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HOWLAND-ROSE COMMENTS ON
AN ELECTRICAL INDUCED POLARIZATION
AND RESISTIVITY SOUNDING TEST SURVEY
PIONEER, NORTH EASTERN TASMANIA
ON BEHALF OF
AMDEX MINING LIMITED

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AND RESISTIVITY SOUNDING TEST SURVEY
PIONEER, NORTH EASTERN TASMANIA
ON BEHALF OF
AMDEX MINING LIMITED

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Data Profiles

*SUMMARY*

Schlumberger electrical soundings for both apparent resistivity and apparent chargeability were undertaken over two known holes (#19 and #21) and four exploratory sites on the Pioneer alluvial tin deposit (Lease 38M-71).

All soundings show a chargeable zone at a depth ranging between 40 and 50 metres whose ABSOLUTE depth is unknown, but whose RELATIVE depth has been interpreted. This zone appears to be deepest BELOW SURFACE at 100 metres north of #20, and shallow to the west, south and east of that point (again relative to surface).

As the origin of this distinctive chargeability marker zone (Z) is unknown, a chargeability hole log of #19 and #21 has been recommended to identify the source.

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INTRODUCTION

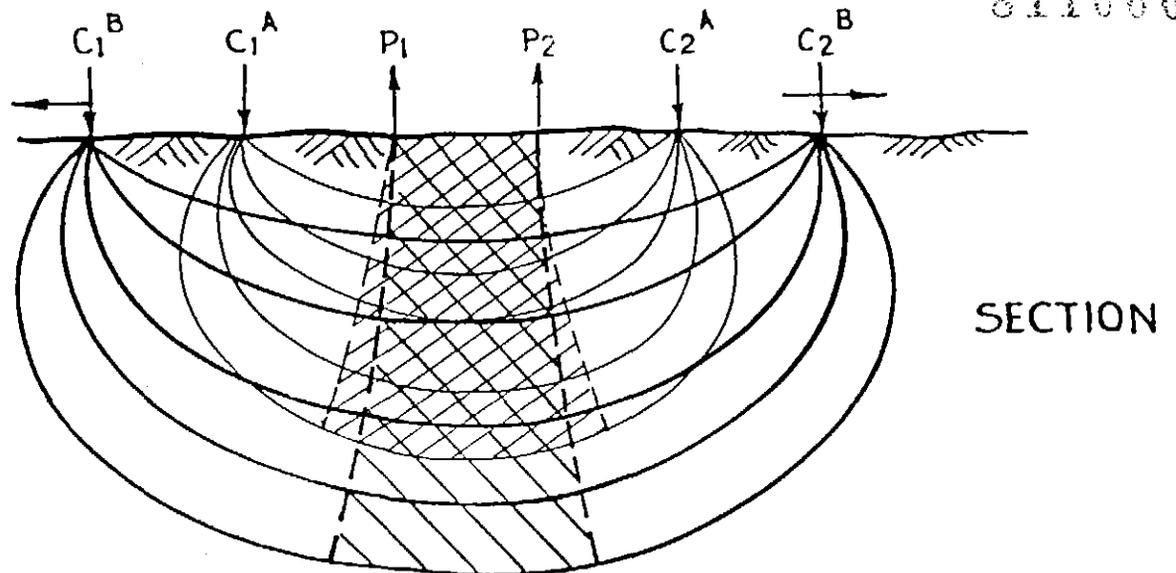
At the request of Mr. I. Shulman, Chairman of Amdex Mining Limited, on the 3rd and 4th March, 1977, Mr. B. Ekstrom, senior Scintrex operator, executed some 8 Schlumberger electrical soundings over sites at Pioneer over Consolidated Lease 38M-71. On site geological direction was undertaken by Mr. K. Piggott of Amdex Mining Limited.

The objective of this short programme was to determine whether an electrical sounding approach could (a) determine with accuracy the depth to basement of the alluvial channel and/or (b) the *relative depth* of the basement between sounding points.

