UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

GEOELECTRIC INVESTIGATIONS WITH SCHLUMBERGER SOUNDINGS NEAR VENICE, PARRISH, AND HOMOSASSA, FLORIDA

By

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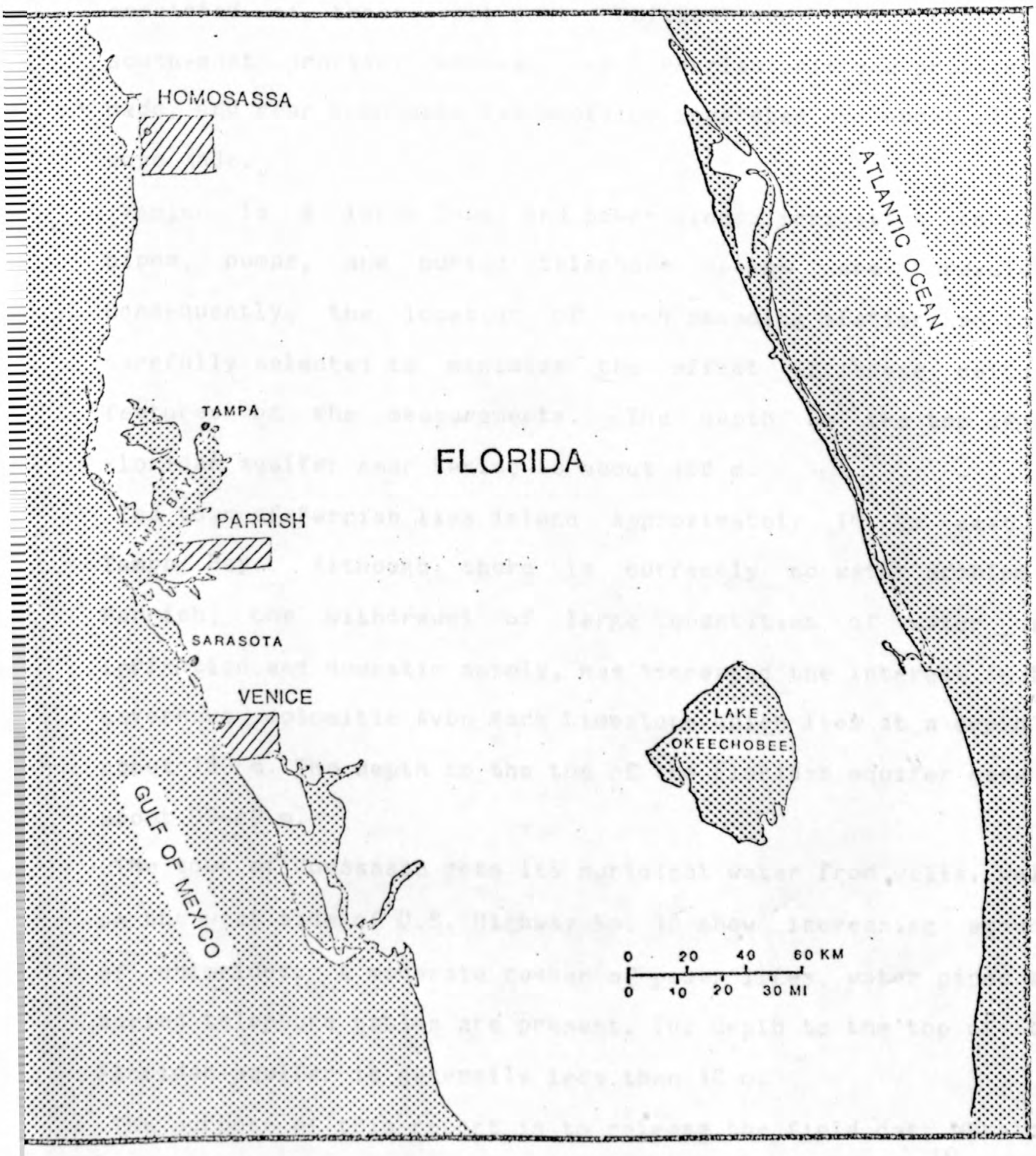

Figure 1.--Map showing the location of Schlumberger sounding surveys (hachured areas) near Venice, Parrish, and Homosassa, Florida.

Figure 1 shows the locations of the survey areas. The survey was made only as a reconnaissance survey, and the individual areas are too far apart to be correlated. Near Venice the survey consisted of three east-west profiles and one north-west south-east profile; whereas, near Parrish only one profile was made, and near Homosassa two profiles separated by about 10 km were made.

Venice is a large town, and power lines, irrigation and water pipes, pumps, and buried telephone cables are prevalent. Consequently, the location of each sounding station had to be carefully selected to minimize the effect of these cultural features on the measurements. The depth to the top of the Floridan aquifer near Venice is about 100 m.

The town of Parrish lies inland approximately 15 km east of Tampa Bay. Although there is currently no water problem at Parrish, the withdrawal of large quantities of water for irrigation and domestic supply, has increased the interest in the cavernous dolomitic Avon Park Limestone which lies at a depth of about 180 m. The depth to the top of the Floridan aquifer here is about 50-60 m.

The town of Homosassa gets its municipal water from wells. Wells on the west side of U.S. Highway No. 19 show increasing amounts of chlorides. A moderate number of power lines, water pipes and buried telephone cables are present. The depth to the top of the Floridan aquifer is generally less than 10 m.

The purpose of this report is to release the field data obtained in this survey. The automatic inversion of the sounding curves and the computer generated geoelectric cross sections are also given and briefly described in the following sections.

SCHULMBERGER SOUNDINGS

Figures 2, 3, and 4 show the Schlumberger sounding locations and their direction of expansion. Sounding 73 is not shown on these location maps. It is located on Florida State Highway No. 494, 5.6 km north of Homosassa Springs (fig. 4) and 610 m west of U.S. Highway No. 19. All the sounding measurements except one, were made using a symmetric Schlumberger array. For sounding 49 the last measurement, at an electrode spacing (AB/2) of 2438 m, was made using an asymmetric array. A standard Schlumberger apparent resistivity was calculated for that asymmetric measurement, by applying a correction formula (Zohdy and Bisdorf, 1976; Zohdy,1978).

The sounding curves are given in the appendix and are numbered consecutively from Florida 1 to Florida 78. All the sounding curves were automatically processed and interpreted (Zohdy, 1973 and 1975) as shown in the graphs. The range of apparent resistivities on soundings 31, 71, and 73 exceeded the range for the accurate application of Ghosh coefficients (Ghosh, 1971). Therefore, for these sounding curves, a larger and more accurate set of coefficients (Anderson, 1975) was used. On some of the graphs (31, 60, 71, 73) the range of ordinate values exceeded the range afforded by the graph paper. On these graphs the ordinate values in question were shifted upward or downward, as

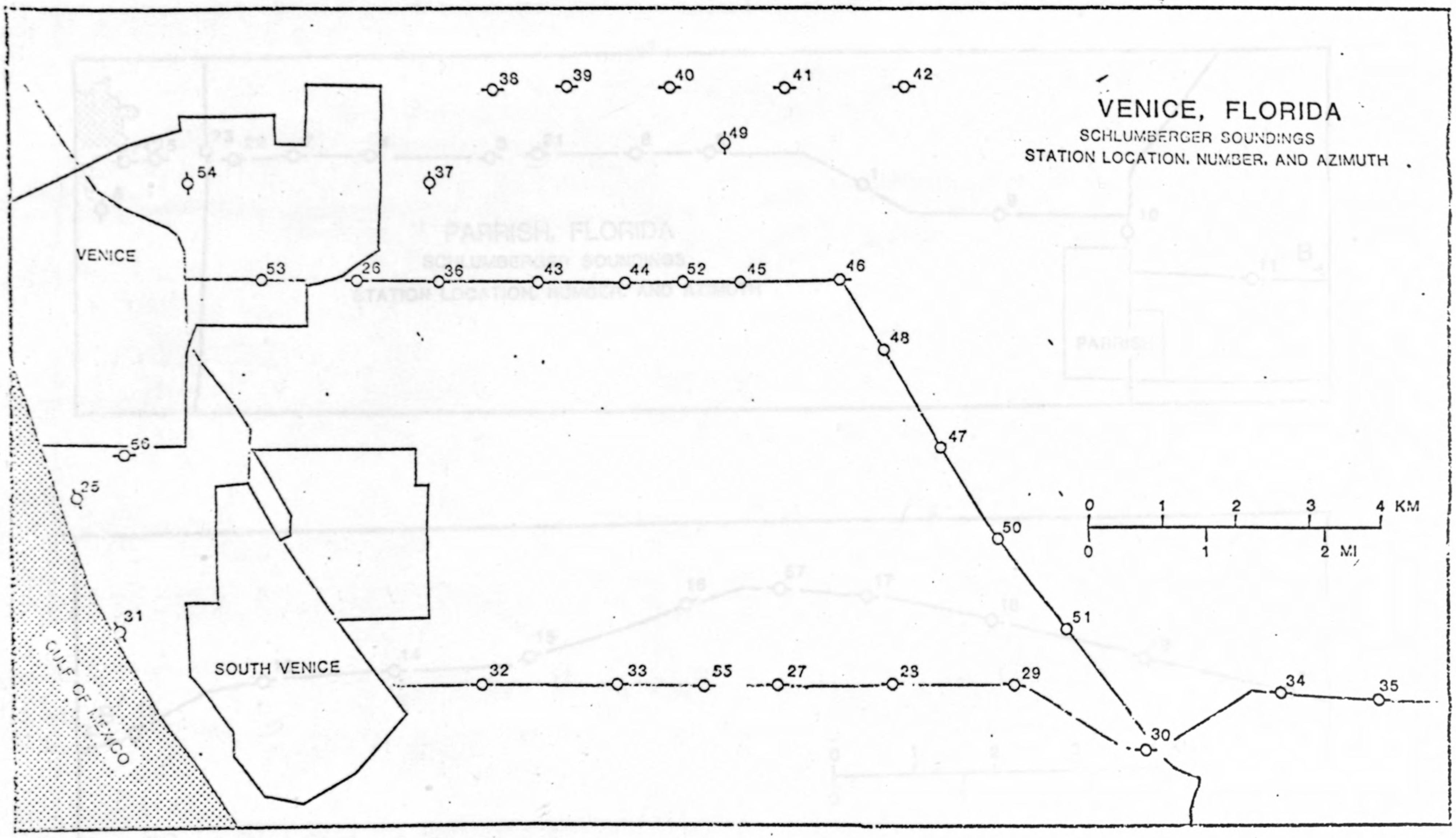

Figure 2.-- Schlumberger sounding location map showing sounding locations and directions of expansion near Venice, Florida.

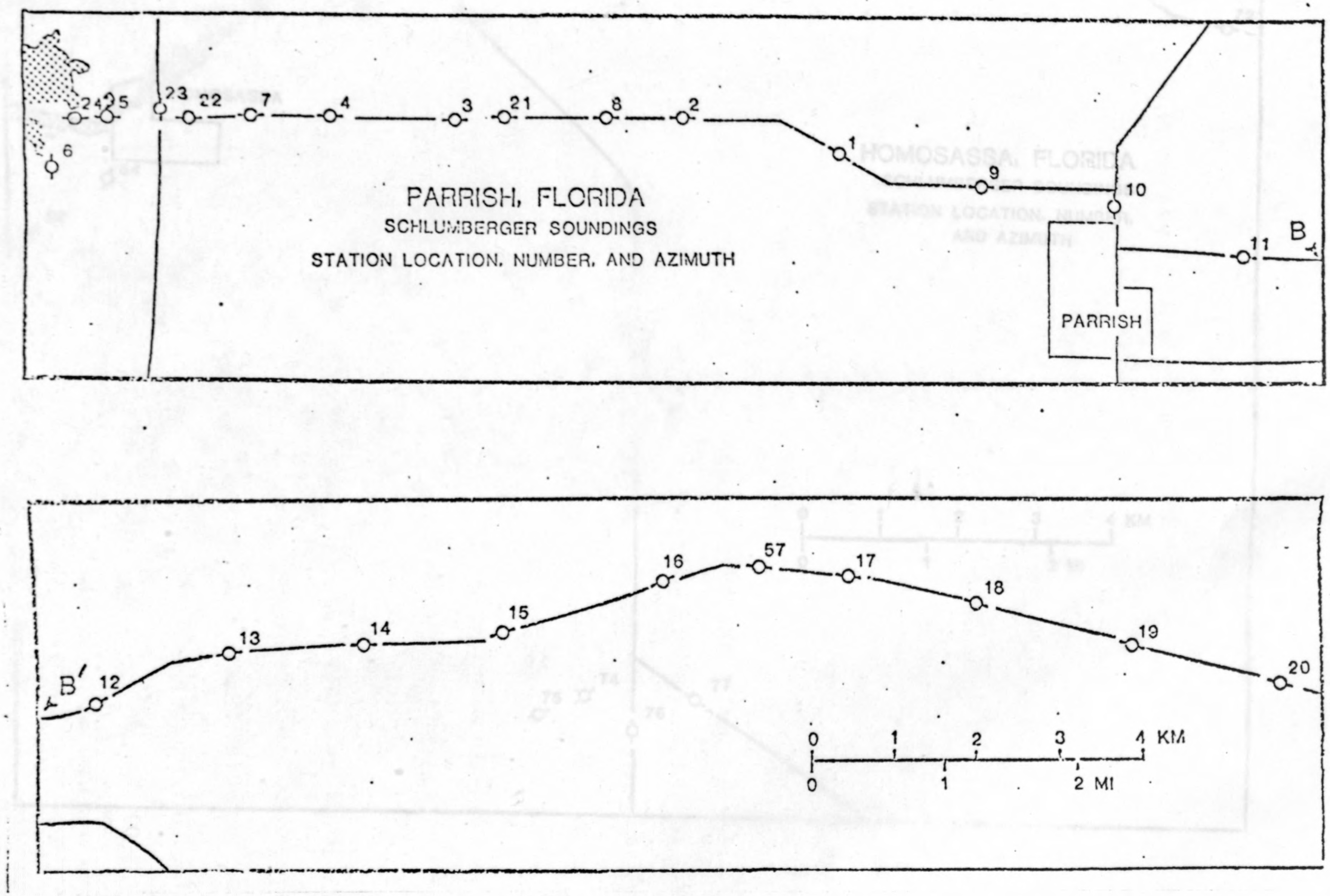

Figure 3.-- Schlumberger sounding location map showing sounding locations and directions of expansion near Parrish, Florida. Points B-B' are coincident.

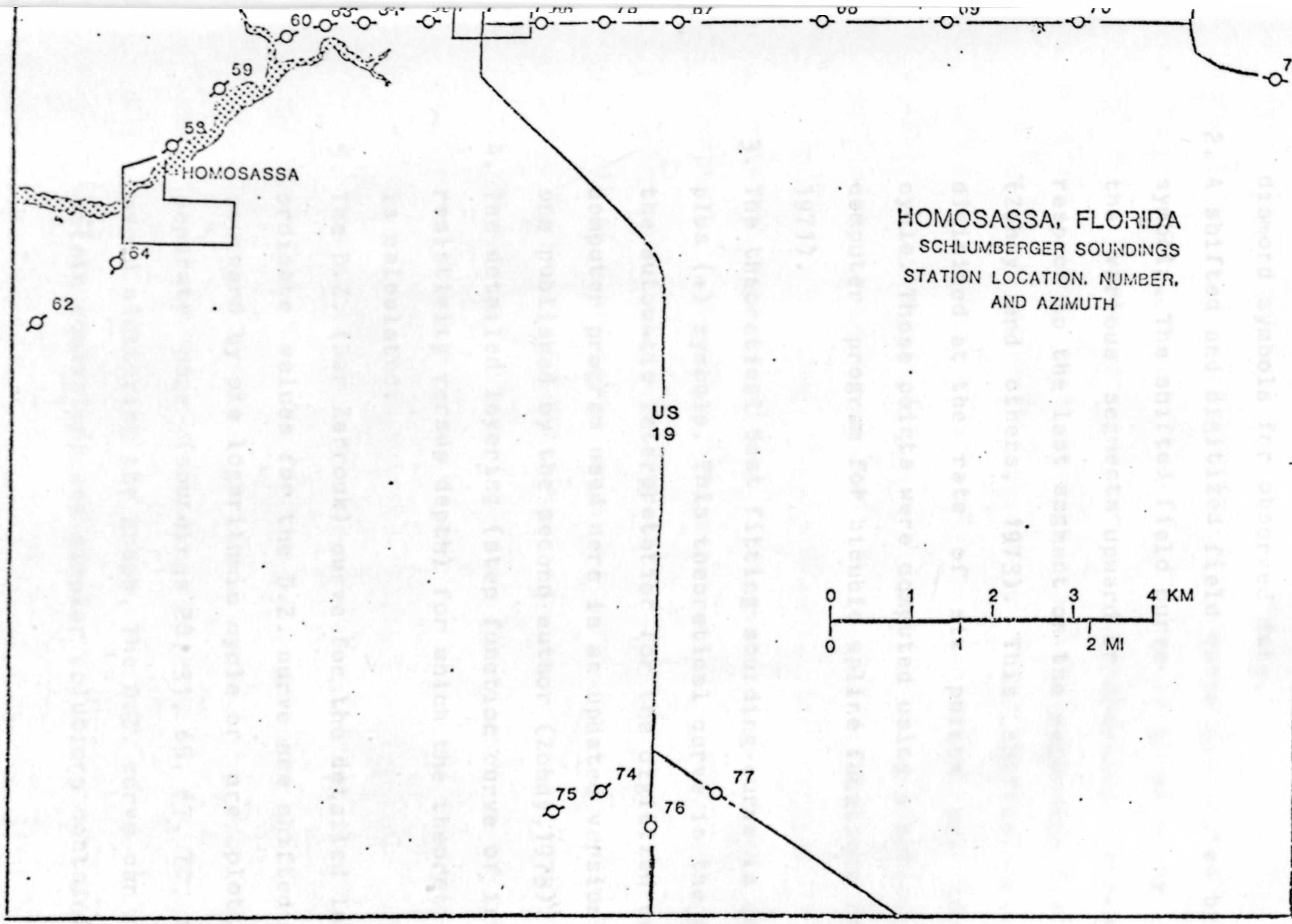

Figure 4.-- Schlumberger sounding location map showing sounding locations and directions of expansion near Homosassa, Florida.

appropriate, by three logarithmic cycles. Each graph shows the following:

1. Field data designated by a segmented, solid line curve, with diamond symbols for observed data.
2. A shifted and digitized field curve designated by square symbols. The shifted field curve is obtained by shifting the various segments upward or downward, generally with respect to the last segment on the segmented field curve (Zohdy and others, 1973). This shifted curve is then digitized at the rate of six points per logarithmic cycle. These points were computed using a subroutine in a computer program for bicubic spline functions (Anderson, 1971).
3. The theoretical best fitting sounding curve is designated by plus (+) symbols. This theoretical curve is the output of the automatic interpretation for the digitized curve. The computer program used here is an updated version of the one published by the second author (Zohdy, 1973).
4. The detailed layering (step function curve of interpreted true resistivity versus depth) 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. curve are shifted upward or downward by one logarithmic cycle or are plotted on a seperate page (soundings 20, 31, 65, 67, 70, and 71) to avoid cluttering the graph. The D.Z. curve can be used to obtain equivalent and simpler solutions containing fewer

number of layers and in which certain constaints can be imposed on layer thicknesses and resistivities(Zohdy, 1974).

GEOELECTRIC CROSSECTIONS

Figures 5 through 11 show computer generated geoelectric sections of interpreted true resistivty. The cross sections were constructed in the following manner.

For each sounding, the detailed layering (given as a step function) is converted to a smooth curve representing a continuous variation of resistivity with depth. This conversion is made by determining the coordinates of the logarithmic midpoint of each horizontal and vertical segment (fig. 12a). The logarithms of these points are splined (Anderson, 1971) to form a continuous curve. Then the computed spline coefficients are used to digitize this continuous curve at the rate of 30 points per decade of depth (fig. 12b). After this is done for each sounding interpretation, the digitized curves generated in this manner are spline-interpolated in the horizontal direction to generate resistivity values at four equally spaced locations between each pair of soundings. This produces a data set in the form of a mesh suitable for contouring. A computer program based on the work of Evenden (1975) was used for contouring the results. It should be noted that even though the logarithms of the resistivities and depths were used for splining, some significant anomalies may still be generated by interpolation between sounding locations. Thus although the automatic contouring method used here is faithful to the interpreted resistivity values beneath each station, there are other equally acceptable methods of contouring these resistivity values. The reader is cautioned that anomalies created by interpolation between sounding stations may not be real (see for example fig. 5a for the closed anomalies generated by interpolation beneath the town of South Venice between soundings 31 and 32). The cross sections are contoured at a logarithmically quasi-equal interval of six points per decade, with contours at 1,1.5,2,3,4.5,7,10,15, ...100,150,200,300, and 450, in ohm meters.

Each section is composed of three parts. The top part shows a ten to one vertically exaggerated presentation of the upper 215 m; the middle part a four to one vertically exaggerated presentation of the upper 926 m; the lower part, a no vertical exaggeration presentation of the upper 926 m.

DISCUSSION

VENICE

Figures 5, 6, 7, and 8 show the geoelectric cross sections obtained near the town of Venice, Florida. The southernmost east-west cross section, shown in figures 5a, b, and c, is 17.6 km in length. It crosses South Venice, and it was constructed from 10 Schlumberger soundings. There is evidence for the presence of 200-250 m of fresh-water saturated limestone and

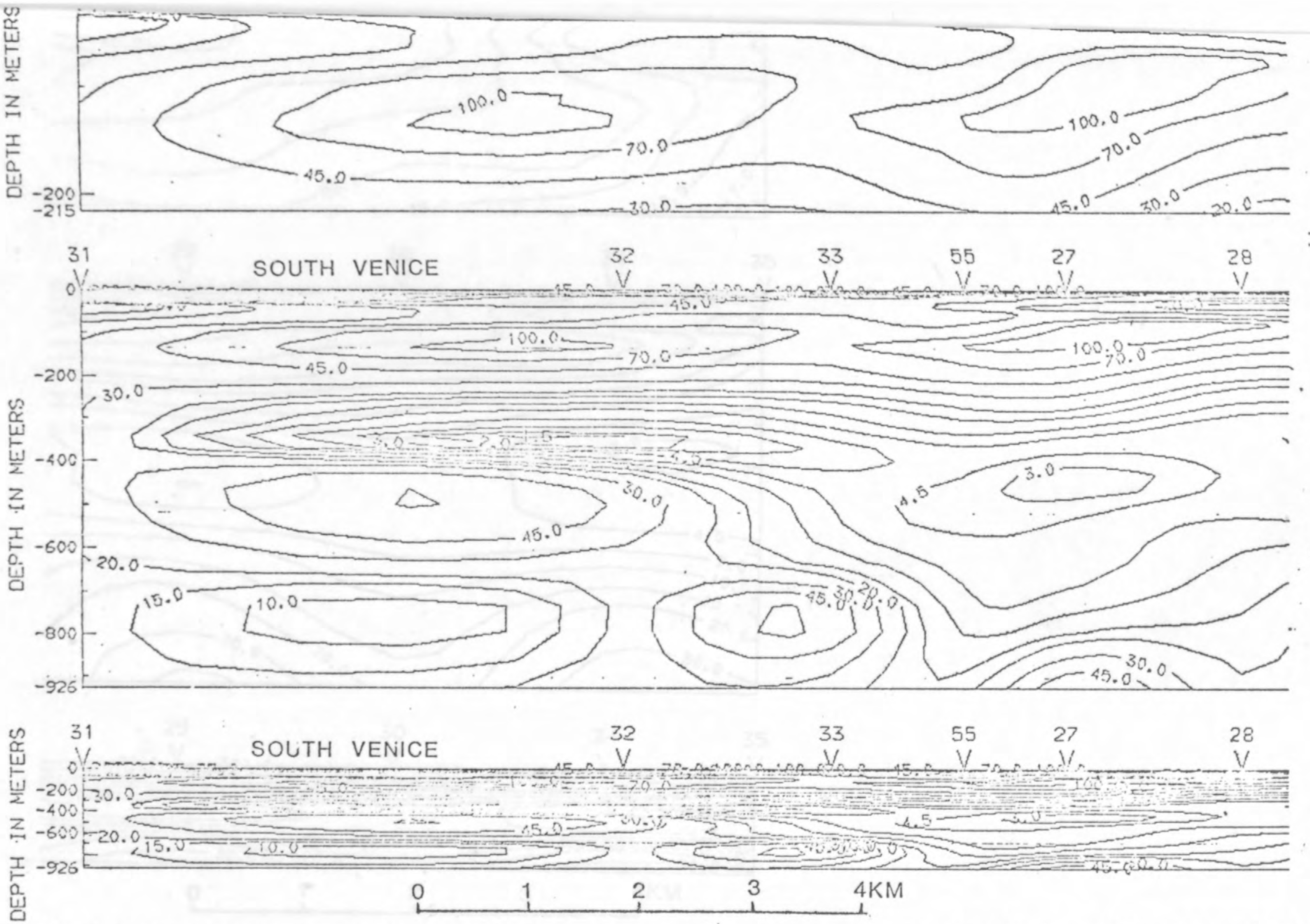

Figure 5a.--Computer generated geoelectric section. See figure 2 for location. Top and middle parts are vertically exaggerated ten and four times, respectively. Bottom part without vertical exaggeration. Contours of interpreted true resistivity in ohm-meters.

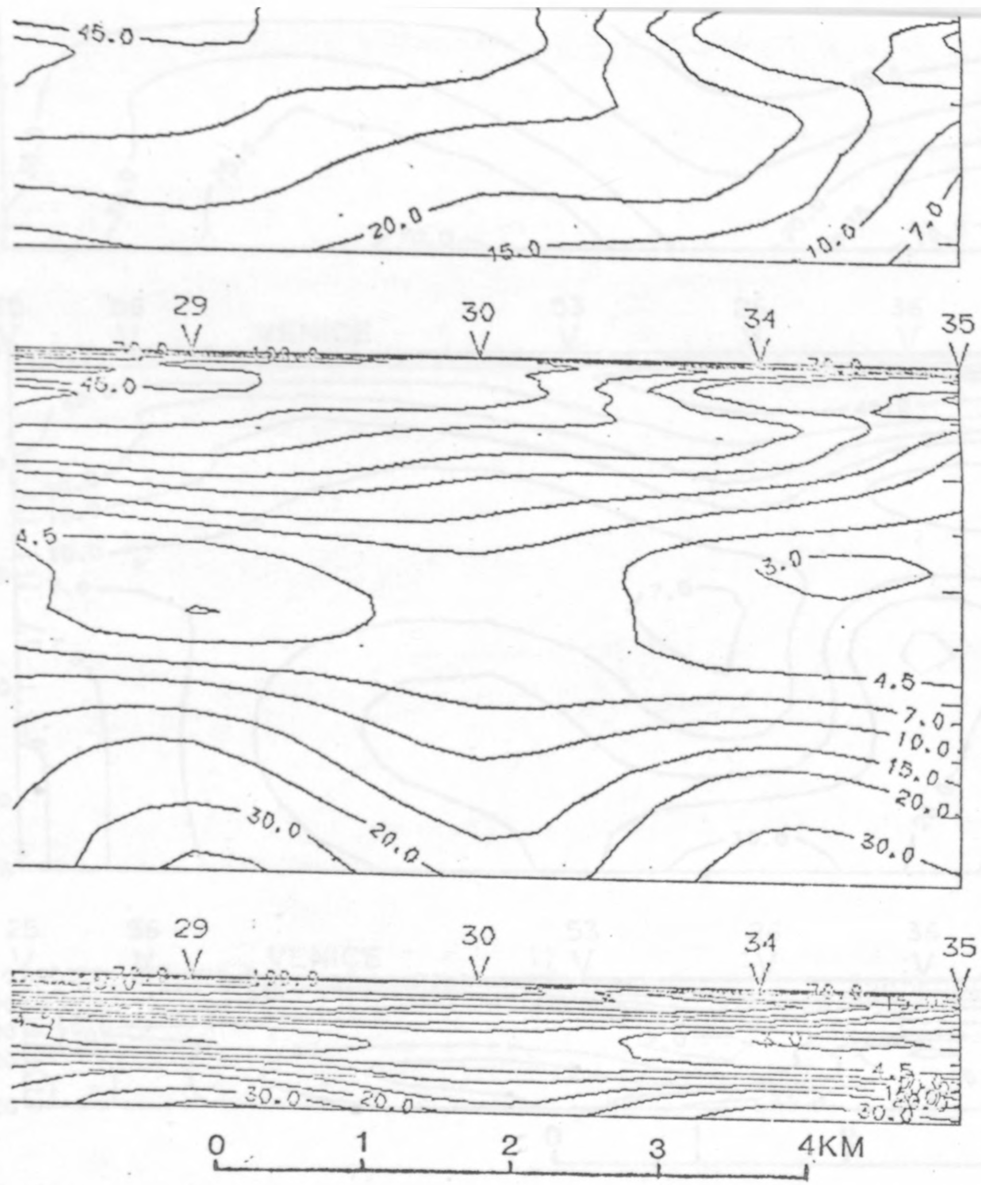

Figure 5b.--Computer generated geoelectric section continued from figure 5a.

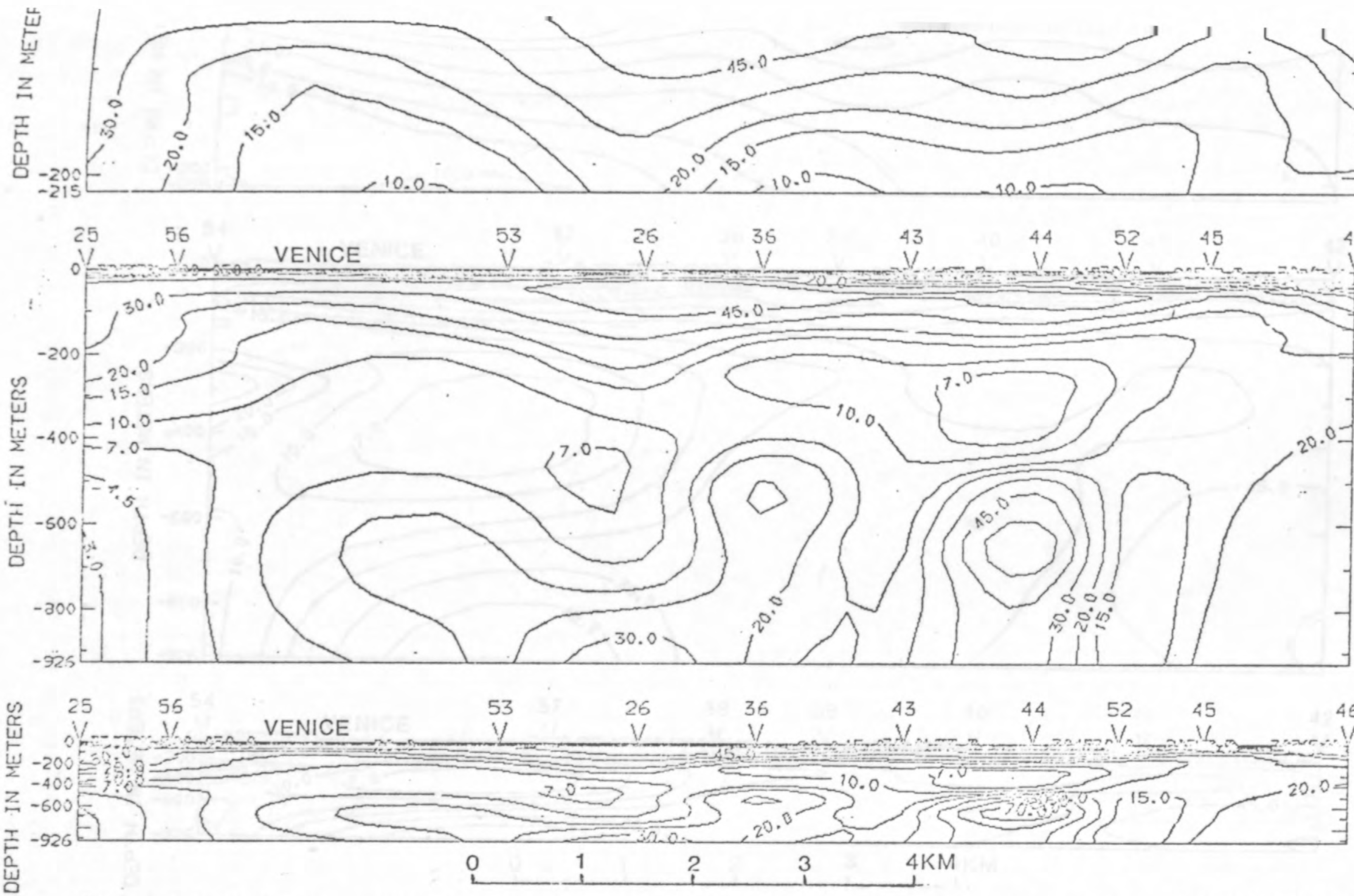

Figure 6.-- Computer generated geoelectric section. See figure 2 for location. Top and middle parts are vertically exaggerated ten and four times, respectively. Bottom part without vertical exaggeration. Contours of interpreted true resistivity in ohm-meters.

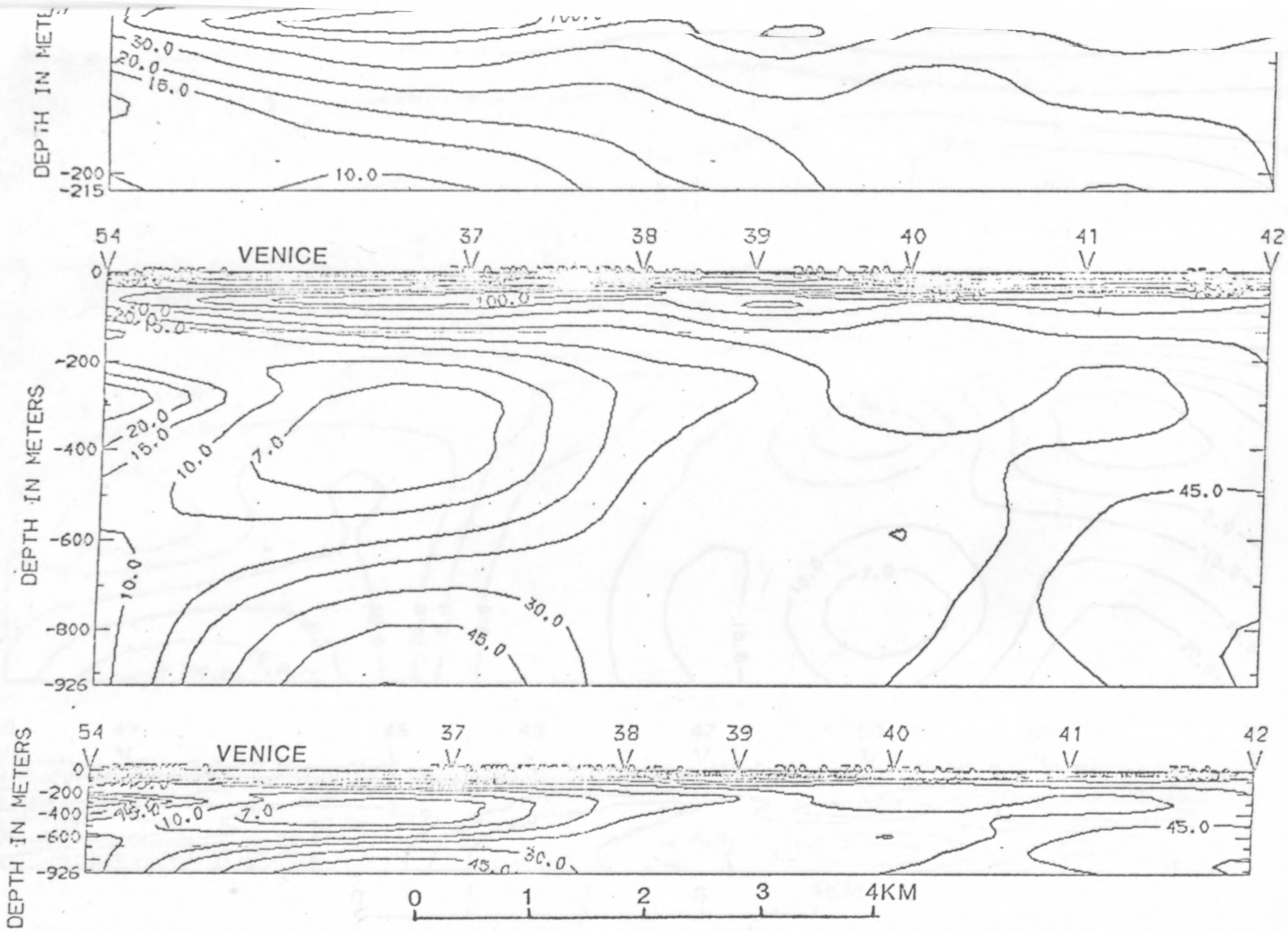

Figure 7.--Computer generated geoelectric section. See figure 2 for location. Top and middle parts are vertically exaggerated ten and four times, respectively. Bottom part without vertical exaggeration. Contours of interpreted true resistivity in ohm-meters.

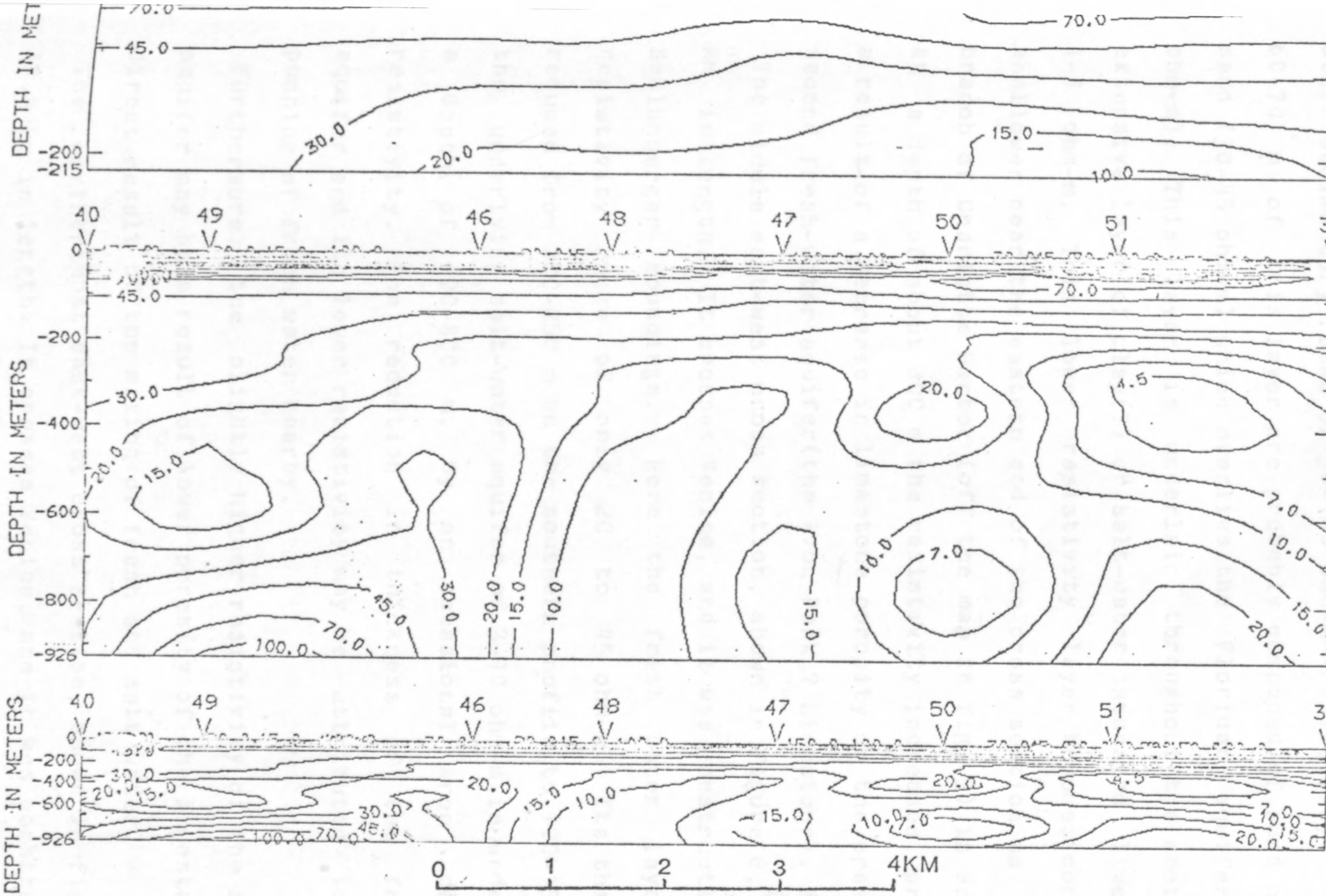

Figure 8.-- Computer generated geoelectric section. See figure 2 for location. Top and middle parts are vertically exaggerated ten and four times, respectively. Bottom part without vertical exaggeration. Contours of interpreted true resistivity in ohm-meters.

other sedimentary rocks of 30-100 ohm-m resistivity. The upper 60-70 m of this layer are probably composed of sand and clayey sand (30-45 ohm-m) which overlies the Floridan aquifer (45-100 ohm-m). This layer is underlain throughout the section by an extensive layer of clay(?) or salt-water saturated limestone of 1-5 ohm-m. This lower resistivity layer becomes considerably shallower near the eastern end of the cross section as the left branch of Charlotte Harbor (off the map in fig. 3) is approached. At a depth of about 800 m the resistivity increases, probably as a result of a decrease in limestone porosity or the presence of a second fresh-water aquifer(the Avon Park ? Limestone).

The middle east-west cross section, shown in figure 6, is 11.6 km in length. It crosses Venice, and it was constructed from 10 Schlumberger soundings. Here the fresh water layer has a resistivity range of only 20 to 45 ohm-m. Its thickness is reduced from 200-250 m on the southern profile to 100-150 m and the underlying salt-water aquifer of 3-10 ohm-m is underlain, at a depth of 600-800 m, by an occasional area of higher resistivity. The reduction in thickness of the fresh water aquifer and its lower resistivity may be attributed to heavier pumping of fresh water nearby.

Furthermore, the slightly higher resistivity of the salt-water aquifer may be a result of lower porosity of the limestone or a direct result of the mixing of fresh and salt water.

The northernmost east-west cross section, shown in figure 7, is 10.3 km in length. It crosses Venice, and it was constructed from 7 Schlumberger soundings. Here the fresh water aquifer resistivity ranges from 30 to 150 ohm-m. In the western portion of this profile the resistivity decreases to values less than 30 ohm-m at a depth of 100 m, indicating the presence of salt-water intrusion. At a depth of 700 m the resistivity increases again as in the previous sections. The eastern portion of the profile shows a much thicker section of rocks with resistivities of greater than 30 ohm-m, which indicates the somewhat limited extent of salt-water intrusion.

The cross section, shown in figure 8, is 11 km in length. It is located along a northwest southeast profile at a distance of about 12 km inland from the coastline, and it was constructed from 8 Schlumberger soundings. Here the resistivity of the fresh-water aquifer ranges from 30 to 150 ohm-m. The depth to the bottom of the fresh-water aquifer is about 125 m in the southeast (near sounding 30) and about 350 m in the northwest. At soundings 40 and 49, the clay or salt-water saturated layer is underlain, at a depth of about 700m, by higher resistivities.

PARRISH

Figure 9 shows an east-west geoelectric cross section obtained near the town of Parrish, Florida. The cross section is 30.5 km in length and it was constructed from 25 Schlumberger soundings. There is evidence for possible sea-water intrusion to a distance of 10 km from the coast line. The depth to the top of this relatively low resistivity (10-30 ohm-m) layer ranges from 30 m near the coastline in the west, to about 120 m at a distance of about 10 km to the east. To the east of sounding 8 there is no

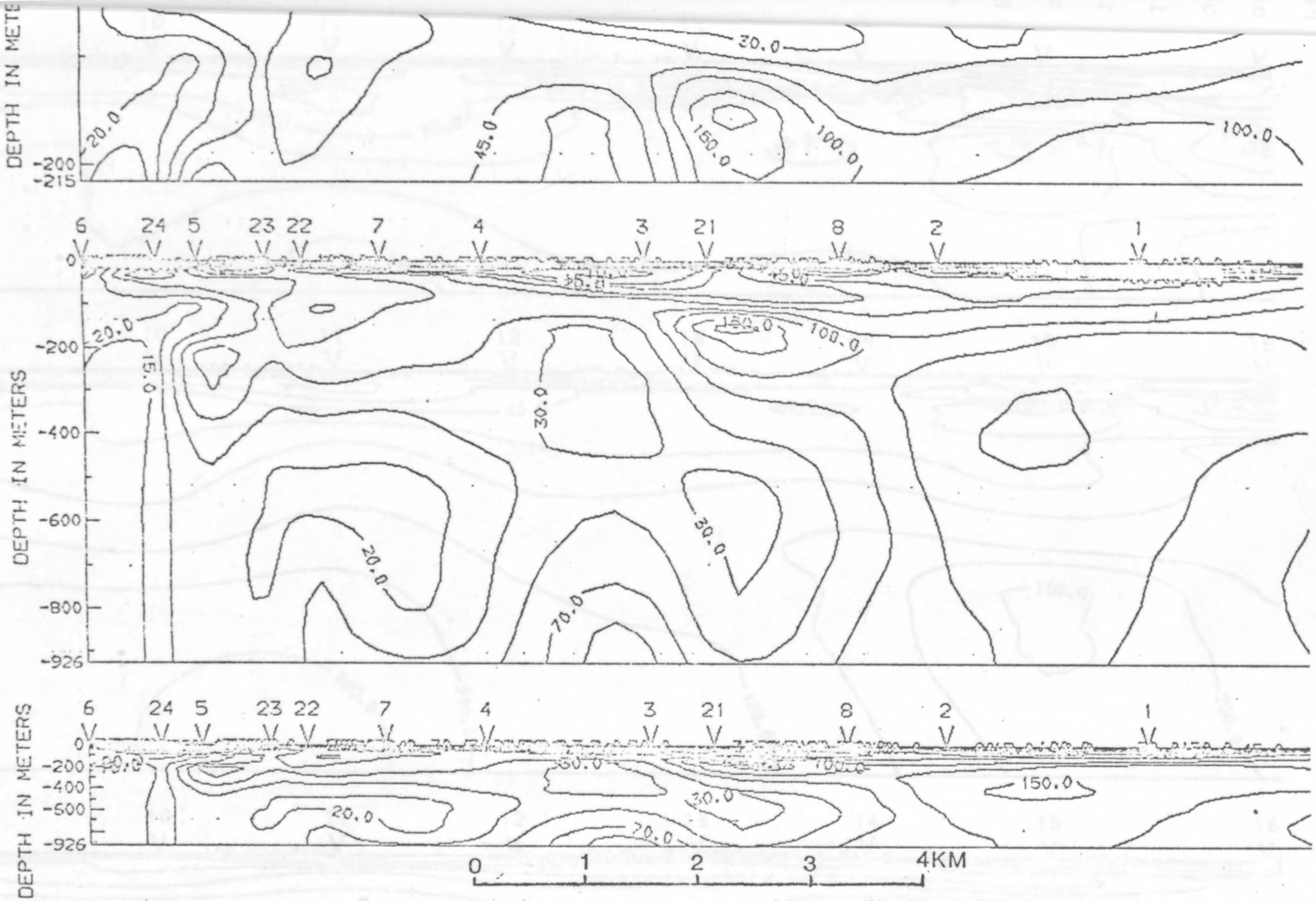

Figure 9a.-- Computer generated geoelectric section. See figure 3 for location. Top and middle parts are vertically exaggerated ten and four times, respectively. Bottom part without vertical exaggeration. Contours of interpreted true resistivity in ohm-meters.

