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# SCHLUMBERGER SOUNDINGS IN THE LOWER MESILLA VALLEY OF THE RIO GRANDE, TEXAS AND NEW MEXICO

By

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and Joseph S. Gates

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This report is preliminary and has not been edited or reviewed for conformity with U.S. Geological Survey standards and nomenclature.

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By Adel A. R. Zohdy, and Robert J. Bisdorf and Joseph S. Gates

Prepared in cooperation with the Texas Water Development Board

In 1973, the U. S. Geological Survey, in cooperation with the Texas Water Development Board, made sixty five Schlumberger resistivity soundings in the lower Mesilla Valley of the Rio Grande River. The survey area includes the westernmost edge of Texas in El Paso County and part of Dona Ana County, New Mexico. The survey was made to estimate and delineate the volume of fill containing fresh ground water.

Figure 1 shows the index map for the location, number, and azimuth of the 65 Schlumberger sounding stations. All the sounding curves were automatically processed and interpreted (Zohdy, 1973 and 1975) as shown in the graphs given in the appendix.

Each graph shows the following:

(1) Field data designated by a segmented solid-line curve with diamond symbols for observed data.

(2) A continuous-dashed curve which represents:

(a) The continuous "field" curve which is generally obtained by maintaining the position of the last segment and shifting each of the previous segments up or down so that the last point on each segment coincides with the corresponding point on the following segment (Zohdy and others, 1973).

(b) The digitized curve at the rate of six points per logarithmic cycle. Although the individual digitized points are not depicted on the dashed curve (to avoid cluttering the graphs) they were computed using a subroutine in a computer program for bicubic spline functions (Anderson, 1971). The digitized data from the continuous dashed curve were then fed into the automatic interpretation program (Zohdy, 1973) to obtain the best fitting theoretical sounding curve for a horizontally layered medium. The automatic interpretation program used here was slightly modified from the one referred to in the above reference. The modifications are identical to those used in another program recently written for inverting Wenner sounding curves (Zohdy and Bisdorf, 1975).

(3) The theoretical best fitting sounding curve plotted as (+) signs.

(4) The detailed layering for which the theoretical curve is calculated.

(5) The D.Z. (Dar Zarrouk) curve for the detailed layering. The ordinate values for the D.Z. curves are shifted upward or downward by one logarithmic cycle or they are plotted on a separate sheet of graph paper (as for Mesilla 21, Mesilla 22,

Mesilla 24, Mesilla 37, Messila 57, and Mesilla 58) to avoid cluttering the graphs. The D.Z. curves can be used to obtain equivalent and simpler solutions containing fewer number of layers. In addition, they can be used to impose certain constraints on the layer thicknesses and resistivities (Zohdy, 1974).

All these graphs were generated on a graphic plotter. The plotter-driving subroutines were developed by G. I. Evenden of the U. S. Geological Survey.

## References

Anderson, W. L., 1971, Application of bicubic spline functions to two dimensional grided data: NTIS (National Technical Information Service), No. PB-203579, Springfield, Virginia.

Zohdy, Adel A. R., 1973, A computer program for the automatic interpretation of Schlumberger sounding curves over horizontally stratified media: NTIS (Natl. Tech. Inf. Service) PB-232703/AS, 25 p. Springfield, Virginia.

Zohdy, Adel A. R., 1974, The use of Dar-Zarrouk curves in the interpretation of VES data: U.S. Geol. Survey Bull. 1313-D, 41 p.

Zohdy, A. A. R., 1975, Automatic interpretation of Schlumberger sounding curves using modified Dar-Zarrouk functions: U.S. Geol. Survey Bull. 1313-E, 39 p.

Zohdy, A. A. R., Anderson, L. A., and Muffler, L. J. P., 1973, Resistivity self potential, and induced polarization surveys of a vapor-dominated geothermal system: Geophysics, v. 38, p. 1130-1144.

Zohdy, A. A. R., Bisdorf, R. J., 1975, Computer programs for the forward calculation and automatic inversion of Wenner sounding curves: NTIS (Natl. Tech. Inf. Service) PB-247265/AS, Springfield, Virginia.

APPENDIX

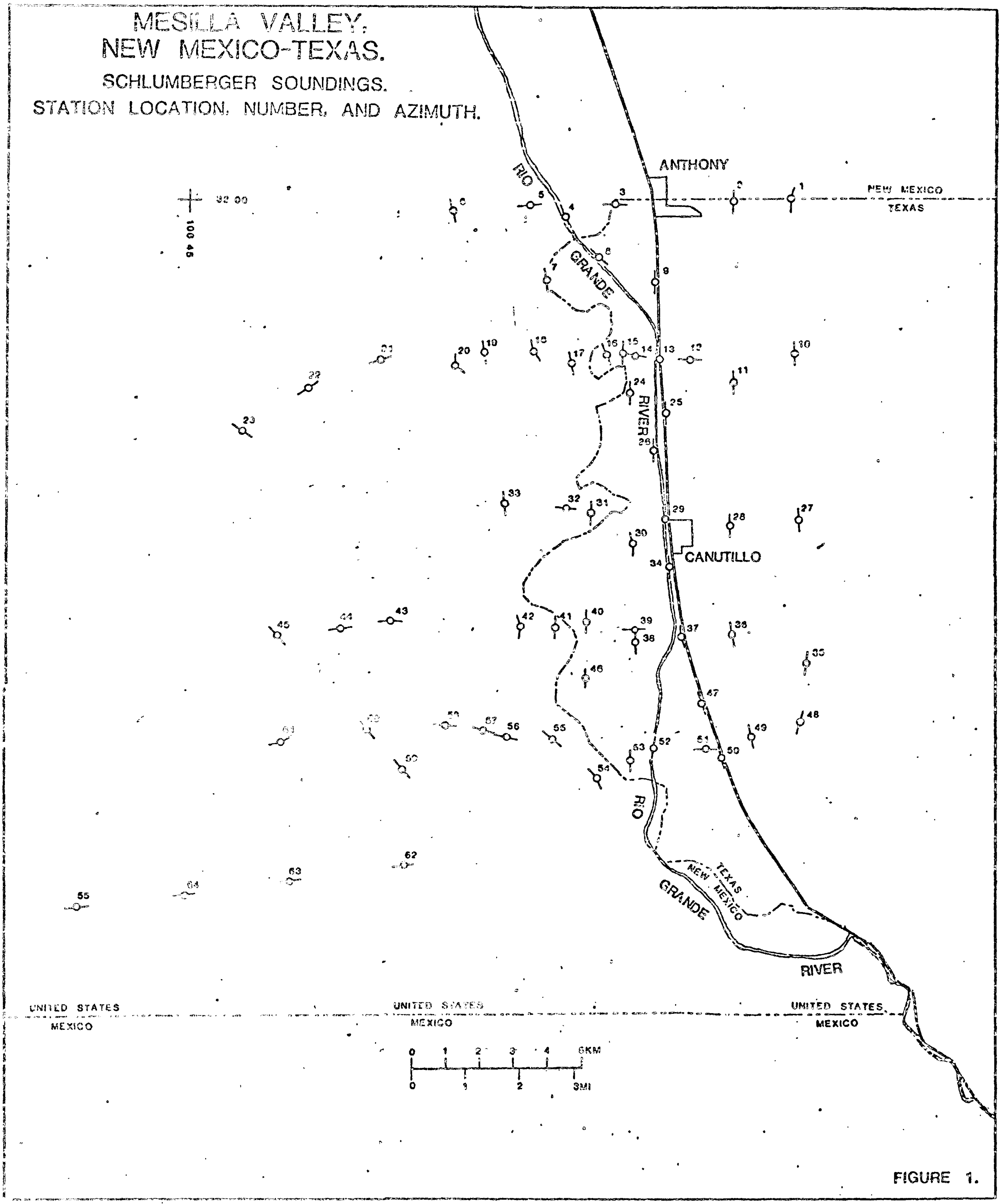
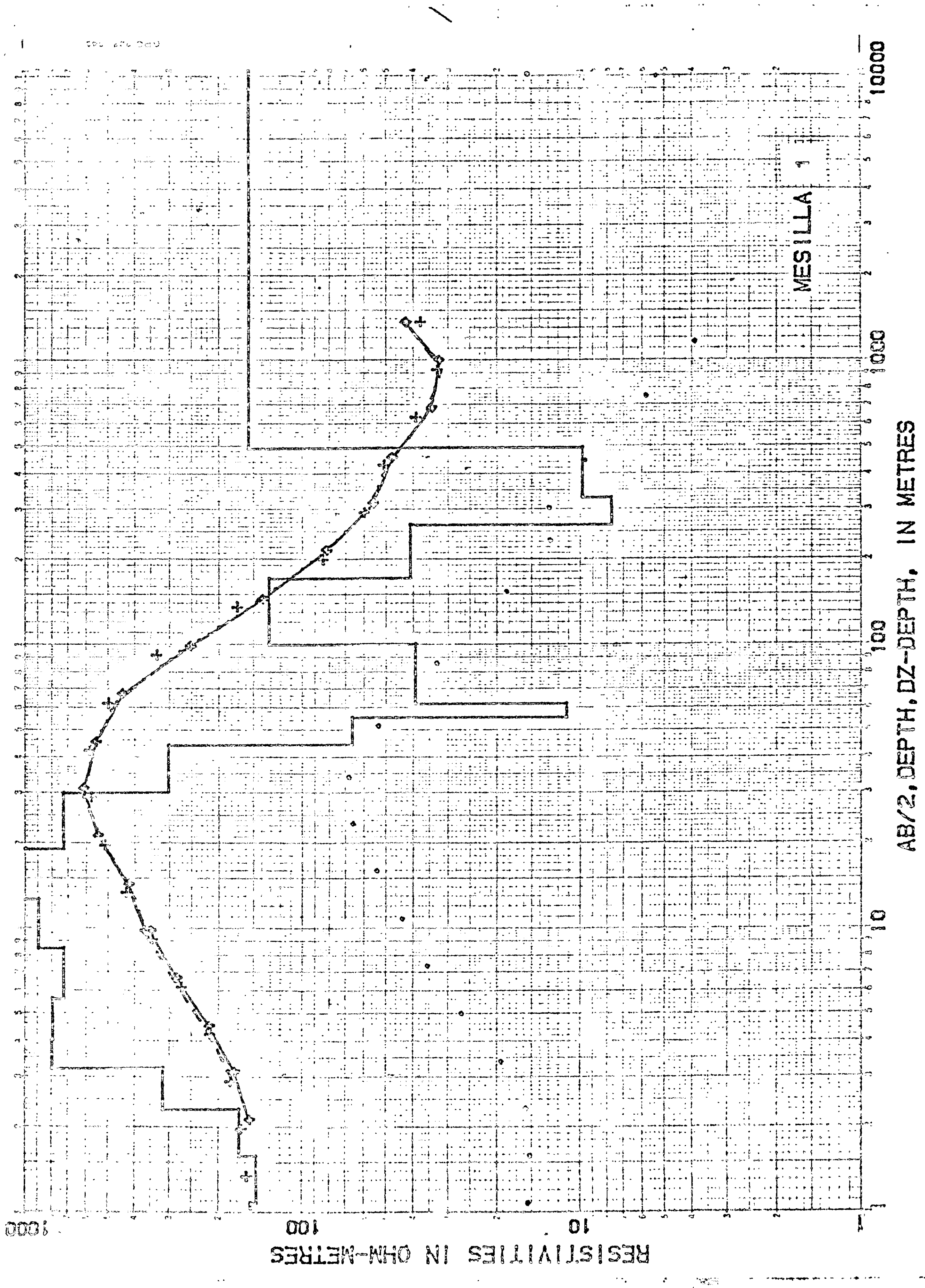
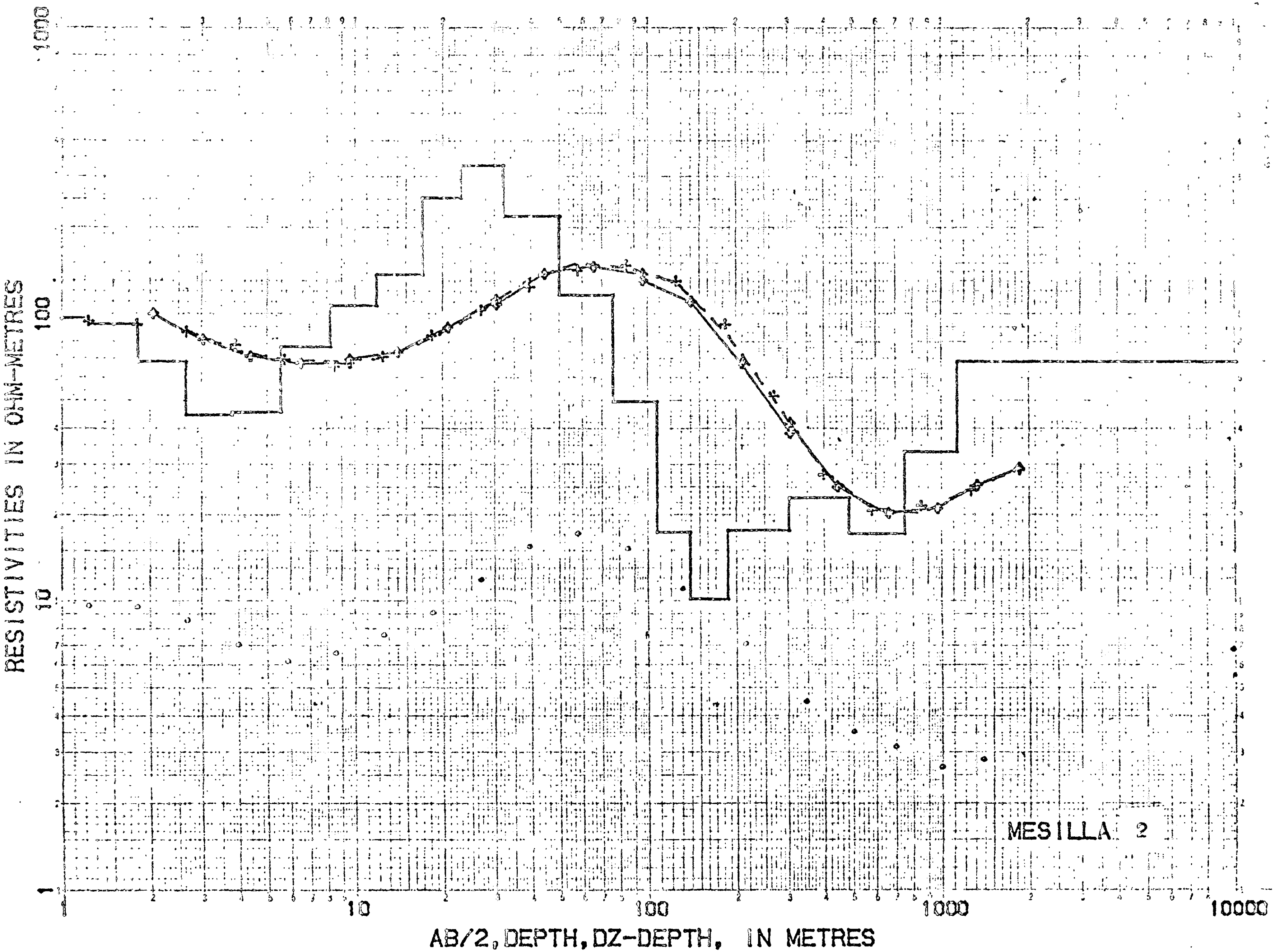
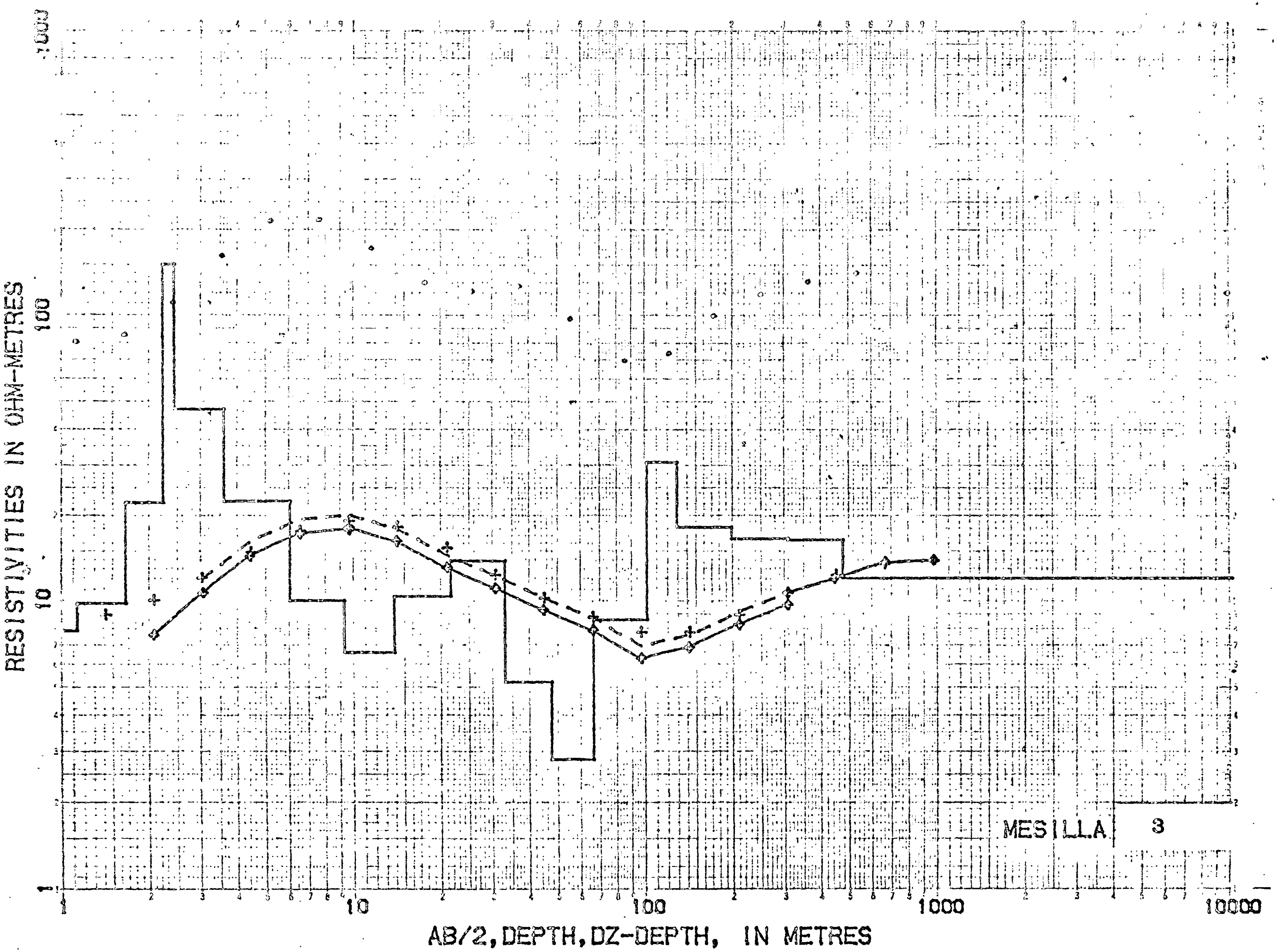

MESILLA VALLEY,
NEW MEXICO-TEXAS.
SCHLUMBERGER SOUNDINGS.
STATION LOCATION, NUMBER, AND AZIMUTH.
ANTHONY
NEW MEXICO
TEXAS
RIO
GRANDE
RIVER
CANUTILLO
RIO
GRANDE
RIVER
TEXAS
NEW MEXICO
UNITED STATES
MEXICO
UNITED STATES
MEXICO
UNITED STATES
MEXICO
0 1 2 3 4 5KM
0 1 2 3MI

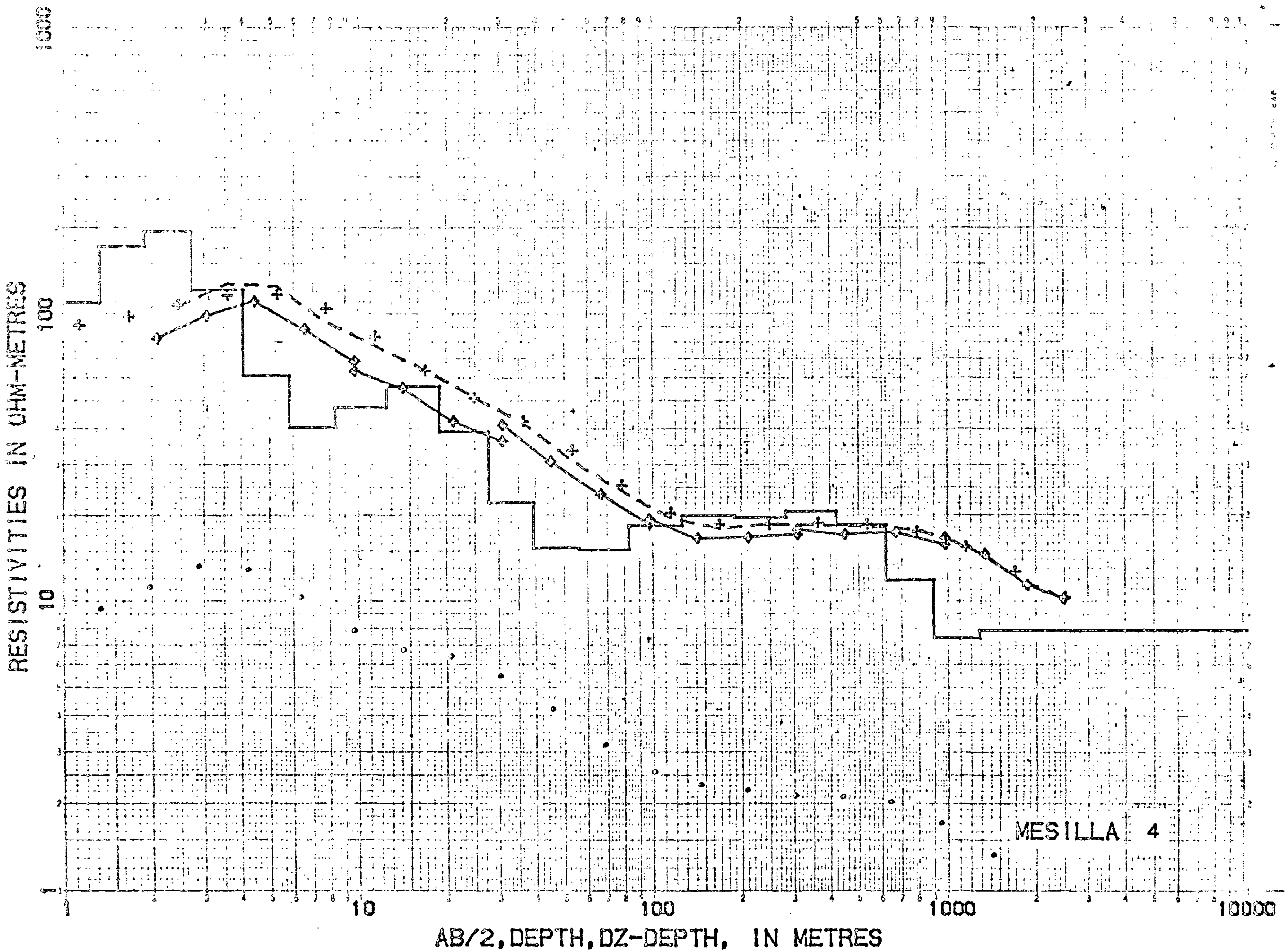
FIGURE 1.

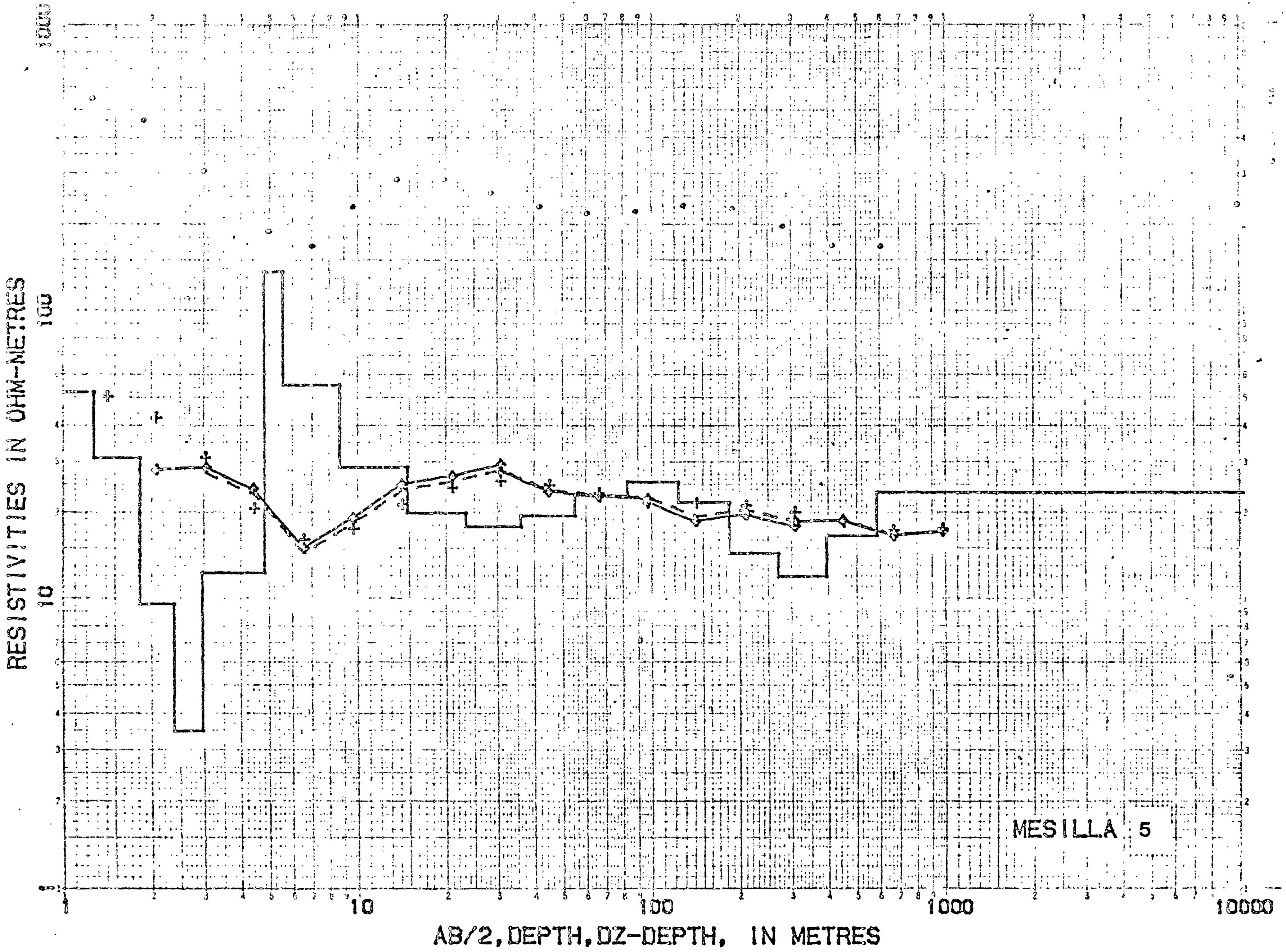


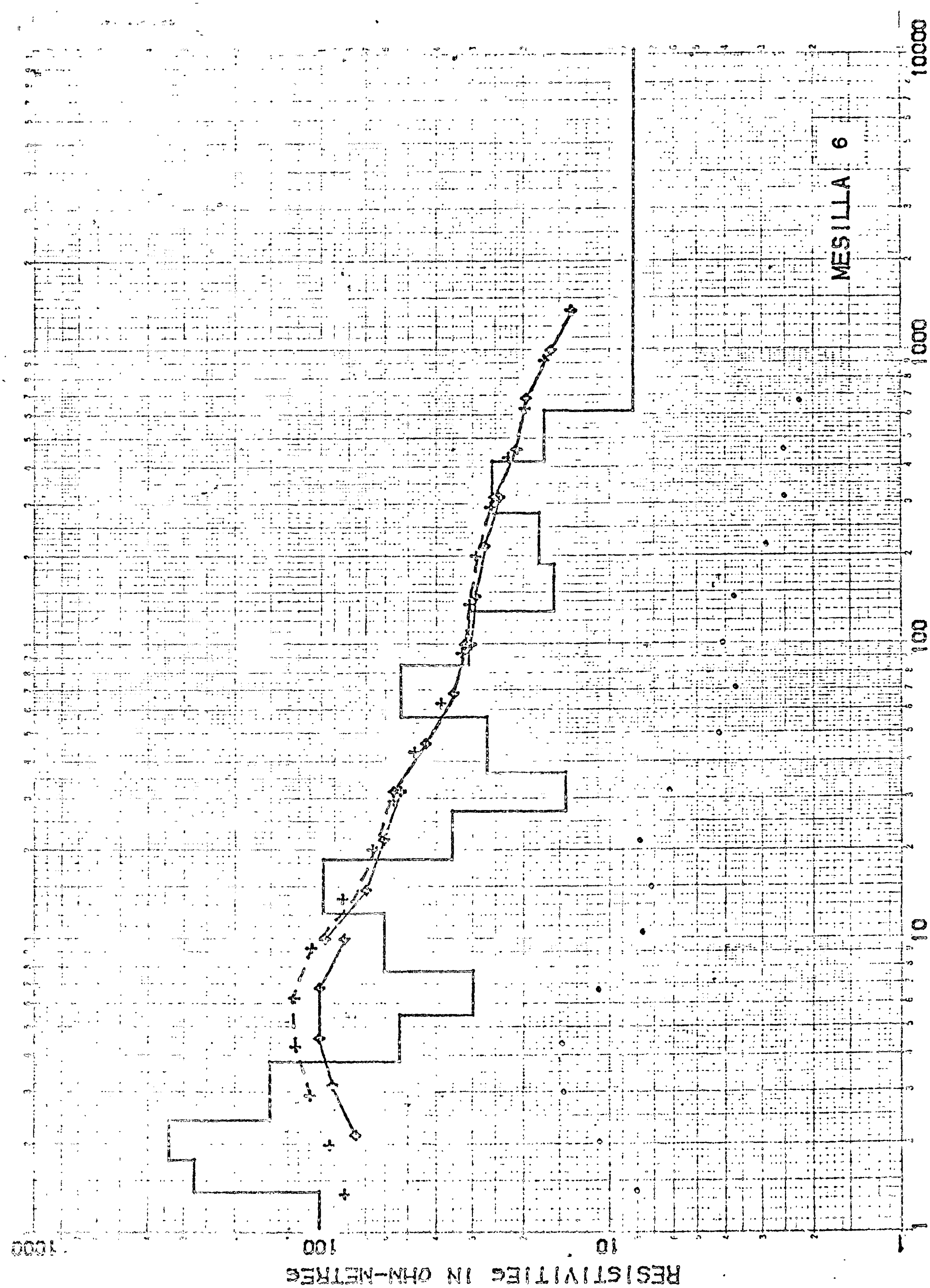
MESILLA 1
AB/2, DEPTH, DZ-DEPTH, IN METRES
10
100
1000
10000
RESISTIVITIES IN OHM-METRES
1000
100
10

