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CLONCURRY AREA TEST RESISTIVITY SURVEY, QUEENSLAND, 1973

by

R.D. Ogilvy

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SUMMARY

Between 15 August and 10 October 1973, resistivity surveys were made in the Cloncurry 1:100 000 Sheet area. The surveys were made to investigate the capabilities and limitations of the resistivity method to detect lateral resistivity changes in Precambrian rocks overlain by a sequence of Mesozoic sedimentary rocks. The surveys used profiling and depth-sounding techniques and employed a variety of electrode arrays.

Resistivity depth-soundings provided reliable information on the depth to Precambrian basement and the geo-electric properties of the overlying Mesozoic sediments. However, the low resistivity of the Mesozoic sediments and the lack of significant resistivity contrasts in the basement preclude the routine mapping of buried Precambrian rocks by resistivity methods.

1. INTRODUCTION

Between 25 August and 10 October 1973 test resistivity surveys were made near Pymurra and Arrolla, which are in the Cloncurry 1:100 000 Sheet area (Plate 1). The surveys were designed to investigate the use of the resistivity method to map Precambrian rocks beneath a cover of Mesozoic sediments.

In the Pymurra area a resistivity-profiling survey was made along an 11 km east-west traverse which extended from outcropping Precambrian rocks in the west to Precambrian rocks buried under 100 m of Mesozoic sediments in the east. The thickness and homogeneity of the Mesozoic sediments along the traverse were investigated by resistivity depth-soundings.

In the Arrolla area Mesozoic cover is up to 200 m thick and resistivity-soundings were made at spacings of 2 km along a 6 km east-west traverse.

The Schlumberger array was the main electrode array used in the surveys, but soundings were also made with the equatorial dipole array to compare the sensitivity of the methods to selected subsurface features. In a few instances the pole-multidipole or the bilateral equatorial dipole array were used to investigate inhomogeneities and non-horizontal layering.

To assist the geological interpretation of the resistivity data a sounding was made at the BMR Cloncurry No. 2 bore, 4 km south of the Pymurra traverse.

2. GEOLOGY

The Cloncurry 1:100 000 Sheet area contains outcrops of both Precambrian and Mesozoic rocks. The Precambrian rocks crop out in the west and form an undulating sequence of steeply dipping beds of undifferentiated metamorphics, volcanics, and indurated sediments. The Mesozoic rocks crop out in the east of the Sheet area, and are flat-lying sediments of the Eromanga Basin. The Mesozoic sediments rest unconformably on the Precambrian basement and are covered by a thin Cainozoic layer. The Precambrian geology is described by Glikson & Derrick (1970) and the Mesozoic and Cainozoic geology by Grimes (1972). Results of drilling in the area are described by Grimes & Smart (1970).

In the Pymurra area the Mesozoic sediments lap onto Precambrian outcrop and thicken rapidly to the east. In the Arrolla area the Mesozoic sediments are up to 200 m thick.

The Mesozoic sediments are mainly mudstone, shale, and siltstone of the Wallumbilla Formation which is part of the Lower Cretaceous Rolling Downs Group. In the Pymurra area the Wallumbilla Formation rests directly on Precambrian basement. In the Arrolla area the Wallumbilla Formation rests on Jurassic/Cretaceous sandstone of the Gilbert River Formation, which rests unconformably on the Precambrian basement. Toolebuc Limestone of the Rolling Downs Group overlies the Wallumbilla Formation in the Arrolla area.

3. METHOD

The current (I) flowing into the ground through one pair of electrodes is related to the potential difference (ΔV) between another pair of electrodes on the ground by a factor known as apparent resistivity (ρa).

Apparent resistivity is defined by the equation

$$\rho a = G\Delta V/I$$

where G is a "geometric factor" which depends on the position of the current and potential electrodes. In a homogeneous earth, apparent resistivity is the same as true resistivity and remains constant as G is varied. However, in a non-homogeneous earth, apparent resistivity will change as G is varied. In some cases the change in apparent resistivity with G can be used to interpret the resistivity and geometry of rocks beneath the surface.

Electrode configuration

The sensitivity of surface resistivity measurements to subsurface structure depends on the magnitude of subsurface contrasts and on the electrode configuration used. The electrode configurations used in this survey are described below and shown diagrammatically in Plate 2.

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Schlumberger array. This array consists of four electrodes in line and can be used for both horizontal profiling and depth-sounding. The potential electrodes (M and N, Plate 2) are placed at an equal distance on either side of the midpoint between the current electrodes (A and B, Plate 2) and have a separation of 1/5 or less of the current-electrode separation.

When used for horizontal profiling, the array geometry remains constant and the midpoint of the array is moved along a traverse at station intervals of usually less than AB/2.

When the array is used for depth-sounding the current dipole AB is progressively increased but the potential electrodes remain stationary for several successive increases in the current-electrode spacing. The stationary potential dipole makes the Schlumberger array relatively less sensitive to near-surface inhomogeneities than say the Wenner array and improves the definition of deeper structures.

Equatorial dipole array. This is a depth-sounding technique in which the potential and current dipoles are parallel. The potential electrodes are placed at right angles to the perpendicular bisector of the current dipole. A depth-sounding is made by increasing the spacing between the potential dipole and the stationary current dipole. This array has the ability to resolve smaller angles of dip than the Schlumberger array and is simpler to use for deep soundings as shorter cable lengths are required. The dipole lengths are generally less than 1/5 of the spacing between the centres of the potential and current dipoles. The equatorial dipole array is widely used in deep structural investigations. A bilateral equatorial dipole sounding measures the apparent resistivities on both sides of the current dipole, as shown in Plate 2.

As discussed by Al'pin (1966) the distance AB/2 for the Schlumberger array is equivalent to R for the equatorial dipole array and the results of an equatorial dipole array survey are equivalent to a Schlumberger array survey over the same ground provided the ground is horizontally stratified and laterally homogeneous.

If the resistivity contrasts are not horizontal the two sets of results obtained from the bilateral equatorial dipole array will not be equal (Berdichevskii & Zagarmistr, 1966).

Pole-multidipole array (PMD). This is a depth-sounding technique which gives multiple coverage of subsurface resistivity distributions. The electrode configuration consists of a single mobile current electrode which is moved away from a set of stationary potential electrodes. A remote current electrode is offset from the centre of the potential electrode spread. This array minimises the influence of local near-surface effects and can be shown to provide similar results to those of the Schlumberger array if the ground is horizontally layered.

Instrumentation

A 3.2-kW, frequency domain, Austral IP transmitter was used as the source of a 0.1-Hz square current pulse. A Fluke high-impedance voltmeter and a Hewlett Packard 7100 BM chart recorder were used to measure and record potentials.

At large current-electrode spacings where the potentials were of the order of microvolts and degraded by telluric noise, the measured potentials were amplified and recorded on the chart recorder, and the signal was averaged over several periods. S-P voltages were cancelled with a bucking circuit across the input terminals of the voltmeter and a zero-adjustment on the chart recorder.

For operational convenience both transmitting and recording systems were mounted in vehicles. This proved particularly efficient during profiling operations, where even in rough terrain 3 to 4 km of traverse could be surveyed each day.

Interpretation

The vertical electrical-sounding (VES) results were interpreted by partial curve-matching techniques, and complete curve-matching using computer-generated theoretical curves.

4. SURVEY DETAILS

Depth-sounding, BMR Cloncurry No. 2

A Schlumberger depth sounding was carried out near the stratigraphic drill hole BMR Cloncurry No. 2. The objective was to assist the interpretation of depth-soundings in both the Arrolla and Pymurra areas by correlating lithologies shown in the geological log of the drill hole with the geo-electric layers interpreted from the depth-sounding.

Pymurra area surveys

Surveys in the Pymurra area (Plate 1) consisted of resistivity-profiling along lines N-00-S and a parallel line 100 m to the south (100 S) To assist in the planning and interpretation of the profiling traverses, depth-soundings were made at stations along the N-00-S traverse.

Traverse N-00-S extended from Precambrian outcrop to an area of thick Mesozoic cover and was intended to investigate the depth to which lateral variation in resistivity could be traced beneath the sedimentary rocks. Previous resistivity depth-soundings in the area (Sampath & Ogilvy, 1974) indicate that the overlying Mesozoic sediments are flat-lying and laterally homogeneous.

Depth-soundings line N-00-S. Schlumberger soundings were made along this traverse at 4000W/00N, 2000W/00N, 00E/00N, 1500E/00N, and 3000E/00N to determine the depth to the Precambrian basement. The soundings were orientated north-south and parallel to the assumed strike of the Precambrian rocks. It was generally possible to expand these arrays to an AB/2 spacing of 1000 m.

Bilateral equatorial dipole soundings were made at stations 2000W/00N, 1000W/00N, 00E/00N, and 3000E/00N to determine the dip of the basement. These arrays were expanded east-west and an R spacing of 1700 m was achieved without difficulty.

One pole-multidipole sounding was made at station 1500E/00N to provide information on the effects of near-surface inhomogeneities. This array was expanded north-south.

Resistivity-profiling line N-00-S. Resistivity-profiling measurements were made at 100 m intervals along traverse N-00-S from 8000 W to 3000 E (Plate 1).

From 8000 W to 2000 W the traverse was mainly over Precambrian outcrop, and both Schlumberger and equatorial dipole arrays were used to permit a comparison of the response of the two arrays to inhomogeneities. The Schlumberger array was used exclusively east of 2000 W where the thickness of the Mesozoic sediments is up to 100 m.

The electrode spacings used depended on the depth of cover. Schlumberger array spacing varied from AB/2 = 50 m on the Precambrian outcrop to AB/2 = 300 m over the Mesozoic sediments.

Two values of apparent resistivity were obtained at each station using two different current-electrode separations. This procedure indicates whether changes in apparent resistivity are the result of near-surface inhomogeneities.

Resistivity-profiling line 100 S. To assist the delineation of surface and lateral effects a second profiling traverse was made along 100 S from 8000 W to 4000 W. Only the Schlumberger array was used on this traverse.

Arrolla area surveys

In the Arrolla area, four resistivity-soundings were made along an east-west line, as shown in Plate 1. These soundings were made to investigate the ability of the resistivity method to map resistivity changes in the Precambrian basement rocks under more than 200 m of Mesozoic sediment.

The soundings were orientated north-south, and, to minimise the effects of near-surface lateral sensitivity changes, combined Schlumberger/equatorial dipole soundings were used. The Schlumberger array was used for the small separations up to AB/2 = 768 m. The equatorial dipole array was used for spacings greater than 1 km since surface variations at these large separations are less significant and the dipole method is operationally more advantageous.

5. RESULTS

Electrical-sounding, BMR Cloncurry No. 2

The Schlumberger depth-sounding at the stratigraphic drill hole BMR Cloncurry No. 2 did not provide the control necessary for reliable regional interpretation of the resistivity data in the Pymurra and Arrolla areas, particularly as the low-resistivity layer evident on the Pymurra traverse was not observed.

The sounding is shown in Plate 3 and has the appearance of a simple three-layer curve. However, if interpreted on this basis, it is not possible to produce a geo-electric section which correlates well with the geological log.

Theoretical curves computed for the fixed boundaries as indicated in the geological log could not be matched satisfactorily to the observed data; only the boundary between Cainozoic and Mesozoic rocks has apparently been defined by the sounding. Presumably the remainder of the geological column has a fairly uniform resistivity. In particular, note that there is no apparent resistivity contrast between the Mesozoic sediments and the Precambrian basement rocks intersected at a depth of 38 m.

Electrical-soundings, Pymurra area

4000 W/00N. This sounding was made over outcropping Precambrian slates and indicates a fairly uniform resistivity of 25 ohm-m. The downturn in resistivity values evident in the terminal branch of the resistivity curve may mean that beds of lower resistivity are present and have been sampled by the larger expansions; alternatively it may reflect the influence of saline groundwater within the bedrock. A terminal decrease in resistivity occurs in several of the depth-sounding curves in the Pymurra area, but is observed only where the depth of sampling has greatly exceeded a realistic depth to the boundary between Precambrian and overlying rocks. Accordingly where a resistivity boundary was interpreted consistent with the assumed depth to the Precambrian bedrock surface, further variations in the sounding curve have been excluded from quantitative interpretation.

2000 W/00N. This sounding was made in an area of Cainozoic cover overlying Mesozoic sediments. The Schlumberger depth-sounding indicates a three-layer geo-electric section as shown in Plate 4. The top layer can be attributed to the Cainozoic cover of sand and gravel. The second layer is interpreted to represent Mesozoic sandstone/mudstone, the high conductivity being attributed to the salinity of the groundwater. The resistivity value of 26.4 ohm-m assigned to Precambrian bedrock is similar to the value of 25 ohm-m obtained at 4000 W over Precambrian slate, and implies the presence of a similar rock type beneath 2000 W.

A bilateral equatorial dipole sounding at 2000 W (Plate 4) exhibits a pronounced divergence of the right-hand portions of the sounding curves obtained for R expanded west and east, and indicates a deepening to the Precambrian bedrock towards the east. The absence of a highly resistive bedrock precludes any estimation of dip or quantitative analysis of the individual curves. Interpretation of the averaged sounding curve, however, shows good agreement with that obtained from the Schlumberger sounding and illustrates the theoretical equivalence of the two methods.

1000 W/00N. The bilateral equatorial dipole sounding curves at this station were averaged and interpreted to give a three-layer geo-electric section as shown in Plate 5. The depth to Precambrian bedrock was interpreted to be 20.7 m. An easterly dip is inferred from this sounding.

00/00N. The Schlumberger sounding at this station was not readily interpreted in terms of horizontal layers owing to several marked distortions in the curve (Plate 6). The curve shows sharp discontinuities between AB/2 = 32 m and 48 m, and between AB/2 = 276 m and 384 m. However, the bilateral equatorial dipole sounding expanded east-west was relatively free of marked lateral effects and the averaged curve was interpreted to be caused by the four-layer geo-electric section shown in Plate 6. This interpretation indicates a depth of 58.9 m to Precambrian bedrock. The individual dipole curves are nearly identical, indicating that near 00 the Mesozoic sediments and the surface of the Precambrian basement are essentially flat-lying.

