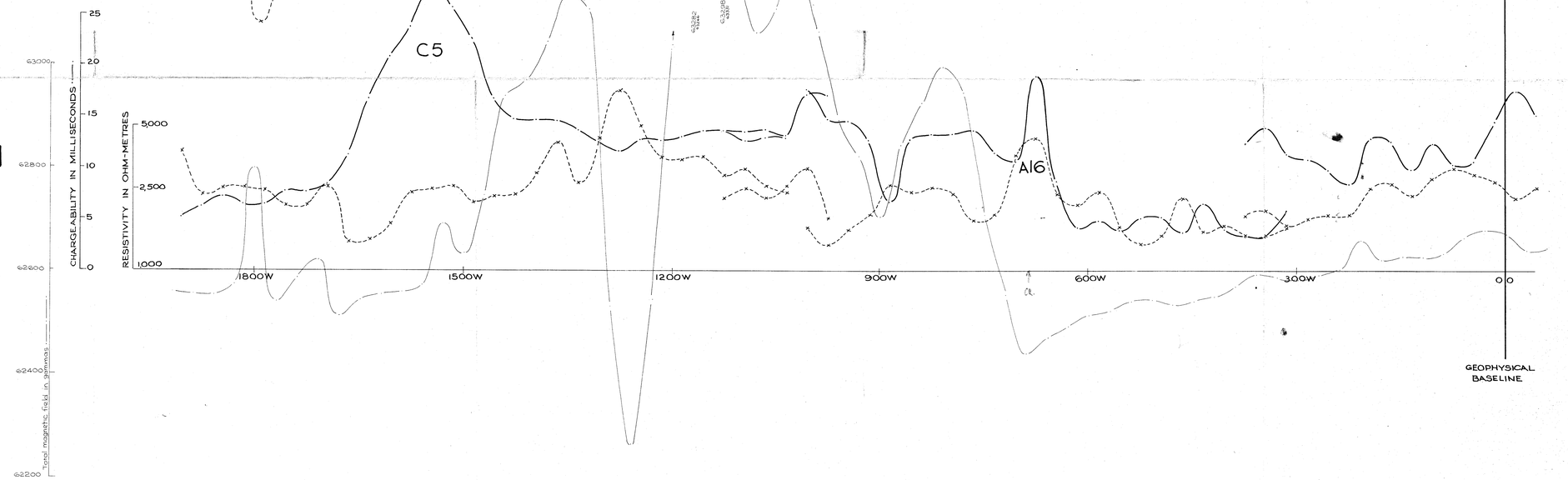


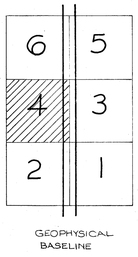
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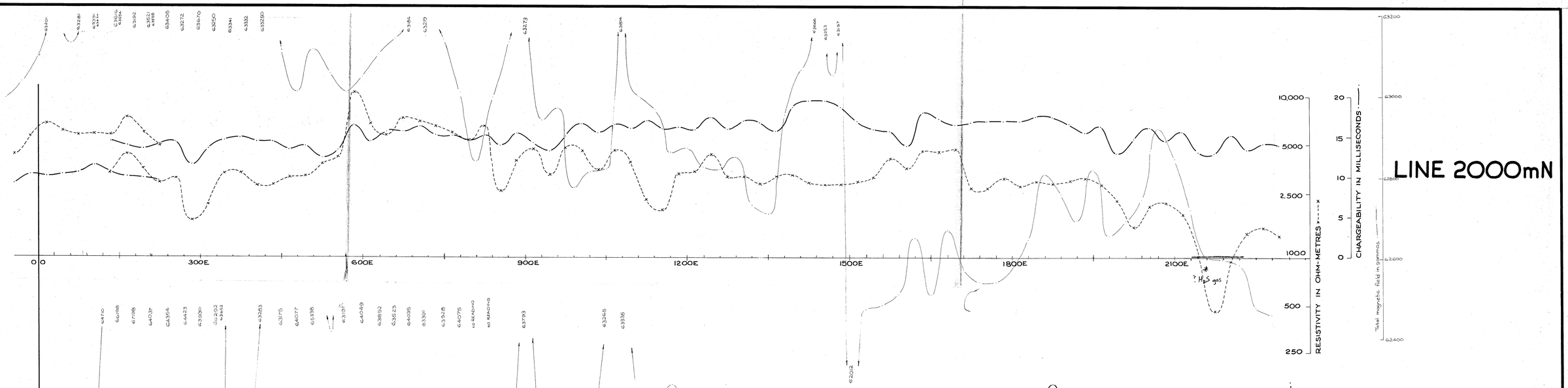


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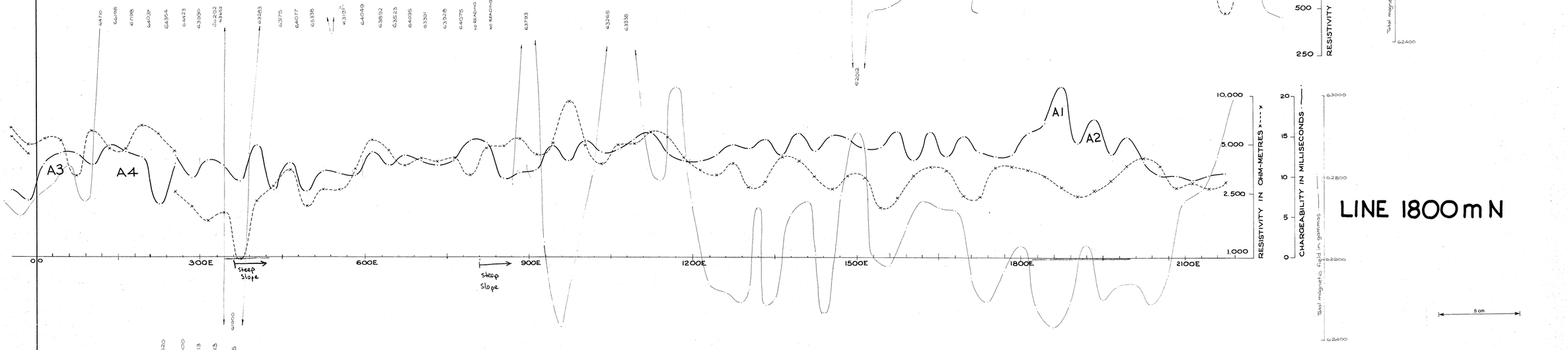
Job No. TAS-035-D Sheet 4 of 6 Plate 1