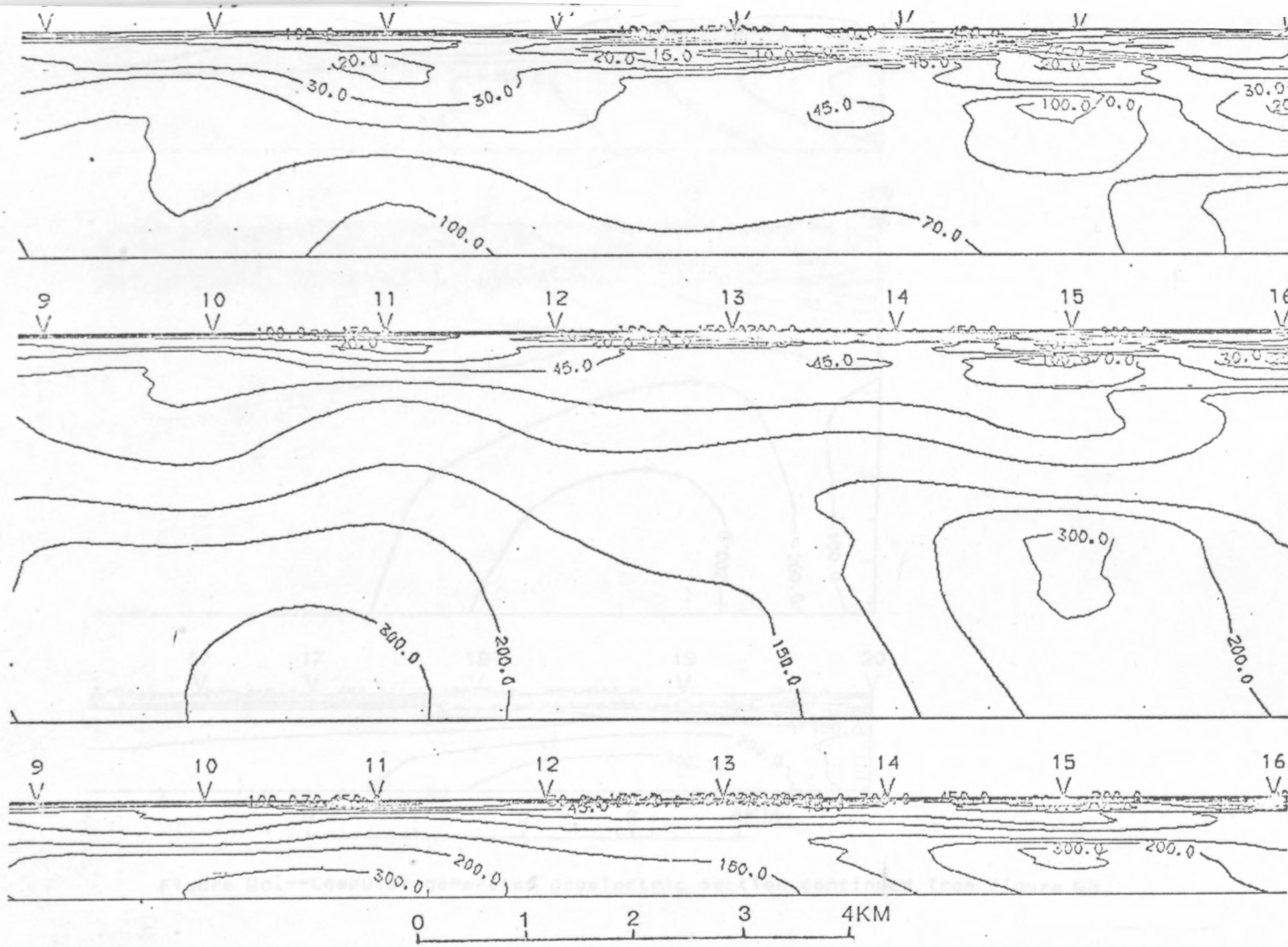

Figure 9b.--Computer generated geoelectric section continued from figure 9a.

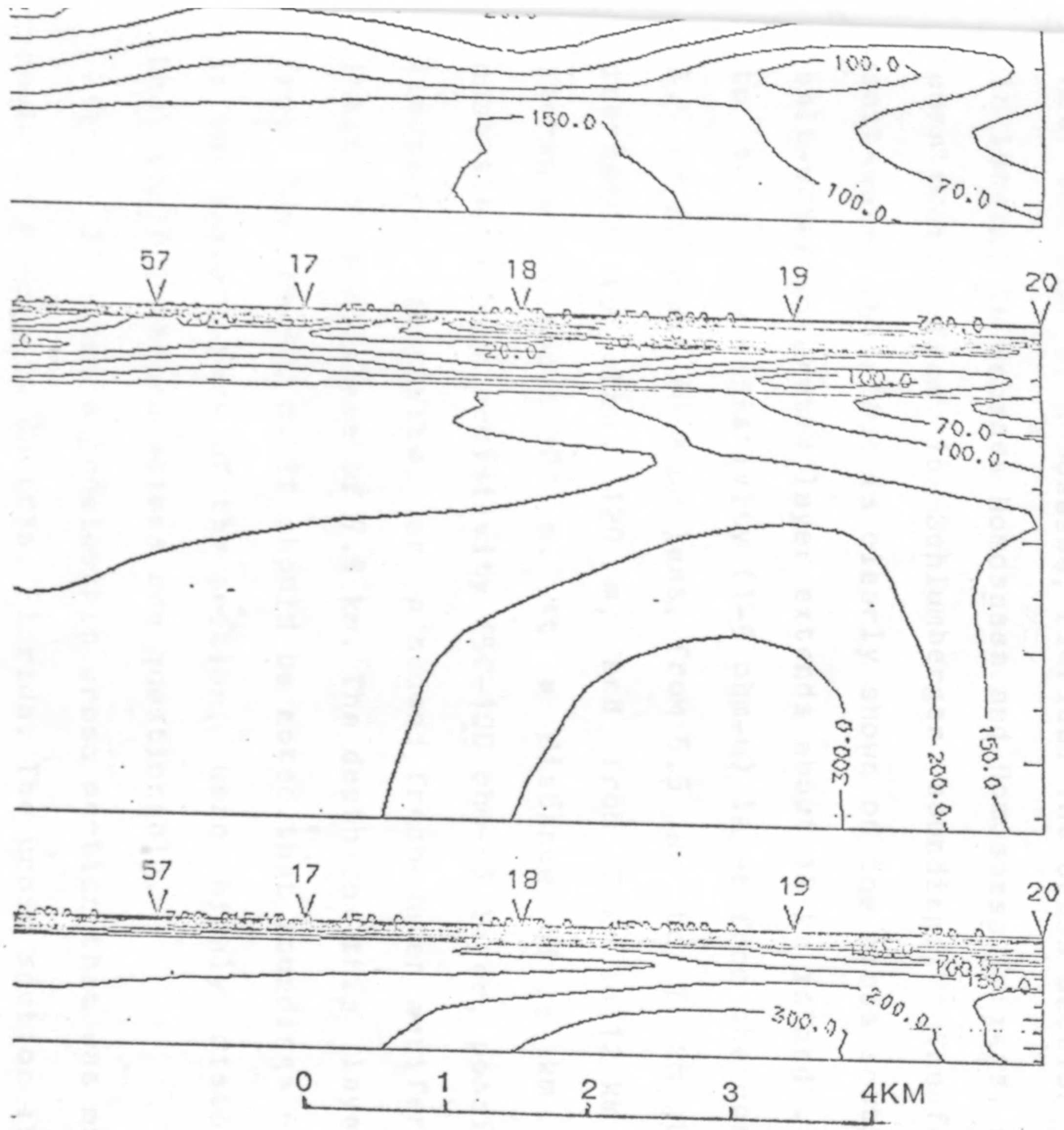

Figure 9c.--Computer generated geoelectric section continued from figure 9b.

evidence of salt-water intrusion. It seems that to the east of sounding 8 the resistivity of the Ocala Limestone saturated with fresh water is in the range of 30 to 70 ohm-m. The underlying higher resistivity rocks of 100-300 ohm-m, at a depth of about 200 m, probably correspond to the cavernous dolomitic Avon Park Limestone from which most of the water in this area is obtained.

HOMOSASSA

Figure 10 shows an east west geoelectric cross section obtained near the town of Homosassa, Florida. The cross section is 17 km in length. It crosses Homosassa and Homosassa Springs, and it was constructed from 16 Schlumberger soundings. The fresh-water salt-water interface is clearly shown on the cross section. The salt-water saturated layer extends about 12 km inland . The depth to this low resistivity (1-5 ohm-m) layer from the coastline to 5.5 km is about 20 m or less, from 5.5 km to 7 km the depth increases to about 120 m, and from 7 km to 12 km the depth increases to about 300 m. At a distance of 3 km from the coastline a high resistivity (50-100 ohm-m) layer, possibly tight limestone, anhydrite, or a second fresh-water aquifer, extends inland to a distance of 7.5 km. The depth to this layer ranges from 300 to 500 m. It should be noted that soundings 69 and 71, in the eastern part of the section, were highly distorted and that their interpretations are questionable.

Figure 11 shows a geoelectric cross section that was made 10 km south of Homosassa Springs, Florida. The cross section is 2.1 km in length and it was constructed from 4 Schlumberger soundings.

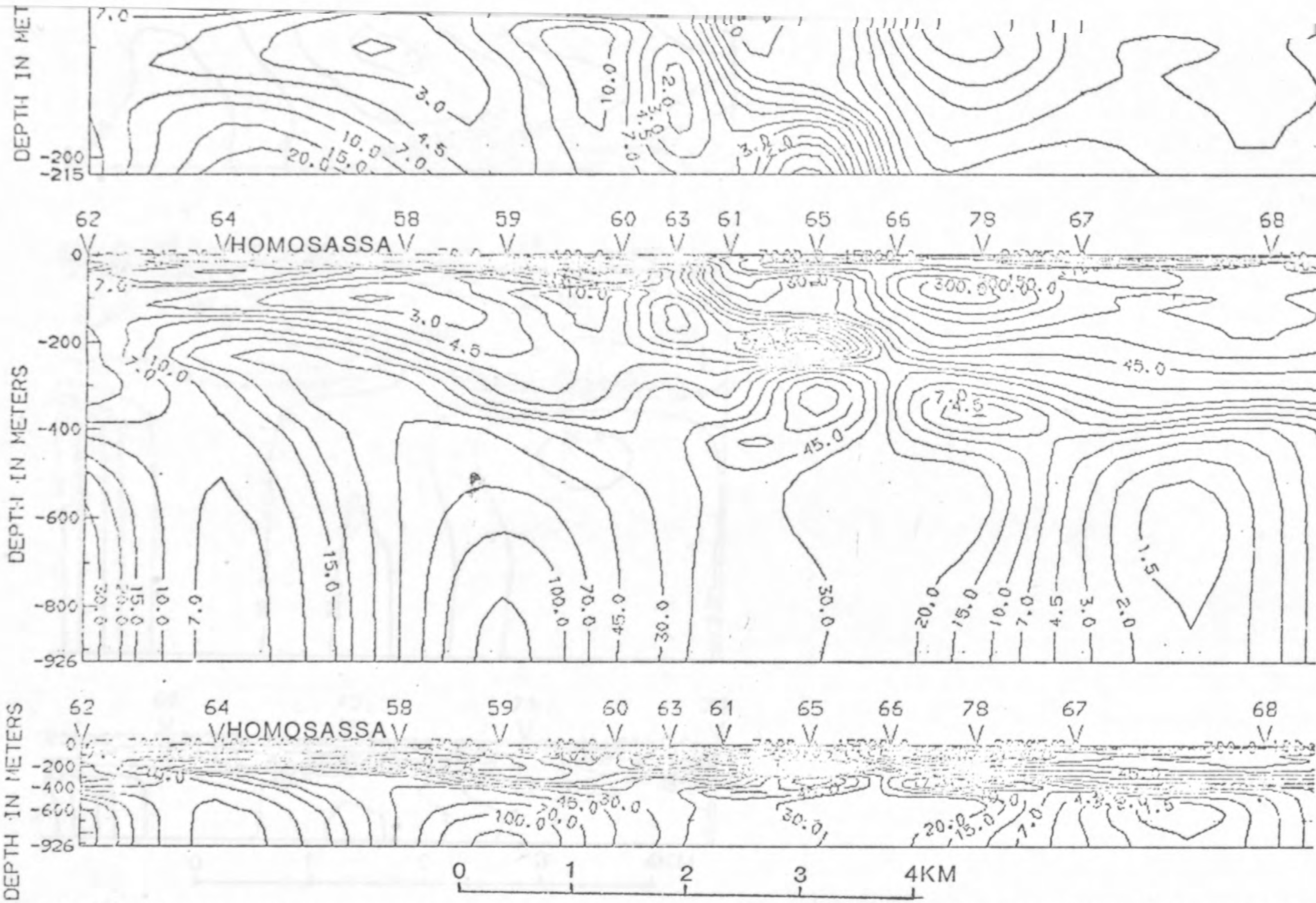

Figure 10a.-- Computer generated geoelectric section. See figure 4 for location. Top and middle parts are vertically exaggerated ten and four times, respectively. Bottom part without vertical exaggeration. Contours of interpreted true resistivity in ohm-meters.

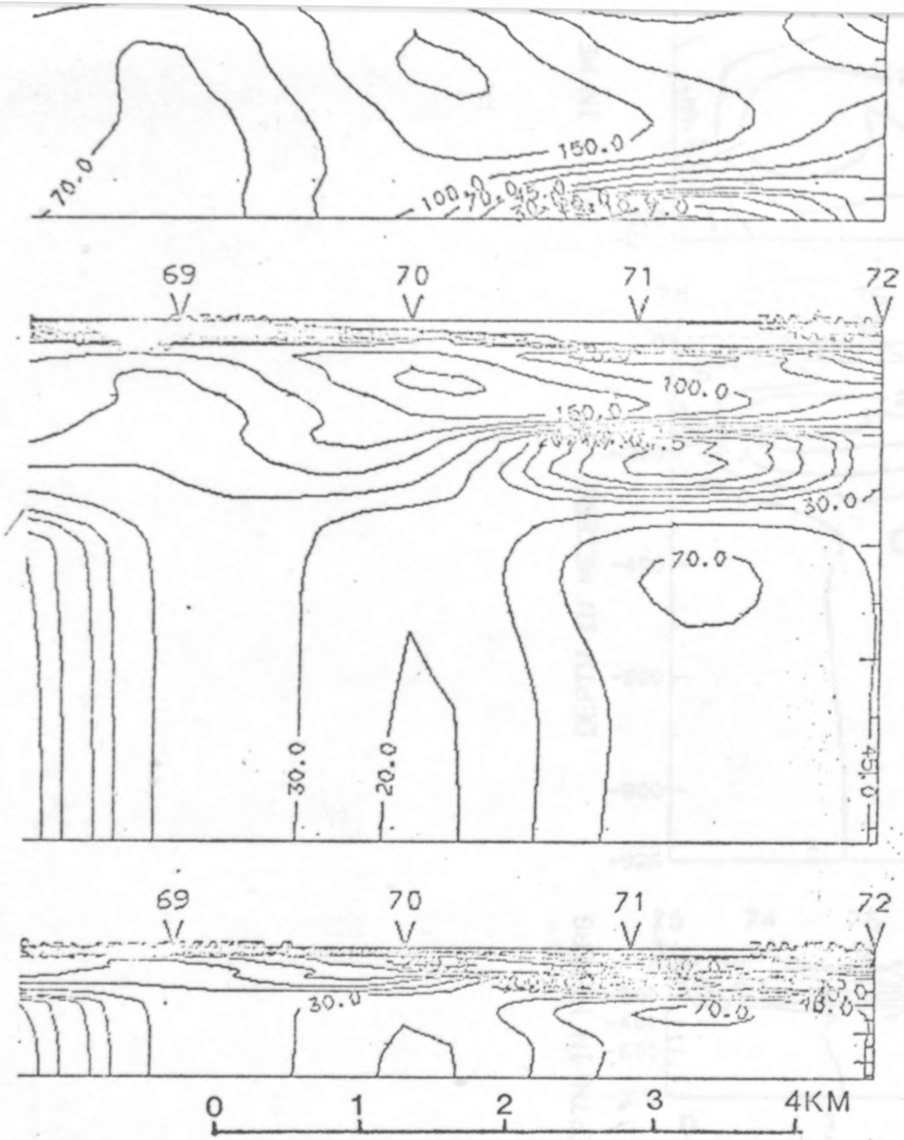

Figure 10b.--Computer generated geoelectric section continued from figure 10a.

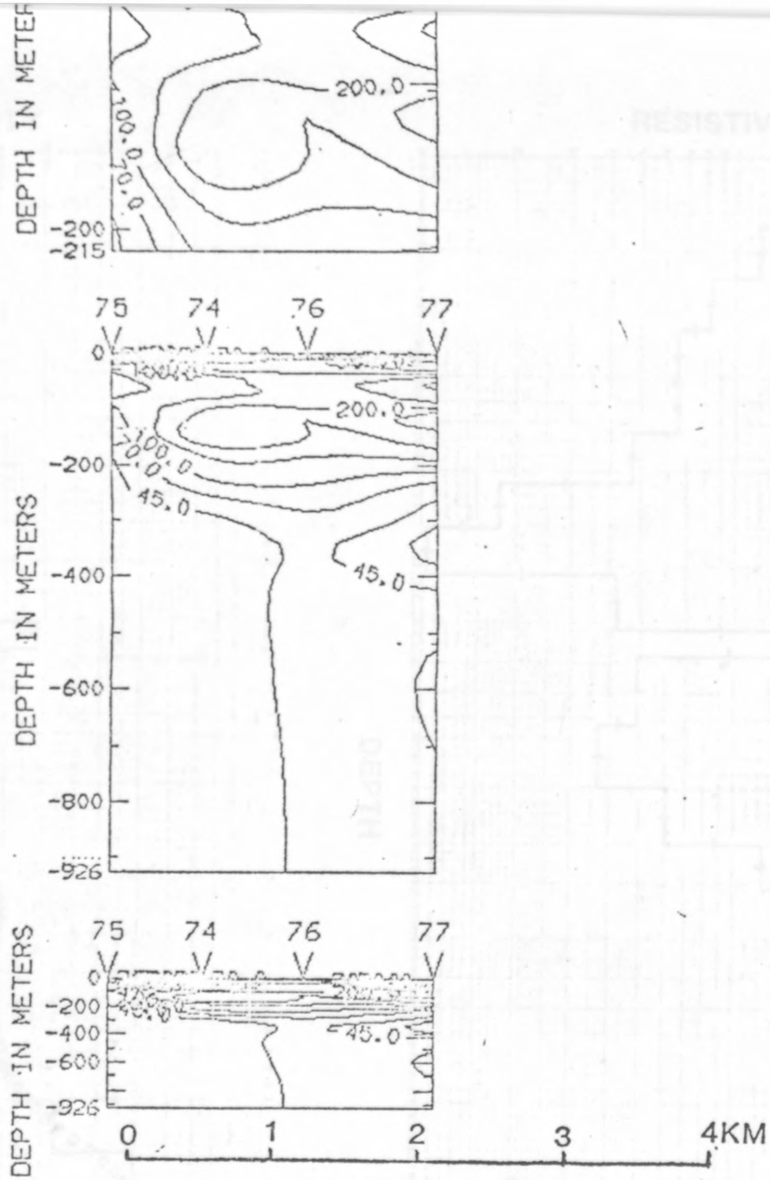

Figure 11.-- Computer generated geoelectric section. See figure 4 for location. Top and middle parts are vertically exaggerated ten and four times, respectively. Bottom part without vertical exaggeration. Contours of interpreted true resistivity in ohm-meters.

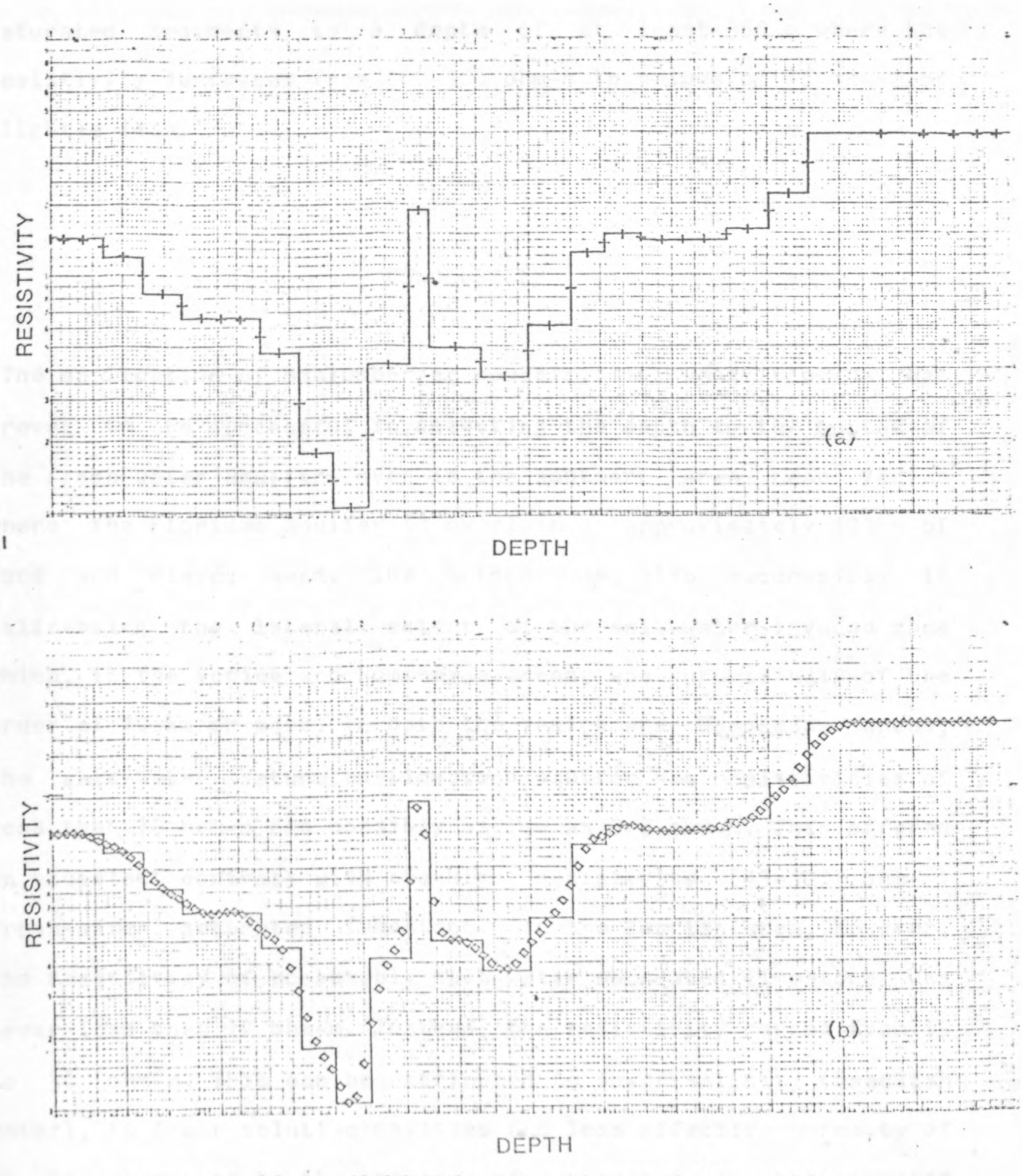

Figure 12.--(a) Detailed layering and coordinates of the logarithmic midpoint of each horizontal and vertical segment (represented by plus symbols);

(b) Detailed layering and continuous curve digitized at the rate of 30 points per decade (represented by diamond symbols).

This cross section shows no evidence of clays or salt-water saturated sediments to a depth of at least 350 m where the resistivity decreases from 100-300 ohm-m to values of 45 ohm-m or slightly less.

CONCLUSIONS

The application of Schlumberger soundings in west Florida has proven to be successful in detecting the depth to the bottom of the fresh-water aquifer, even in the southern area near Venice where the Floridan aquifer is overlain by approximately 100 m of sand and clayey sand. The method was also successful in delineating the lateral extent of the salt-water invaded zone which, in the Venice and Homosassa areas, was surprisingly of the order of 10 km or more. In both the Venice and Homosassa areas, the salt-water saturated limestone aquifer has resistivities of less than 10 ohm-m and possibly as low as 2-3 ohm-m. This offered an excellent contrast with the high resistivity (45-300 ohm-m) fresh-water saturated limestone. In the Parrish area, however, the resistivity of presumably salt-water saturated limestone was never less than 10 ohm-m. Instead, the resistivity ranged from 15 to 30 ohm-m. This can be attributed to lower salinity (brackish water), to fewer solution cavities and less effective porosity of the limestone, or to the presence of evaporites in the invaded zone.