1500 E/00N. The Schlumberger depth-sounding at this station gave a satisfactory computer curve-match for a three-layer geo-electric section (Plate 7). However, the pole-multidipole (PMD) sounding data show considerable scatter in resistivity values obtained for individual dipole measurements and illustrate the many sources of apparent resistivity change which can lead to an erroneous interpretation. Interpretation of the PMD sounding gave a geo-electric section similar to that derived from the Schlumberger sounding. During the field operations it became evident that although the PMD array had certain interpretational advantages over the Schlumberger array the additional data acquired did not justify the extra time involved in its collection.

3000 E/00N. The Schlumberger sounding at this station indicates a four-layer geo-electric section as shown in Plate 8. The resistive first and second layers are tentatively interpreted as Cainozoic sand and gravel beds. The conductive third layer is interpreted as Mesozoic sandstone/mudstone containing saline groundwater. However the boundary between the second and third layers may be related to the water-table rather than to a distinct change in rock type. The fourth layer is probably Precambrian bedrock.

A similar curve was obtained from a single equatorial dipole sounding expanded west. However, the terminal branch of the field curve (Plate 8) rises at a steeper angle than the corresponding Schlumberger sounding curve, suggesting an easterly dip for the Precambrian bedrock surface. For this reason the interpretation of the equatorial dipole sounding differs from that of the Schlumberger sounding curve.

East-West geo-electric section, Pymurra area

The interpretation of the resistivity layering obtained from the electrical soundings along traverse N-00-S are combined in Plate 9 to show an east-west section along this traverse. With the exception of near surface variations in resistivity caused by the variable nature of the Cainozoic cover, the section shows a fair uniformity in the resistivity values of the Mesozoic sediments and the Precambrian bedrock. As expected the section shows a deepening of the Precambrian bedrock surface towards the east.

With the possible exception of the area around station 00, there do not appear to be any major structural or lateral inhomogeneities within the sedimentary cover that would adversely affect detailed exploration of the Precambrian bedrock. However, the rapid increase in total conductance of the Mesozoic sediments can be expected to limit effectively any attempt to detect lateral variations in resistivity at depth.

Resistivity-profiling, Pymurra area

The results of resistivity-profiling along traverses N-00-S and 100 S are shown in Plate 10. The geological section along traverse N-00-S is also shown in this plate and indicates that Precambrian rocks outcropping from 8000 W to 3000 W consist mainly of slate, with subordinate volcanics and amphibolite.

The Schlumberger profile from 8000 W to 3000 W is characterised by an apparent resistivity of 50 to 100 ohm-m, but local apparent resistivity lows occur near 6700 W, 6100 W, 4500 W and 3800W. These resistivity lows do not appear to be due to lateral variation within the Precambrian rocks but are primarily associated with creek beds and alluvial-filled channels. The Schlumberger traverse over Precambrian outcrop along traverse 100 S shows similar features to those observed along N-00-S. Results of the equatorial dipole survey over outcropping Precambrian rocks along traverse N-00-S show more erratic changes in apparent resistivity than was obtained with the Schlumberger array. This comparison indicates the sensitivity of the equatorial dipole array to near-surface effects.

The Schlumberger profiling survey east of 3000 W traversed a gradually increasing thickness of conductive Mesozoic sediments which are reflected in the gradual decrease of apparent resistivity values from around 50 ohm-m at 3000 W to around 15 ohm-m at 3000 E. The increase in apparent resistivity observed when AB/2 is increased from 200 m to 300 m reflects the influence of the high-resistivity Precambrian basement. However, there are no indications of lateral changes in the resistivity of the Precambrian basement. The minor increases in apparent resistivity at 1100 W, 1600 W, and 2100 W are similar in the 200 m and 300 m AB/2 measurements, and therefore are most probably due to near-surface changes in resistivity. It would appear that the masking influences of conductive sediments east of 3000 W would prohibit the detection of all but substantial changes in the resistivity of buried Precambrian rocks. The problem of masking is particularly serious in this area because the profiling results over outcropping Precambrian rocks do not indicate strong resistivity contrasts within the Precambrian rocks.

The problems associated with interpretation of resistivity profiling surveys in this area are further illustrated by the effects of near-surface inhomogeneities which are highlighted by the use of a lateral inhomogeneity index as shown in Plate 10. This index is the ratio of the apparent resistivities measured at two values of AB/2. Where the ground is laterally homogeneous this index will be a smooth line but the presence of shallow lateral inhomogeneities will be shown up by peaks and troughs in the curve. Note that the lateral inhomogeneity profiles are much more erratic for equatorial dipole results then for Schlumberger results. The greater sensitivity of the equatorial dipole array to lateral inhomogeneities is a result of moving the potential electrodes at successive expansions.

Electrical-soundings, Arrolla area

The four soundings along traverse N-00-S were made in an area of thick Cainozoic cover. Bores in the area indicate that the combined thickness of Cainozoic and Mesozoic cover is in excess of 100 m in this area. The geological log obtained from hole R2734, which is located west of the Arrolla traverse, is shown in Plate 14.

00W/00N. The combined Schlumberger/equatorial dipole curve obtained at this site was interpreted to indicate a seven-layer geo-electric section (Plate 11). A comparison with the geological log of borehole R2737, 2½ km to the north, suggests that the interpretation can be correlated with the main units of the Mesozoic sediments in this area. The interpretation indicates a substantial thickness of Cainozoic alluvium. The Mesozoic Wallumbilla Formation is reflected by a layer of 35 ohm-m from 14.6 to 115 m. Toolebuc Limestone, which in some localities is known to occur above the Wallumbilla Formation, is not evident in the depth-sounding data at this site. The conductive sixth layer from 115 m to 181 m may be attributed to sandstone of the Gilbert River Formation; its high conductivity is presumably due to saturation by saline groundwater.

The Precambrian basement was detected by equatorial dipole measurements expanded to the west of 00 and showing a steep rise in the terminal branch of the sounding curve. Limited access prevented equatorial dipole expansions to the east of 00, and averaged dipole values could not be used for the final computer curve match. Hence the interpreted depth and resistivity of the Precambrian basement is questionable.

2000W/00N. A single equatorial dipole and a combined Schlumberger/equatorial dipole depth-soundings were made at 2000 W (Plate 12). Both curves appear to have been influenced by non-horizontal resistivity changes and are therefore not readily interpreted. The equatorial dipole sounding, made by expanding the potential dipole to 1500 m west of 2000 W, shows the presence of a strong lateral heterogeneity from R = 150 to R = 250 m, which indicates that the potential dipole was placed over a structure of high resistivity. Geological inspection shows limy concretions at R = 200 m and suggests the presence of high resistivity Toolebuc Limestone immediately beneath the black soil cover. Alternatively a fault may be responsible for the lateral change in resistivity.

The influences of near-surface inhomogeneities are minimised in the combined Schlumberger/equatorial dipole sounding. Although no obvious discontinuities occur in the Schlumberger sounding curve the high apparent resistivity at AB/2 = 96 m is followed by a sharp fall at the next electrode spacing. This may again reflect the influence of a fault zone or a shallow high-resistivity layer of limited lateral extent.

To obtain some idea of the subsurface resistivity distribution a computer curve was matched to the undisturbed sections of the sounding curves. The Schlumberger sounding indicates a six-layer geo-electric section and the equatorial dipole sounding a similar but four-layer geo-electric section. A greater uncertainty exists in the latter interpretation owing to obvious distortions in the sounding curve and the sensitivity of a single equatorial dipole expansion to dipping boundaries.

The simplest interpretation of the combined Schlumberger/equatorial dipole sounding curve suggests that the asymtotic rise in resistivity values for electrode spacings 5 m to 100 m is due to a single lithological unit. However, this section of the curve was given a two-layer structure because of the geological evidence for a near-surface limestone layer of high resistivity. The influence of a highly-conductive layer is clearly observed on both sounding curves for electrode spacings greater than 96 m. Owing to the influence of non-horizontal geological structures, the interpretations for these sections of the curve are less reliable than the interpretations for smaller electrode spacings. In particular the depths to the top of the highly conductive layer were interpreted to be 31 m and 26.5 m for the two soundings. If this layer is sandstone of the Gilbert River Formation, then the interpreted depth is at variance with the depths inferred from other soundings in the Arrolla area. It seems more probable that the sounding curves beyond AB/2, R = 96 m reflect a complex geological situation and are not amenable to interpretation by idealised horizontal layers. Neither sounding curve shows the presence of a high-resistivity Precambrian basement, although electrode spacings were expanded to 1500 m either side of 2000 W.

4000W/00N. The Schlumberger/equatorial dipole sounding curve obtained at 4000 W (Plate 13) has the appearance of a five-layer type curve. However, like the sounding at 2000 W this curve has been interpreted in terms of a six-layer geo-electric section to accommodate a high-resistivity Toolebuc Limestone layer. A good computer curve match was obtained, and the interpreted structure of the Mesozoic sediments agrees well with that obtained at site 00. The sounding curve at 4000 W indicates the presence of a high-resistivity basement at a depth of 165.5 m, which is consistent with a depth of 152.5 m to Precambrian volcanics observed in borehole R2734 - 4 km to the west.

6000W/00N. The Schlumberger/equatorial dipole sounding at site 6000 W is very similar to that obtained at site 4000 W and was also interpreted as a six-layer geo-electric section with a high-resistivity near-surface layer (Plate 13). The interpreted depth of 167 m to Precambrian basement agrees well with the depth of 165.5 interpreted at 4000 W and the depth of 152.5 m to basement in hole R2734.

East-west geo-electric section, Arrolla area

A geo-electric section based on the results of the four depth soundings along the Arrolla traverse is shown in Plate 14, along with the geological log of drill hole R2734, which is projected onto the line of the cross-section.

The interpreted section shows a reasonable correlation with the principal lithological units of the Mesozoic sediments in the Arrolla area, but the Toolebuc Limestone appears to be absent east of 2000 W. The Cainozoic cover varies in thickness over the length of the 6 km traverse. The interpreted section indicates that the Precambrian basement is flat-lying, but a fault is indicated near site 2000 W.

The sandstone of the Gilbert River Formation appears to be the most distinctive electrical unit owing to its low resistivity of less than 1 ohm-m. The resistivity of the Cainozoic cover is usually less than 50 ohm-m, and the resistivity of the Wallumbilla Formation is fairly constant at between 30 to 40 ohm-m. The Toolebuc Limestone appears to have a resistivity of around 100 to 150 ohm-m and the Precambrian basement appears to have a resistivity of greater than 200 ohm-m.

Although some changes in the resistivity of the basement rocks are indicated, the effects of screening and lateral inhomogeneity would prevent the mapping of basement resistivity by profiling methods in this area.

6. CONCLUSIONS

In the Pymurra area, resistivity profiling and sounding surveys did not detect any significant lateral variation in the resistivity of the Precambrian basement. However, resistivity depth-soundings provided reliable information on the depth to Precambrian basement and the geo-electric properties of the overlying Mesozoic sediments. Similar information on the Precambrian basement and Mesozoic sediments was provided by resistivity-soundings in the Arrolla area.

The low resistivity of the Mesozoic sediments in this area, and the lack of significant contrasts in the resistivity of the Precambrian basement, preclude the use of resistivity-profiling methods to map lateral changes in basement resistivity in this area. Electrical soundings might be used for basement mapping, but the effects of screening, shallow lateral inhomogeneities, and operational complexity would result in an inefficient mapping tool.

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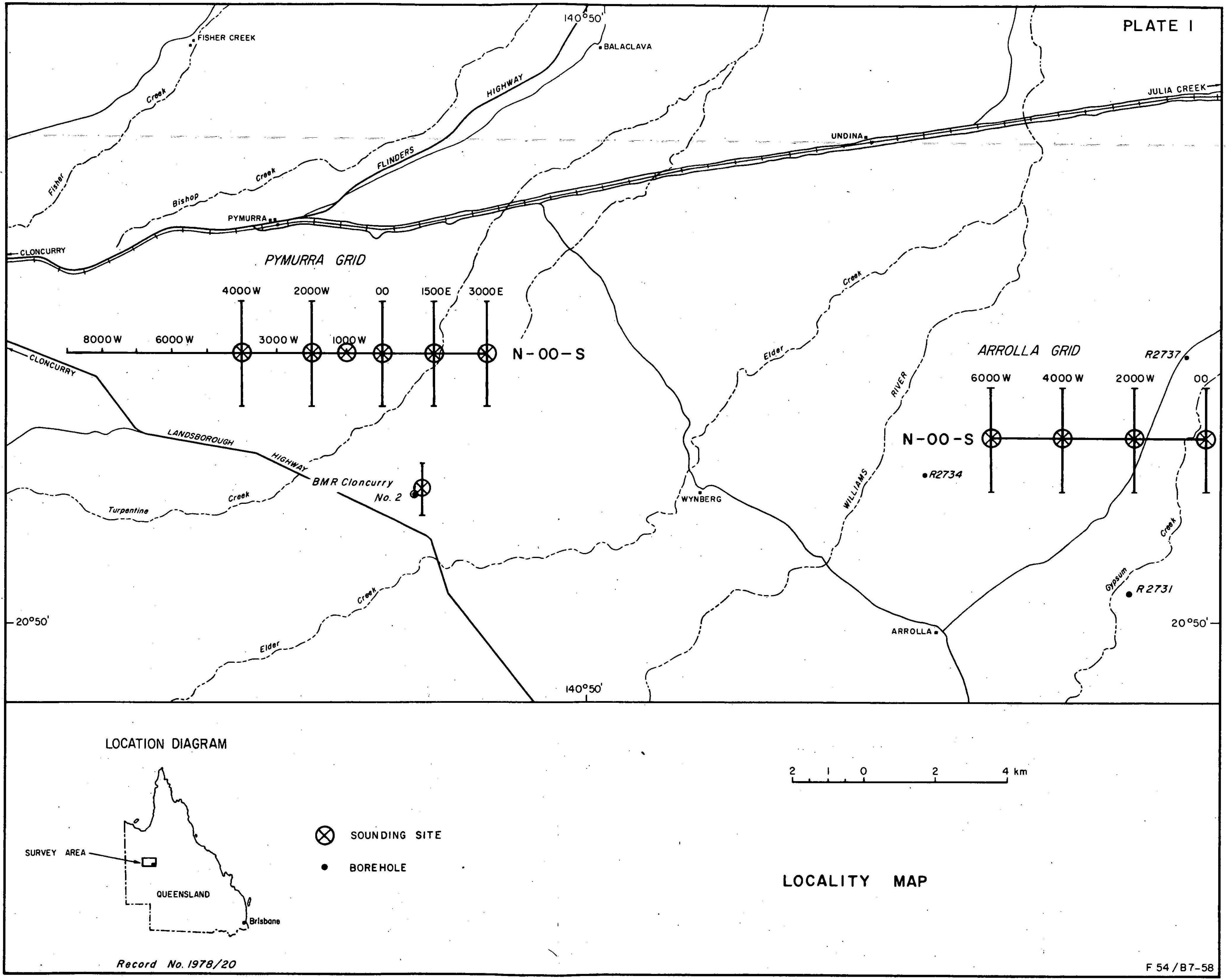
PLATE I