004

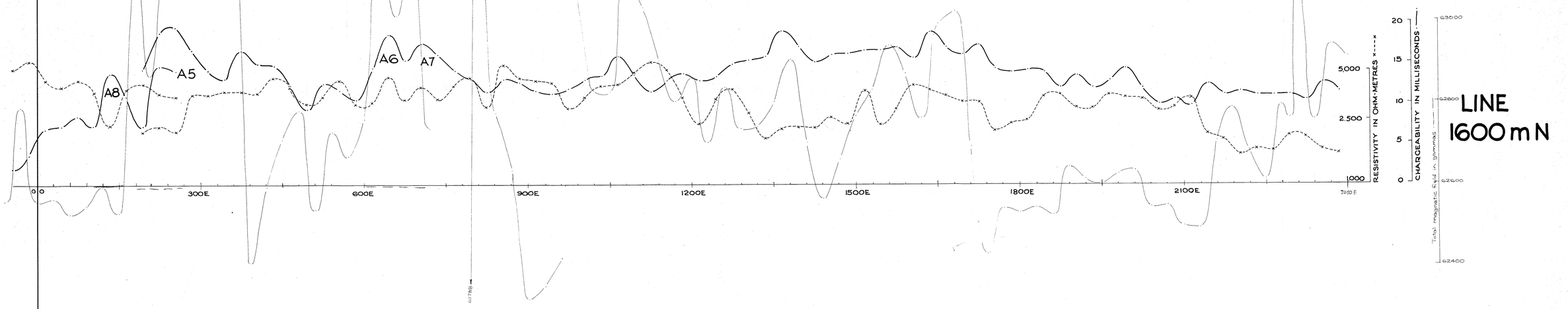
LINE 2000mN



LINE 1800mN



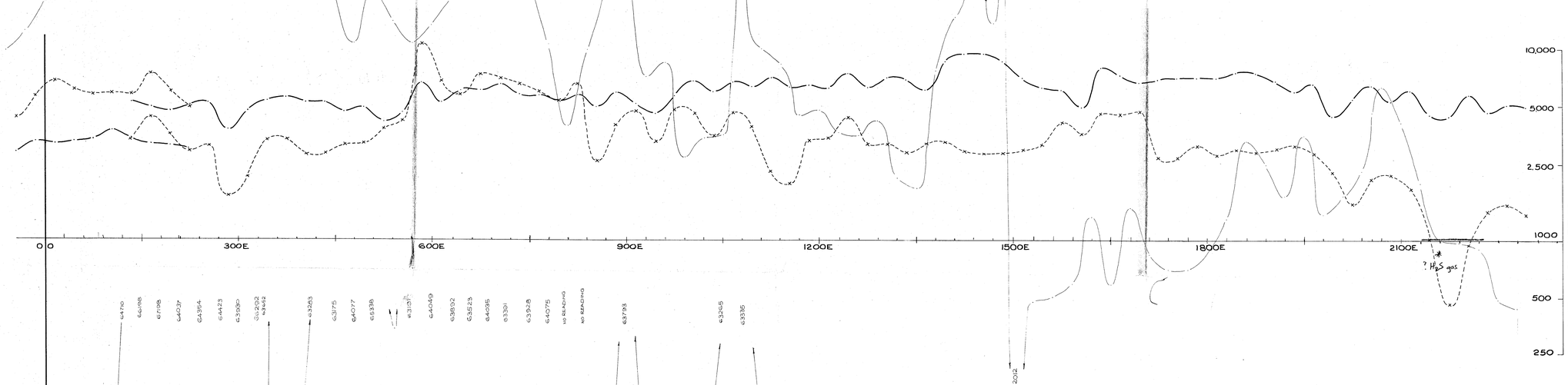
LINE 1600mN



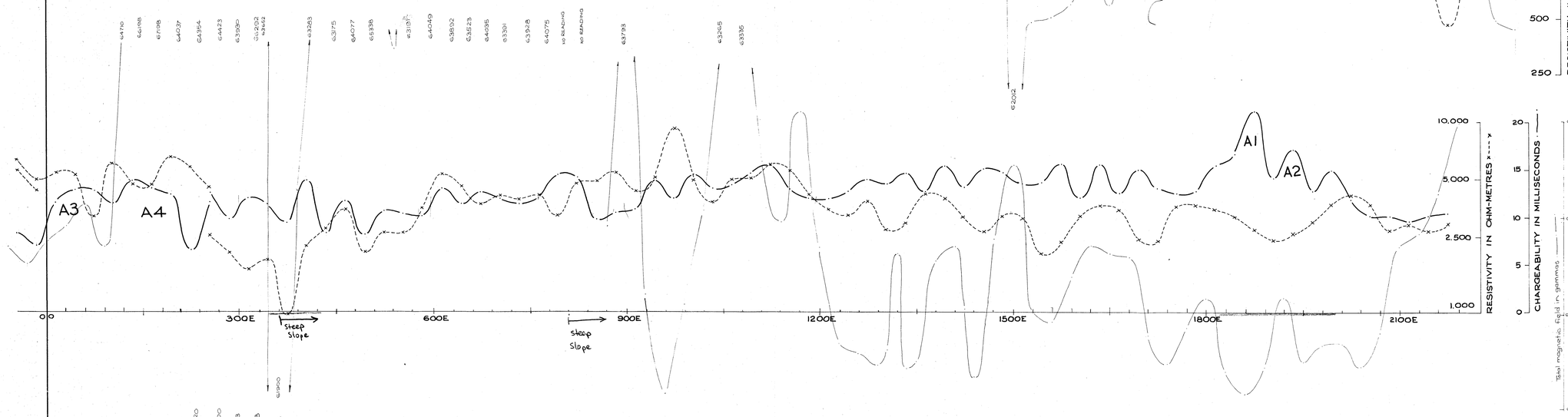
LINE 1400mN

5 cm

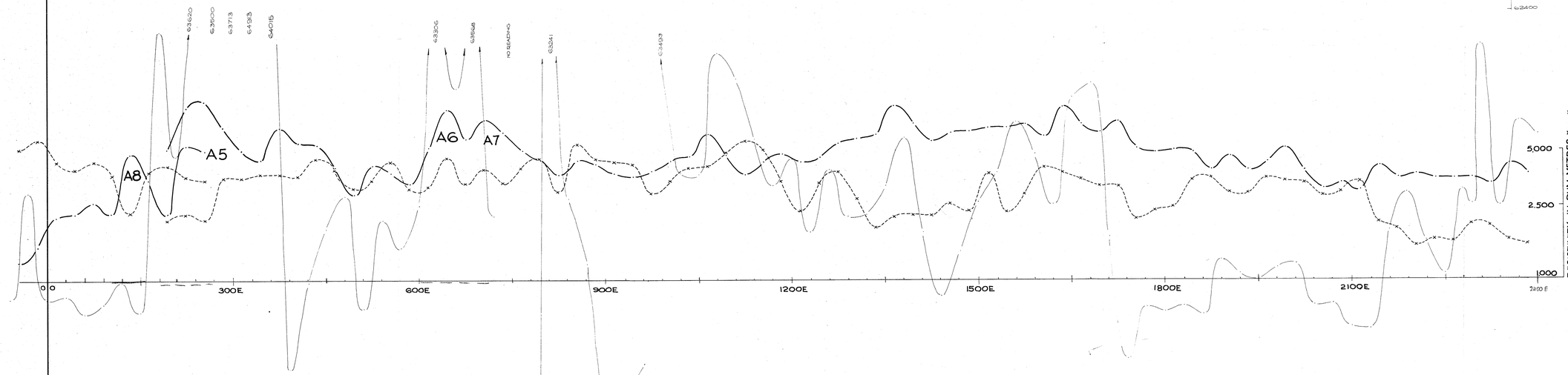