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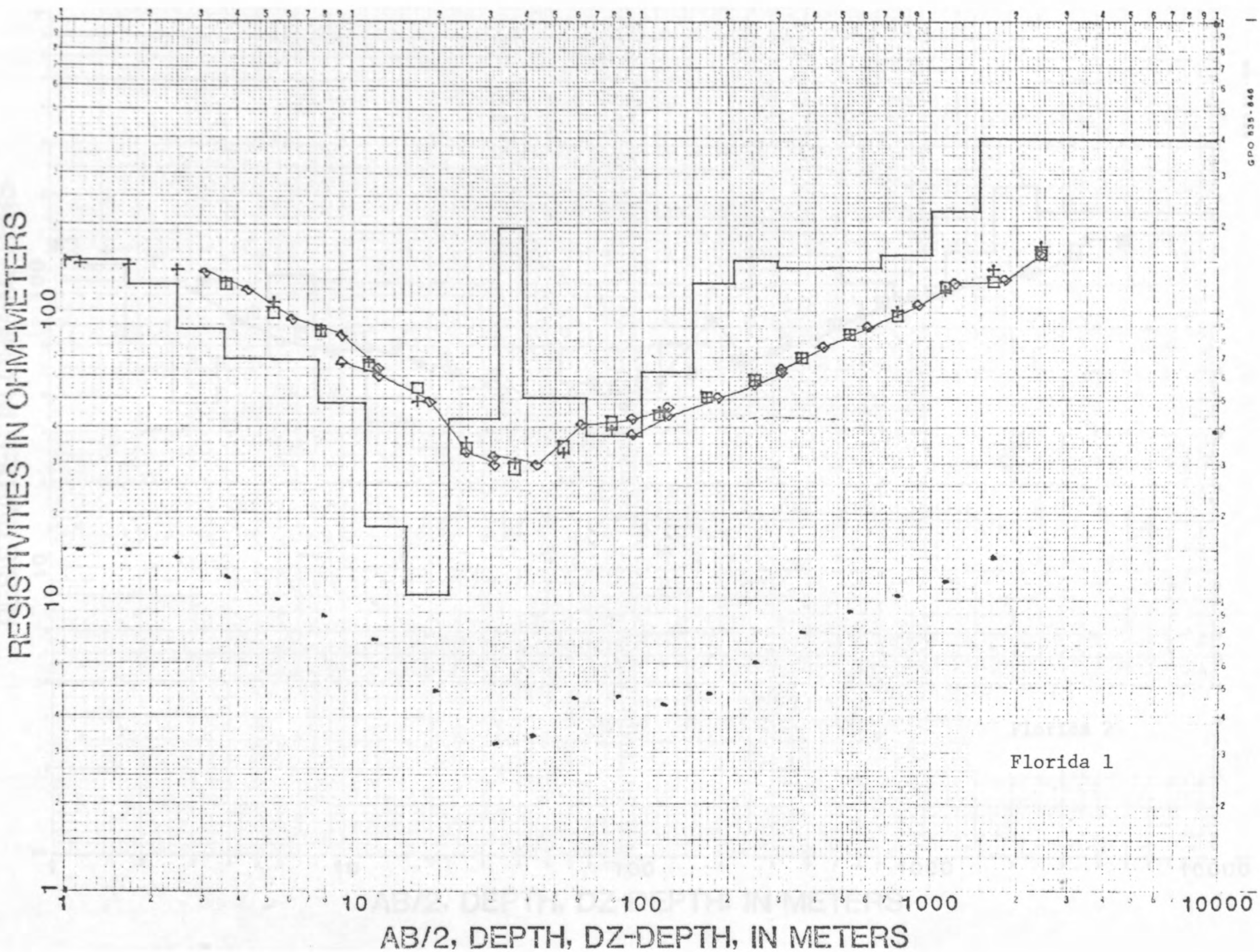
appendix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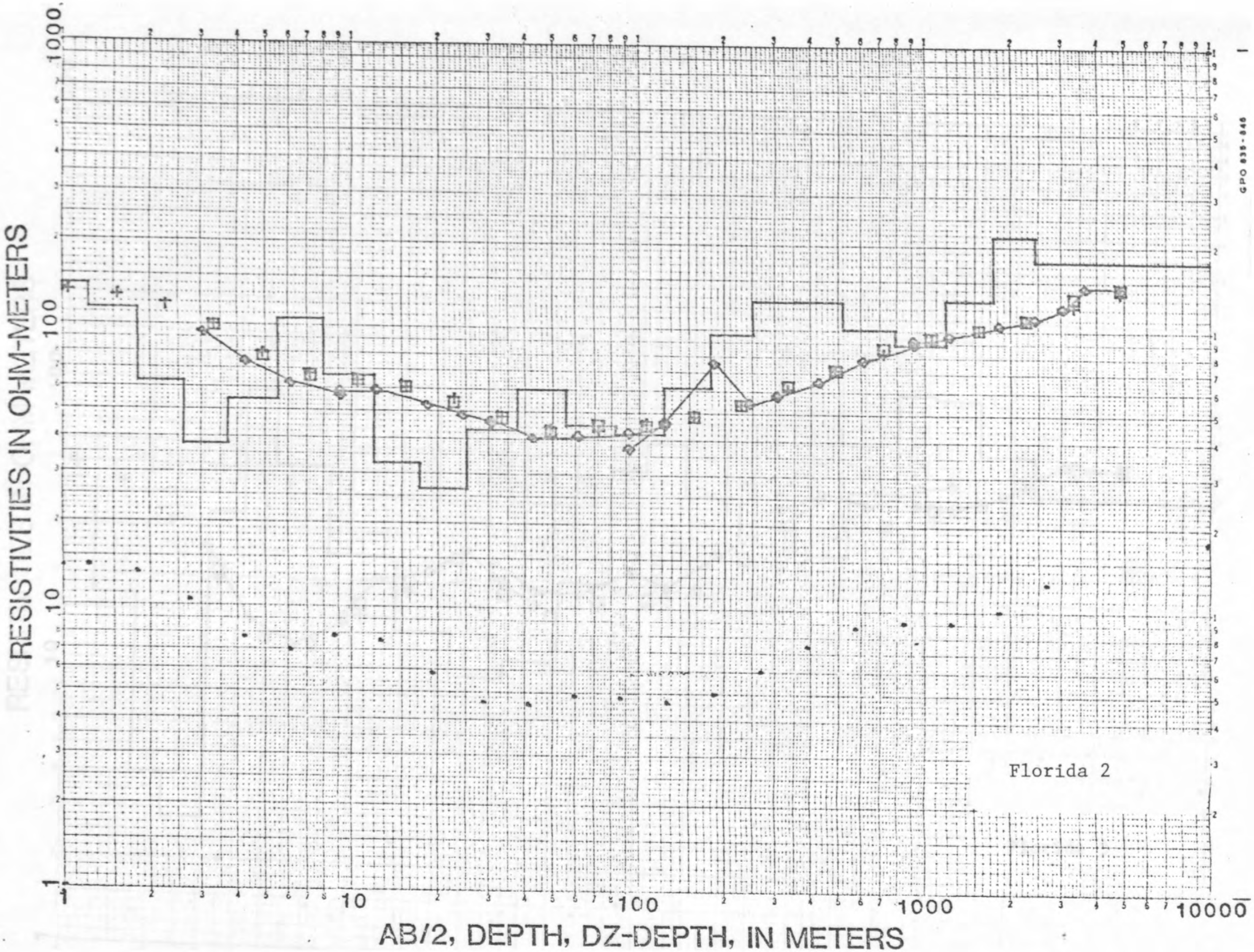
Florida 1
GPO 835-846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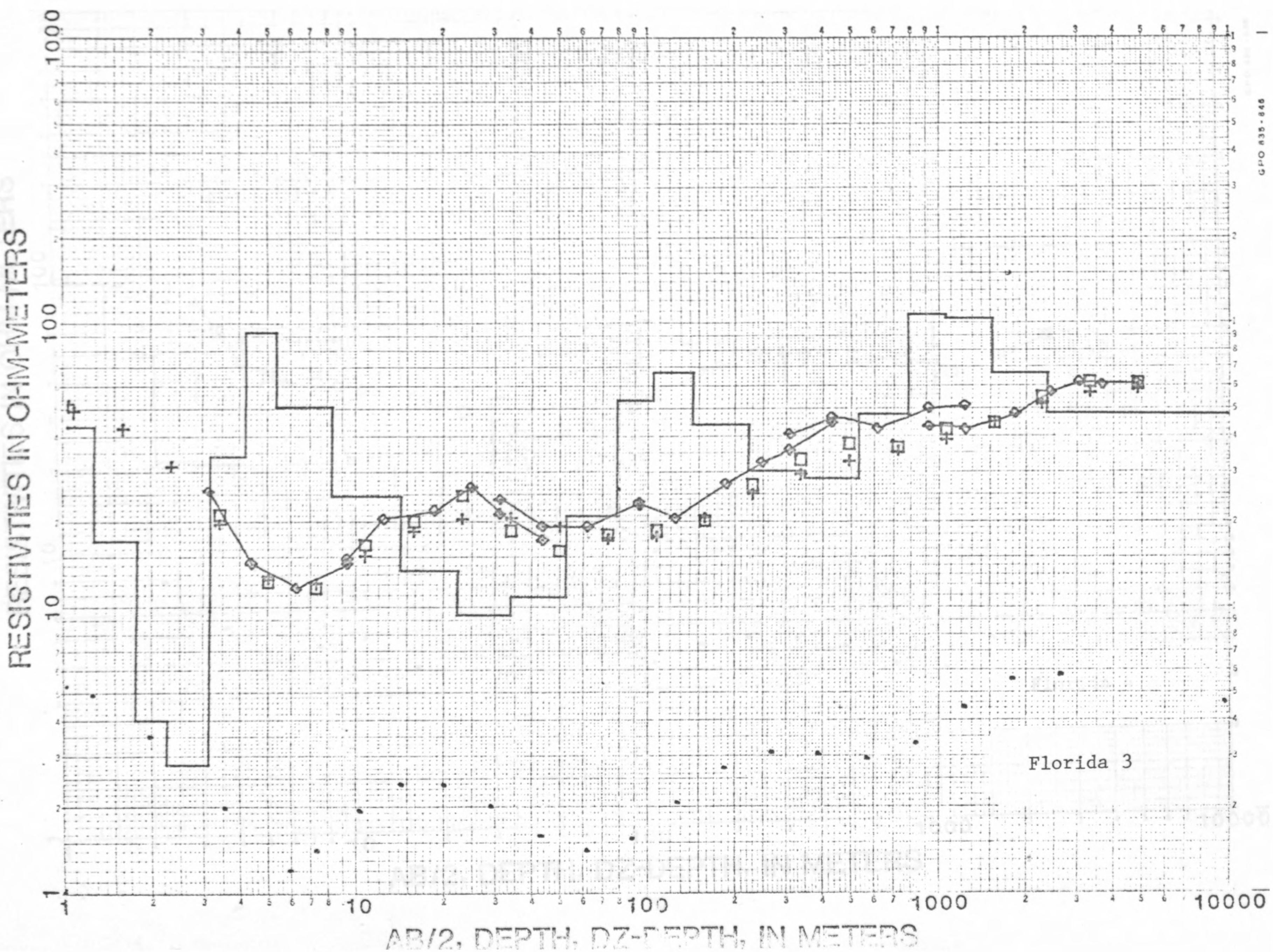
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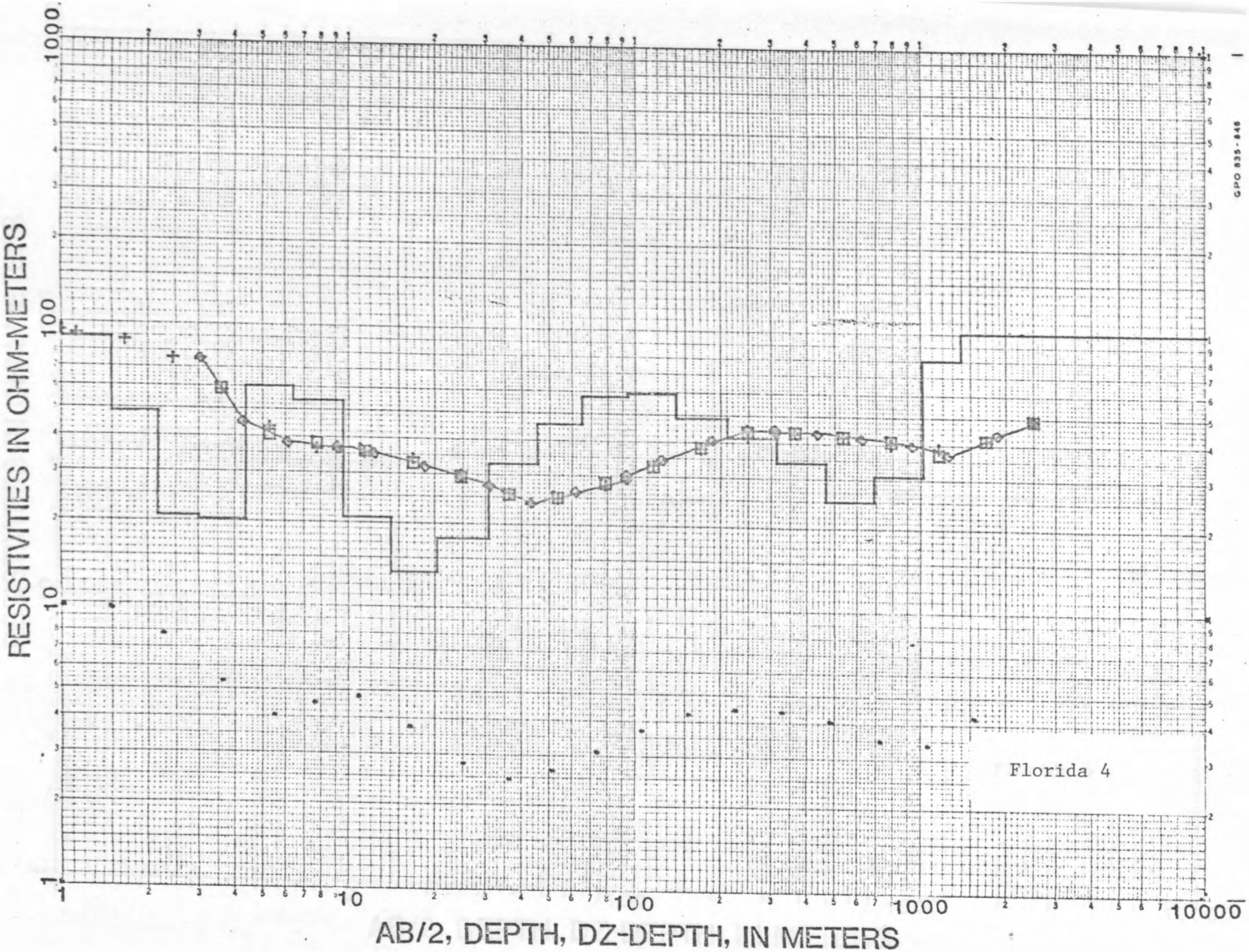
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RESISTIVITIES IN OHM-METERS
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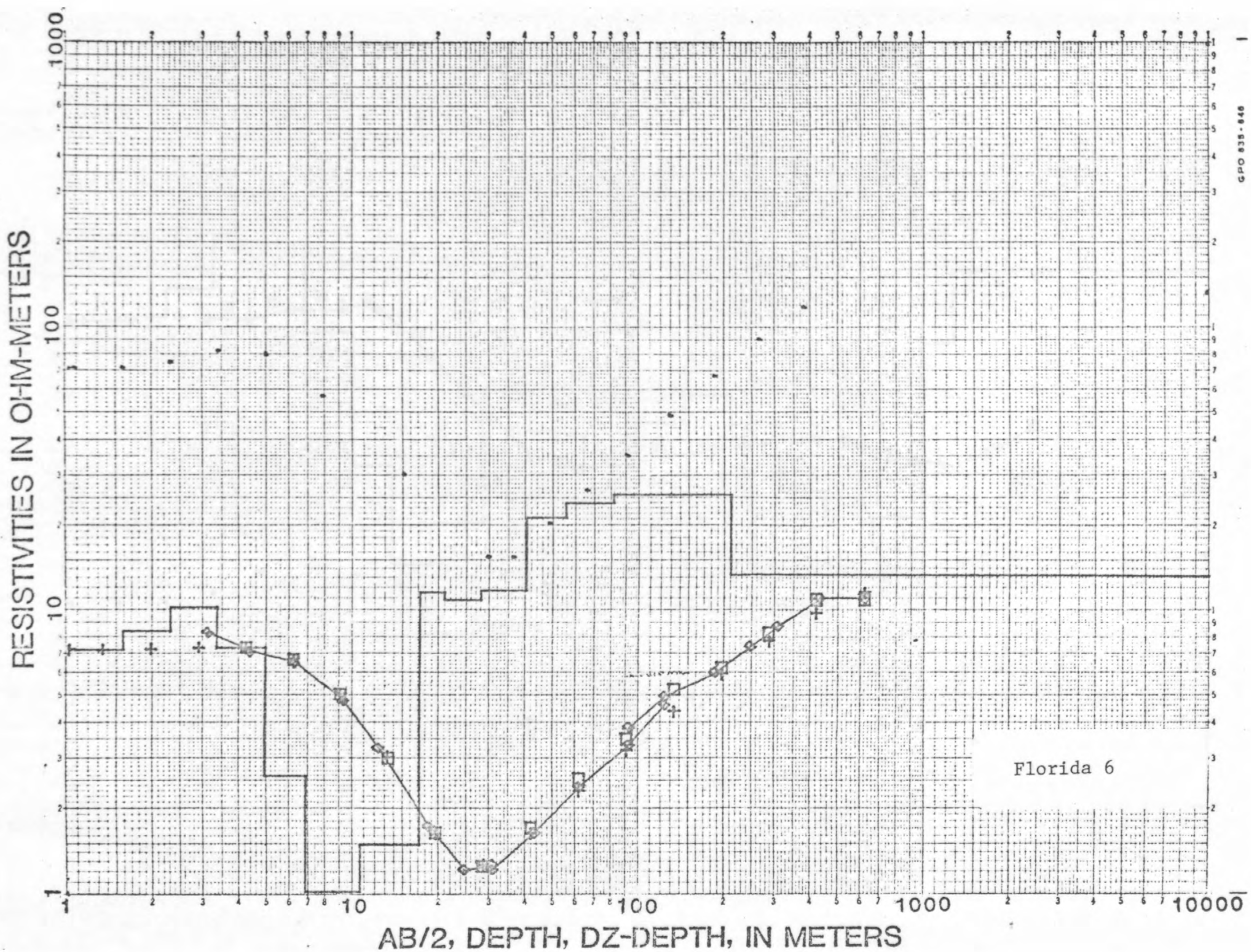
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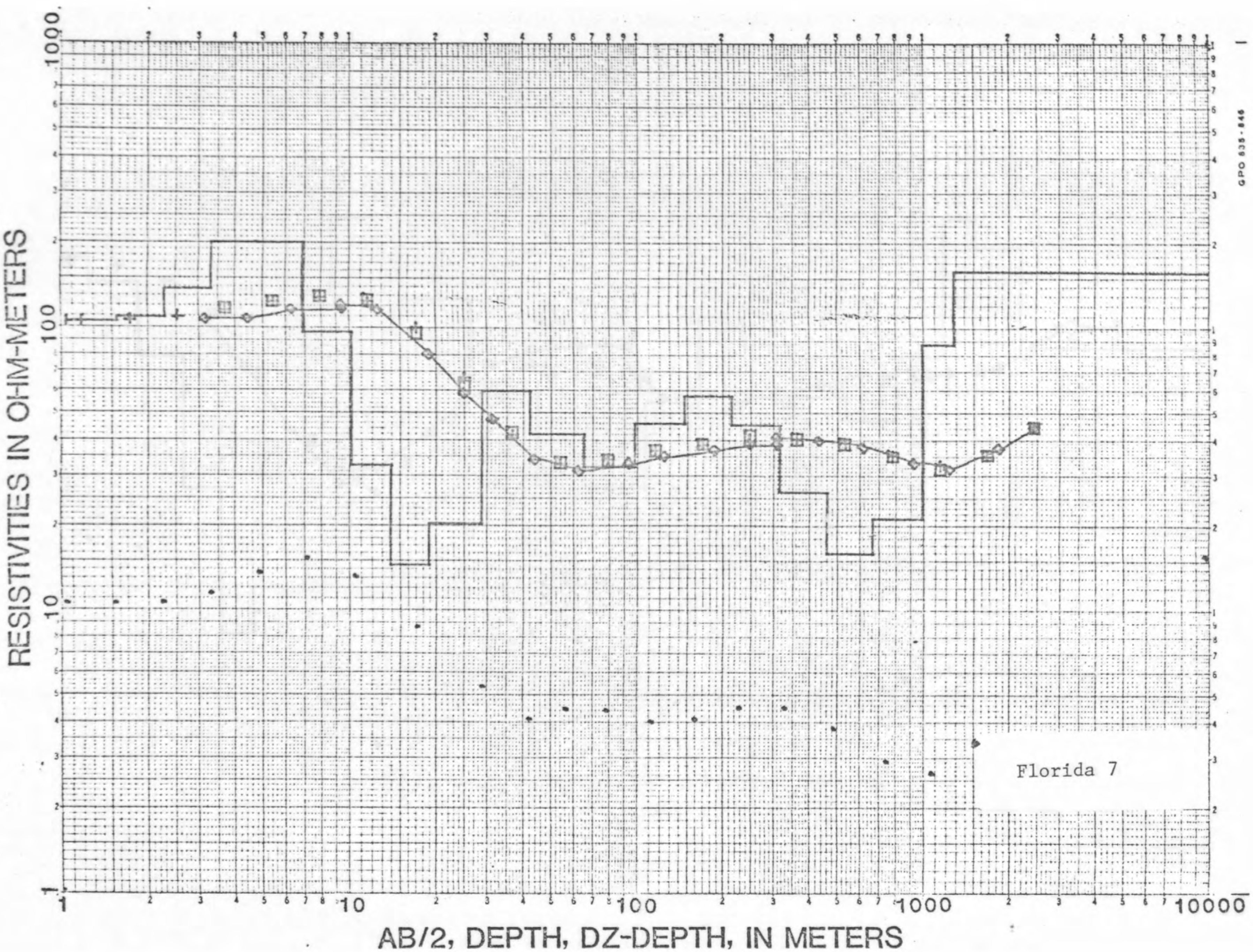
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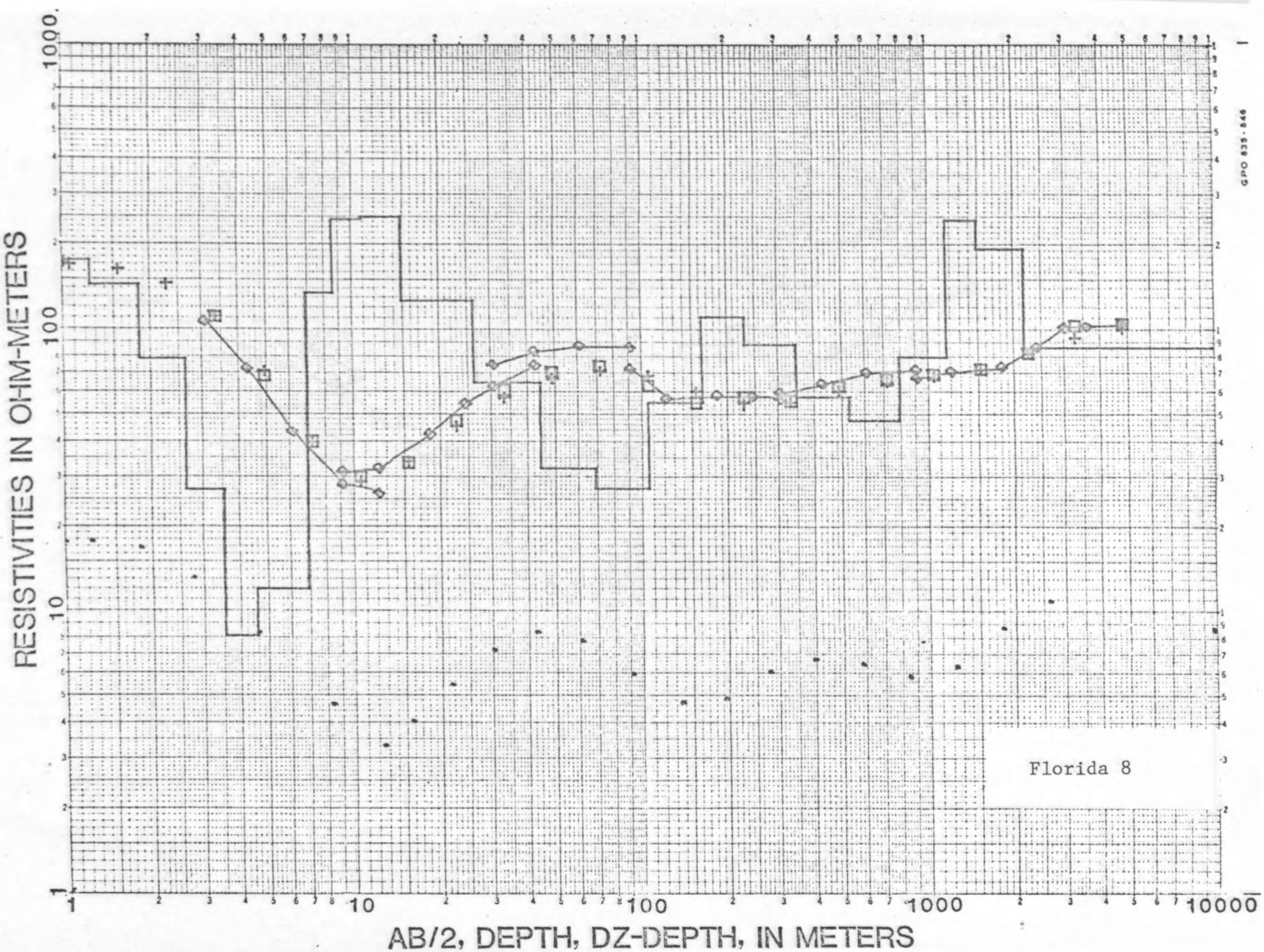
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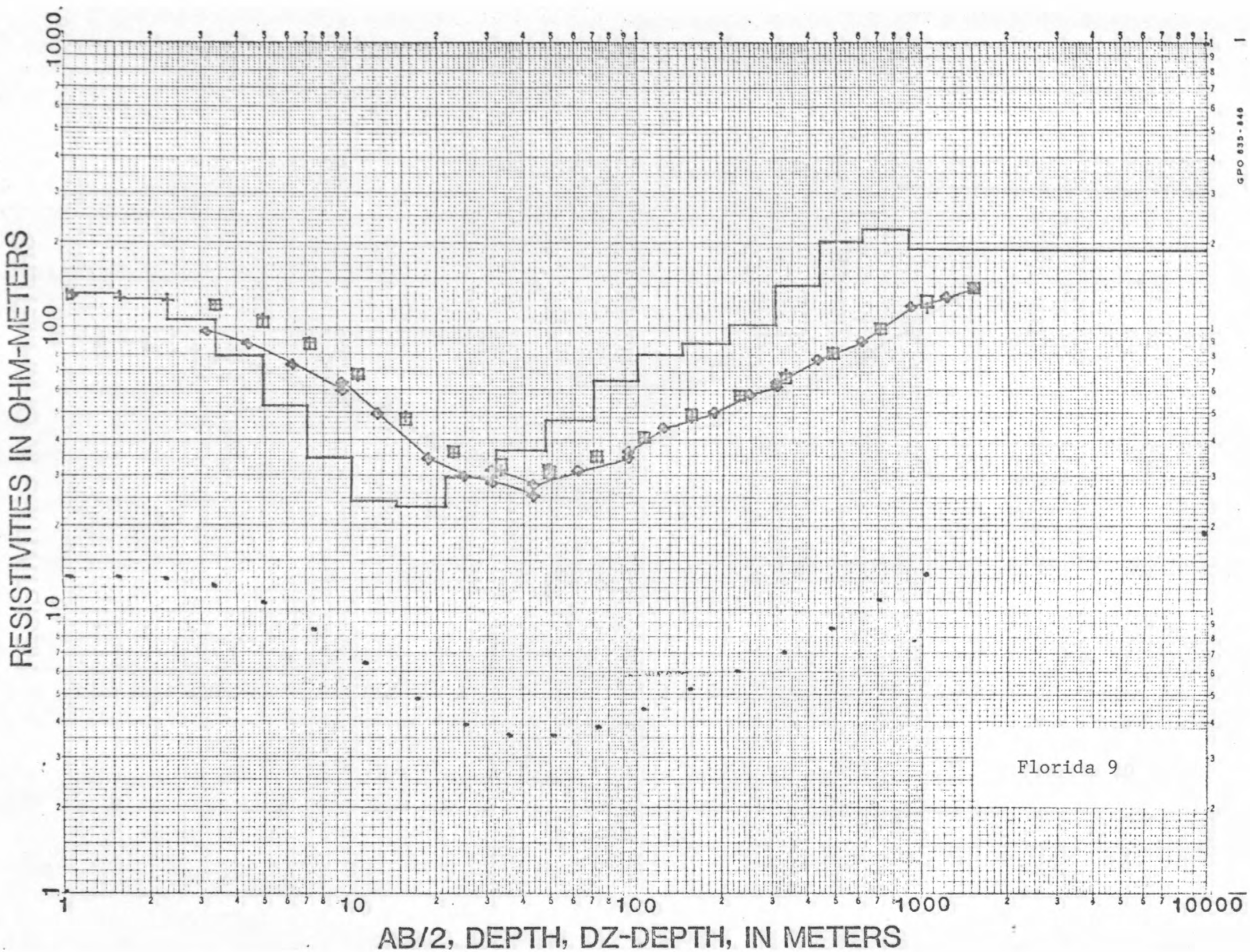
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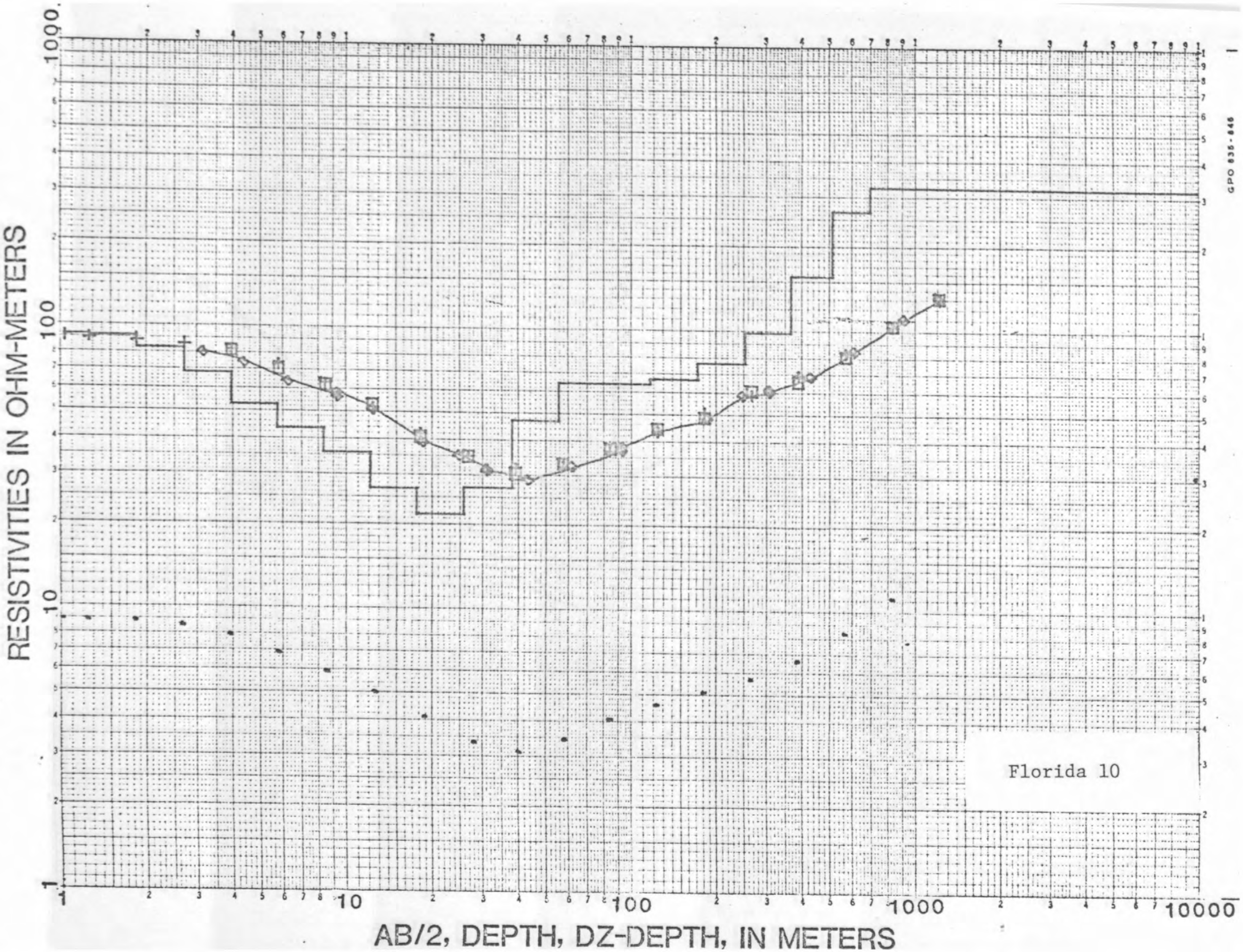
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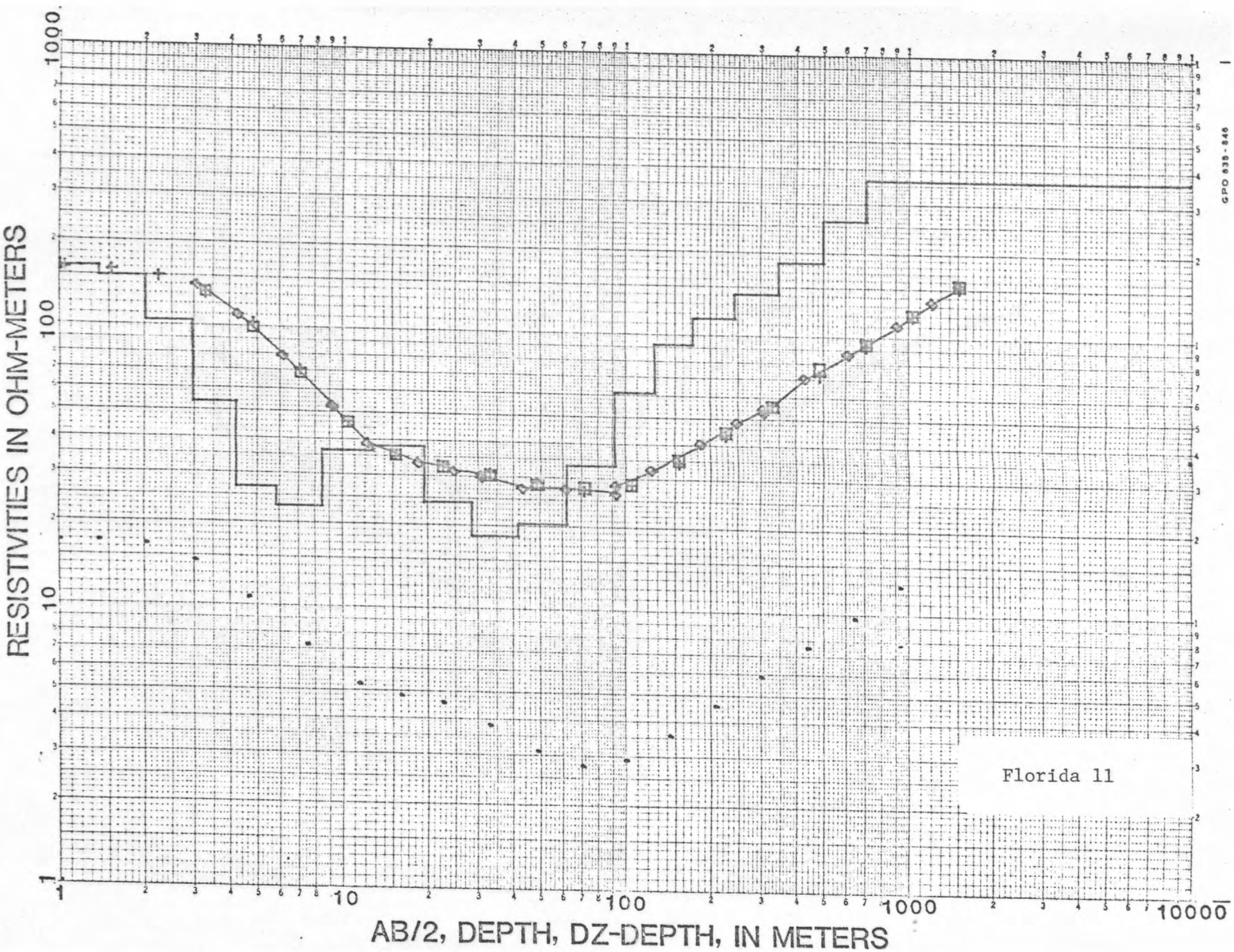
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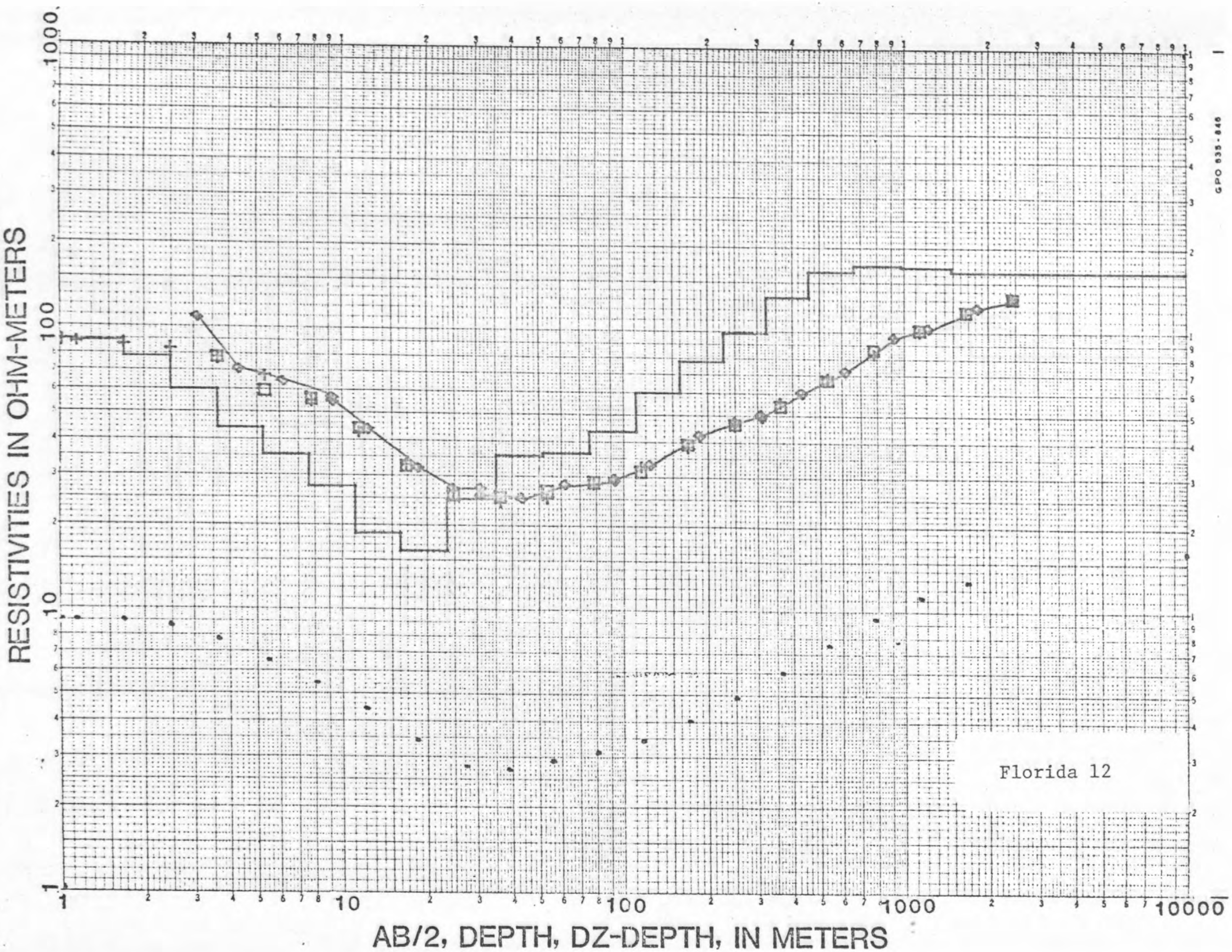
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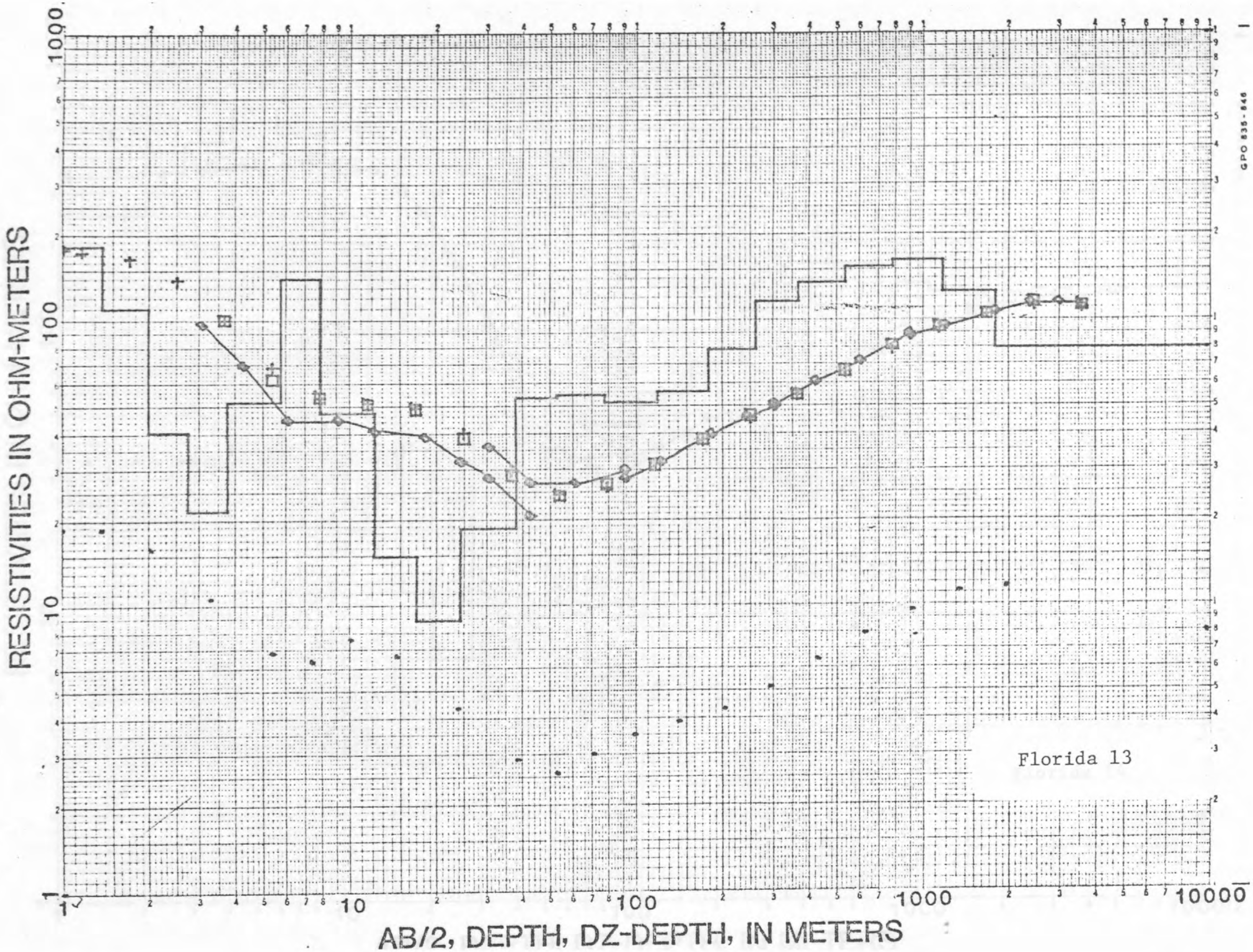
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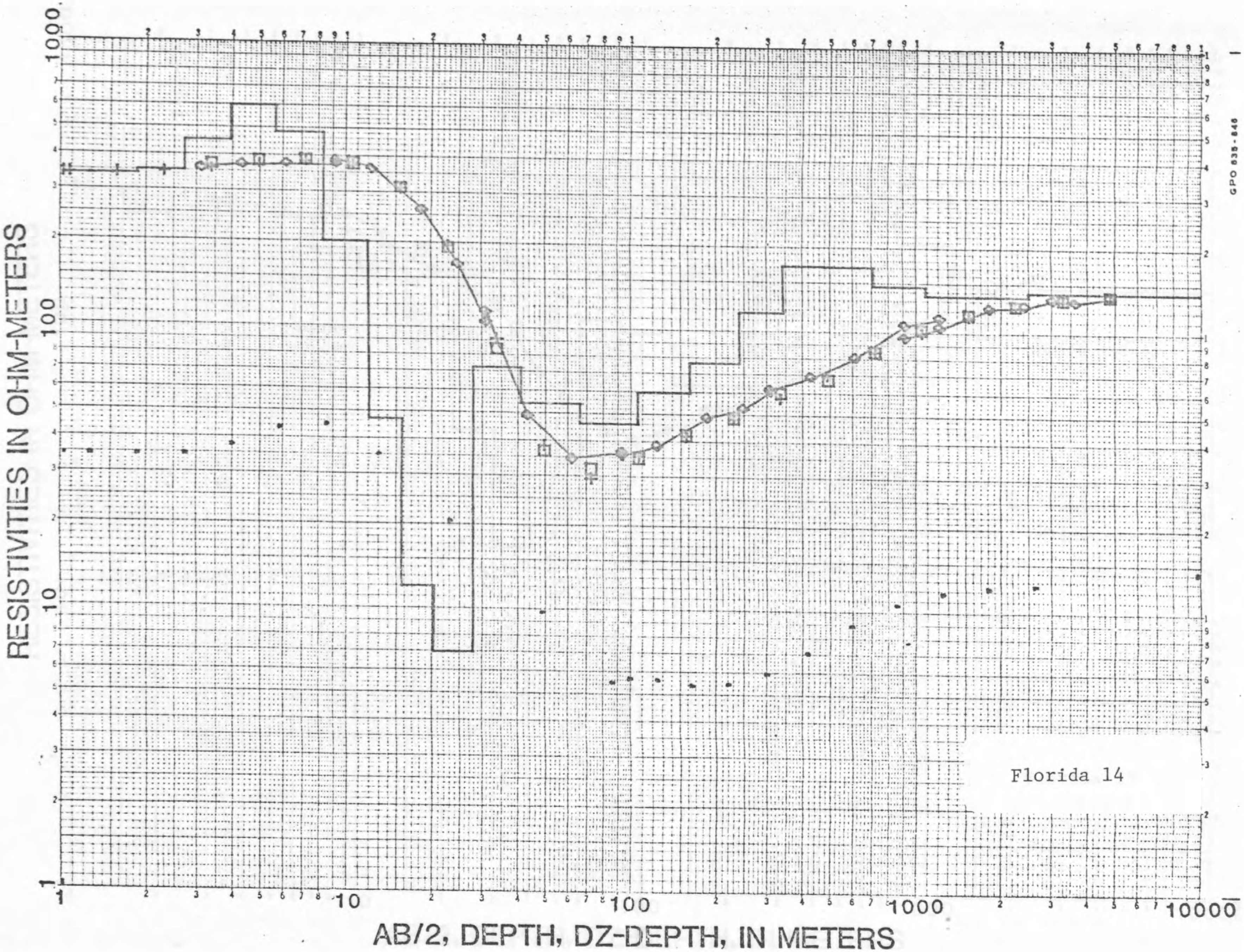
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100
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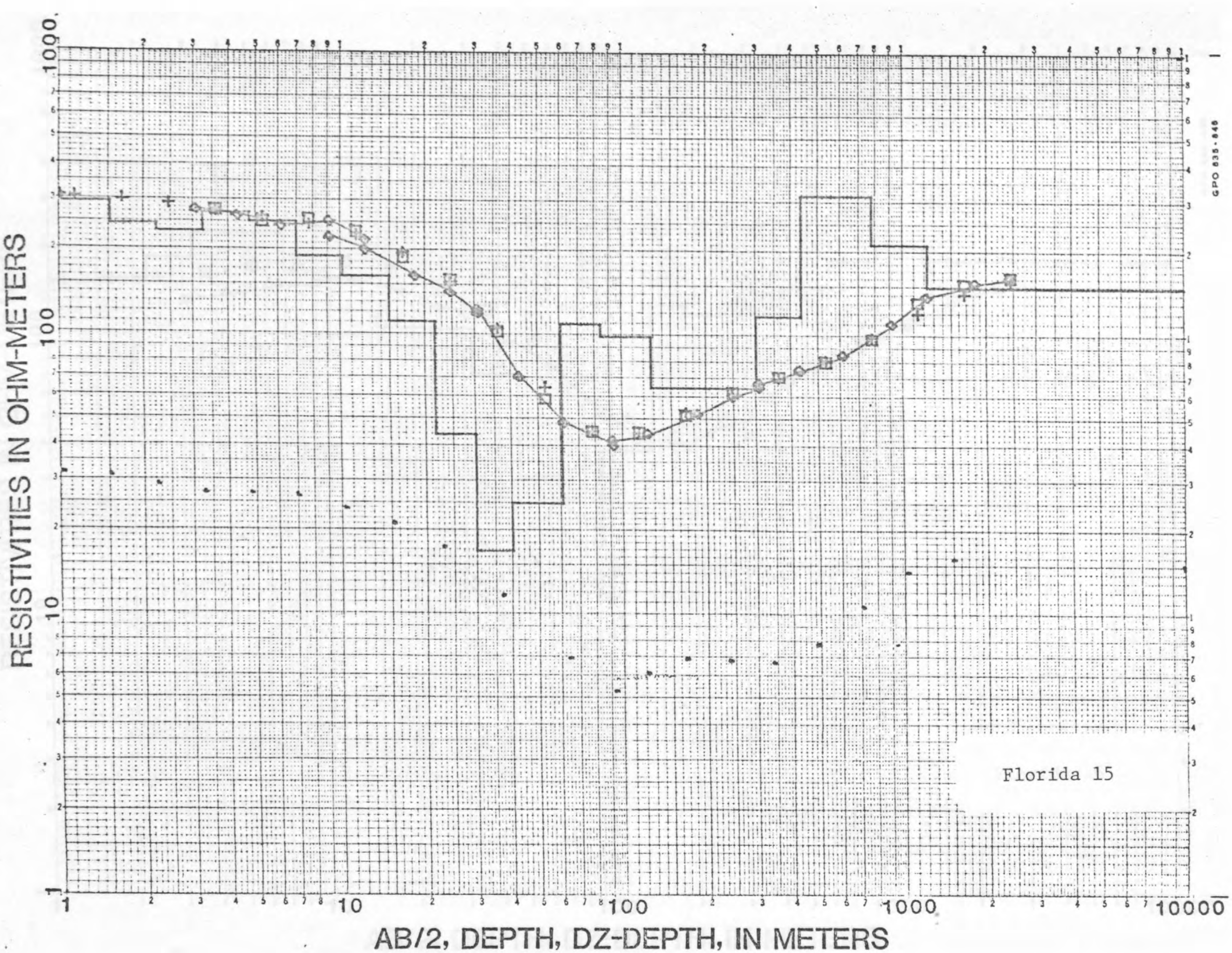
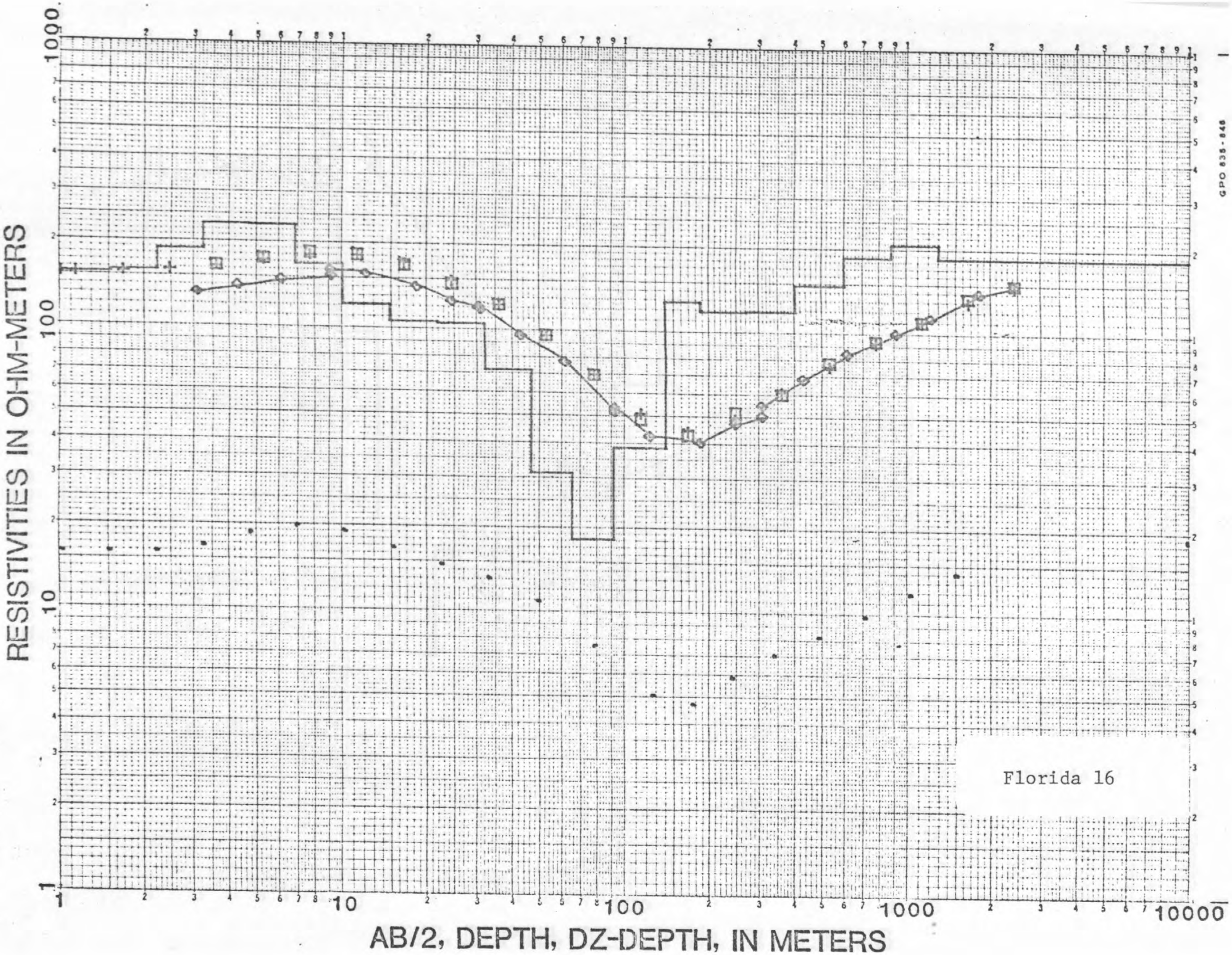
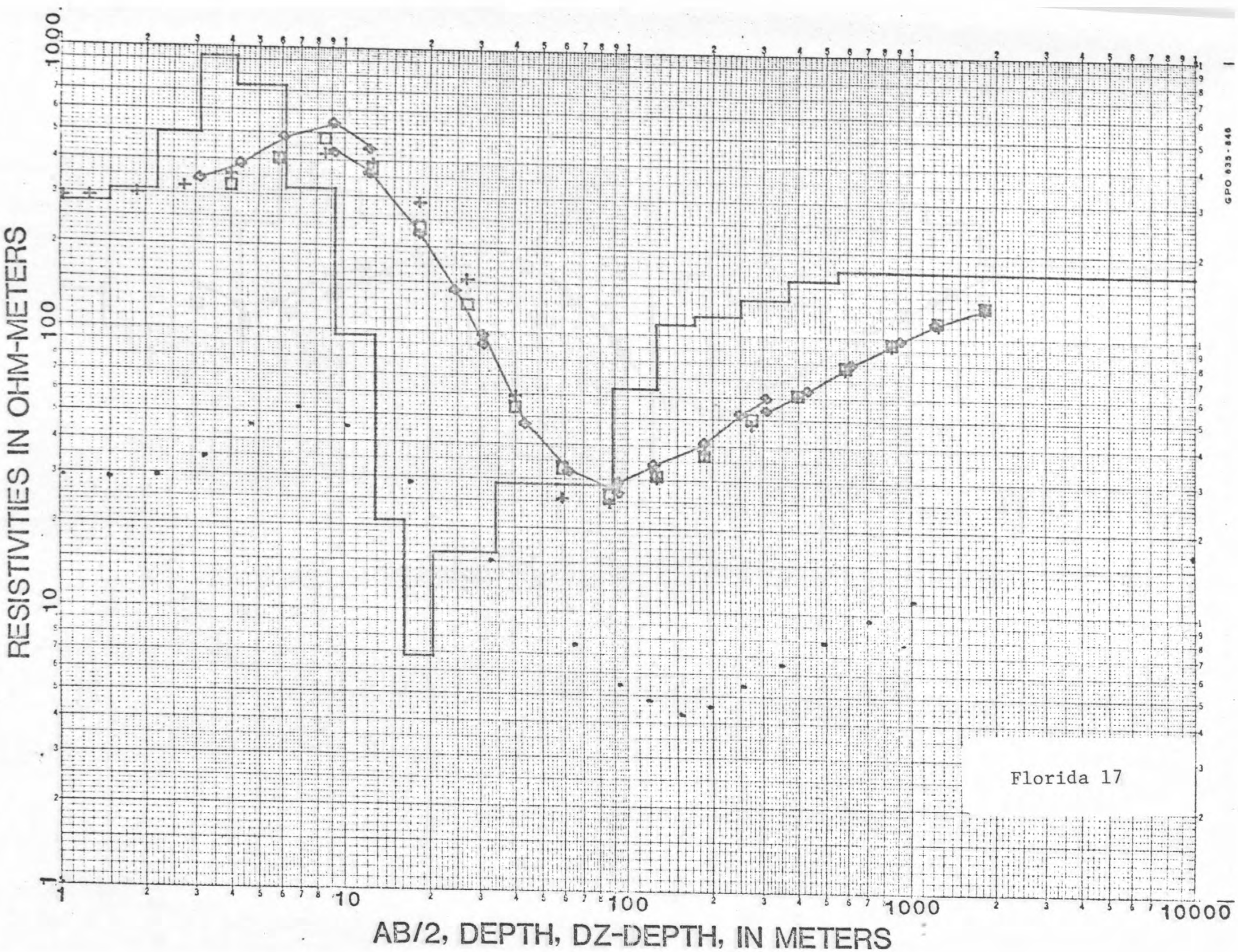
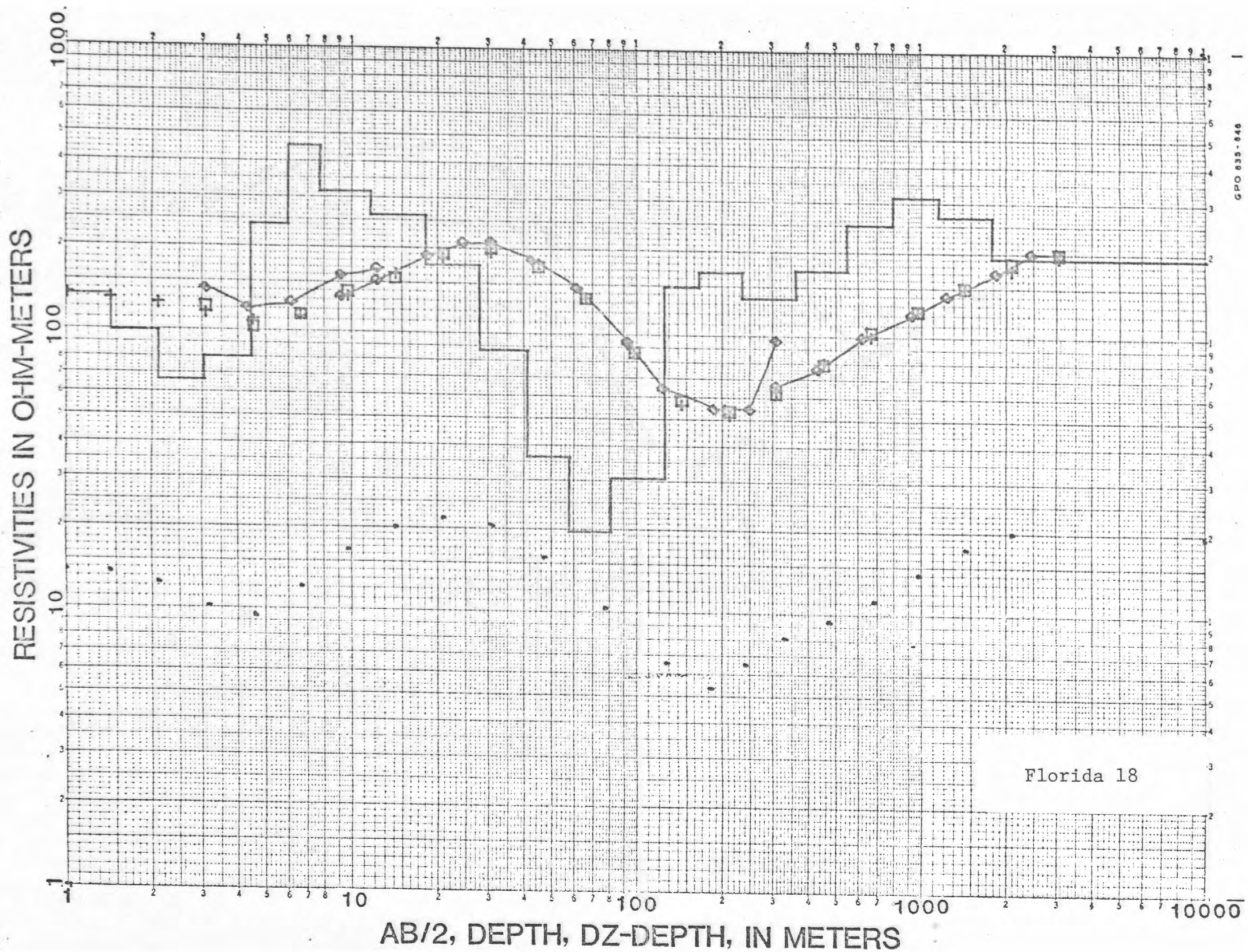
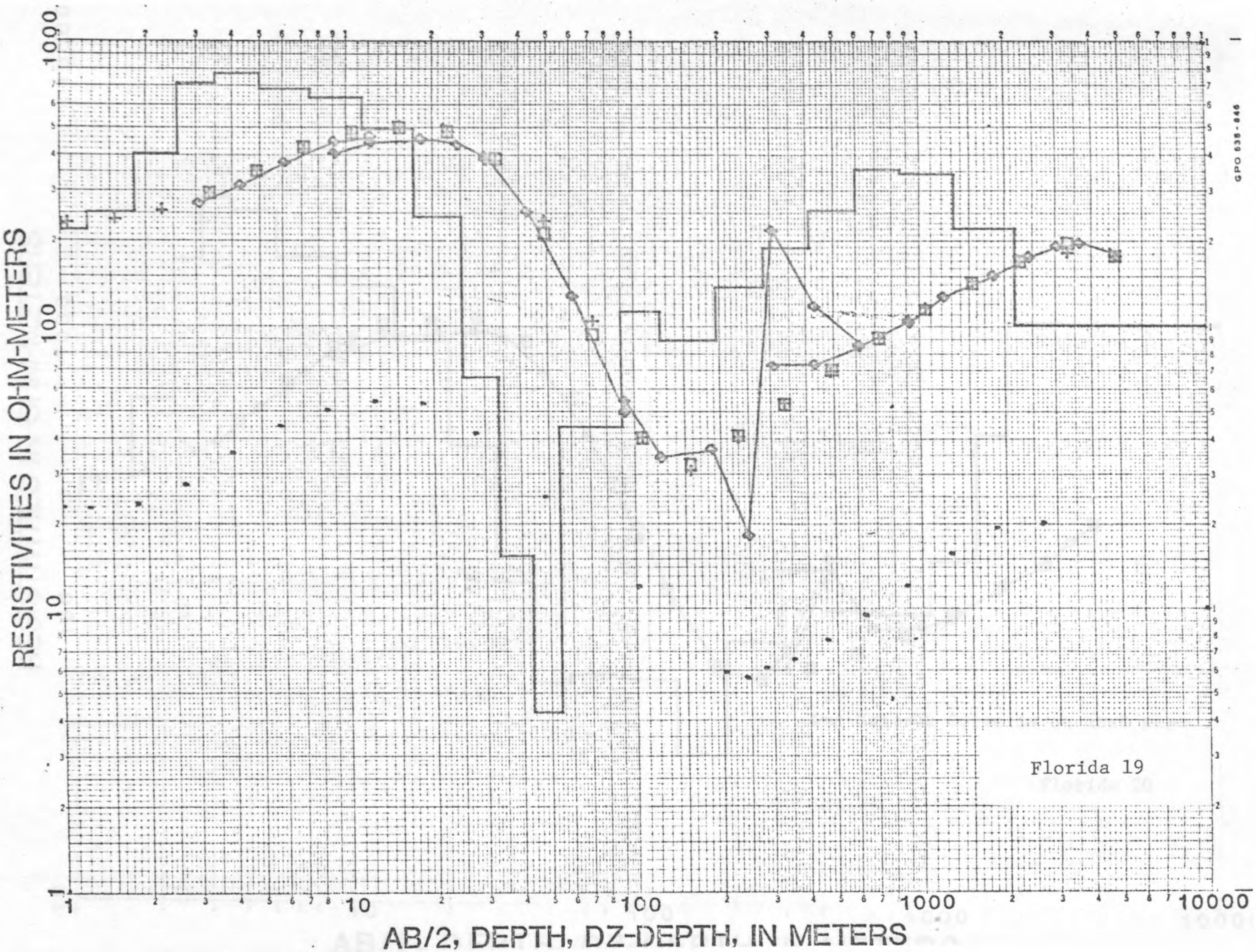
10000
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 14