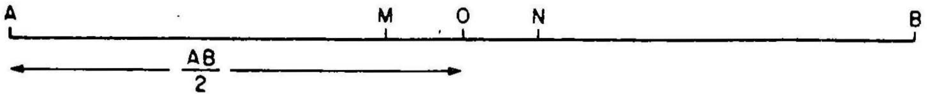


LOCALITY MAP

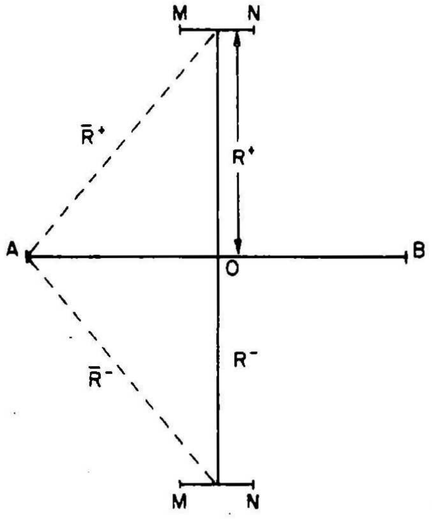
Record No. 1978/20

F 54/B7-58

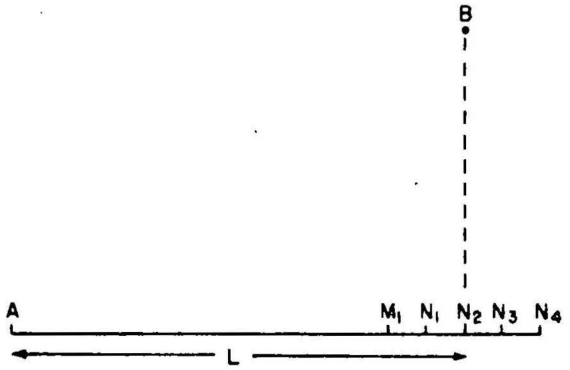
PLATE 2



SCHLUMBERGER ARRAY



BILATERAL EQUATORIAL DIPOLE
ARRAY



POLE — MULTIDIPOLE ARRAY (PMD)

LEGEND

• A B *CURRENT ELECTRODES*

• M N *POTENTIAL ELECTRODES*

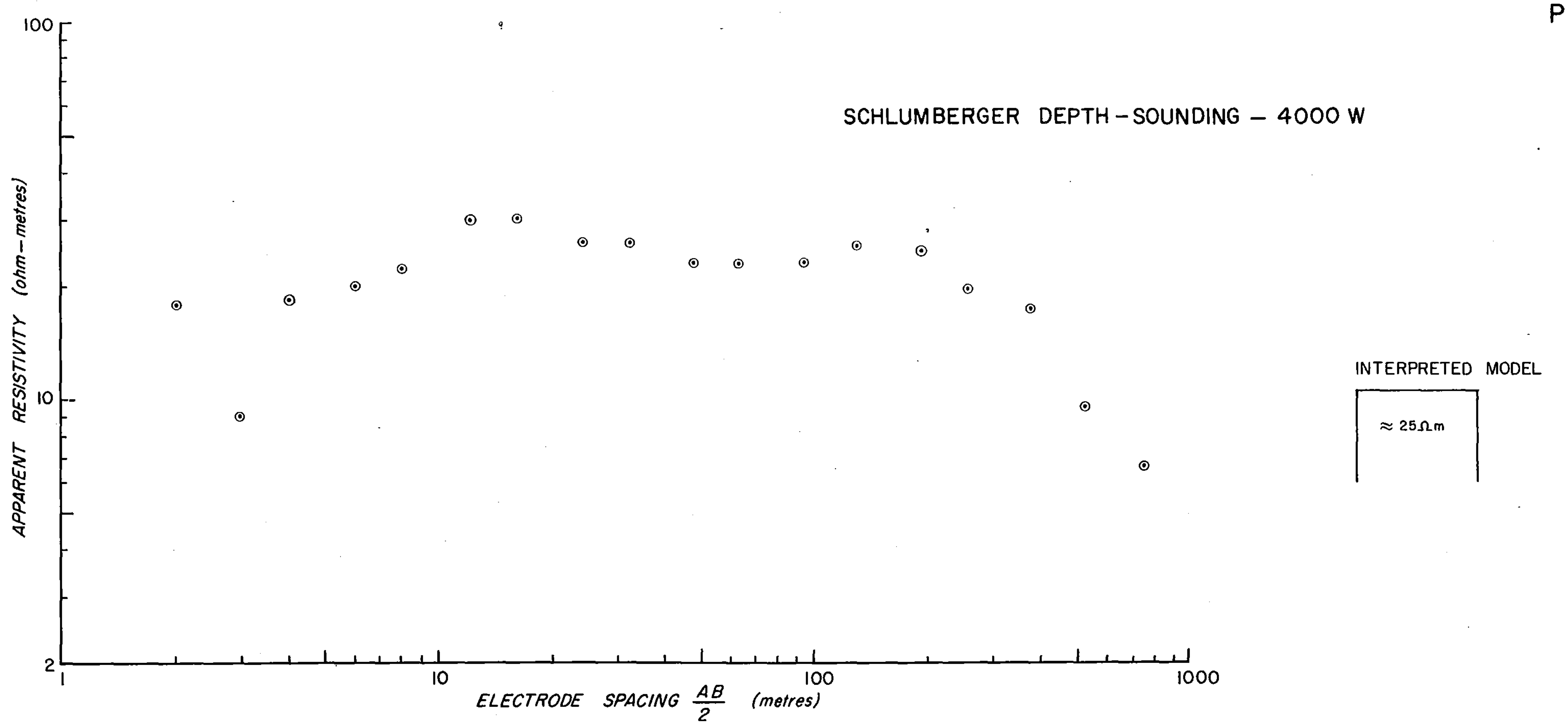
$\bar{R}$ *EFFECTIVE SPACING OF EQUATORIAL ARRAY, WHERE*

$$(\bar{R} = \sqrt{(R^2 + (\frac{\overline{AB}}{2})^2}\ )$$

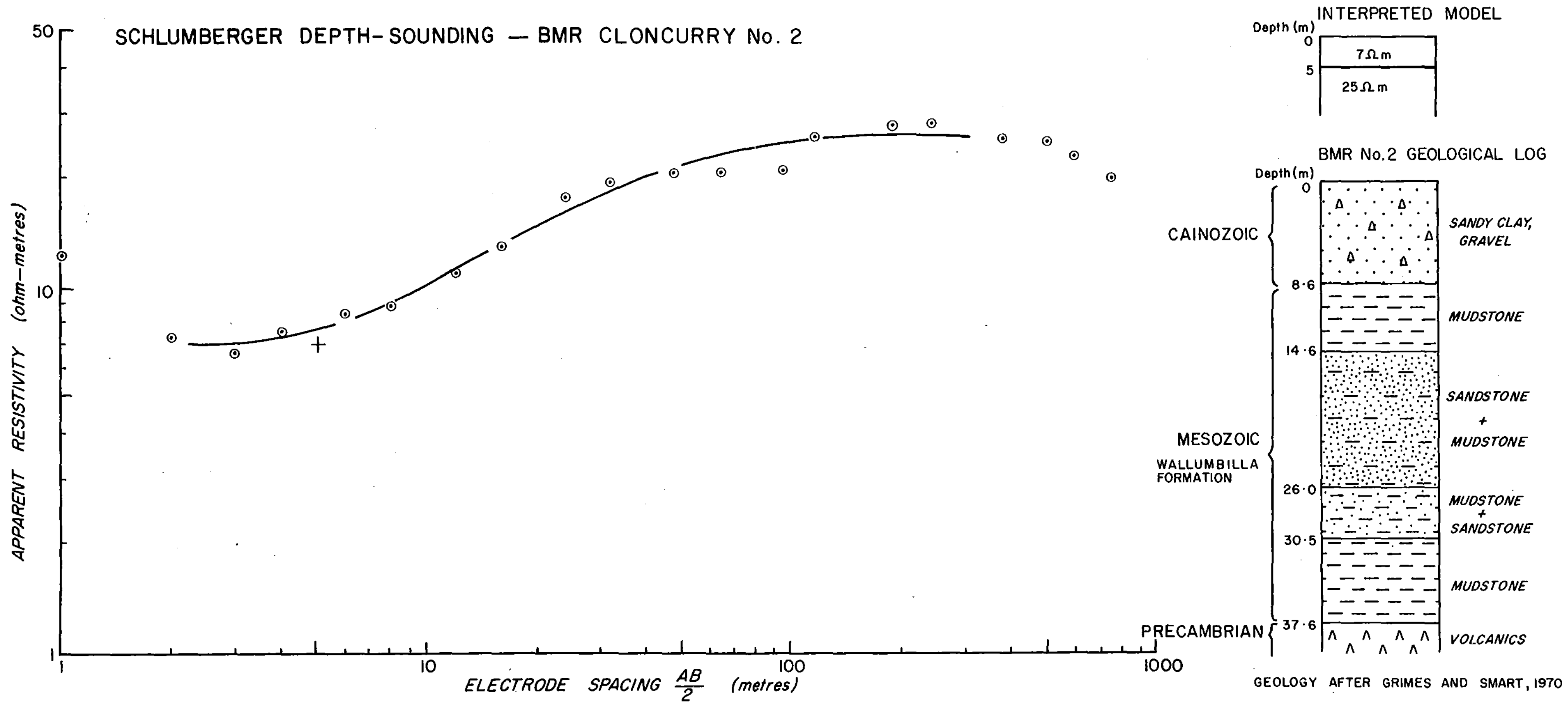
L = *PMD ELECTRODE SPACING*

$\frac{AB}{2}$ = *SCHLUMBERGER ELECTRODE SPACING*

ELECTRODE CONFIGURATIONS: PLAN VIEW



SCHLUMBERGER DEPTH-SOUNDING – 4000 W



SCHLUMBERGER DEPTH-SOUNDING — BMR CLONCURRY No. 2

GEOLOGY AFTER GRIMES AND SMART, 1970

LEGEND

⊙ OBSERVED DATA

— THEORETICAL CURVE

+ ORIGIN OF CURVE

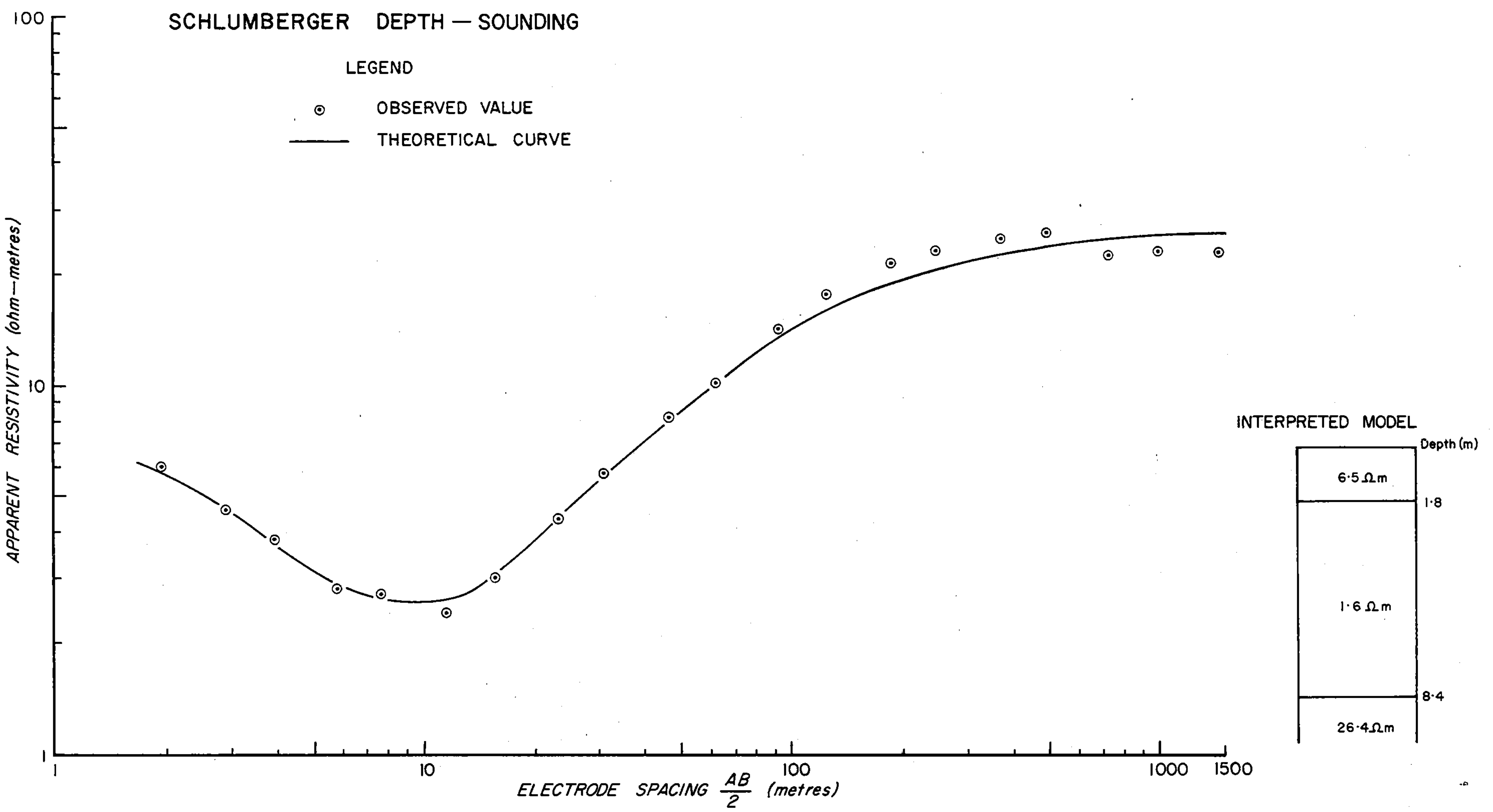
SCHLUMBERGER DEPTH-SOUNDINGS, PYMURRA AREA, 4000W AND BMR CLONCURRY No. 2 DRILL HOLE