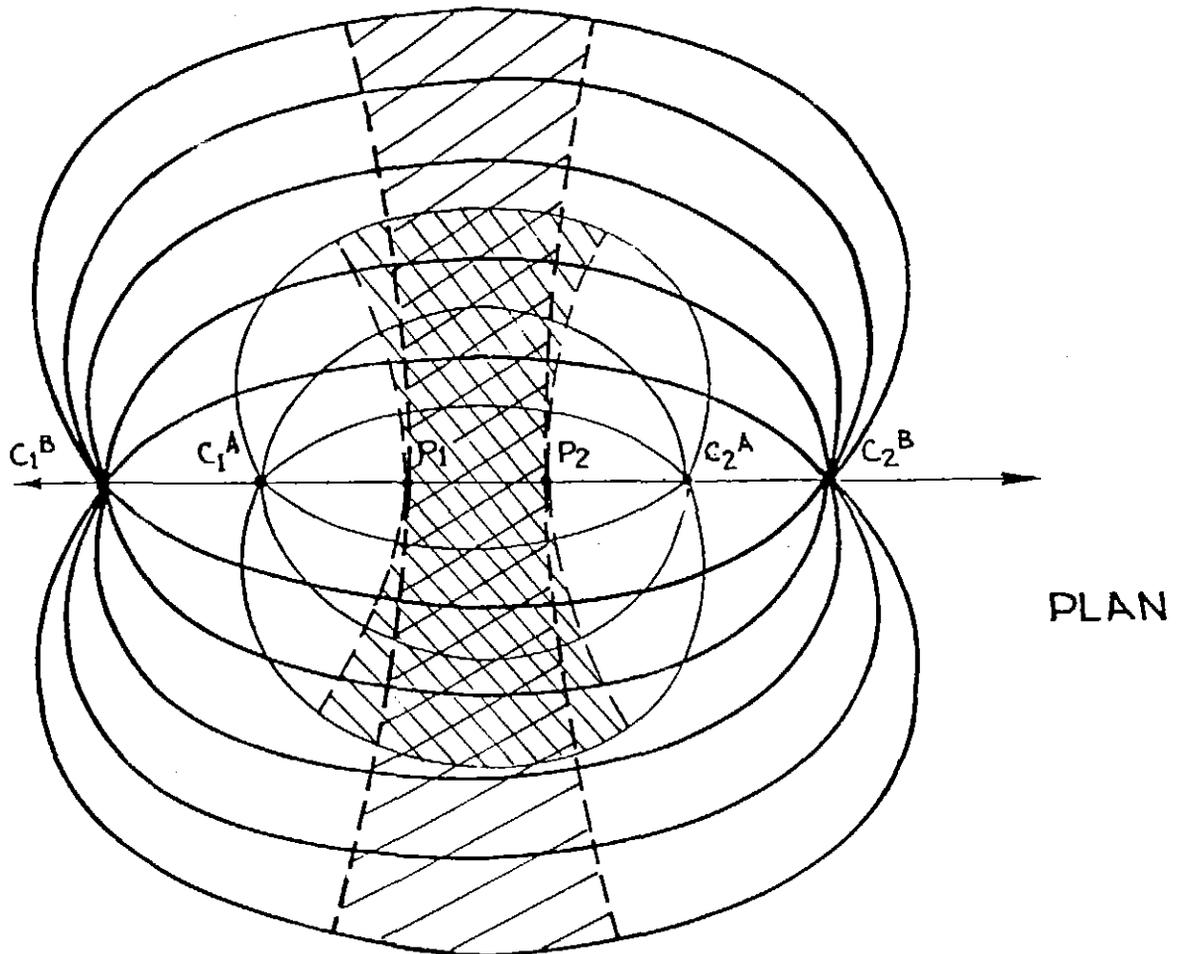
METHOD AND EQUIPMENT

The equipment used consisted of a Scintrex 3KW induced polarization transmitter powered by a 7HP Briggs & Stratton motor, and a Scintrex IPR-8 induced polarization receiver.

The array used to investigate the soundings was the Schlumberger array. This array was employed to test the horizontal layering. The two potential electrodes (P_1 , P_2) are placed *between* the two



SECTION



PLAN

Schlumberger array showing the primary equipotential field by which the resistivity measurements are taken.

FIGURE 1

current electrodes (C_1 , C_2). The latter are then progressively moved out and progressively deeper volumes are sampled. Note that progressively larger *sideways* sampling *also* occurs. Thus lateral and longitudinal inhomogeneities can influence the results.

A comparison with standard curves will indicate horizontal layering and will be reliable *providing* (i) the layering is horizontal, (ii) there are no *lateral* inhomogeneities, and (iii) there are no *longitudinal* inhomogeneities (i.e. along traverse lines).

The apparent chargeability (Ma) is similarly acquired, and once the apparent resistivity has been studied, Ma can also be used to compute the depth to any chargeable layer

DISCUSSION OF RESULTS

The objective being to be able to ascertain the depth to basement or at least determine the *relative* depth to basement of adjacent soundings, it was necessary to determine first the lateral homogeneity around the sounding. This is necessary because should there be material inhomogeneity, then it would not be possible to determine the absolute or relative depth to basement. Therefore two sets of mutually perpendicular soundings were executed over drill holes 19 and 21. To make doubly sure of the potential readings acquired, two separate b (potential dipole) spacings of 1 metre and three metres were employed for each a (current dipole) spacing.

DRILL HOLE #19

The results of these two mutually perpendicular soundings positioned over drill hole #19, are shown on Plates SX-19A and SX-19B. It will be seen on each of these plates that the $b = 1$ and $b = 3$ chargeability (solid line) and apparent resistivity (dashed line), are sub-parallel and in close proximity to one another. Also the curves for each direction are very similar. This is a most satisfactory result as it shows that over this sounding site the characteristics of the underlying sediments are horizontal and have very similar characteristics radially around the hole sounded.

The *apparent resistivity* data shows a near surface layer (X) of about 2500 to 3000 ohm-metres and chargeability of 7 to 8 millivolts/volt, to a depth of $10\frac{1}{2}$ metres $\pm 1\frac{1}{2}$ metres.

This layer is underlain by a zone of much lower resistivity (Y) (of the order of 100 ohm-metres) and much lower chargeability, approaching zero.

This second layer is in turn underlain by a zone (Z) whose chargeability increases dramatically to 8 to 10 millivolts/volt. This increase in chargeability is dramatically illustrated by the plot of residual chargeability ($M_a - M_1$) plotted on a log log scale. However, this residual cannot be matched to any calculated form, but it is a distinct marker horizon.

DRILL HOLE #21

The chargeability and resistivity data are presented on plates SX-21A and SX-21B. The soundings were carried out mutually perpendicular to one another. As in the case of SX-19A and SX-19B, the $b = 1$ and $b = 3$ data are very similar and the form of the mutually perpendicular soundings is also very similar.

In this case the same three layers as defined in drill hole #19 can be recognised here also. These are as follows....

- (X) The upper-most layer is about 8 to 10 metres thick and is of resistive 4000 to 7000 ohm-metres material whose chargeability is about 6 to 8 millivolts/volt.

- (Y) This layer is of materially lower resistivity of the order of 200 ohm-metres, whose chargeability is about 1 to $1\frac{1}{2}$ millivolts/volt.

- (Z) At depth, a more chargeable zone was logged whose depth cannot be accurately assessed, but which the mutually perpendicular soundings infers to be greater than 45 metres. As with drill hole #19, the residual chargeability dramatically shows up this interface.

CONCLUSIONS FROM THE TEST WORK OVER HOLES #19 AND #21

1. The horizontal layering around holes #19 and #21 can be considered to be similar in the two dimensions sounded.
2. Both show three layers....
Surface (X) Resistive and moderately chargeable
Middle (Y) Conductive with low chargeability
Bottom (Z) High chargeability but still quite low resistivity
3. From experience in the region, and elsewhere, it is *suggested* that the *surface* layer (X) may be derived from more recent erosion, the *middle* layer (Y) being the material derived during the tertiary. Sediments deposited in this period are characterised by low resistivities and intrinsic chargeabilities approaching zero. The *bottom* layer (Z) of higher chargeability. could represent less weathered bedrock, but K. Piggott has suggested that this increased chargeability may represent a pyrite-tin-ilmenite horizon. This is quite possible.
4. It is not possible to ascertain the depth to the chargeable horizon absolutely, however, it can be seen that this horizon is *deeper* in hole #21 than in hole #19.
5. It is recommended that holes #19 and #21 be logged using a 1 metre three-array log to unambiguously ascertain the depth

to, and origin of this chargeable horizon.

6. It would appear from the two test sites that the method adopted is capable of ascertaining the *relative depth* of the chargeable layer, which, when the *absolute* depth is obtained by logging, may be capable of being calibrated to yield absolute depths at other locations.
7. As a consequence of the apparent lateral regularity of the layering away from the drill holes, it was decided to run a single sounding over the test sites described below.

EXPLORATORY SOUNDINGS

*Site 100 Metres North of #19.....*Essentially the same three zones as recognised in holes #19 and #21, can be recognised here, *but* with the addition of a shallow, conductive (about 200 ohm-metres) near surface zone, 5½ metres deep. The underlying resistive layer is the equivalent of the resistive section (X) seen nearer surface on all other soundings.

This zone is then followed by a more resistive (1500 to 2000 ohm-metres) zone of 6 to 7 millivolts/volt (X) underlain by the more conductive, less chargeable horizon (Y) at an estimated depth of the order of 15 metres or so below surface. This is subject to a +20% error.