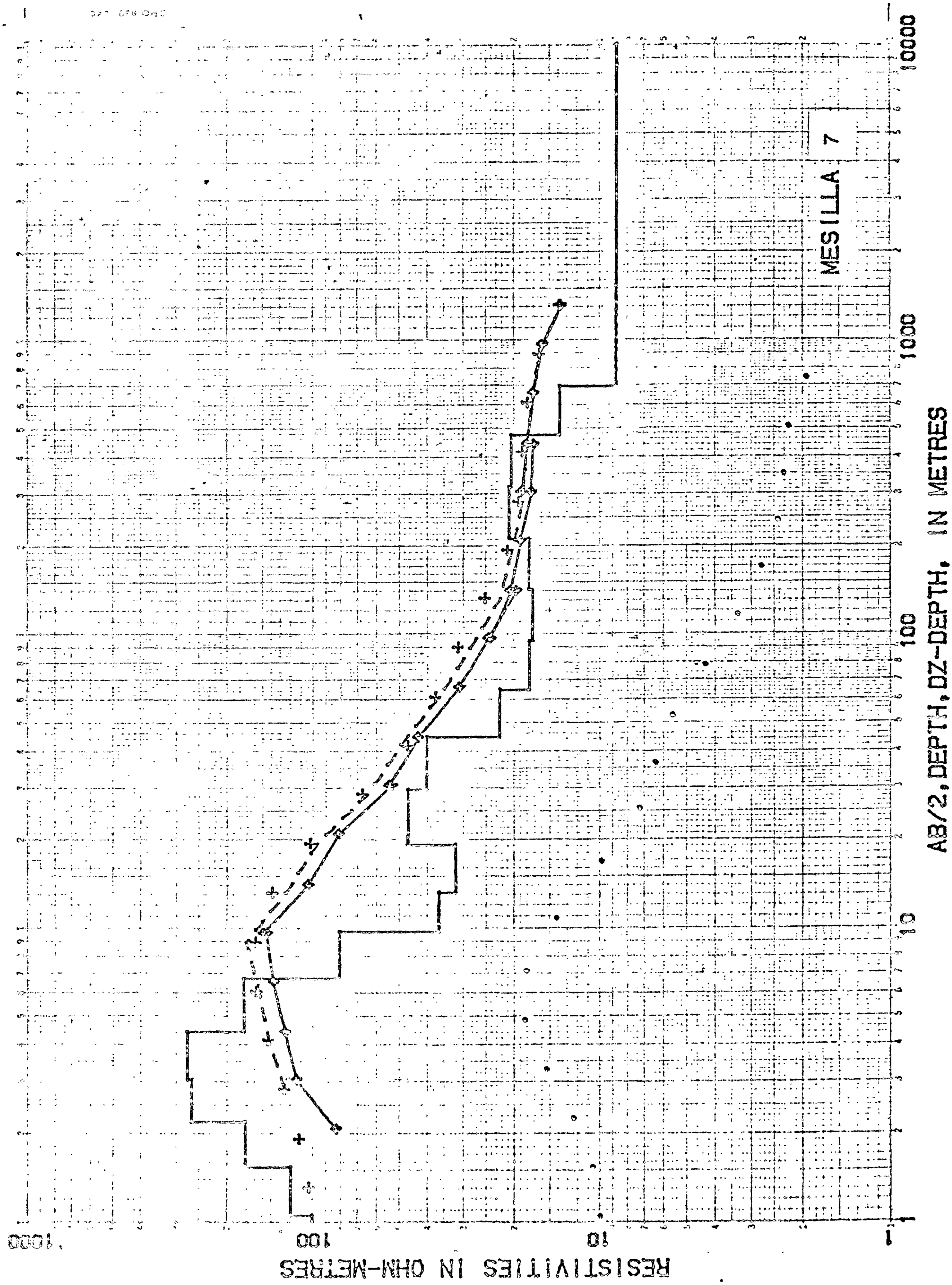

1000
100
10
1
RESISTIVITIES IN OHM-METRES
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH, IN METRES
MESILLA 2

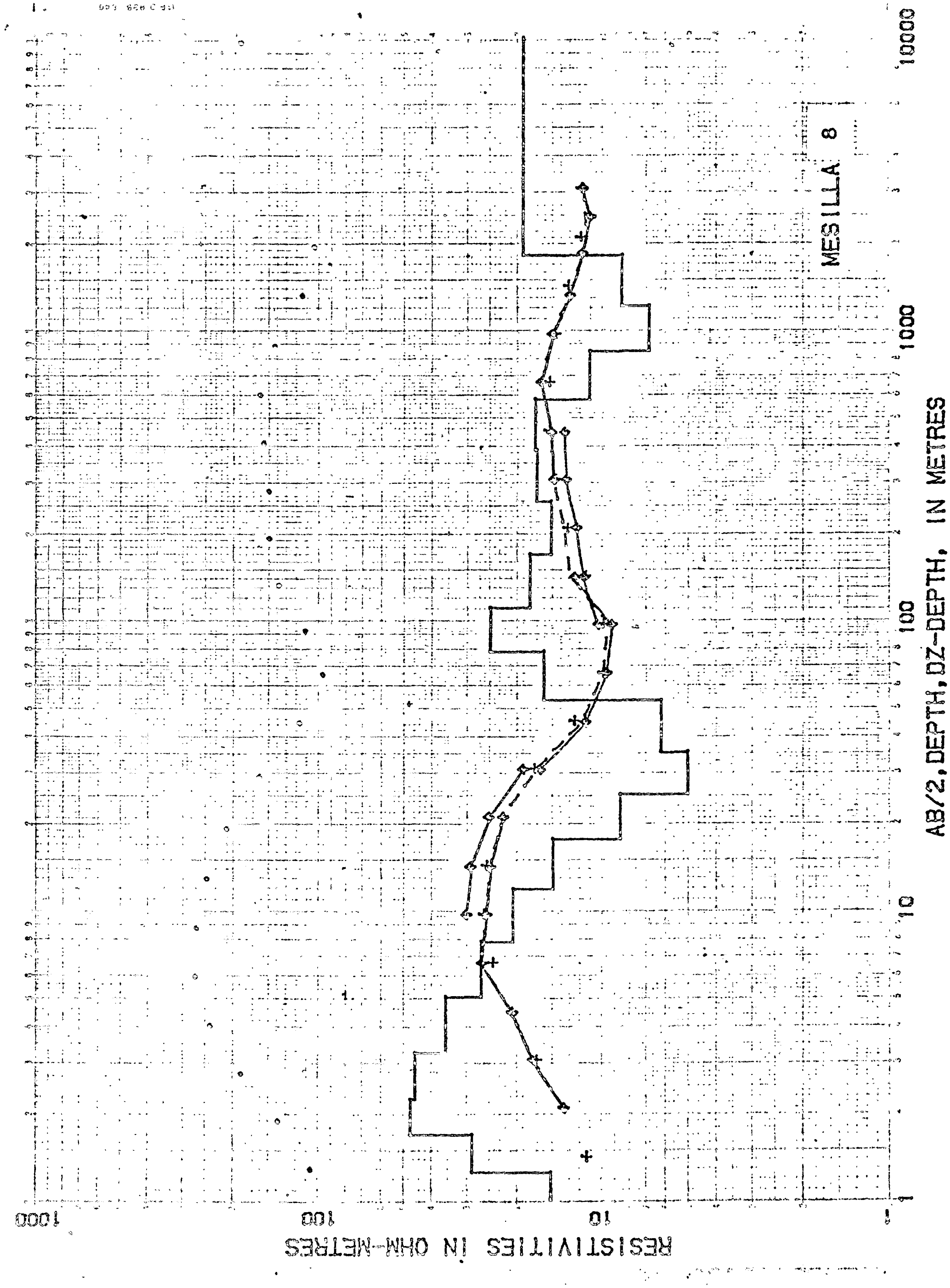

RESISTIVITIES IN OHM-METRES
1000
100
10
1
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH, IN METRES
MESILLA 3

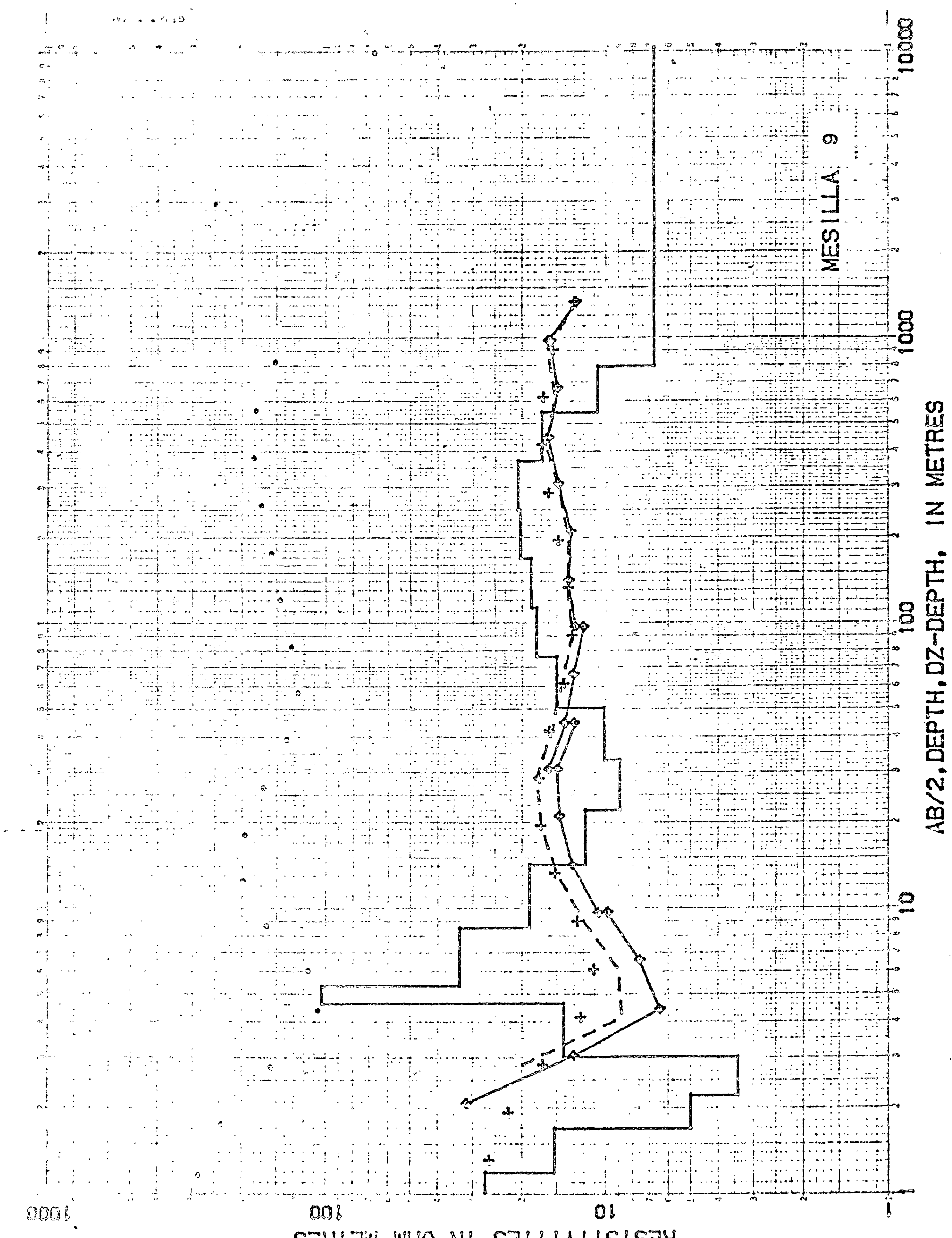

1000
100
10
RESISTIVITIES IN OHM-METRES
1
10
100
1000
10000
AB/2,DEPTH,DZ-DEPTH, IN METRES
MESILLA 4

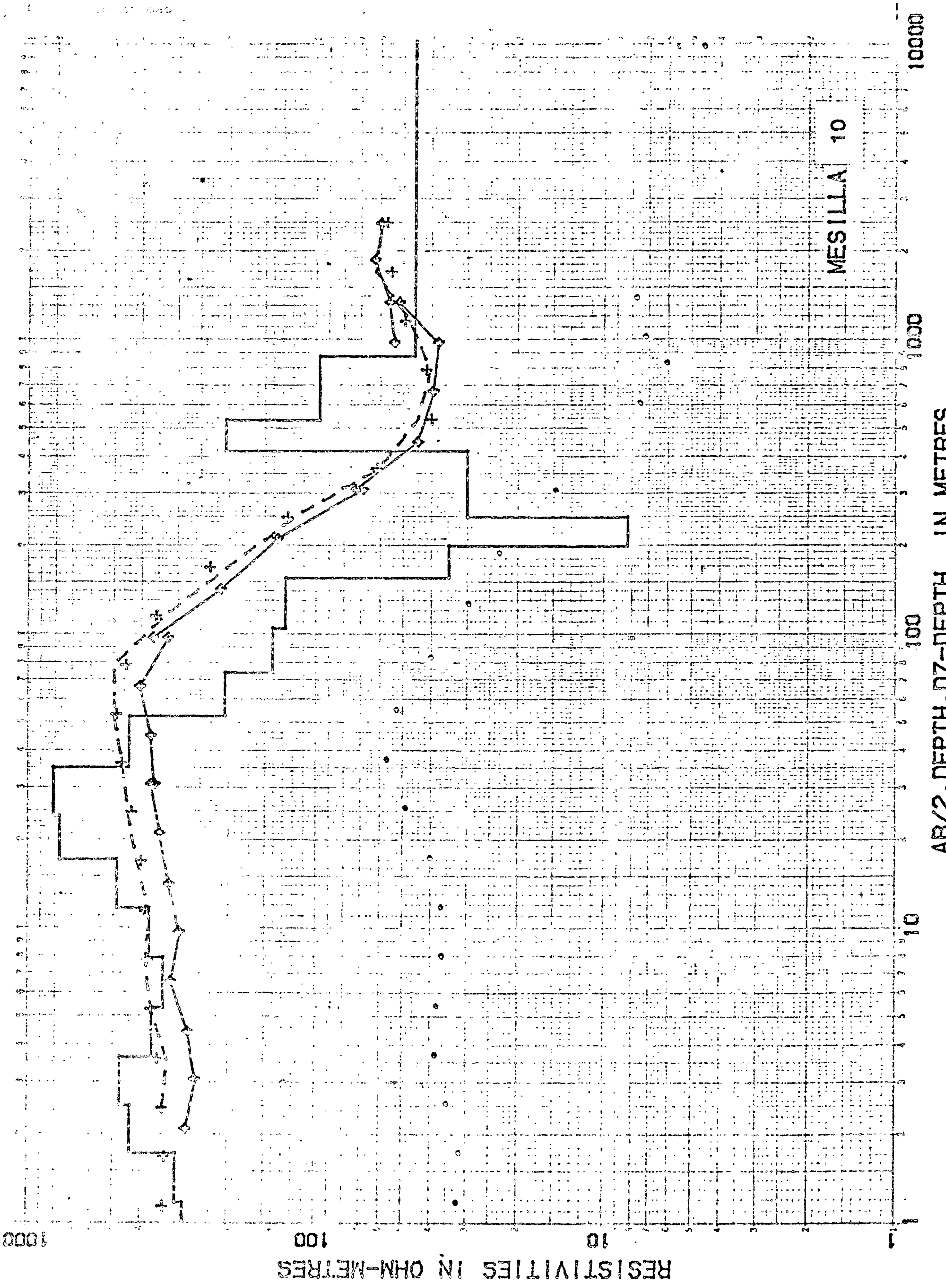

MESILLA 5
RESISTIVITIES IN OHM-METRES
1000
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH, IN METRES

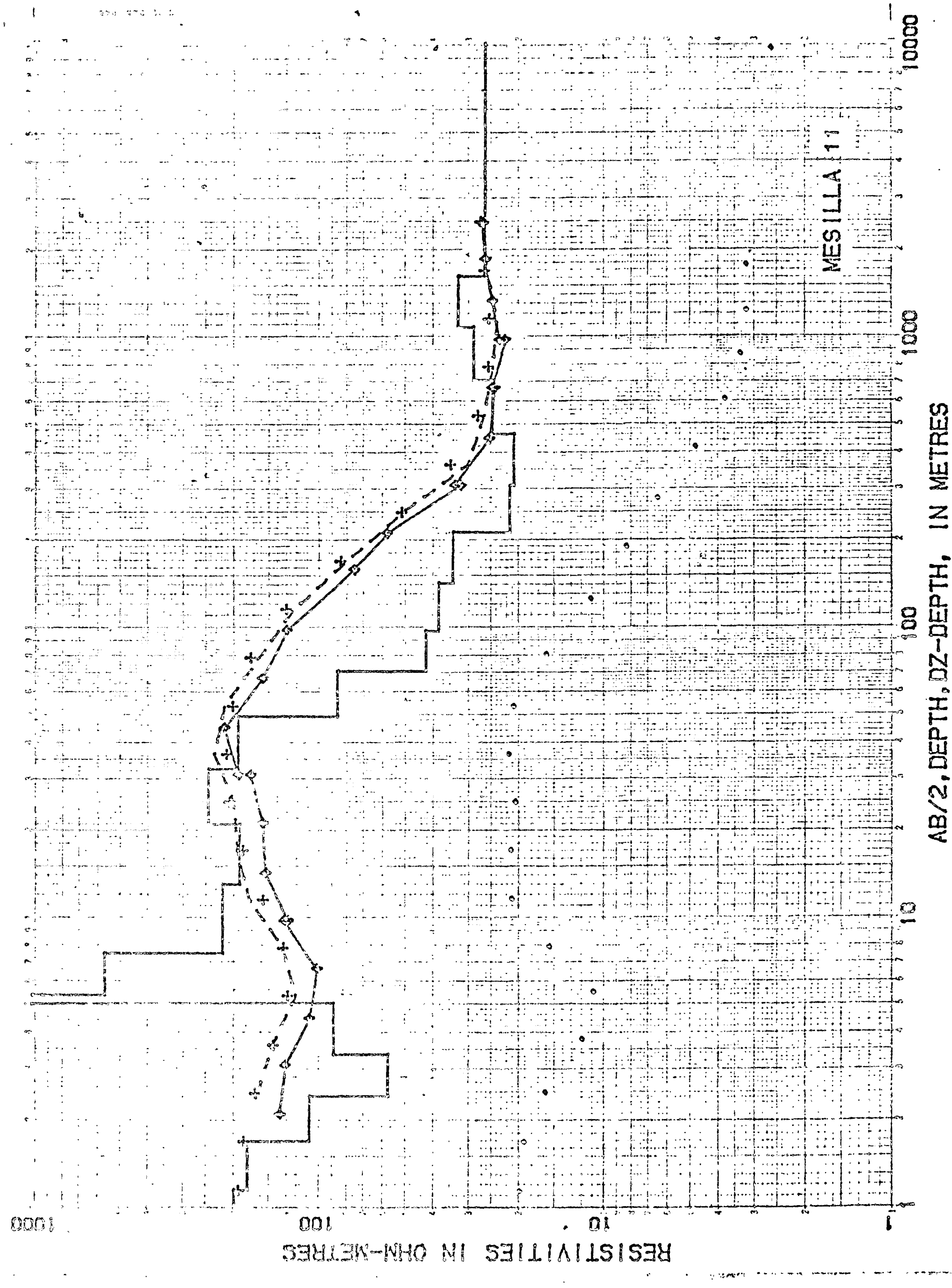

MESILLA 6
AB/2,DEPTH,DZ-DEPTH, IN METRES
1
10
100
1000
10000
RESISTIVITIES IN OHM-METRES
1000
100
10
1

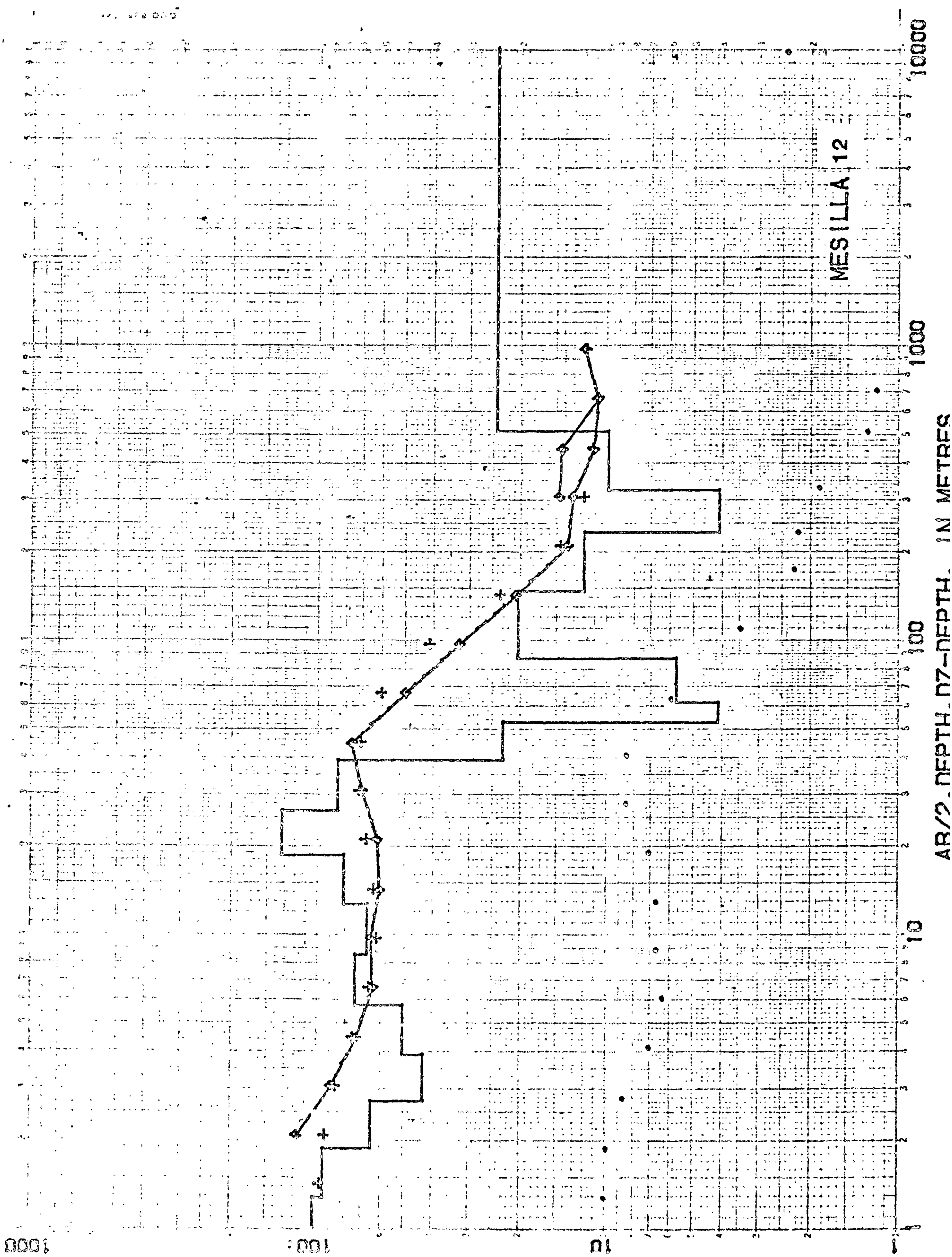

MESILLA 7
AB/2, DEPTH, DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
1
10
100
1000
10000

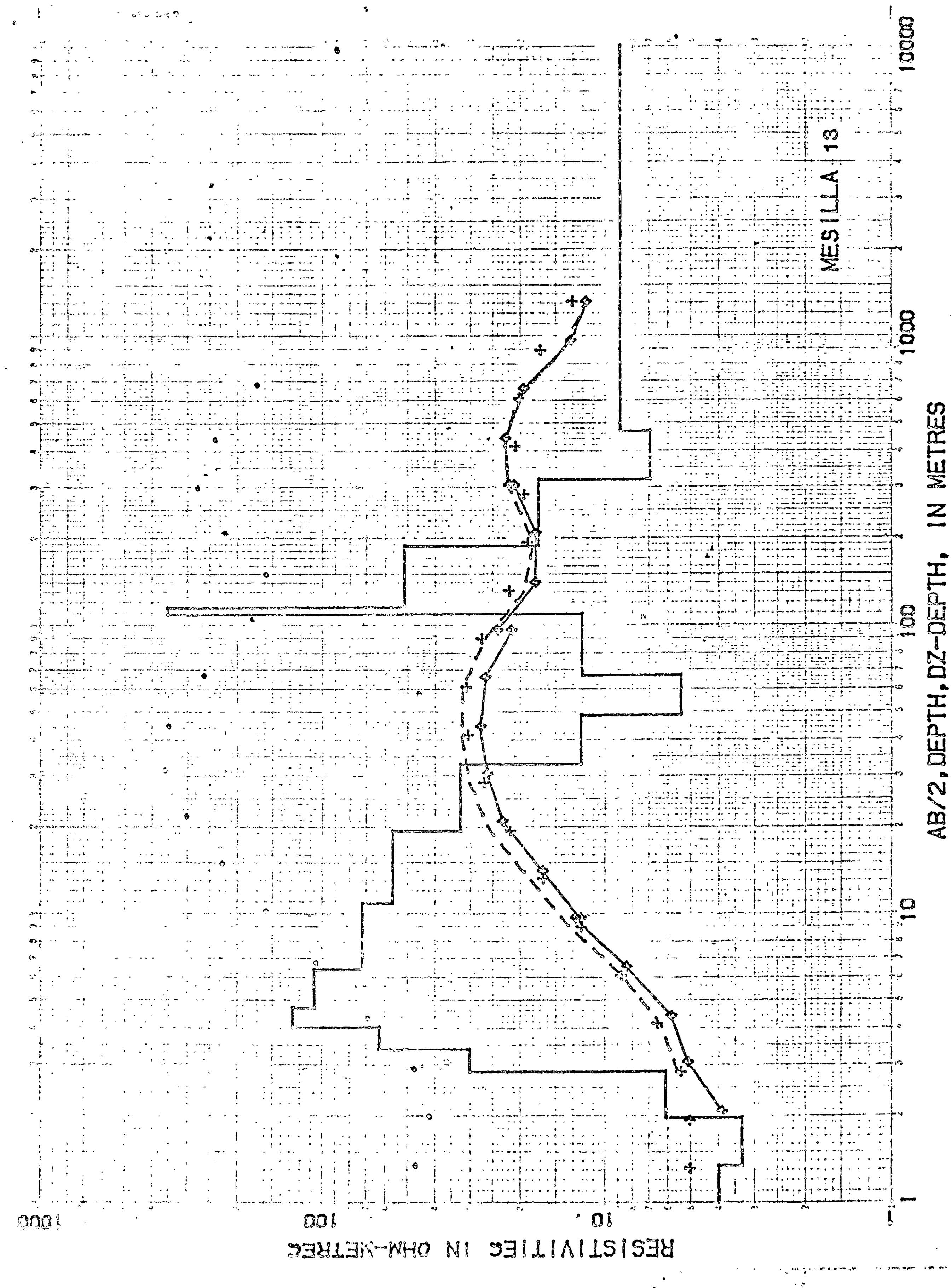

MESILLA 8
AB/2, DEPTH, DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
1000
100
10
1
10000

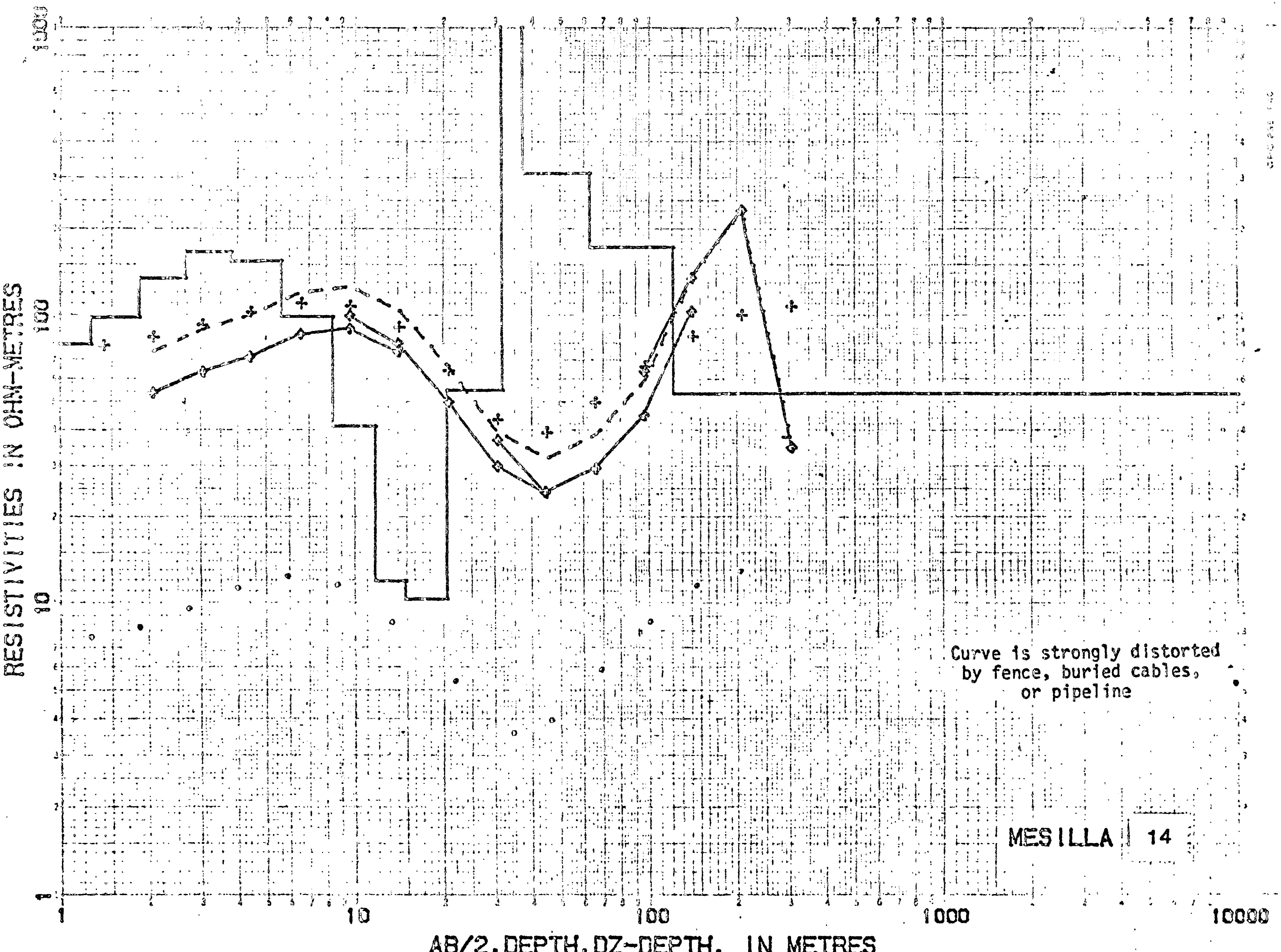

MESILLA 9
AB/2, DEPTH, DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
1
10
100
1000
10000


MESILLA 10
AB/2,DEPTH,DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
1000
100
10
1
10000

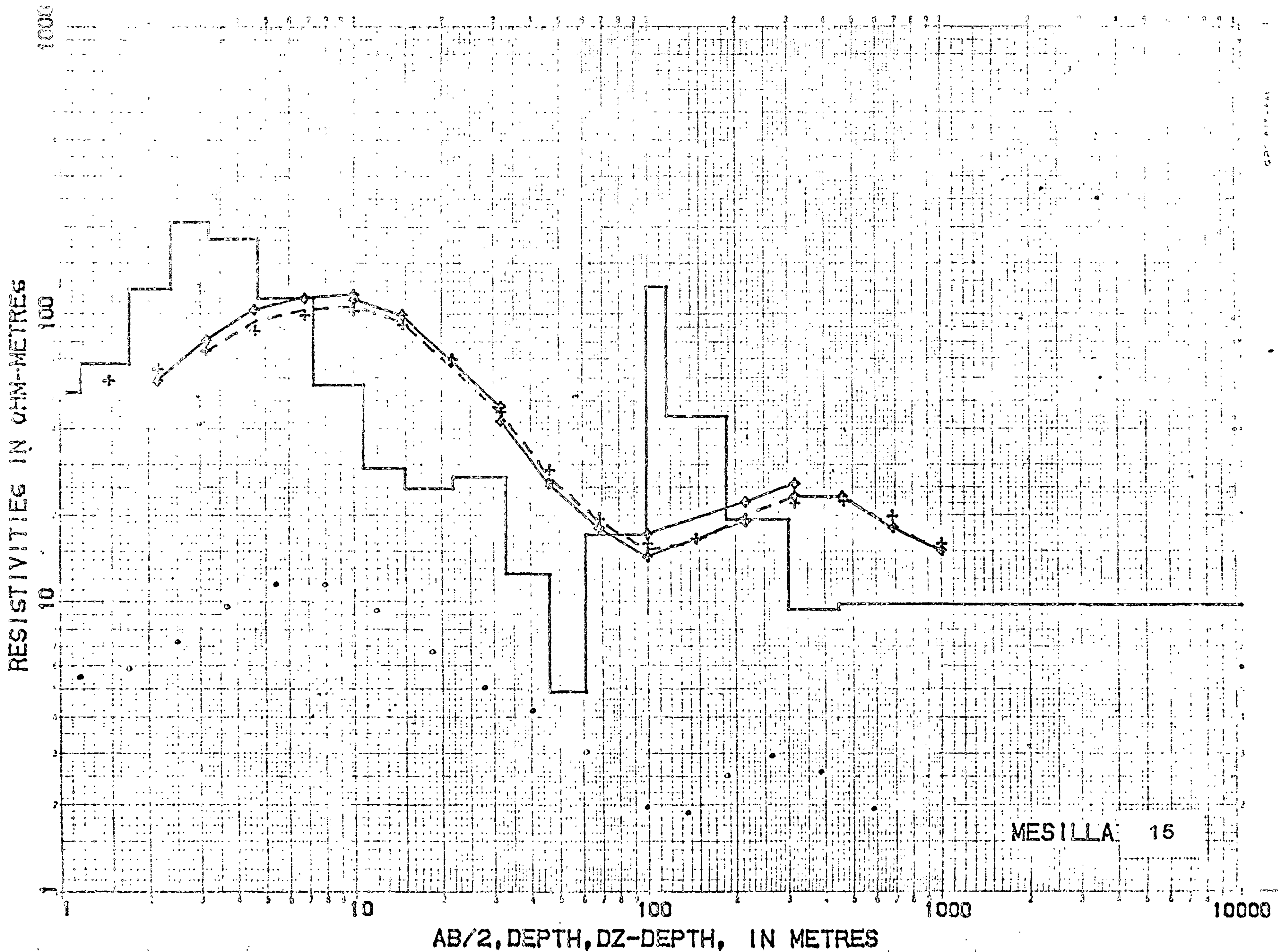

MESILLA 11
AB/2, DEPTH, DZ-DEPTH, IN METRES
10
100
1000
10000
RESISTIVITIES IN OHM-METRES
1000
100
10
1


MESILLA 12
AB/2, DEPTH, DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
1
10
100
1000
10000

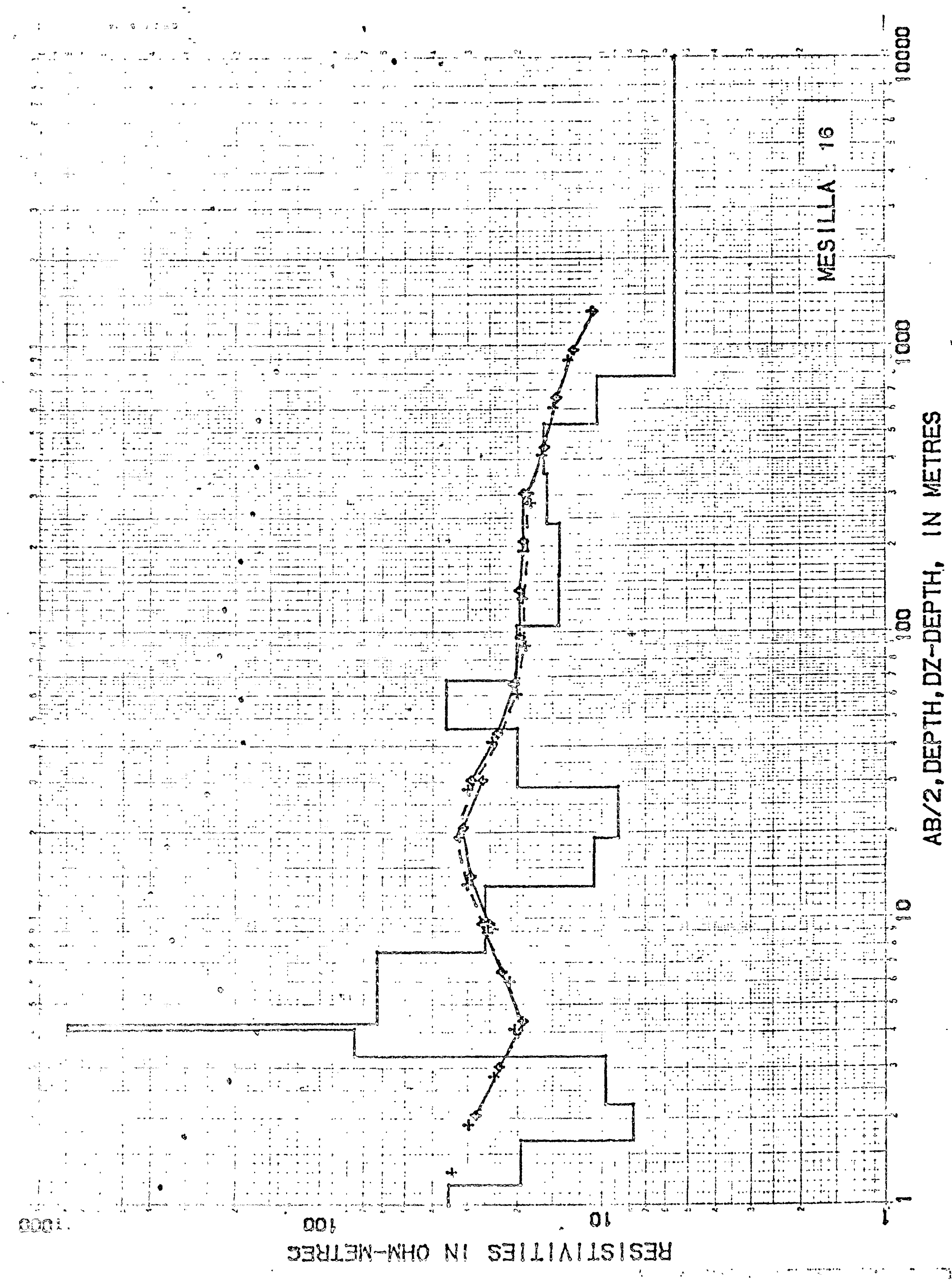

MESILLA 13
AB/2, DEPTH, DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
1
10
100
1000
10000