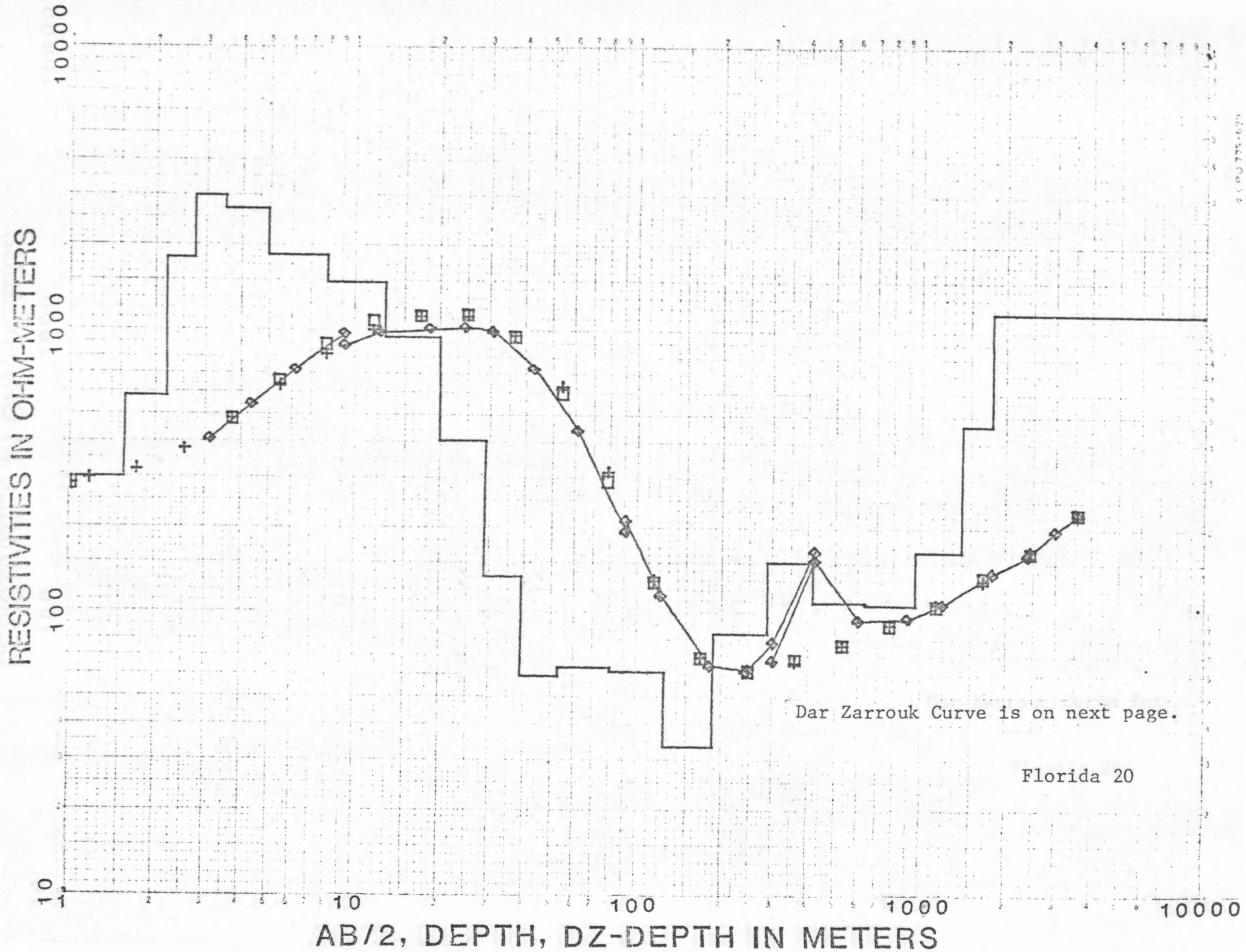

RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
1
10
100
1000
10000
Florida 15
GPO 835-848

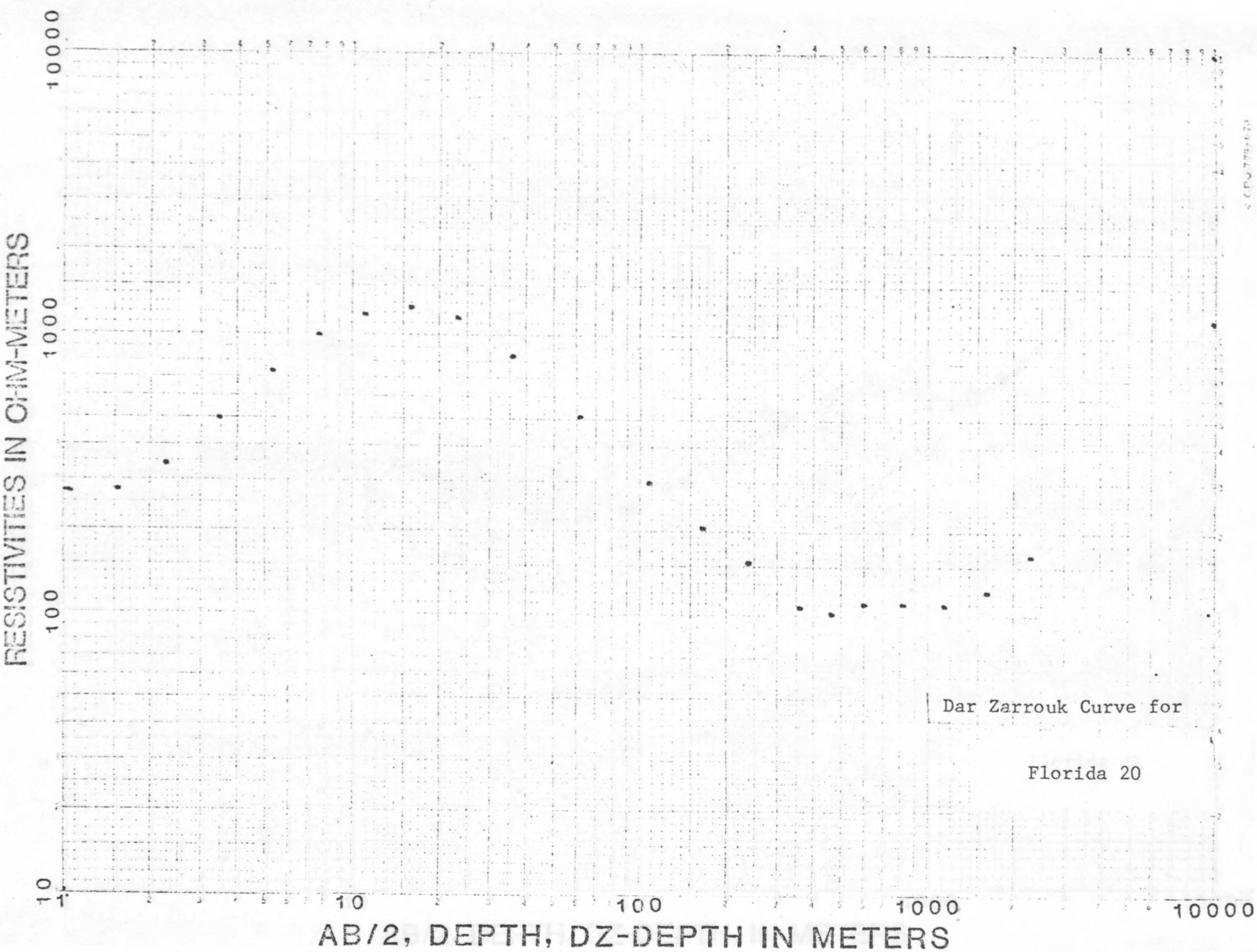

RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 16


RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 17
GPO 835-846

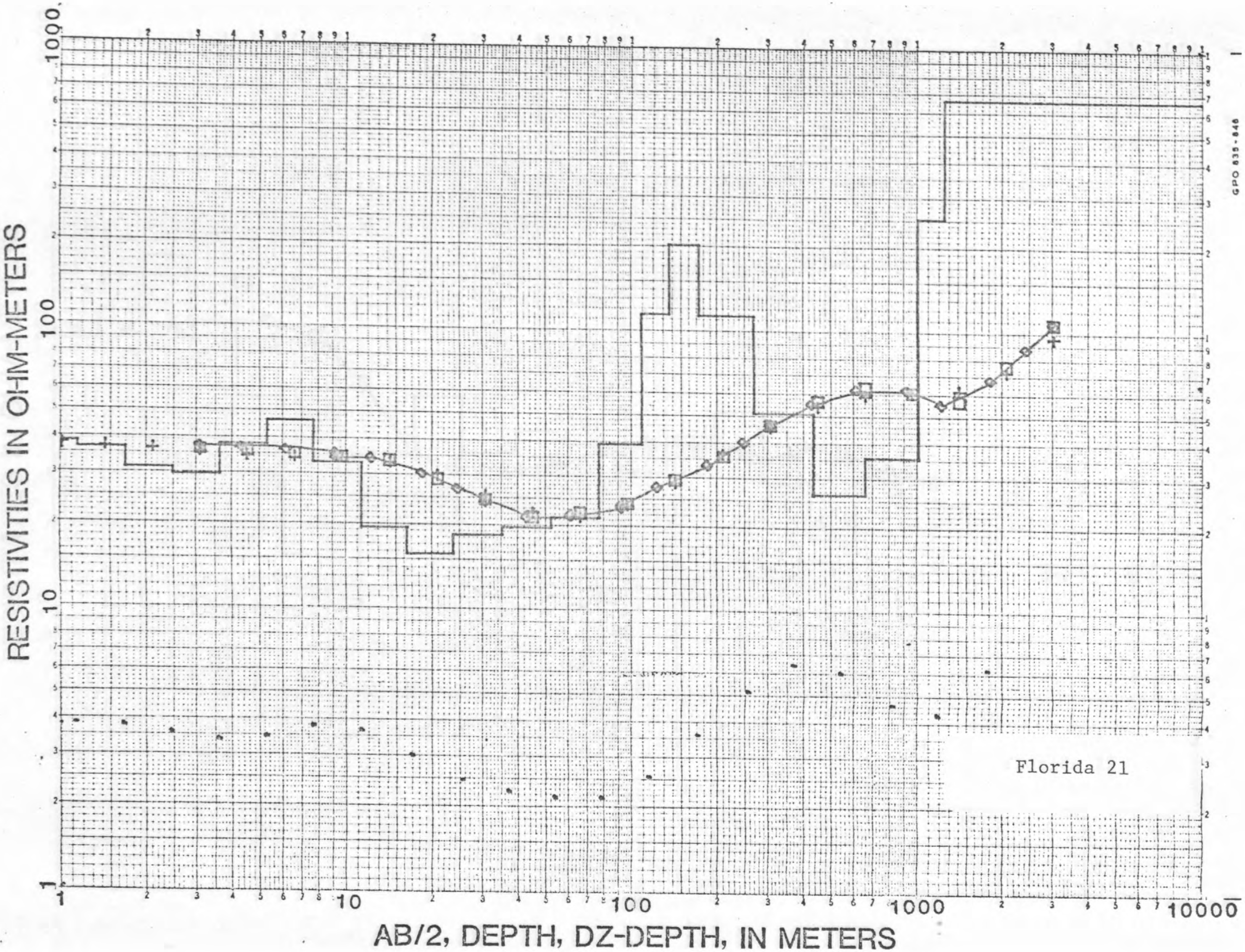

RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 18
1
10
100
1000
10000
GPO 835-846

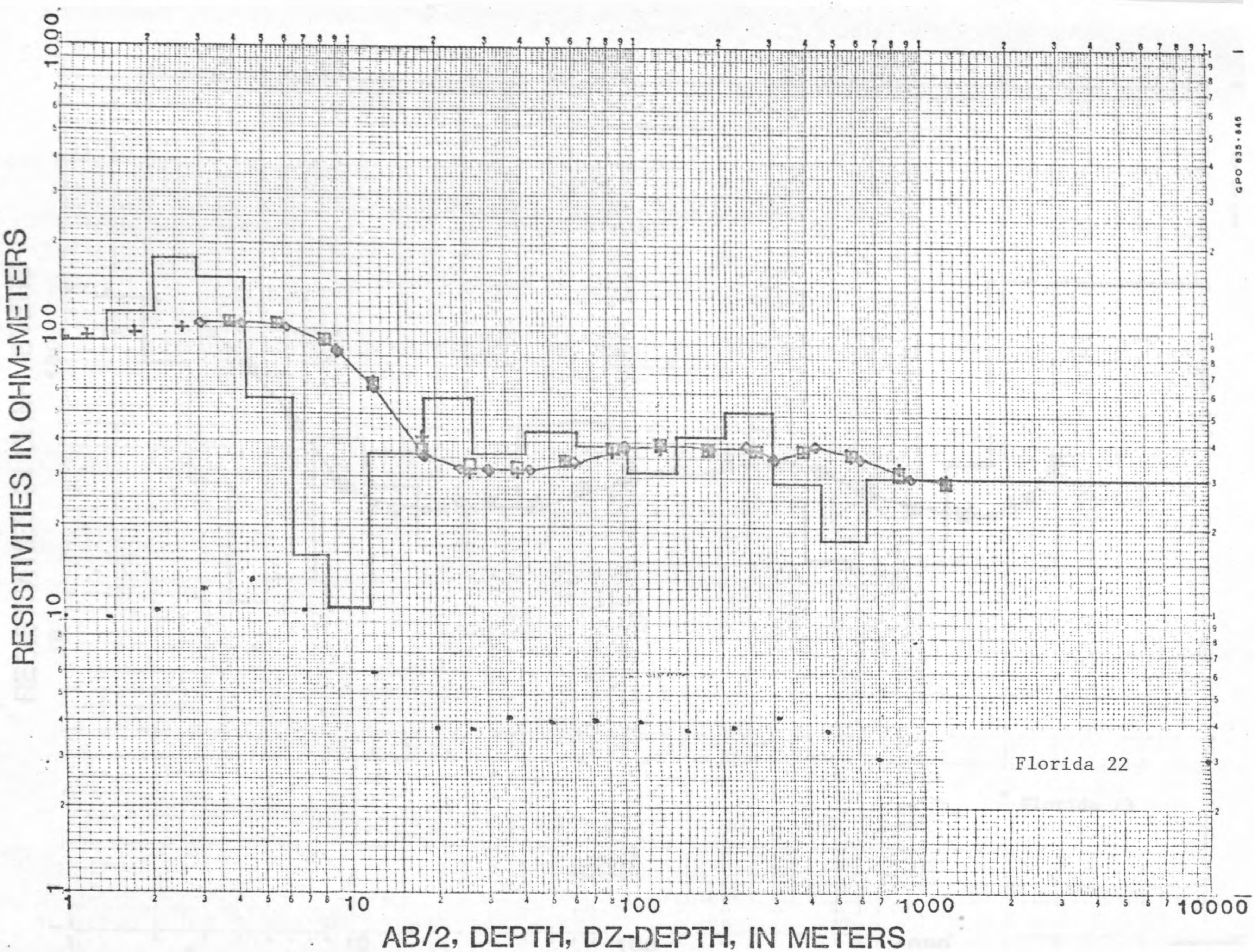

RESISTIVITIES IN OHM-METERS
1000
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 19
GPO 535-846

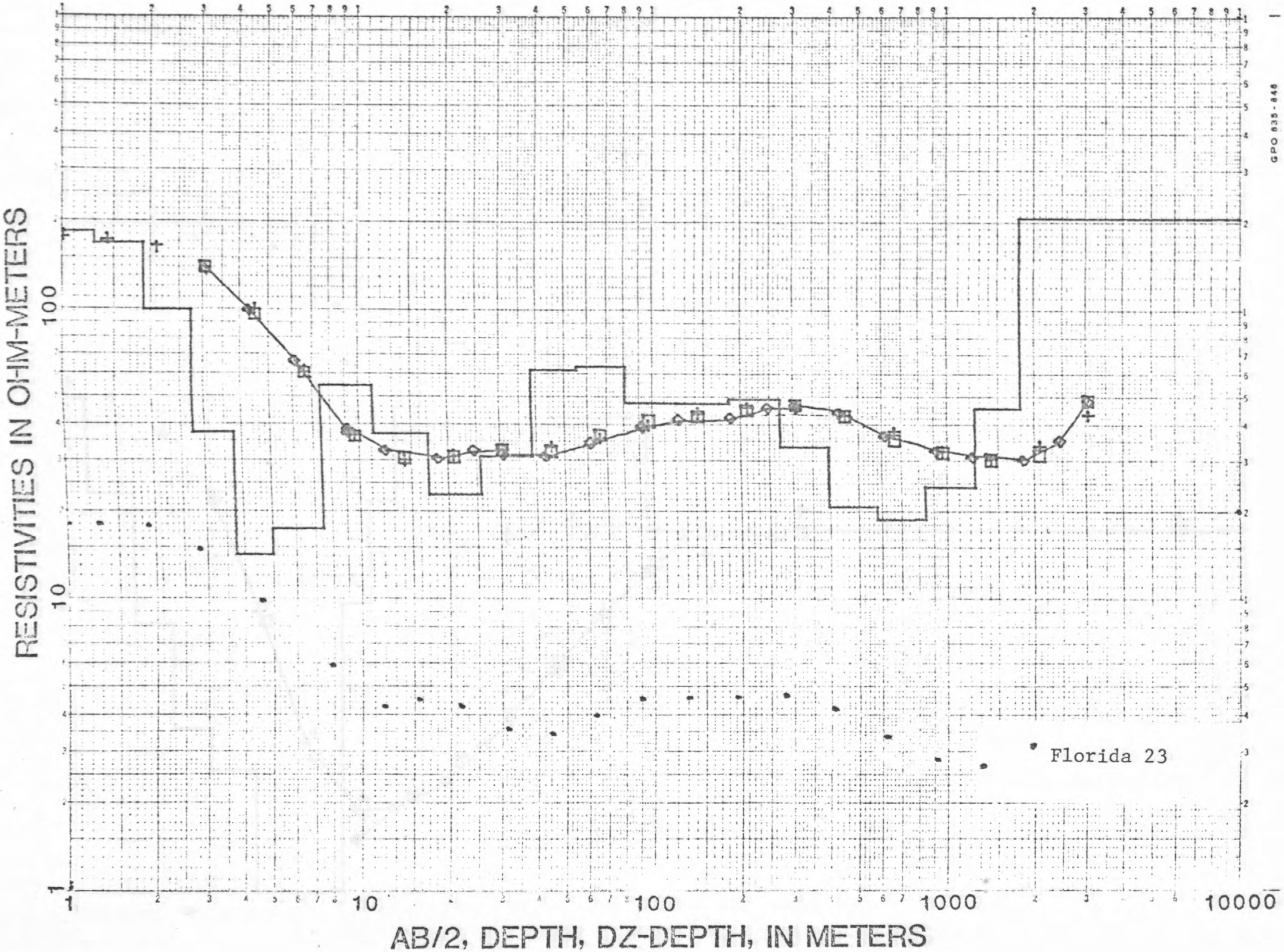

RESISTIVITIES IN OHM-METERS
10000
1000
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH IN METERS
Dar Zarrouk Curve is on next page.
Florida 20

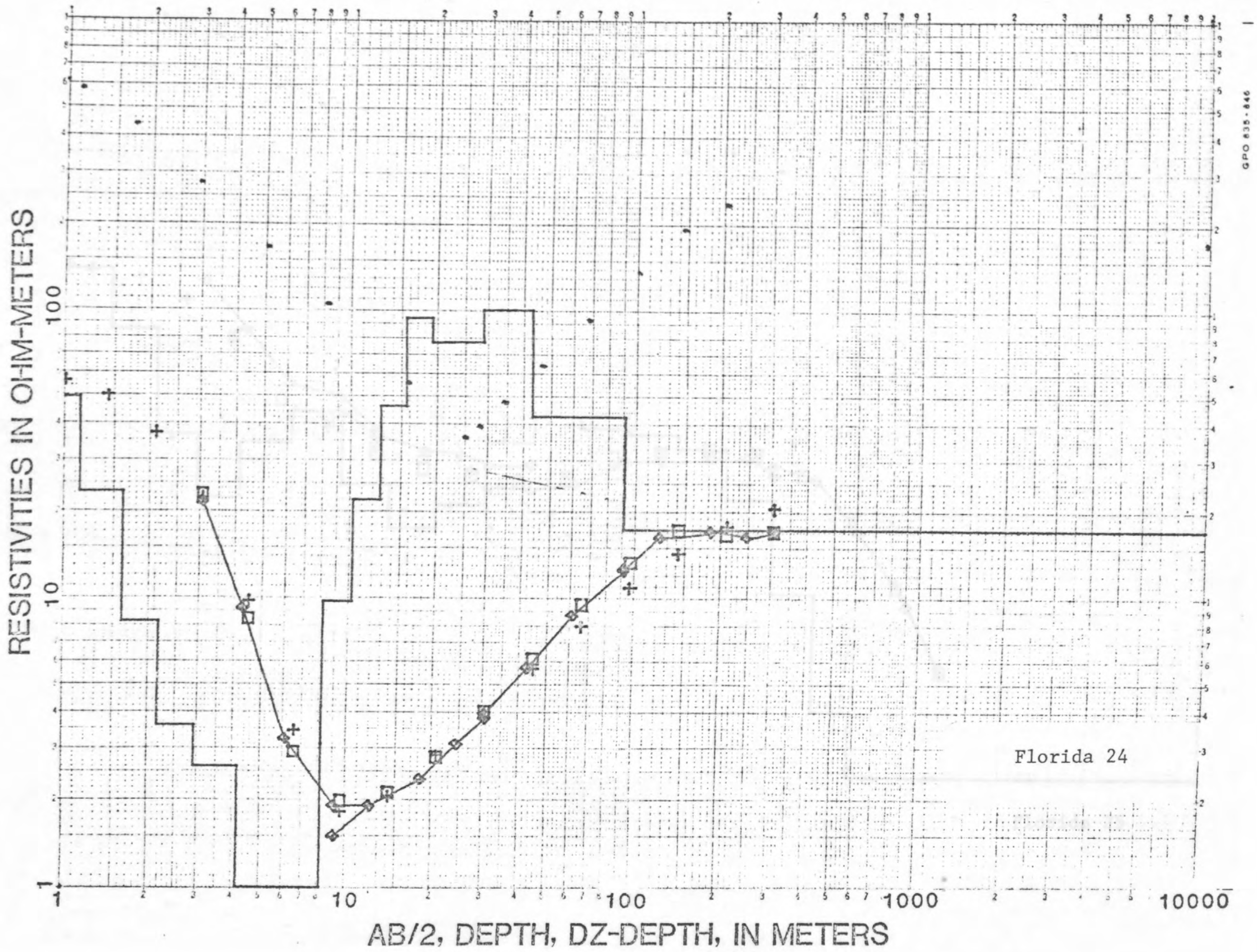


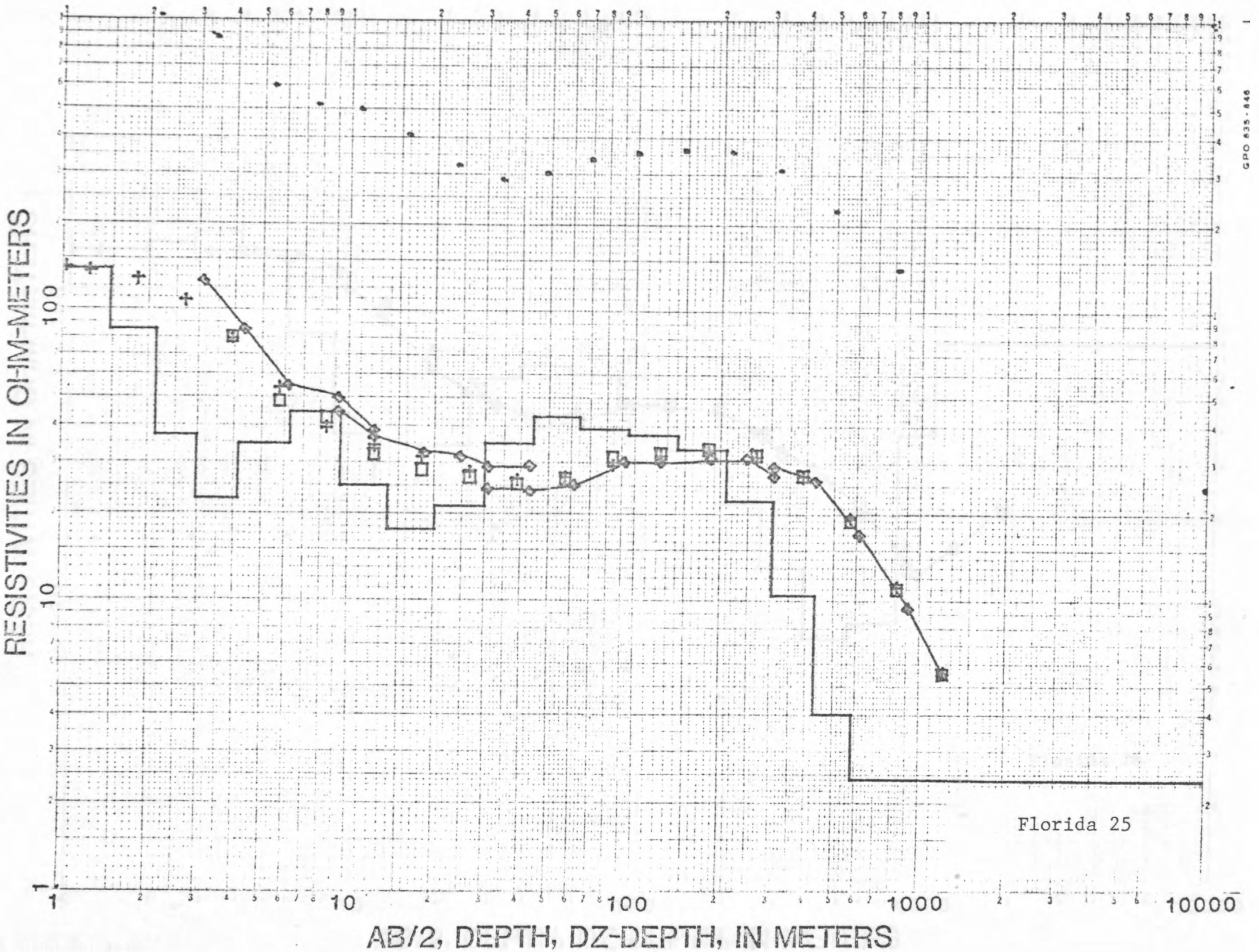
RESISTIVITIES IN OHM-METERS
10000
1000
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH IN METERS
Dar Zarrouk Curve for
Florida 20


RESISTIVITIES IN OHM-METERS
1000
100
10
1
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 21
GPO 835-846

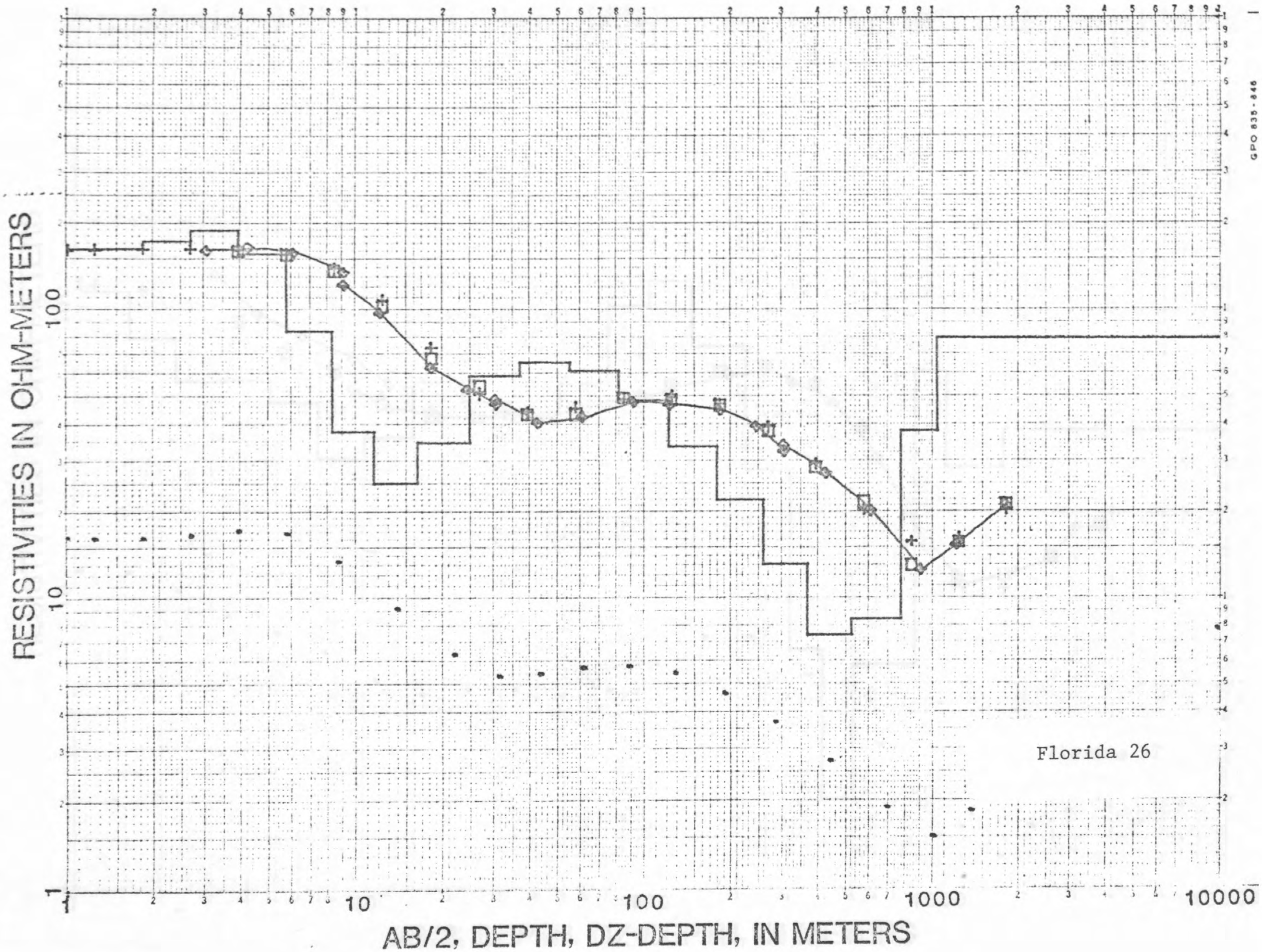

RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
1
10
100
1000
10000
Florida 22
GPO 835-846

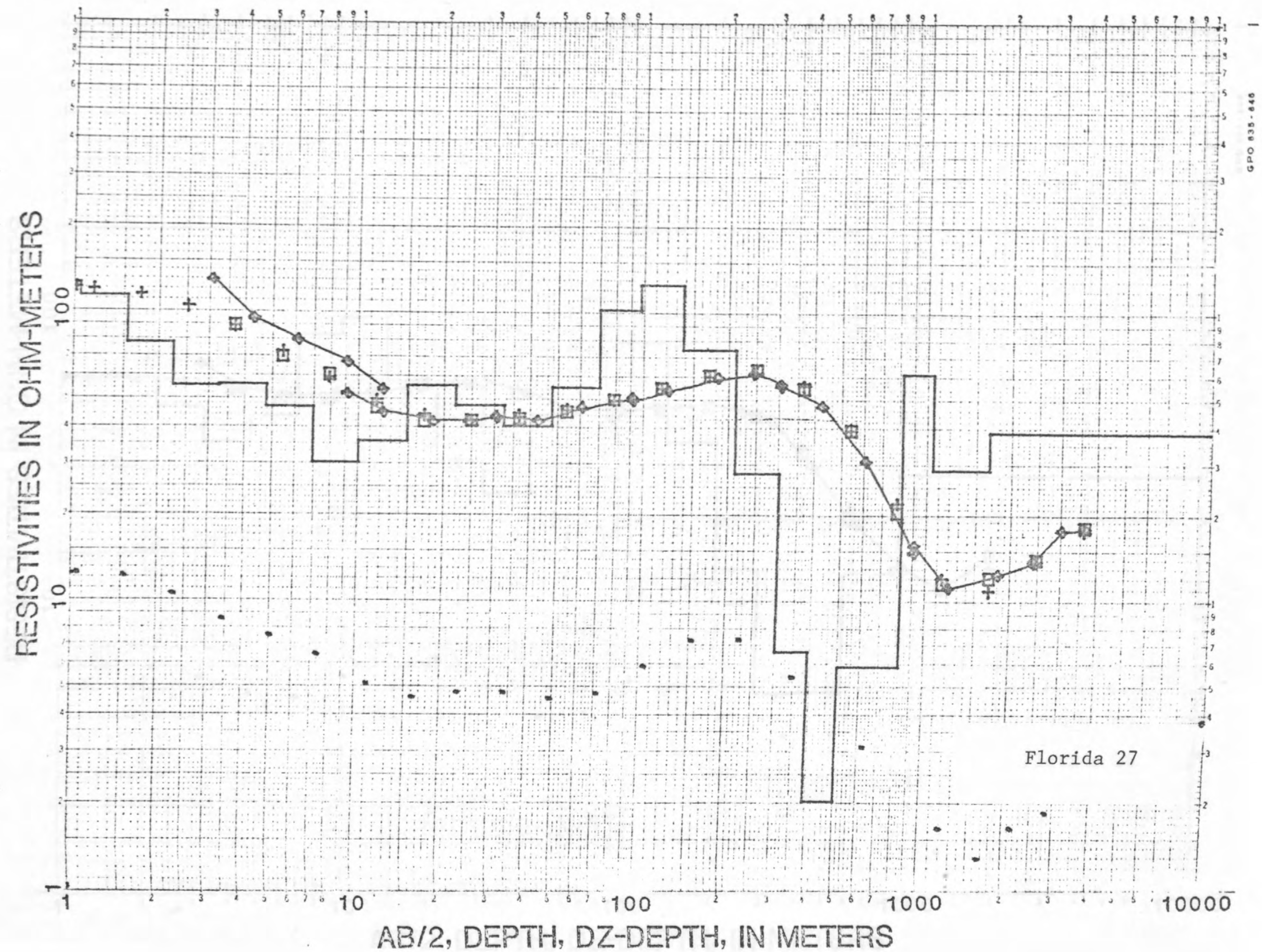

RESISTIVITIES IN OHM-METERS
1
10
100
AB/2, DEPTH, DZ-DEPTH, IN METERS
1
10
100
1000
10000
Florida 23

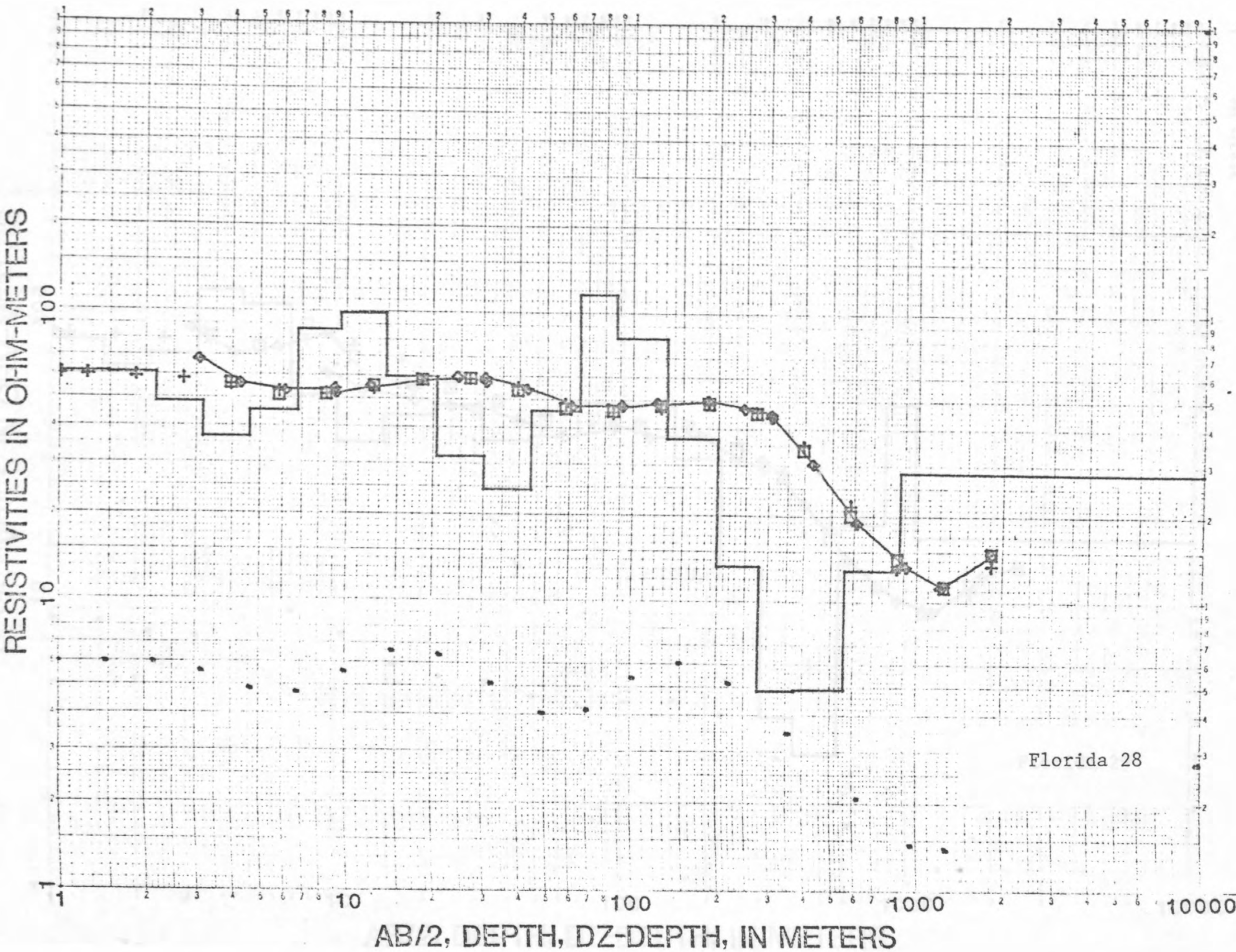

RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
1
10
100
1000
10000
Florida 24
GPO 835-846



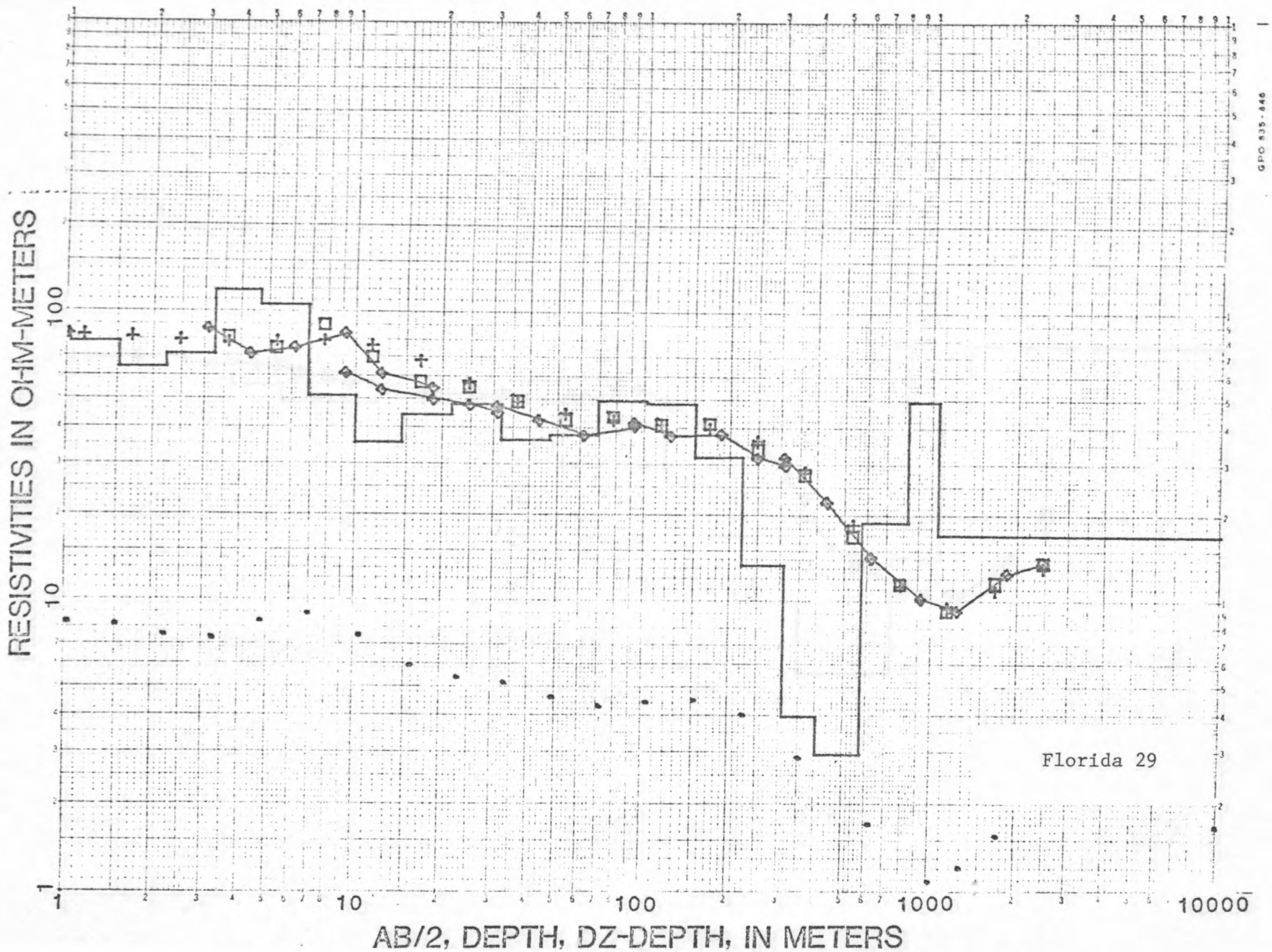
RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
1
10
100
1000
10000
Florida 25
GPO 835-446

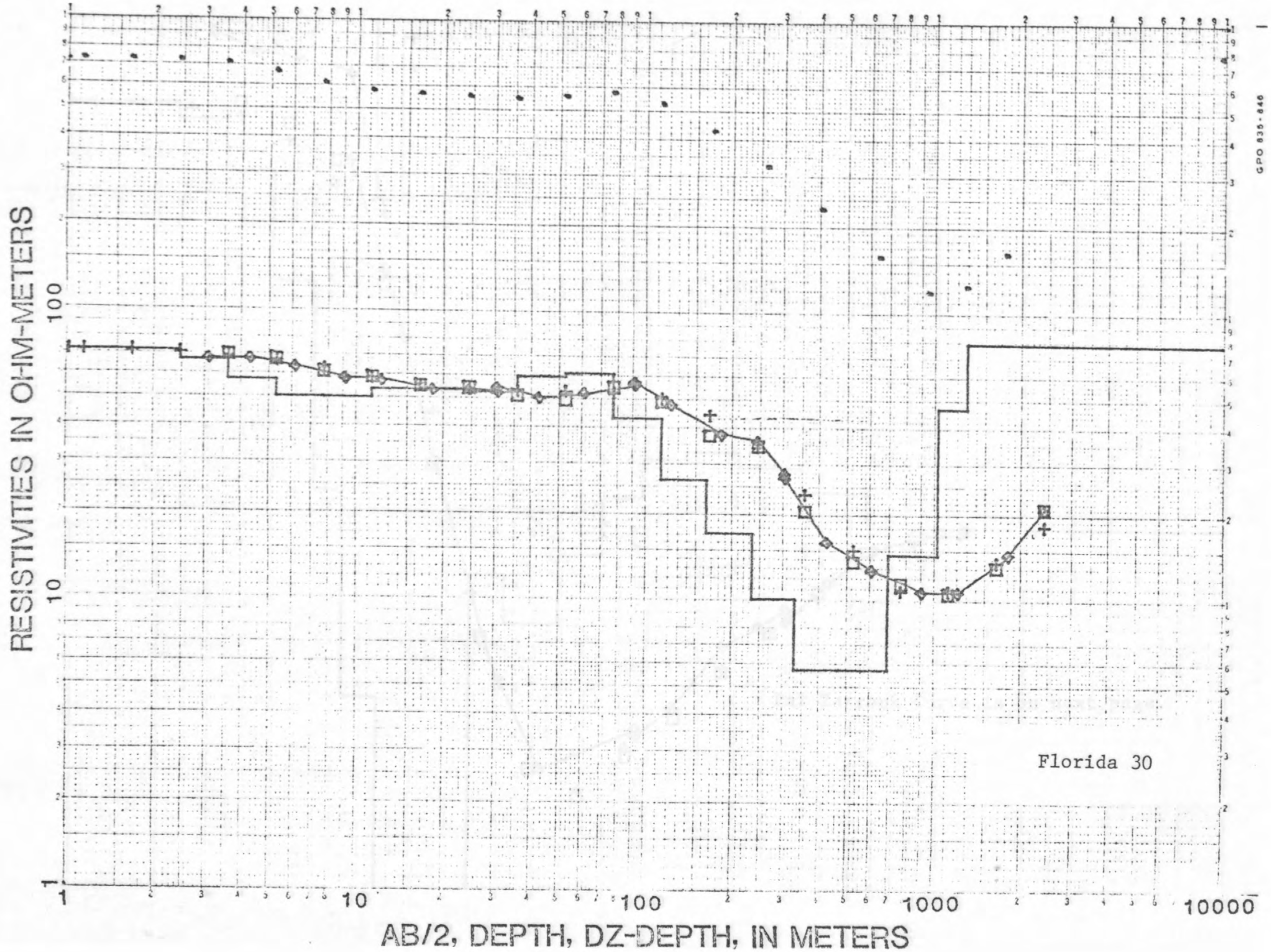

RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 26
GPO 835-846
1
10
100
1000
10000