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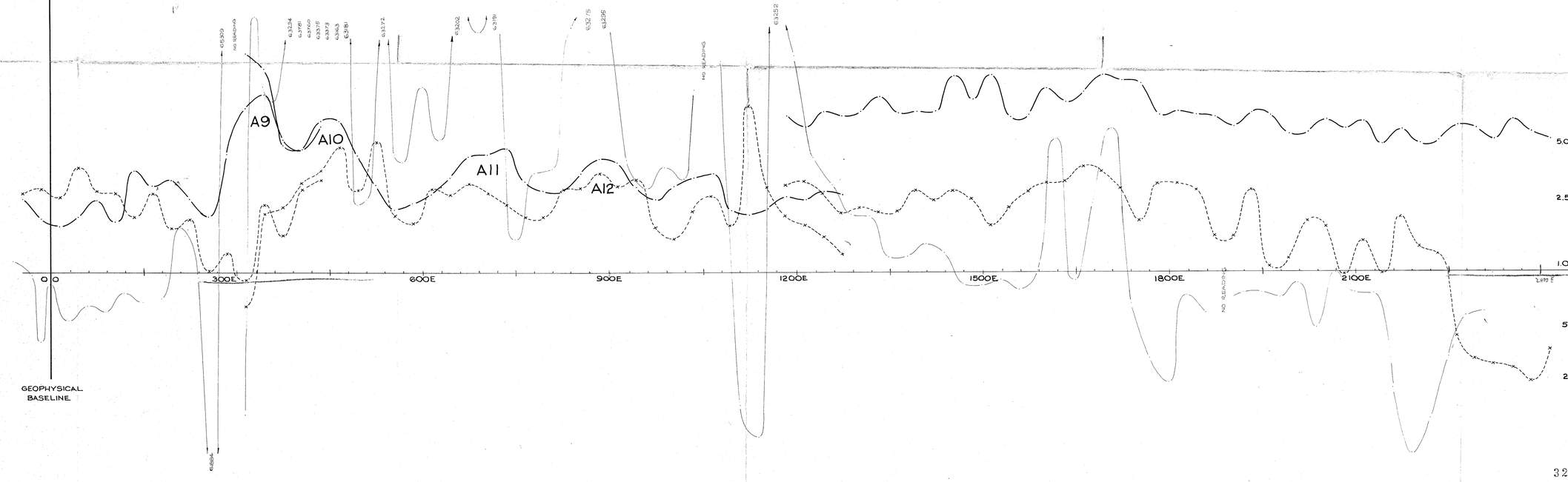
LINE 1800mN



LINE 1600mN



LINE 1400mN



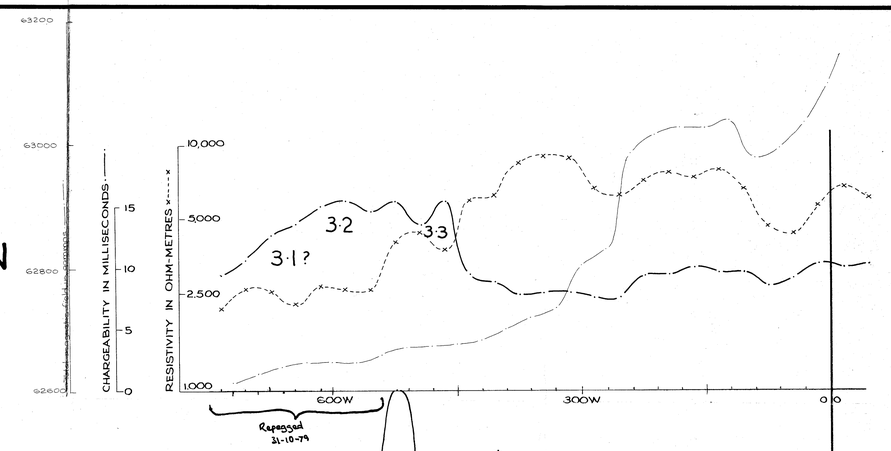
325048

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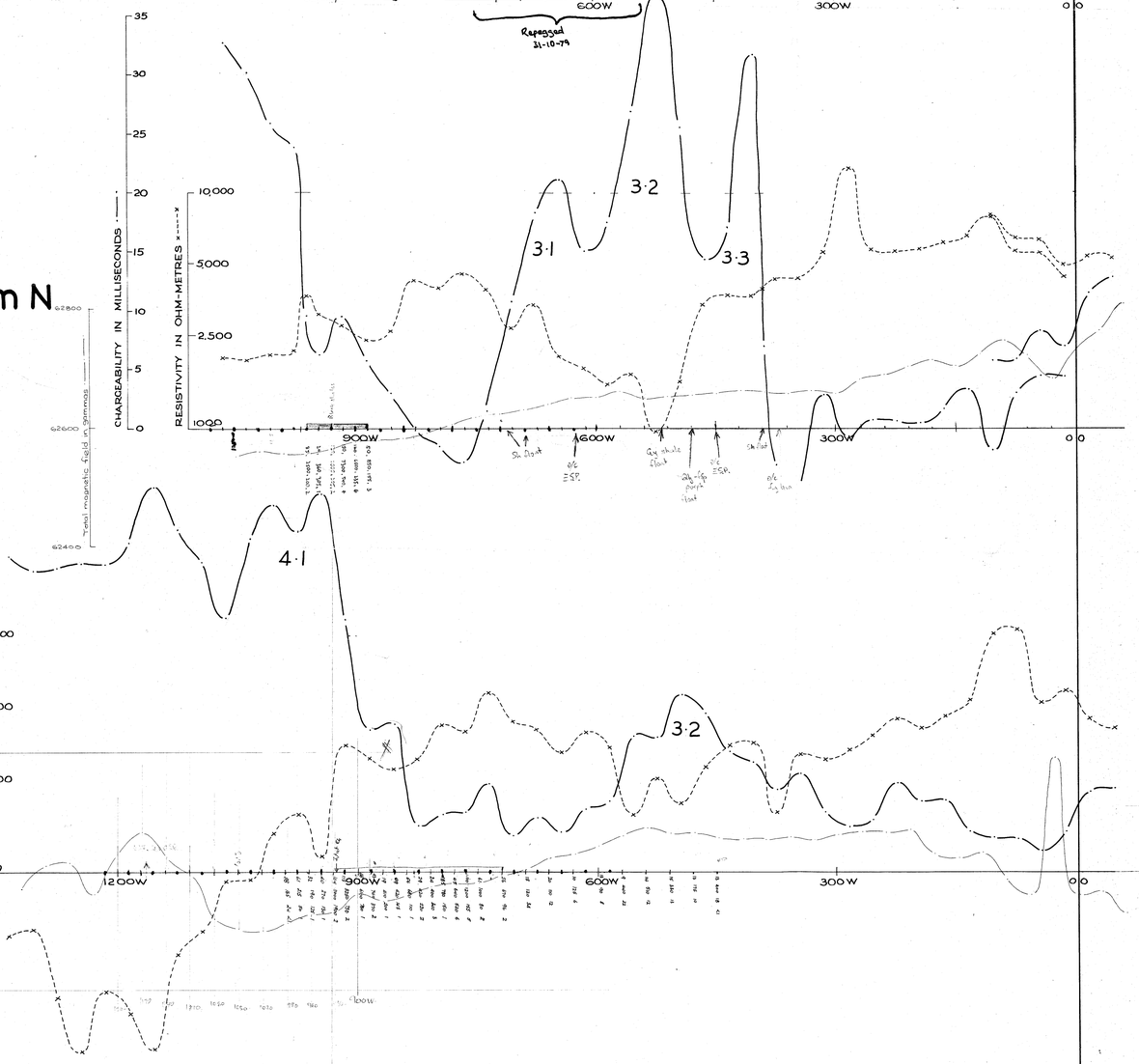
005