Below this, a zone of increased chargeability (Z) was noted which is particularly evident on the residual ($M_a - M_1$) log plot.

It is concluded that the multiple layering of this sounding makes a precise depth to basement estimate difficult, however, the zone of increased chargeability was seen to be present at a depth below surface greater than that seen at hole #19.

*Site 100 Metres North of Hole #21.....*The three layers, (X), (Y) and (Z), seen in type holes #19 and #21, can be recognised at this site.

The surface zone (X) is about $5\frac{1}{2}$ metres deep, has a chargeability of about 7 ± 1 millivolts/volt, and has a resistivity of 2000 ohm-metres

The underlying (Y) zone is about 400 to 500 ohm-metres apparent resistivity, while the chargeability approaches zero.

The deepest chargeable zone (Z) is seen at a depth of the order of 50 metres, but the actual depth cannot be quantified. However, the depth to (X) is clearly inferred to be *deeper than* seen in hole #21.

It is concluded that the same three horizons, (X), (Y) and (Z) as seen in holes #19 and #21, exist here, and further, horizon (Z) is at a depth greater than that seen in hole #21.

Site 100 Metres North of Hole #20..... At this site the resistive surface layer (X) was about 7 metres deep, but in this case the chargeability remained a low 2 to 3 millivolts/volt, while the absolute resistivity of the upper layer was about 1000 ohm-metres.

The middle layer has chargeability of about 3 to 4 millivolts/volt with resistivity of the order of 200 to 250 ohm-metres.

The deepest layer (Z) is chargeable, as seen to east and west, and in this case the layer appears deeper at this site than either to east or west. The absolute depth, however, cannot be determined.

*Site 200 Metres North of Hole #23.....*The surface layer in this case is both the most resistive (4000 to 8000 ohm-metres) and the most chargeable (10 to 12 millivolts/volt) seen in the area. The depth of this surface layer is about 7 metres.

The middle layer (Y) has apparent chargeabilities of the order of 5 millivolts/volt but the interpreted level is about half that. The interpreted resistivity of the middle layer is about 250 ohm-metres.

The deepest layer recognised (Z), is shown by higher chargeabilities with no material increase in resistivity. While the depth cannot be accurately determined, it can be seen that it is of the order of 40 metres and *shallower* than the adjacent sounding to the east (100 metres north of #21).

CONCLUSIONS FROM THE FOUR EXPLORATORY SOUNDINGS

1. The three layers (X), (Y) and (Z), defined in the area of holes #19 and #21, were recognised at these sites also.
2. Diagram 2 summarises the correlation between these four soundings. From this diagram it can be seen that the layers change their form and characteristics laterally as detailed below.
3. Zone (X) while always remaining more resistive than the layer below, becomes progressively more resistive to the west. The chargeability of this zone is generally 6 to 7 millivolts/volt.
4. Zone (Y) is invariably more conductive at about 250 ohm-metres, than (X), while the chargeability is invariably lower at 1 to 2 millivolts/volt. At 100 metres north of #20 this zone is both more resistive and chargeable than to the east or west.
5. The deepest zone (Z), is characterised by an increase in chargeability and this zone is judged to be deepest in sounding 100 metres north of #20, followed by 100 metres north of #19 100 metres north of #21, and shallowest in hole 200 metres north of #23.

The origin of this zone is unknown but could be due to extremely weathered bedrock or, as has been suggested by K. Piggott, be

due to chargeable material within a distinct horizon. The ilmenite-pyrite present within the tin horizon could well cause the response seen, especially when it is realised that the layer immediately above (Y) has a chargeability which is abnormally low (0 to 4 millivolts/volt averaging 1 to 2 millivolts/volt).

While the *absolute* depth cannot be ascertained, the range of depths is 40 to 50 metres, but the *relative* depths are considered reliable.

The chargeable zone (Z) seems thinner and less significant on 200 metres north of #23.

OPERATIONAL CONCLUSIONS

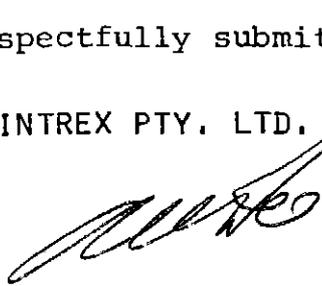
1. The soundings need to be taken out a further 20 metres or so beyond the *a* spacings used. The chargeability residual shown in a number of the soundings (e.g. 100 metres north of #20) is questionable. This means *a* spacings to 100 to 200 metres are required.
2. The origin of the chargeable zone must be clearly identified by logging holes #19 and #21 using a 1 metres three-array log. (about 2 hours work).

FINAL COMMENT

It is not possible to judge from the geophysical data alone whether the approach was successful or not. This decision really rests with the identification of the chargeable layer located in all holes. It is suggested that this zone need not be the basement or the pyrite-ilmenite-cassiterite zone itself to be useful, but it should bear a stratigraphic relationship to one or the other.