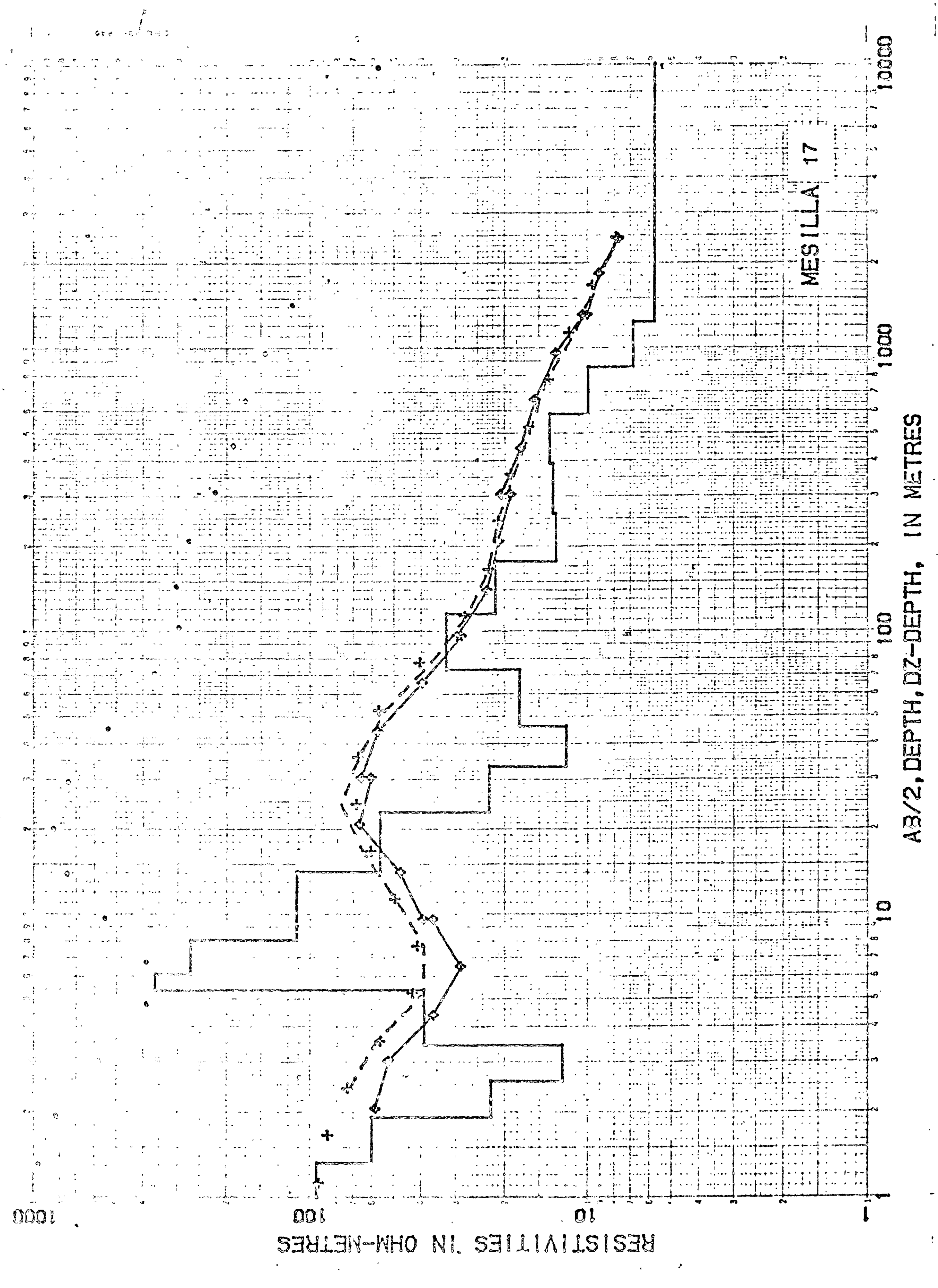


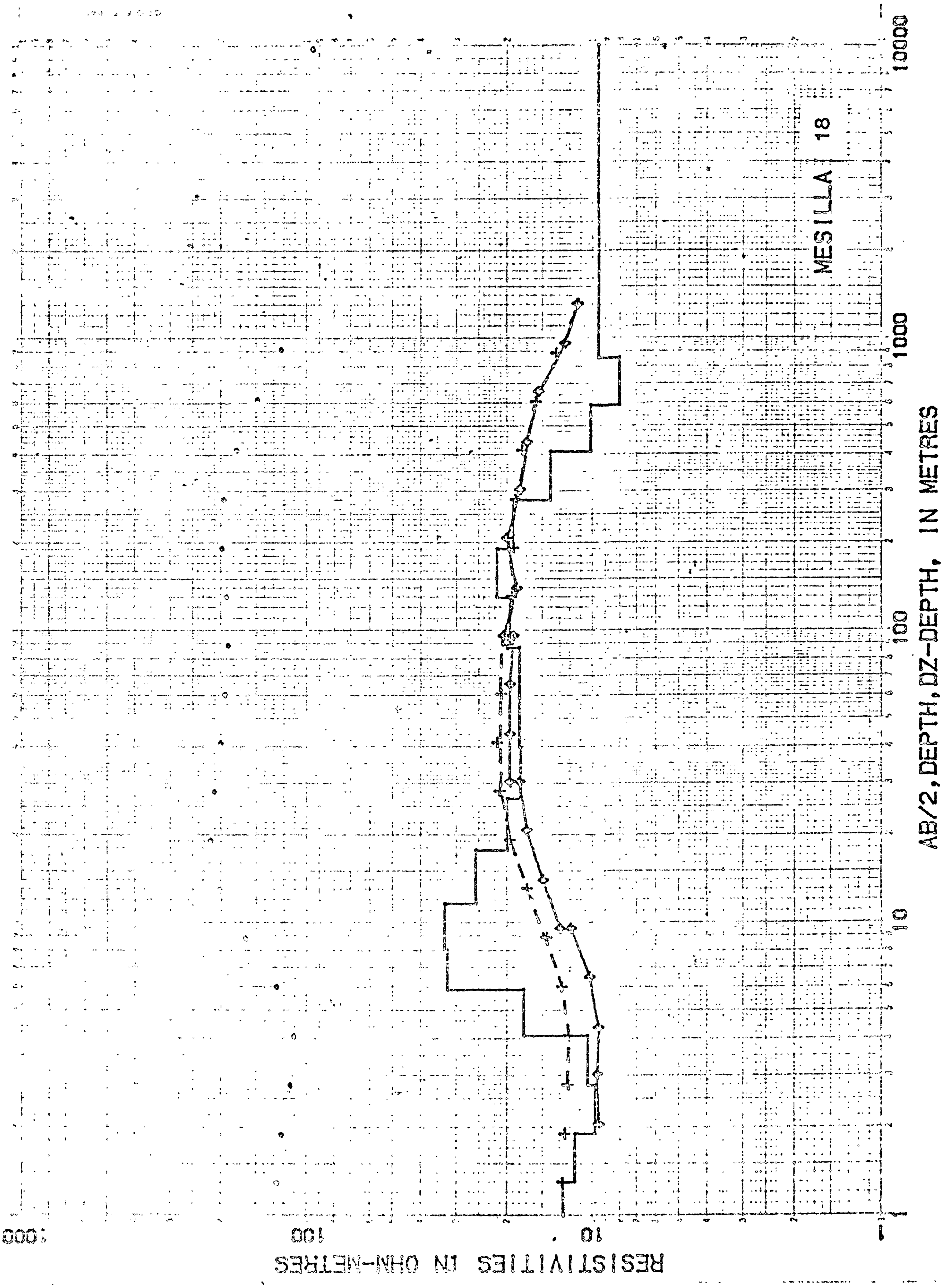
1000
100
10
1
RESISTIVITIES IN OHM-METRES
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH, IN METRES
Curve is strongly distorted
by fence, buried cables,
or pipeline
MESILLA 14



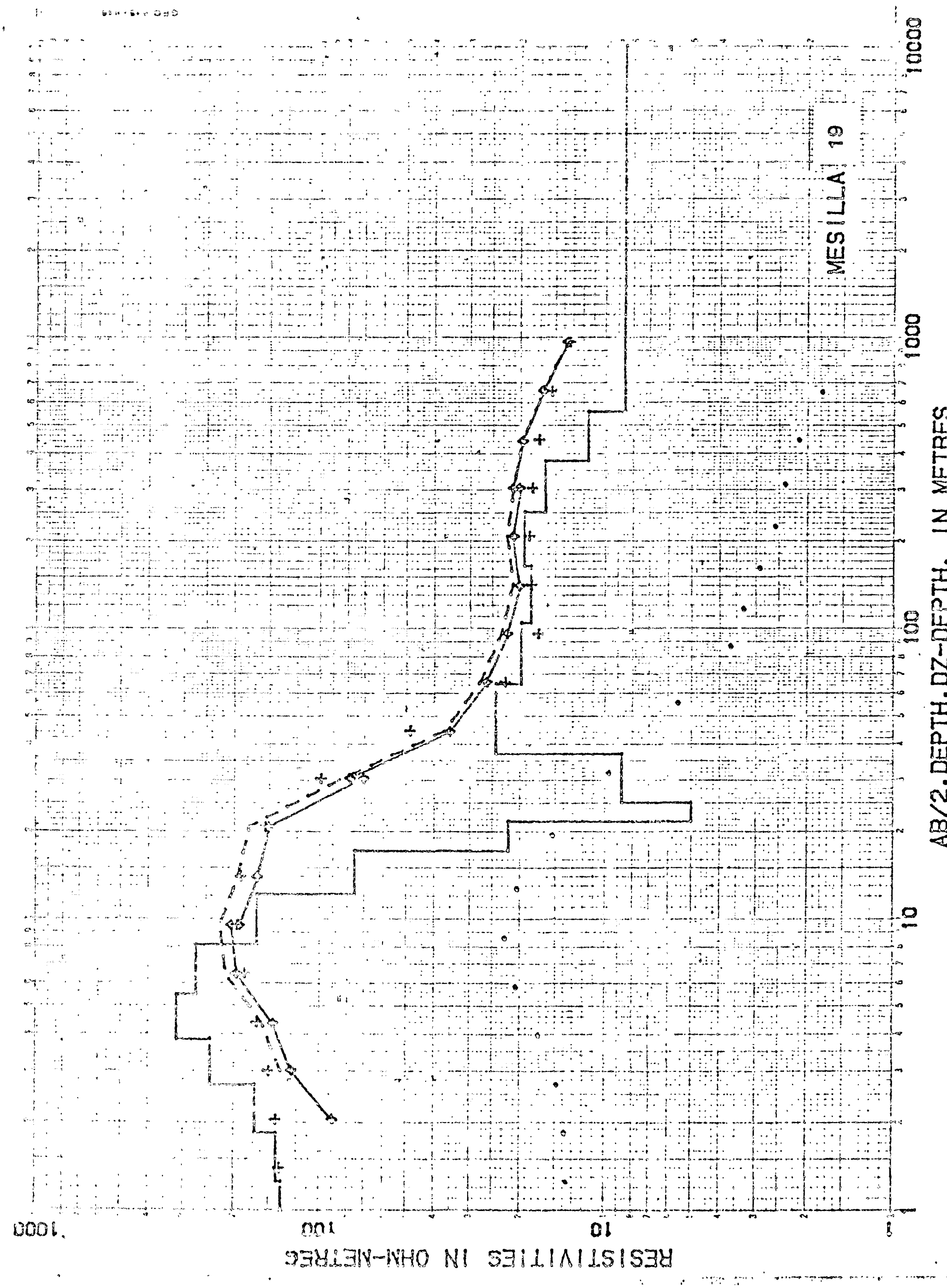
RESISTIVITIES IN OHM-METRES
1000
100
10
1
AB/2, DEPTH, DZ-DEPTH, IN METRES
1
10
100
1000
10000
MESILLA 15

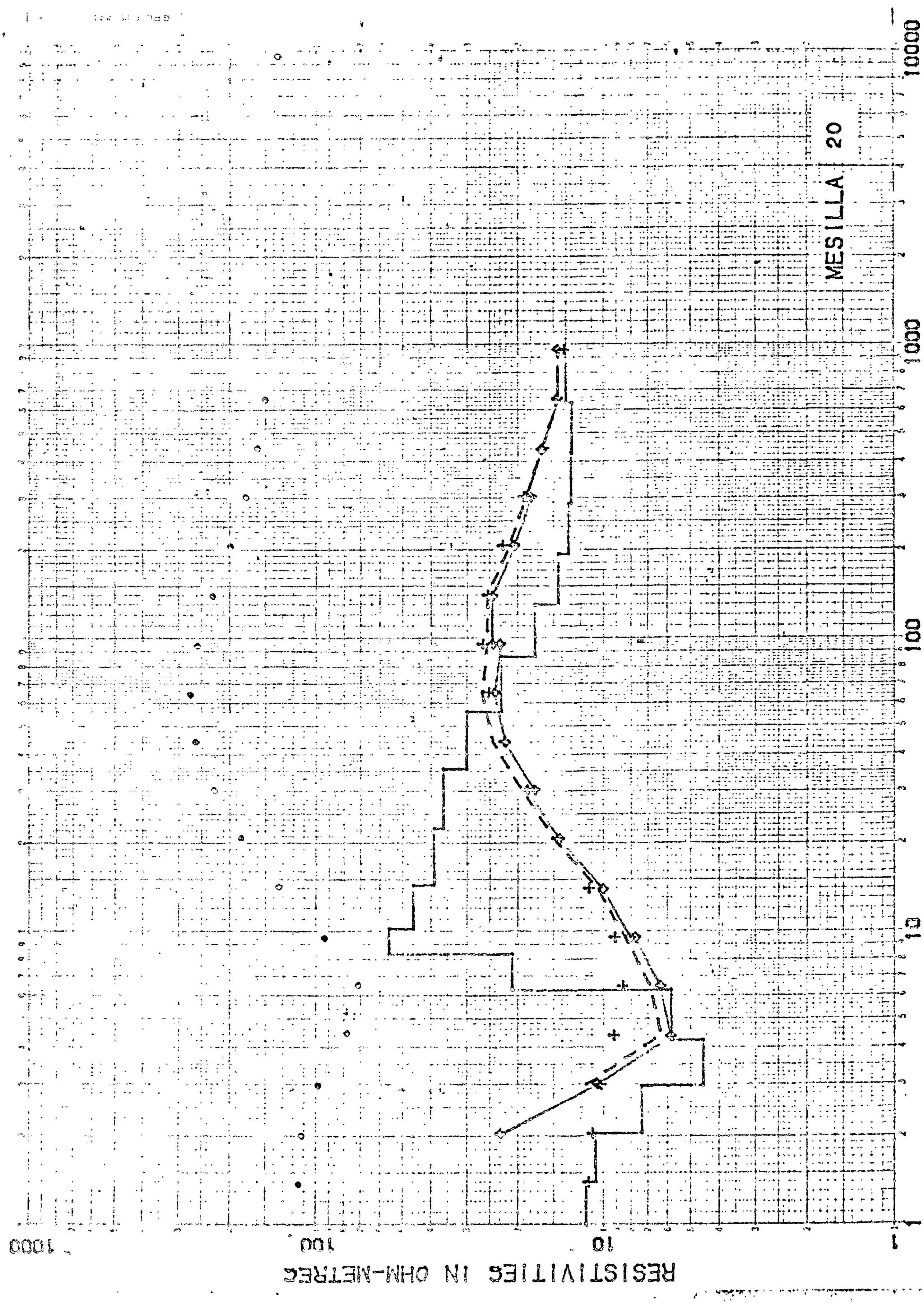

MESILLA 16
AB/2, DEPTH, DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
1
10
100
1000
10000

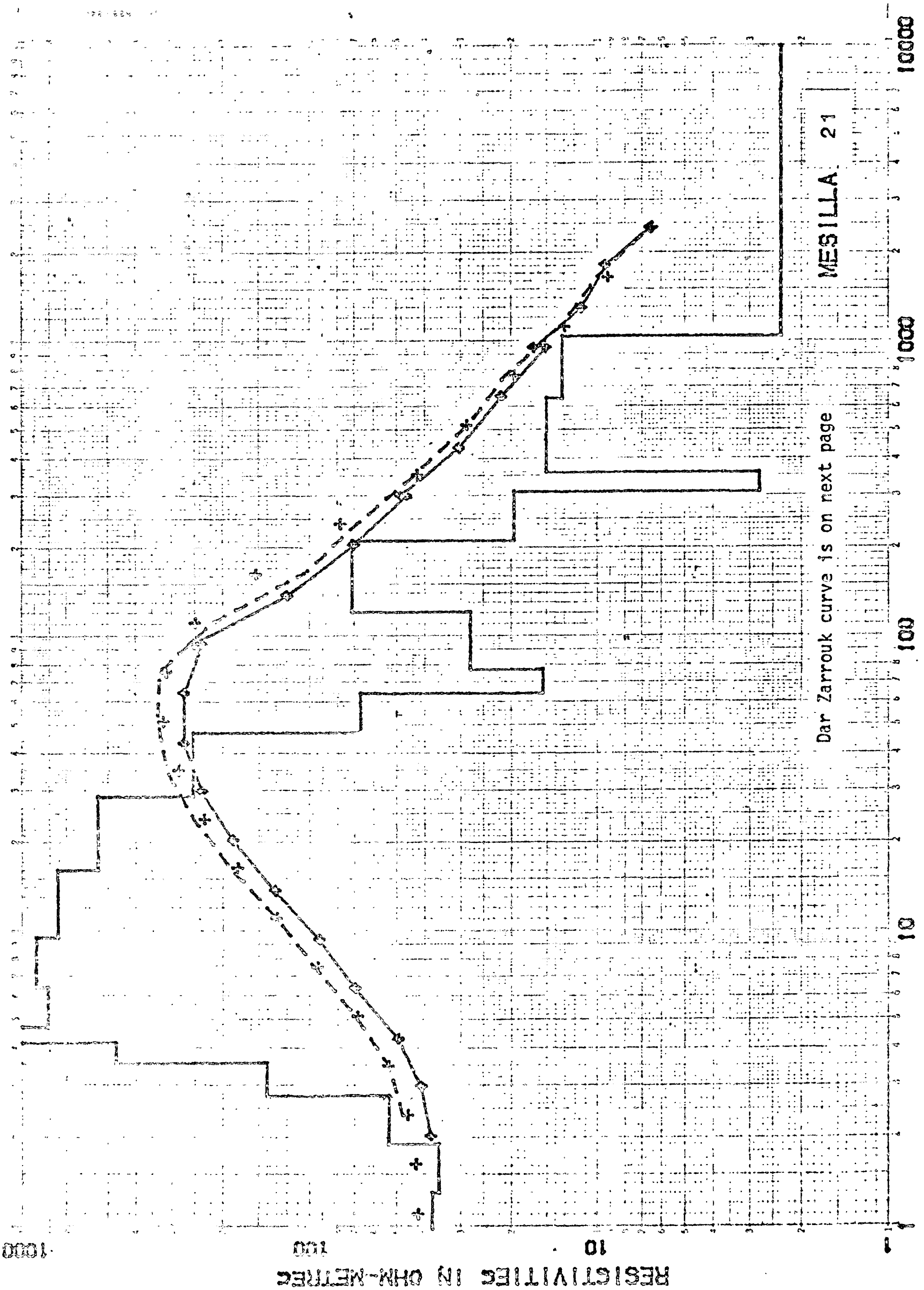

MESILLA 17
AB/2, DEPTH, DZ-DEPTH, IN METRES
1
10
100
1000
10000
RESISTIVITIES IN OHM-METRES
1000
100
10
1

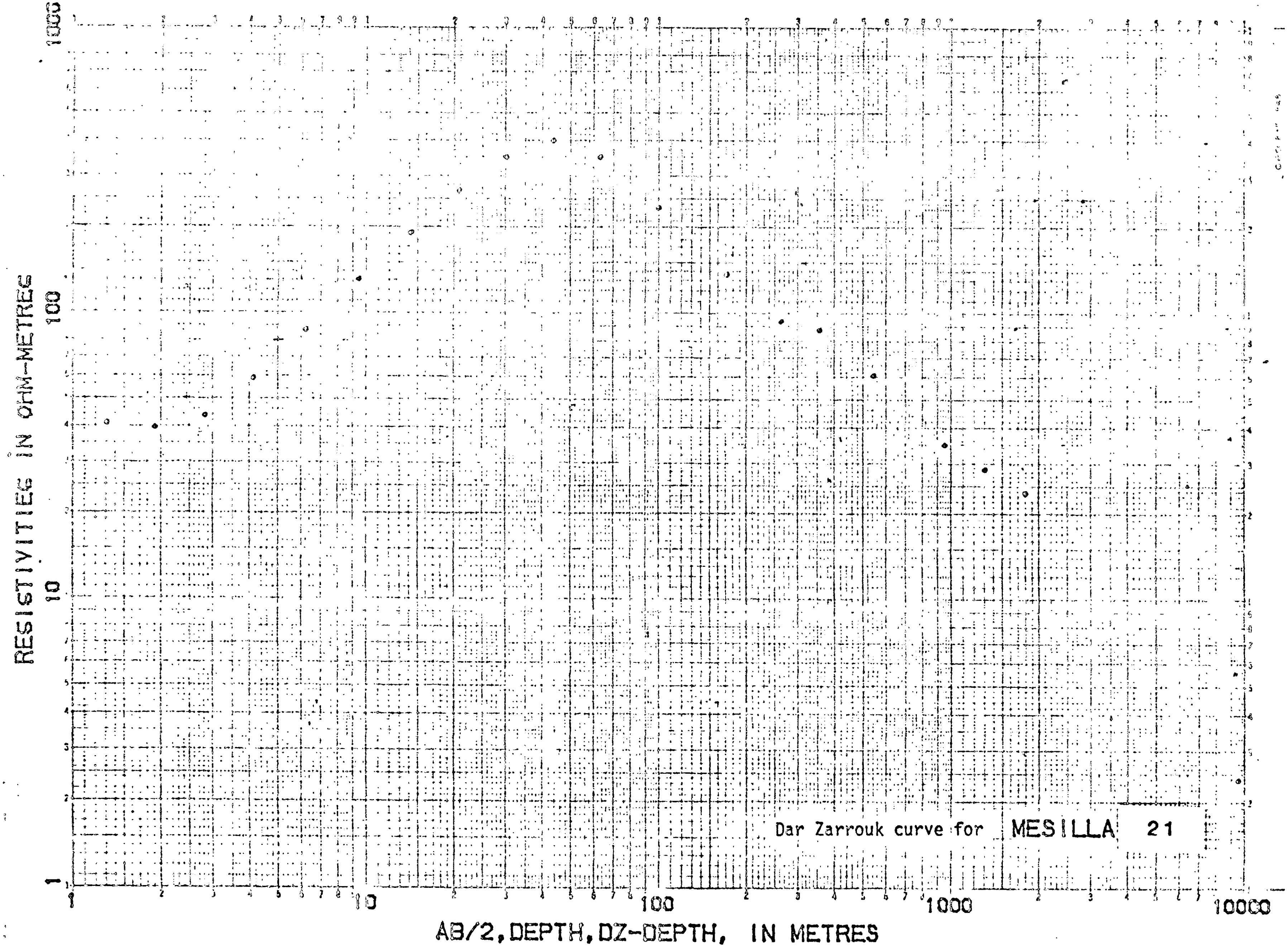


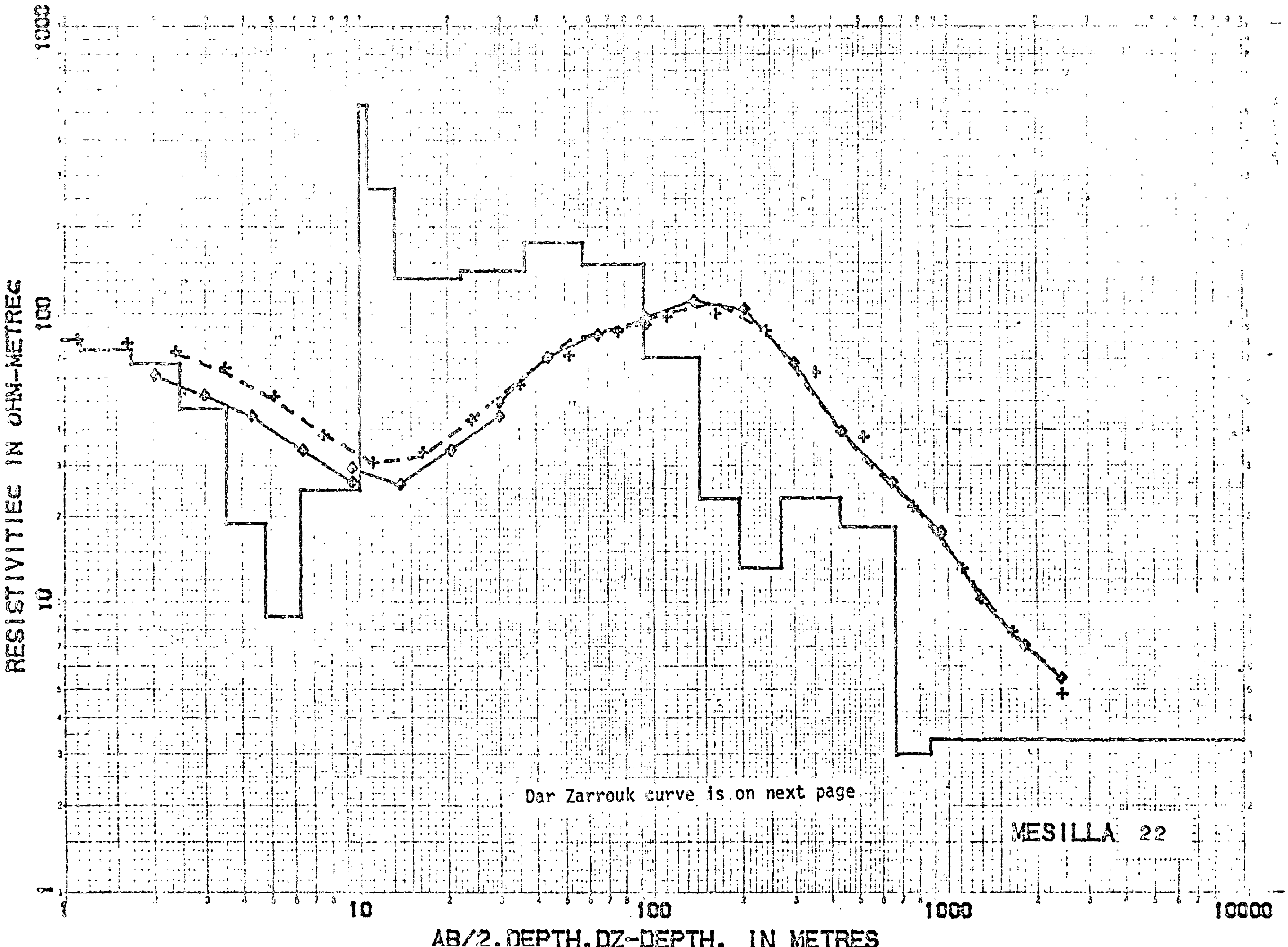
MESILLA 18
AB/2, DEPTH, DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
1
10
100
1000
10000

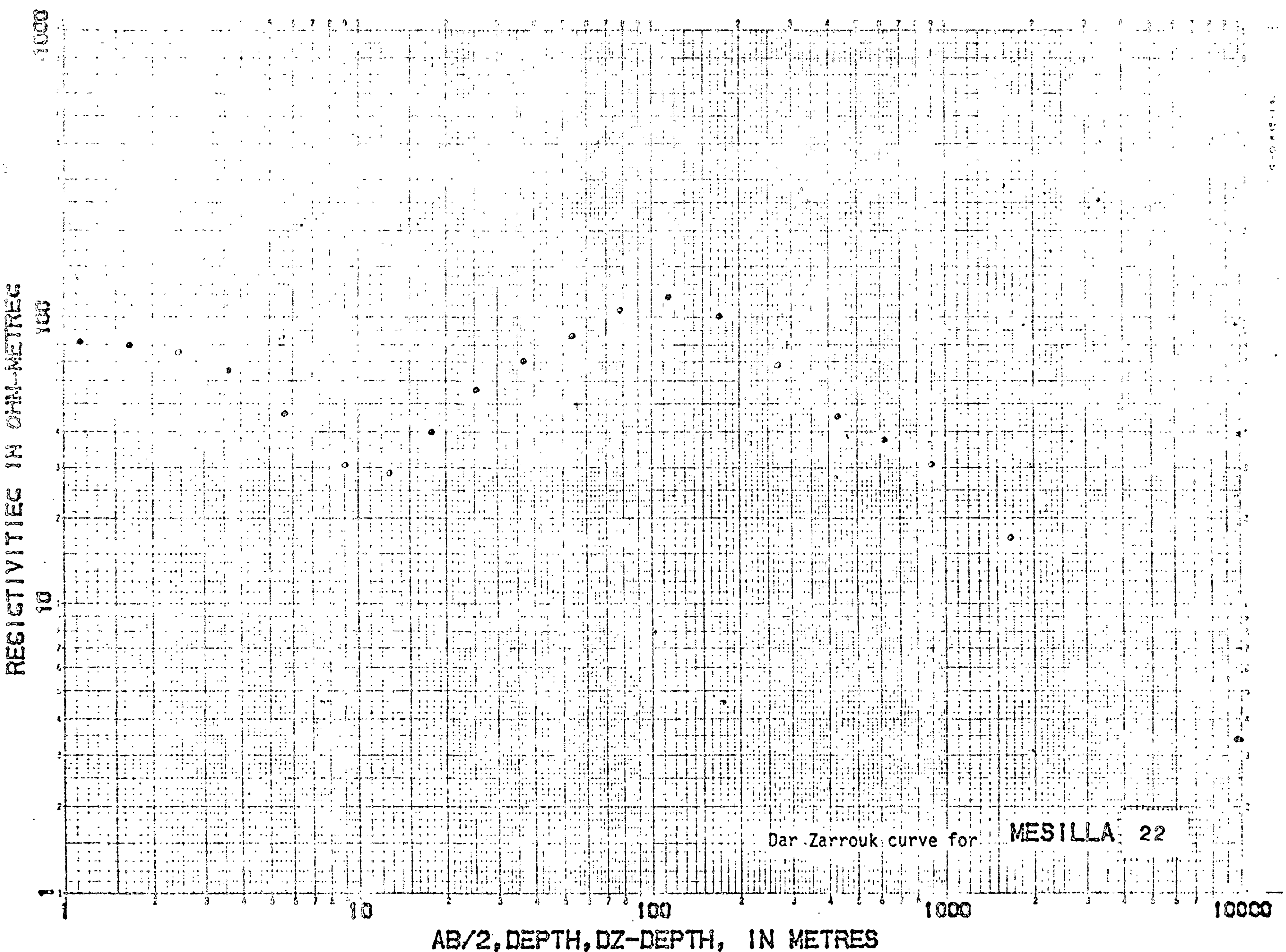

MESILLA 19
AB/2, DEPTH, DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
10
100
1000
10000
1000
100
10
1

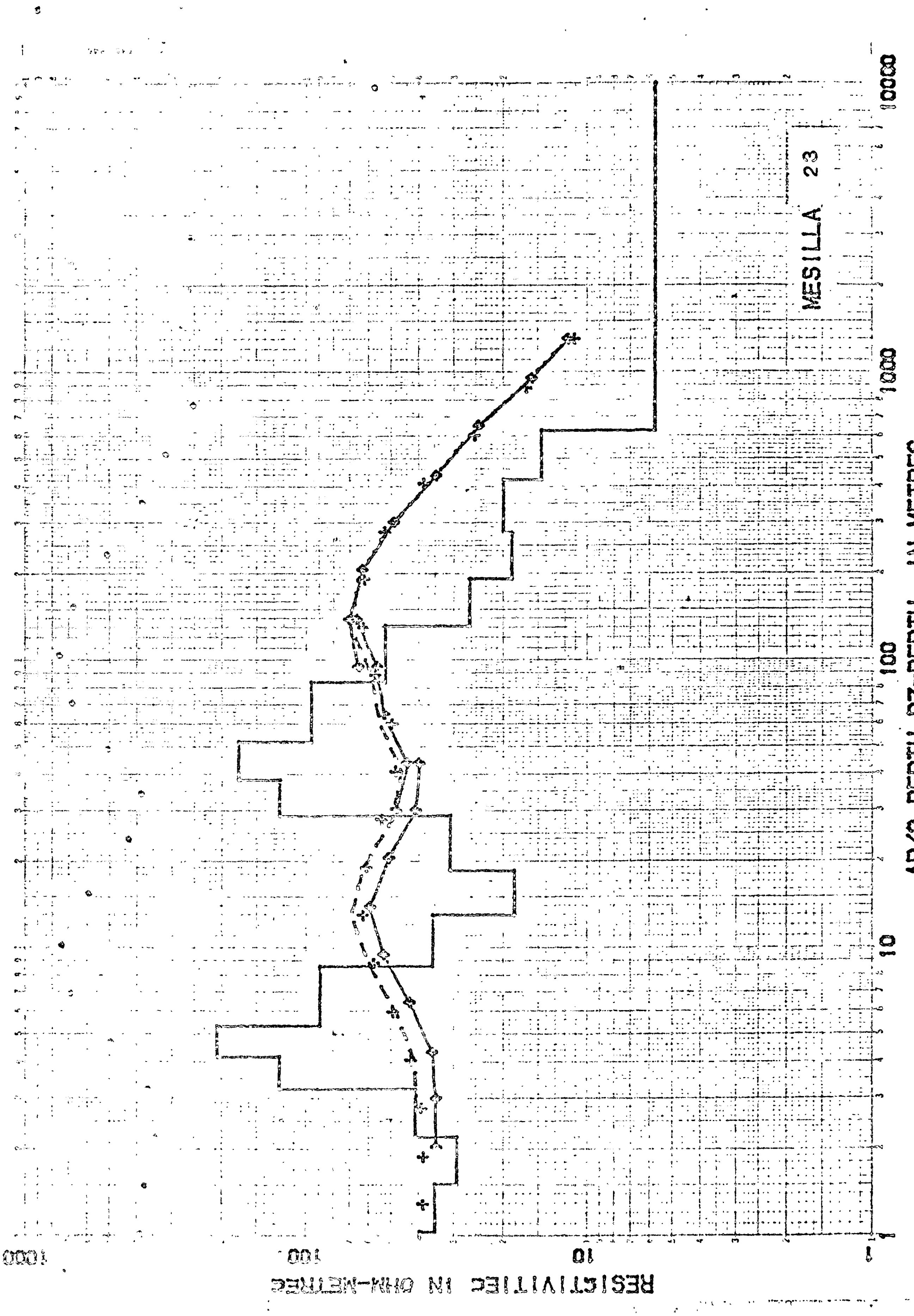

MESILLA 20
AB/2, DEPTH, DZ-DEPTH, IN METRES
1
10
100
1000
10000
RESISTIVITIES IN OHM-METRES
1000
100
10
1

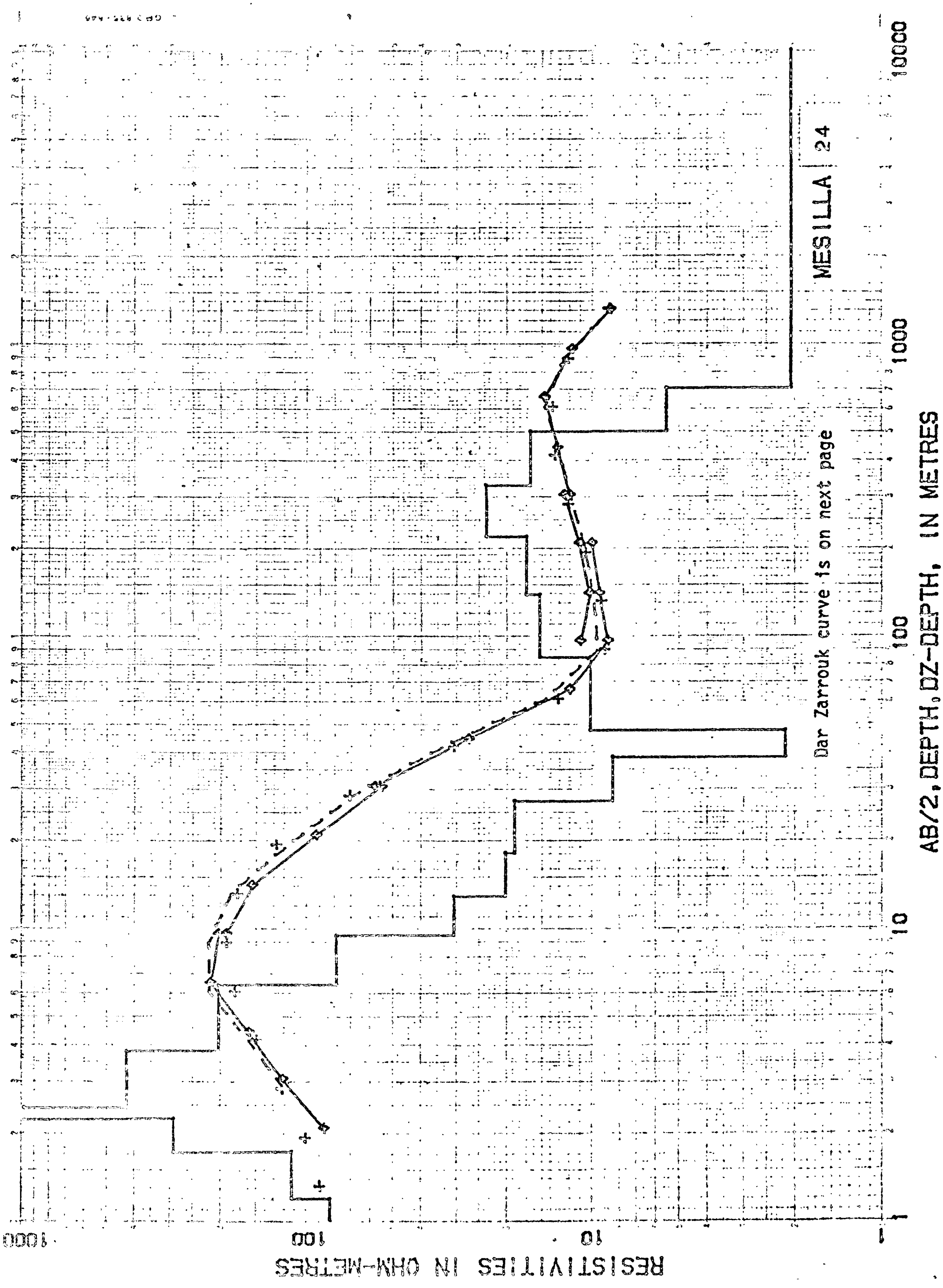

MESILLA 21
Dar Zarrouk curve is on next page
AB/2.DEPTH.DZ-DEPTH. IN METRES
10
100
1000
10000
RESISTIVITIES IN OHM-METRES
1000
100
10
1