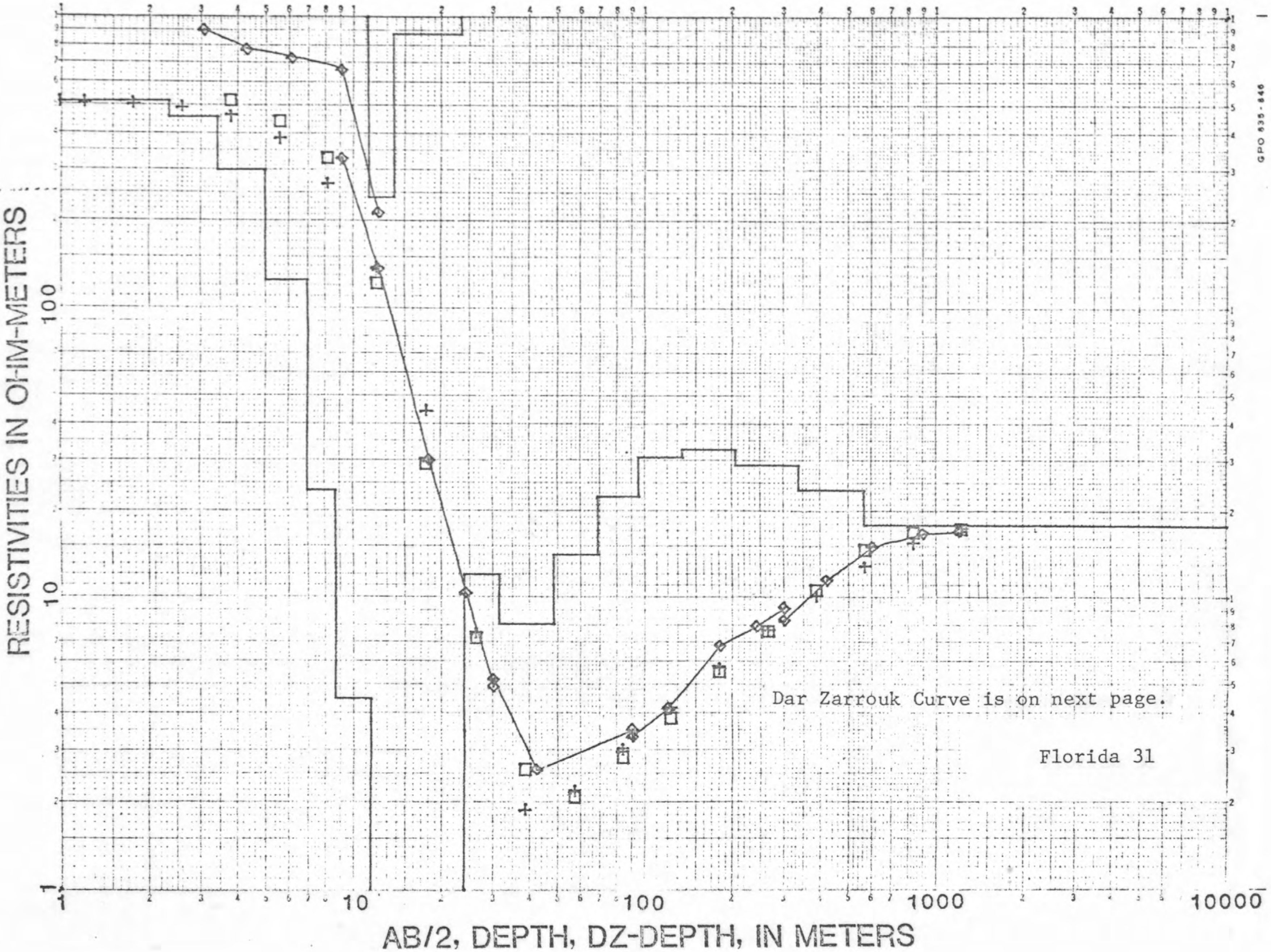

RESISTIVITIES IN OHM-METERS
100
10
1
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 27

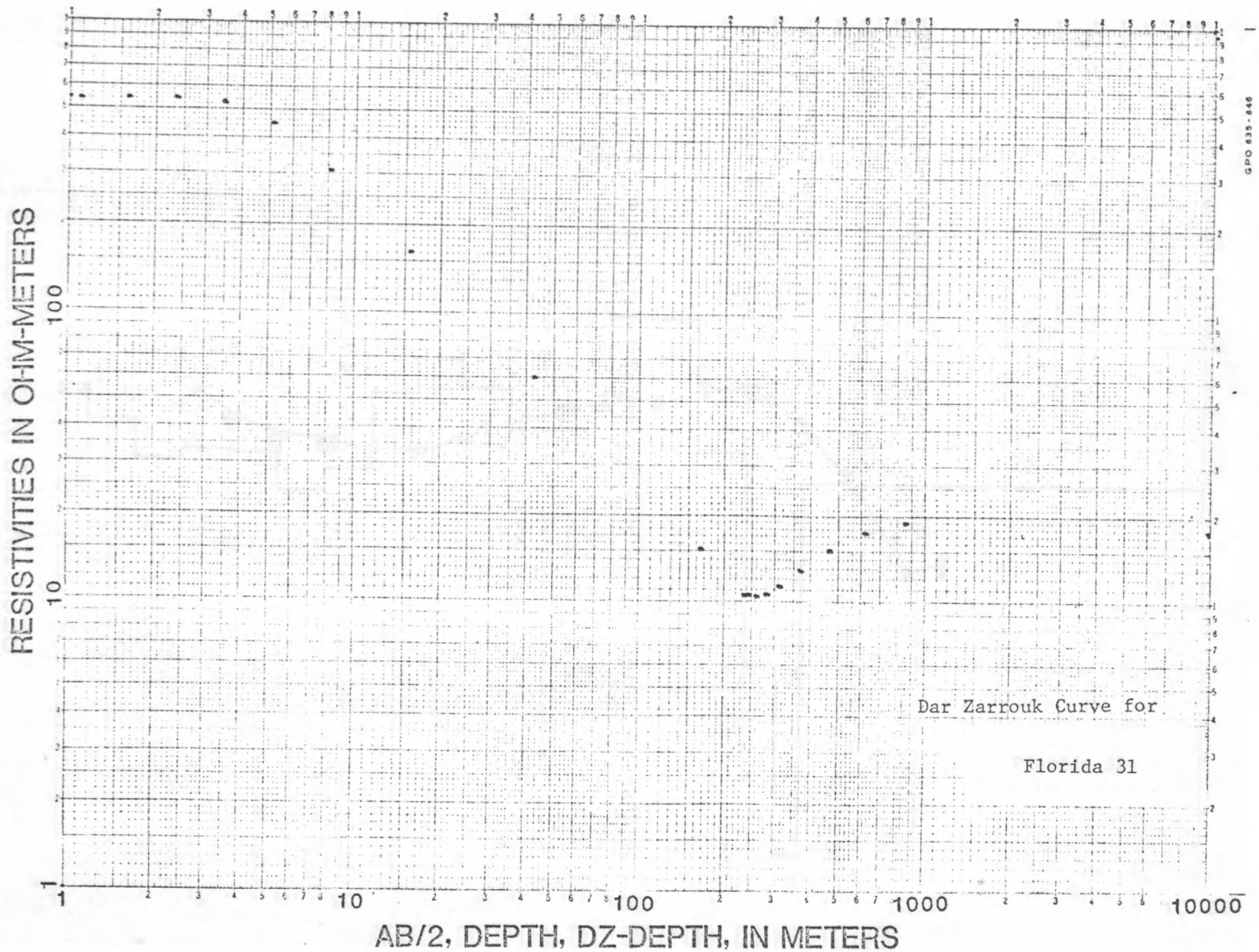


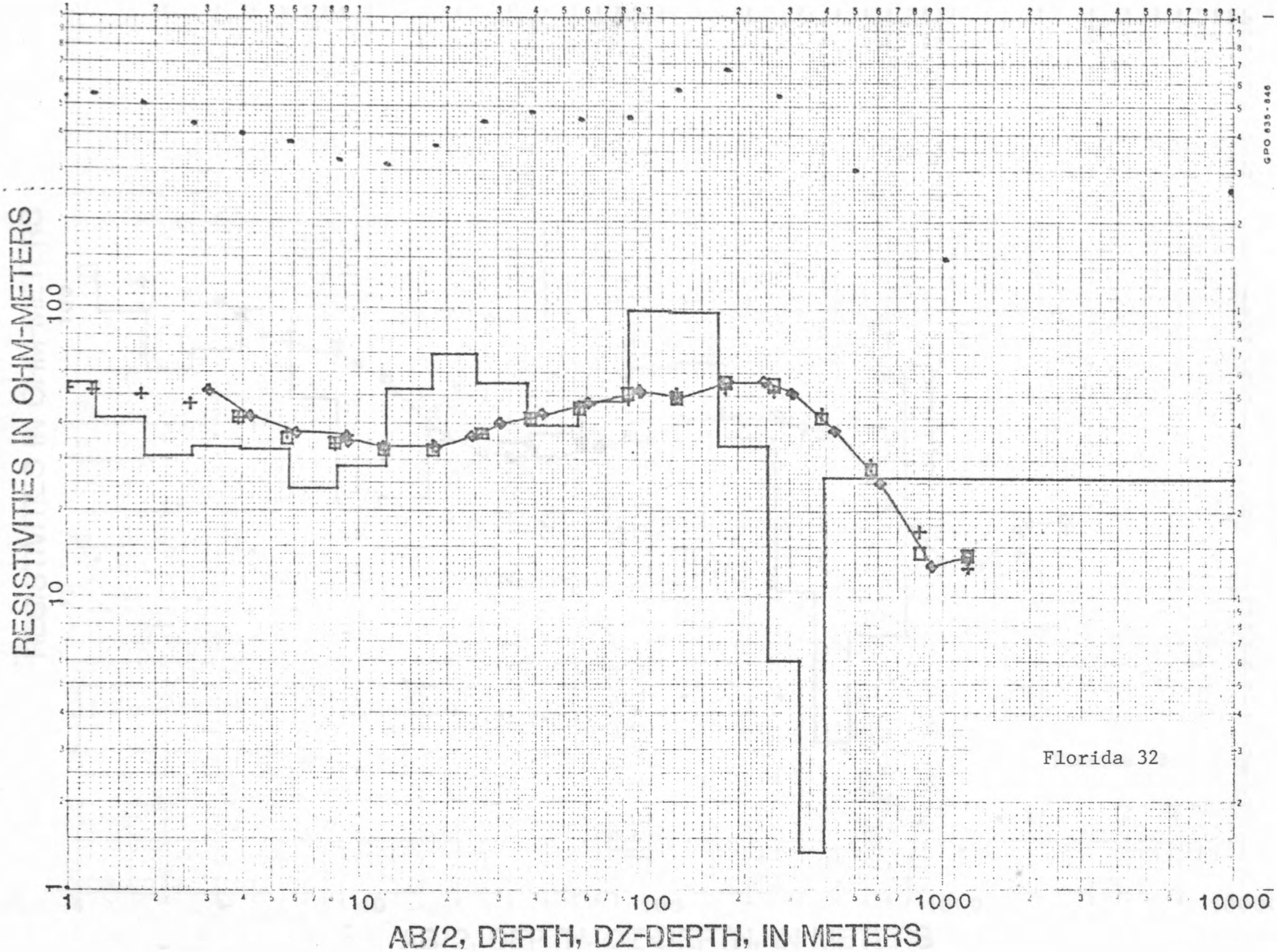
RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
1
10
100
1000
10000
Florida 28
GPO 835-846

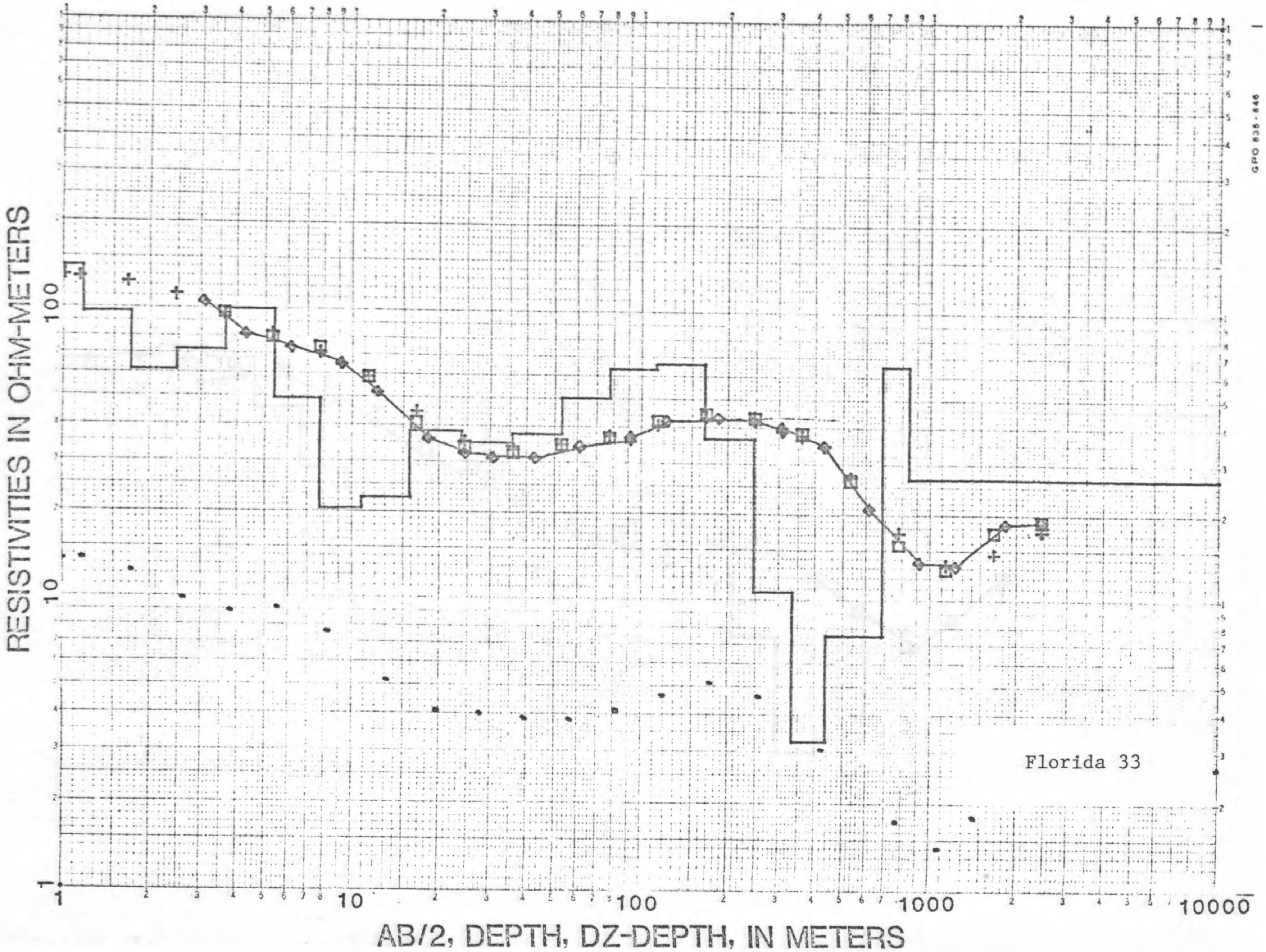

RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
1
10
100
1000
10000
Florida 29
GPO 835-846

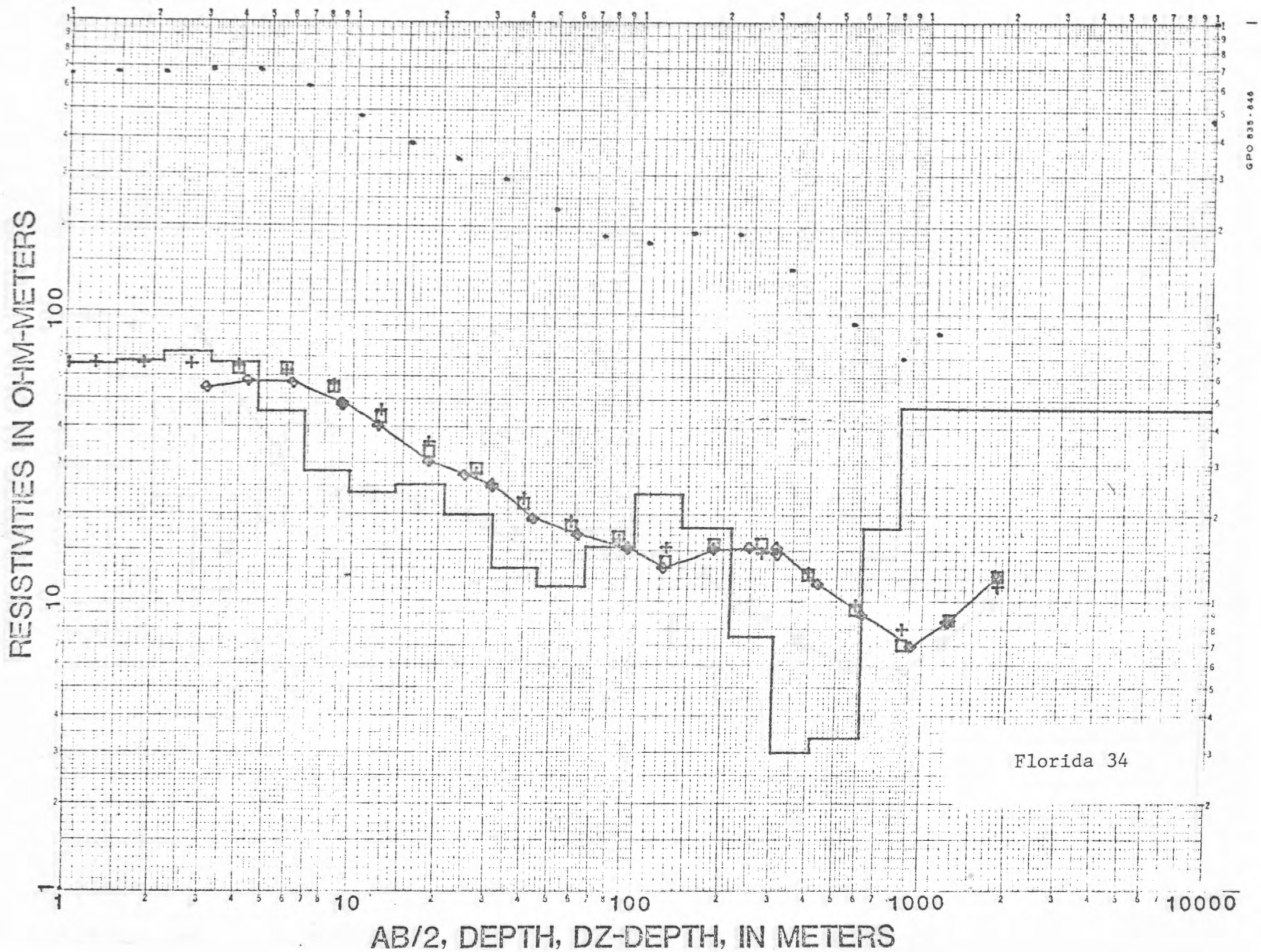

RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
1
10
100
1000
10000
Florida 30
GPO 835-846

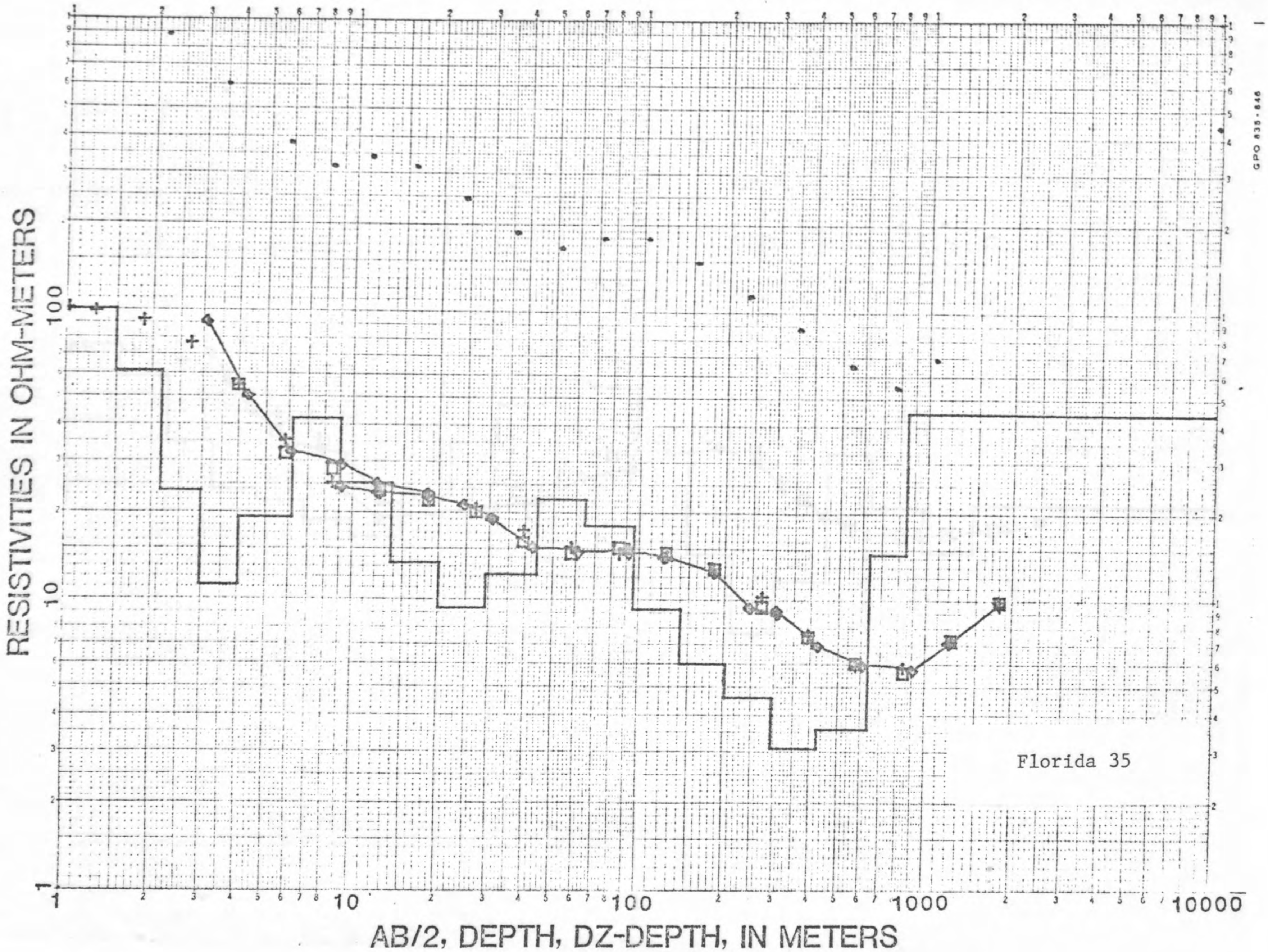

RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
1
10
100
1000
10000
Dar Zarrouk Curve is on next page.
Florida 31
GPO 835-846

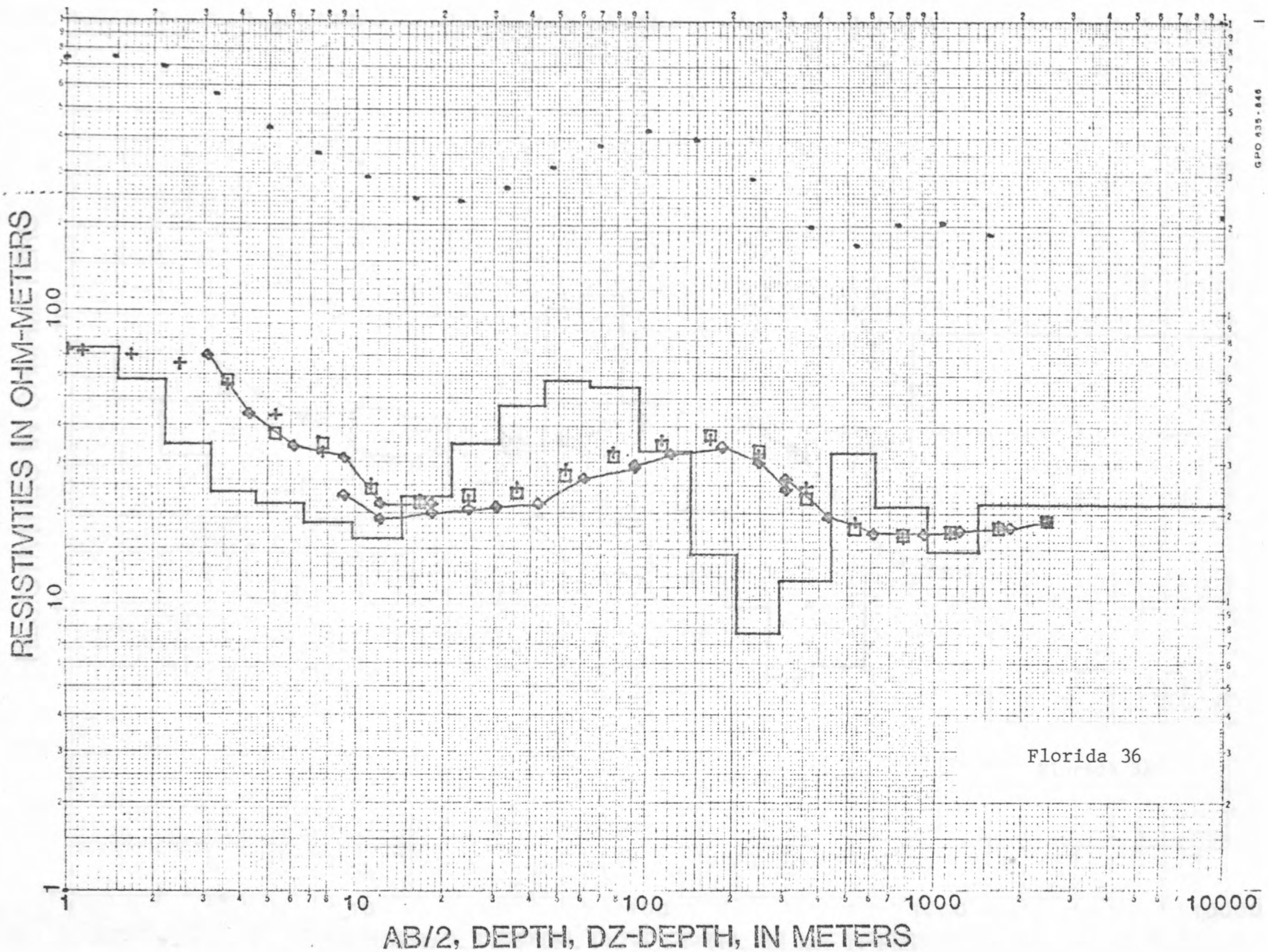

RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
1
10
100
1000
10000
Dar Zarrouk Curve for
Florida 31
GPO 835-846

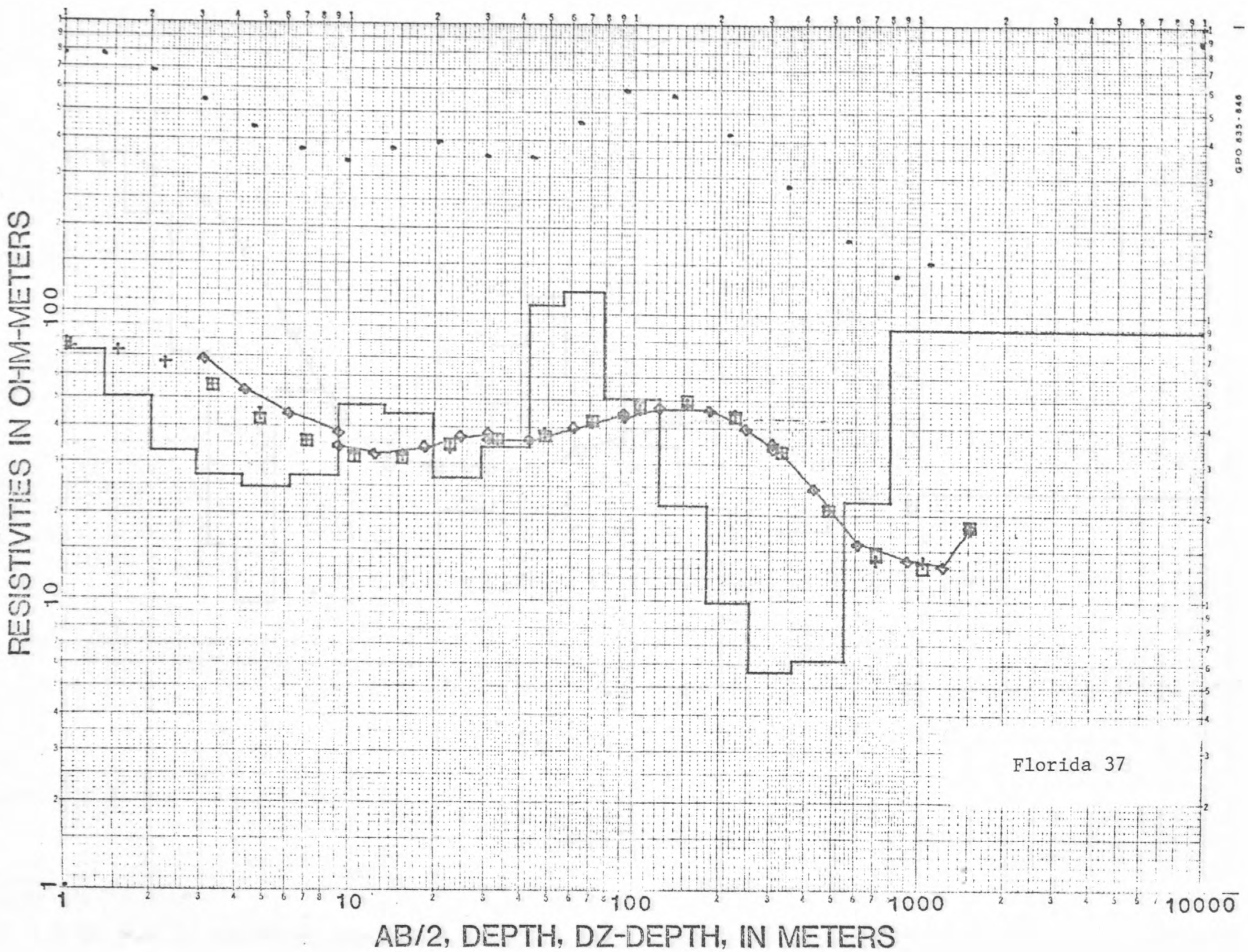

RESISTIVITIES IN OHM-METERS
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 32

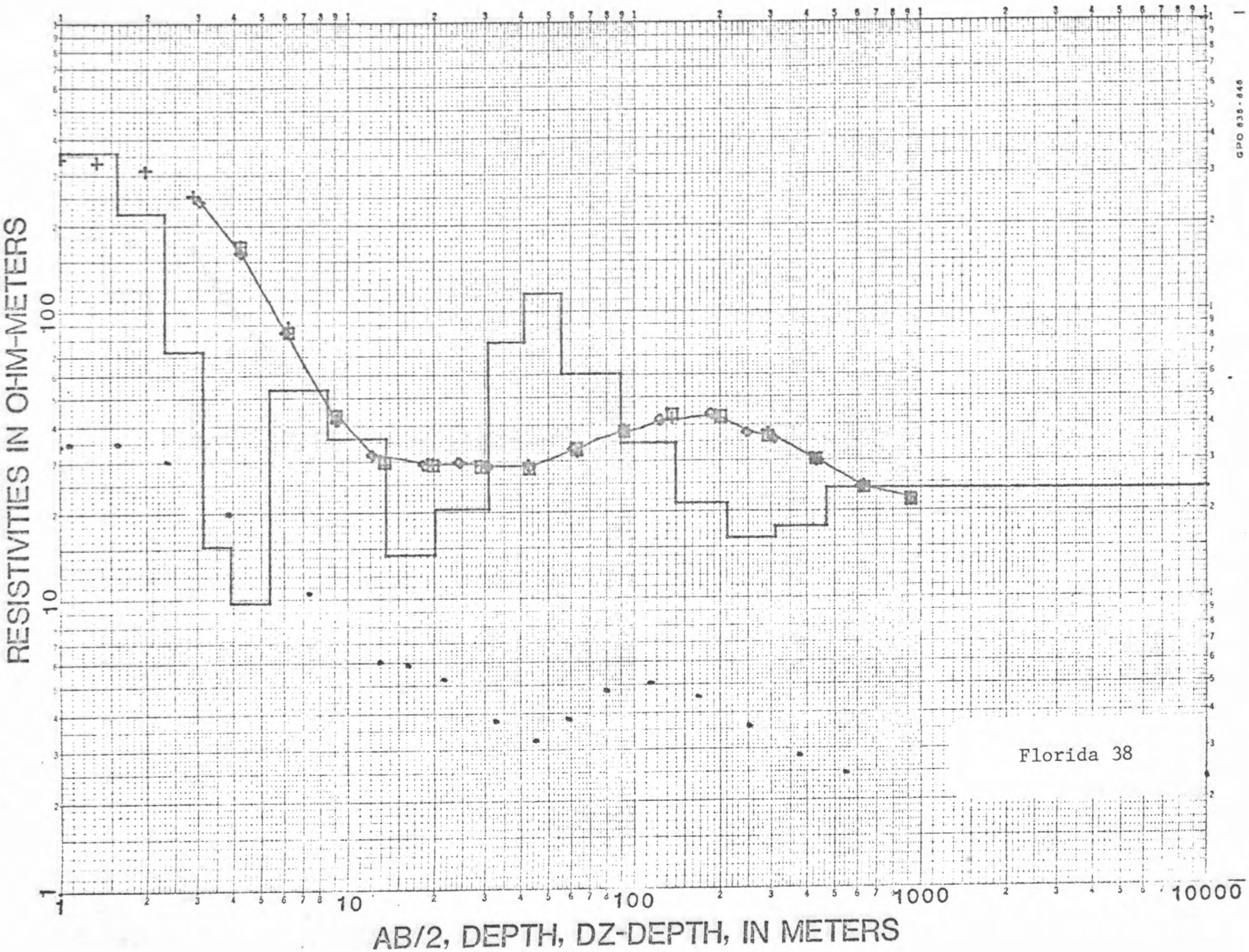

RESISTIVITIES IN OHM-METERS
100
10
1
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 33

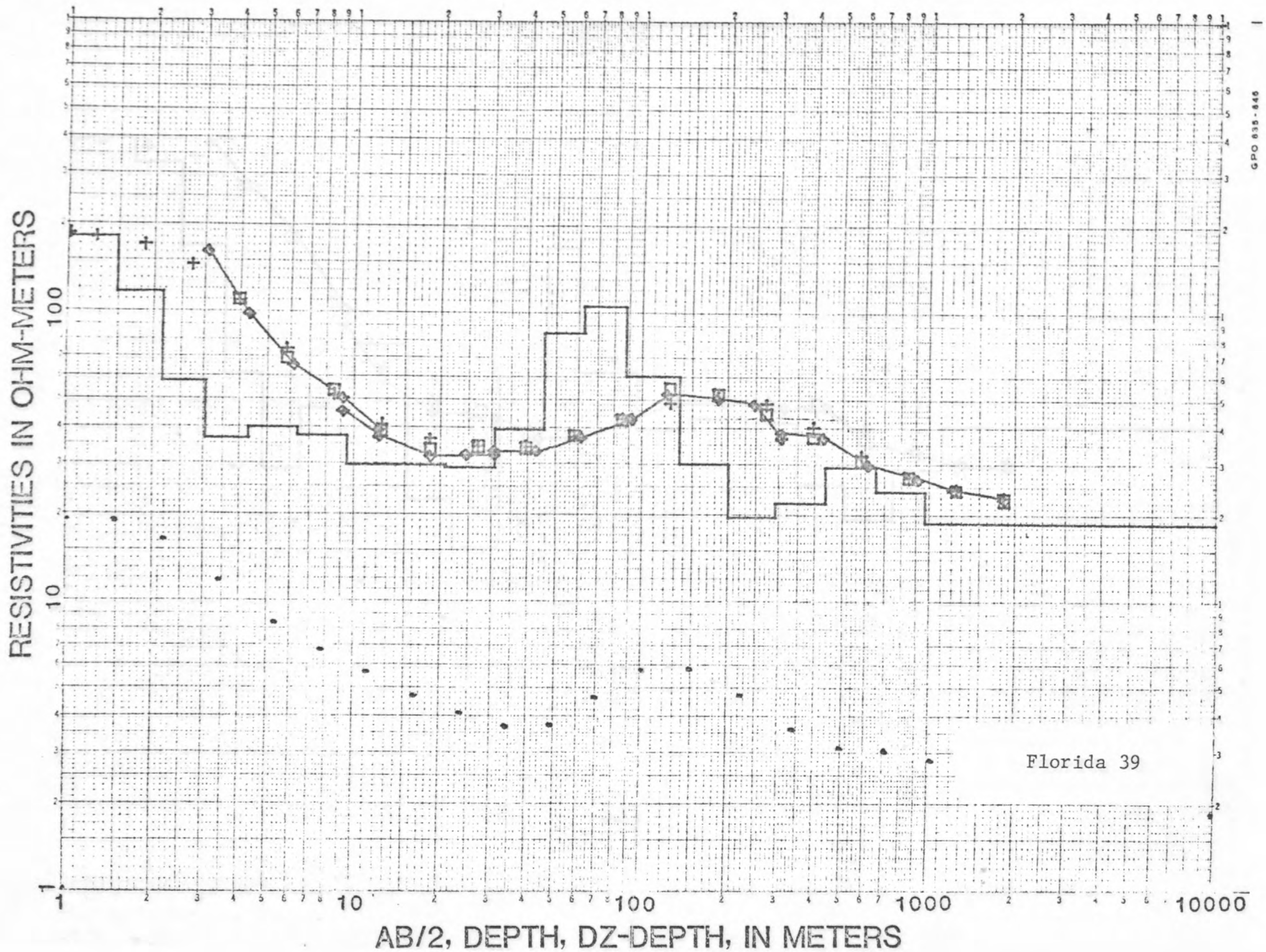

RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
1
10
100
1000
10000
Florida 34
GPO 835-846


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

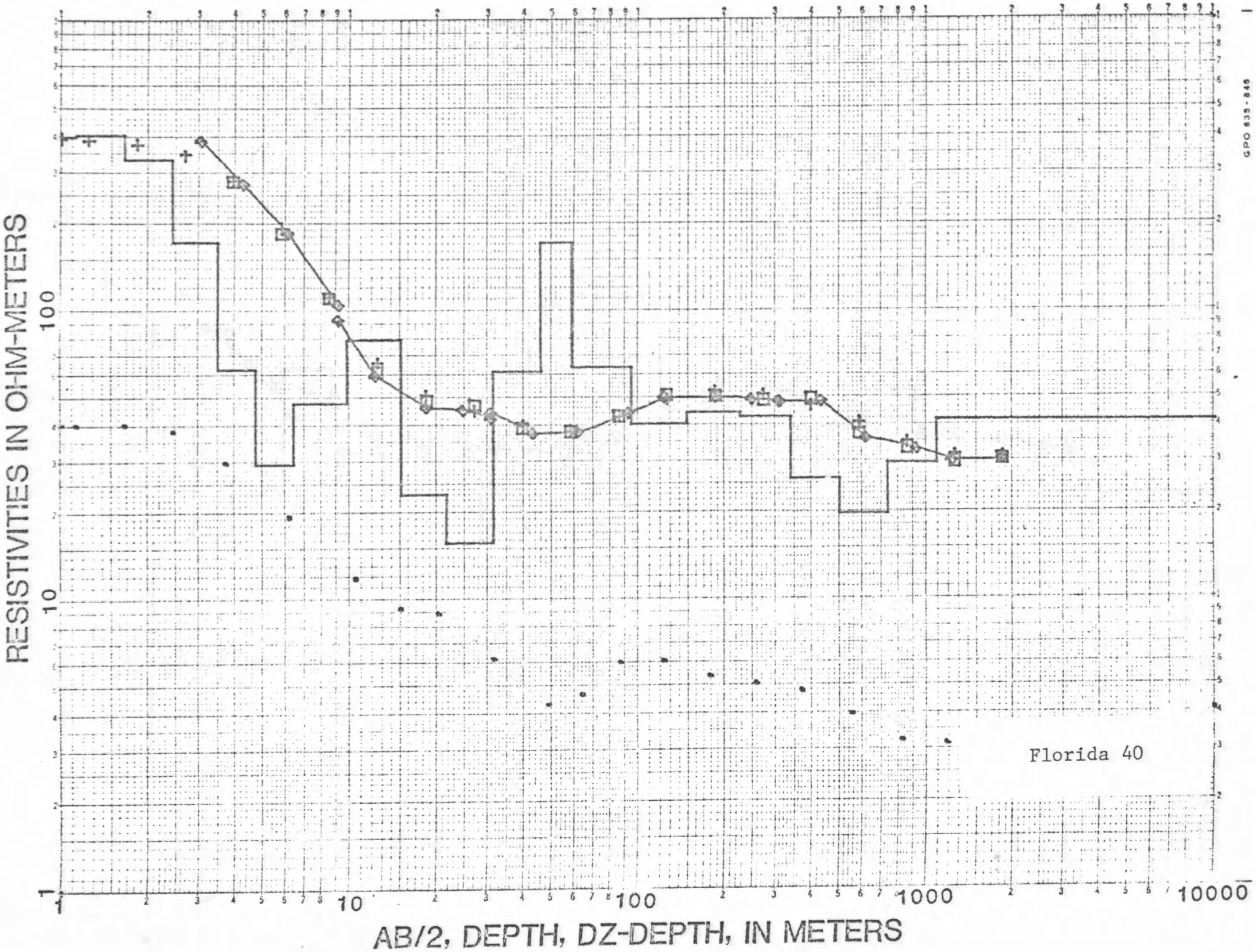

RESISTIVITIES IN OHM-METERS
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 36

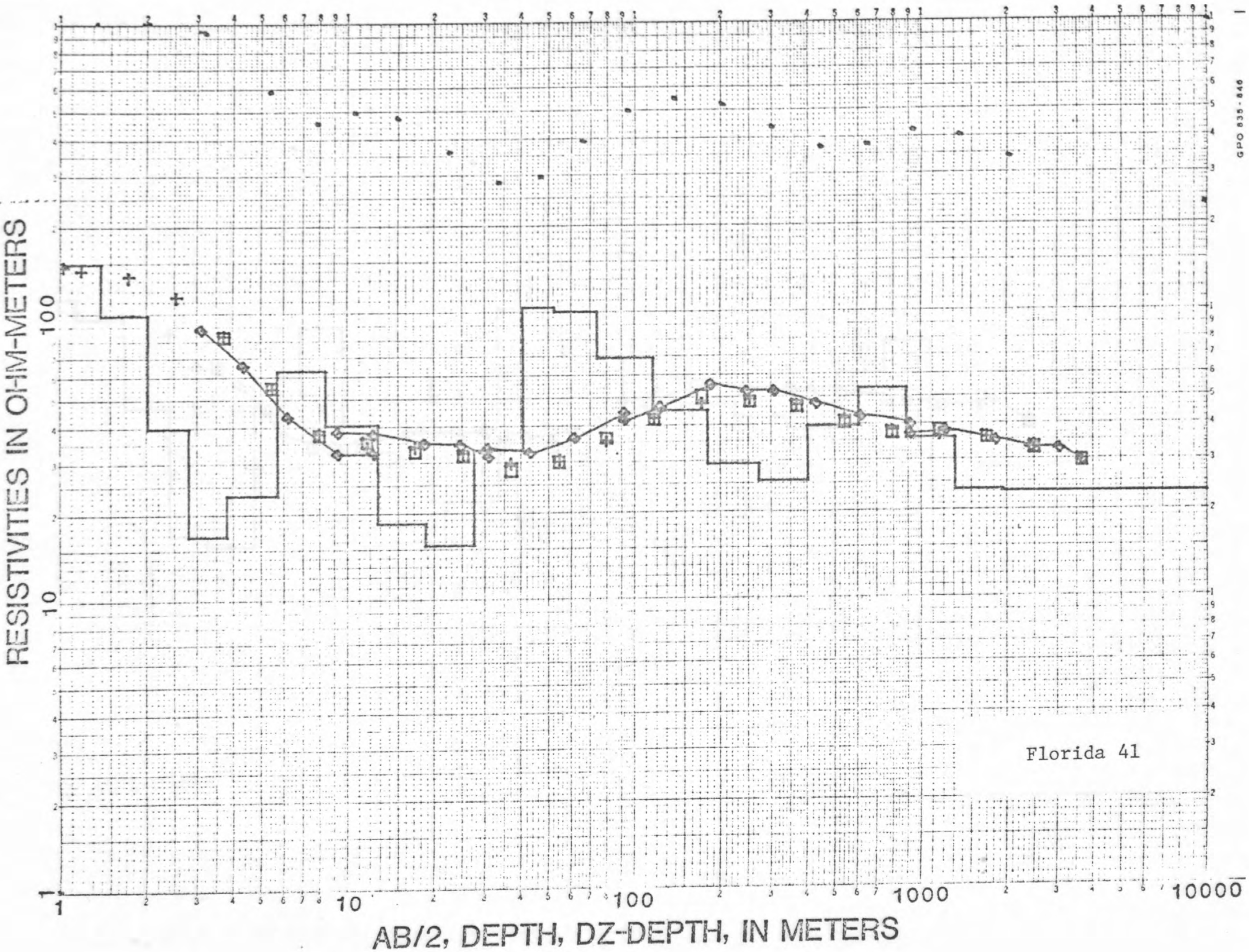

RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
1
10
100
1000
10000
Florida 37