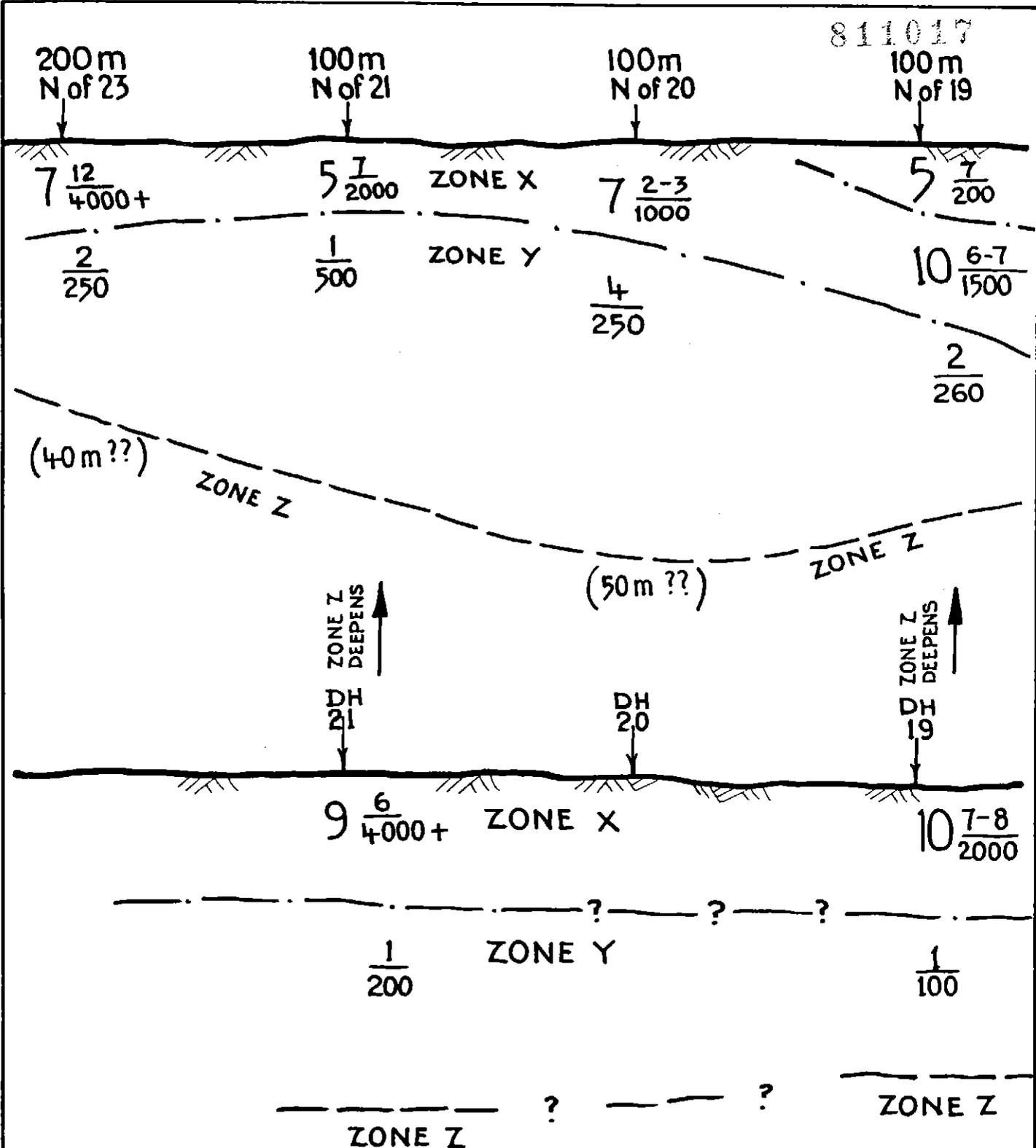
Respectfully submitted on behalf of:

SCINTREX PTY. LTD.



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

GEOPHYSICIST



LEGEND

$9 \frac{6}{4000+}$ Thickness in metres
 ← Chargeability Mv/v
 ← Resistivity in Ω metres.

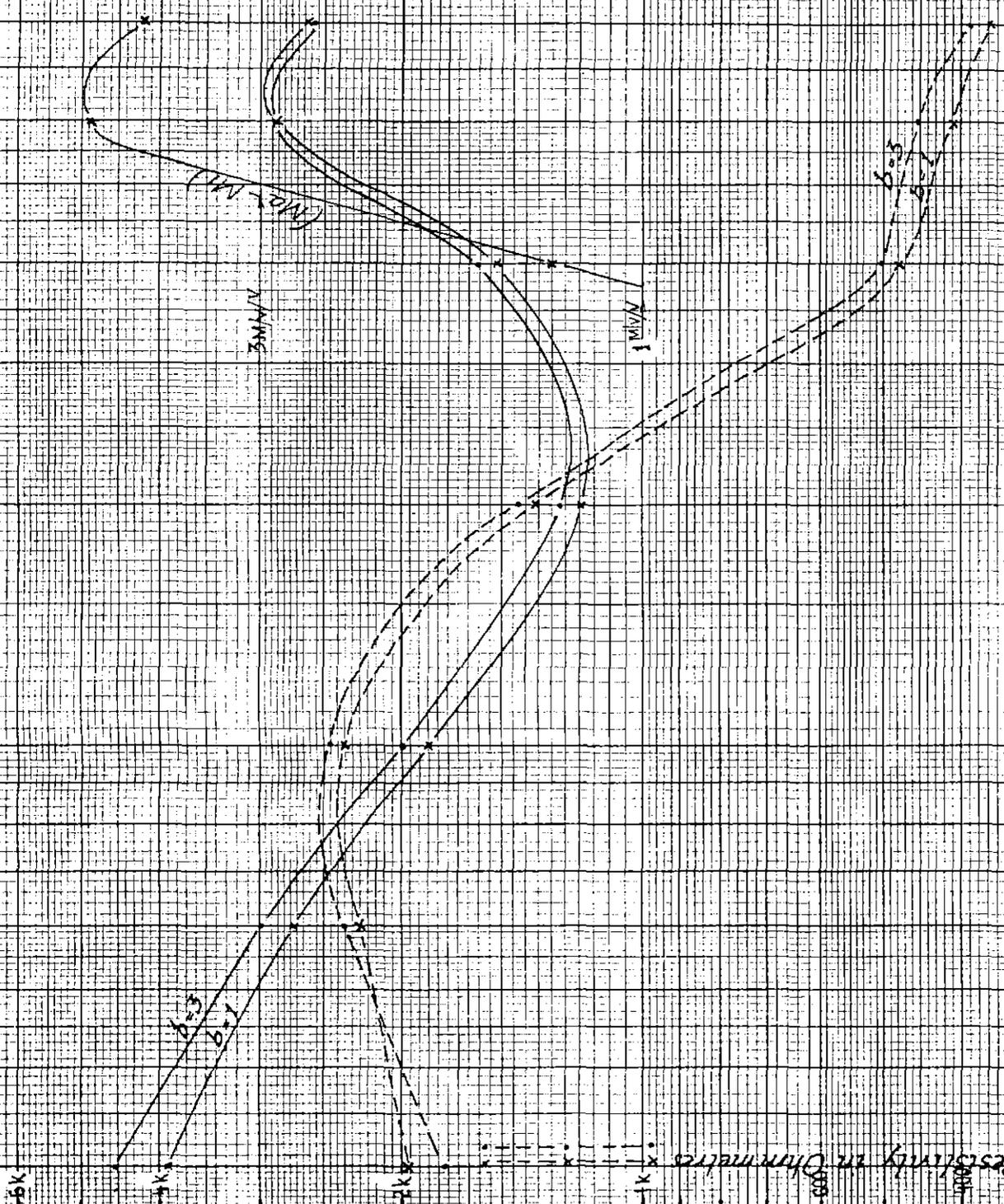
Depth not to scale

DIAGRAM 2.