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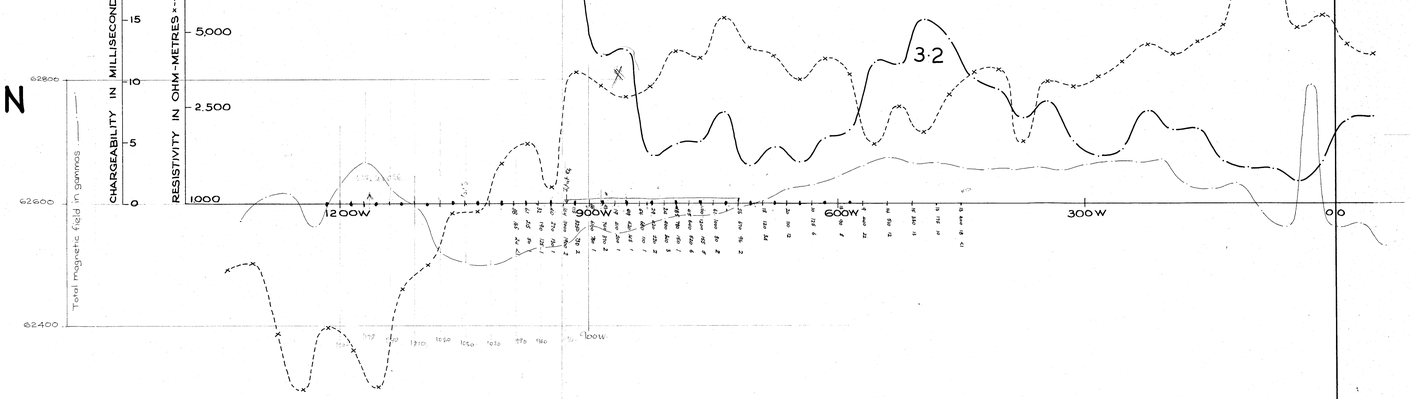
LINE 2000mN