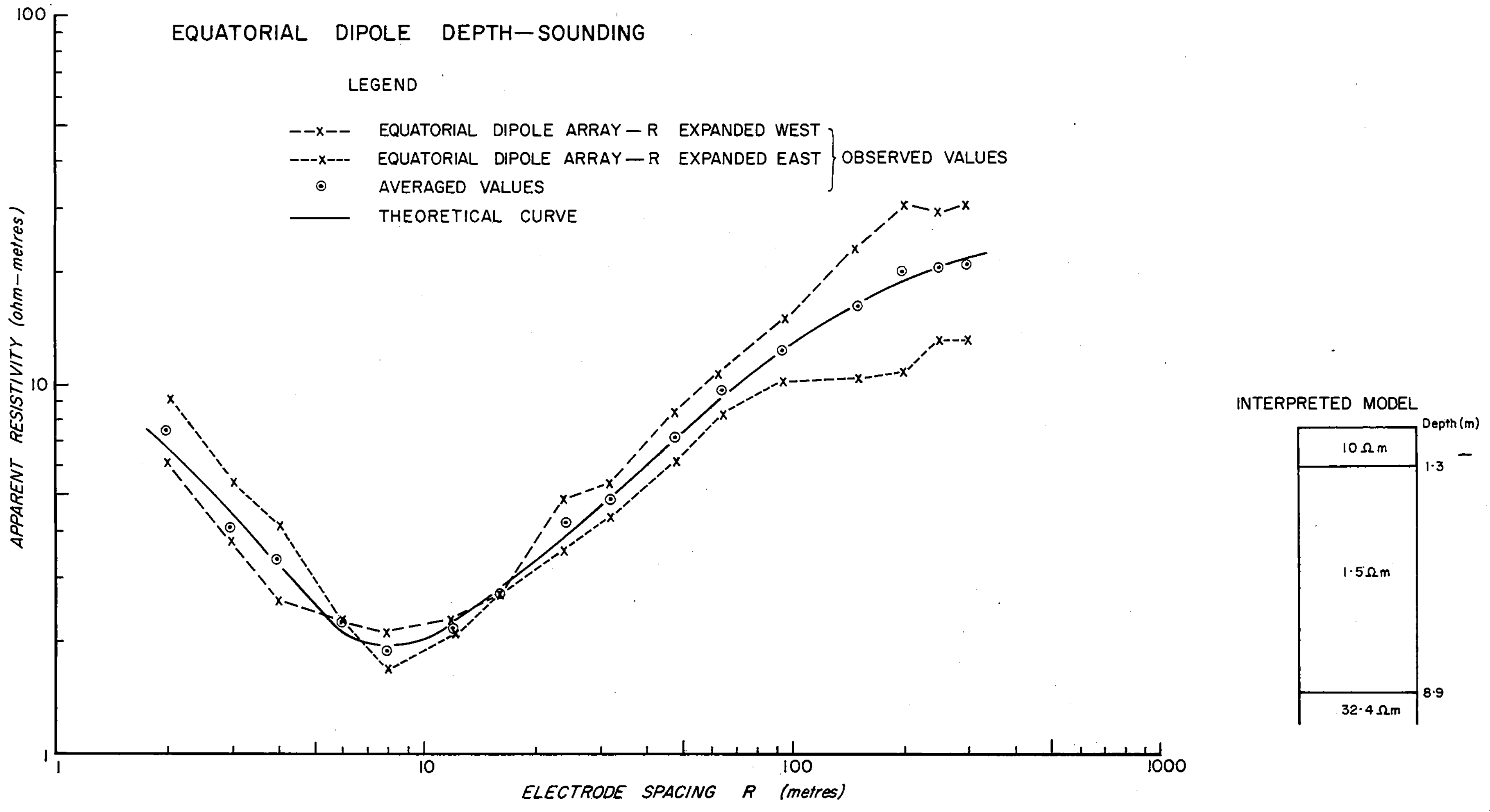
Record No. 1978/20

F54/B7-60

PLATE 4

F54/B7-61



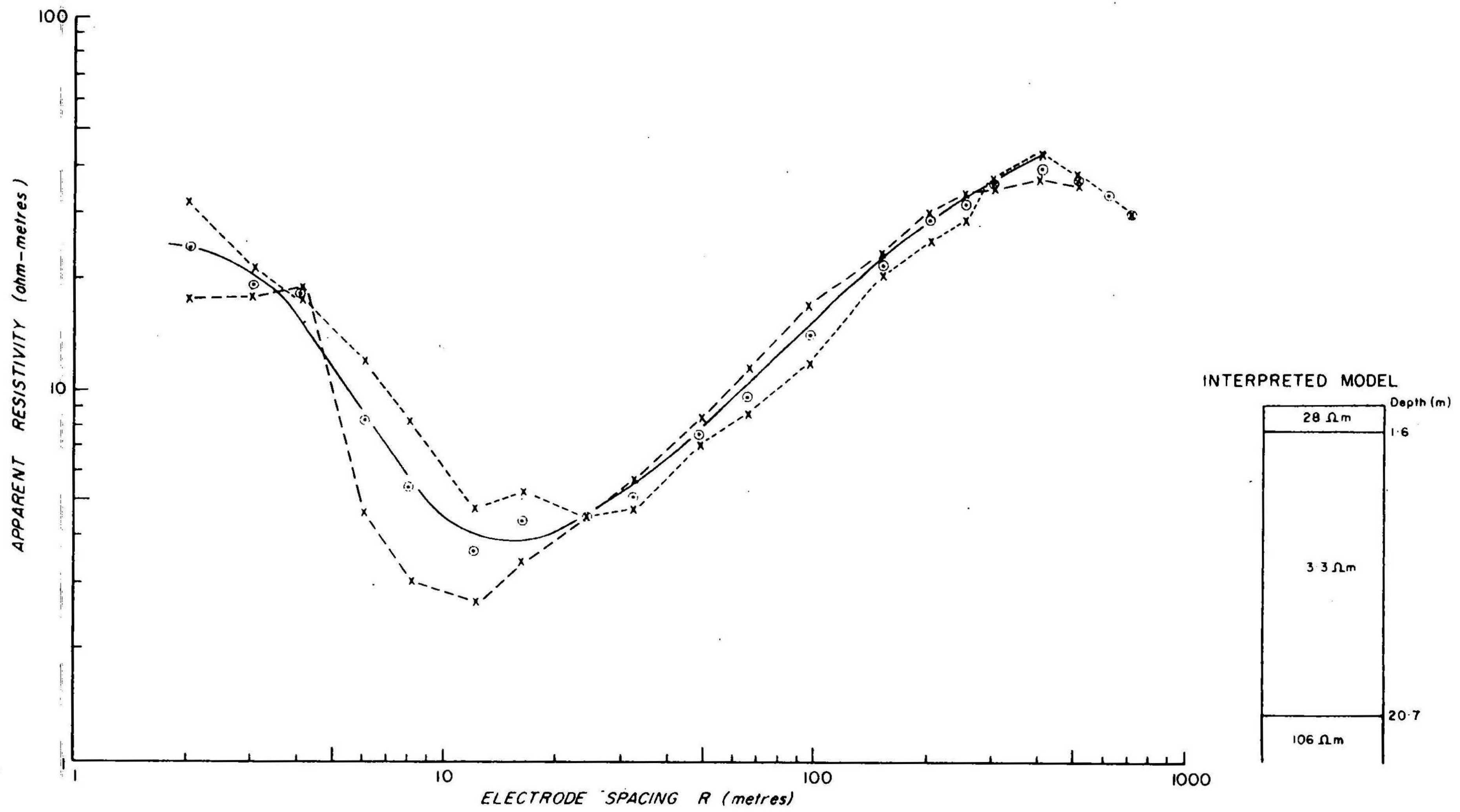


SCHLUMBERGER AND EQUATORIAL
DIPOLE DEPTH-SOUNDINGS,
PYMURRA AREA, 2000 W

Record No. 1978/20

PLATE 5

F54/B7-62A

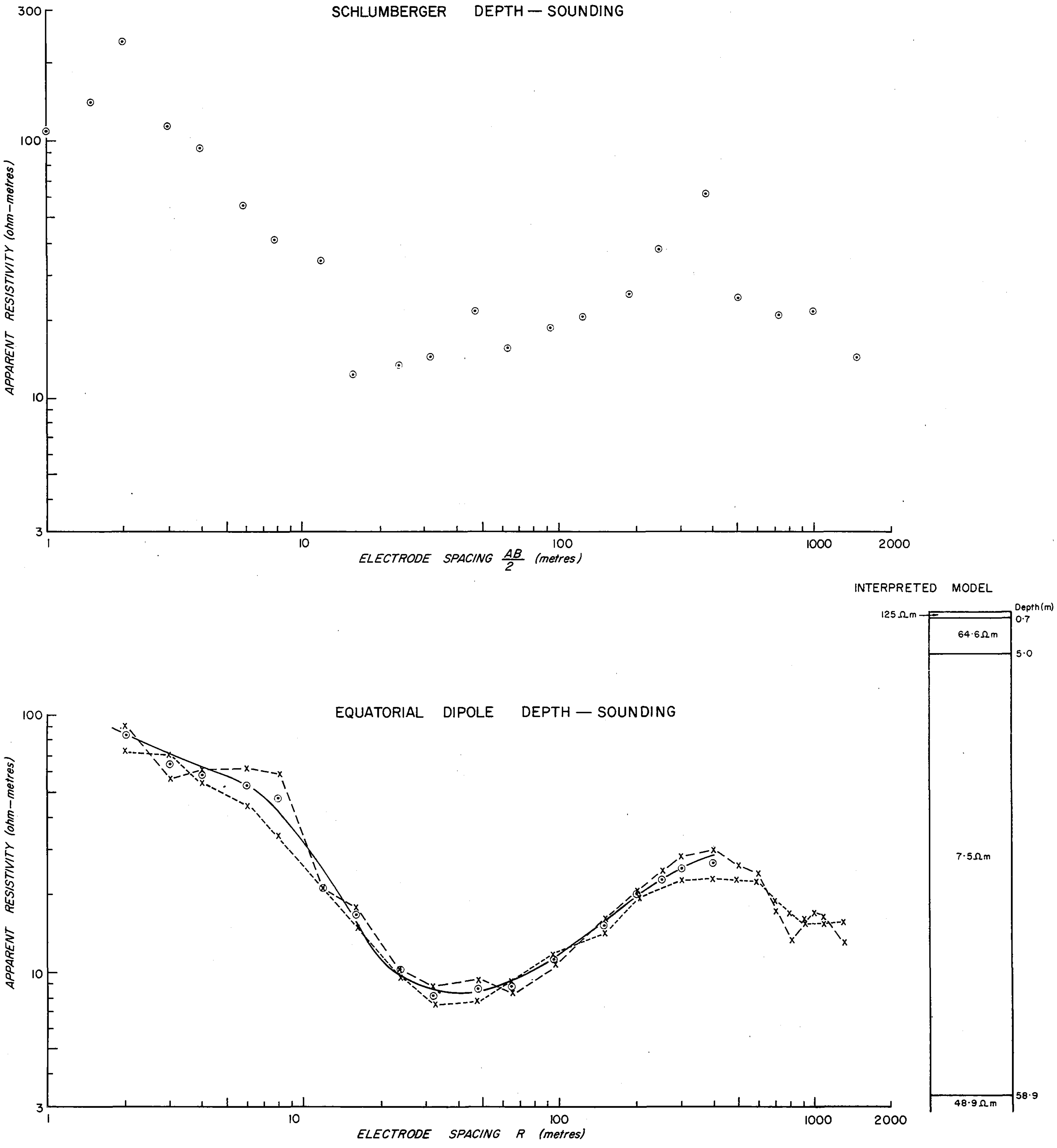


EQUATORIAL DIPOLE DEPTH-SOUNDING,
PYMURRA AREA, 1000 W

Record No.1978/20

PLATE 6

F54/B7-63

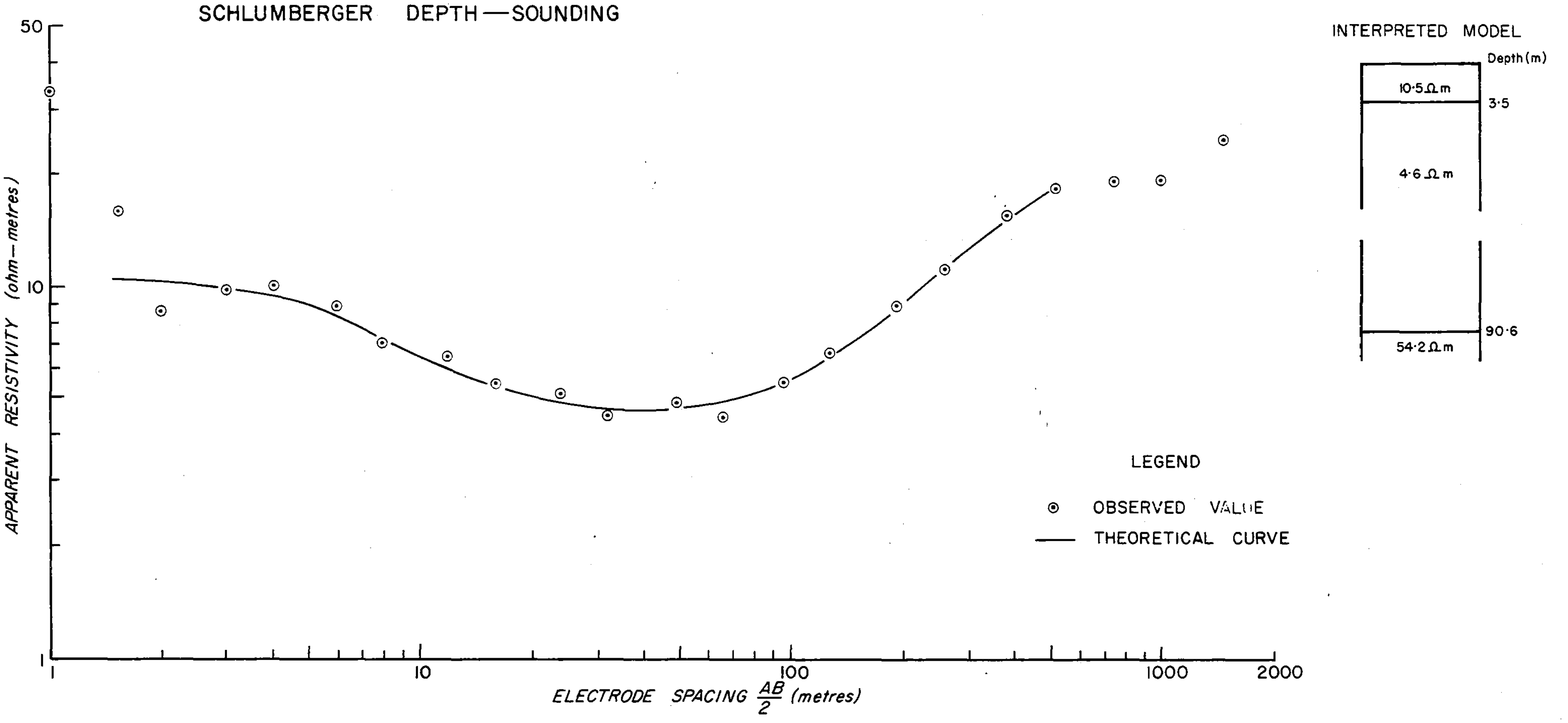


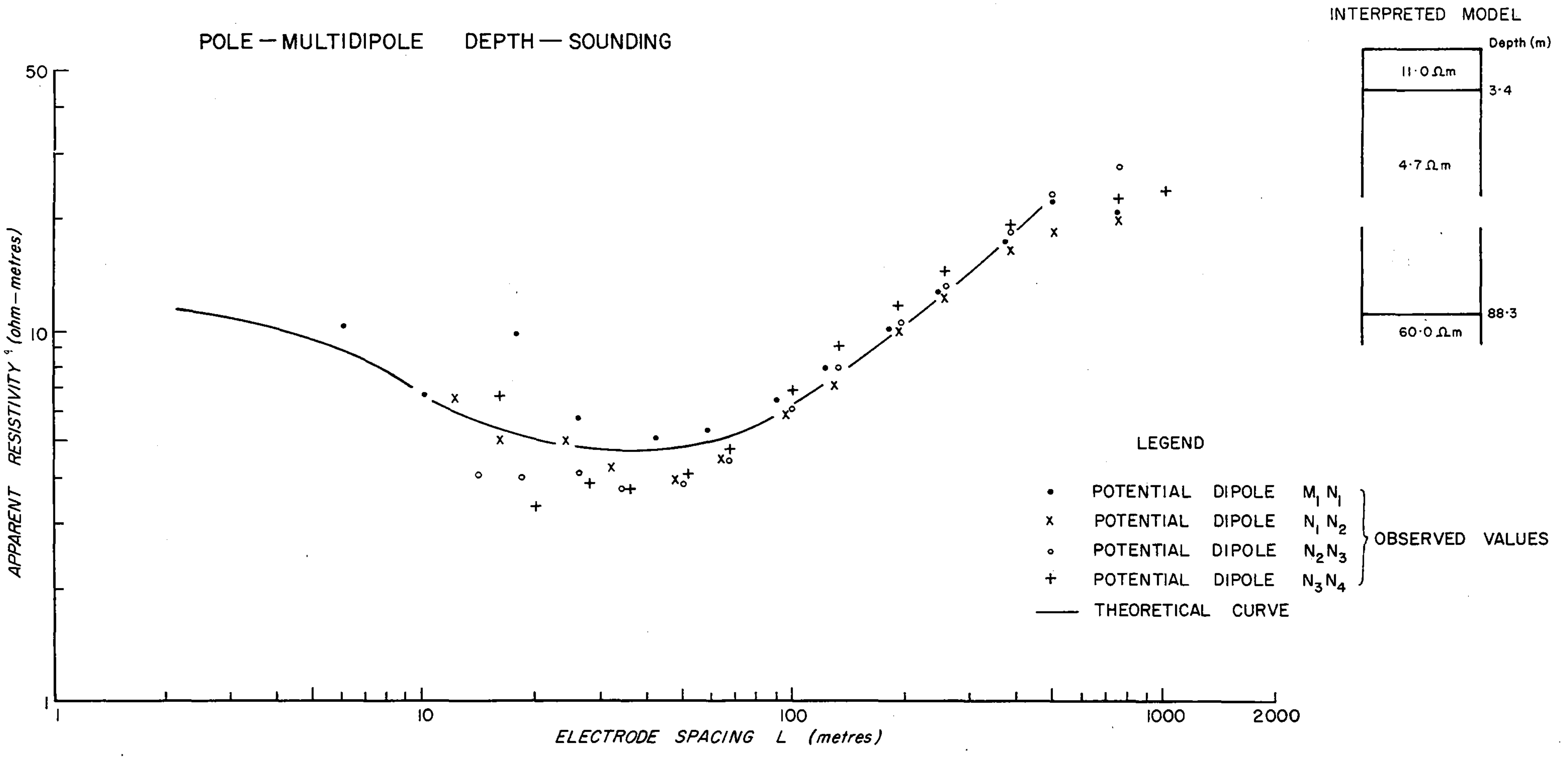