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Chargeability in Millivolts/foot

10



Resistivity in Ohm-metres

6k

4k

2k

1k

0

SX-19A

TAS-39

α in metres

600

400

200

0

10

20

30

40

50

60

70

80

90

100

110

120

130

140

150

160

170

180

190

200

2.5

3

4

5

6

7

8

9

1

2

2.5

3

4

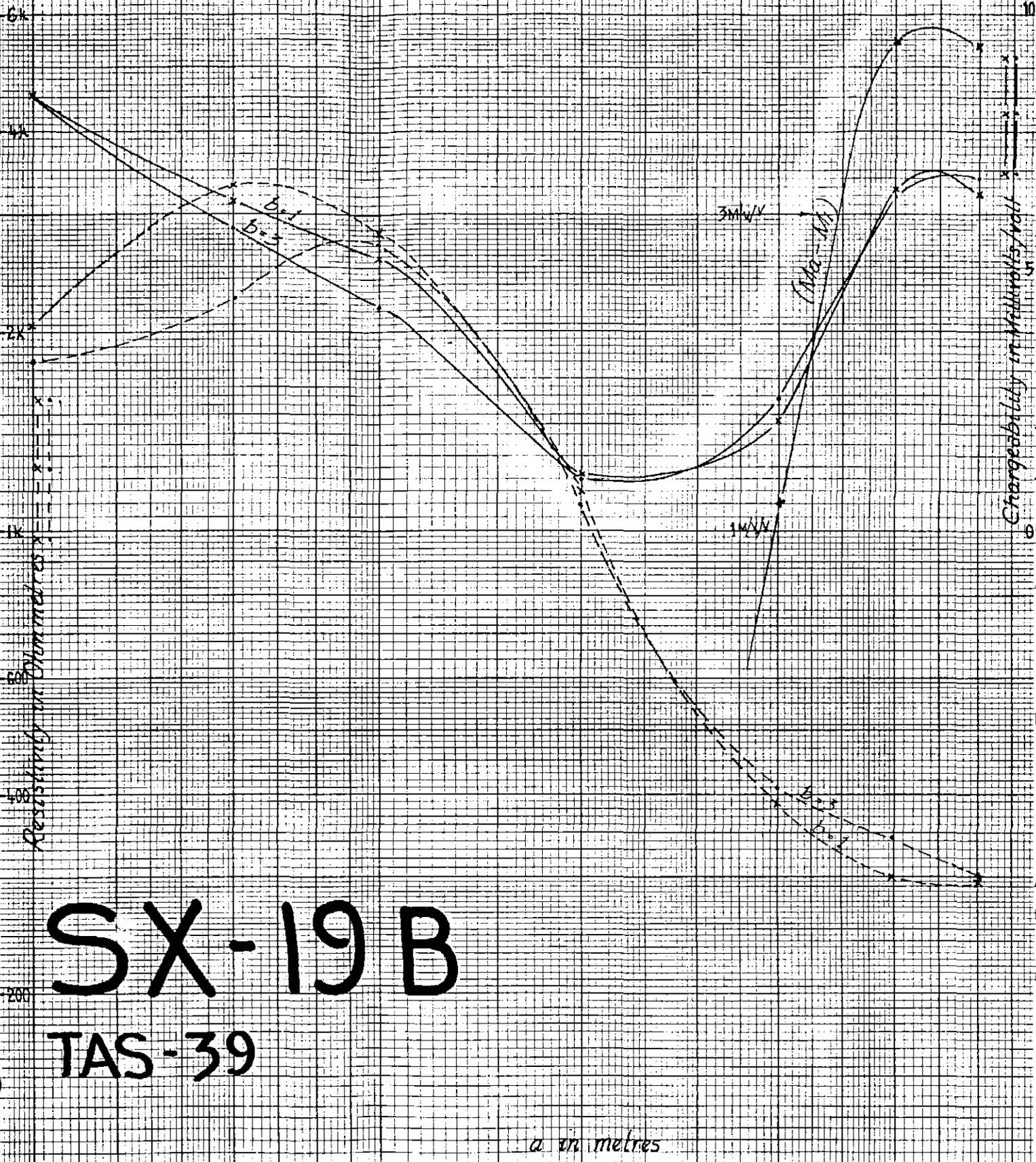
5

6

7

8

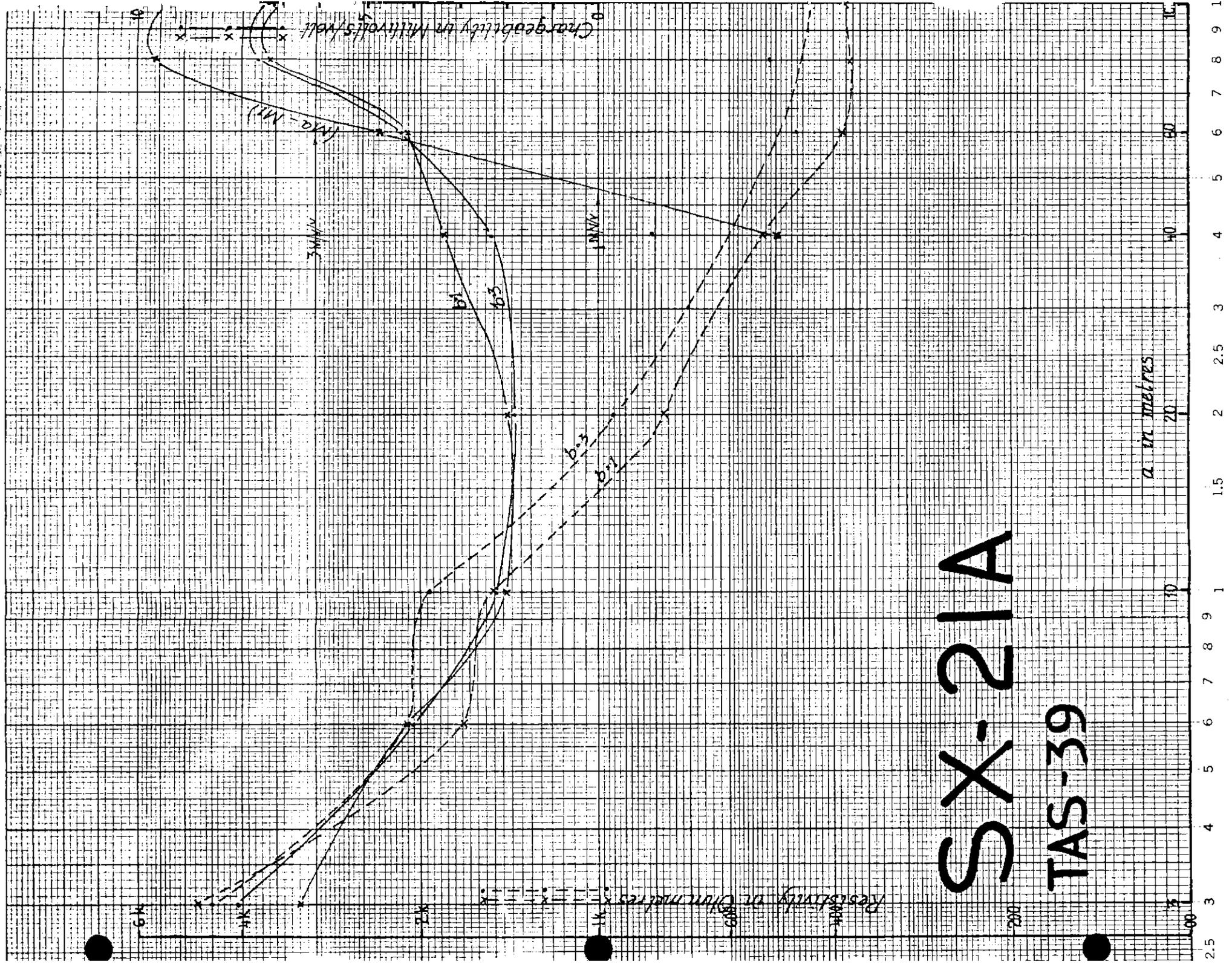
9



SX-19 B

TAS-39

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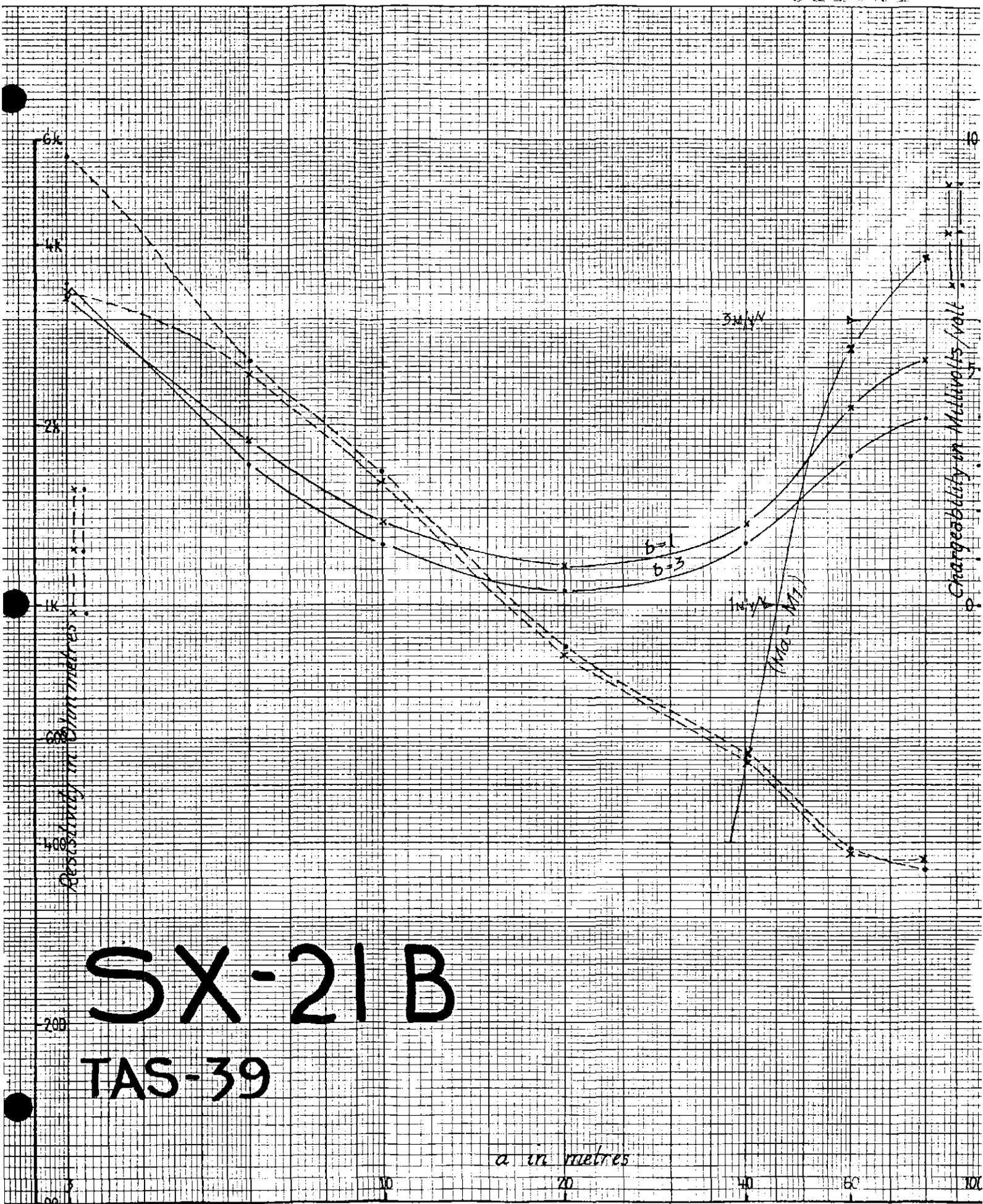


SX-21A

TAS-39

a in metres

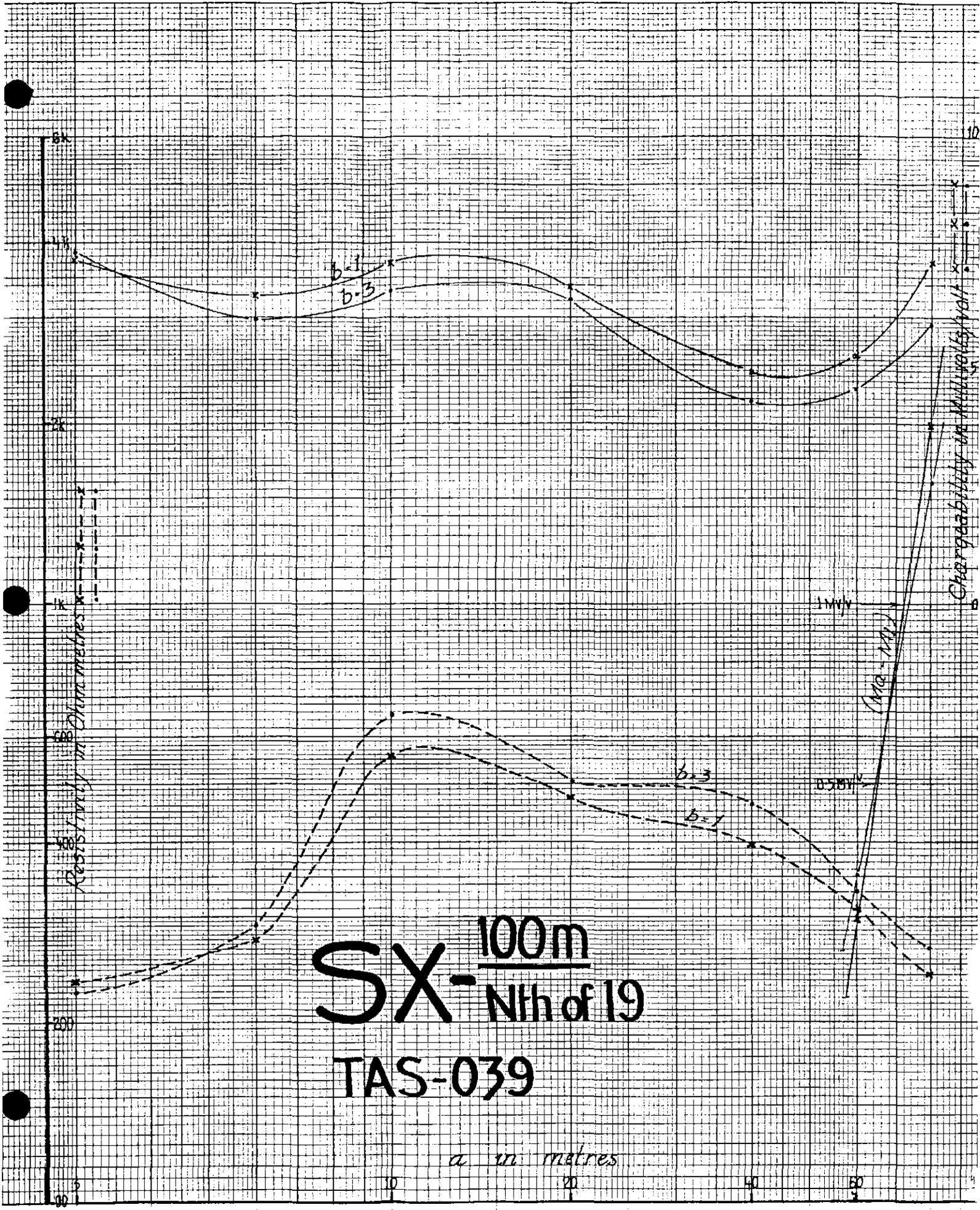
2.5 3 4 5 6 7 8 9 1 10 20 30 40 50 60 70 80 90 100