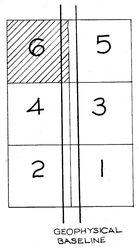


LINE 1800m N

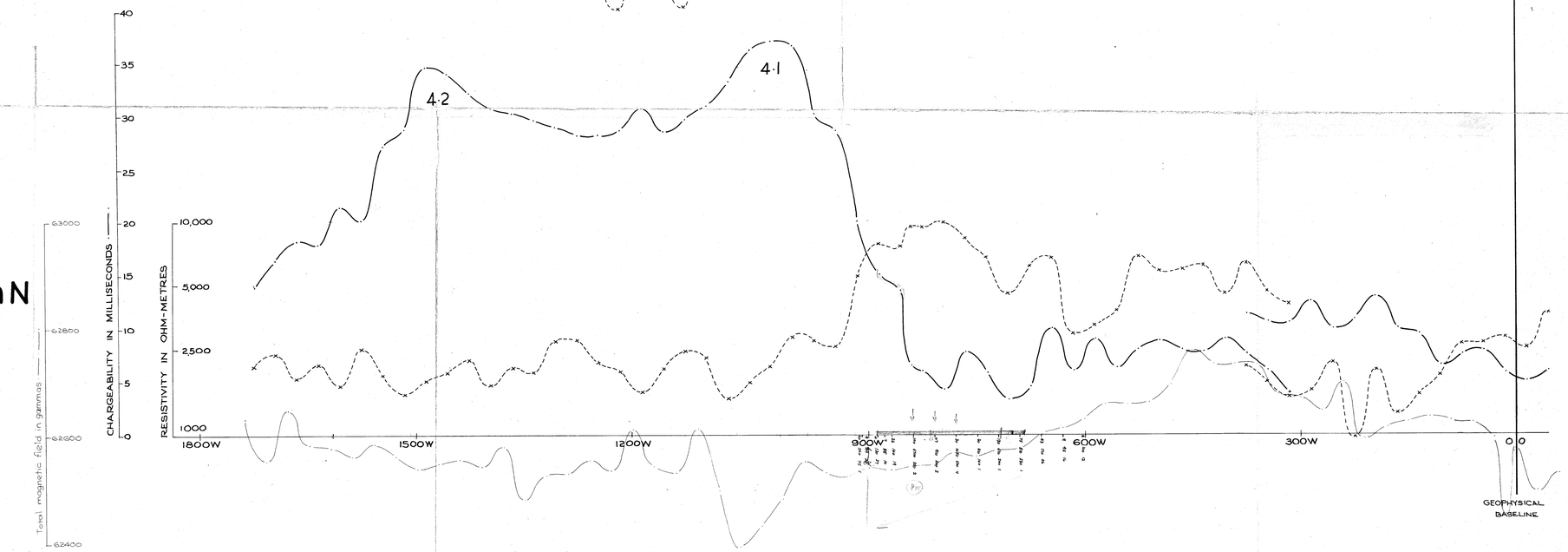


LINE 1600mN

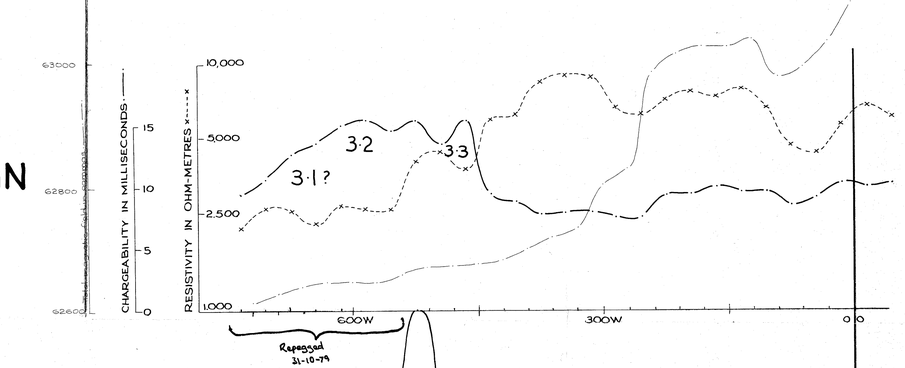




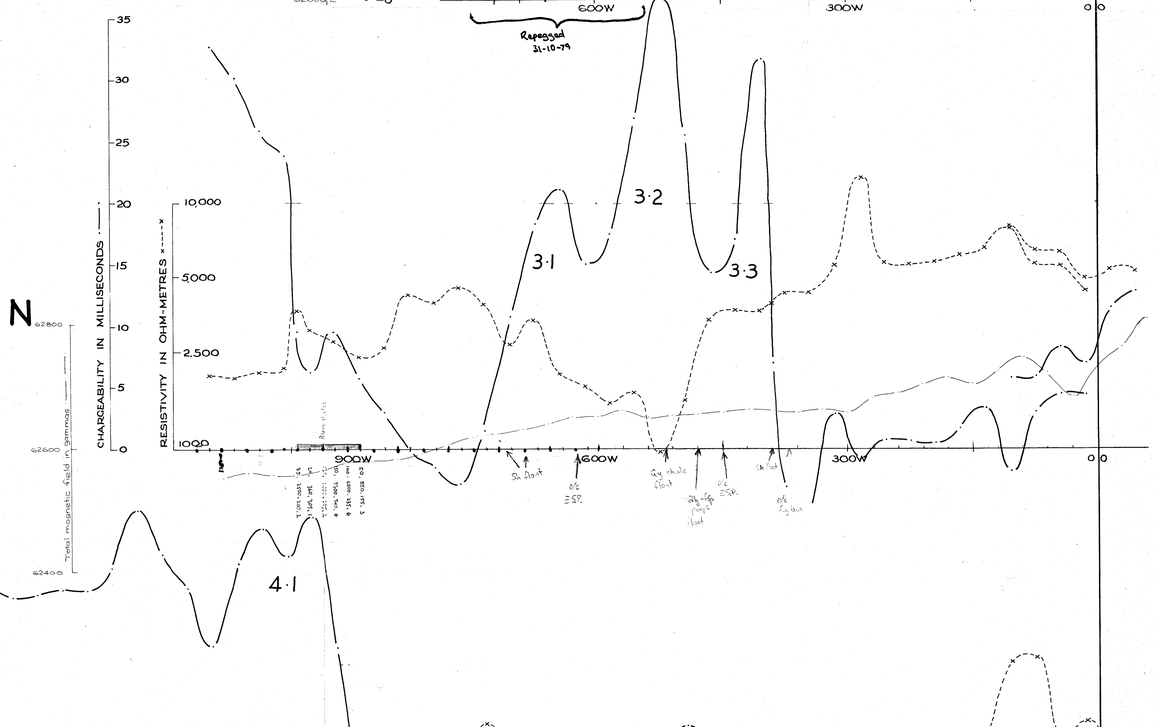
LINE 1400mN



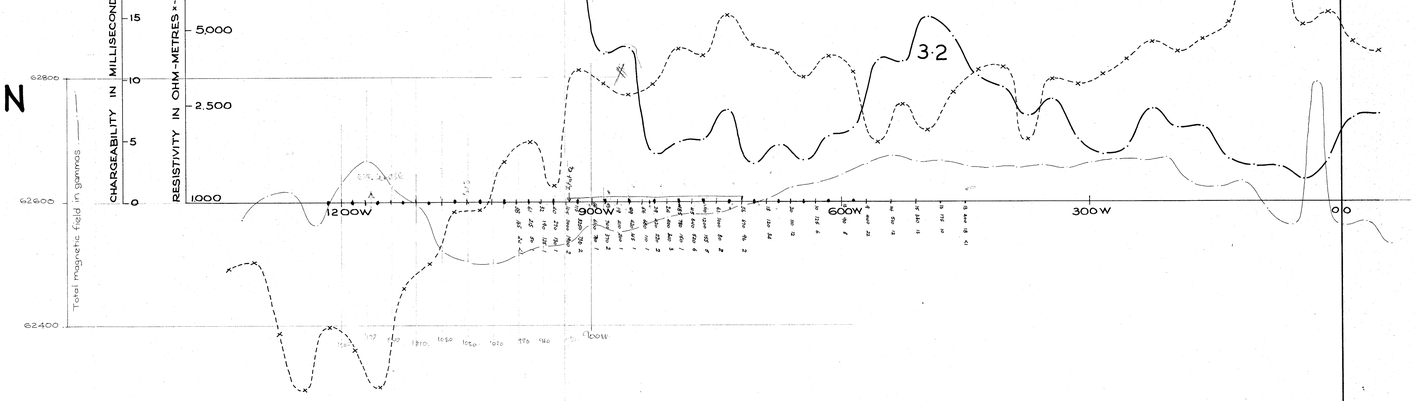
LINE 2000mN

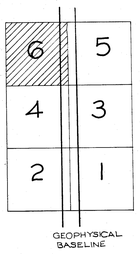


LINE 1800m N

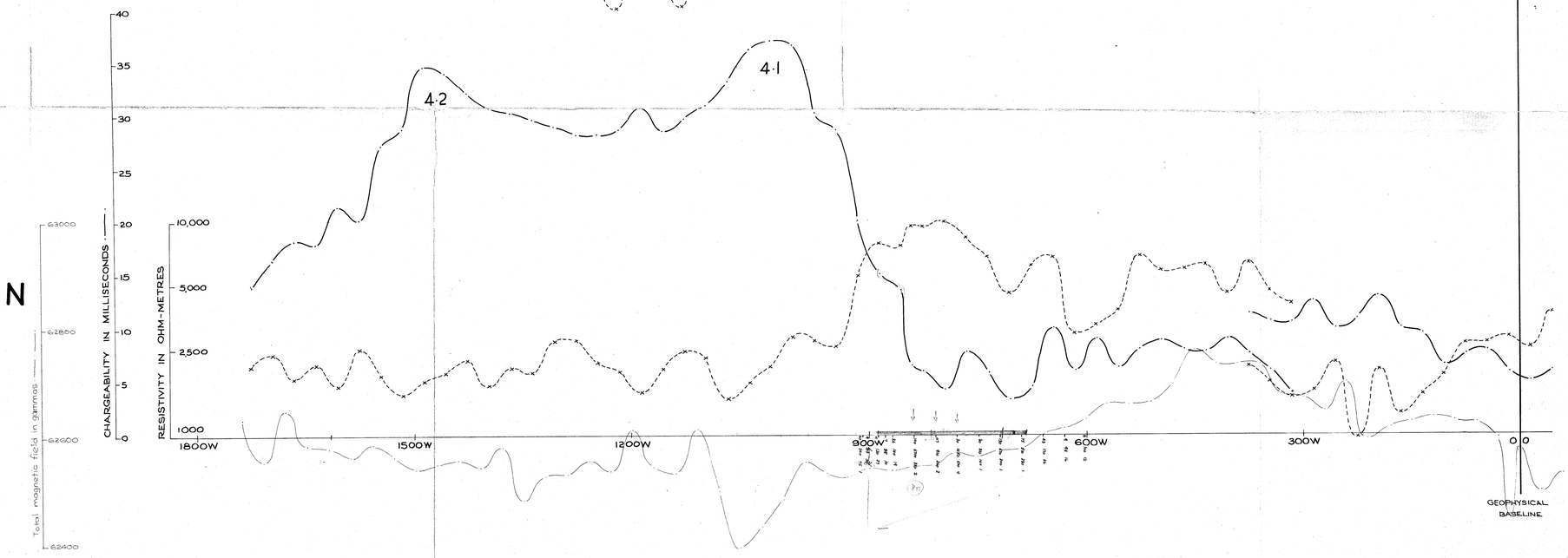


LINE 1600mN





LINE 1400mN



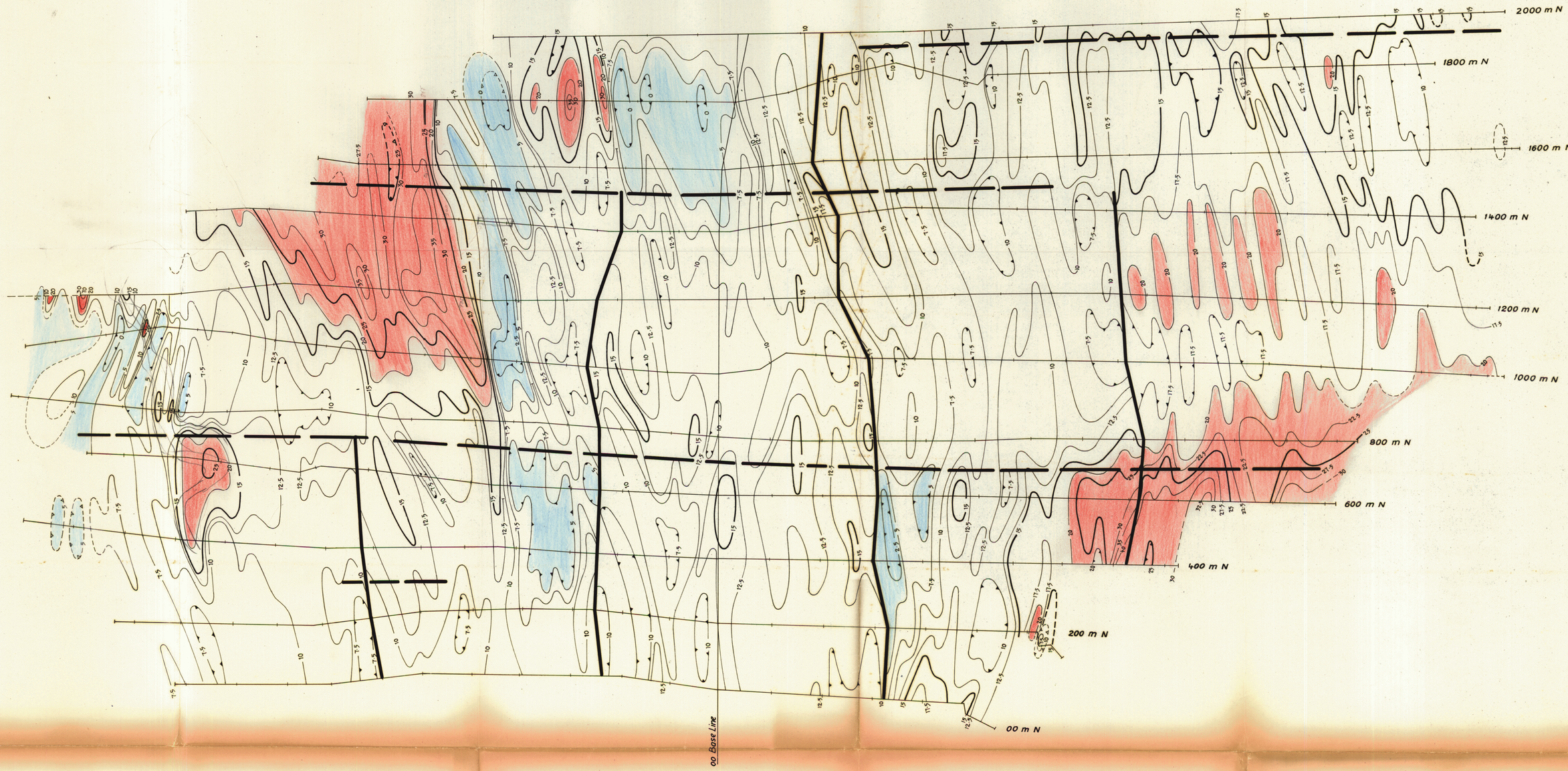
L 16N – 20N western half.

325049

Job. No. TAS-035-D Sheet 6 of 6 Plate 1

006

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LEGEND

Chargeability contours in milliseconds

Gradient block boundary

MOUNT LYELL MINING & RAILWAY COMPANY LTD.

BEATRICE GRID

(NR.) QUEENSTOWN - WEST COAST TASMANIA

ELECTRICAL INDUCED POLARIZATION SURVEY

GRADIENT ARRAY

CHARGEABILITY CONTOUR PLAN

5 cm

SURVEYED & COMPILED BY

SCINTREX PTY., LTD.