RESISTIVITIES IN OHM-METRES
1000
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH, IN METRES
Dar Zarrouk curve for MESILLA 21

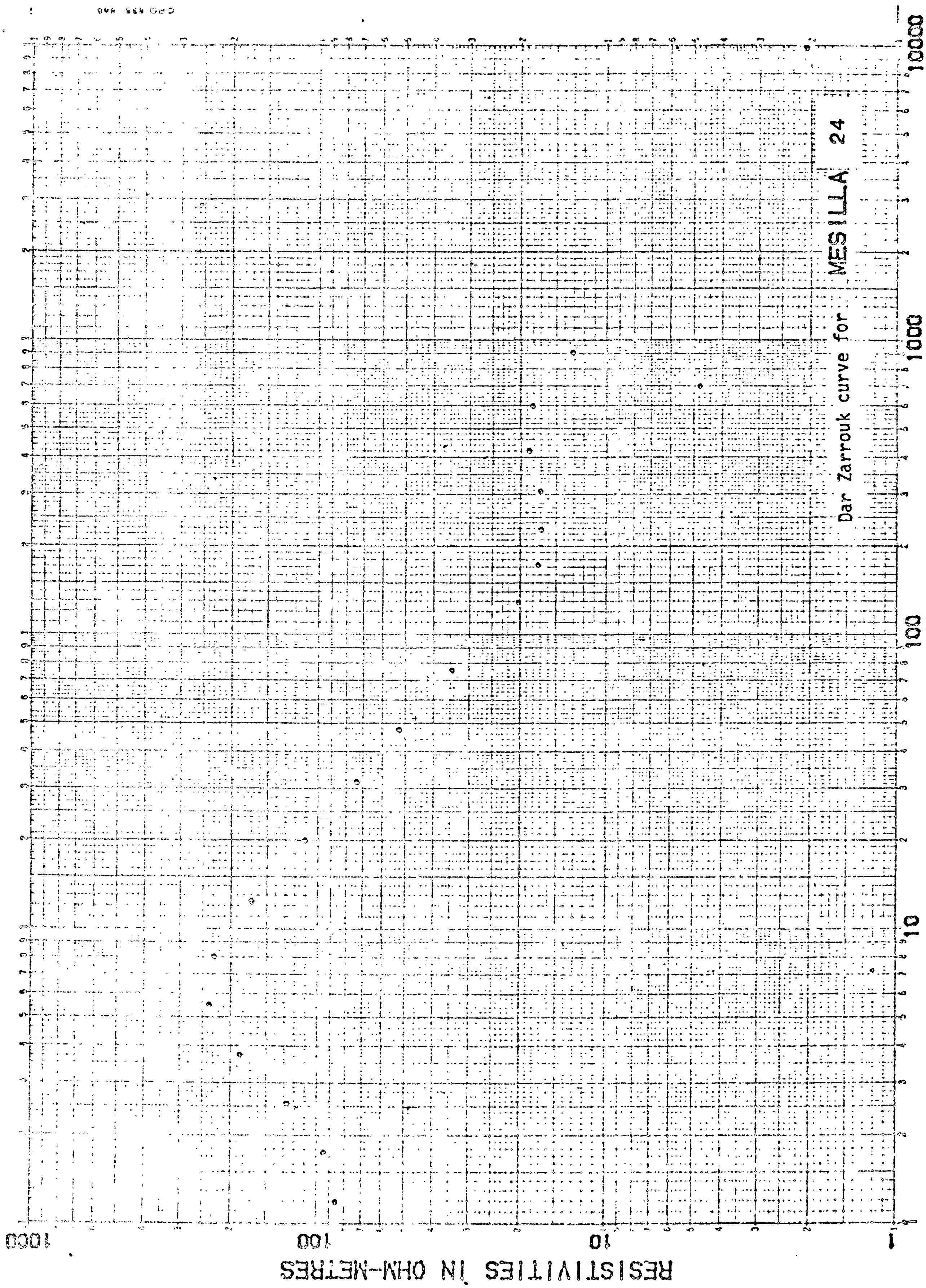

RESISTIVITIES IN OHM-METRES
1000
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH, IN METRES
Dar Zarrouk curve is on next page
MESILLA 22

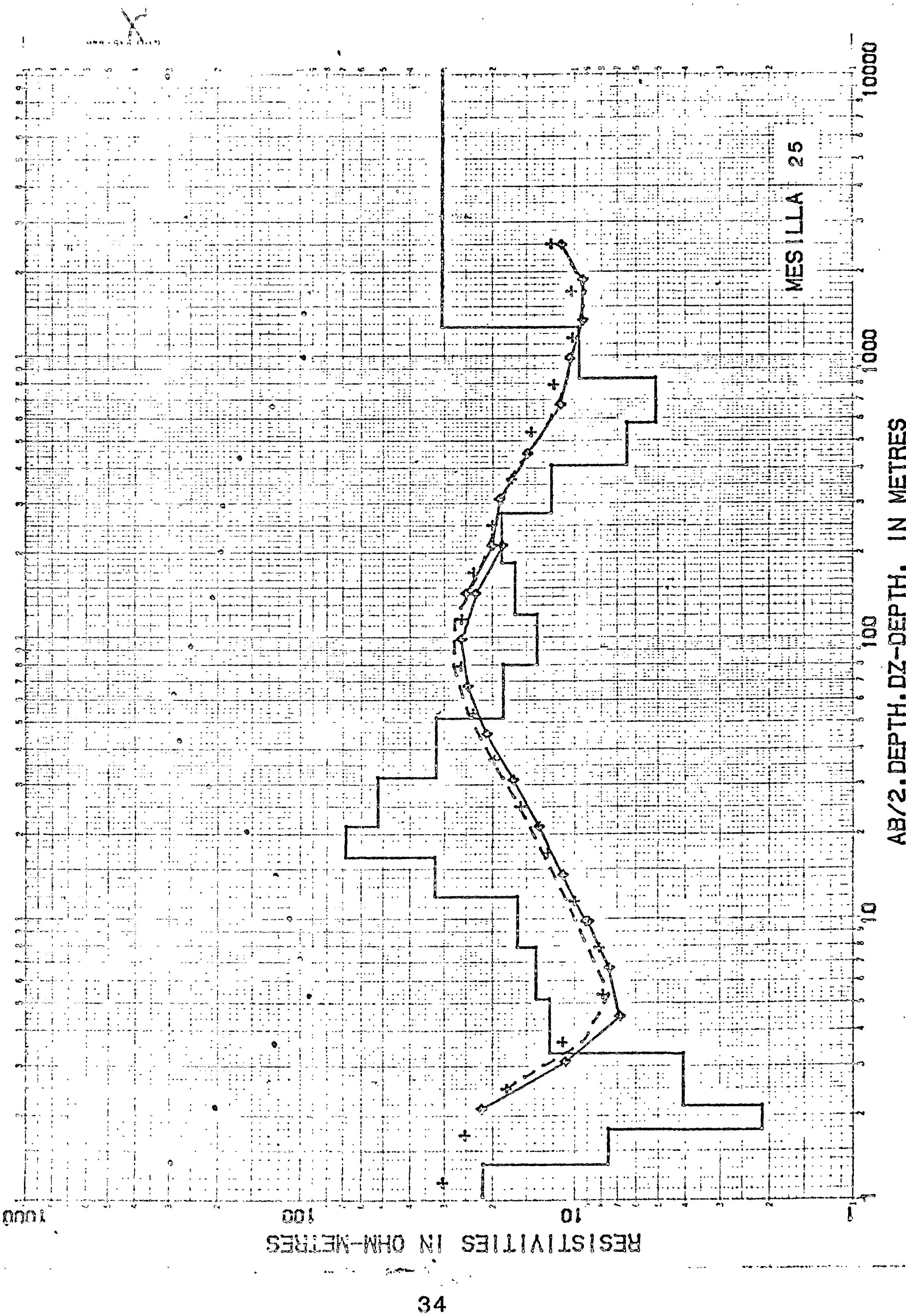

RESISTIVITIES IN OHM-METRES
1000
100
10
1
10
100
1000
10000
Dar Zarrouk curve for MESILLA 22
AB/2, DEPTH, DZ-DEPTH, IN METRES

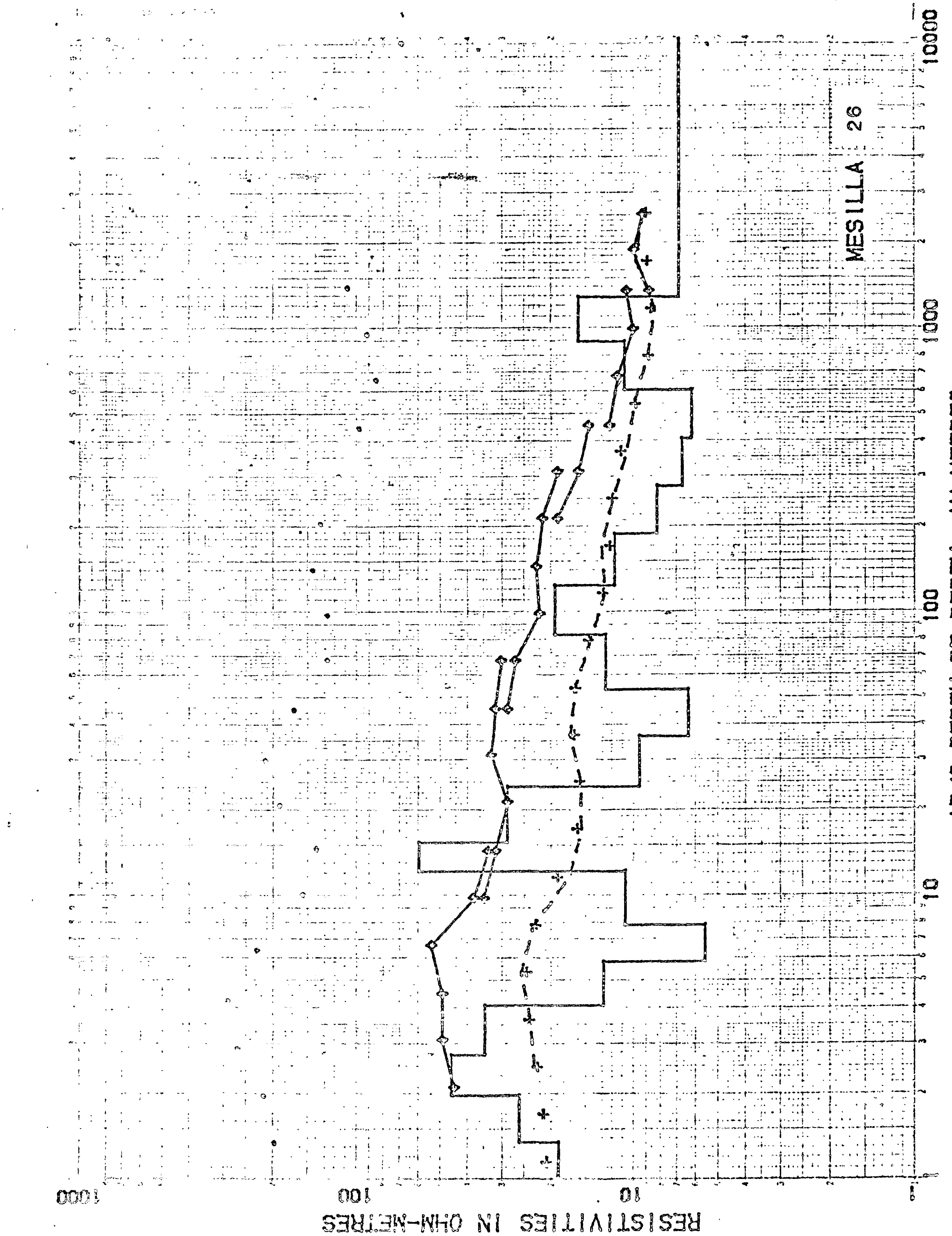

MESILLA 23
AB/2, DEPTH, DZ-DEPTH, IN METRES
1
10
100
1000
10000
RESISTIVITIES IN OHM-METRES
1000
100
10
1

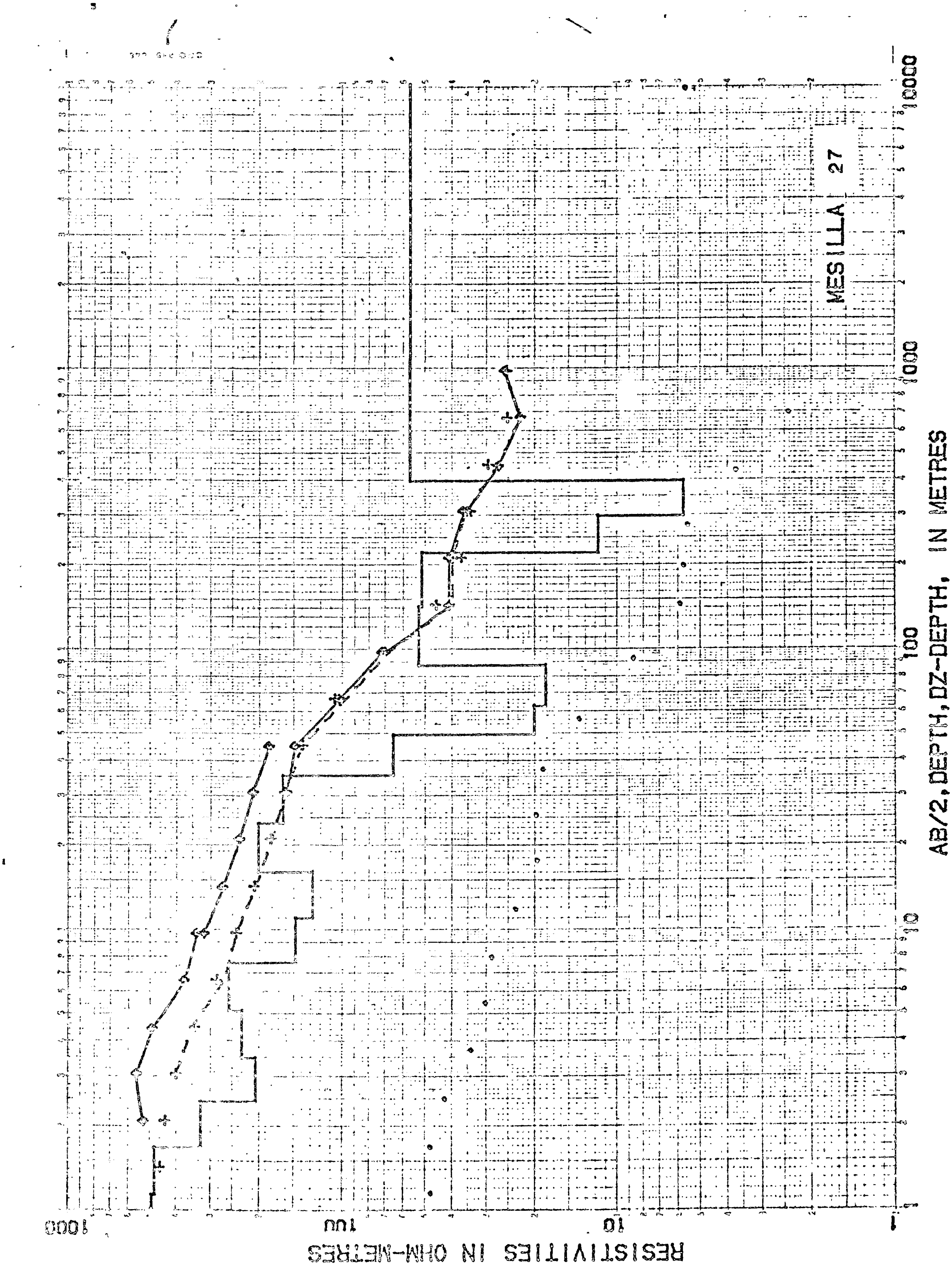


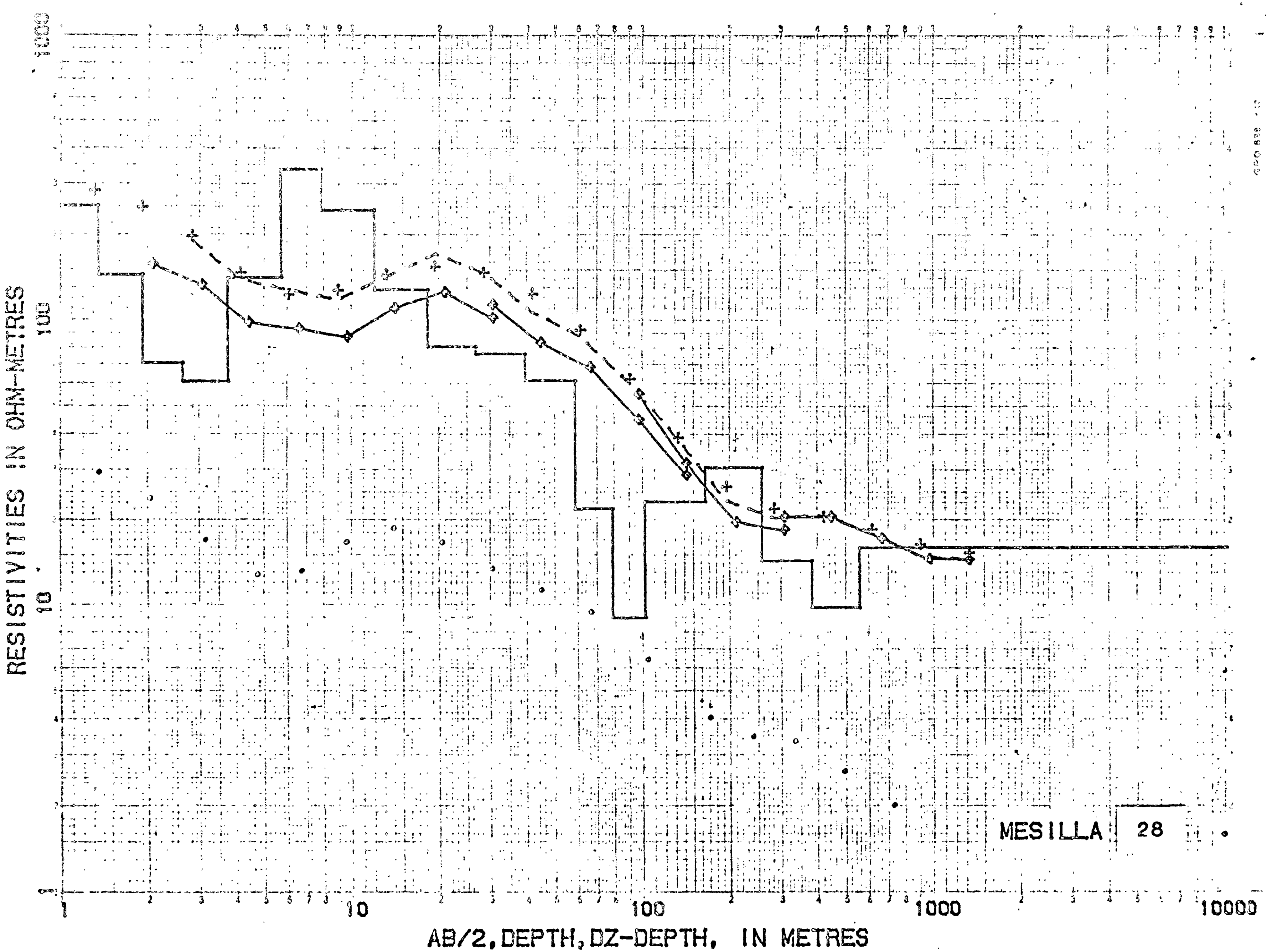
MESILLA 24
Dar Zarrouk curve is on next page
AB/2, DEPTH, DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
1
10
100
1000
10000

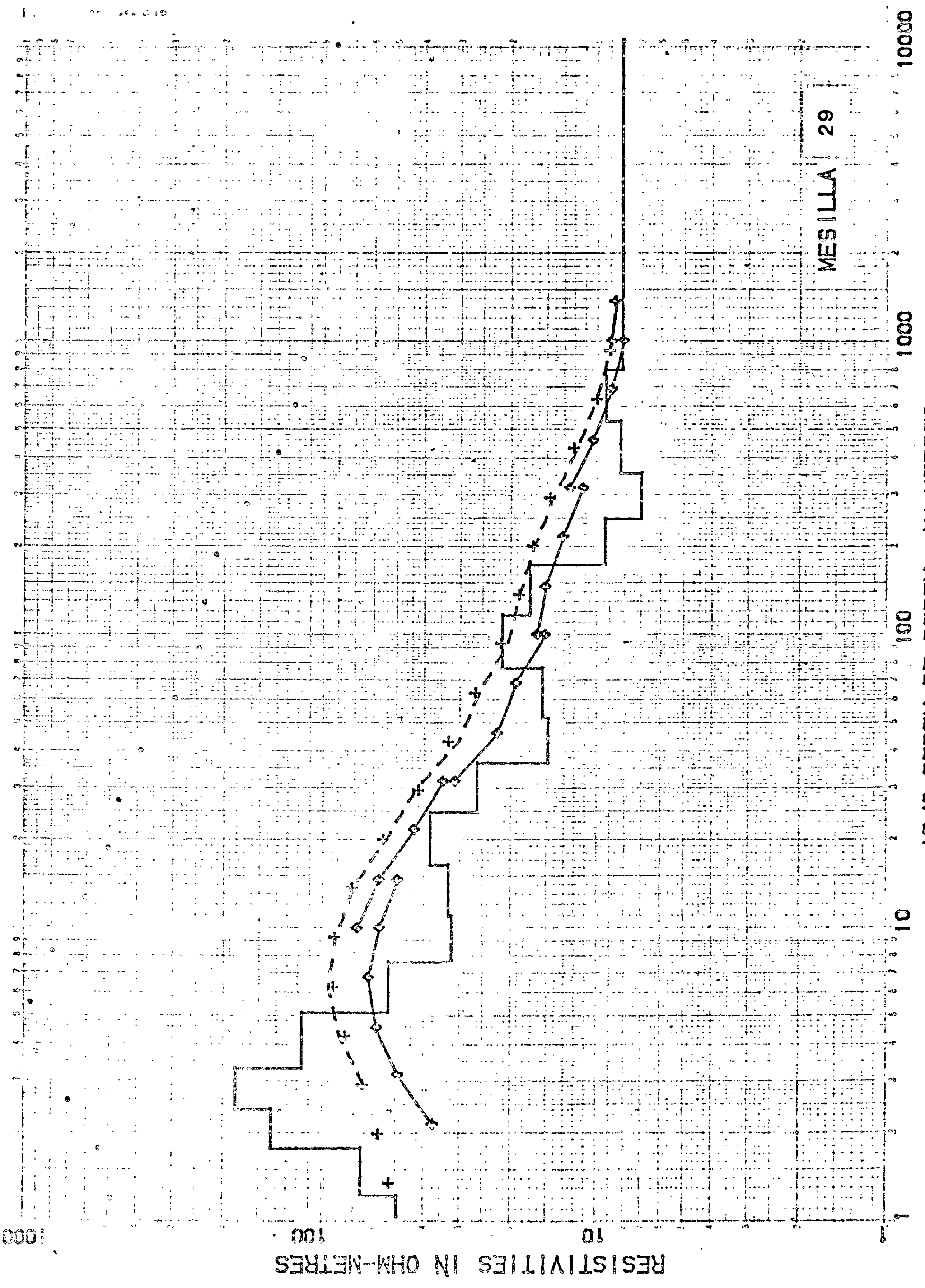

Dar Zarrouk curve for MESILLA 24
AB/2, DEPTH, DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
1
10
100
1000
10000

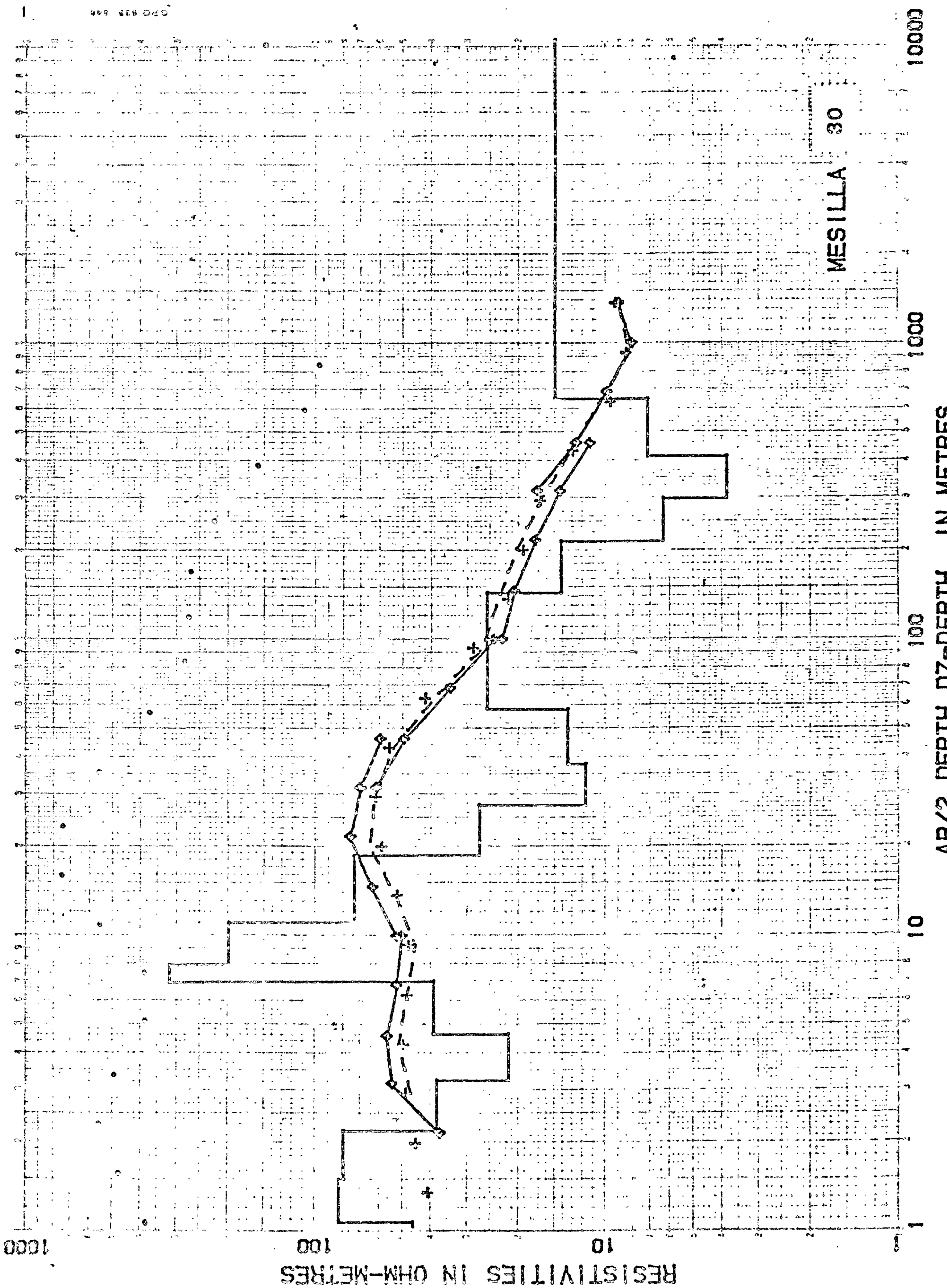

MESILLA 25
AB/2.DEPTH.DZ-DEPTH. IN METRES
1
10
100
1000
10000
RESISTIVITIES IN OHM-METRES
1000
100
10
1

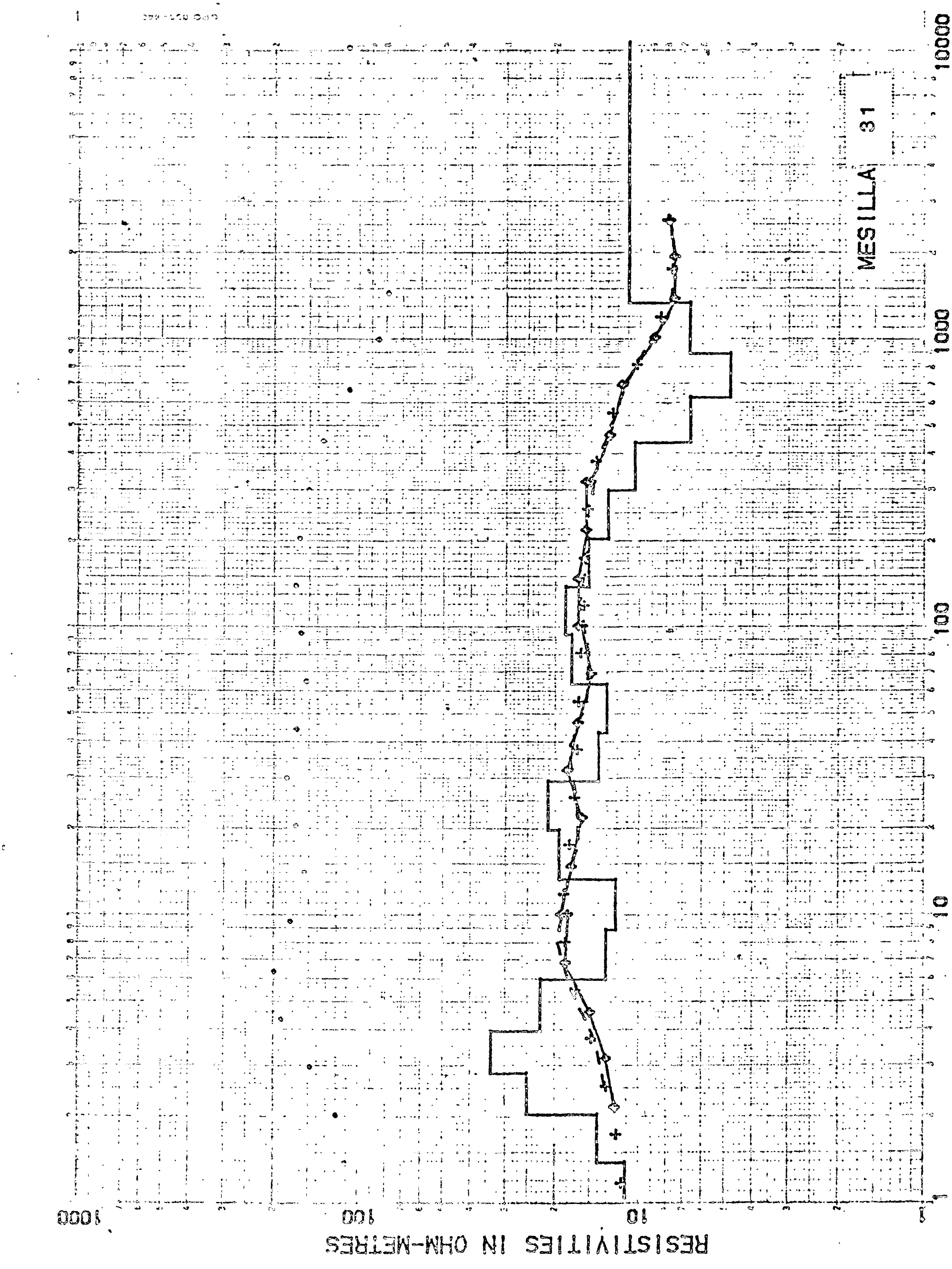

MESILLA 26
AB/2, DEPTH, DZ-DEPTH, IN METRES
1
10
100
1000
10000
RESISTIVITIES IN OHM-METRES
1000
100
10
1

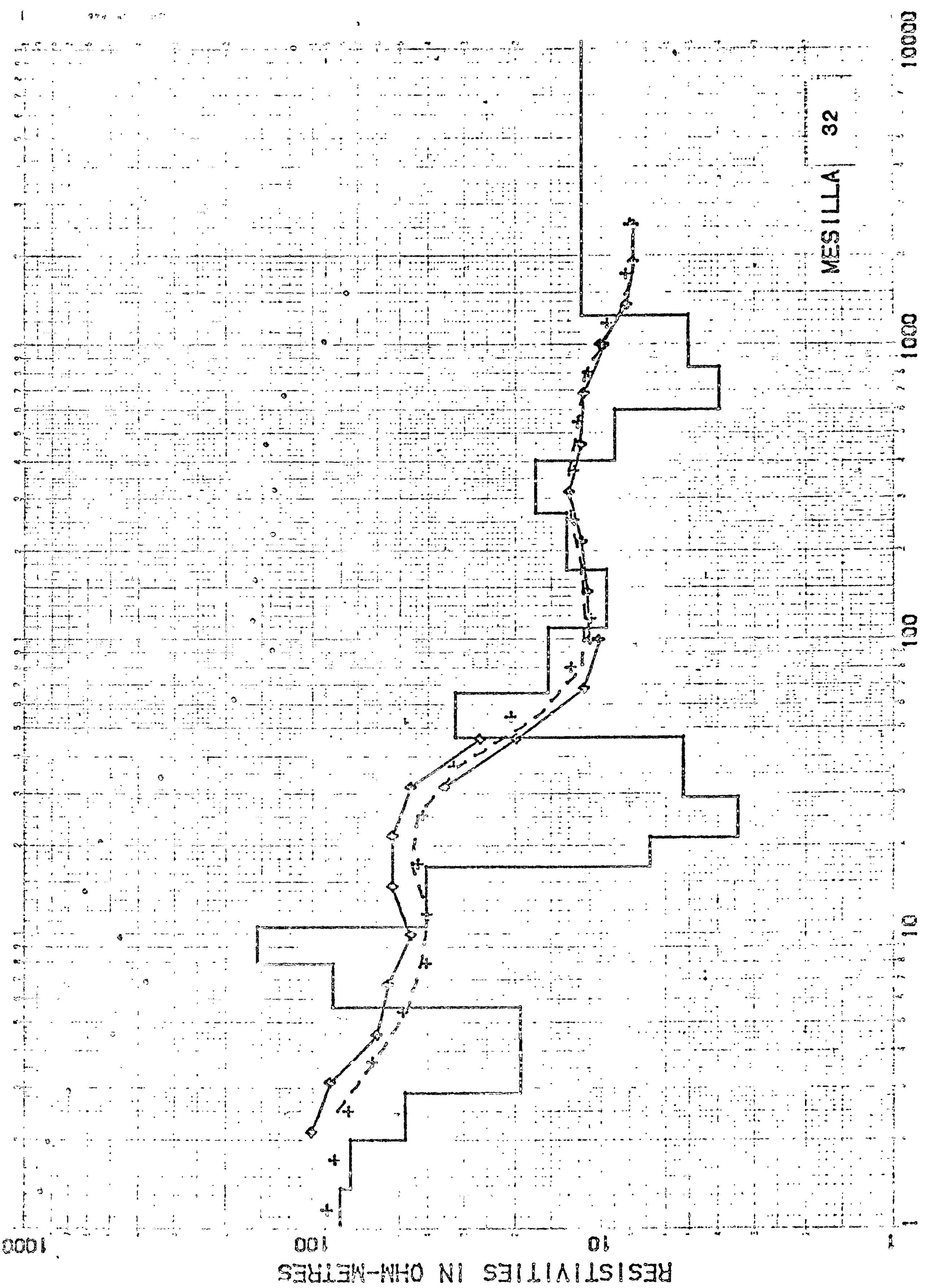

MESILLA 27
AB/2, DEPTH, DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
1000
100
10
1
10
100
1000
10000