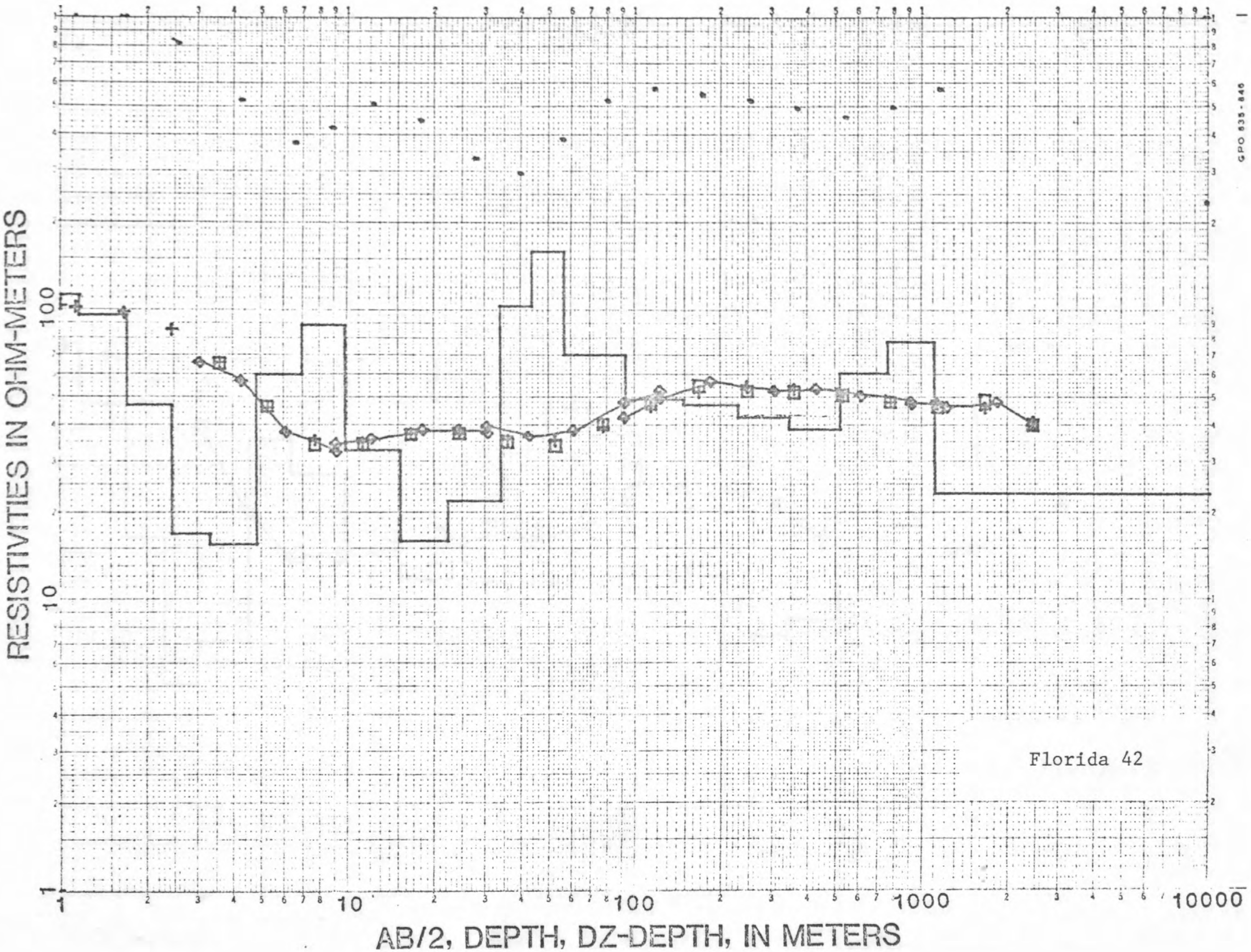

RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 38
1
10
100
1000
10000



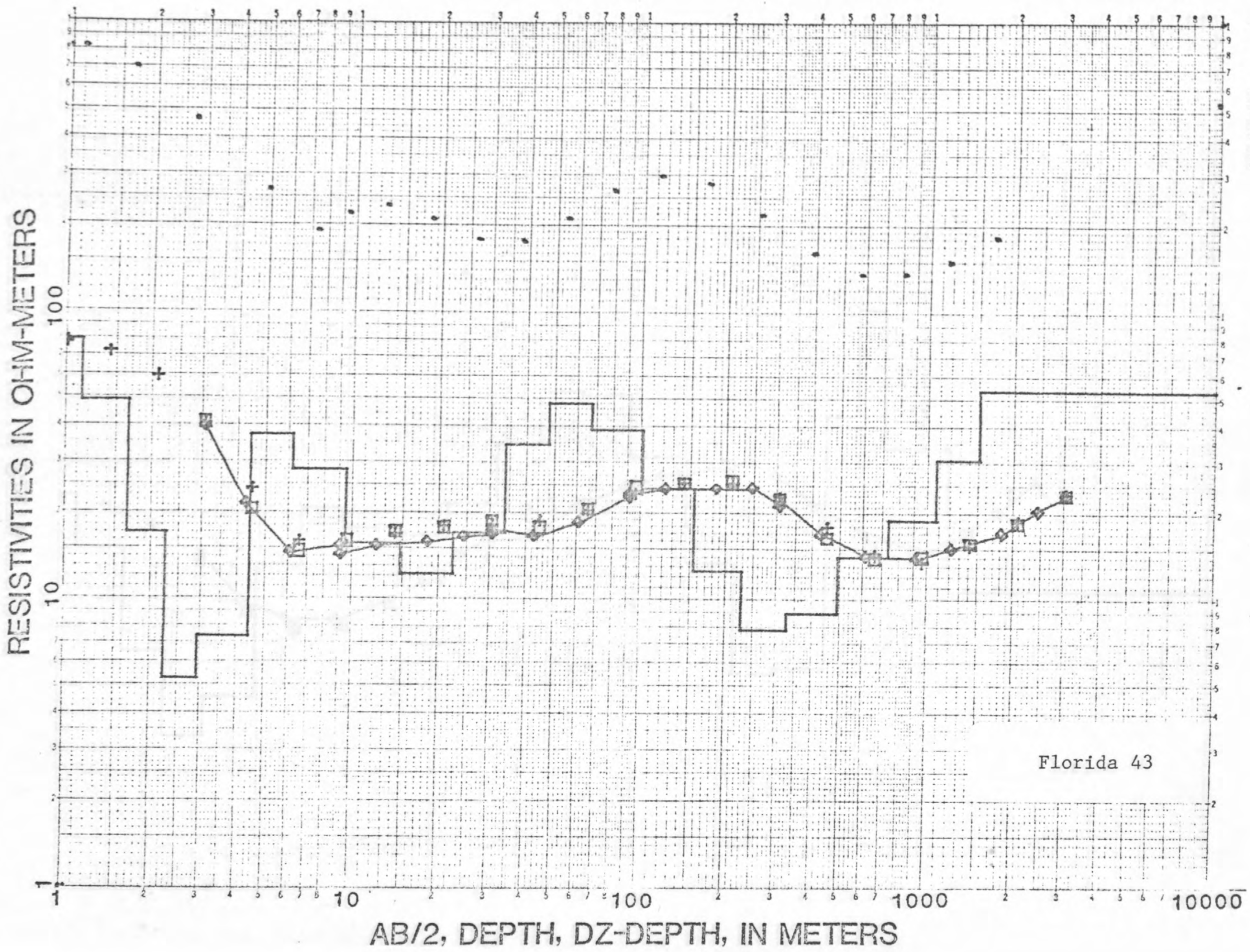
RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 39
GPO 835-846

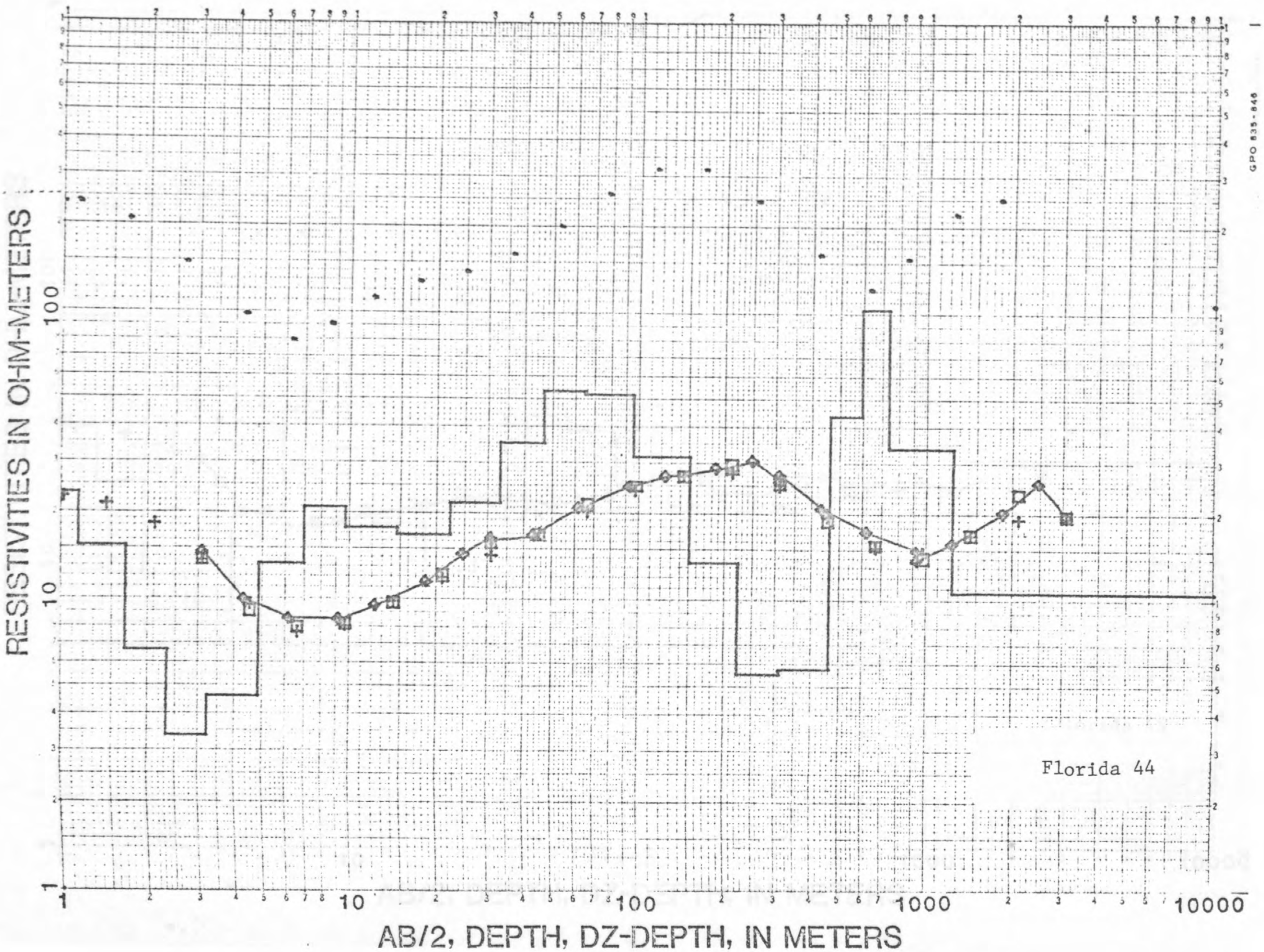

RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 40
GPO 835-845
1
10
100
1000
10000

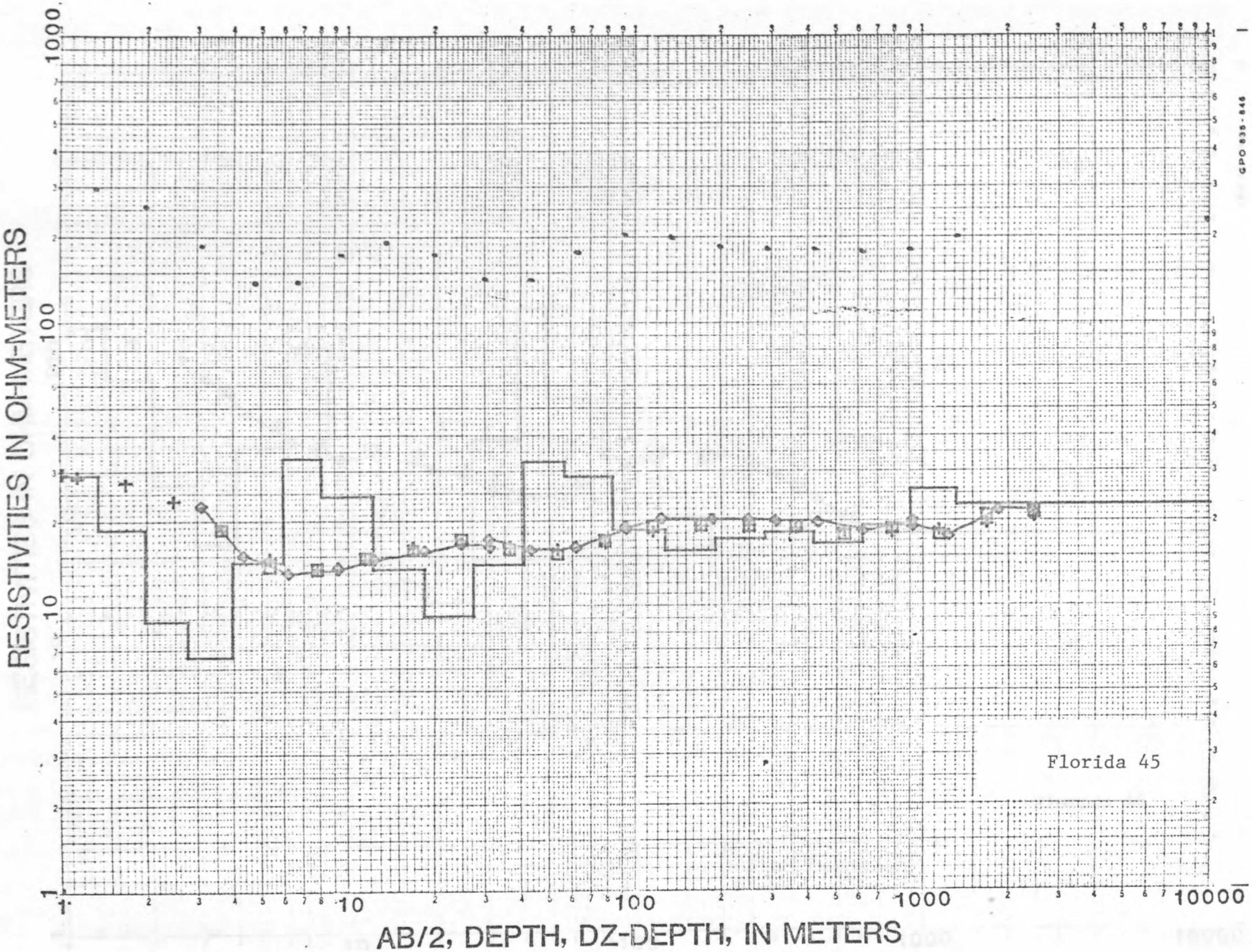

RESISTIVITIES IN OHM-METERS
100
10
1
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 41
GPO 835-846

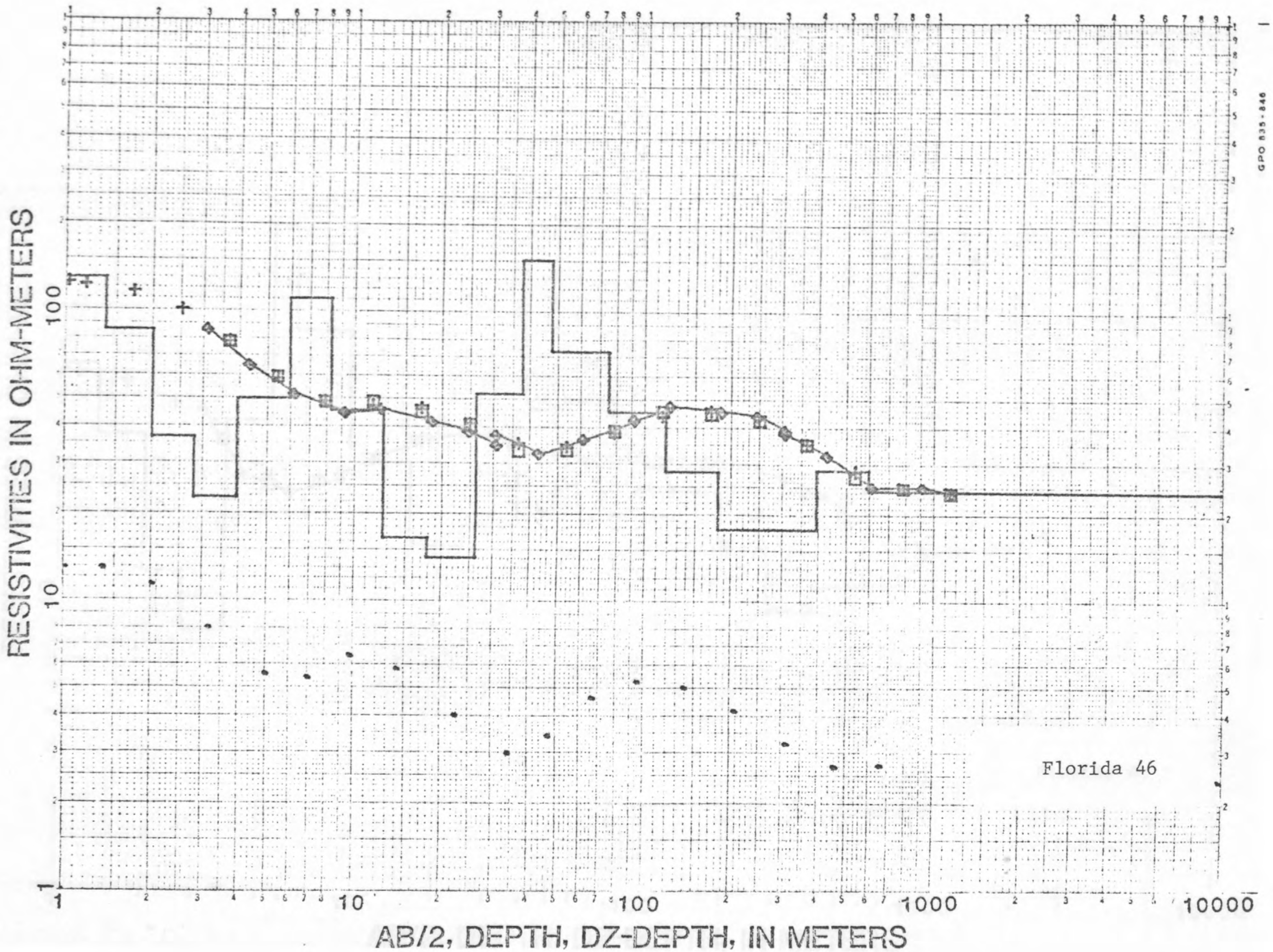


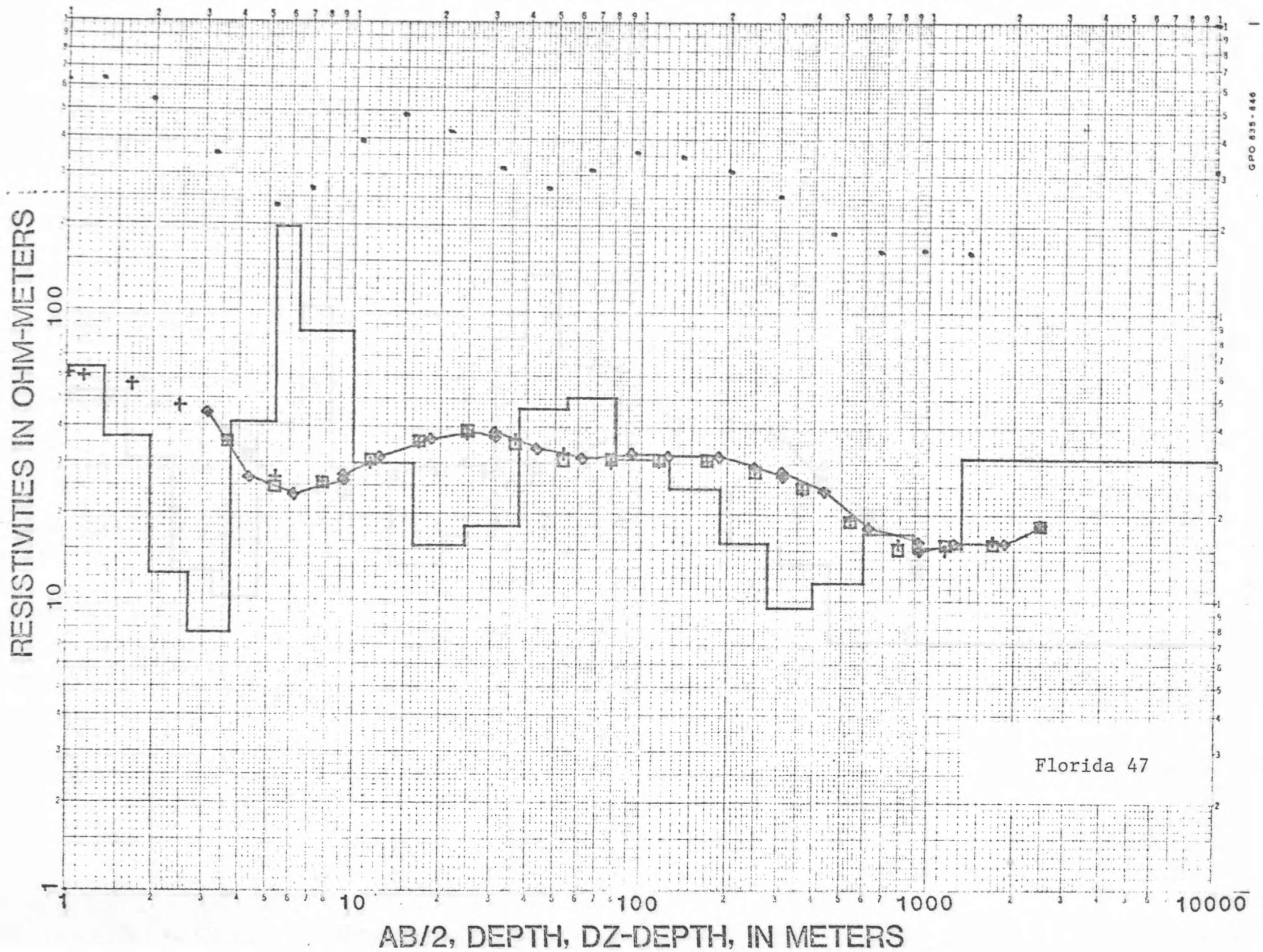
RESISTIVITIES IN OHM-METERS
100
10
AB/2, DEPTH, DZ-DEPTH, IN METERS
1
10
100
1000
10000
Florida 42
GPO 835-846

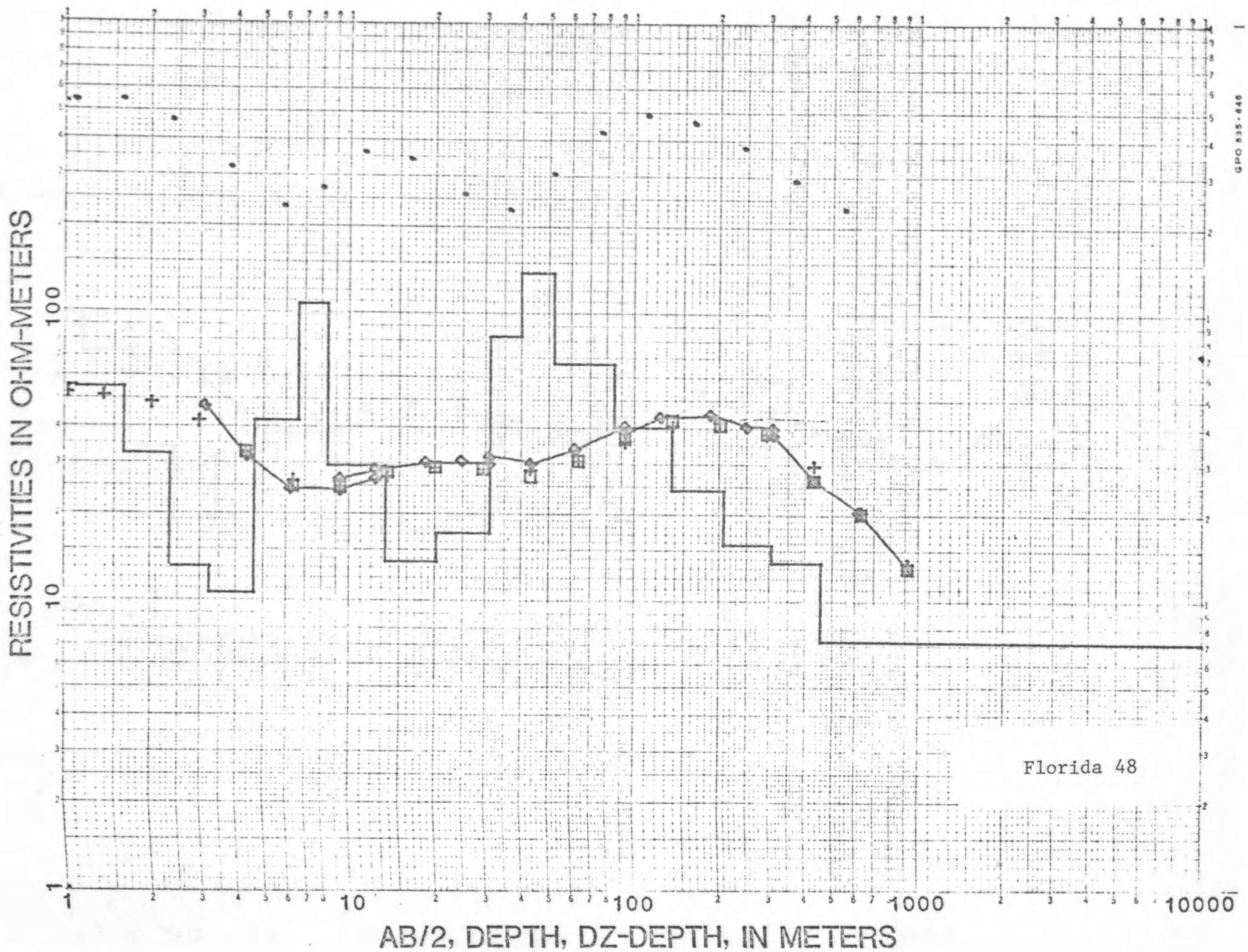

RESISTIVITIES IN OHM-METERS
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 43


RESISTIVITIES IN OHM-METERS
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 44
GPO 835-846

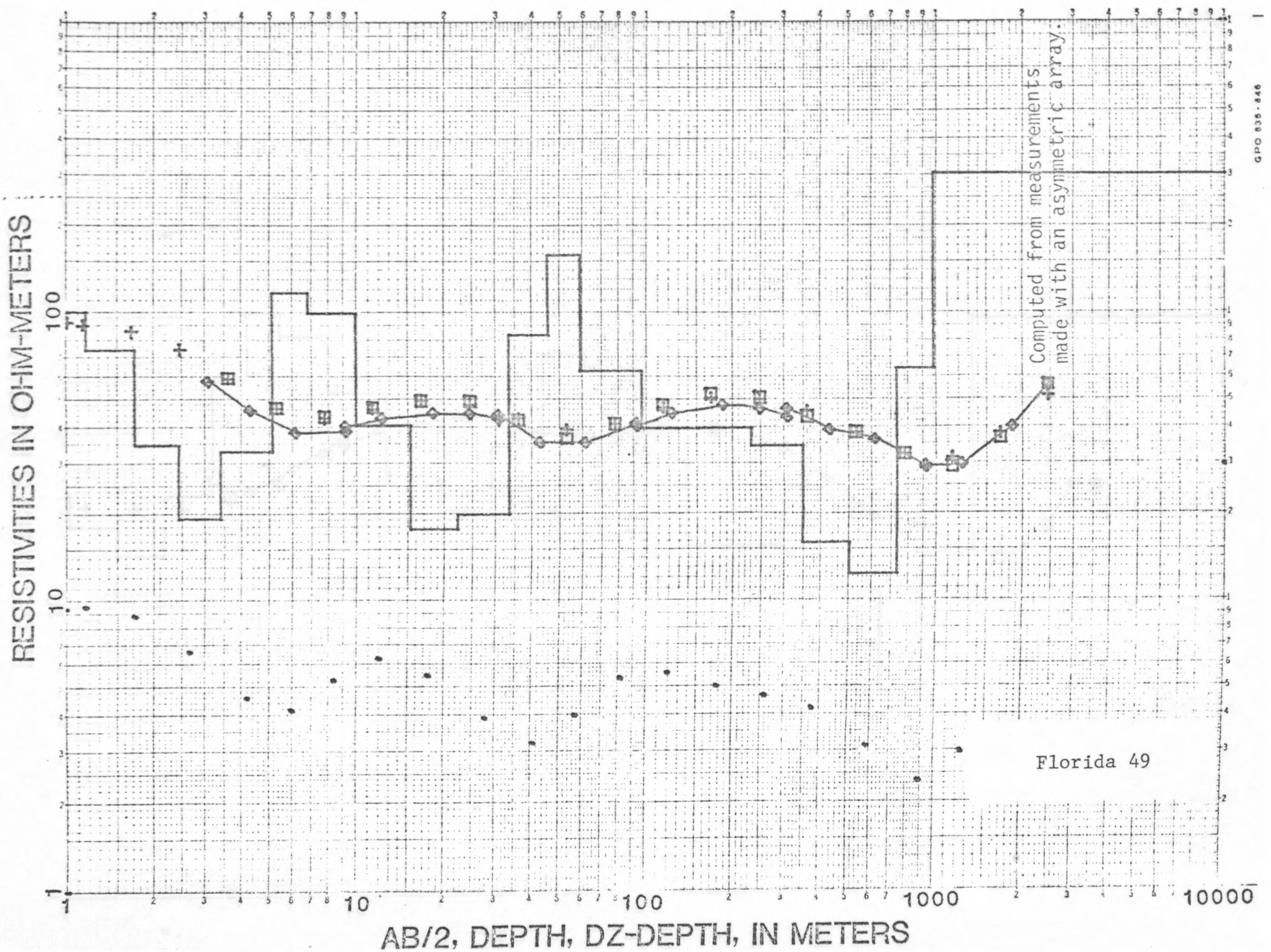

RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
1000
100
10
1
10
100
1000
10000
Florida 45
GPO 835-846

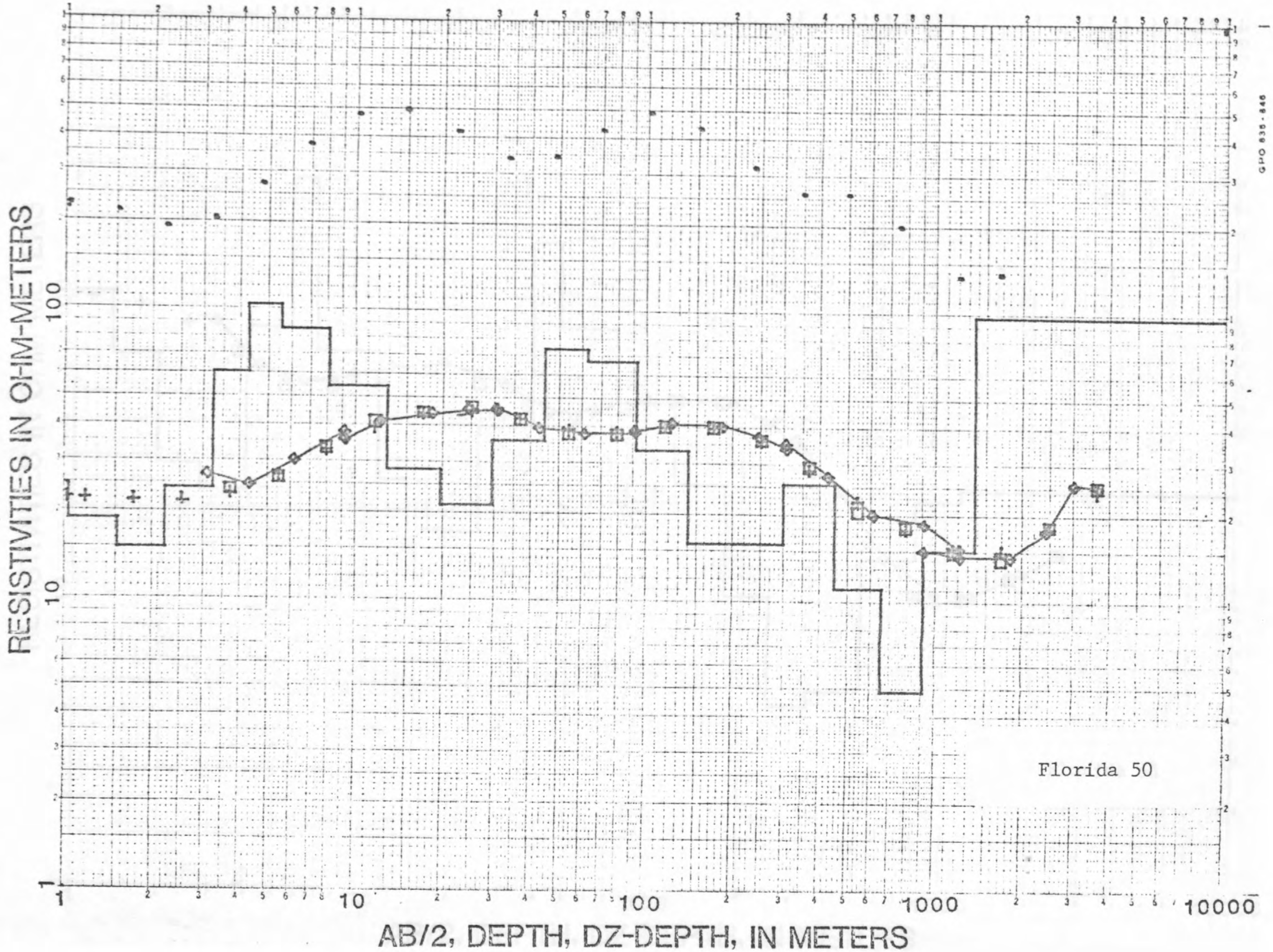

RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
1
10
100
1000
10000
Florida 46
GPO 835-846

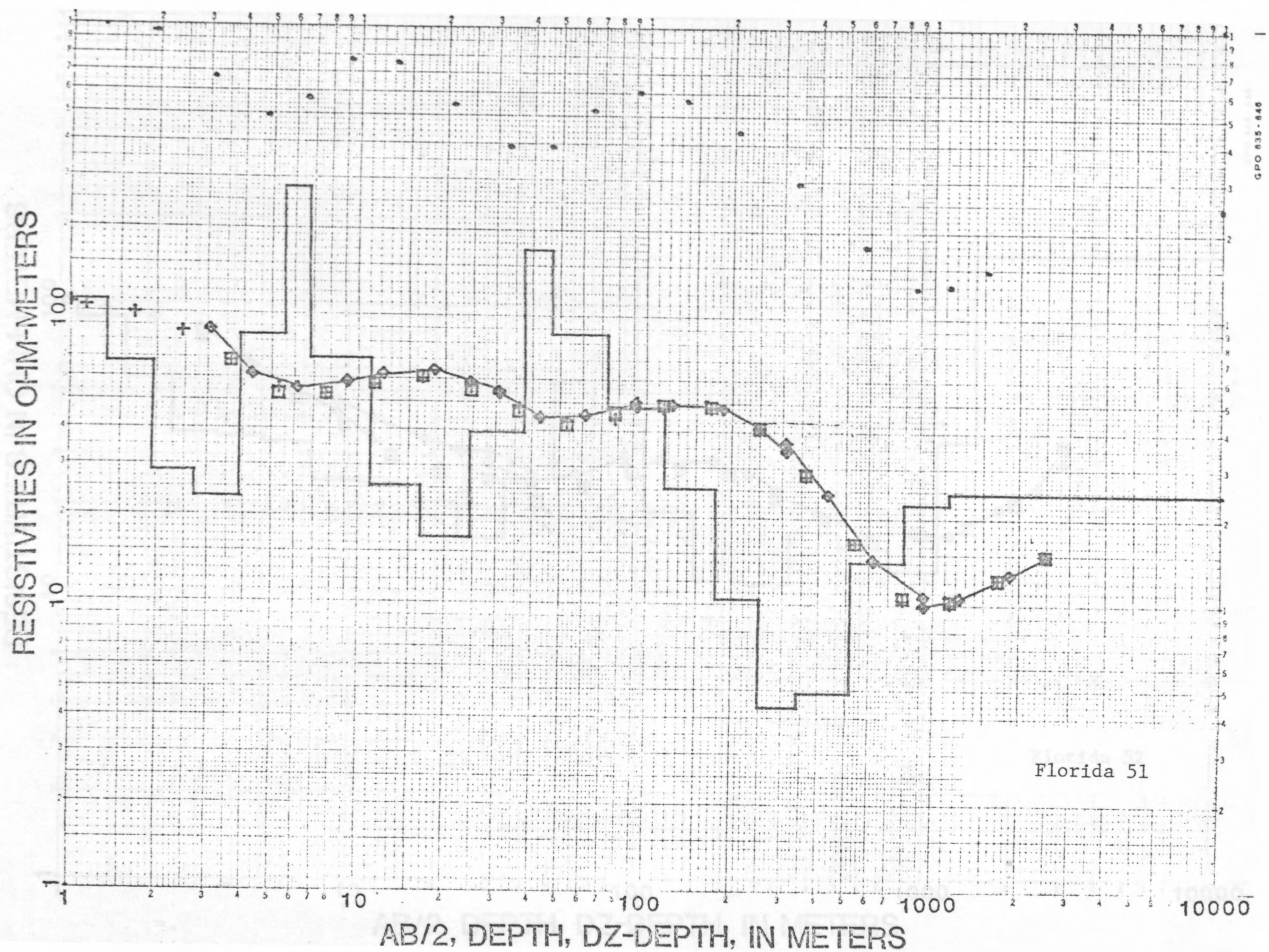

RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
1
10
100
1000
10000
Florida 47

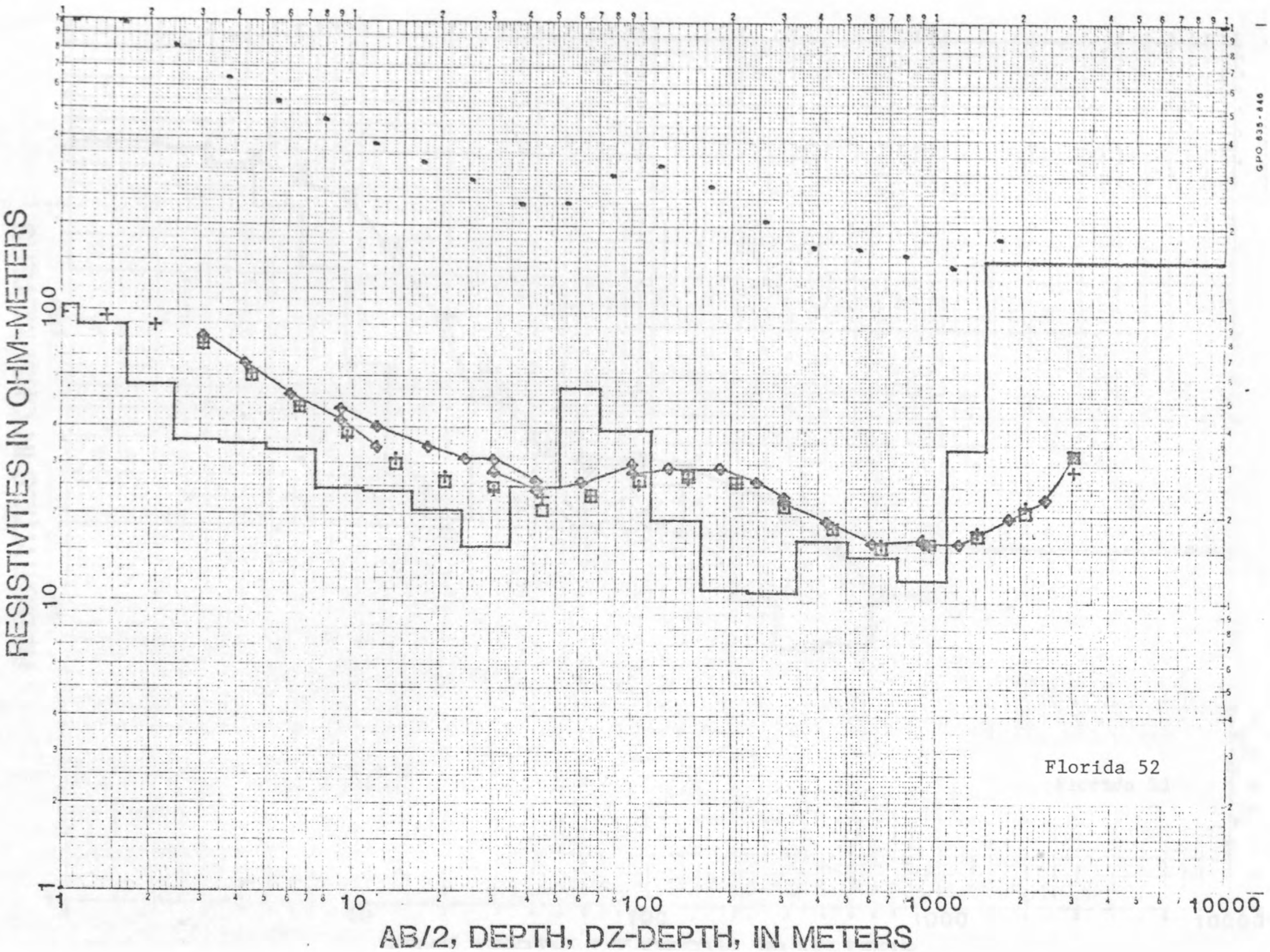


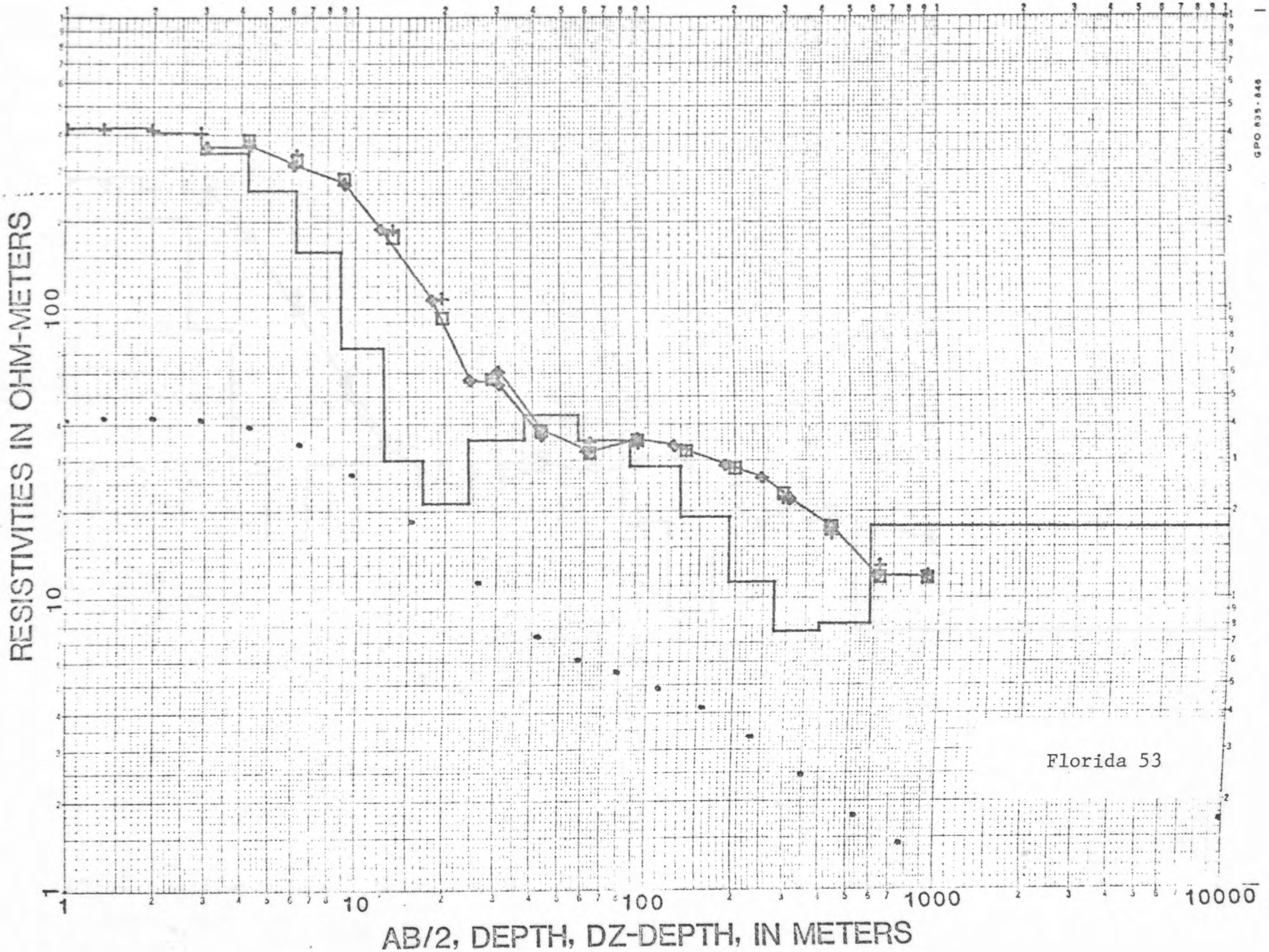
RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 48
GPO 835-848

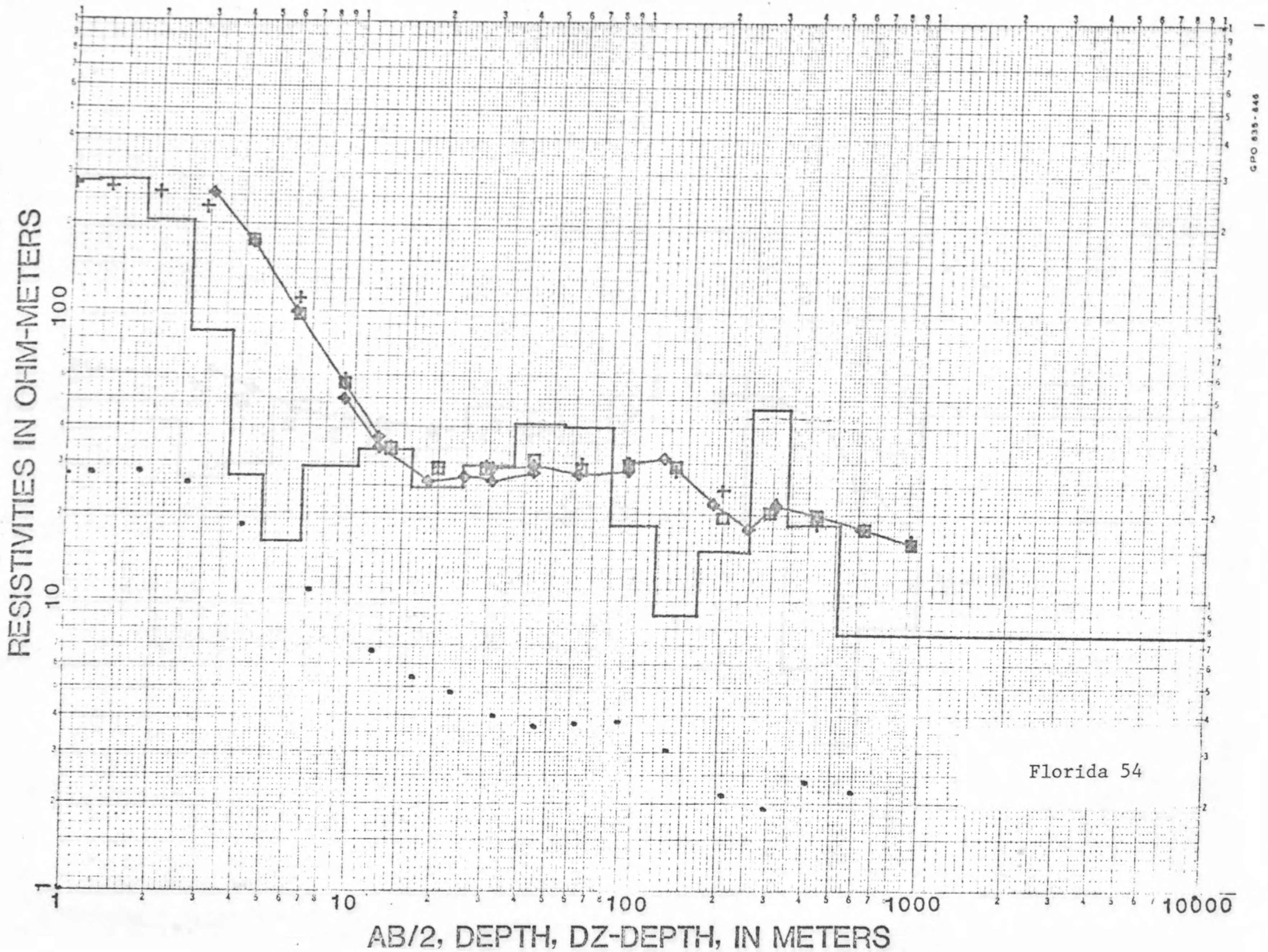

RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
1
10
100
1000
10000
Computed from measurements
made with an asymmetric array.
Florida 49
GPO 835-846