SX-21B

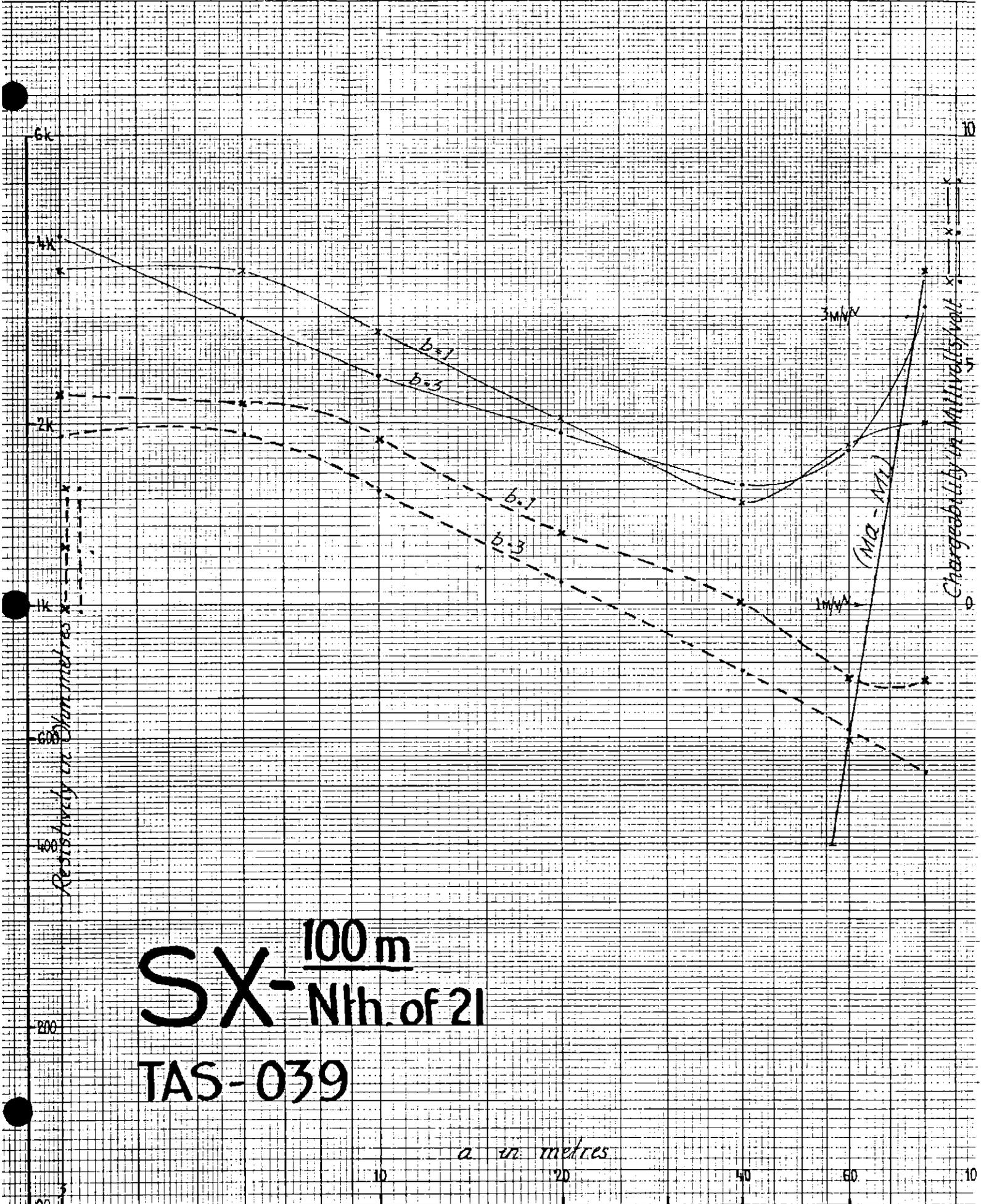
TAS-39

a in metres



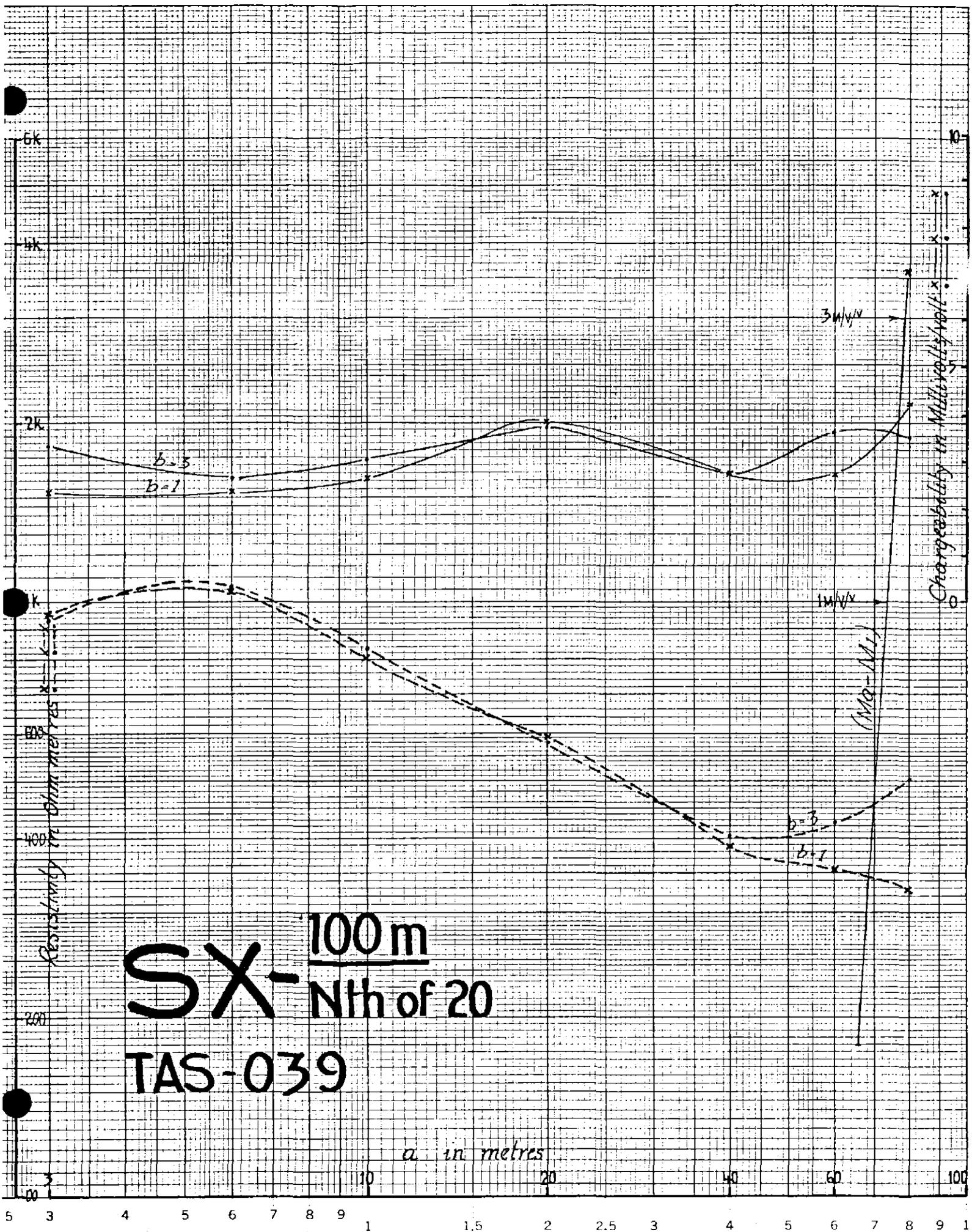
SX-100m
 Nth of 19
 TAS-039

a in metres