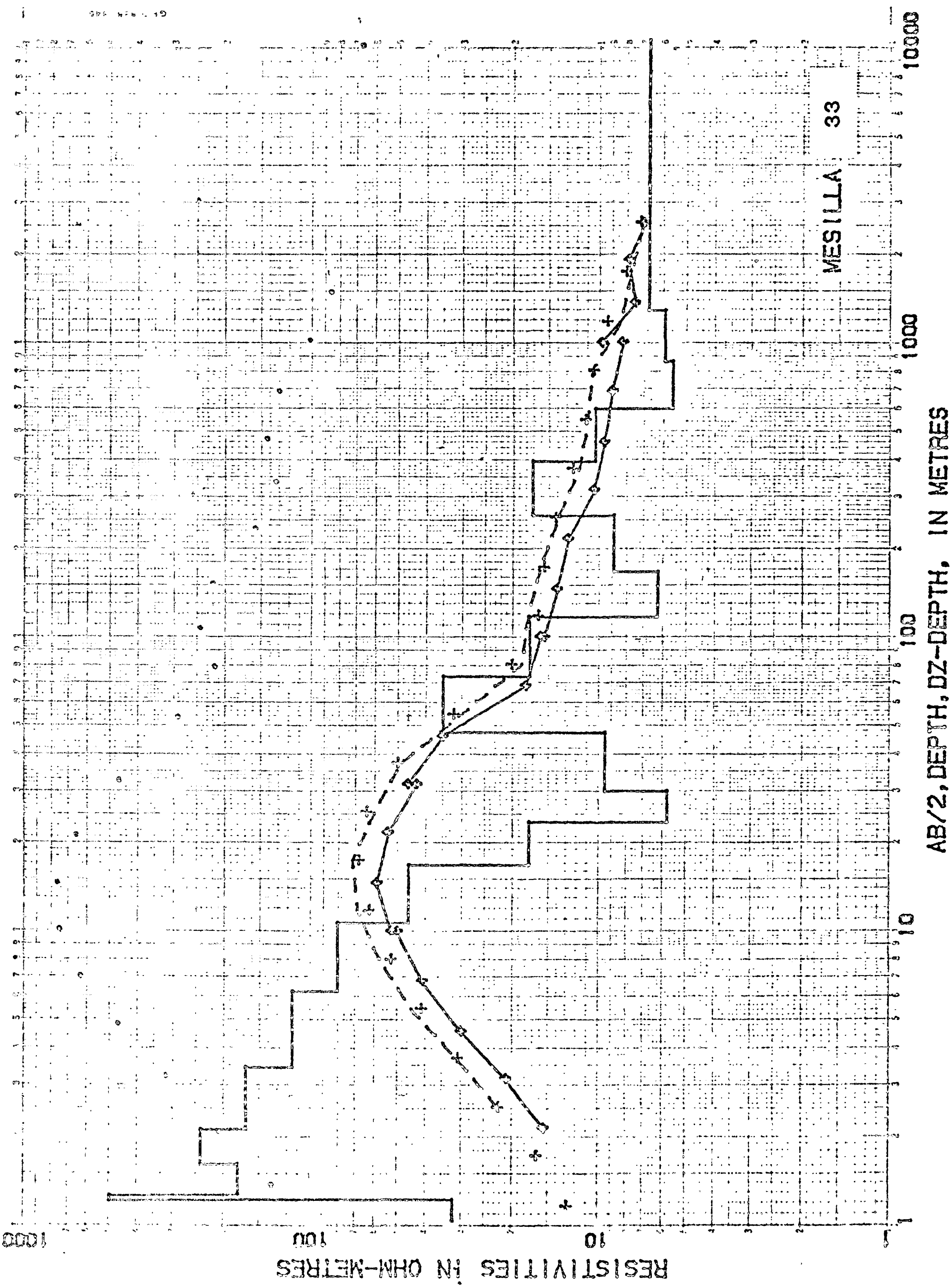

MESILLA 28
RESISTIVITIES IN OHM-METRES
1000
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH, IN METRES

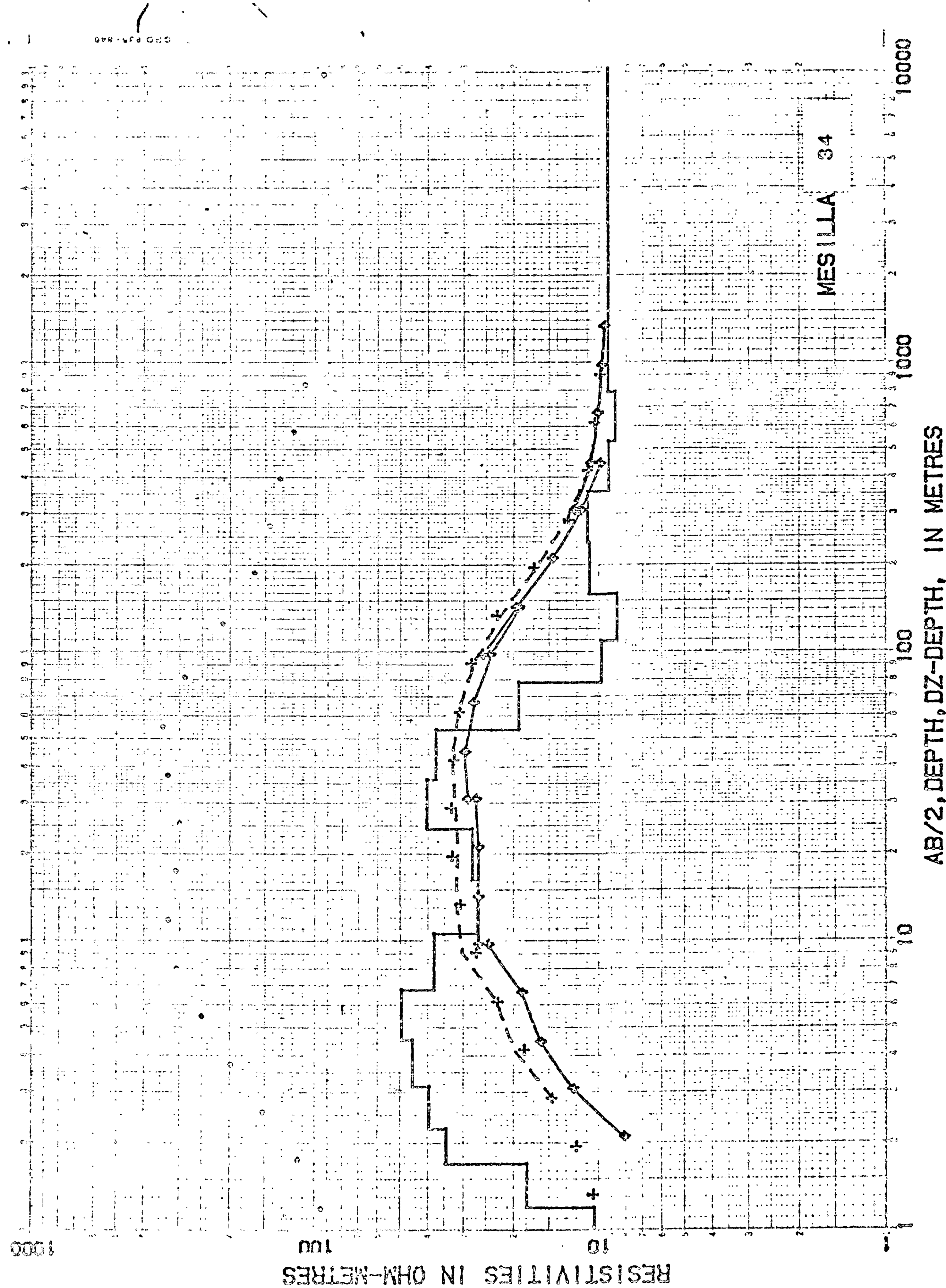

MESILLA 29
AB/2, DEPTH, DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
1000
100
10
1
10000

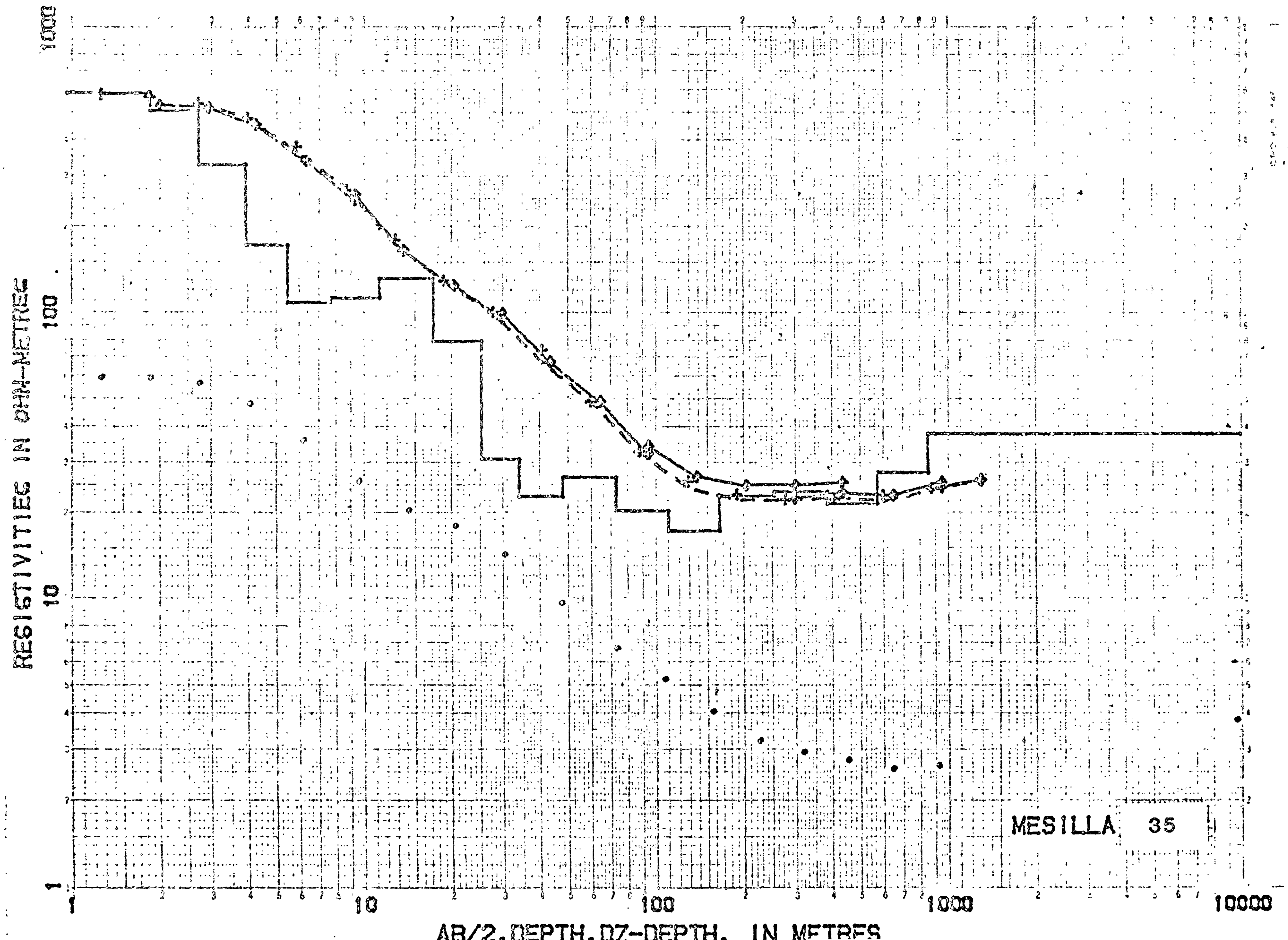

MESILLA
30
AB/2.DEPTH.DZ-DEPTH. IN METRES
1
10
100
1000
10000
RESISTIVITIES IN OHM-METRES
1000
100
10
1

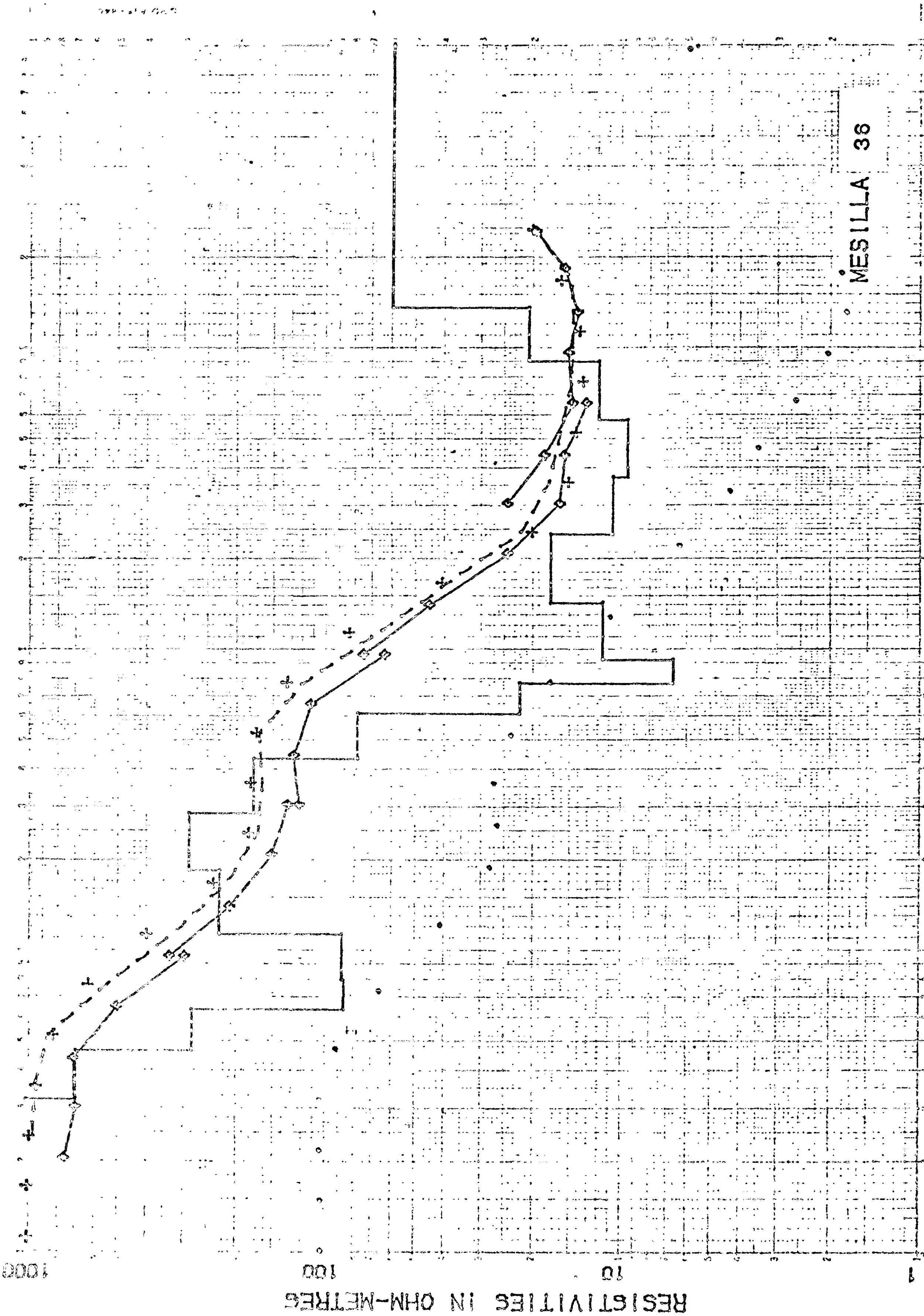

MESILLA 31
AB/2, DEPTH, DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
1
10
100
1000
10000
1000
100
10
1

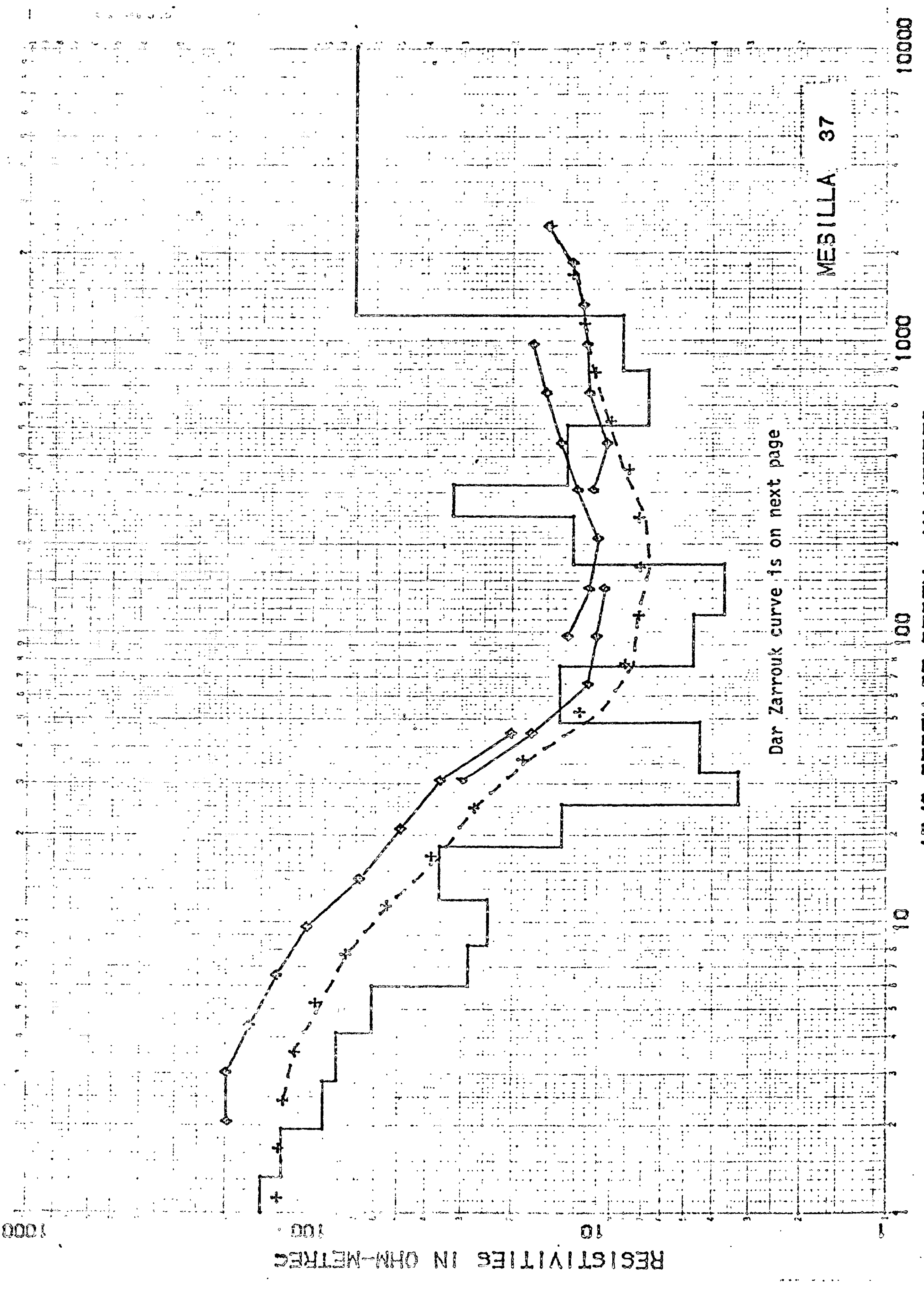

MESILLA
32
AB/2, DEPTH, DZ-DEPTH, IN METRES
1
10
100
1000
10000
RESISTIVITIES IN OHM-METRES
1000
100
10

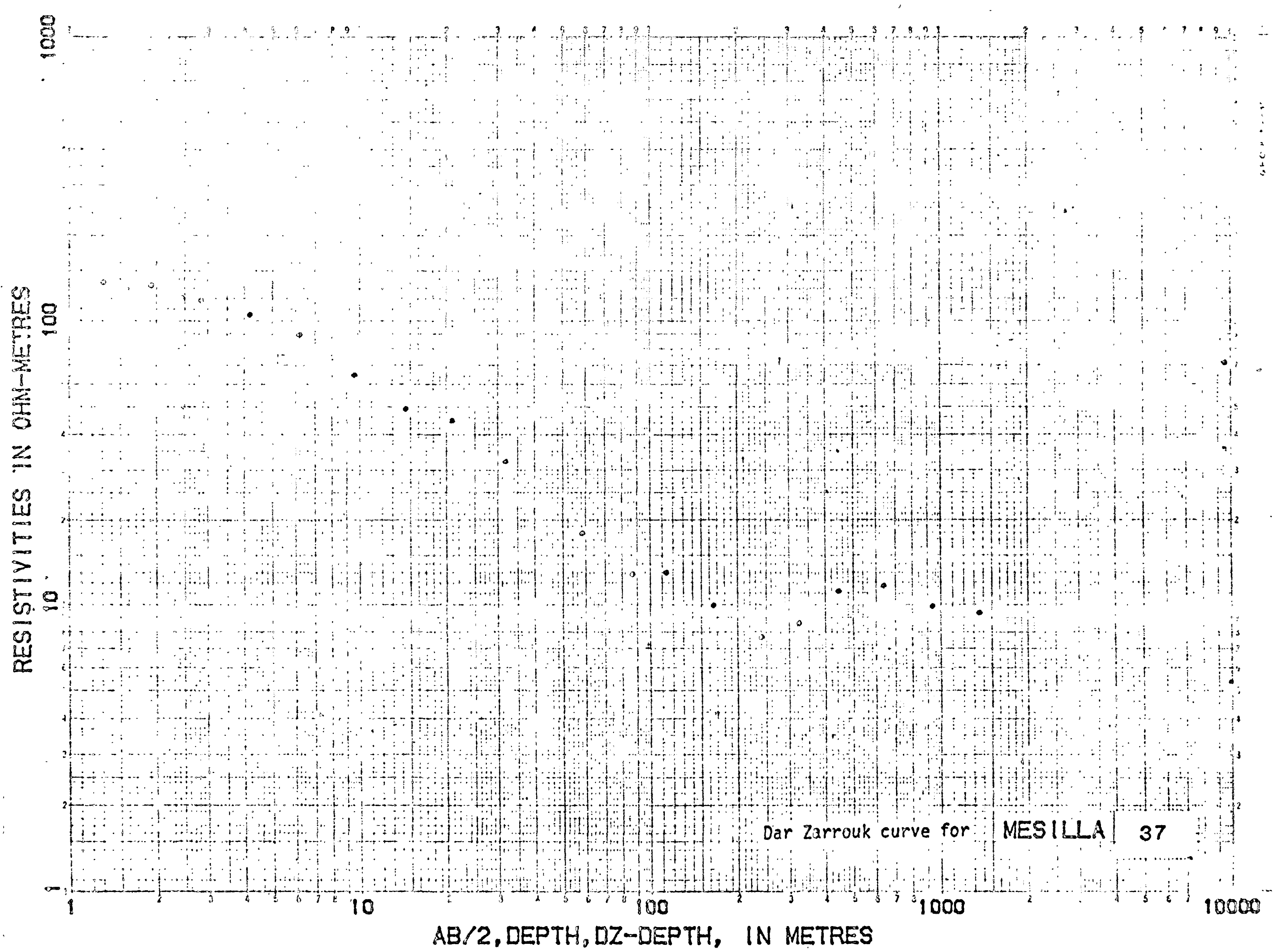

MESILLA 33
AB/2, DEPTH, DZ-DEPTH, IN METRES
1
10
100
1000
10000
RESISTIVITIES IN OHM-METRES
1000
100
10
1

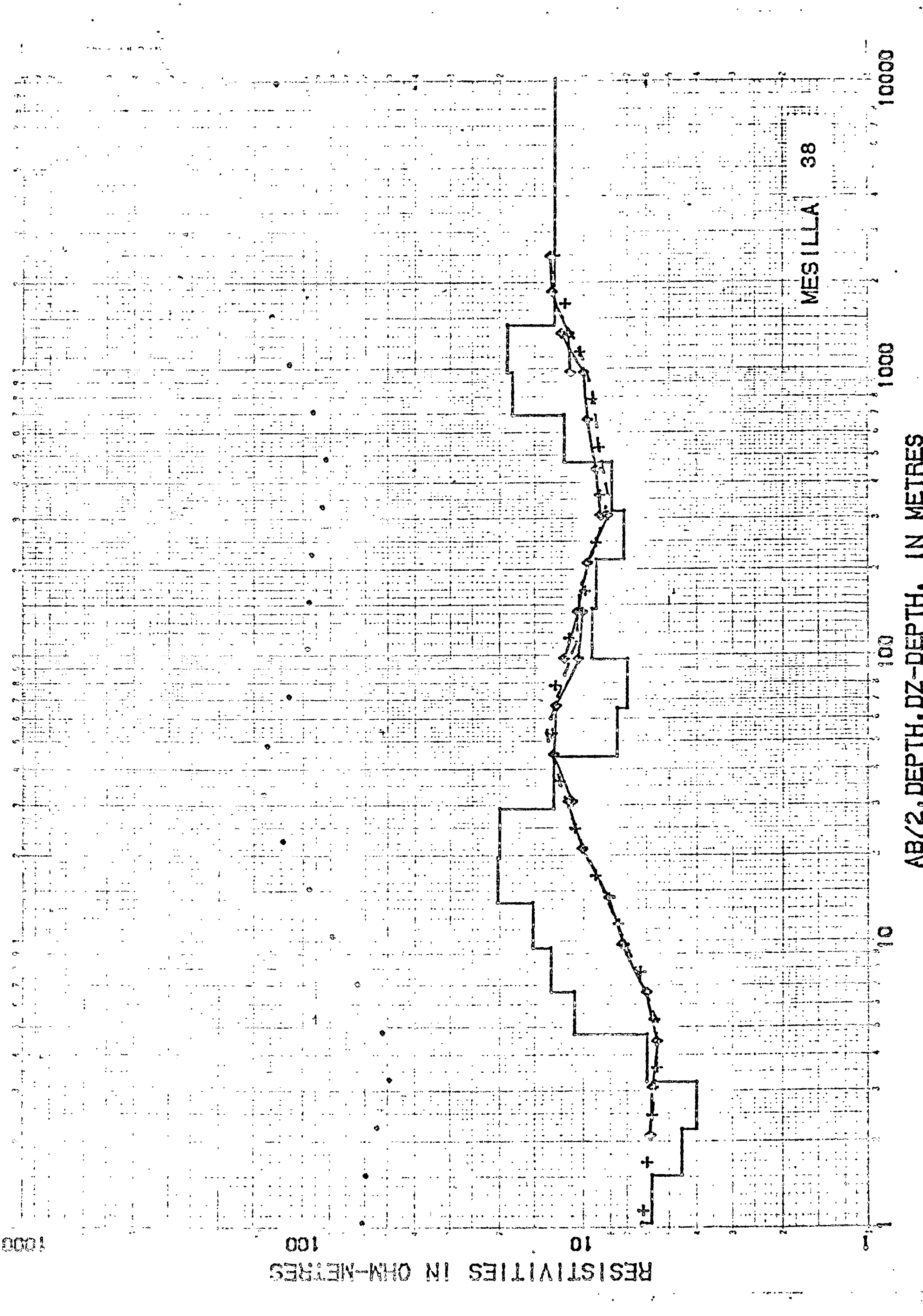

MESILLA 34
AB/2, DEPTH, DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
1
10
100
1000
10000

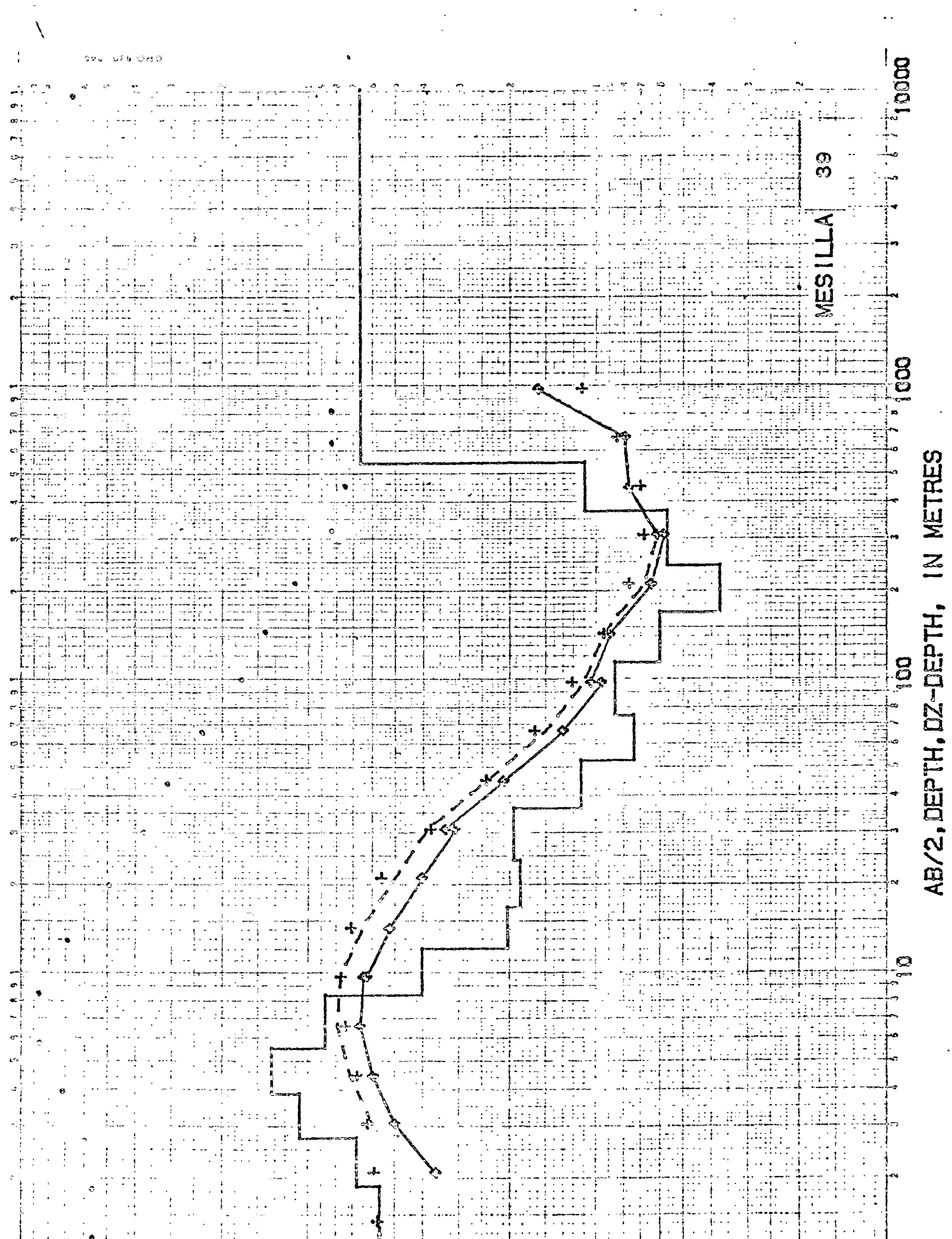

MESILLA 35
RESISTIVITIES IN OHM-METRES
AB/2, DEPTH, DZ-DEPTH, IN METRES
1
10
100
1000
10000

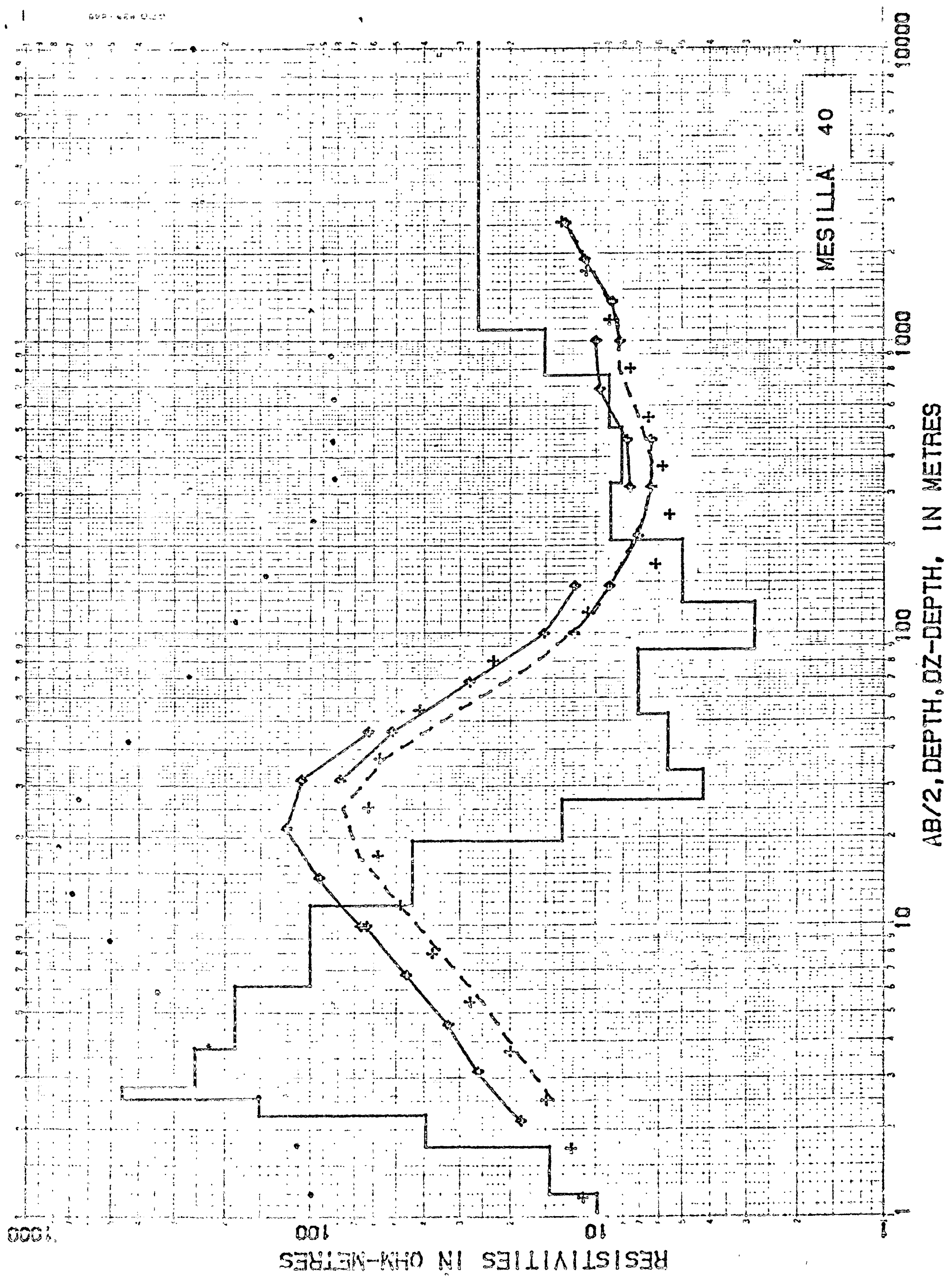

MESILLA 36
AB/2, DEPTH, DZ-DEPTH, IN METRES
10
100
1000
10000
RESISTIVITIES IN OHM-METRES
1000
100
10
1

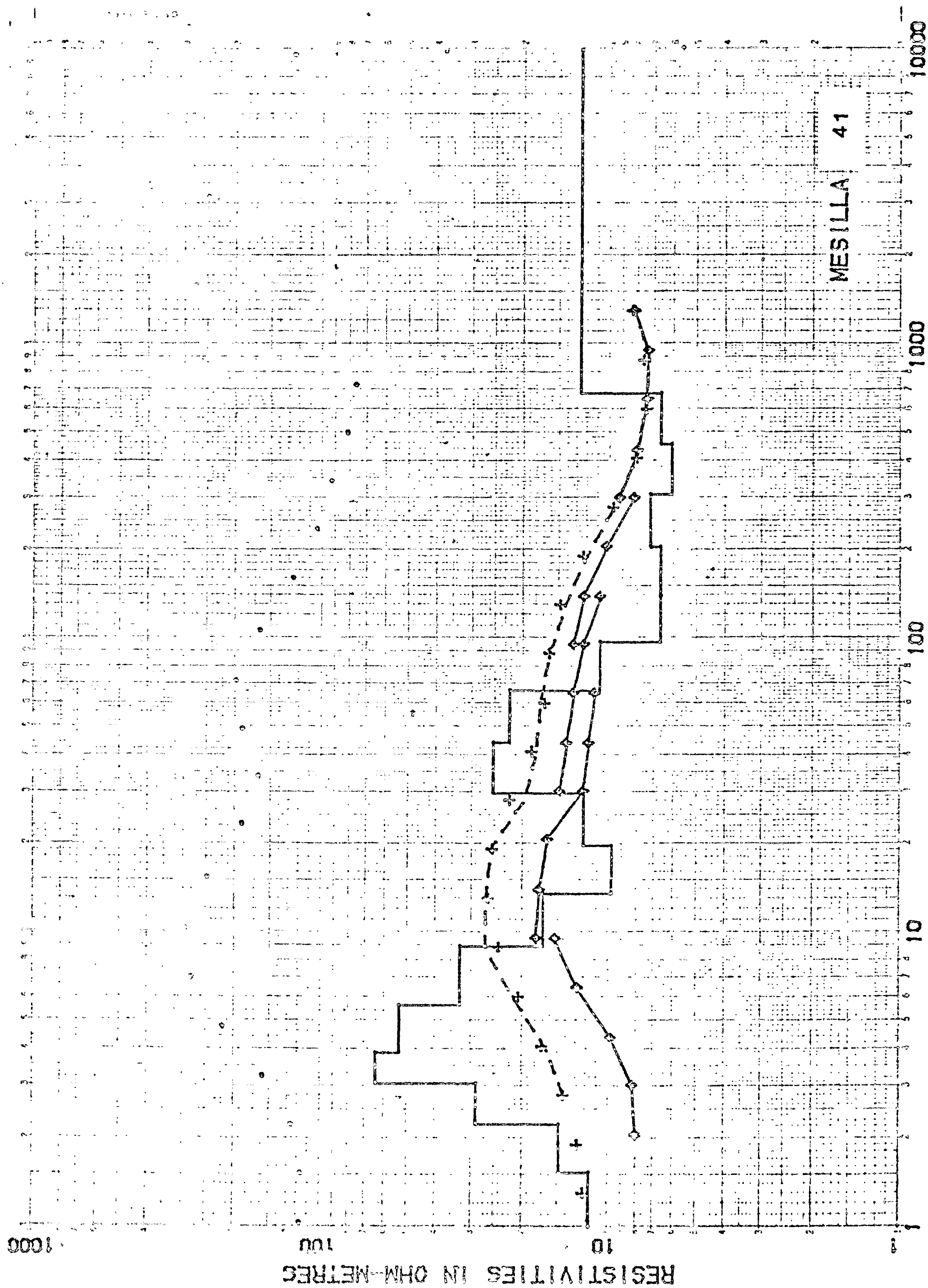

MESILLA 37
Dar Zarrouk curve is on next page
AB/2, DEPTH, DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
1
10
100
1000
10000