FEBRUARY 1977

240 180 120 90 60 30 00 120 240 (metres)

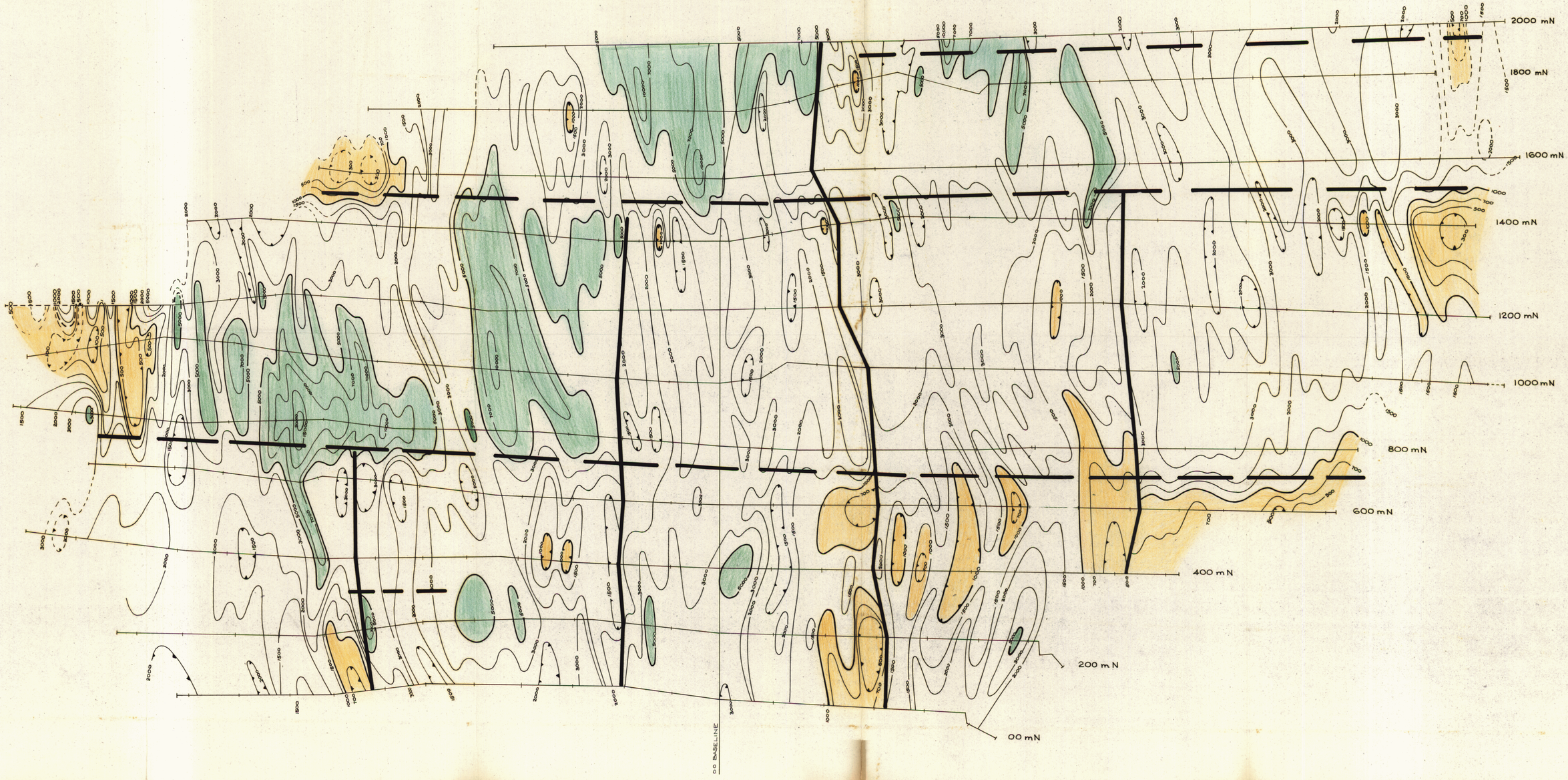
325050

C 007

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PLATE 2.



LEGEND :

Resistivity contours in ohm-metres

Gradient block boundary

MOUNT LYELL MINING & RAILWAY COMPANY LTD.

BEATRICE GRID

(NR.) QUEENSTOWN - WEST COAST TASMANIA

ELECTRICAL INDUCED POLARIZATION SURVEY

GRADIENT ARRAY

RESISTIVITY CONTOUR PLAN

5 cm

SURVEYED & COMPILED BY

SCINTREX PTY., LTD.