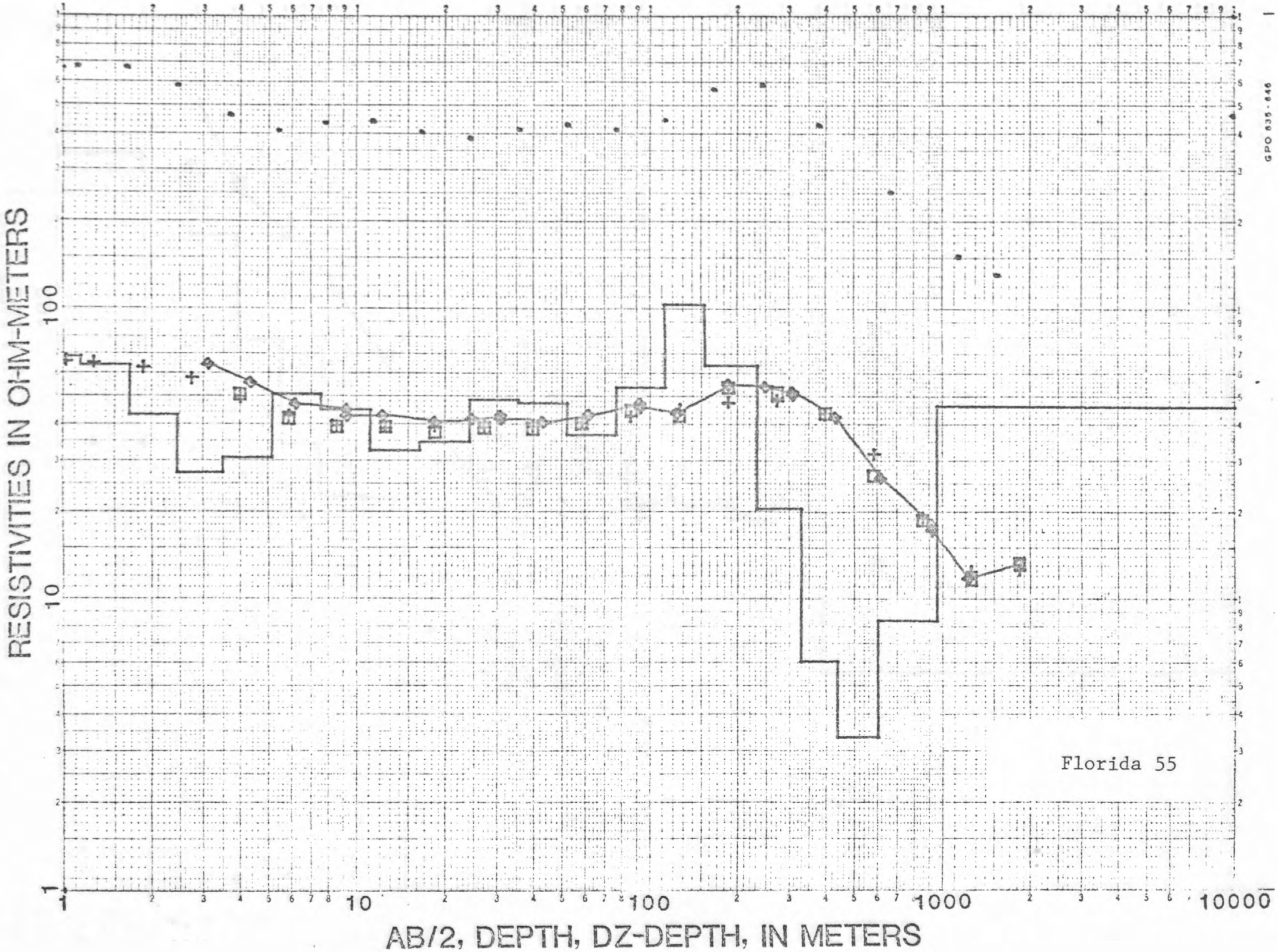

RESISTIVITIES IN OHM-METERS
100
10
1
AB/2, DEPTH, DZ-DEPTH, IN METERS
10
100
1000
10000
Florida 50
GPO 835-846

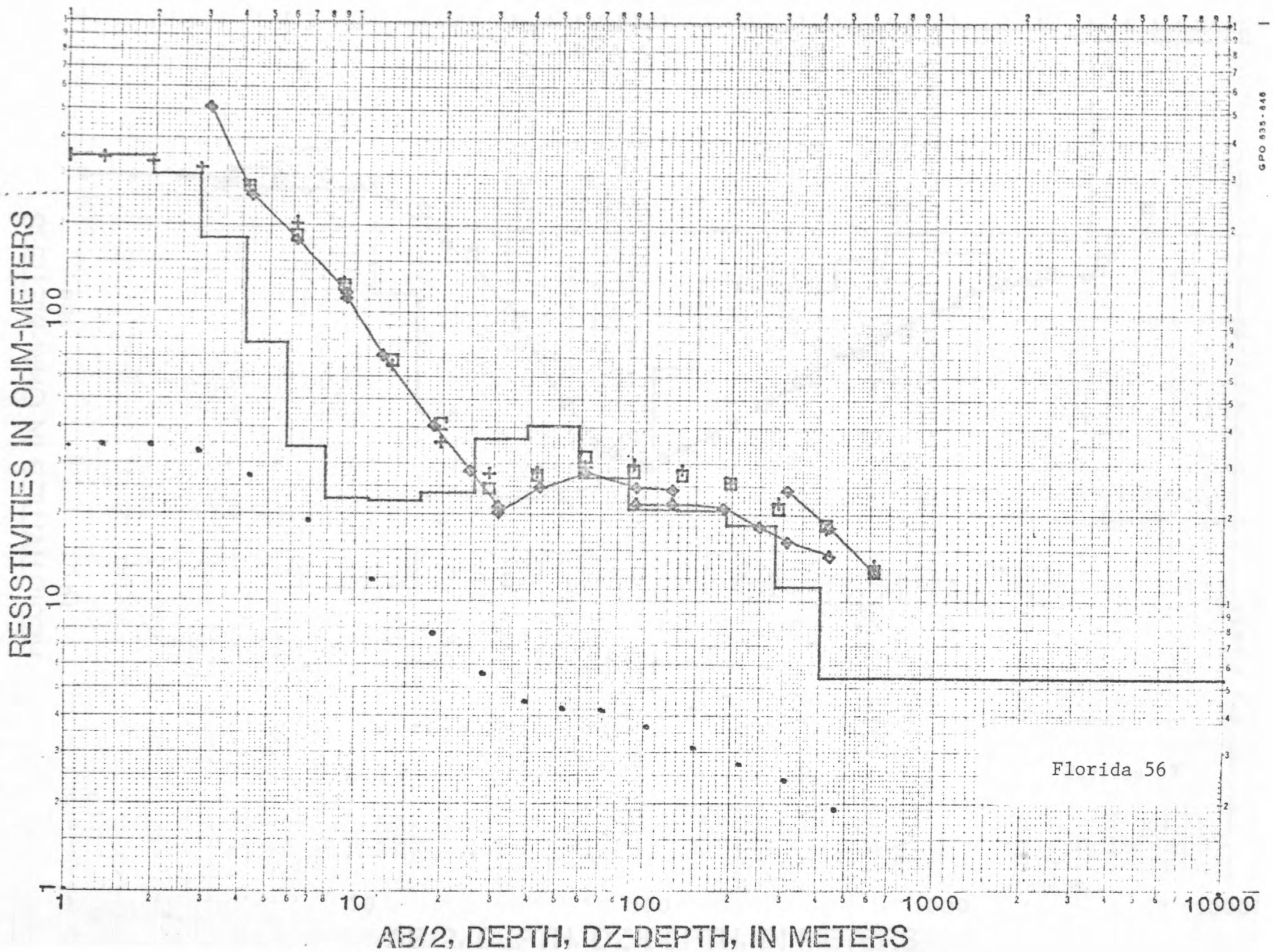

RESISTIVITIES IN OHM-METERS
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 51

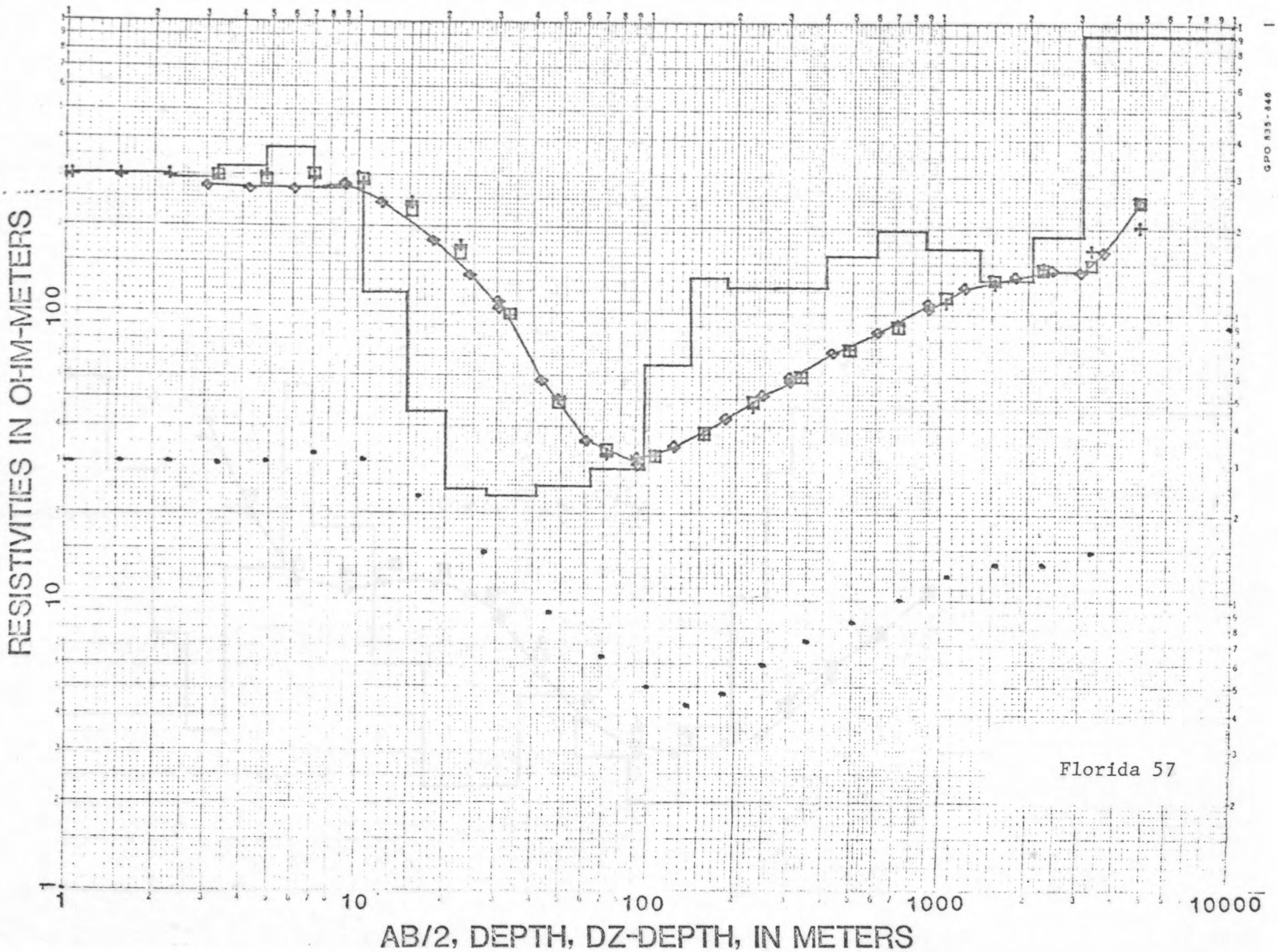

RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 52

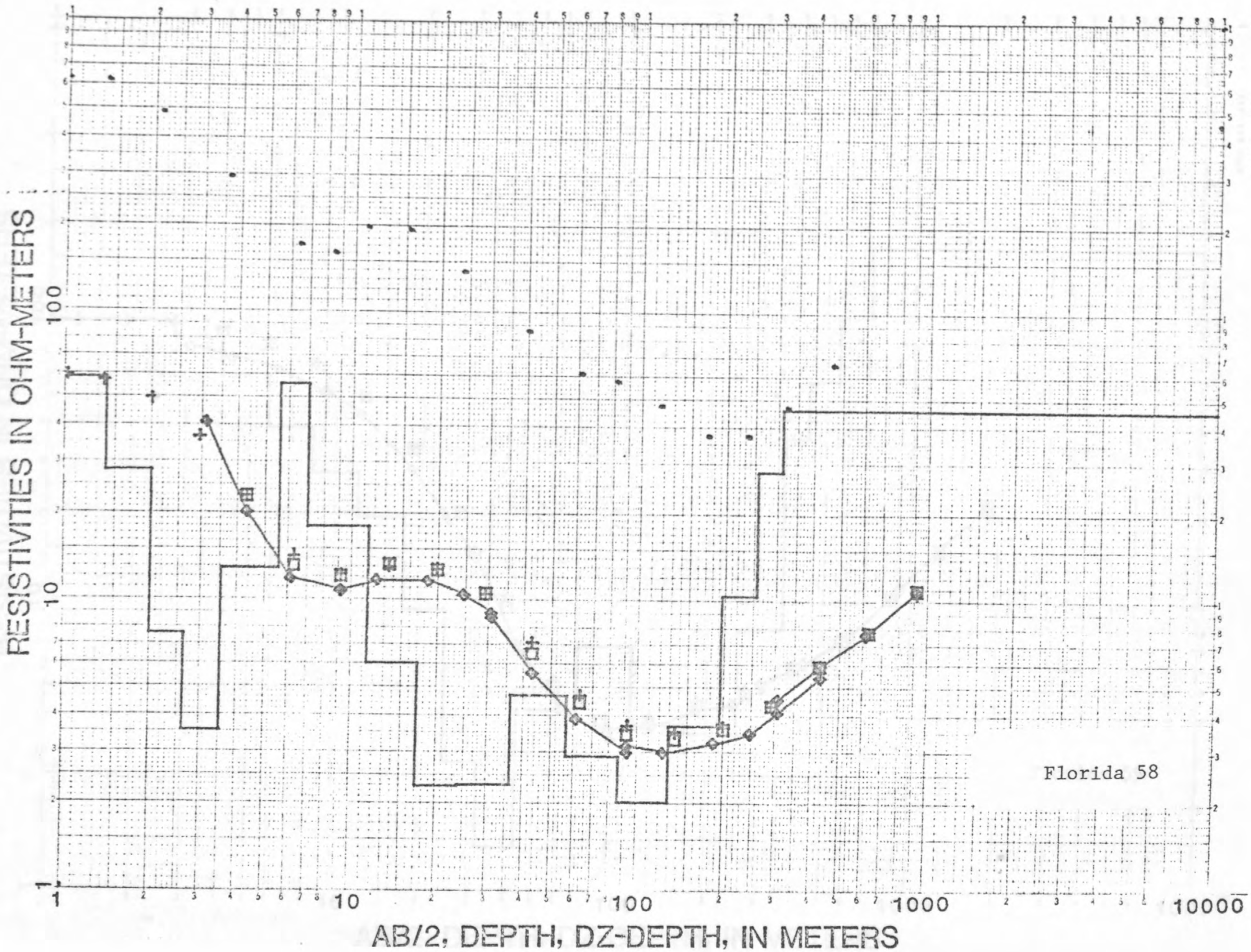

RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 53
1
10
100
1000
10000
GPO 835-846

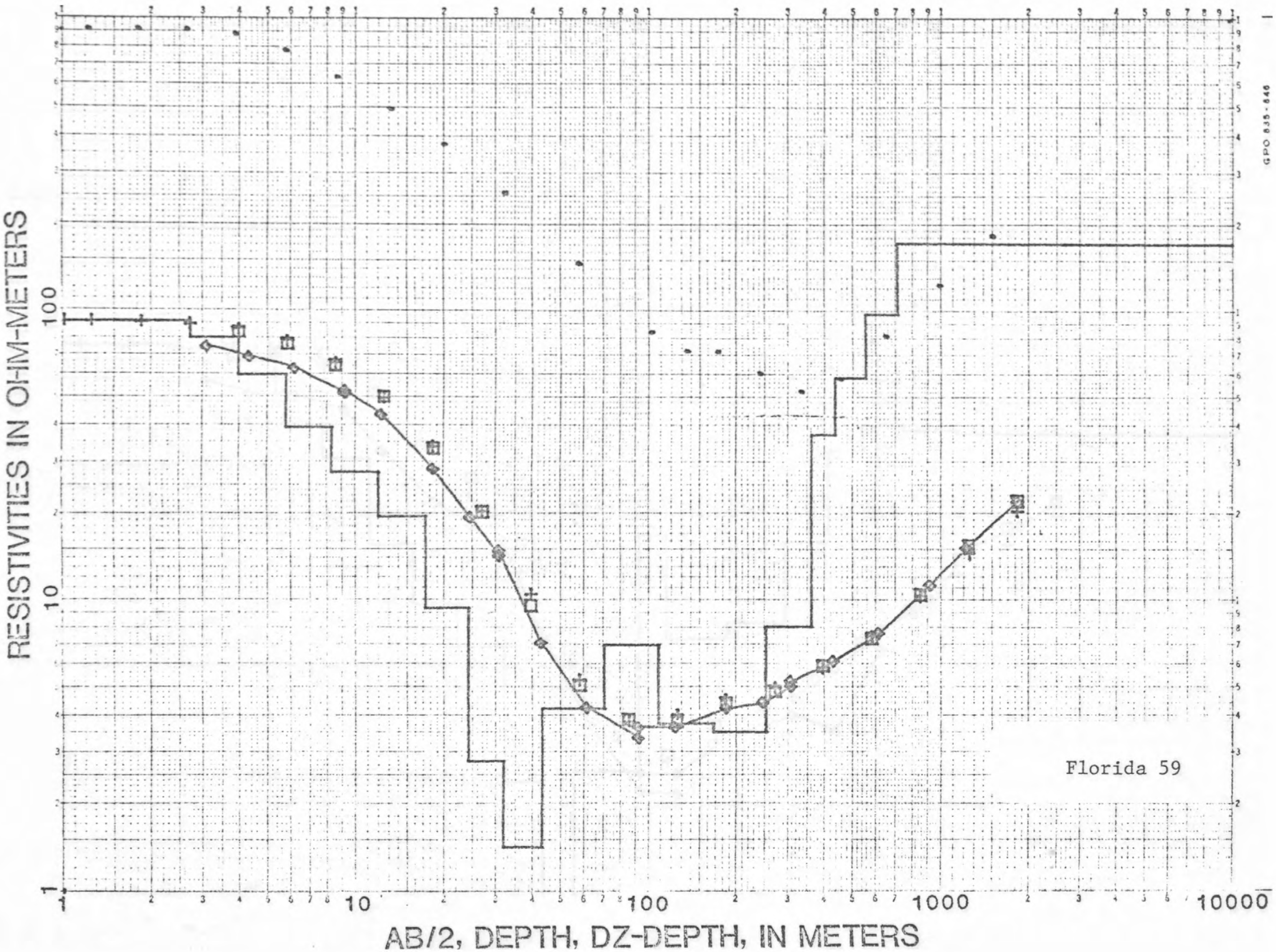

RESISTIVITIES IN OHM-METERS
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 54


RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 55
GPO 835-646
1
10
100
1000
10000

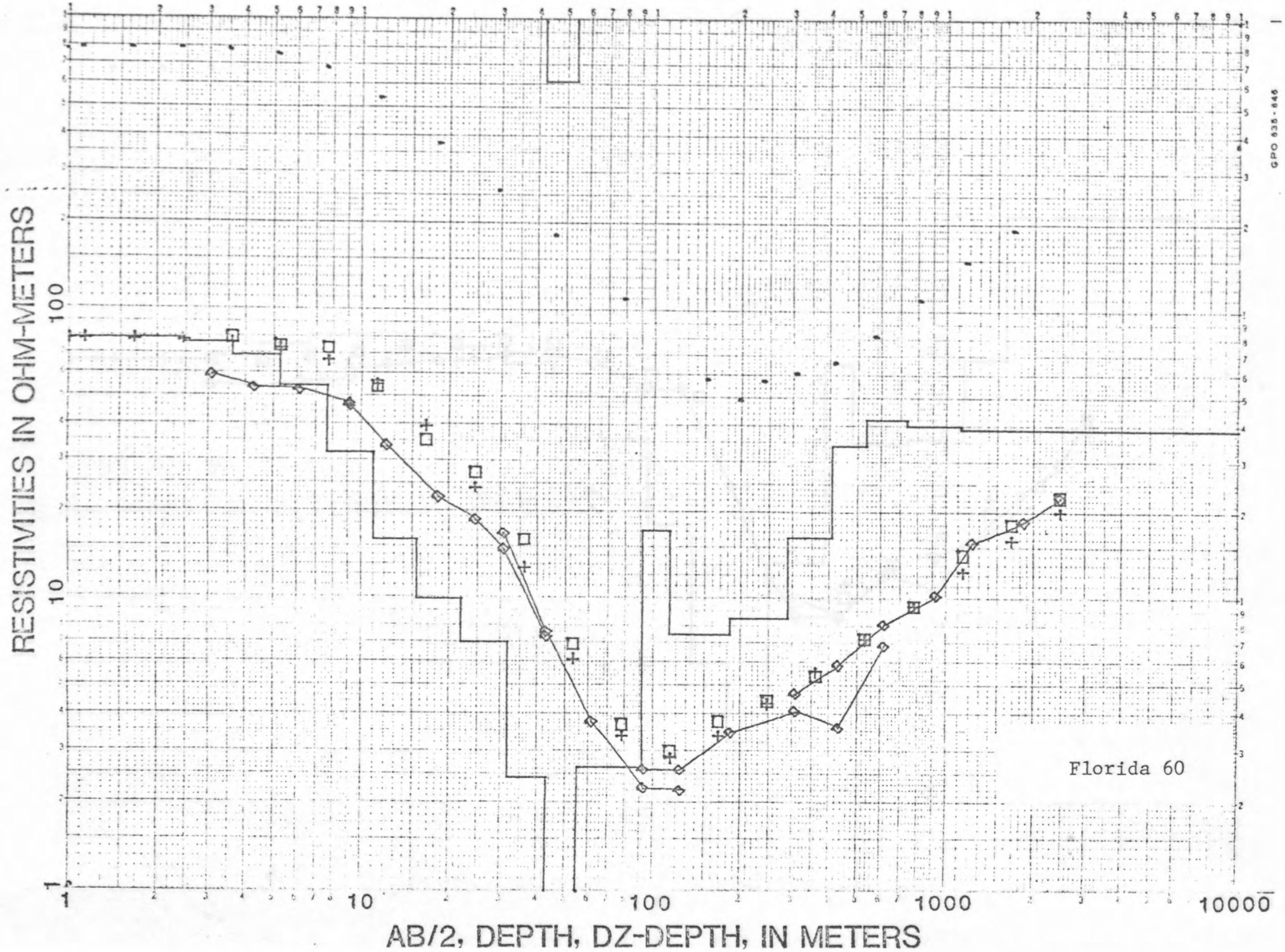

RESISTIVITIES IN OHM-METERS
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 56
GPO 835-848

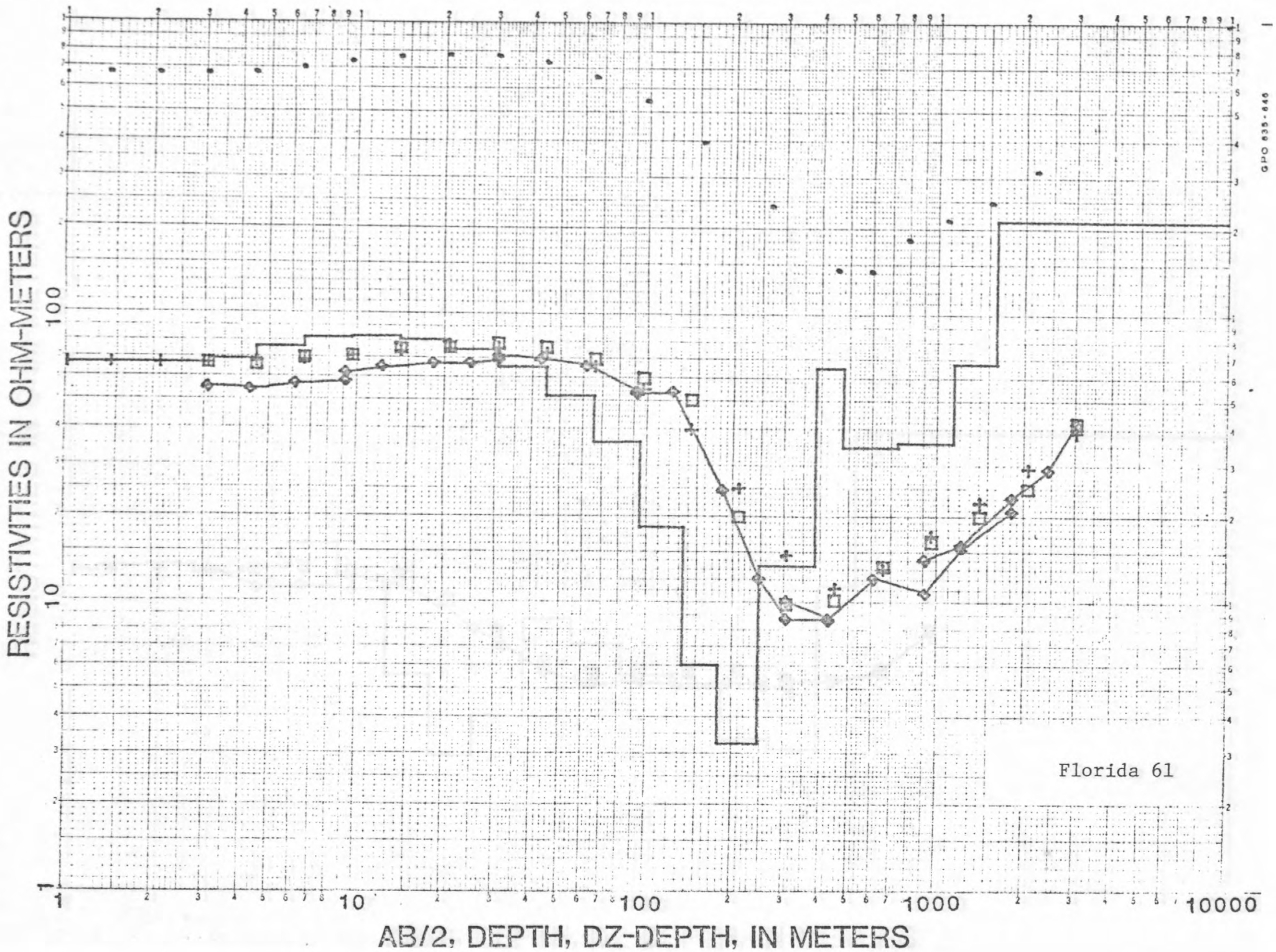

RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
1
10
100
1000
10000
Florida 57
GPO 835-446

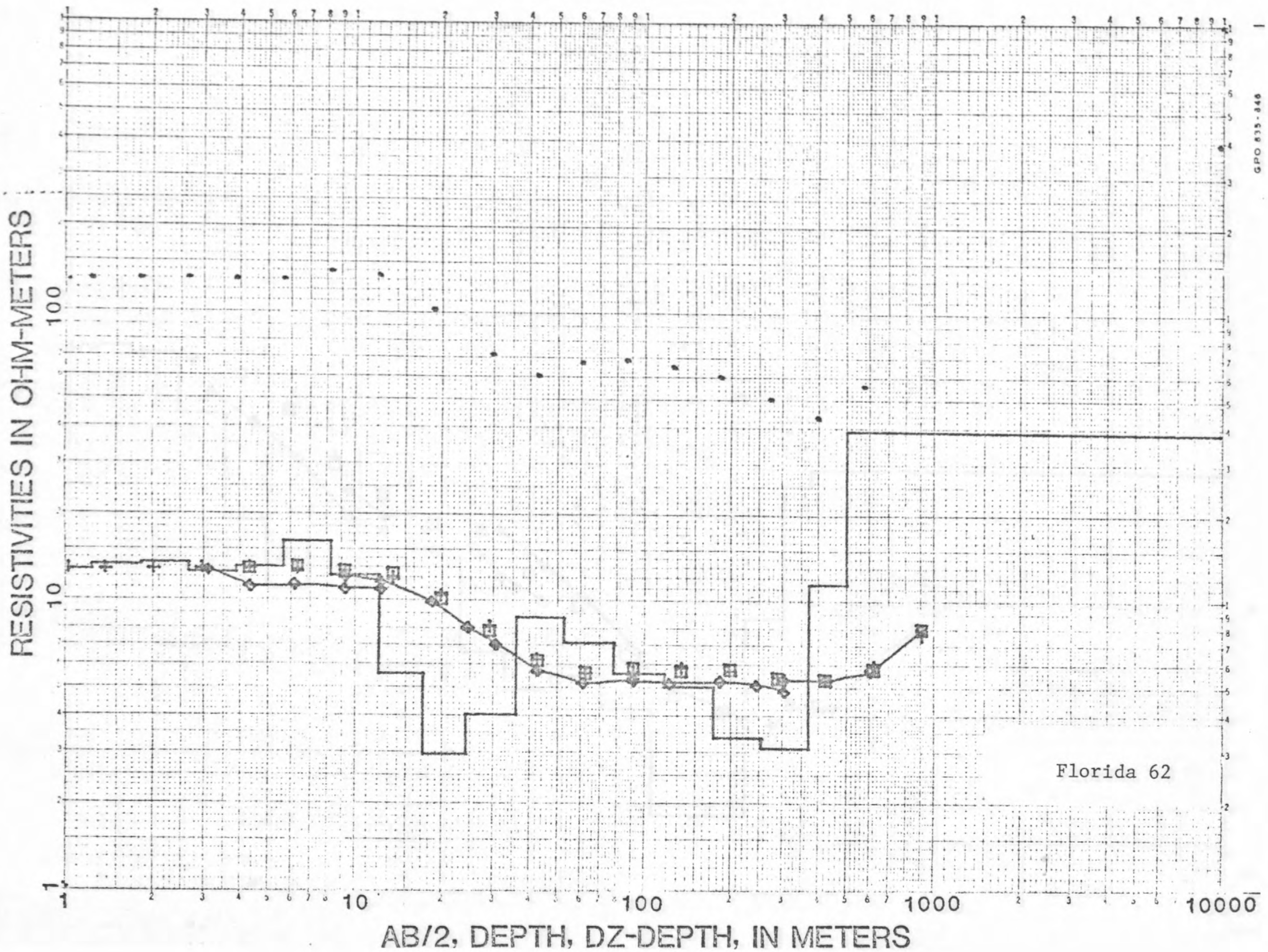

RESISTIVITIES IN OHM-METERS
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 58

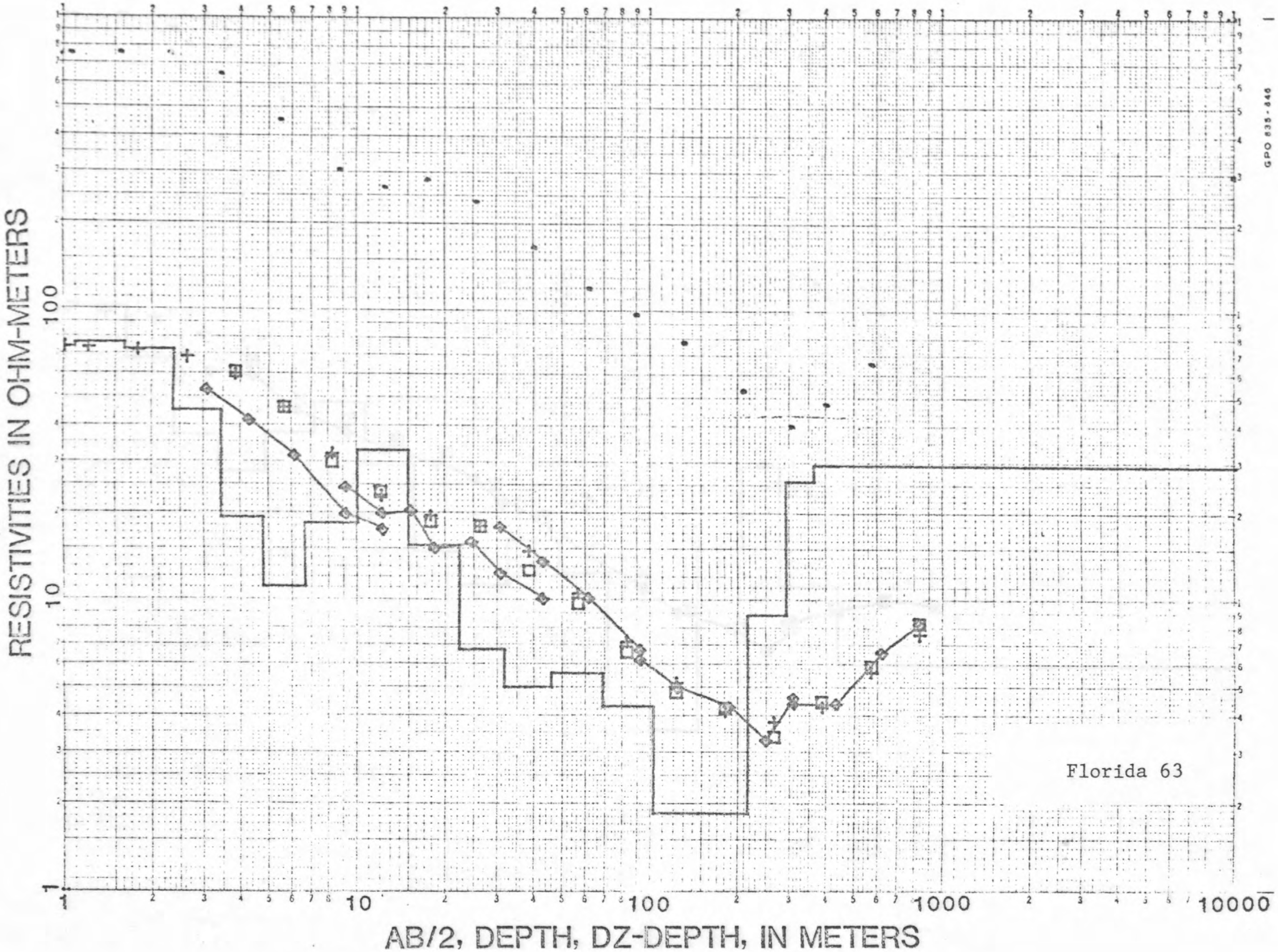


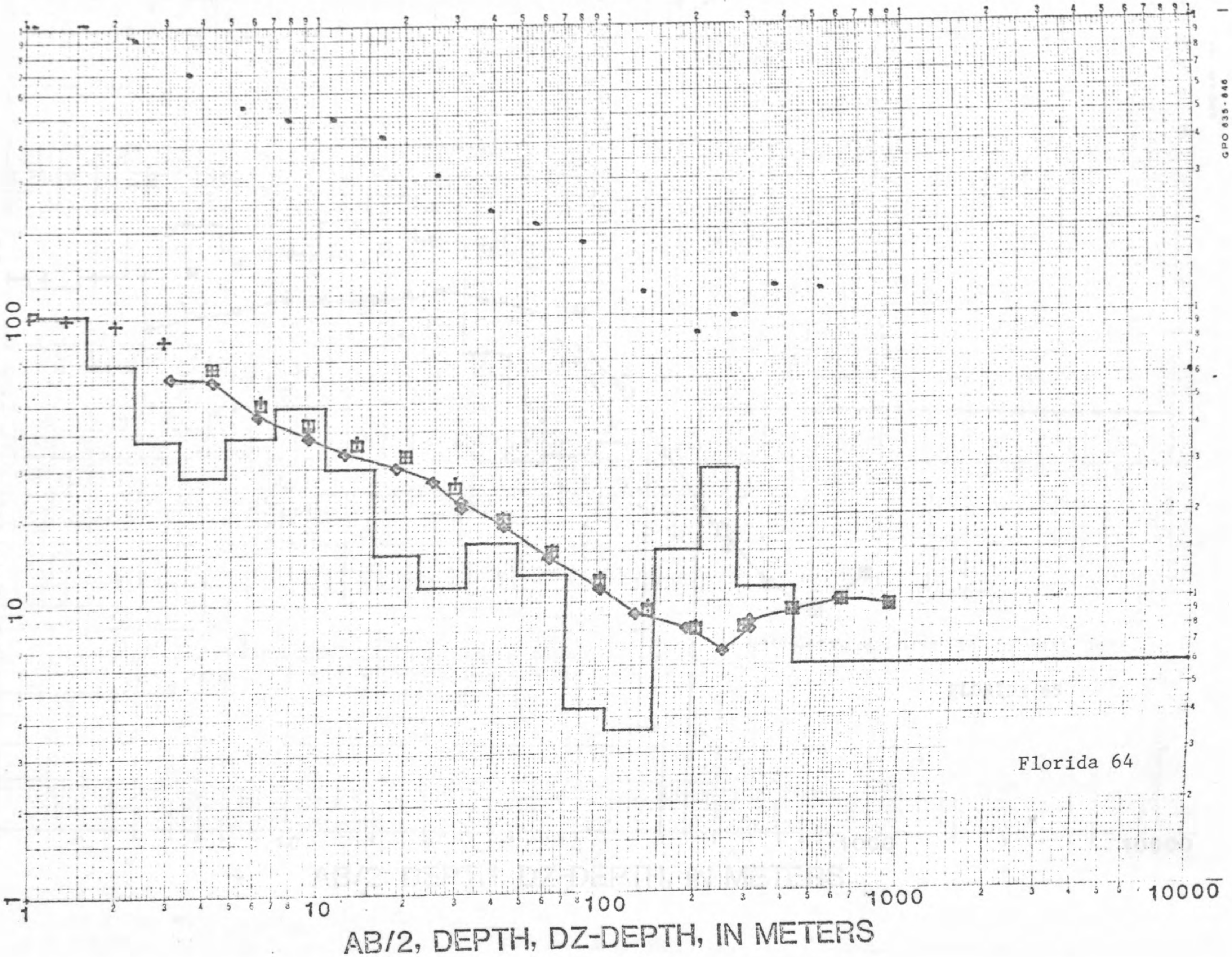
RESISTIVITIES IN OHM-METERS
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 59

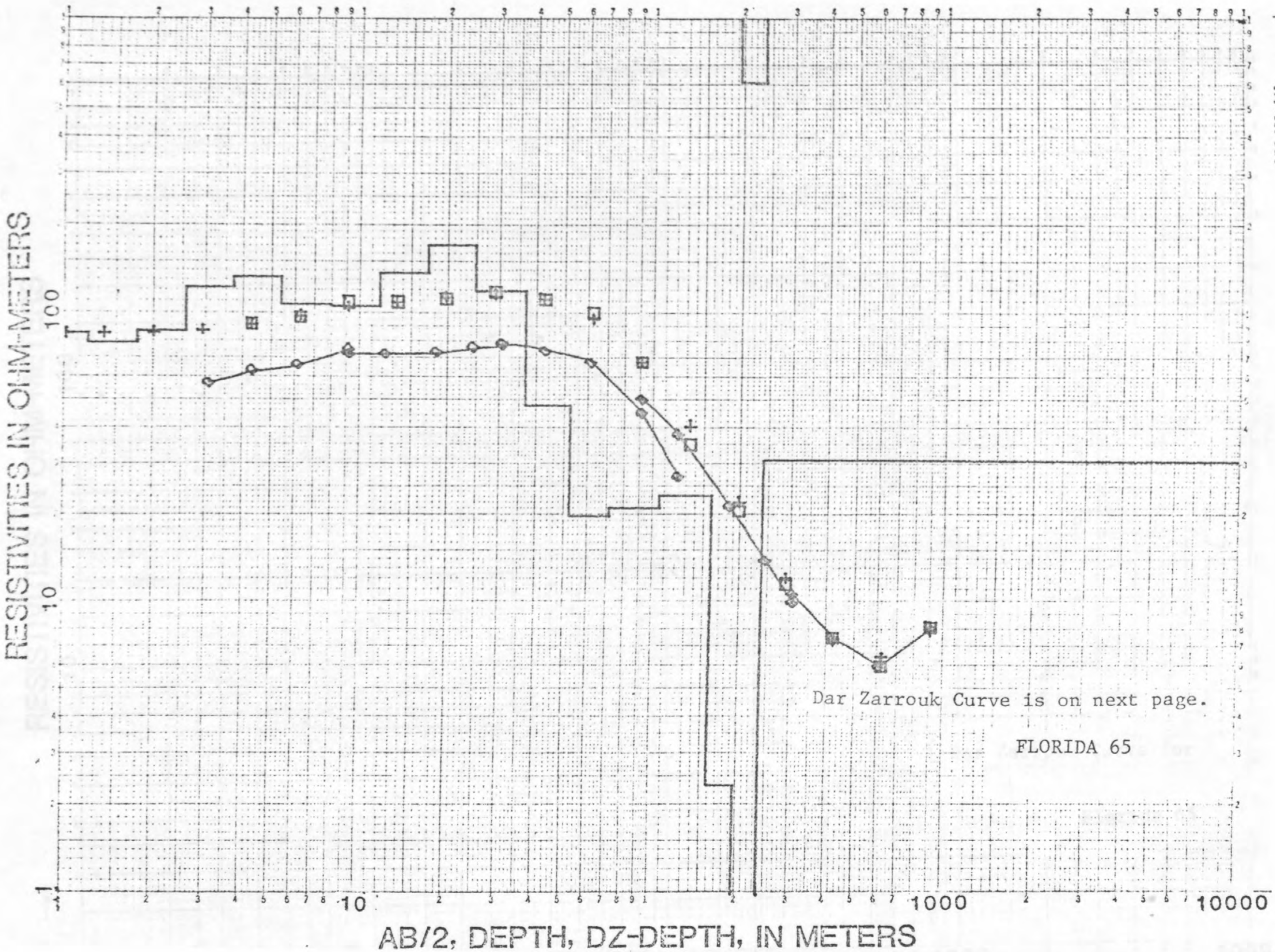

RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 60
GPO 835-845

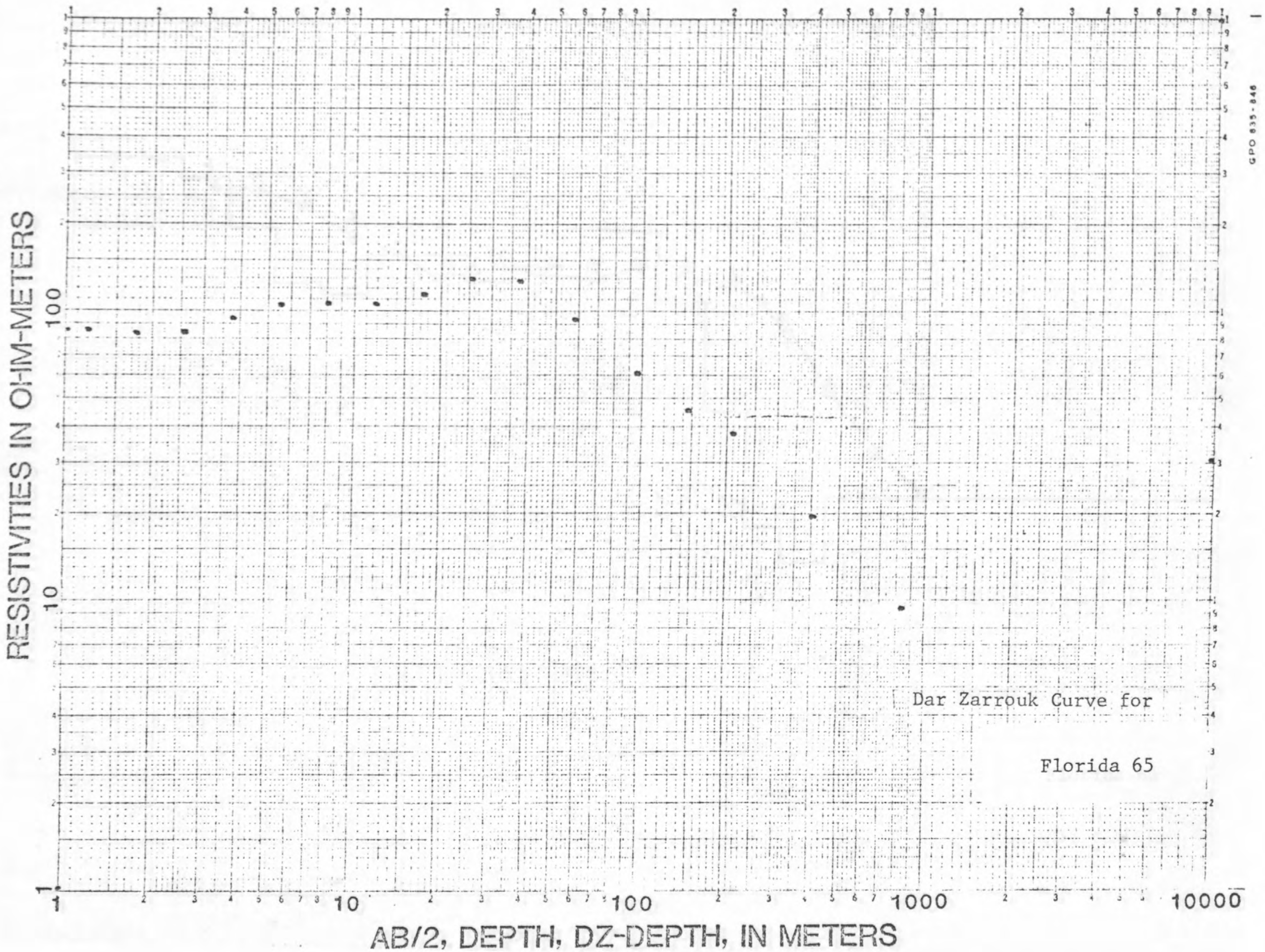

RESISTIVITIES IN OHM-METERS
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 61