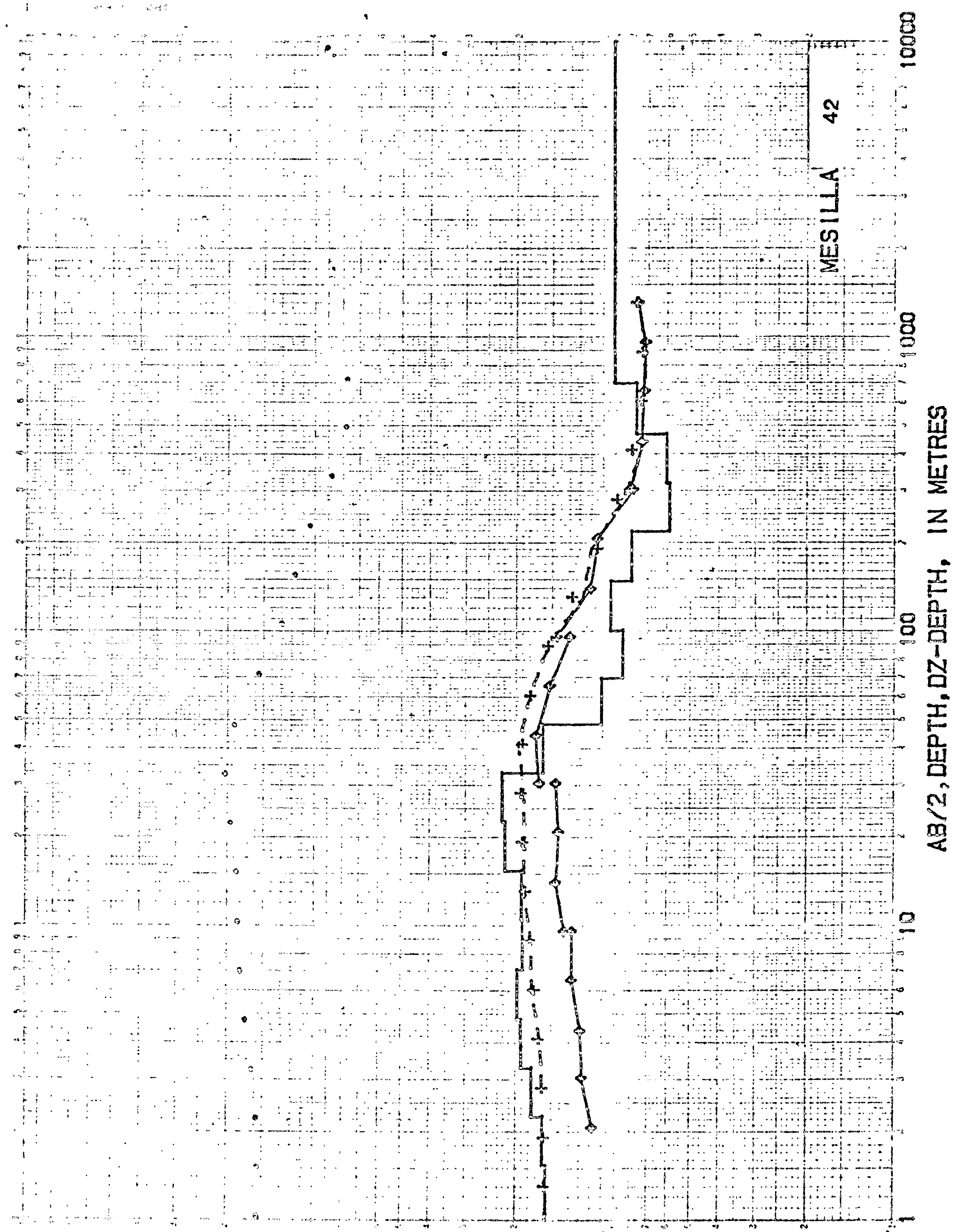

RESISTIVITIES IN OHM-METRES
1000
100
10
1
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH, IN METRES
Dar Zarrouk curve for MESILLA 37

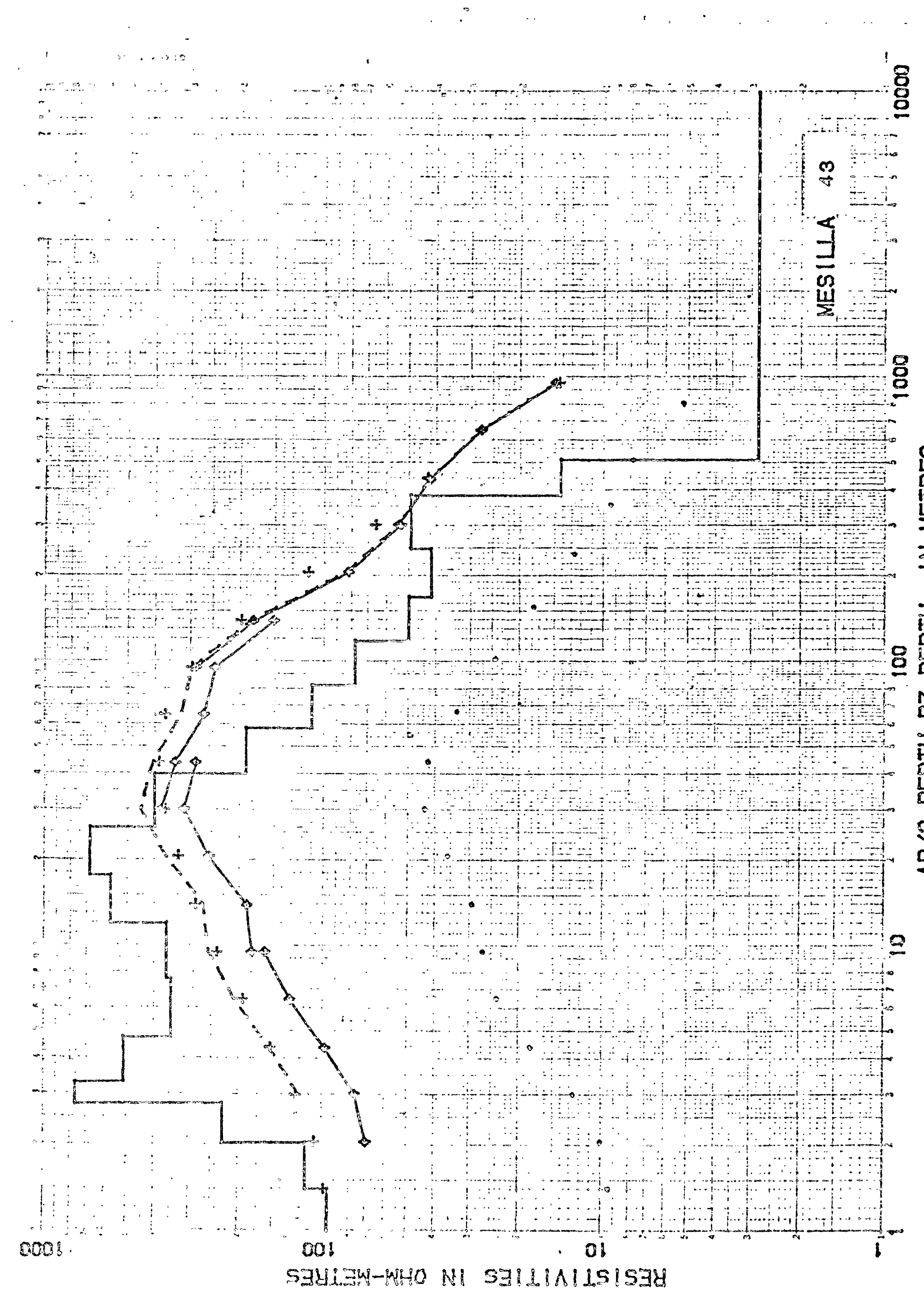

MESILLA 38
AB/2.DEPTH.DZ-DEPTH. IN METRES
RESISTIVITIES IN OHM-METRES
1
10
100
1000
10000
1000
100
10
1

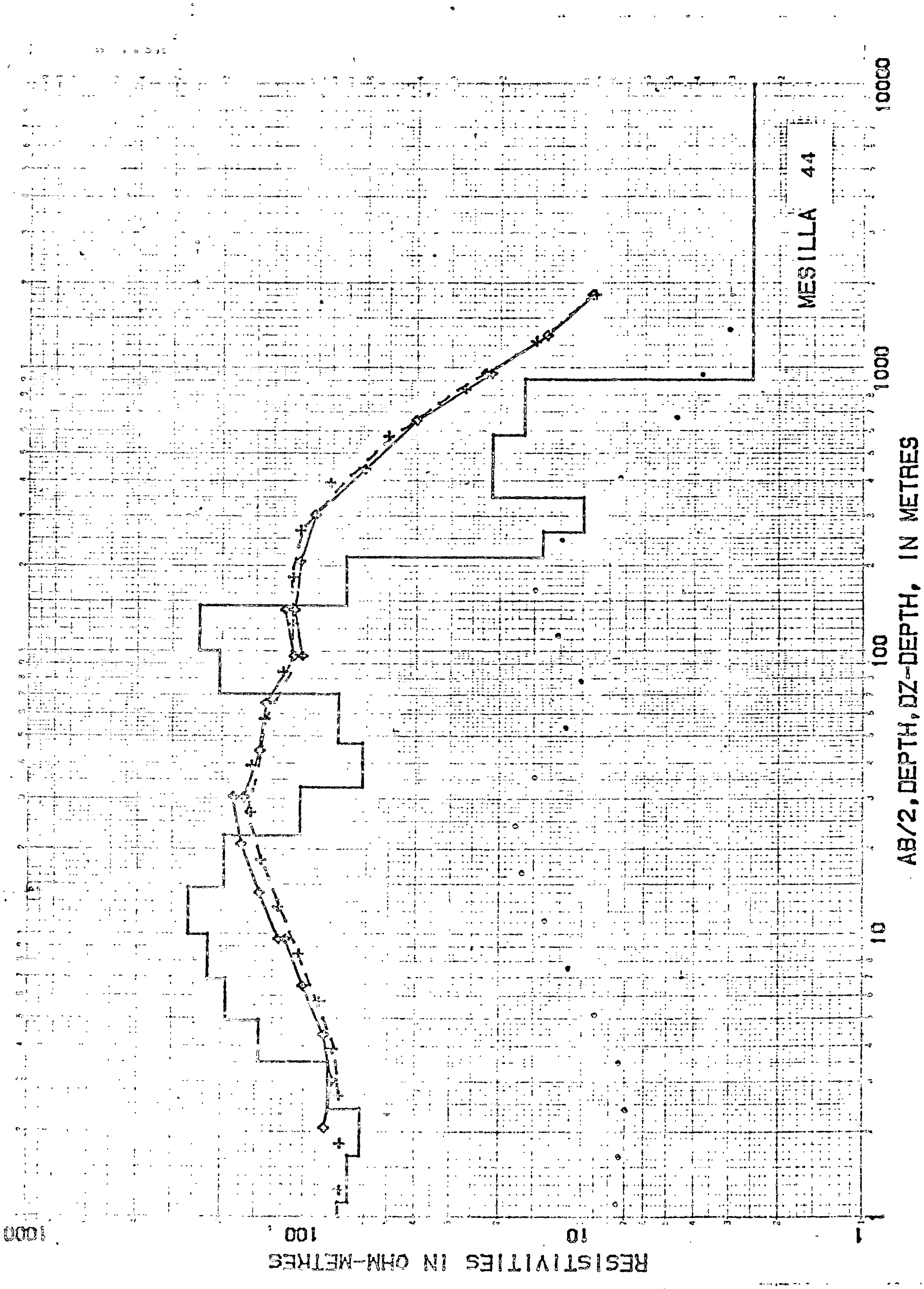

MESILLA 39
AB/2, DEPTH, DZ-DEPTH, IN METRES
1
10
100
1000
10000
RESISTIVITIES IN OHM-METRES
1000
100
10
1


MESILLA 40
AB/2, DEPTH, DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
1
10
100
1000
10000
1000
100
10
1

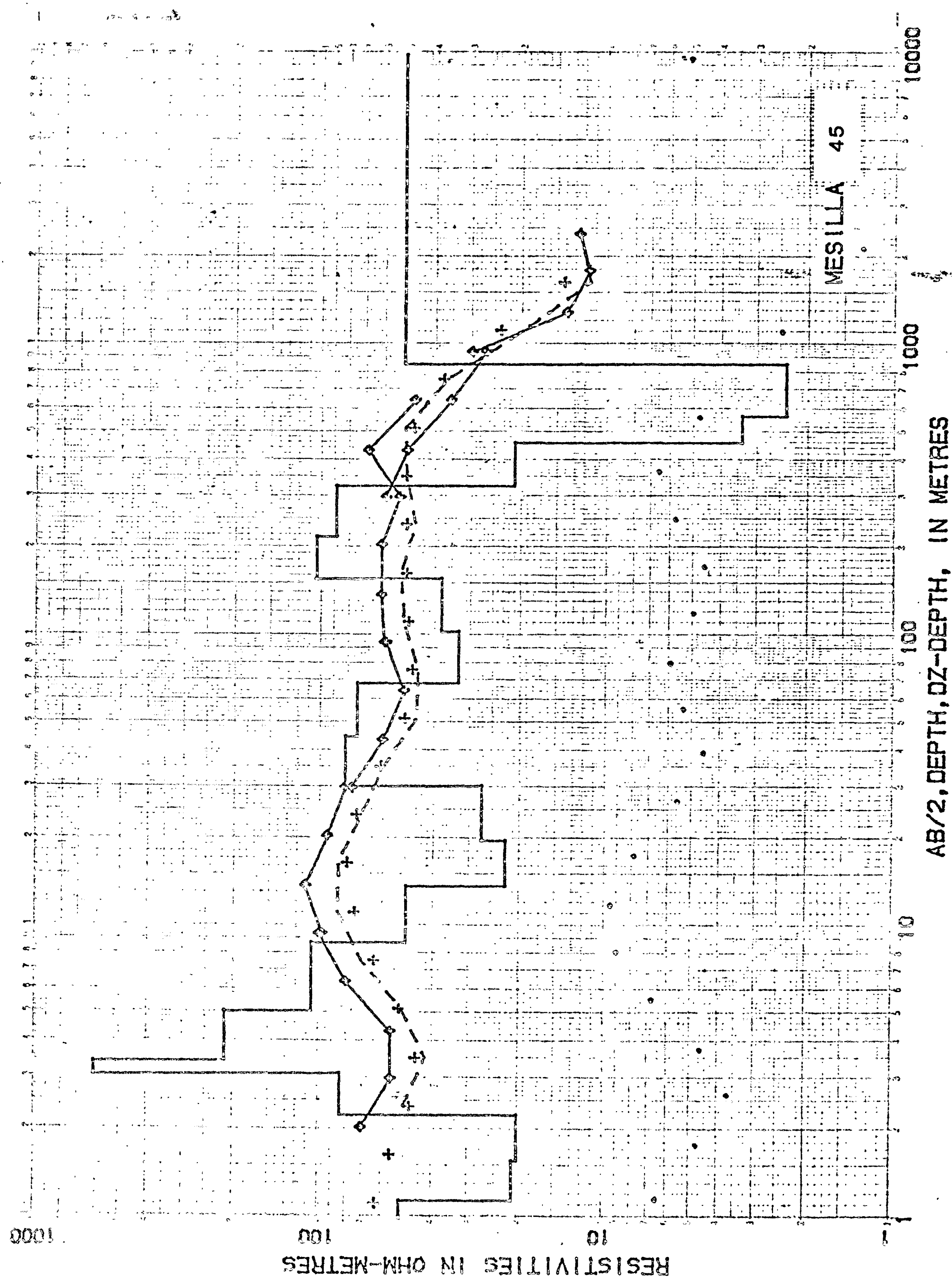

MESILLA 41
AB/2, DEPTH, DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
1
10
100
1000
10000

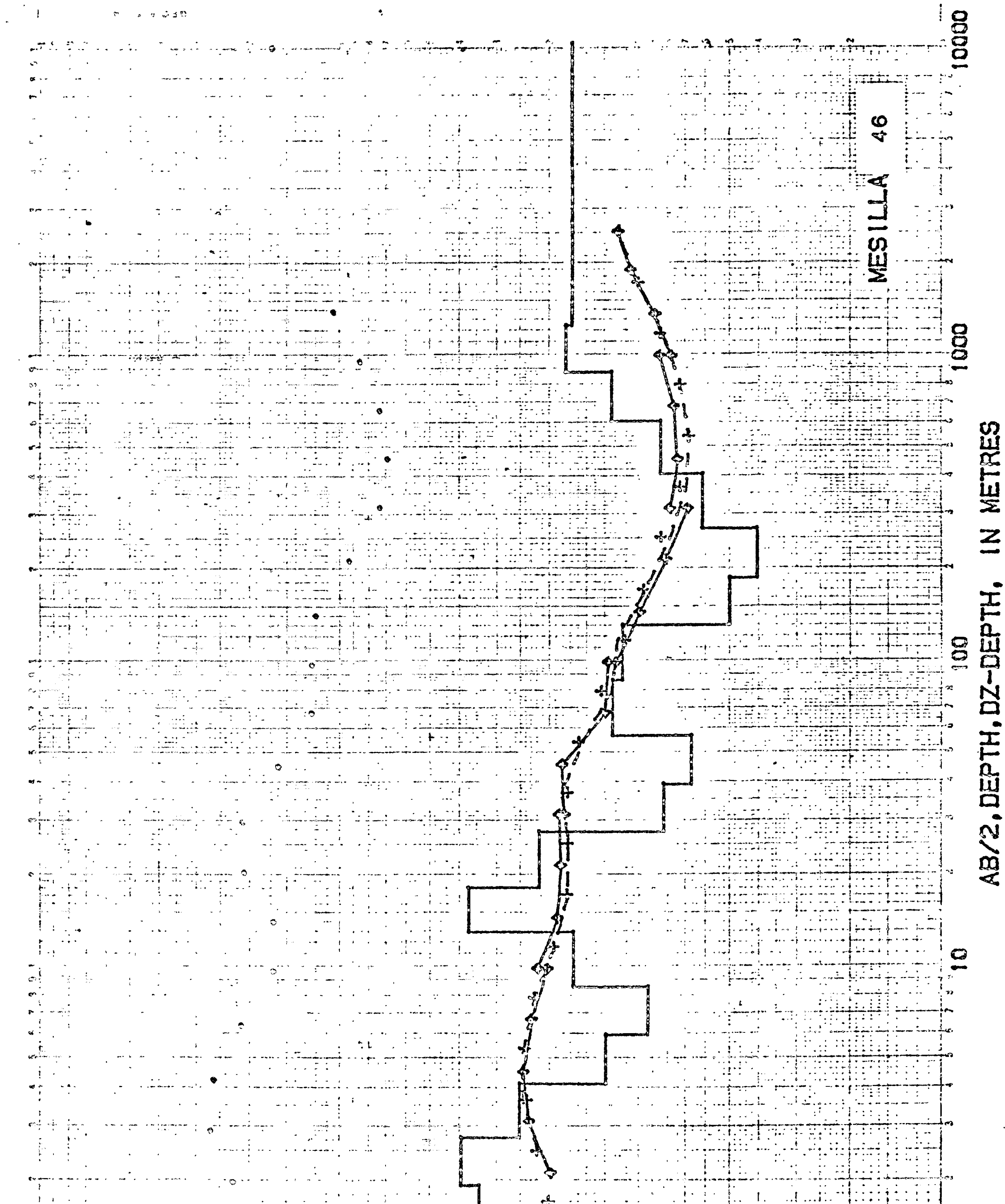

MESILLA 42
AB/2, DEPTH, DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
1
10
100
1000
10000

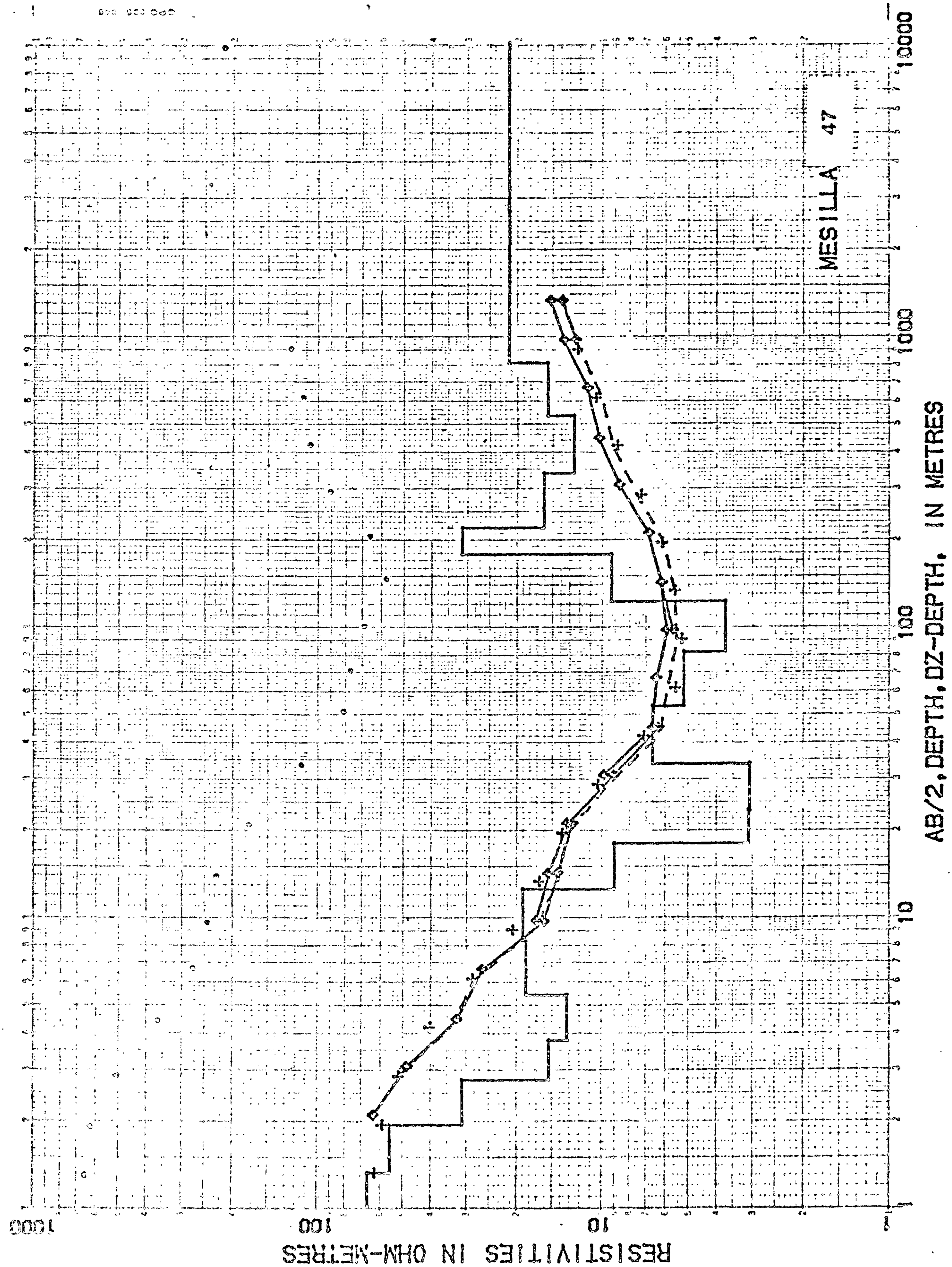

MESILLA 43
AB/2, DEPTH, DZ-DEPTH, IN METRES
1
10
100
1000
10000
RESISTIVITIES IN OHM-METRES
1
10
100
1000

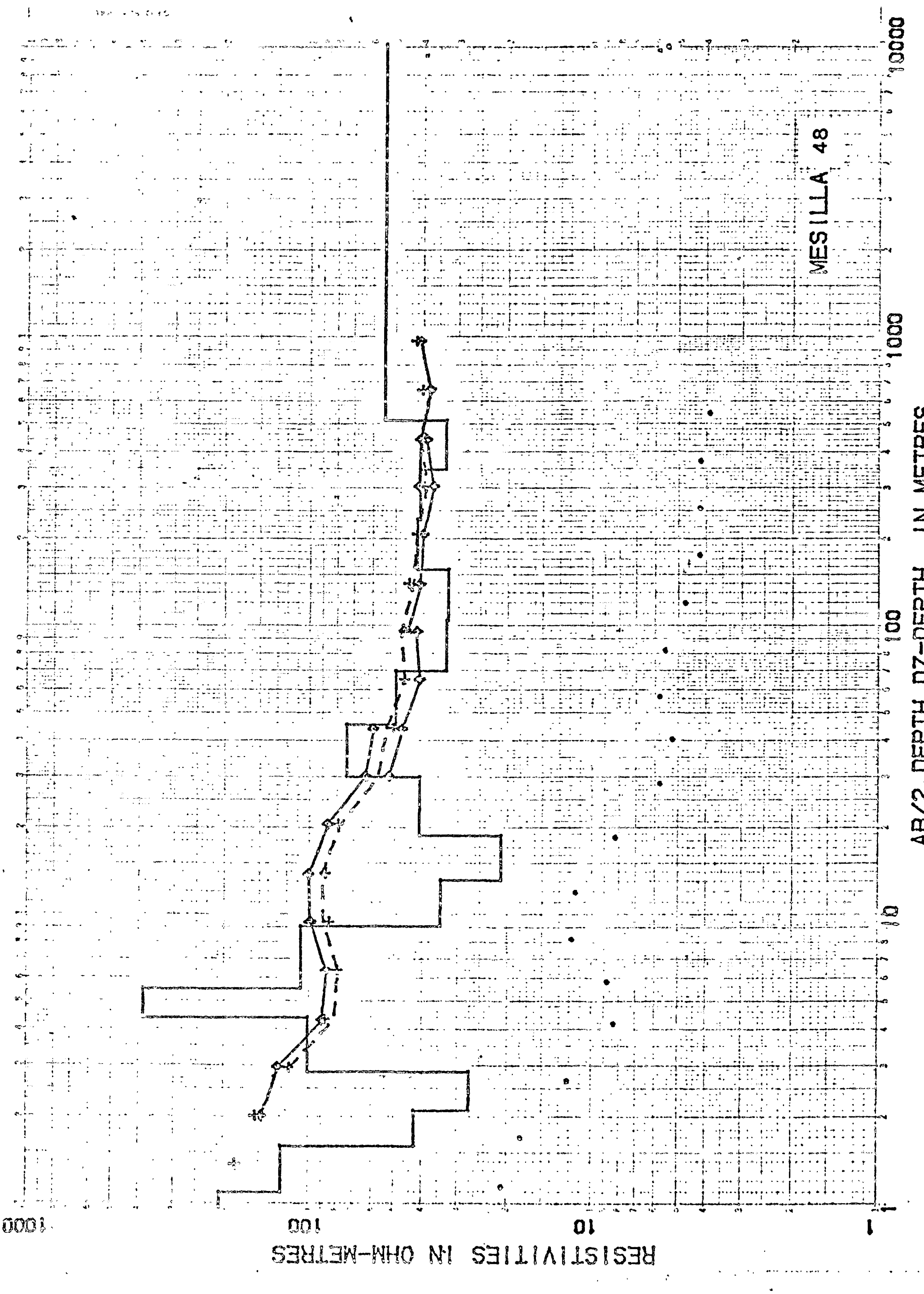


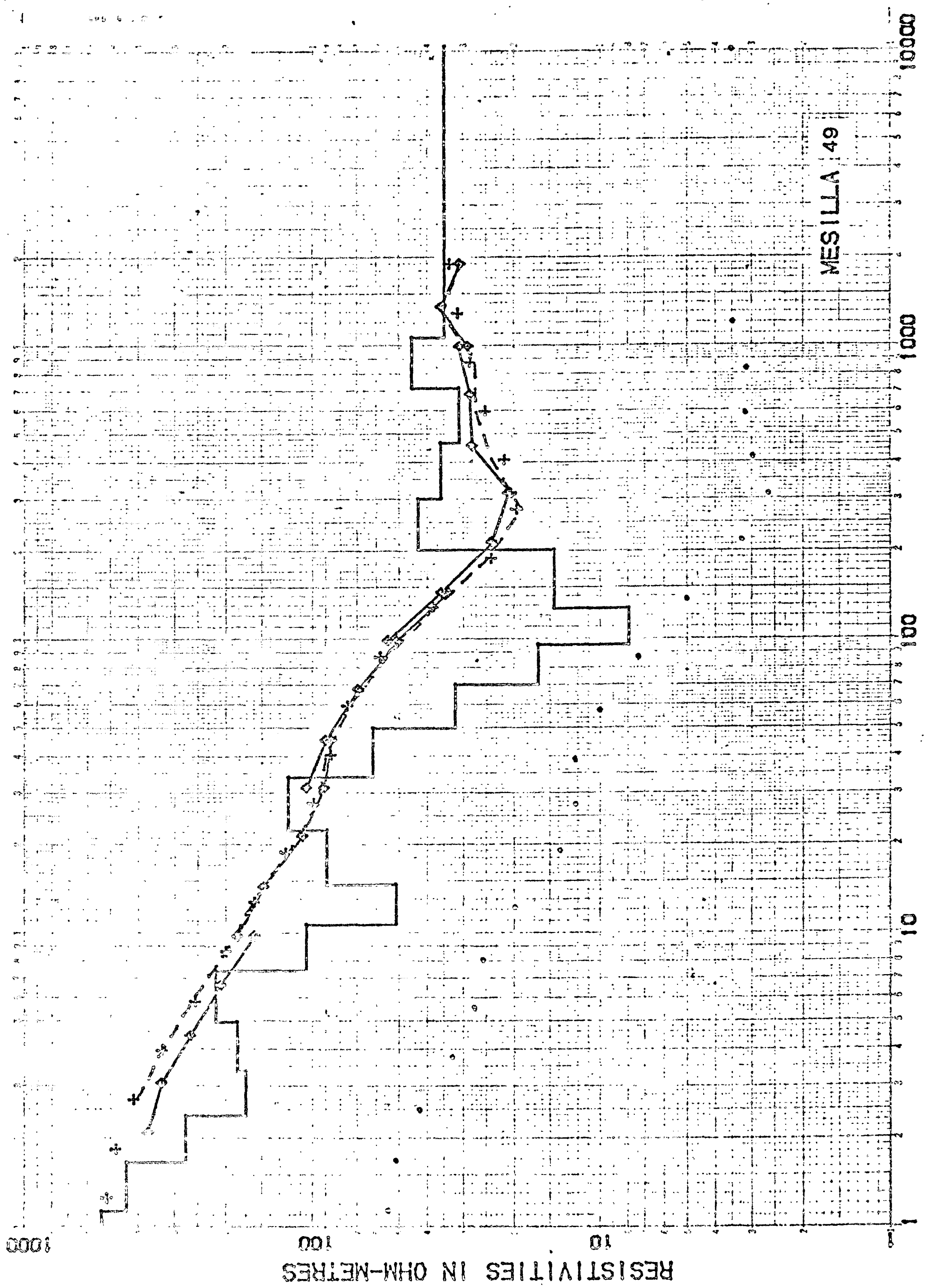
MESILLA 44
AB/2, DEPTH, DZ-DEPTH, IN METRES
1
10
100
1000
10000
RESISTIVITIES IN OHM-METRES
1
10
100
1000