SCHLUMBERGER AND EQUATORIAL DIPOLE DEPTH-SOUNDINGS, PYMURRA AREA, OO

Record No. 1978/20

PLATE 7

F54/B7-64



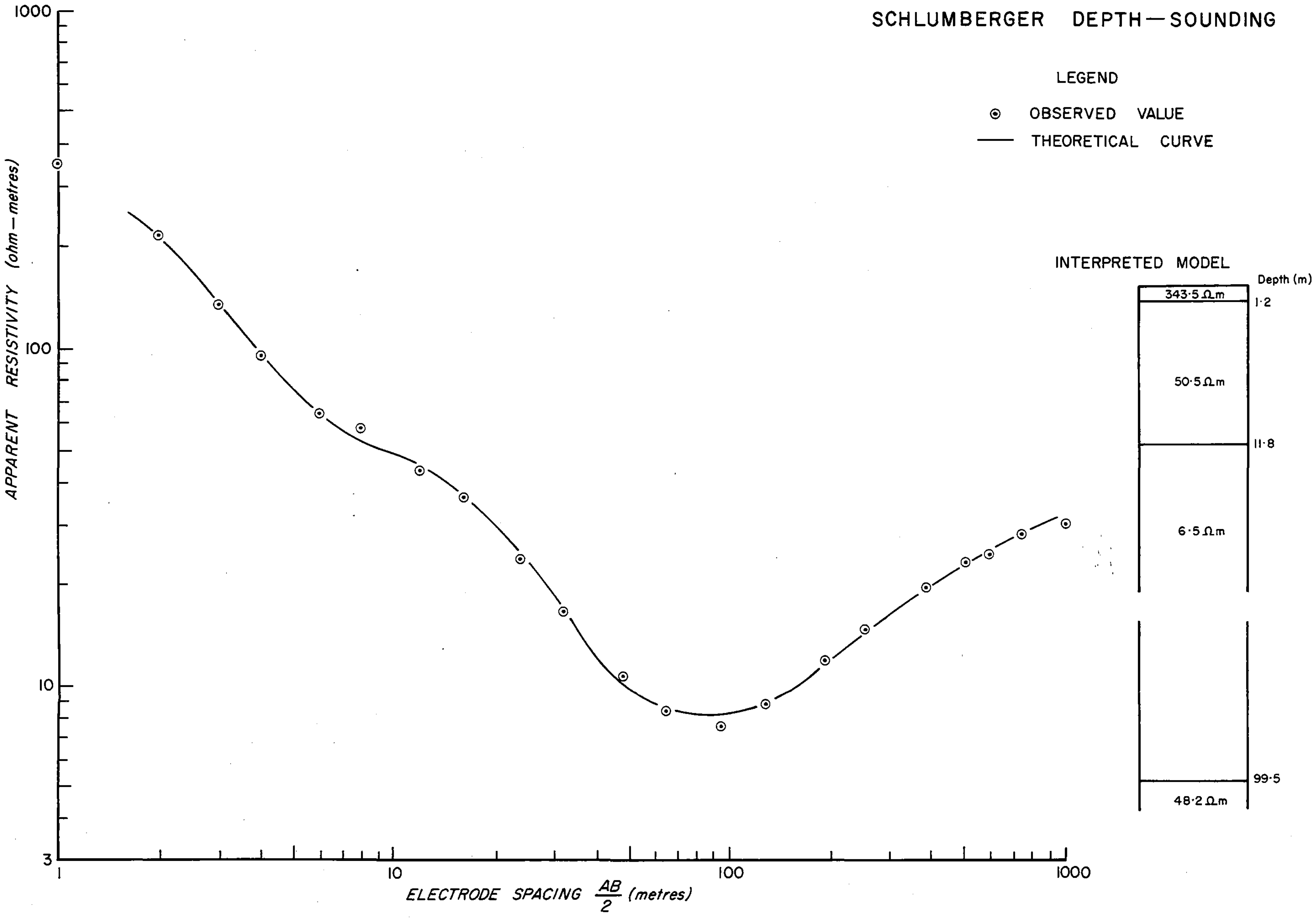


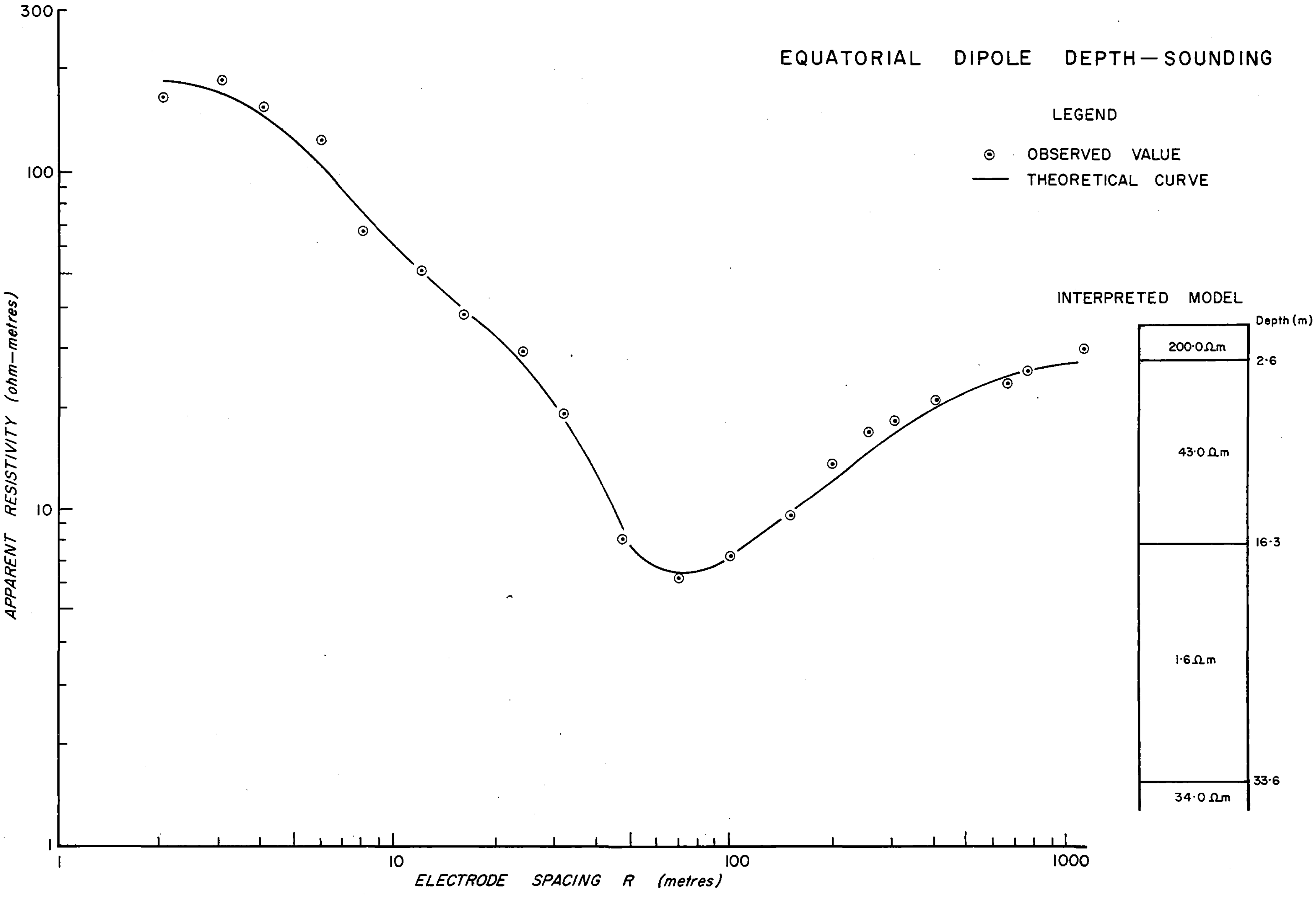
SCHLUBERGER AND POLE- MULTIDIPOLE DEPTH-SOUNDINGS, PYMURRA AREA, 1500 E

Record No. 1978/20

PLATE 8

F 54/B7-65

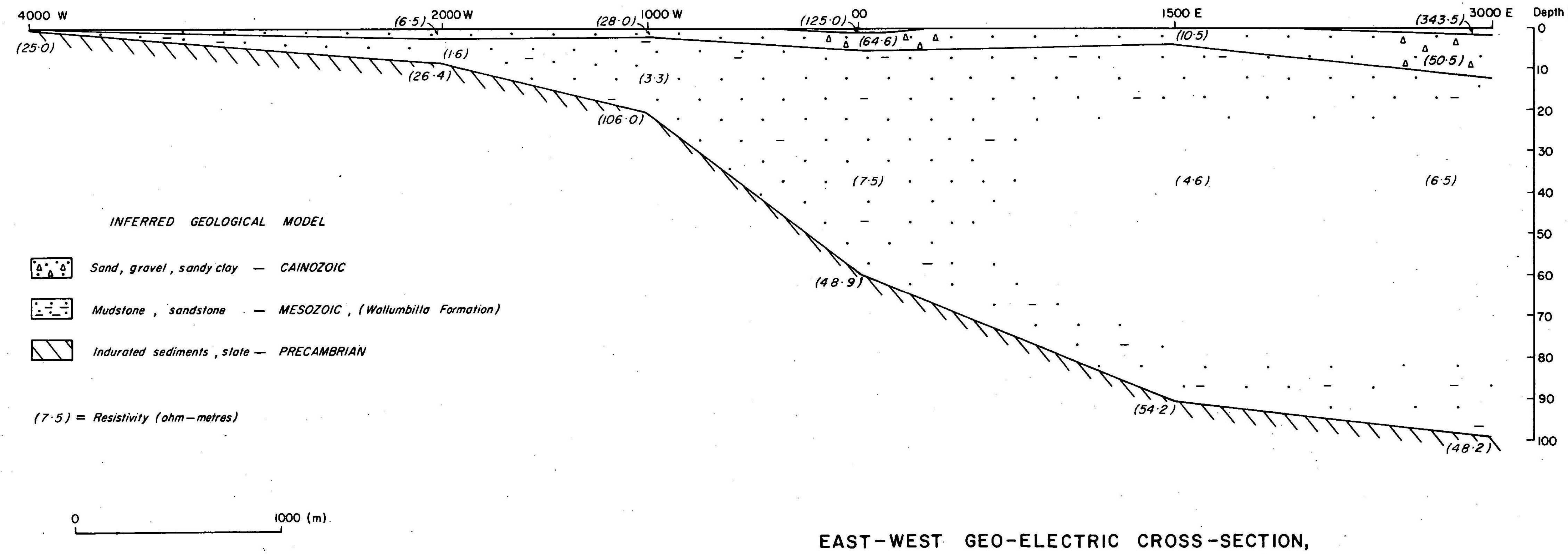




SCHLUMBERGER AND EQUATORIAL
DIPOLE DEPTH-SOUNDINGS,
PYMURRA AREA, 3000 E

Record No.1978/20

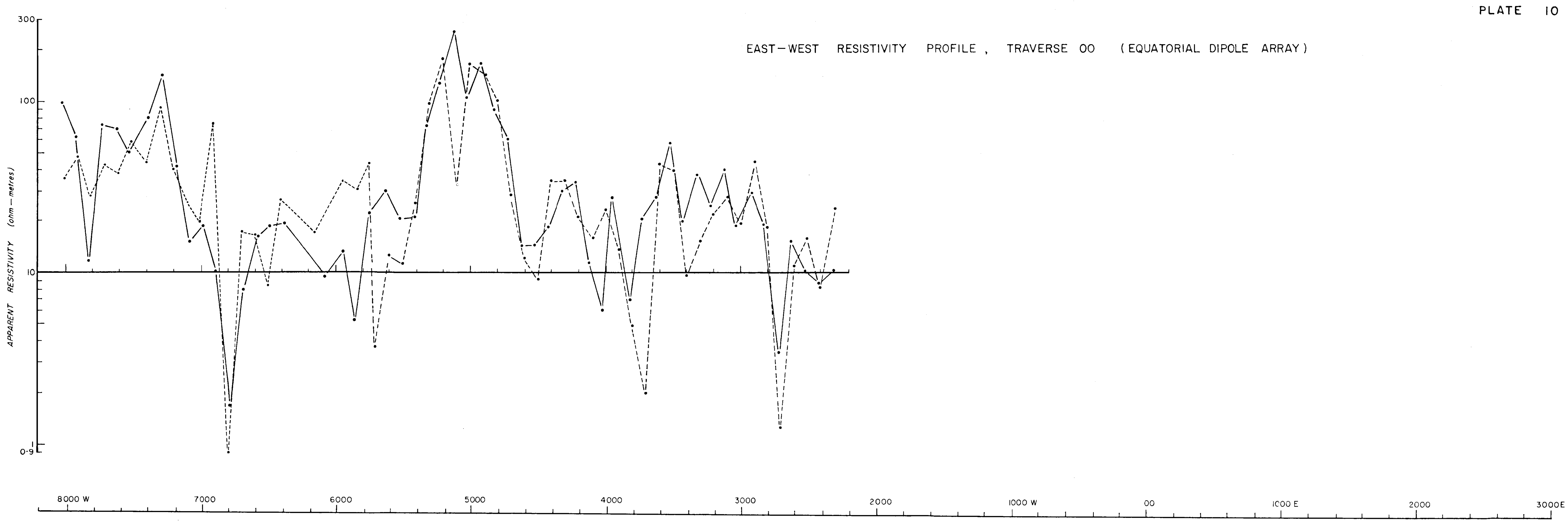