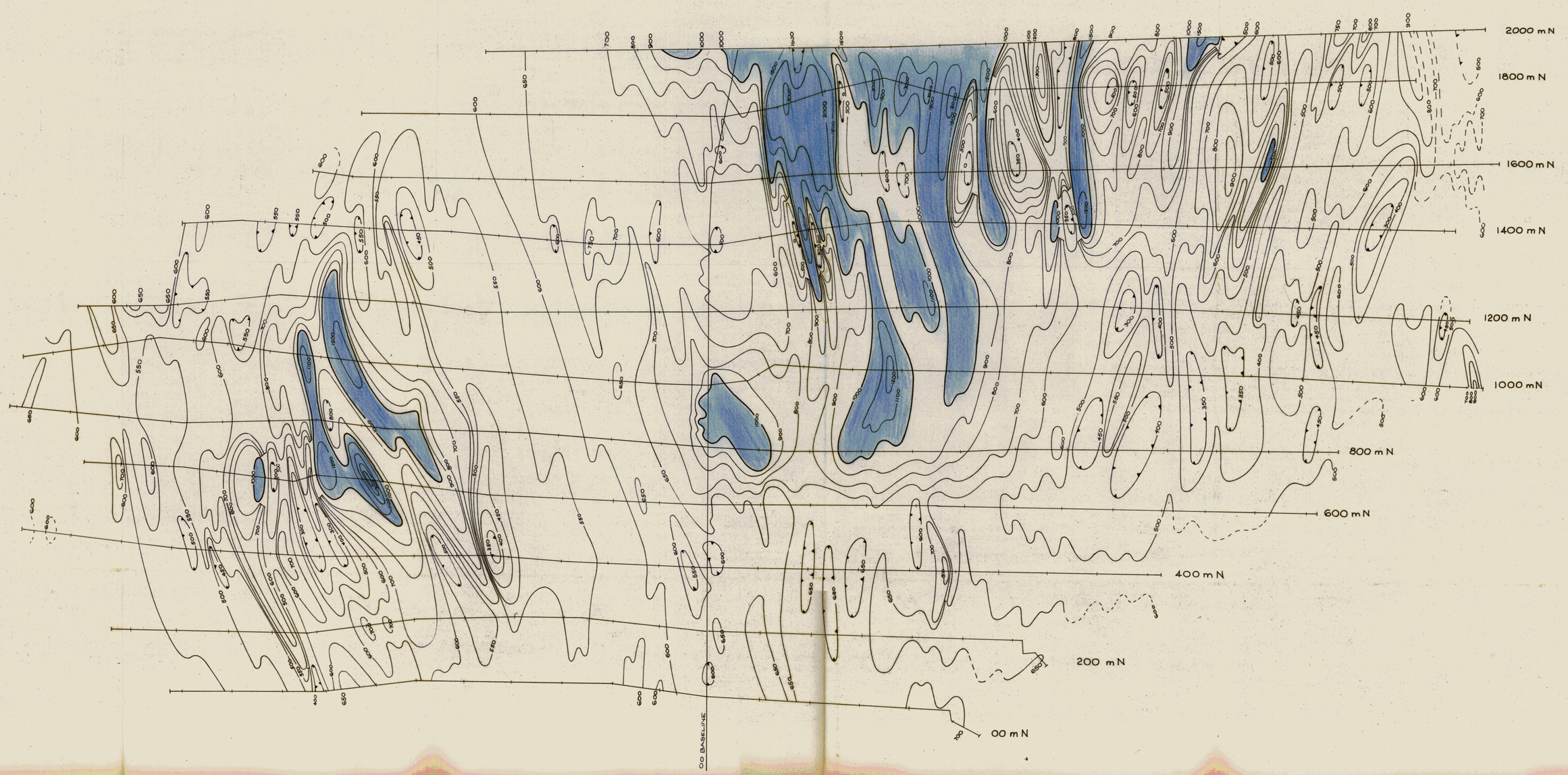
325051 FEBRUARY 1977

240 180 120 90 60 30 00 120 240 (metres)

008

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JOB Nº TAS-035-D Sheet 1 of 1 PLATE 3.



NOTE : For correct total magnetic field, add 62000 gammas to all values.

MOUNT LYELL MINING & RAILWAY COMPANY LTD.

BEATRICE GRID

(NR.) QUEENSTOWN - WEST COAST TASMANIA

TOTAL FIELD MAGNETOMETER SURVEY

CONTOUR PLAN

5 cm

SURVEYED & COMPILED BY
SCINTREX PTY. LTD.

FEBRUARY 1977

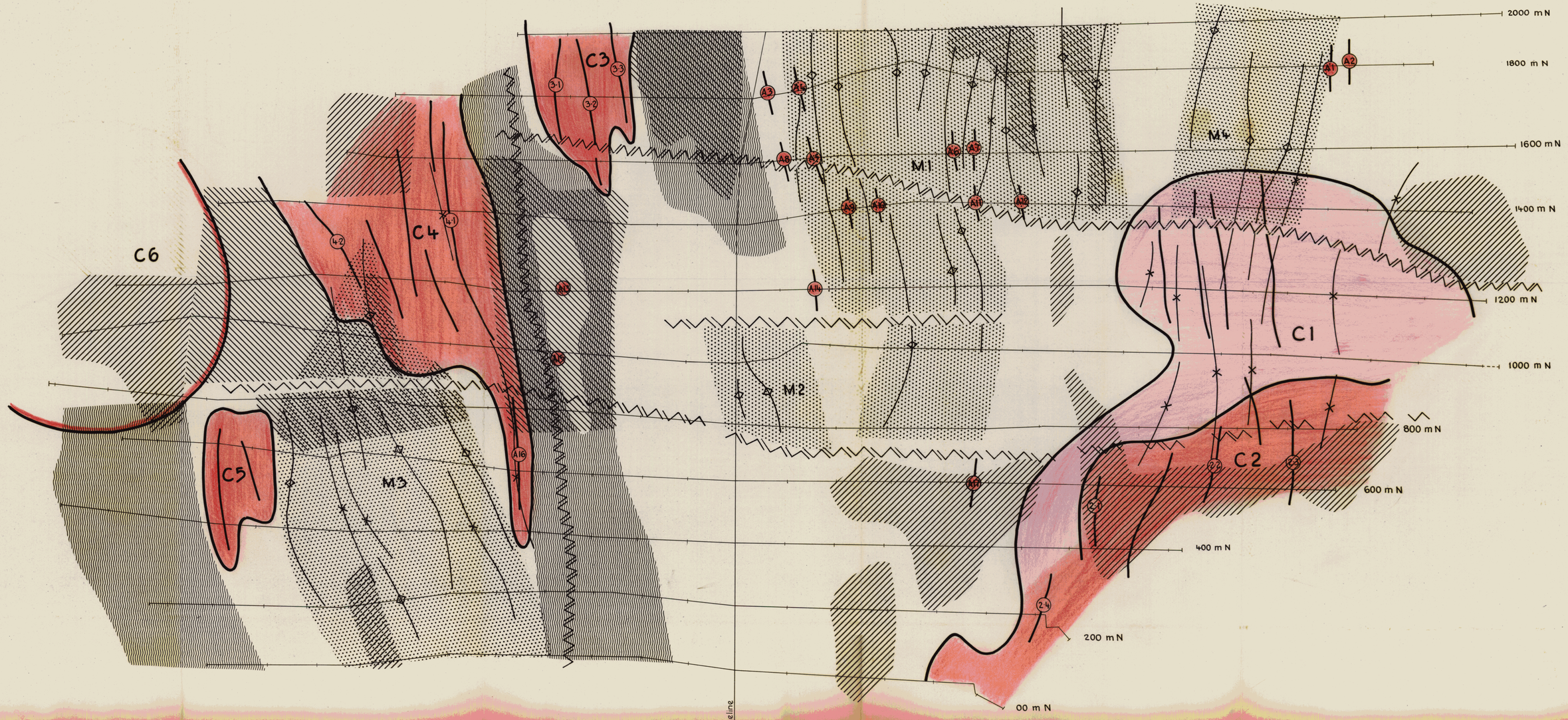
325052

240 180 120 90 60 30 00 120 240 (metres)

009

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JOB Nº TAS-035-D Sheet 1 of 1 PLATE 4.



LEGEND

- Areas of low resistivity
- Areas of high resistivity
- C — Areas of high chargeability background
- Areas of abnormaly low chargeability
- M — Areas of high magnetic background
- Induced polarization responses
- Magnetic lows
- Magnetic highs
- Possible faults

MOUNT LYELL MINING & RAILWAY COMPANY LTD.

BEATRICE GRID

(NR.) QUEENSTOWN - WEST COAST TASMANIA

ELECTRICAL INDUCED POLARIZATION SURVEY

INTERPRETATION PLAN

325053

5 cm

SURVEYED & COMPILED BY
SCINTREX PTY., LTD.
FEBRUARY 1977

240 180 120 90 60 30 00 120 240 (metres)

JOB Nº TAS-035-D Sheet 1 of 1 PLATE 5.

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