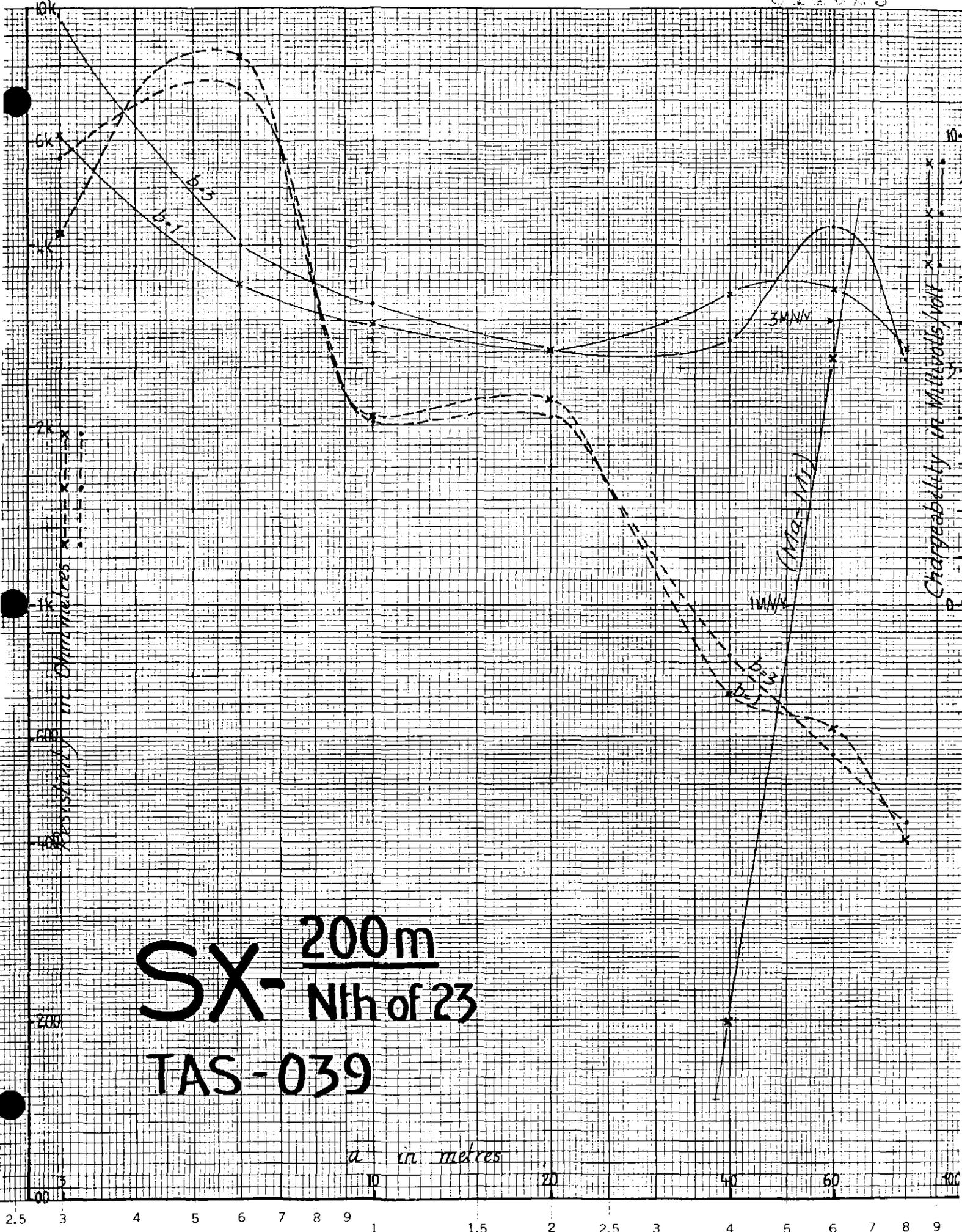
SX ^{100m}
 Nth. of 21
TAS-039

a in metres



SX-100 m
Nth of 20
TAS-039

a in metres



SX- 200m
Nth of 23
TAS-039

a in metres