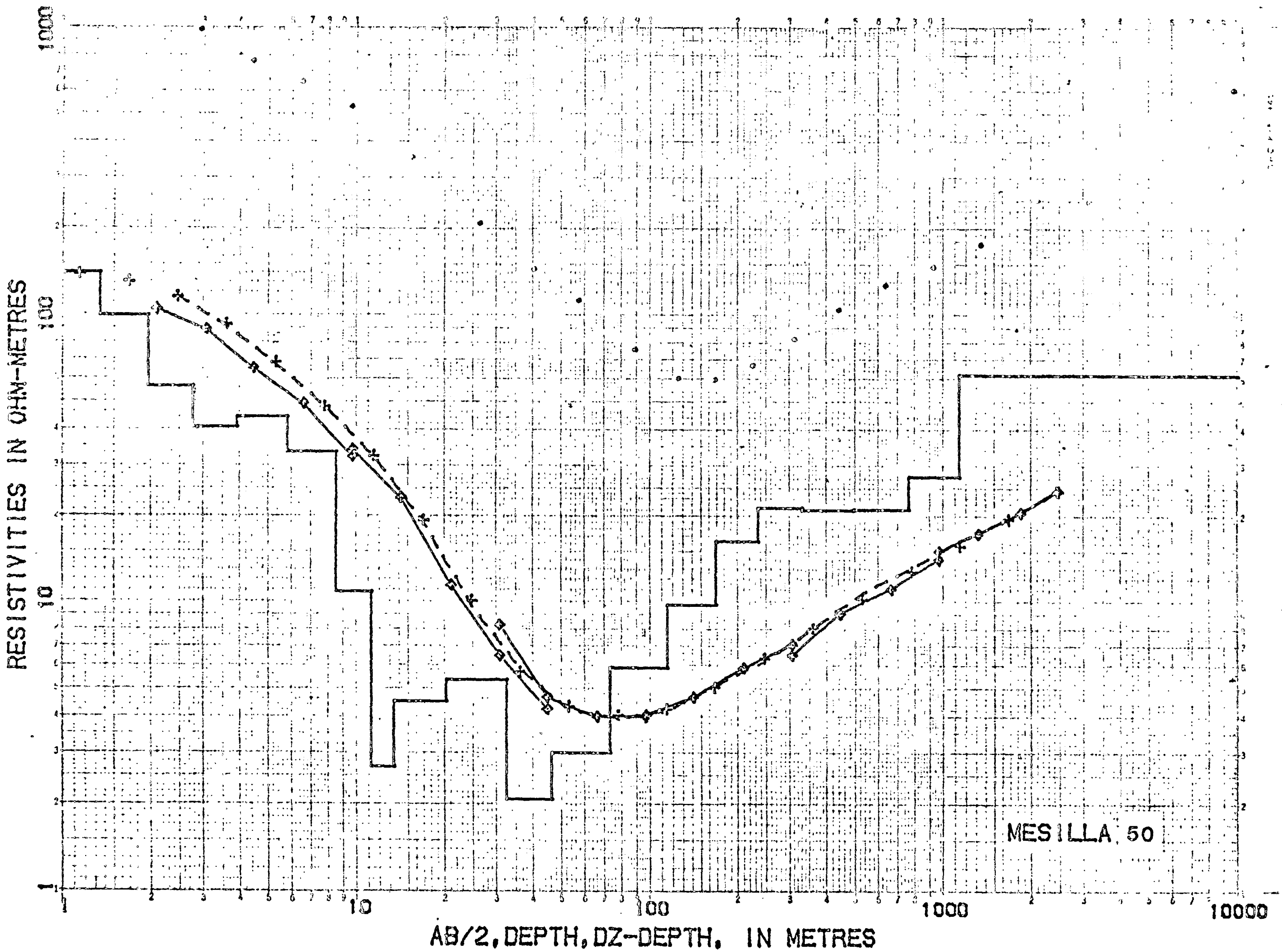

MESILLA 45
AB/2, DEPTH, DZ-DEPTH, IN METRES
10
100
1000
10000
RESISTIVITIES IN OHM-METRES
1000
100
10
1

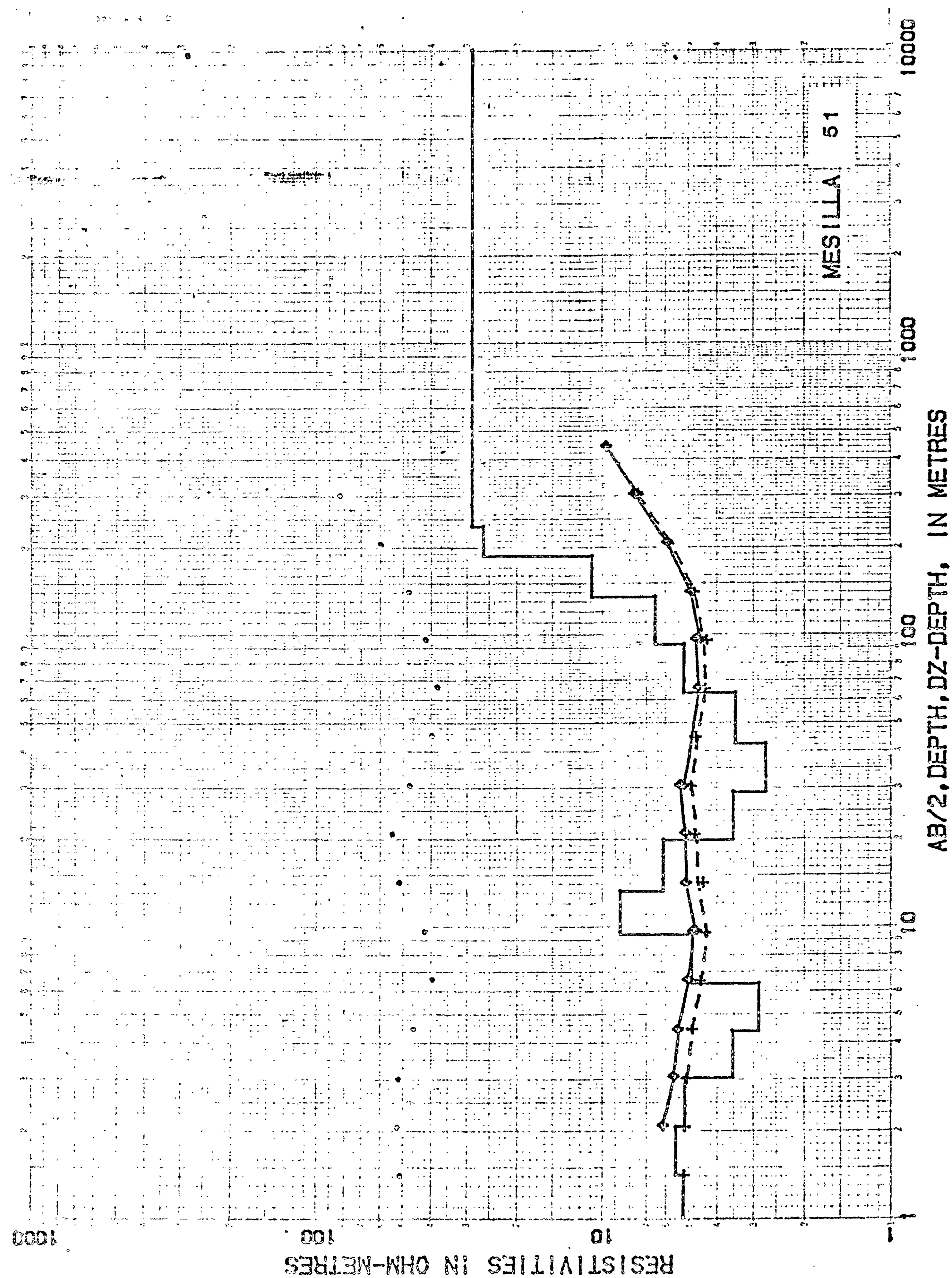

MESILLA 46
AB/2, DEPTH, DZ-DEPTH, IN METRES
1
10
100
1000
10000
RESISTIVITIES IN OHM-METRES
1000
100
10
1

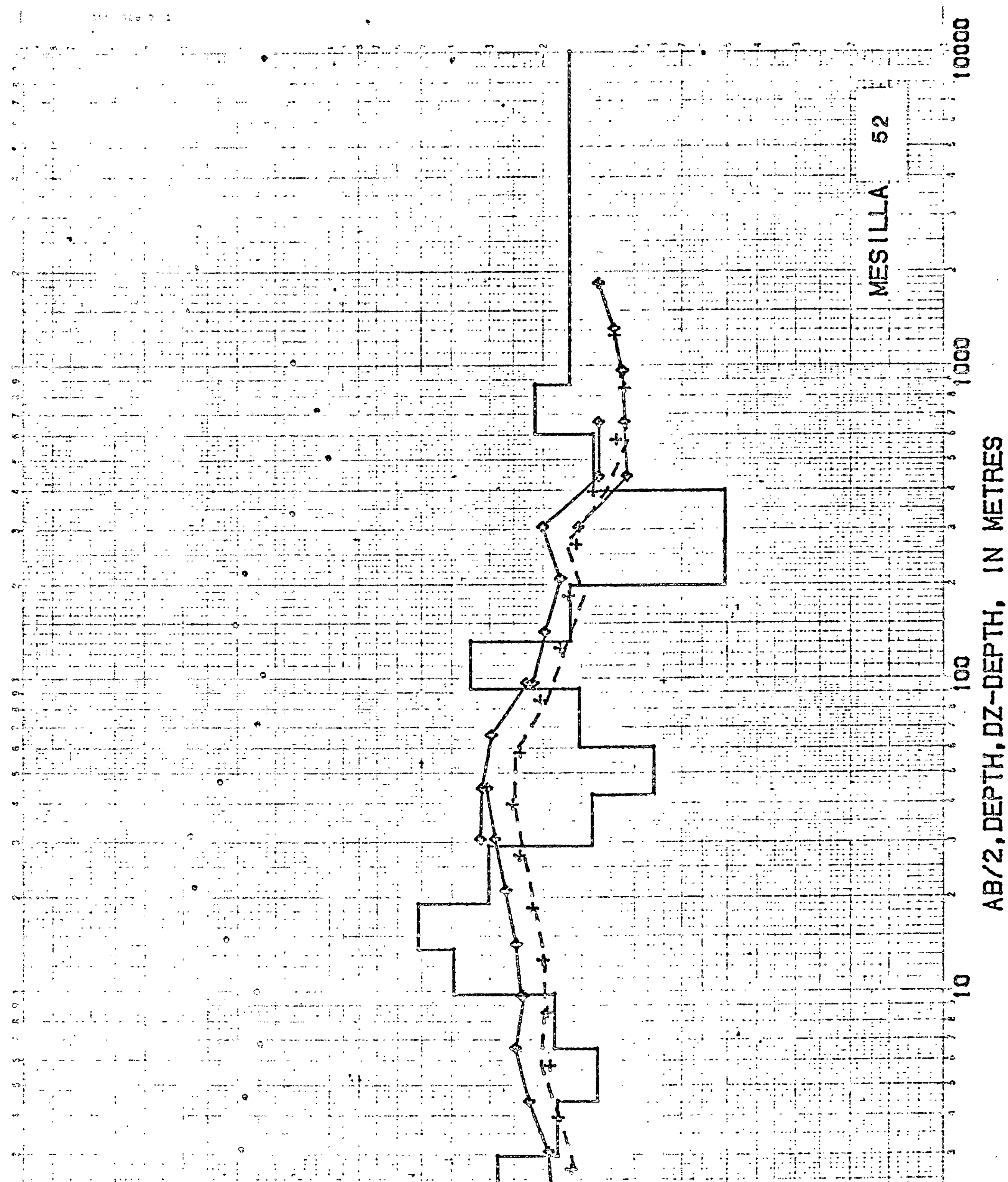

MESILLA 47
AB/2, DEPTH, DZ-DEPTH. IN METRES
1
10
100
1000
10000
RESISTIVITIES IN OHM-METRES
1000
100
10
1

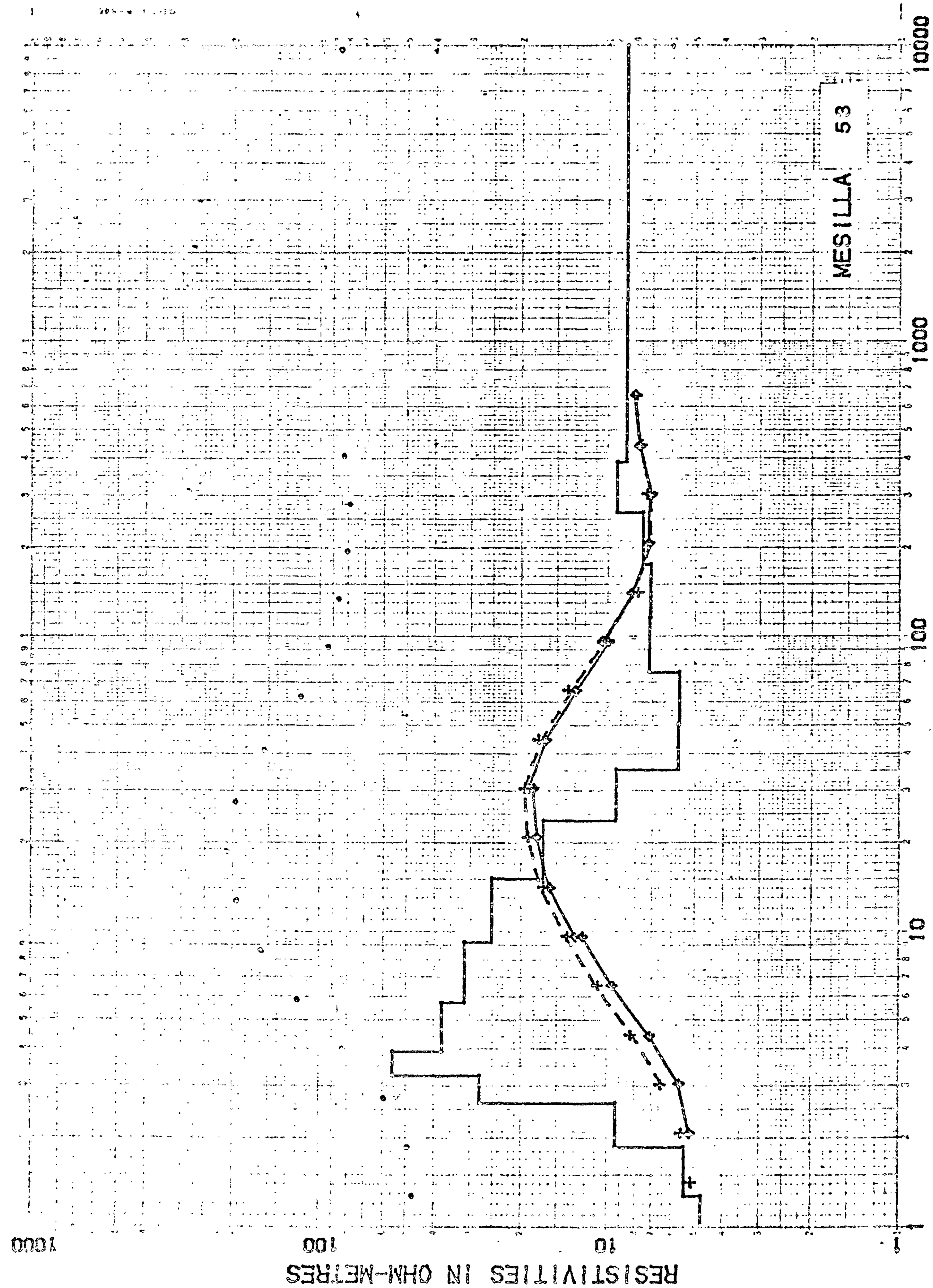

MESILLA 48
AB/2, DEPTH, DZ-DEPTH, IN METRES
10000
1000
100
10
RESISTIVITIES IN OHM-METRES
1000
100
10
1

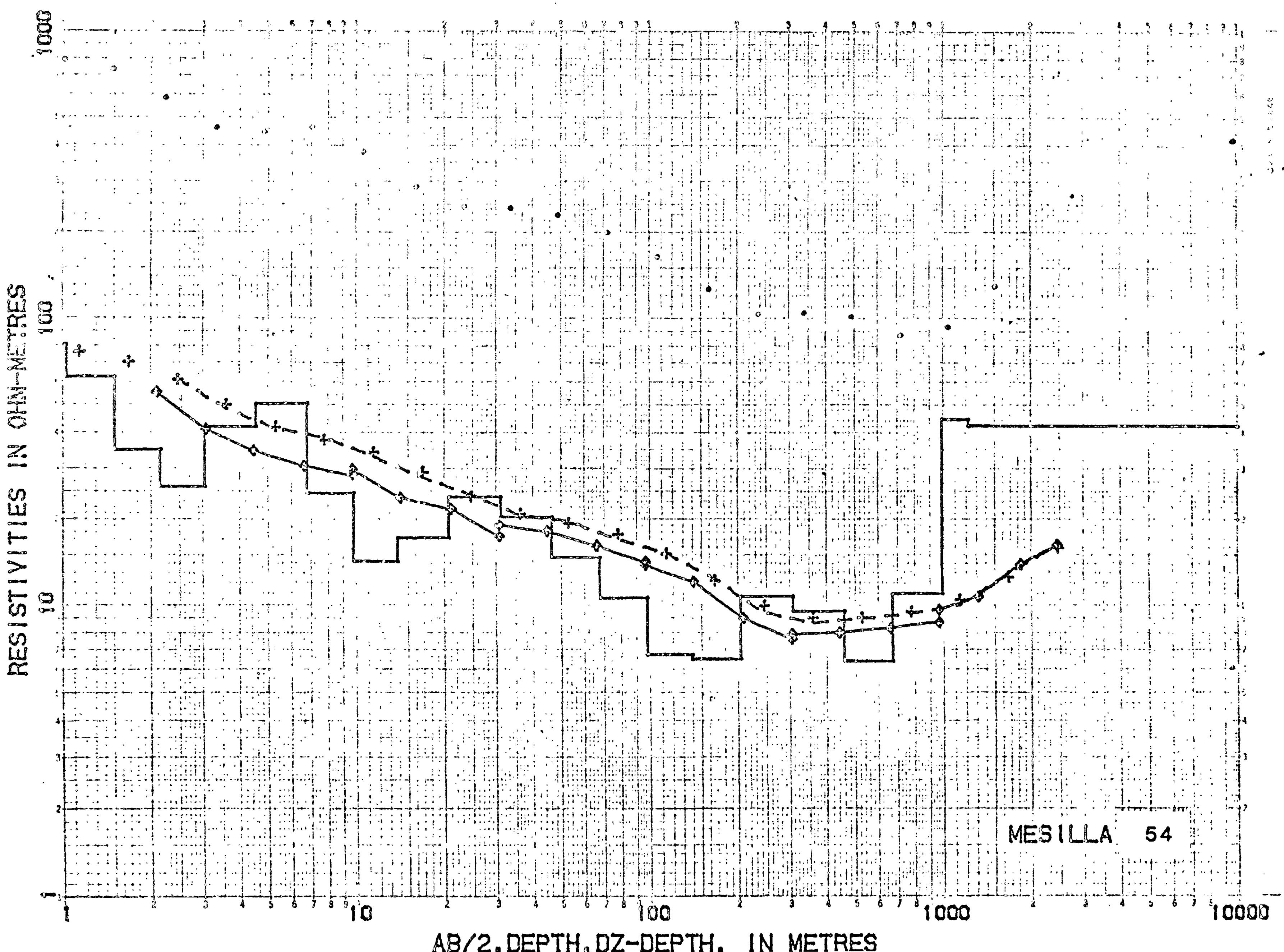

MESILLA 49
AB/2. DEPTH. DZ-DEPTH. IN METRES
1
10
100
1000
10000
RESISTIVITIES IN OHM-METRES
1000
100
10

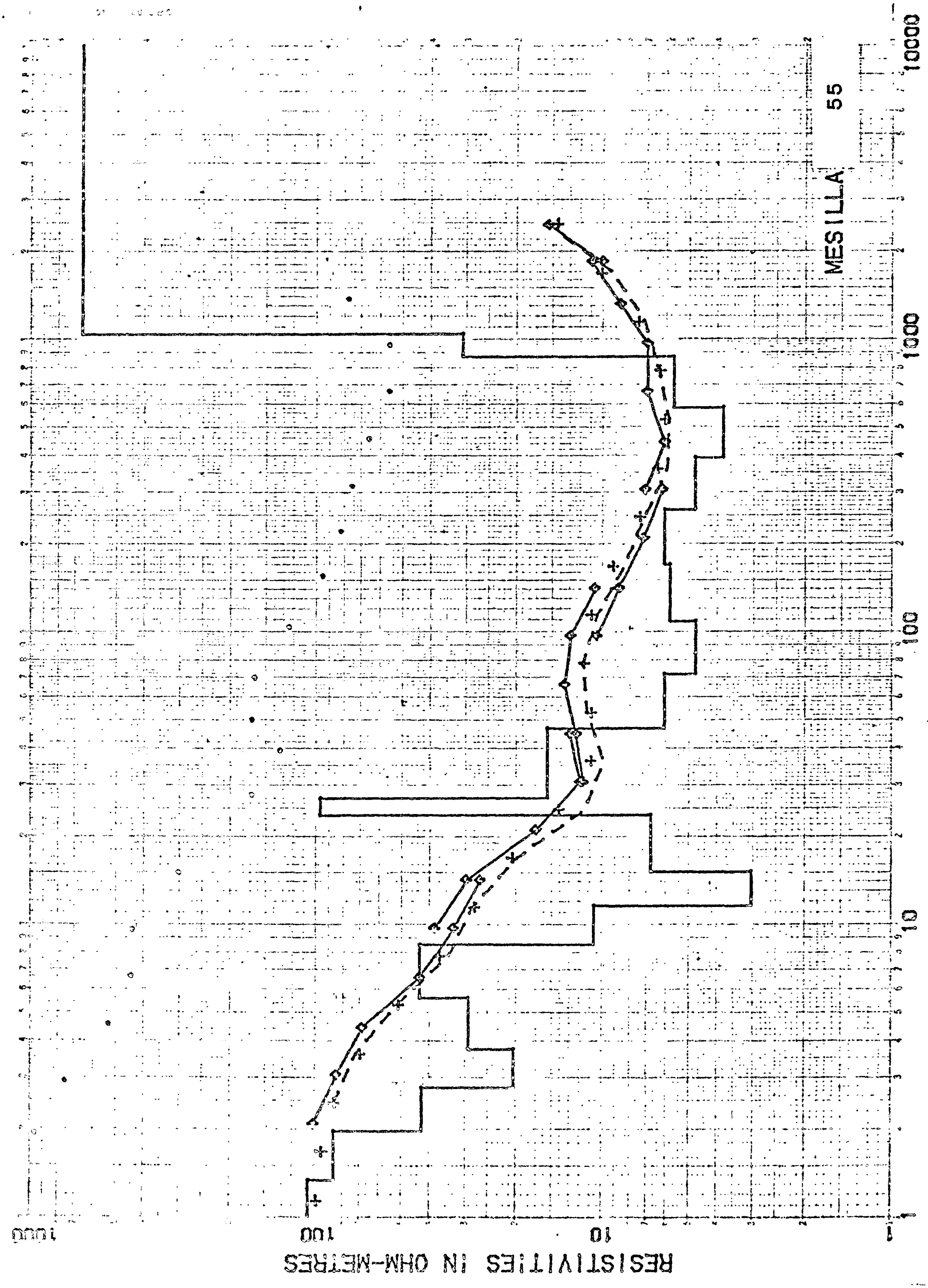

MESILLA 50
RESISTIVITIES IN OHM-METRES
AB/2, DEPTH, DZ-DEPTH, IN METRES
1
10
100
1000
10000

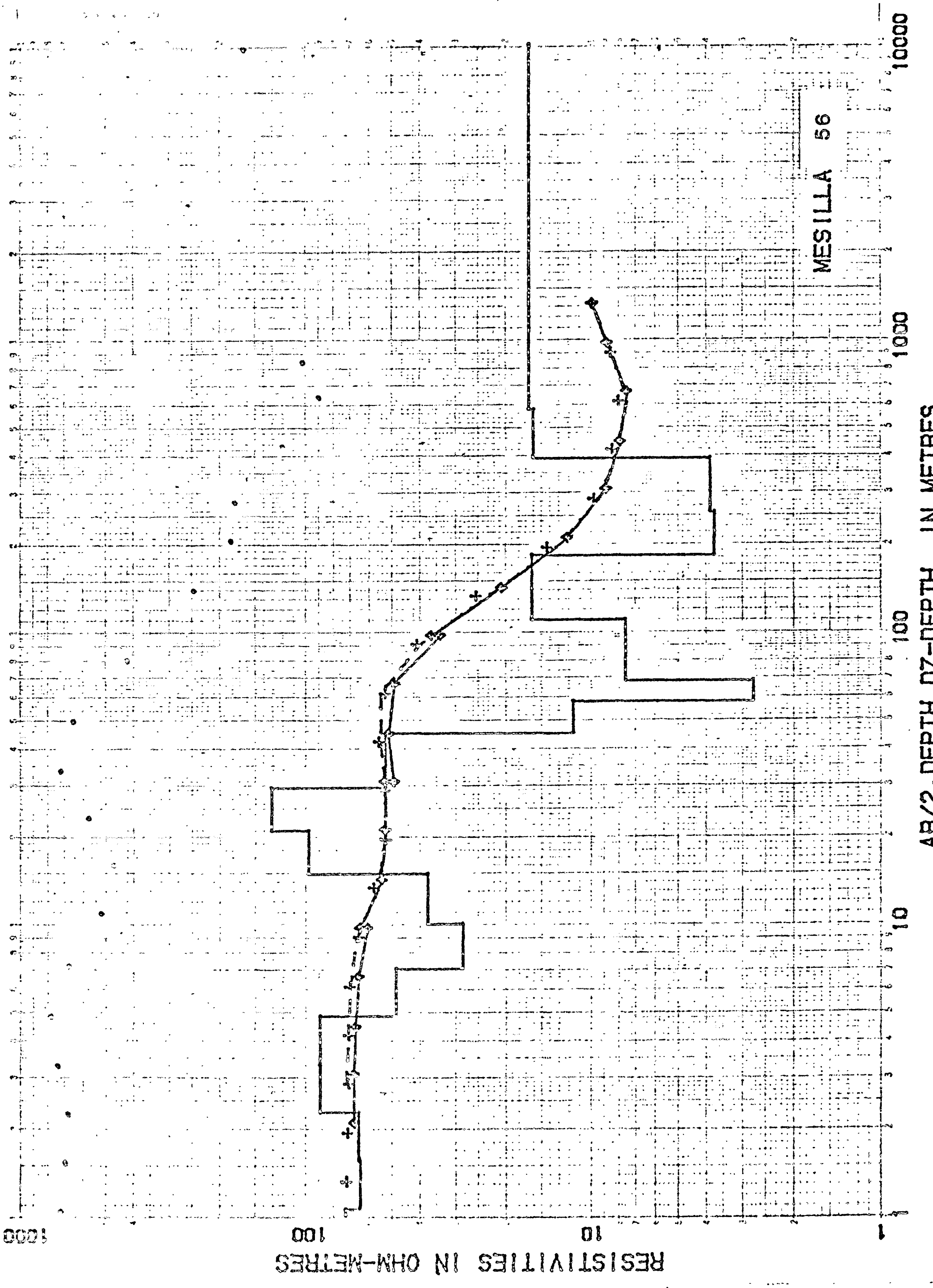

MESILLA 51
10000
1000
100
10
1
AB/2, DEPTH, DZ-DEPTH, IN METRES
1000
100
10
RESISTIVITIES IN OHM-METRES

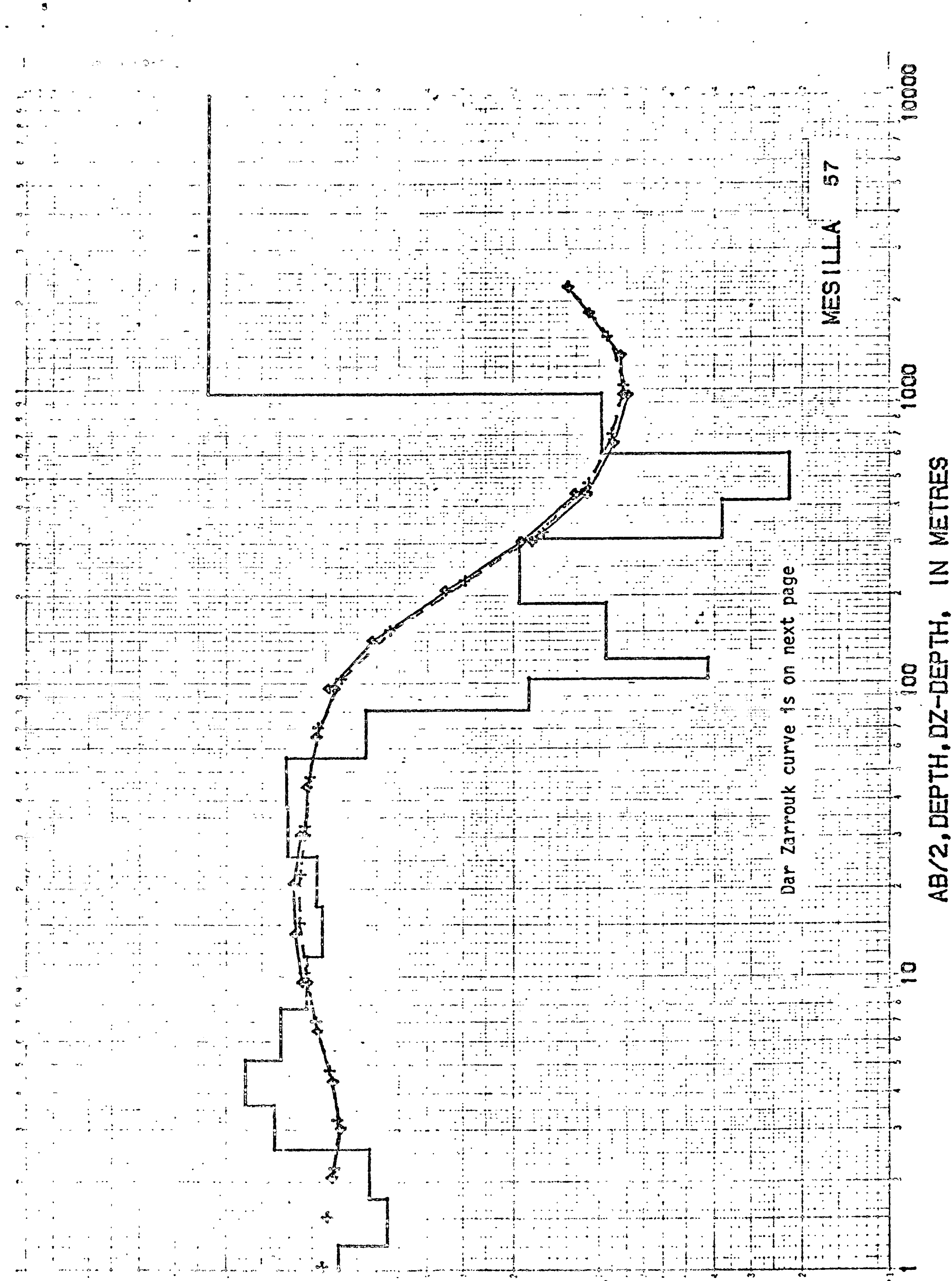

MESILLA 52
AB/2, DEPTH, DZ-DEPTH, IN METRES
1
10
100
1000
10000
RESISTIVITIES IN OHM-METRES
1
10
100
1000


MESILLA 53
AB/2.DEPTH.DZ-DEPTH. IN METRES
1
10
100
1000
10000
RESISTIVITIES IN OHM-METRES
1000
100
10
1

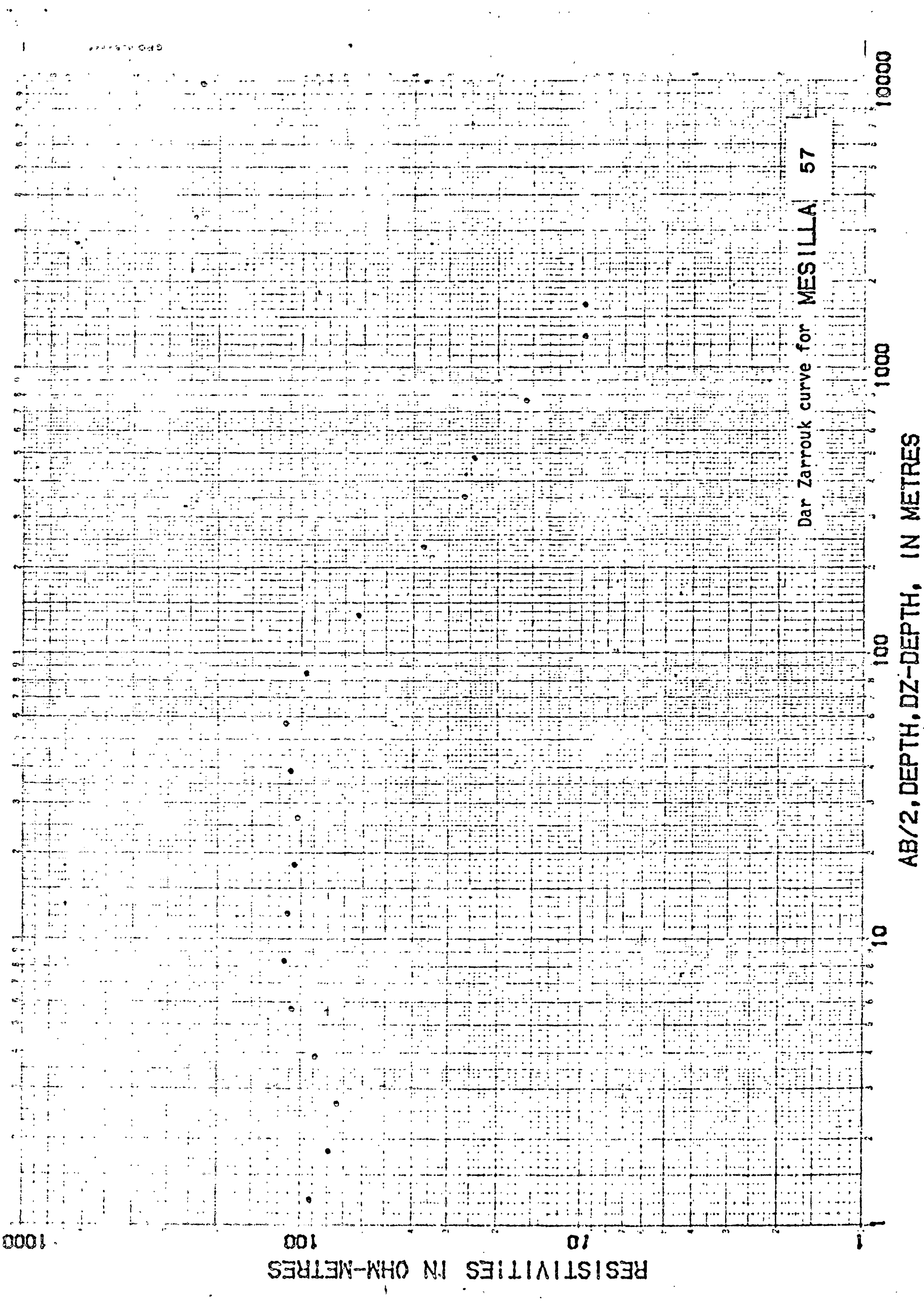

RESISTIVITIES IN OHM-METRES
1000
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH, IN METRES
MESILLA 54

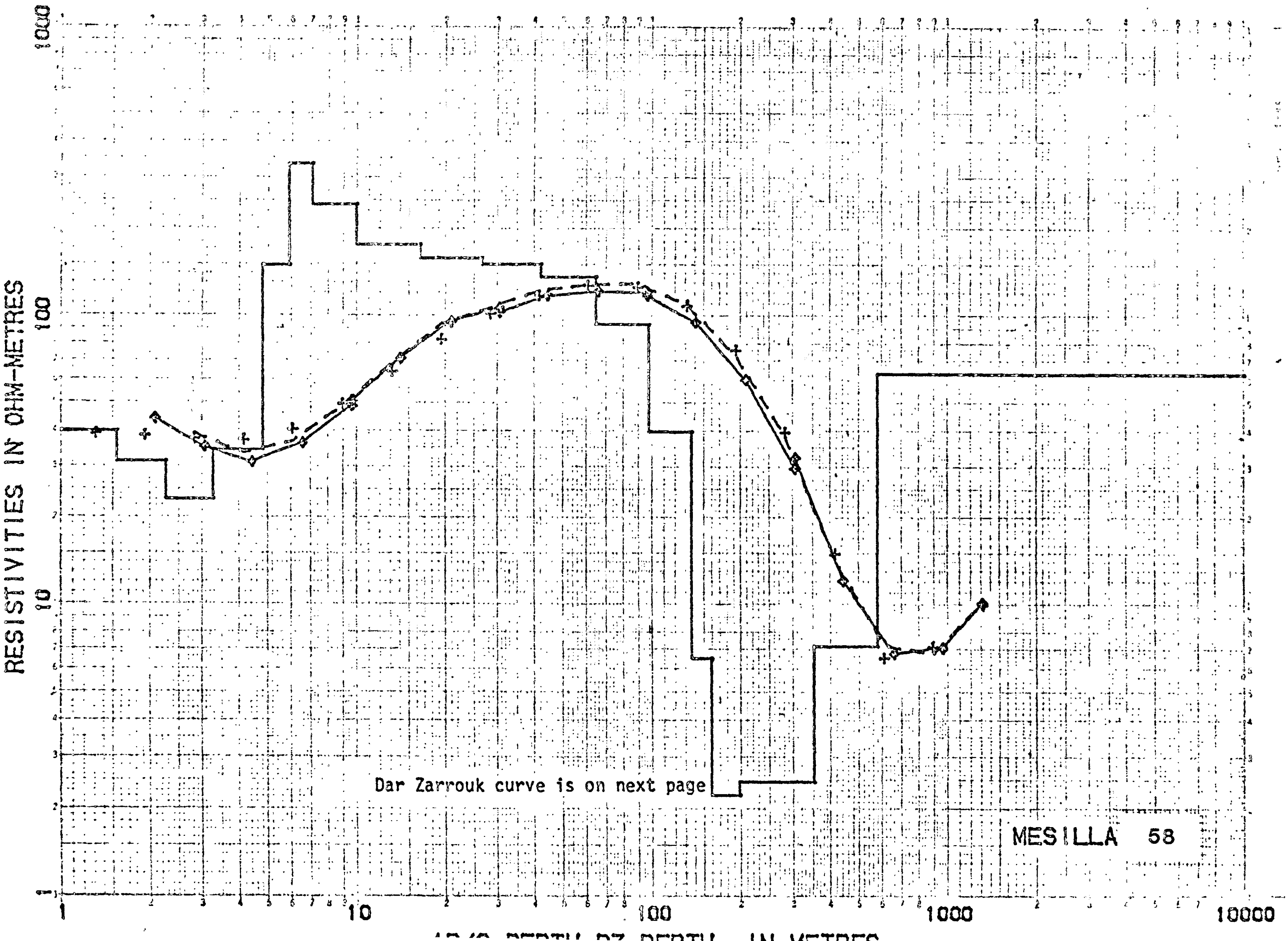

MESILLA 55
AB/2.DEPTH.DZ-DEPTH. IN METRES
10
100
1000
10000
RESISTIVITIES IN OHM-METRES
1
10
100
1000

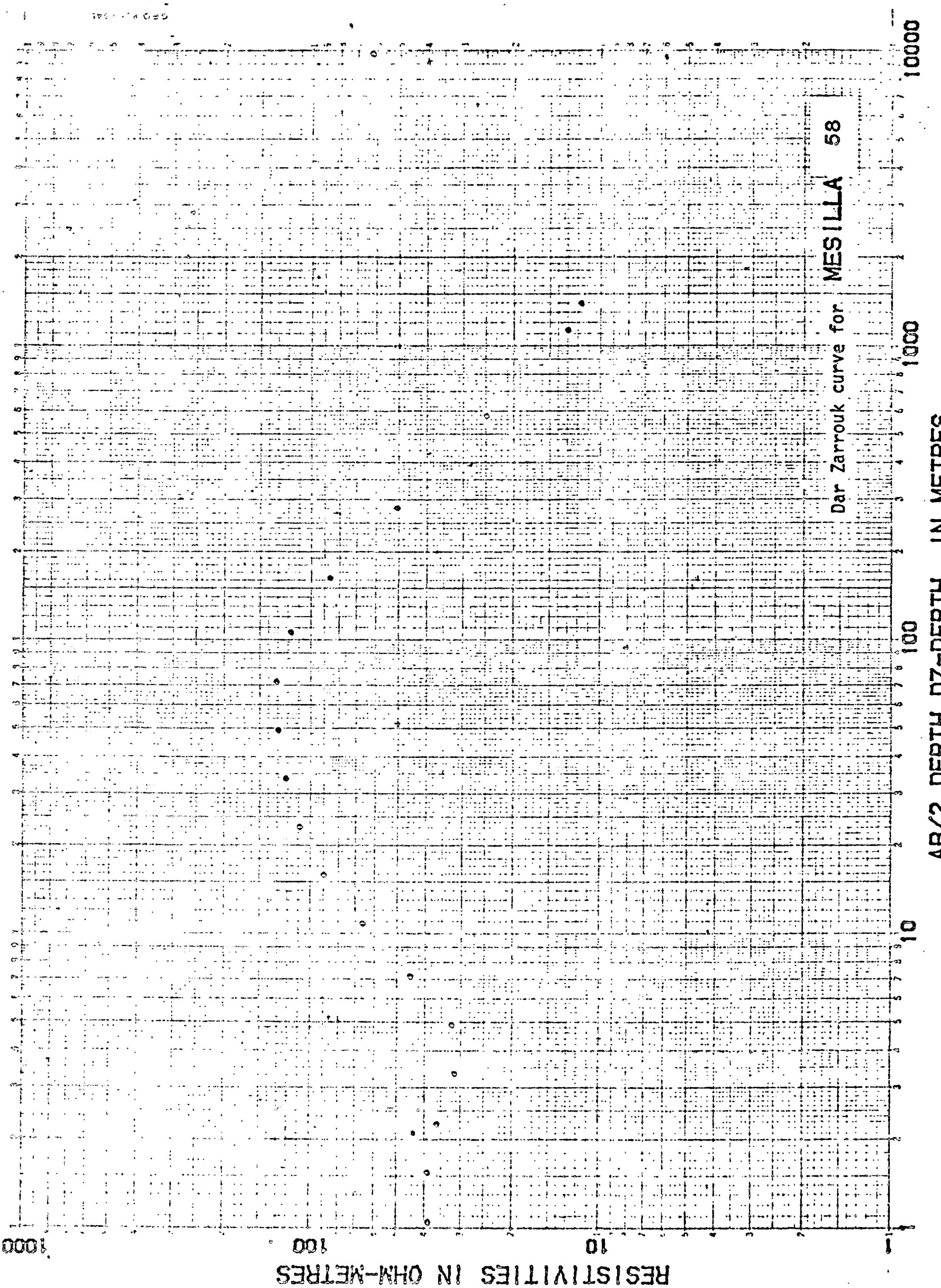