PLATE 9

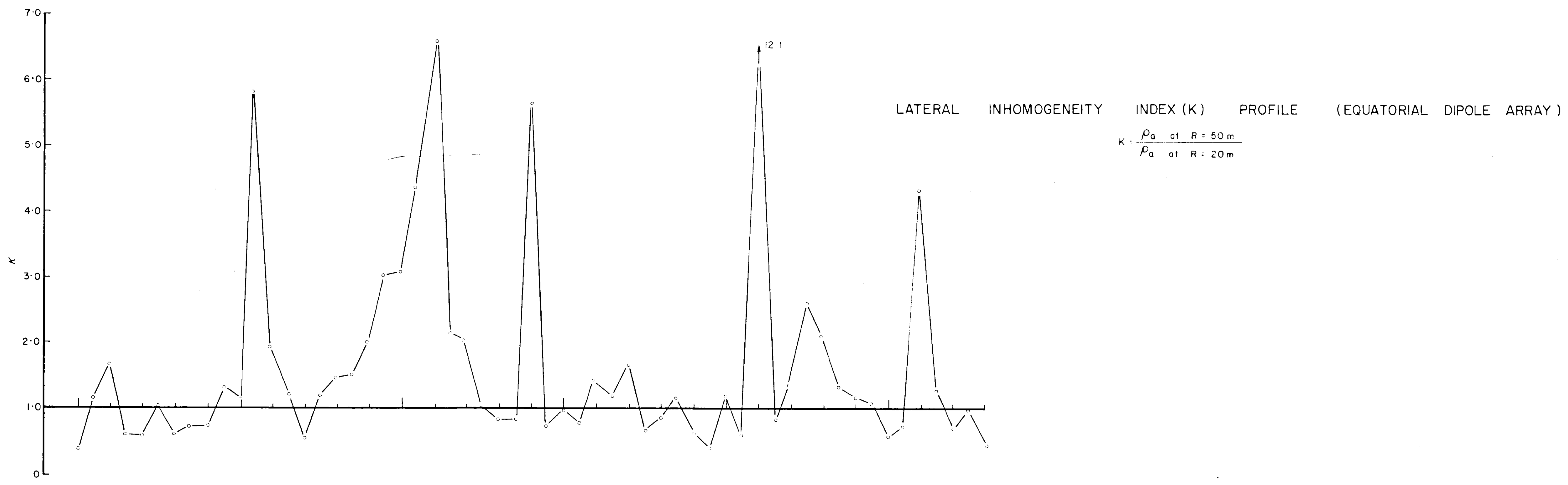


EAST-WEST GEO-ELECTRIC CROSS-SECTION,
PYMURRA AREA

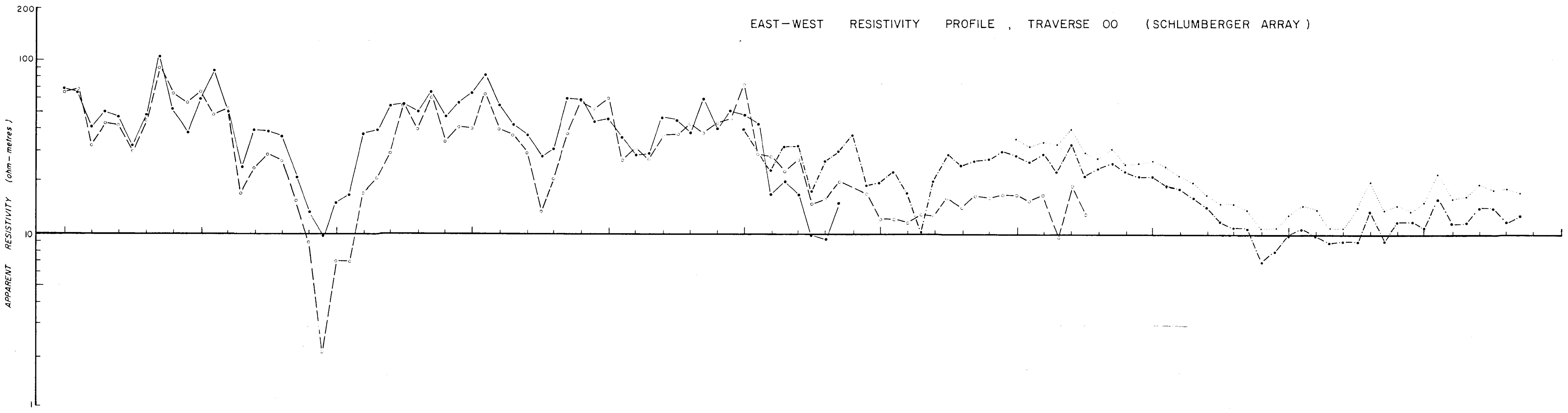
F54/B7-66

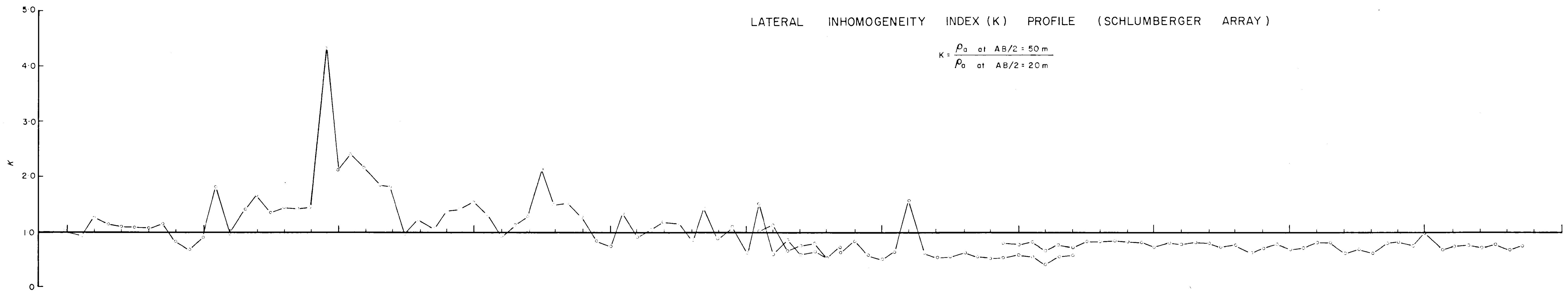
PLATE 10


EAST-WEST RESISTIVITY PROFILE, TRAVERSE 00 (EQUATORIAL DIPOLE ARRAY)


LATERAL INHOMOGENEITY INDEX (K) PROFILE (EQUATORIAL DIPOLE ARRAY)

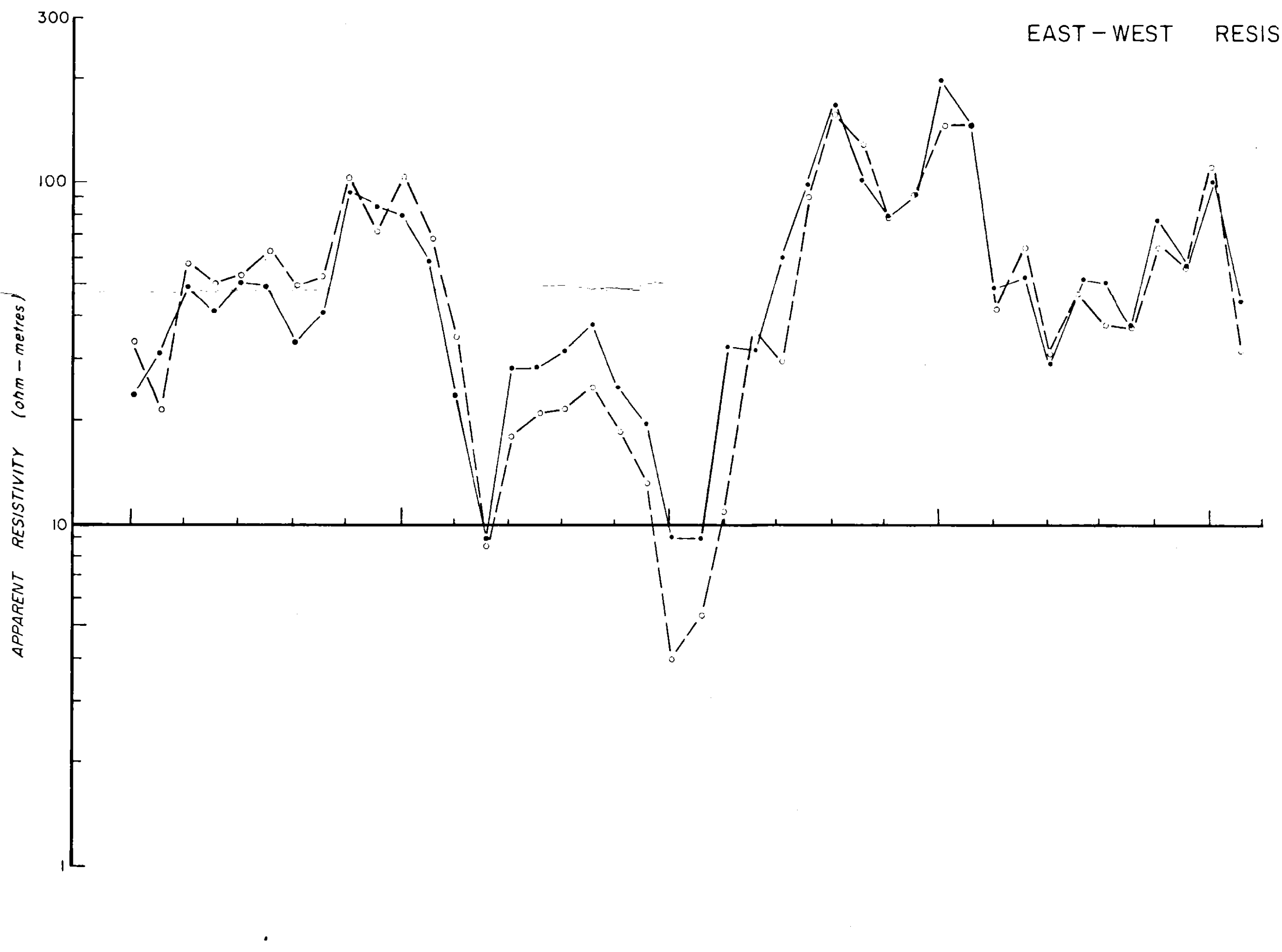
$K = \frac{\rho_a \text{ at } R = 50\,m}{\rho_a \text{ at } R = 20\,m}$