MESILLA 56
AB/2, DEPTH, DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
1
10
100
1000
10000

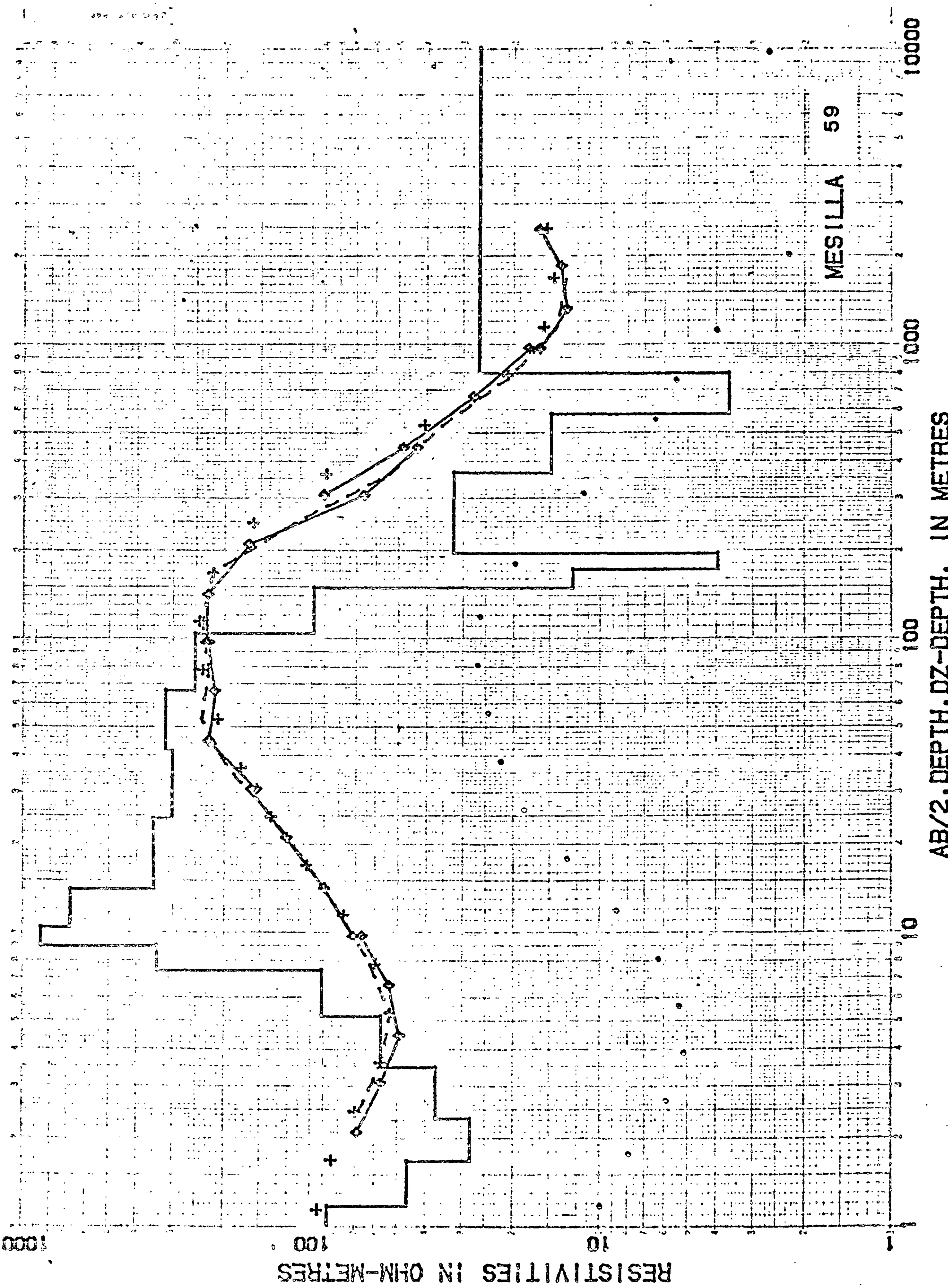


MESILLA 57
Dar Zarrouk curve is on next page
AB/2,DEPTH,DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
1
10
100
1000
10000

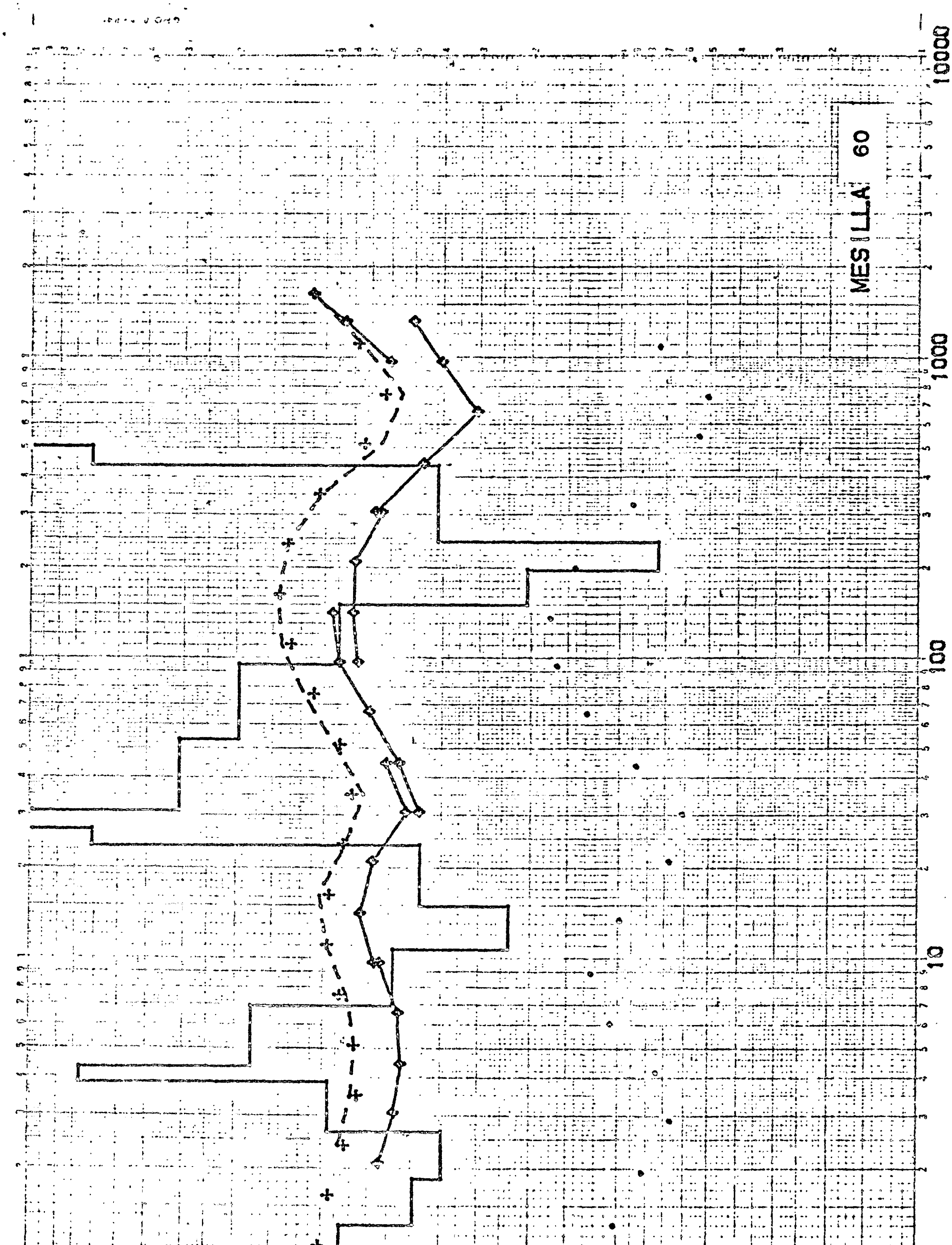

Dar Zarrouk curve for MESILLA 57
AB/2, DEPTH, DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
1
10
100
1000
10000

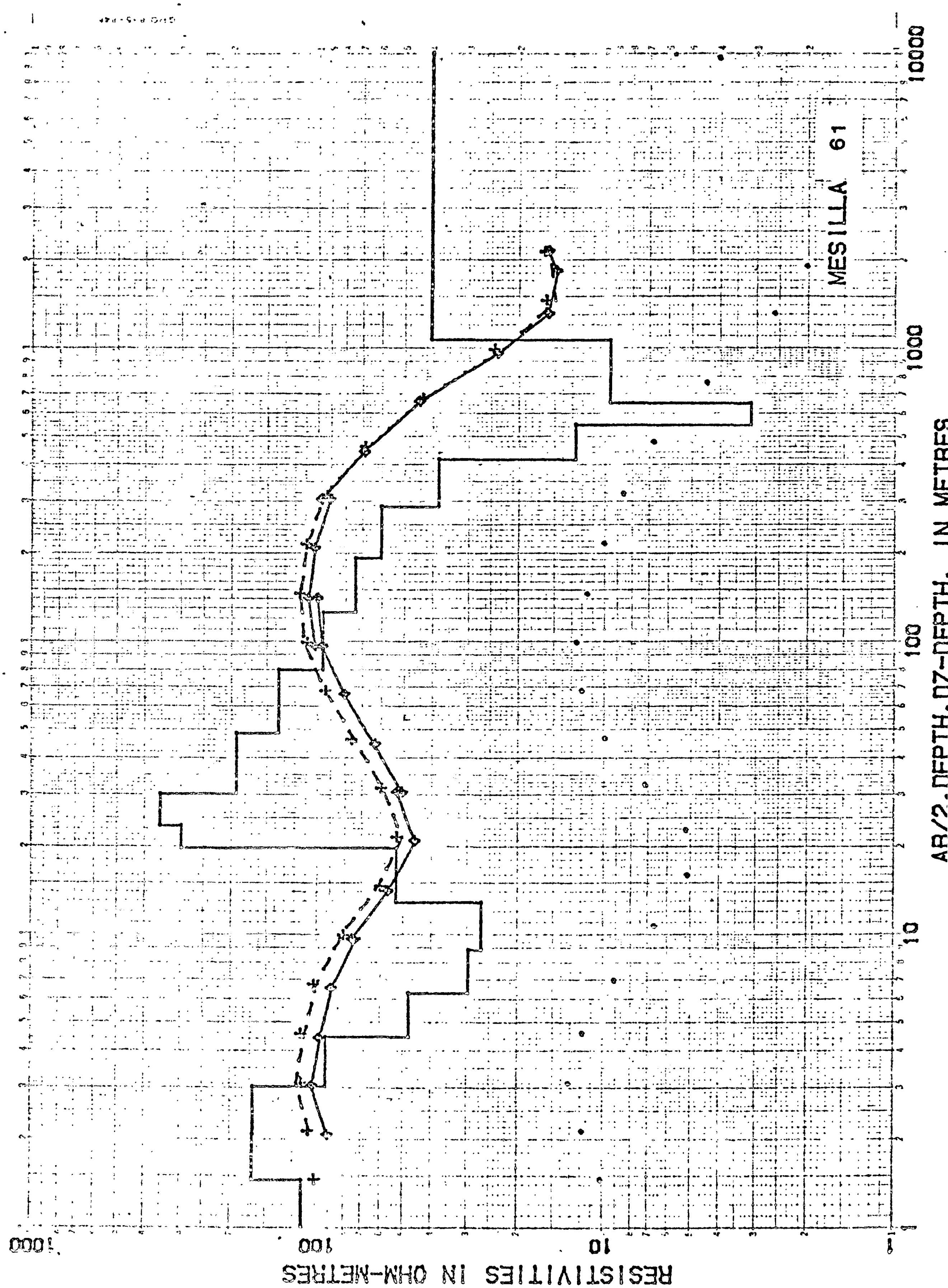

RESISTIVITIES IN OHM-METRES
1000
100
10
1
10
100
1000
10000
Dar Zarrouk curve is on next page
MESILLA 58

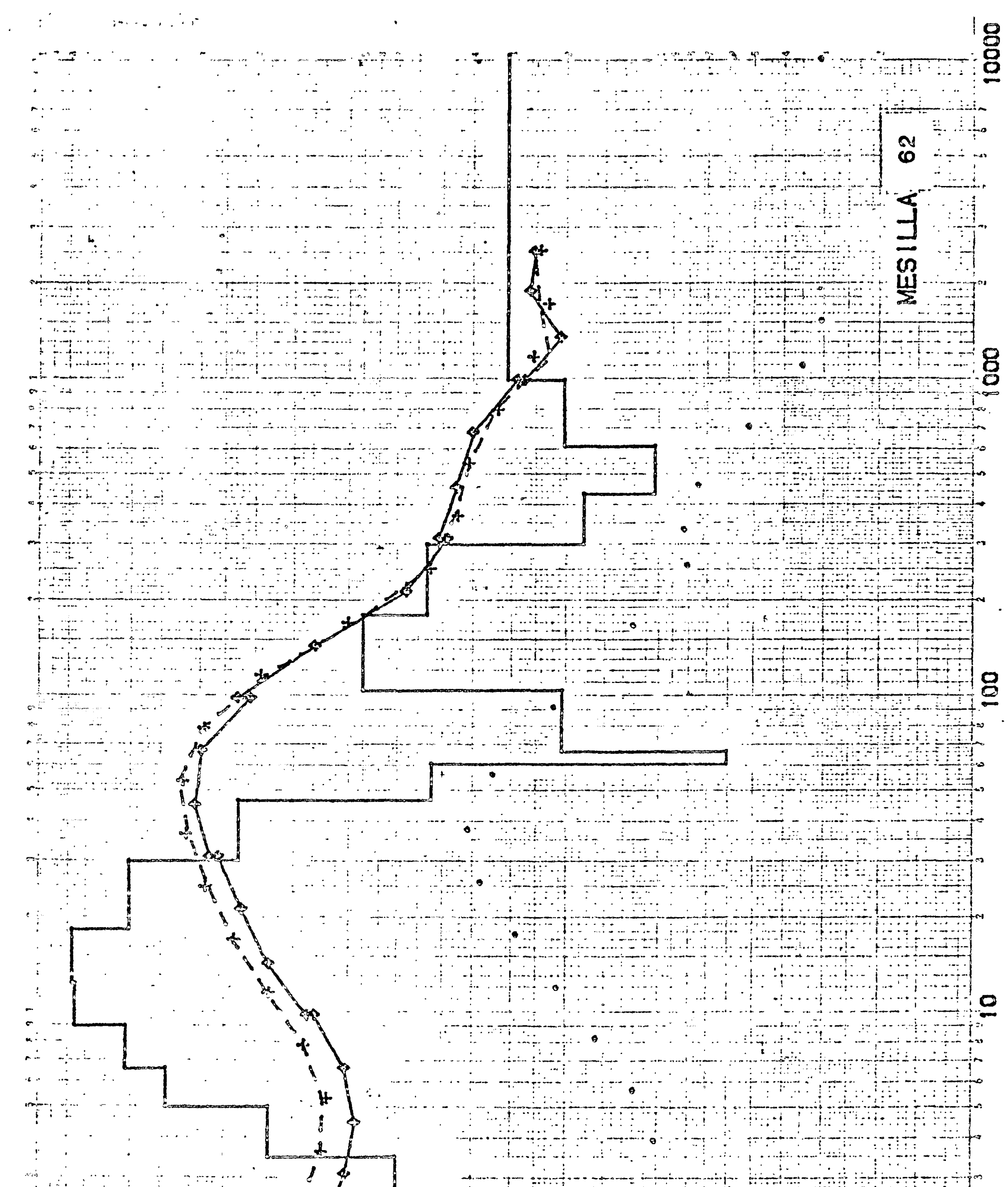

Dar Zarrouk curve for MESILLA 58
AB/2, DEPTH, DZ-DEPTH, IN METRES
10
100
1000
10000
RESISTIVITIES IN OHM-METRES
1000
100
10
1

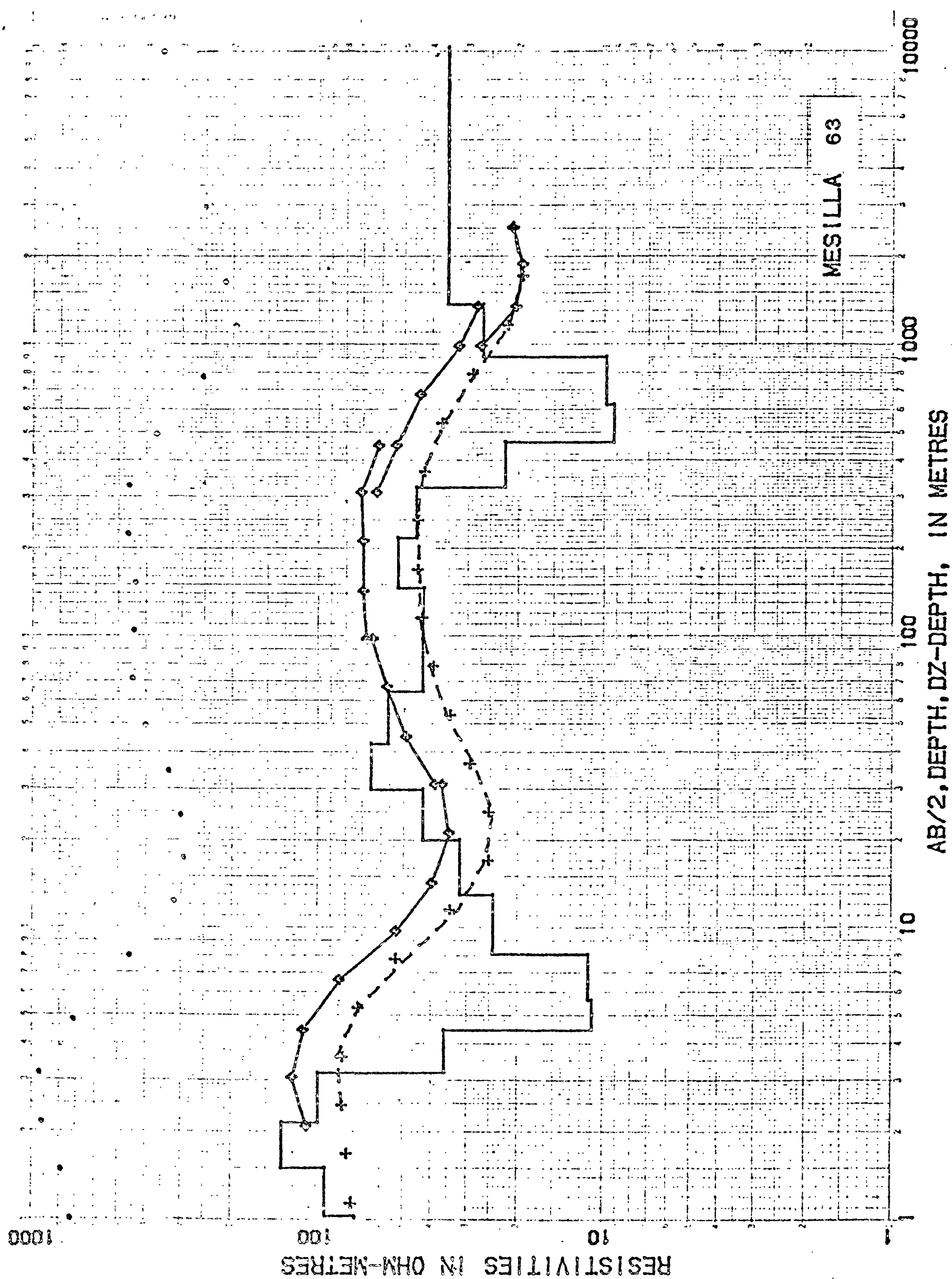


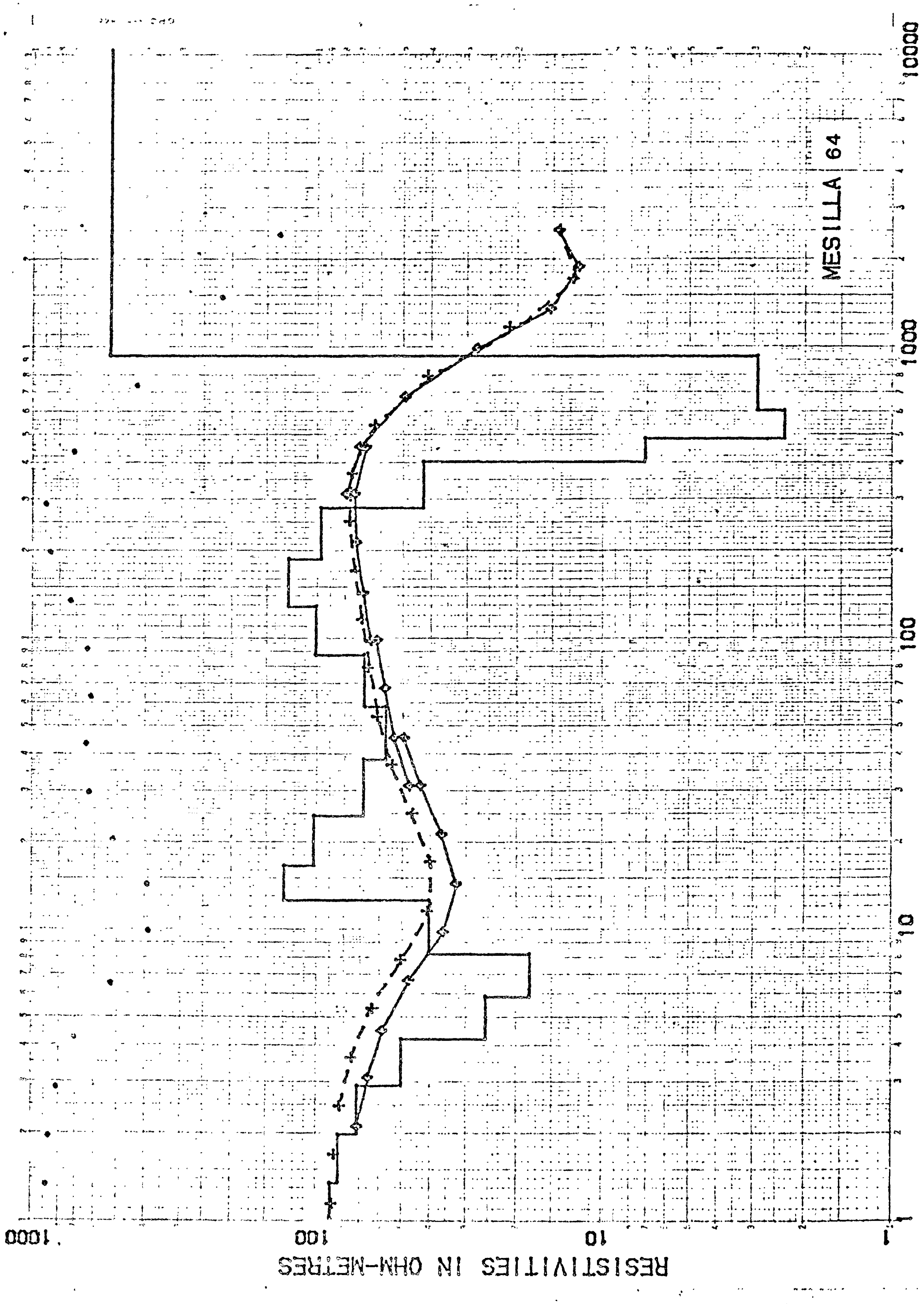
MESILLA 59
AB/2, DEPTH, DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
1
10
100
1000
10000

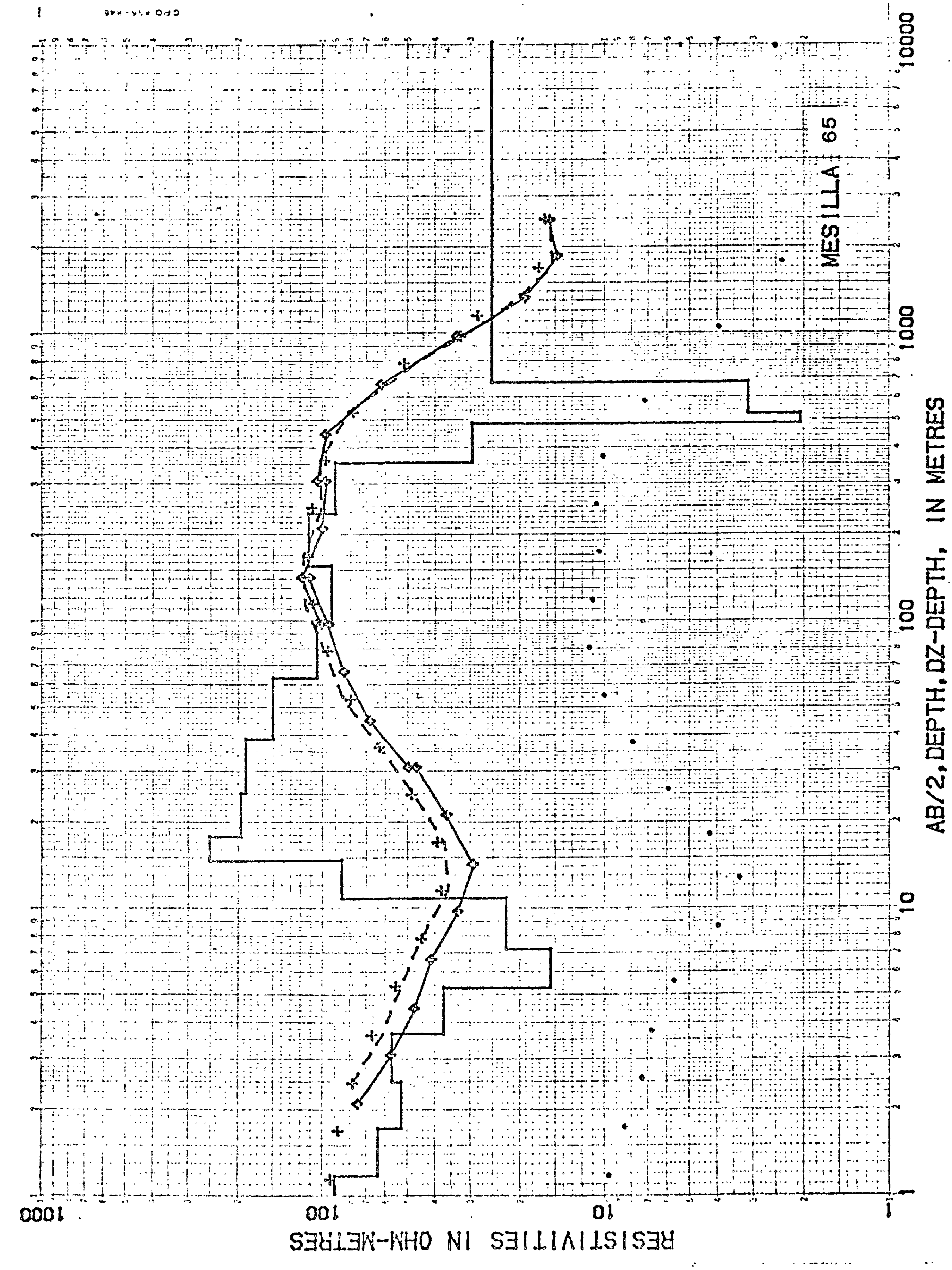

MESILLA 60
AB/2, DEPTH, DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
1
10
100
1000
10000


MESILLA 61
AB/2, DEPTH, DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
1000
100
10
1
10
100
1000
10000


MESILLA 62
AB/2, DEPTH, DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
1
10
100
1000
10000


MESILLA 63
AB/2, DEPTH, DZ-DEPTH, IN METRES
RESISTIVITIES IN OHM-METRES
1
10
100
1000
10000


MESILLA 64
AB/2, DEPTH, DZ-DEPTH, IN METRES
1
10
100
1000
10000
RESISTIVITIES IN OHM-METRES
1000
100
10
1


MESILLA 65
AB/2, DEPTH, DZ-DEPTH, IN METRES
1
10
100
1000
10000
RESISTIVITIES IN OHM-METRES
1000
100
10
1