EAST-WEST RESISTIVITY PROFILE, TRAVERSE 00 (SCHLUMBERGER ARRAY)


LATERAL INHOMOGENEITY INDEX (K) PROFILE (SCHLUMBERGER ARRAY)

$K = \frac{\rho_a \text{ at } AB/2 = 50\,m}{\rho_a \text{ at } AB/2 = 20\,m}$

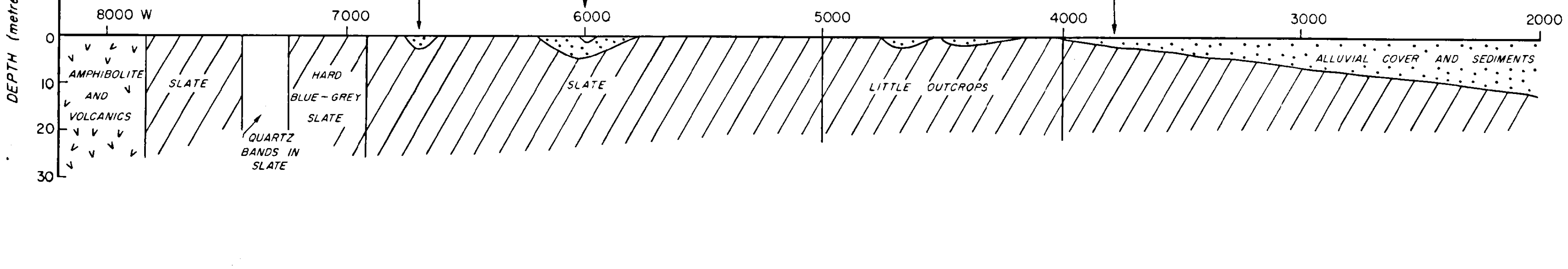
EAST-WEST RESISTIVITY PROFILE, TRAVERSE 100S (SCHLUMBERGER ARRAY)



LEGEND

	SCHLUMBERGER ARRAY	*DIPOLE ARRAY*
•- - - - - - -•	$\frac{AB}{2}$ = 20 m Current Electrode Spacing,	R = 20 m Dipole Separation
•———————•	$\frac{AB}{2}$ = 50 m " " "	R = 50 m "
○—— —— ——○	$\frac{AB}{2}$ = 100m " " "	R = 100m "
•— · — · — · —•	$\frac{AB}{2}$ = 200m " " "	
·· · ·· · ·· · ··	$\frac{AB}{2}$ = 300m " " "	

EAST-WEST GEOLOGICAL CROSS-SECTION TRAVERSE 00

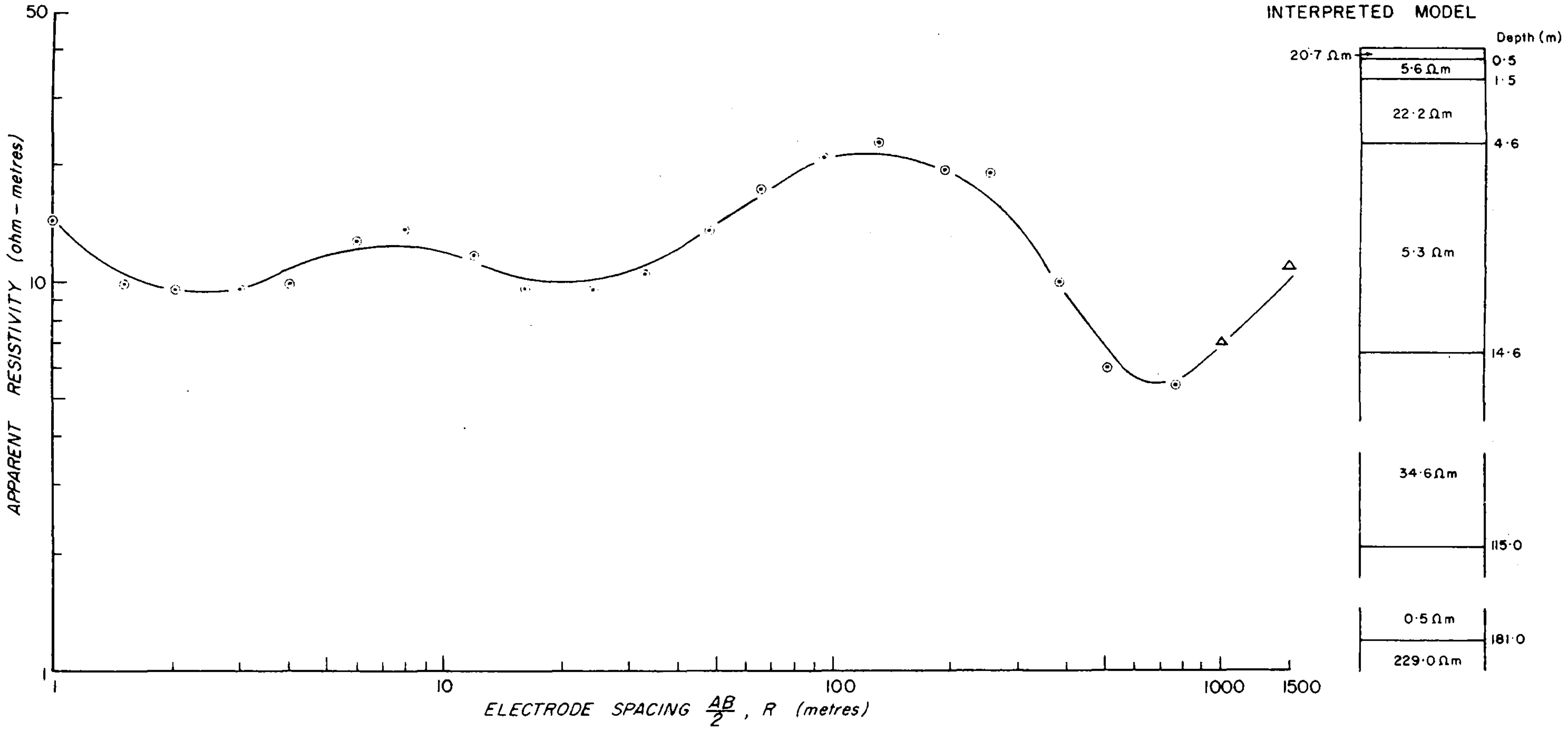


RESISTIVITY-PROFILING RESULTS, PYMURRA AREA

Record No. 1978/20

F54/B7-67

PLATE II



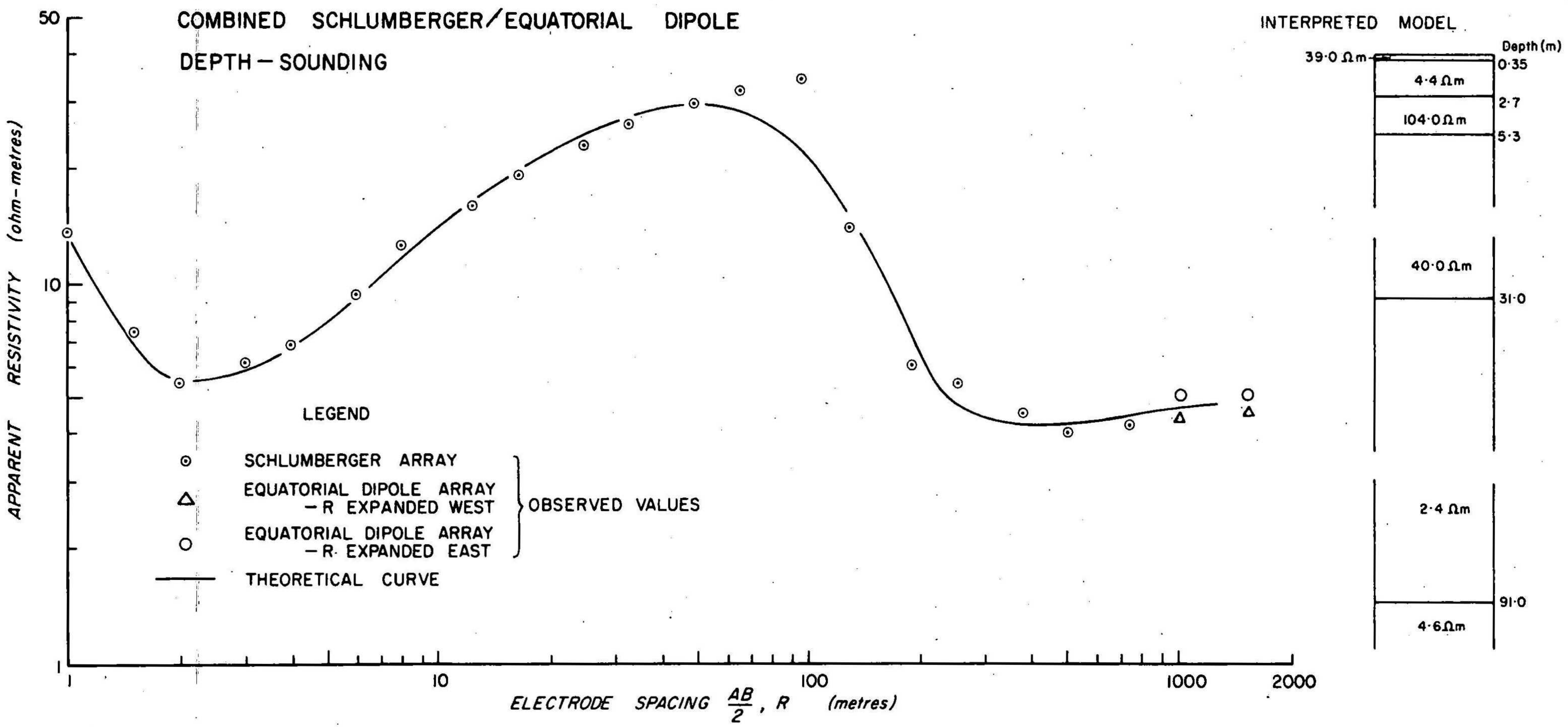
LEGEND

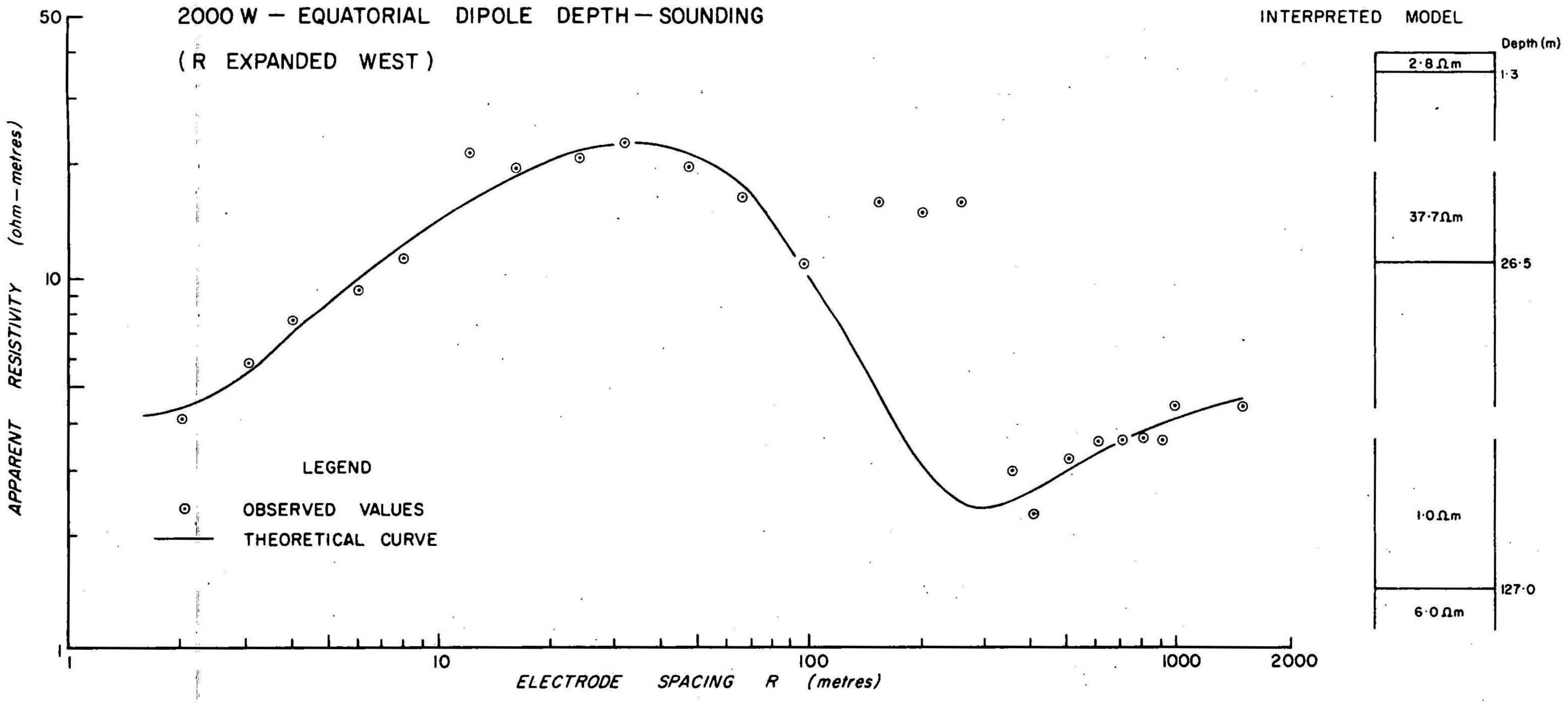
⊙	SCHLUMBERGER ARRAY	OBSERVED VALUES
△	EQUATORIAL DIPOLE ARRAY - R EXPANDED WEST	
—	THEORETICAL CURVE	

COMBINE SCHLUMBERGER/EQUATORIAL DIPOLE DEPTH-SOUNDINGS, ARROLLA AREA, OO

PLATE 12

F54/B7-69

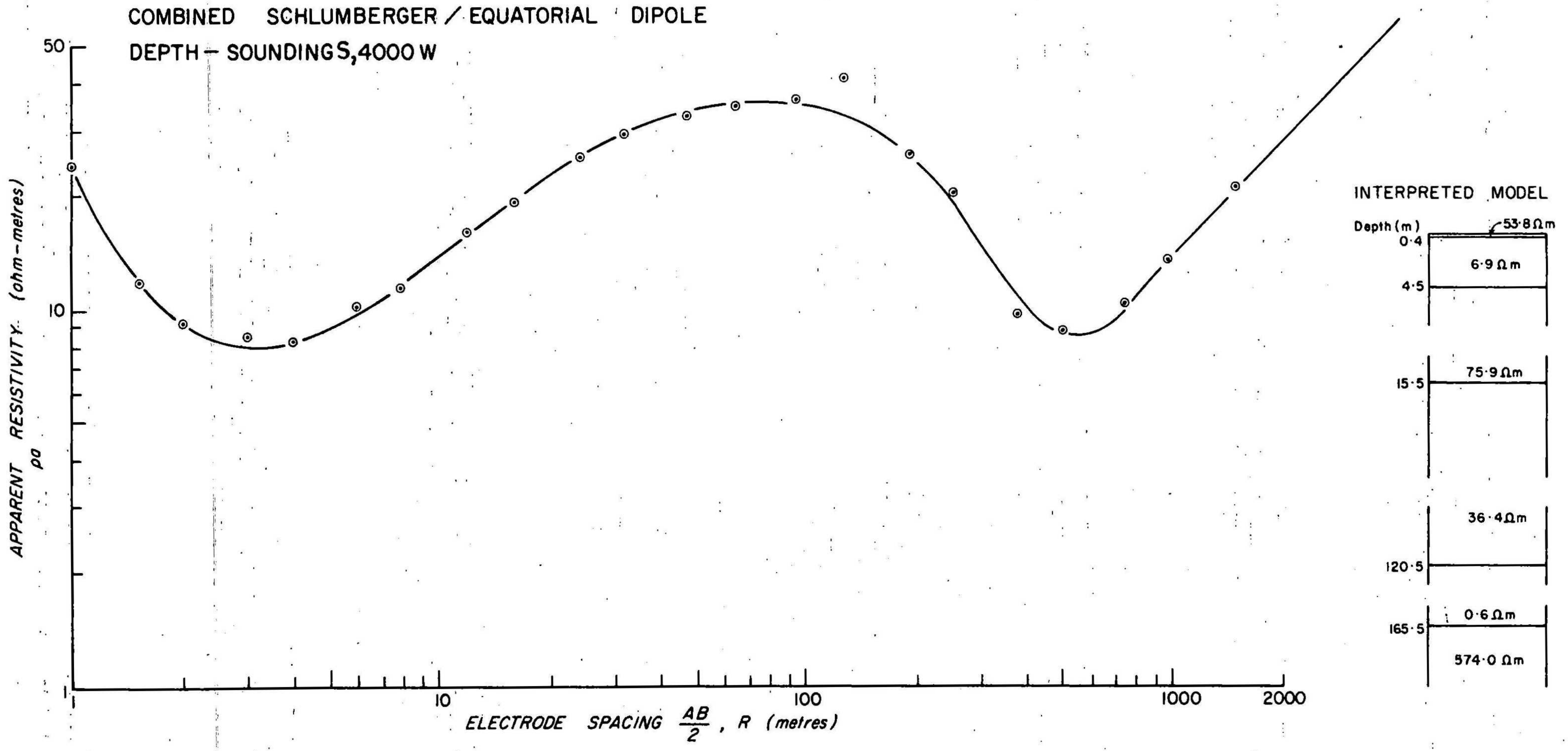

COMBINED SCHLUMBERGER/EQUATORIAL DIPOLE DEPTH-SOUNDING


2000 W - EQUATORIAL DIPOLE DEPTH-SOUNDING (R EXPANDED WEST)

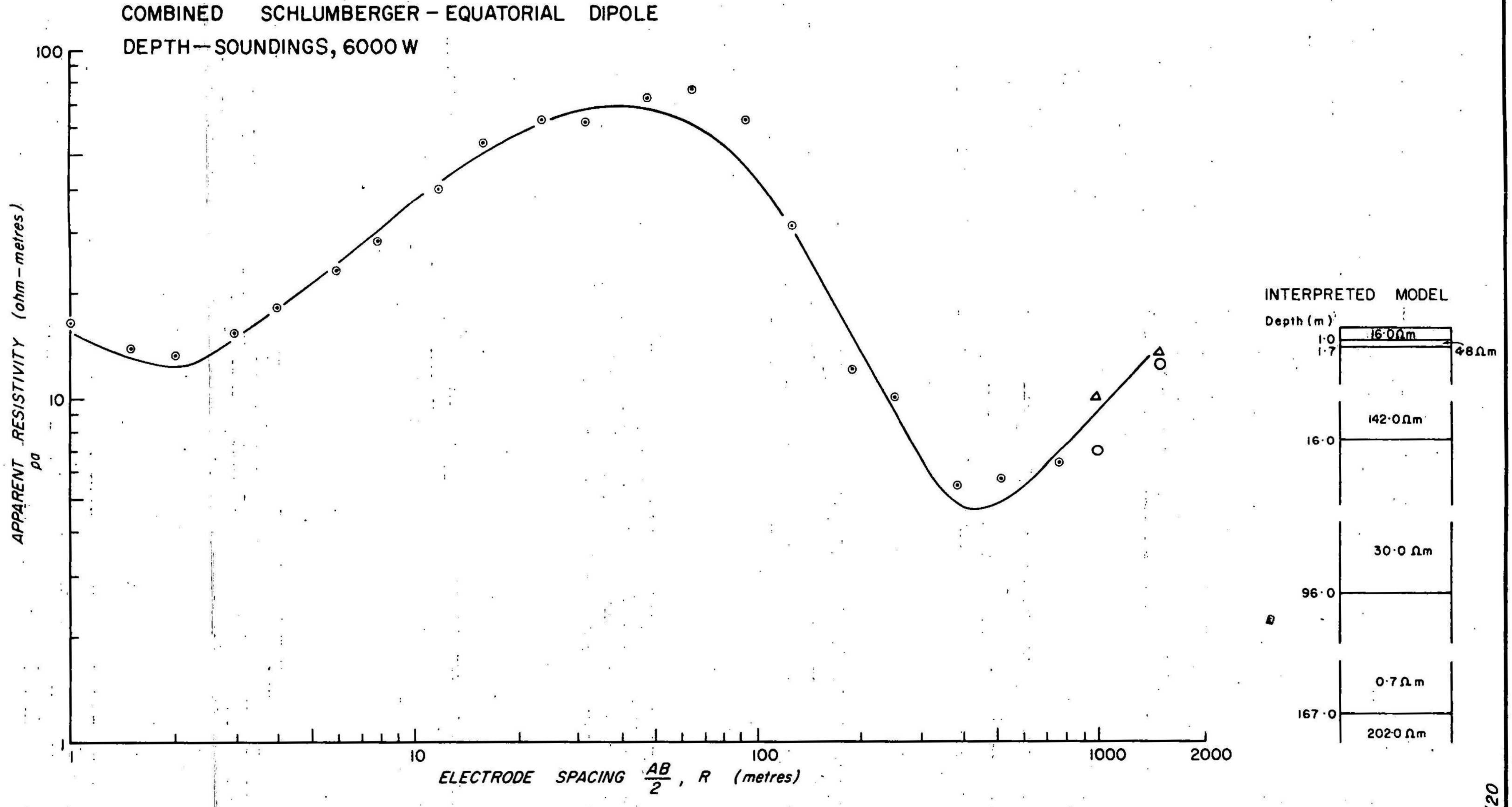
SCHLUMBERGER AND EQUATORIAL DIPOLE DEPTH-SOUNDINGS, ARROLLA AREA, 2000 W

Record No.1978/20

COMBINED SCHLUMBERGER / EQUATORIAL DIPOLE DEPTH-SOUNDINGS, 4000 W



COMBINED SCHLUMBERGER - EQUATORIAL DIPOLE DEPTH-SOUNDINGS, 6000 W

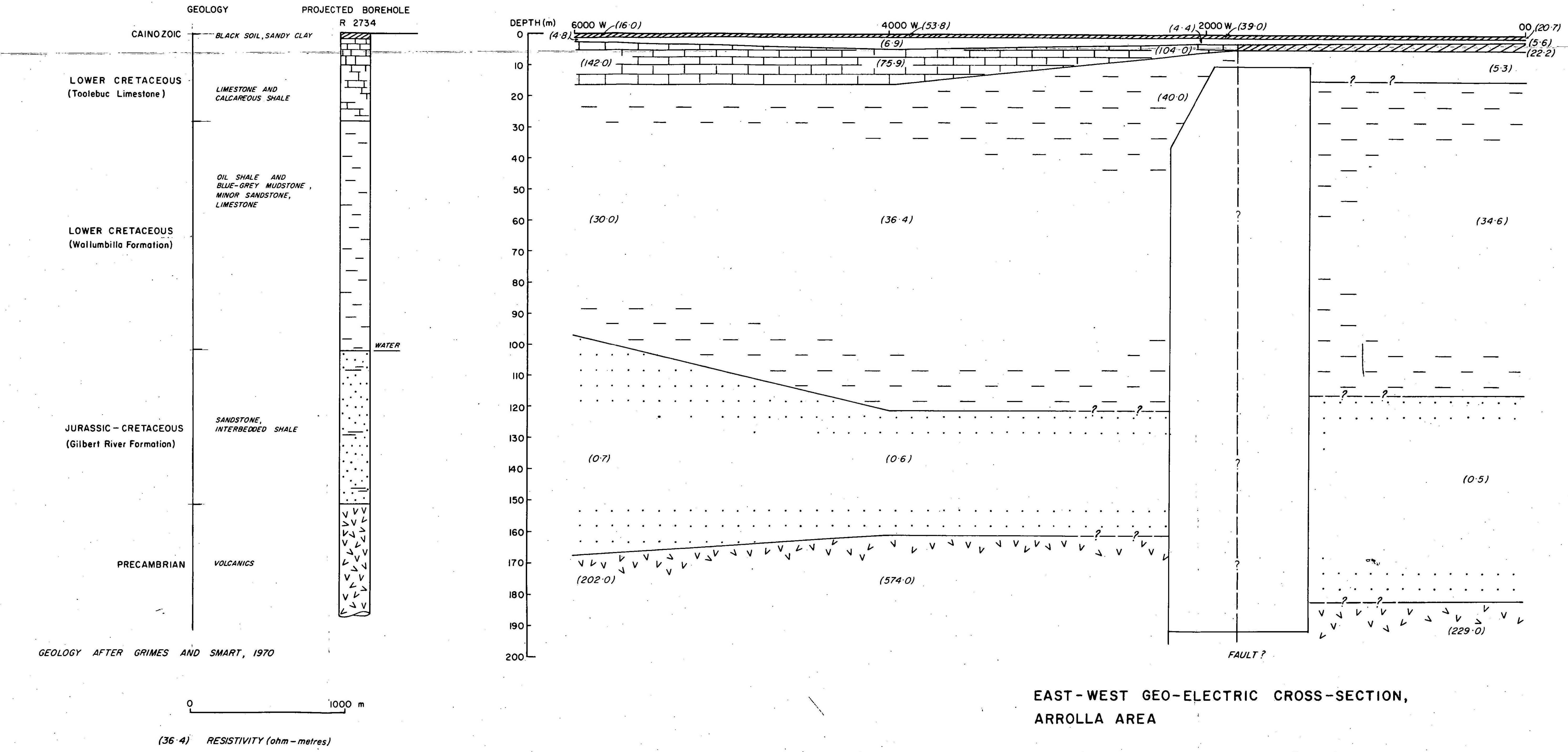


LEGEND

⊙	SCHLUMBERGER ARRAY	OBSERVED VALUES
△	EQUATORIAL DIPOLE ARRAY - R EXPANDED WEST	
○	EQUATORIAL DIPOLE ARRAY - R EXPANDED EAST	
—	THEORETICAL CURVE	

COMBINED SCHLUMBERGER / EQUATORIAL DIPOLE DEPTH-SOUNDINGS, ARROLLA AREA, 4000 AND 6000 W

Record No. 1978/20



GEOLOGY AFTER GRIMES AND SMART, 1970

EAST-WEST GEO-ELECTRIC CROSS-SECTION, ARROLLA AREA