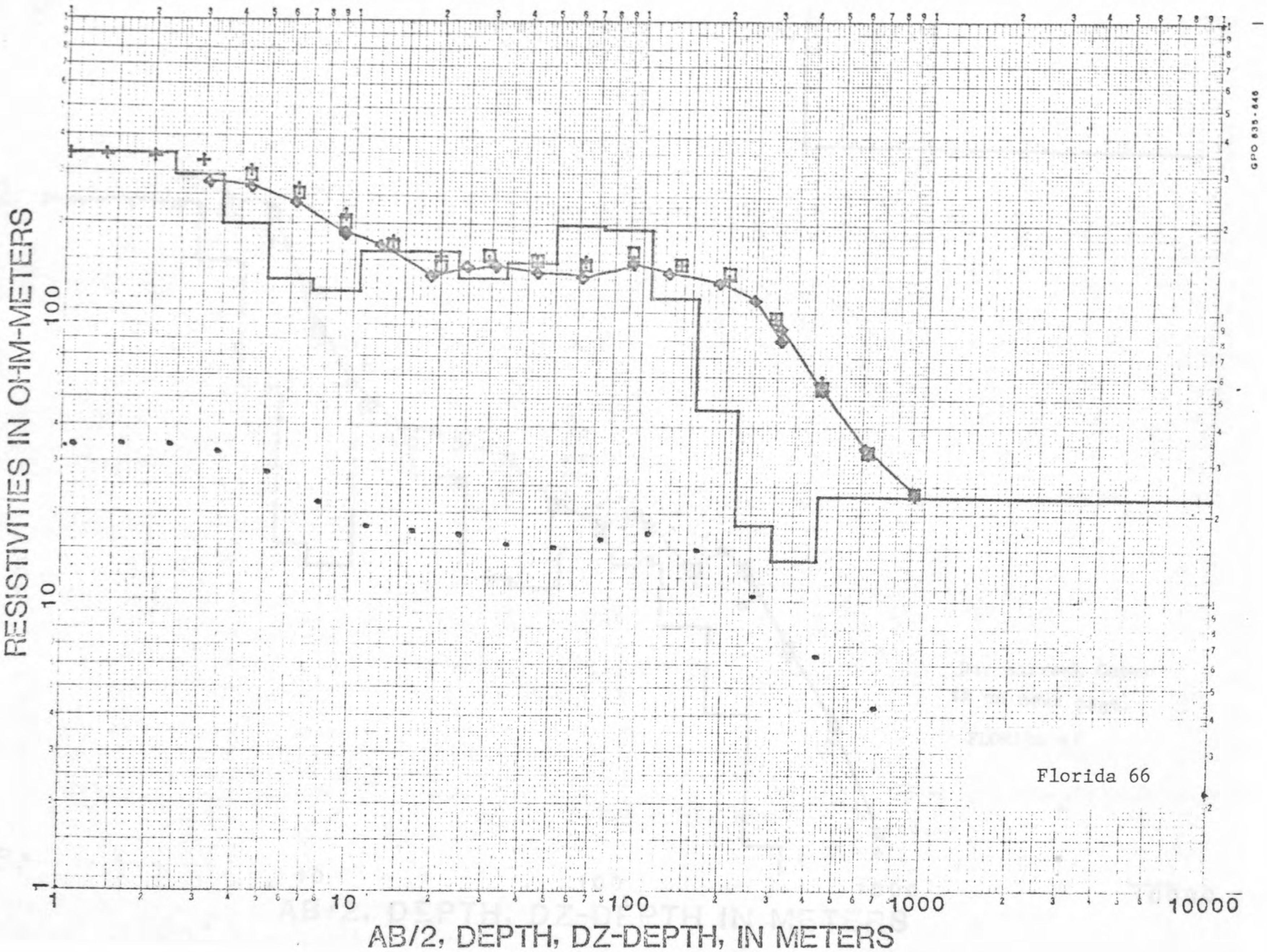

RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 62
GPO 835-846

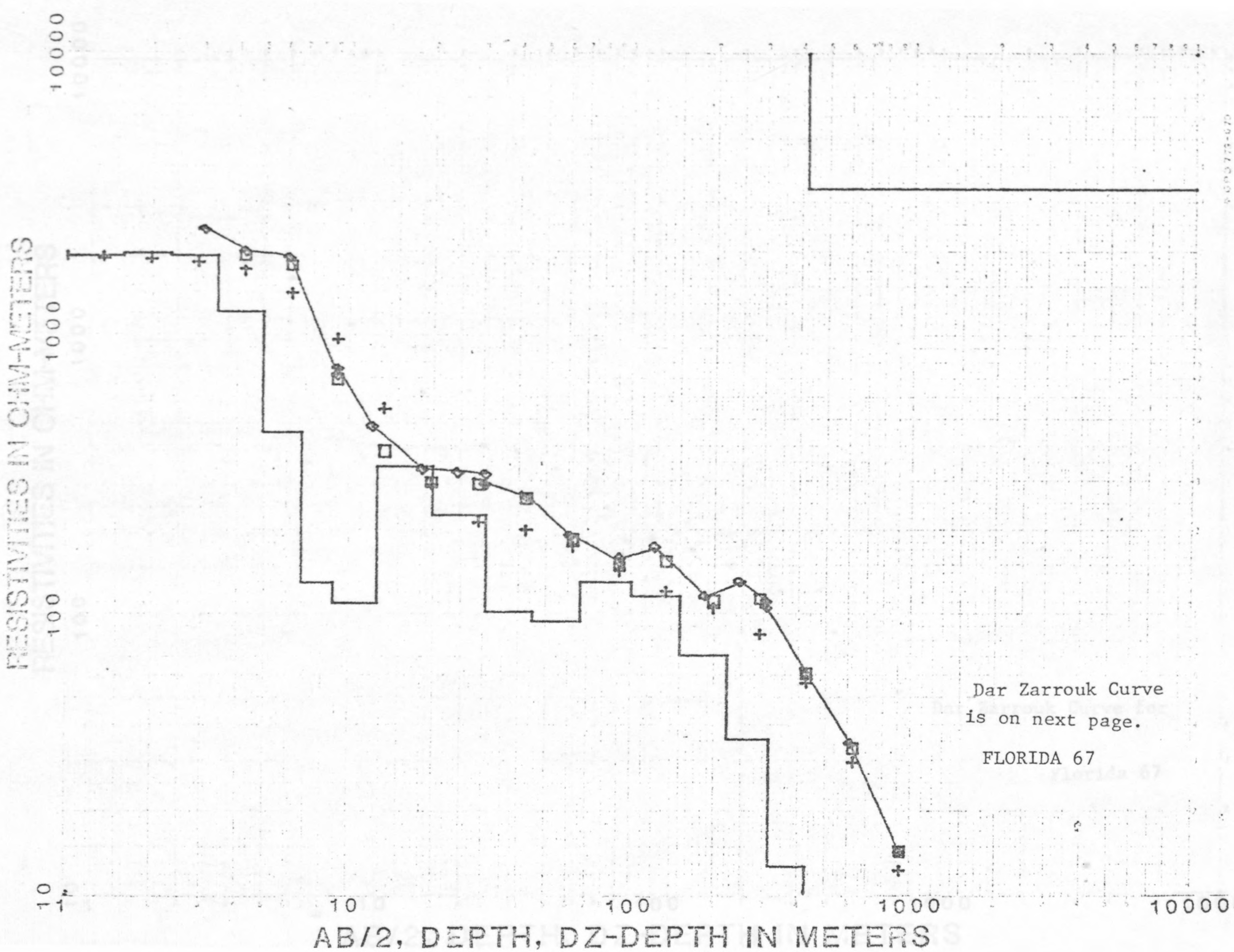

RESISTIVITIES IN OHM-METERS
1
10
100
AB/2, DEPTH, DZ-DEPTH, IN METERS
1
10
100
1000
10000
Florida 63


RESISTIVITIES IN OHM-METERS
1
10
100
AB/2, DEPTH, DZ-DEPTH, IN METERS
1
10
100
1000
10000
Florida 64
GPO 835-846

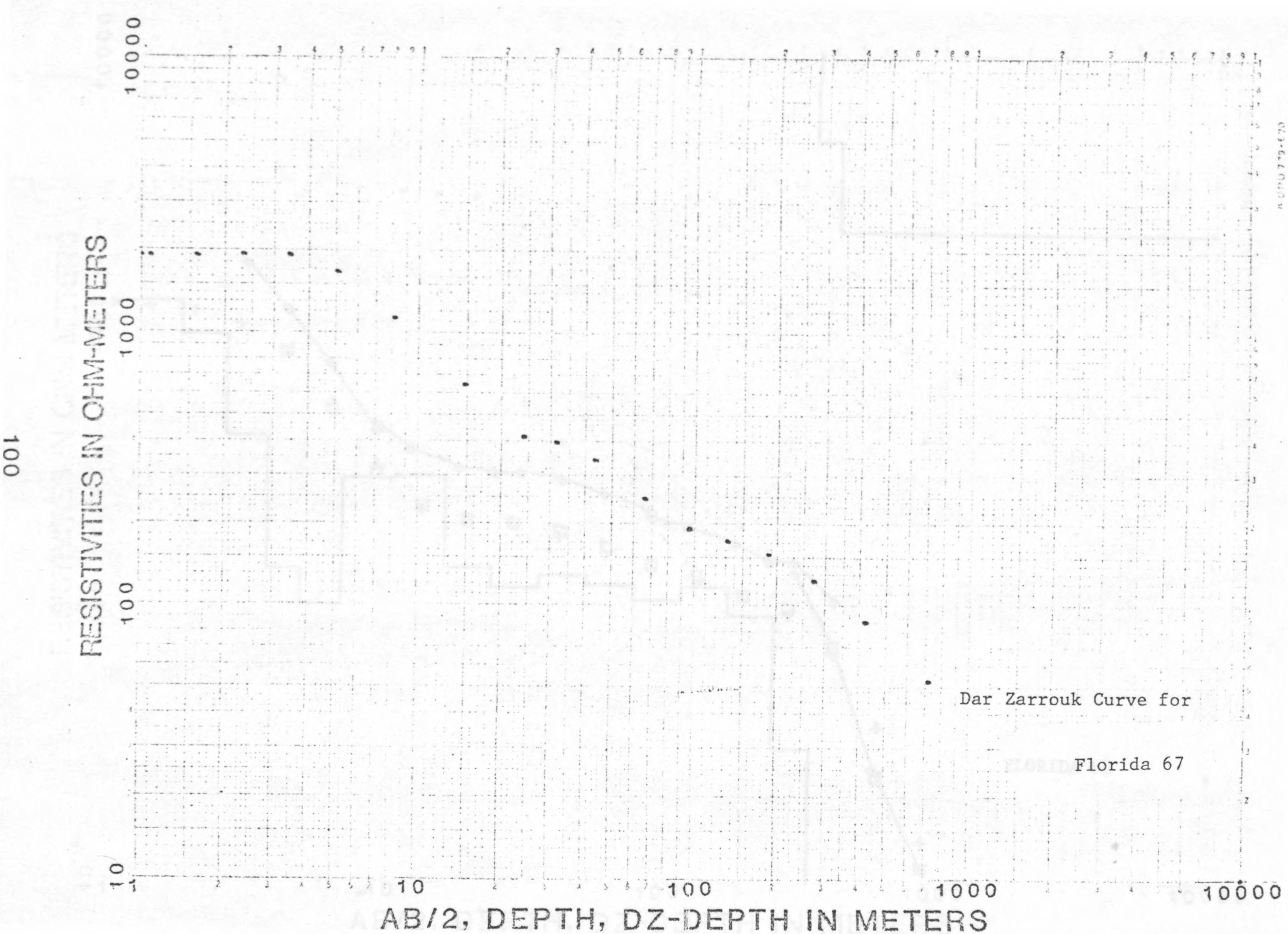

RESISTIVITIES IN OHM-METERS
100
10
1
10
1000
10000
AB/2, DEPTH, DZ-DEPTH, IN METERS
Dar Zarrouk Curve is on next page.
FLORIDA 65

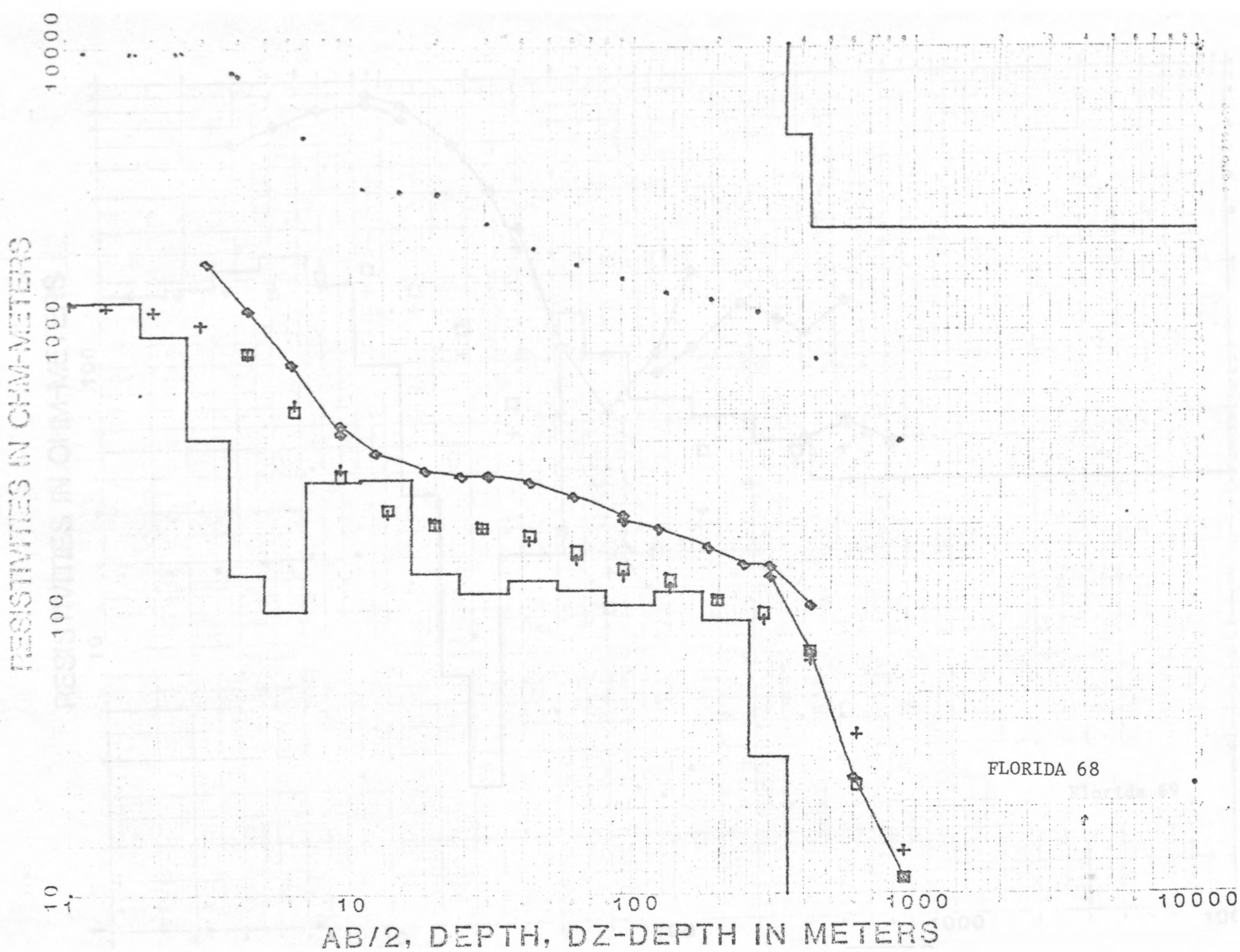

RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
1
10
100
1000
10000
Dar Zarrouk Curve for
Florida 65


RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 66
1
10
100
1000
10000
GPO 835-846

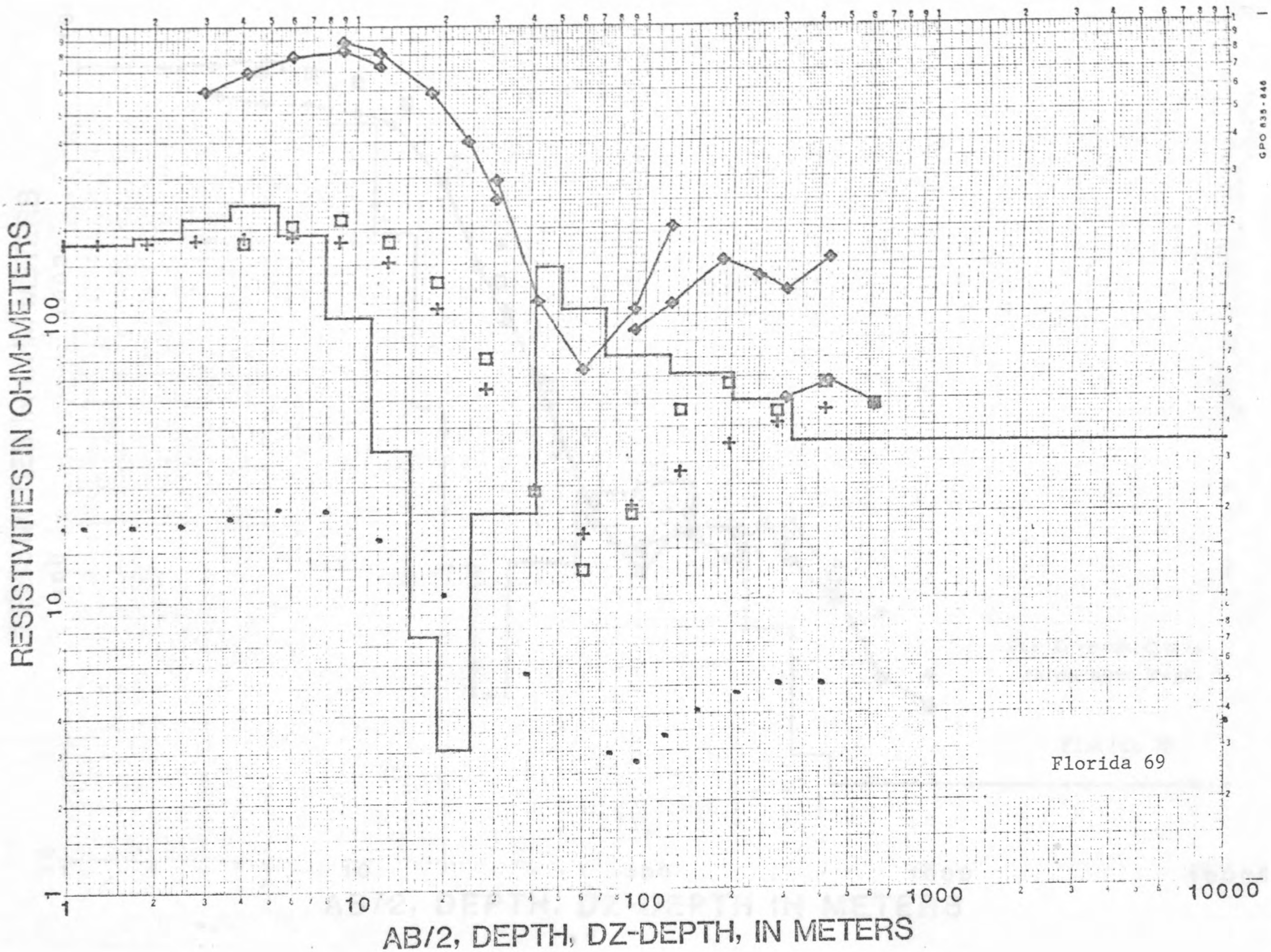


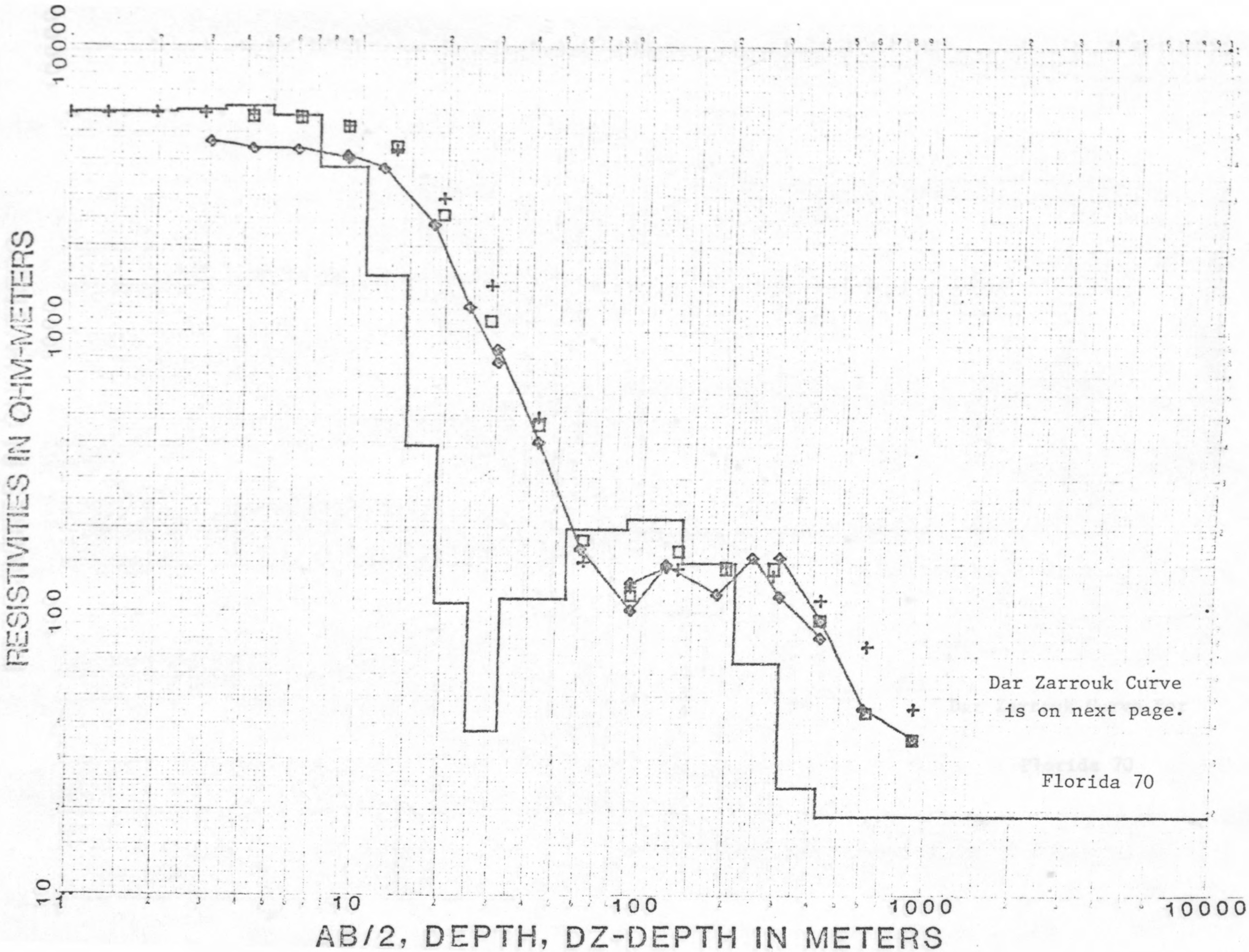
RESISTIVITIES IN OHM-METERS
10000
1000
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH IN METERS
Dar Zarrouk Curve
is on next page.
FLORIDA 67

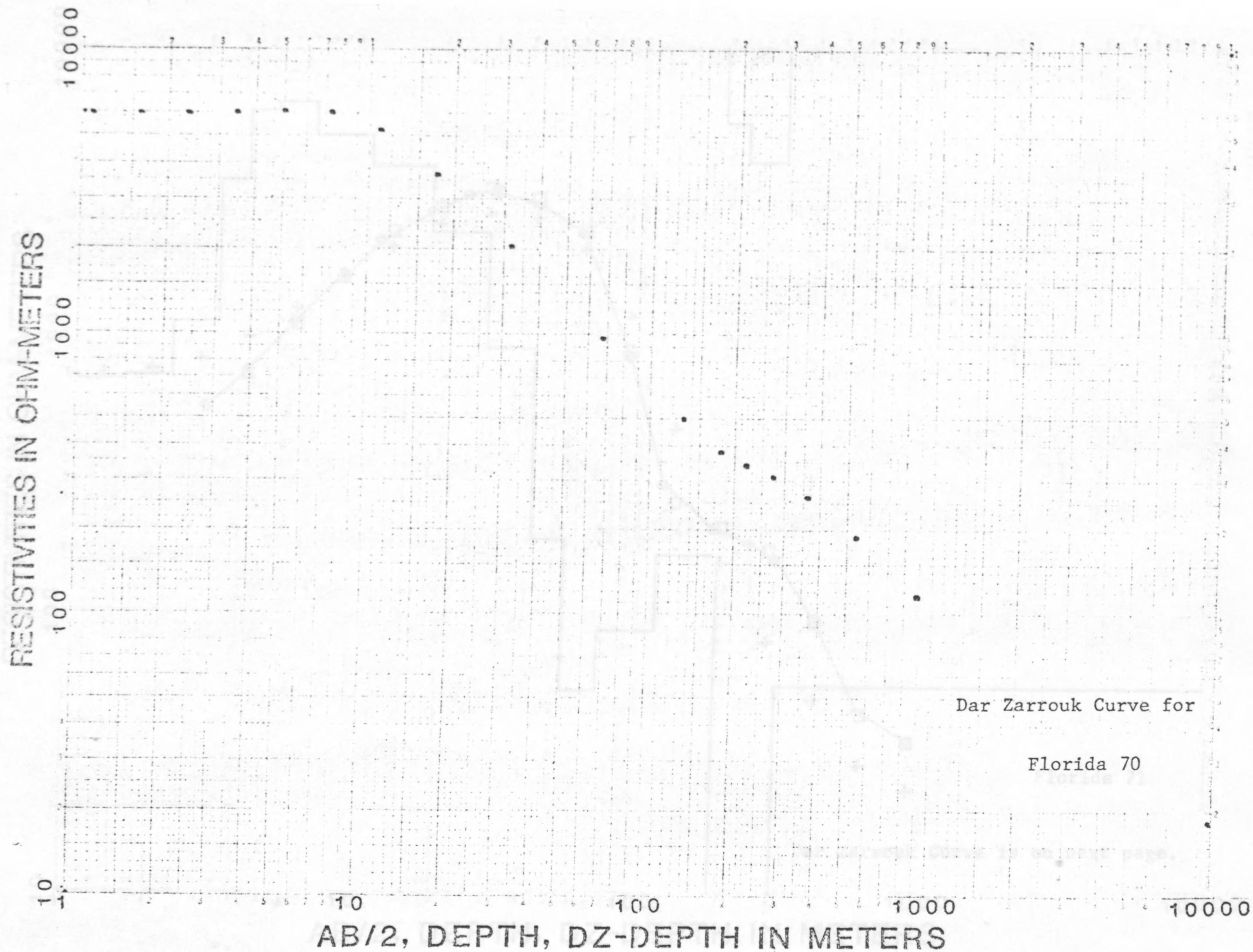

RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH IN METERS
10000
1000
100
10
1
10
100
1000
10000
Dar Zarrouk Curve for
Florida 67

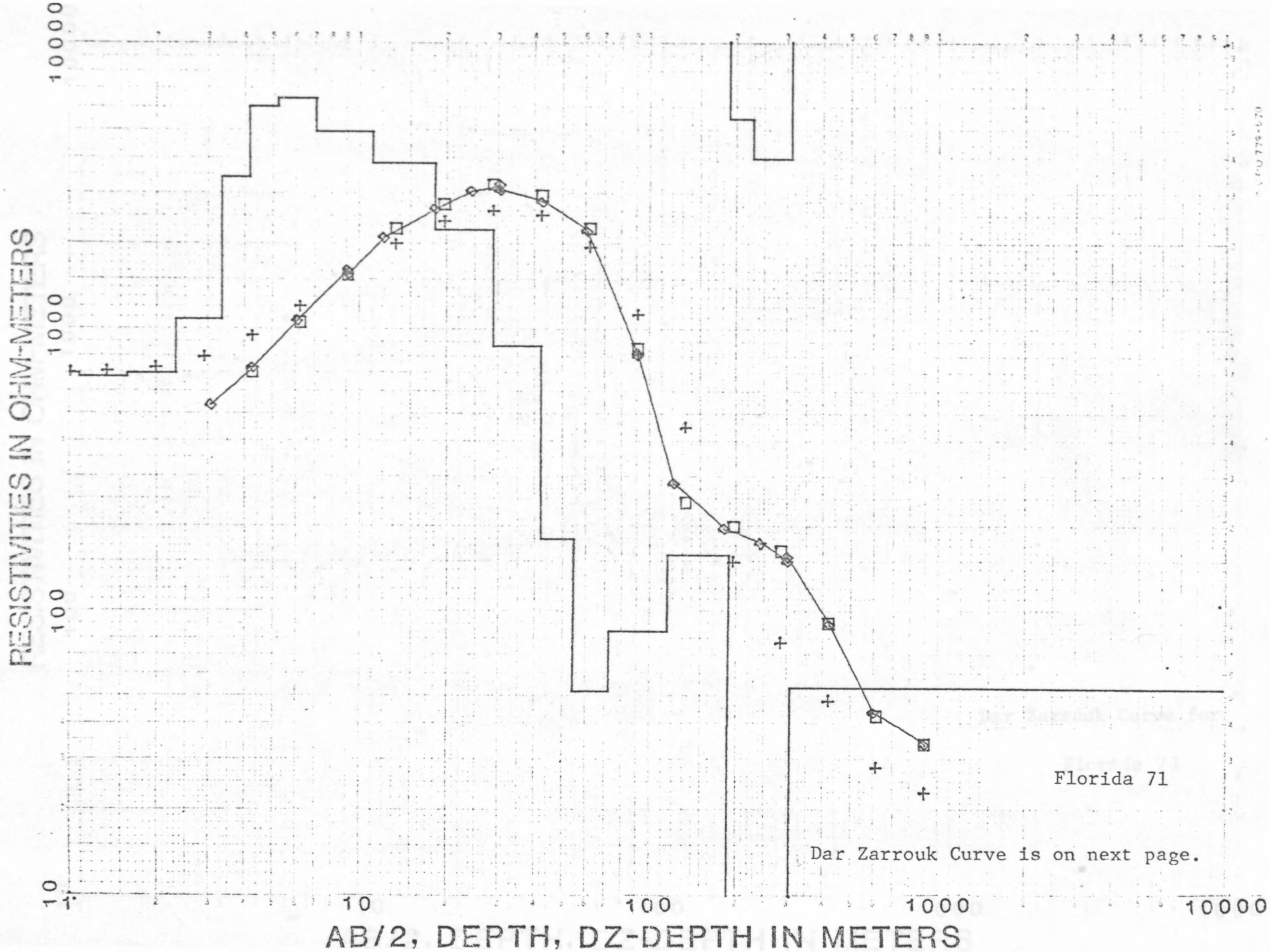


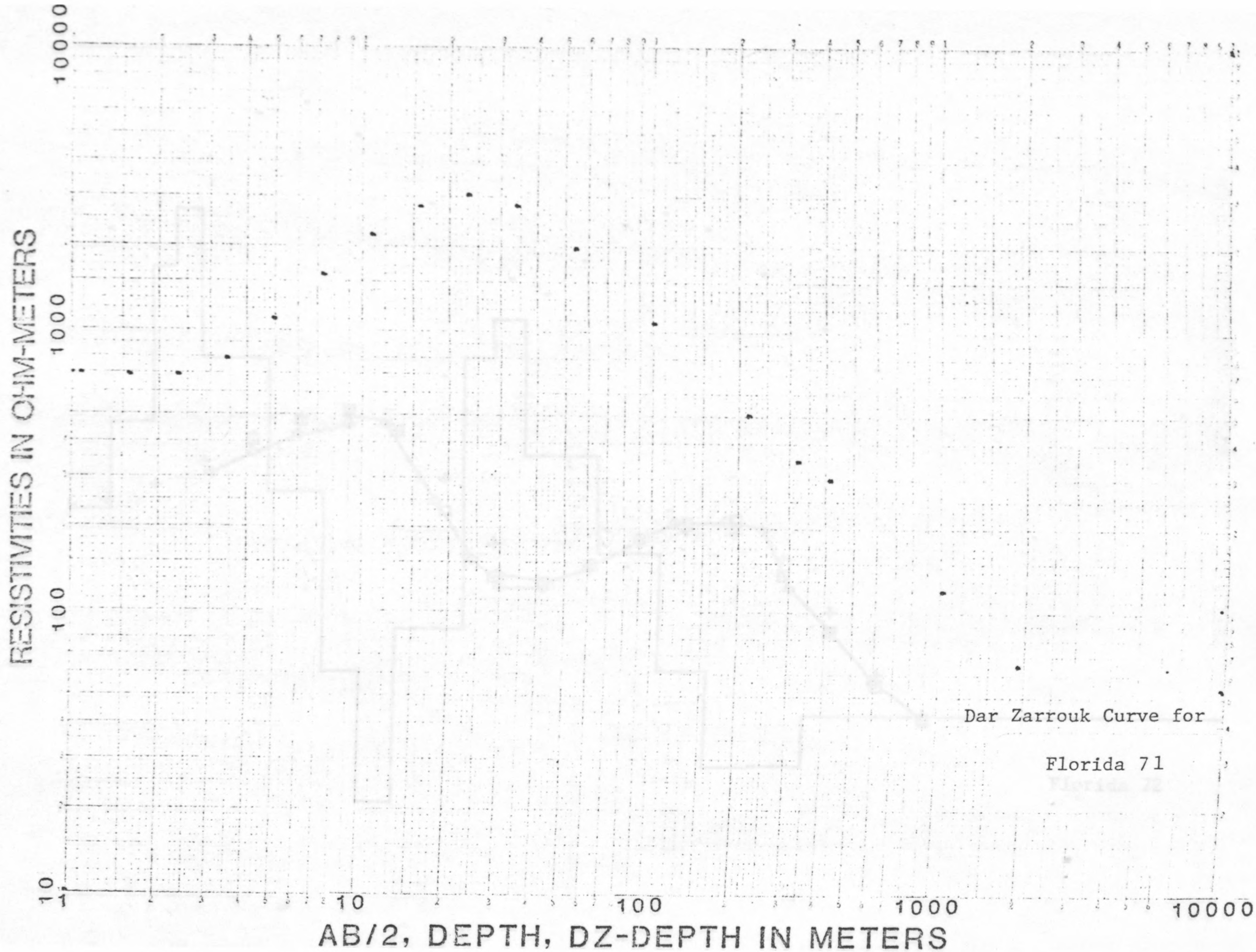
RESISTIVITIES IN OHM-METERS
10000
1000
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH IN METERS
FLORIDA 68


RESISTIVITIES IN OHM-METERS
1
10
100
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH, IN METERS
Florida 69

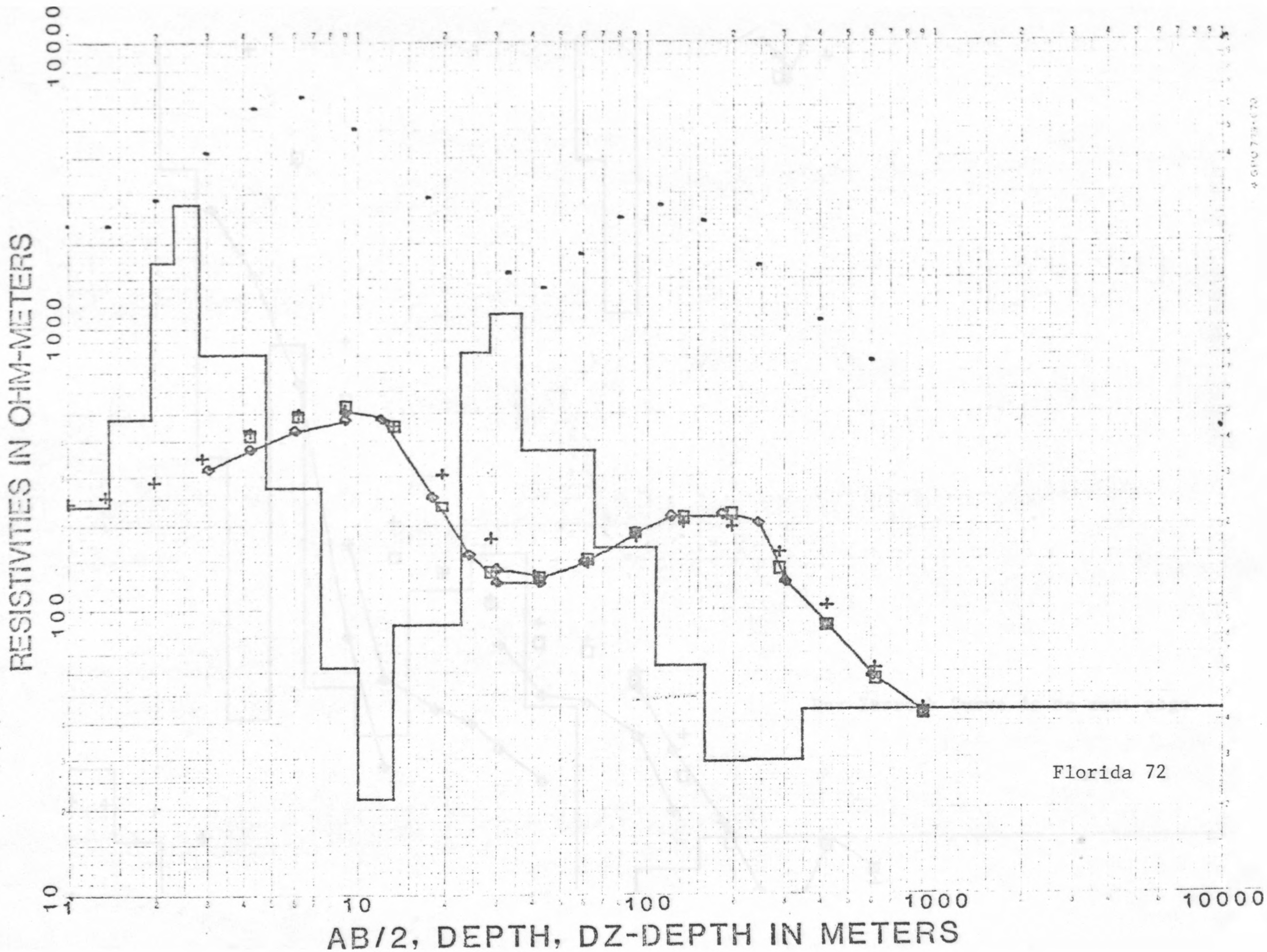

RESISTIVITIES IN OHM-METERS
10000
1000
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH IN METERS
Dar Zarrouk Curve
is on next page.
Florida 70

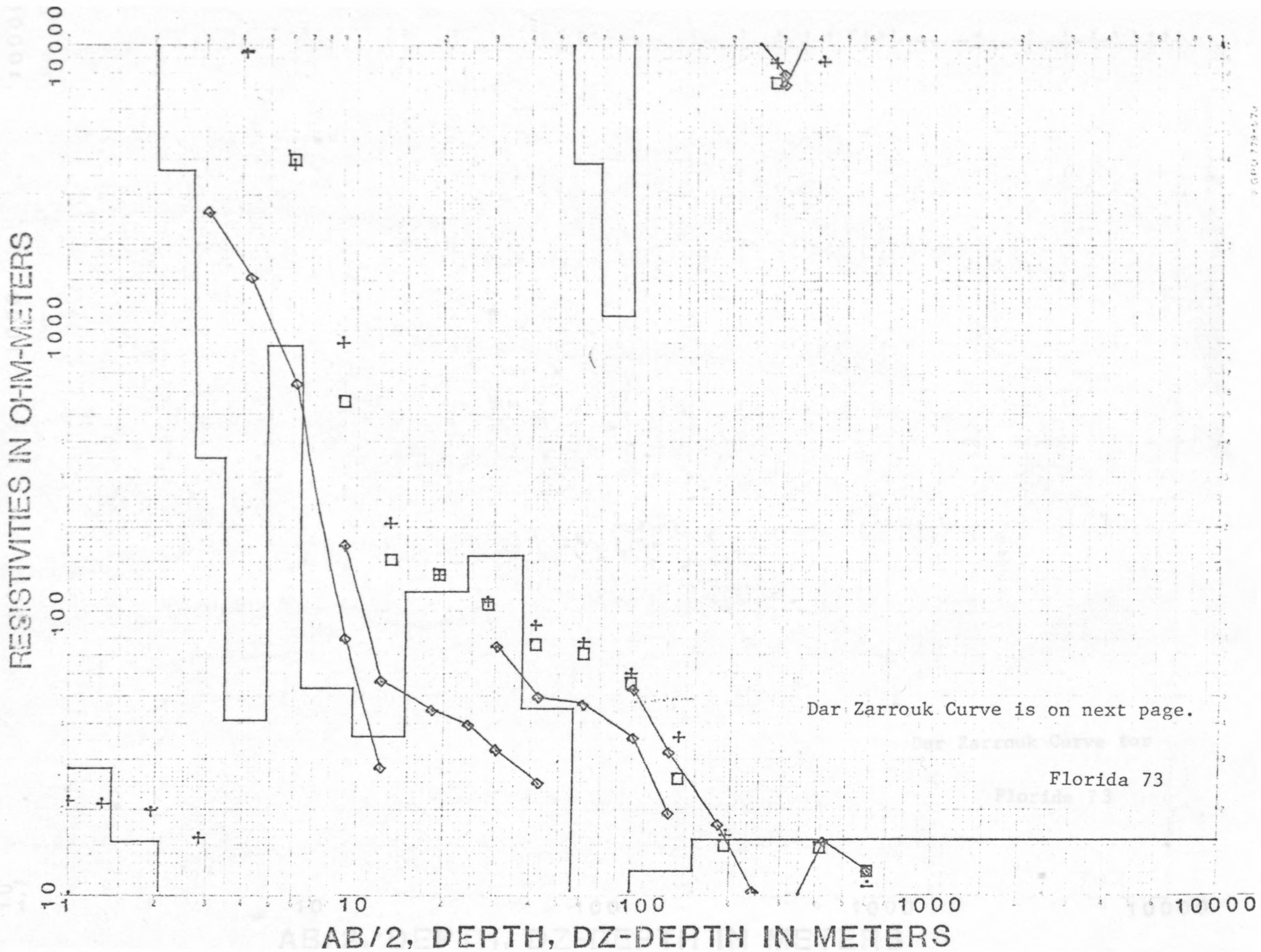

RESISTIVITIES IN OHM-METERS
10000
1000
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH IN METERS
Dar Zarrouk Curve for
Florida 70

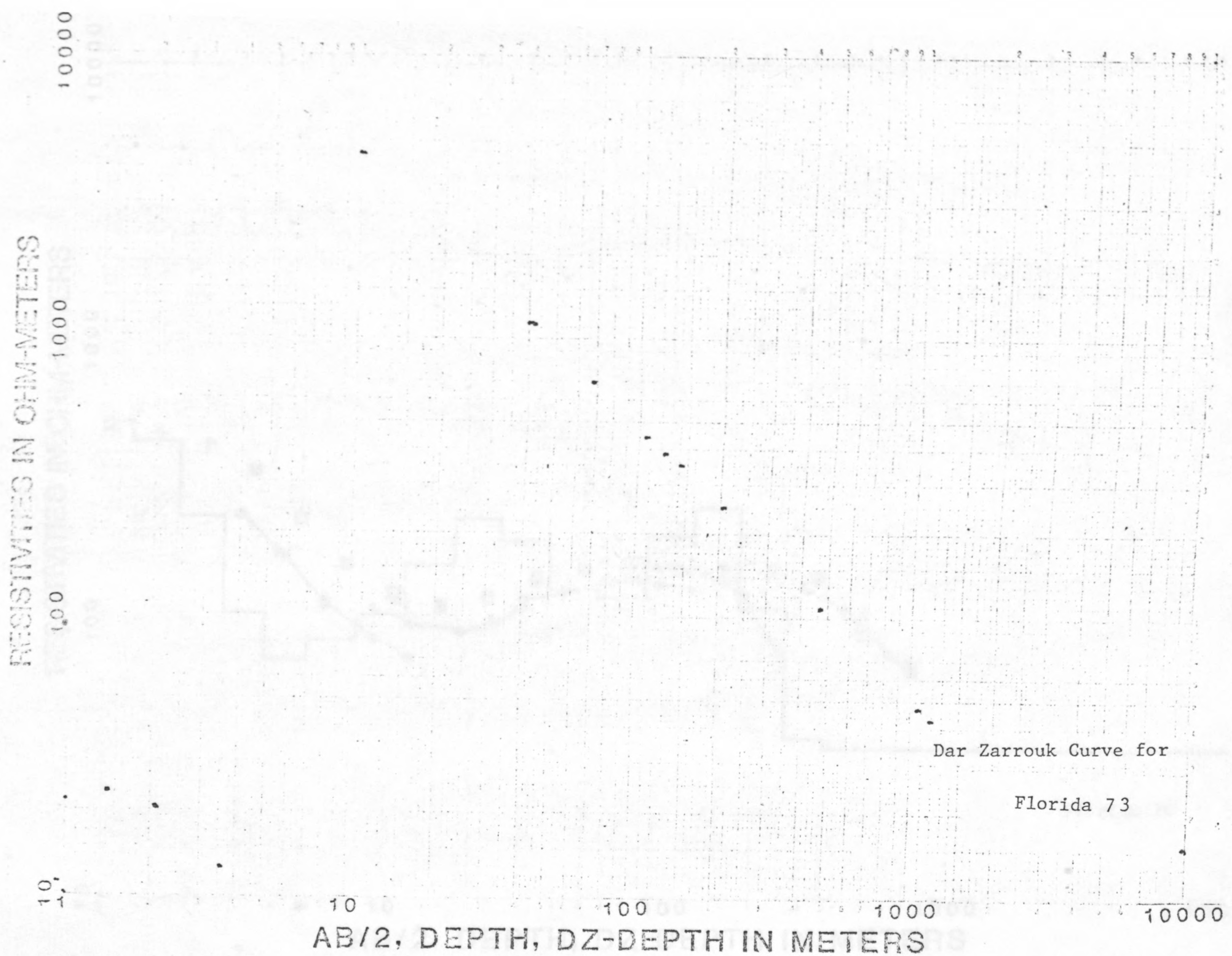

RESISTIVITIES IN OHM-METERS
10000
1000
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH IN METERS
Florida 71
Dar Zarrouk Curve is on next page.

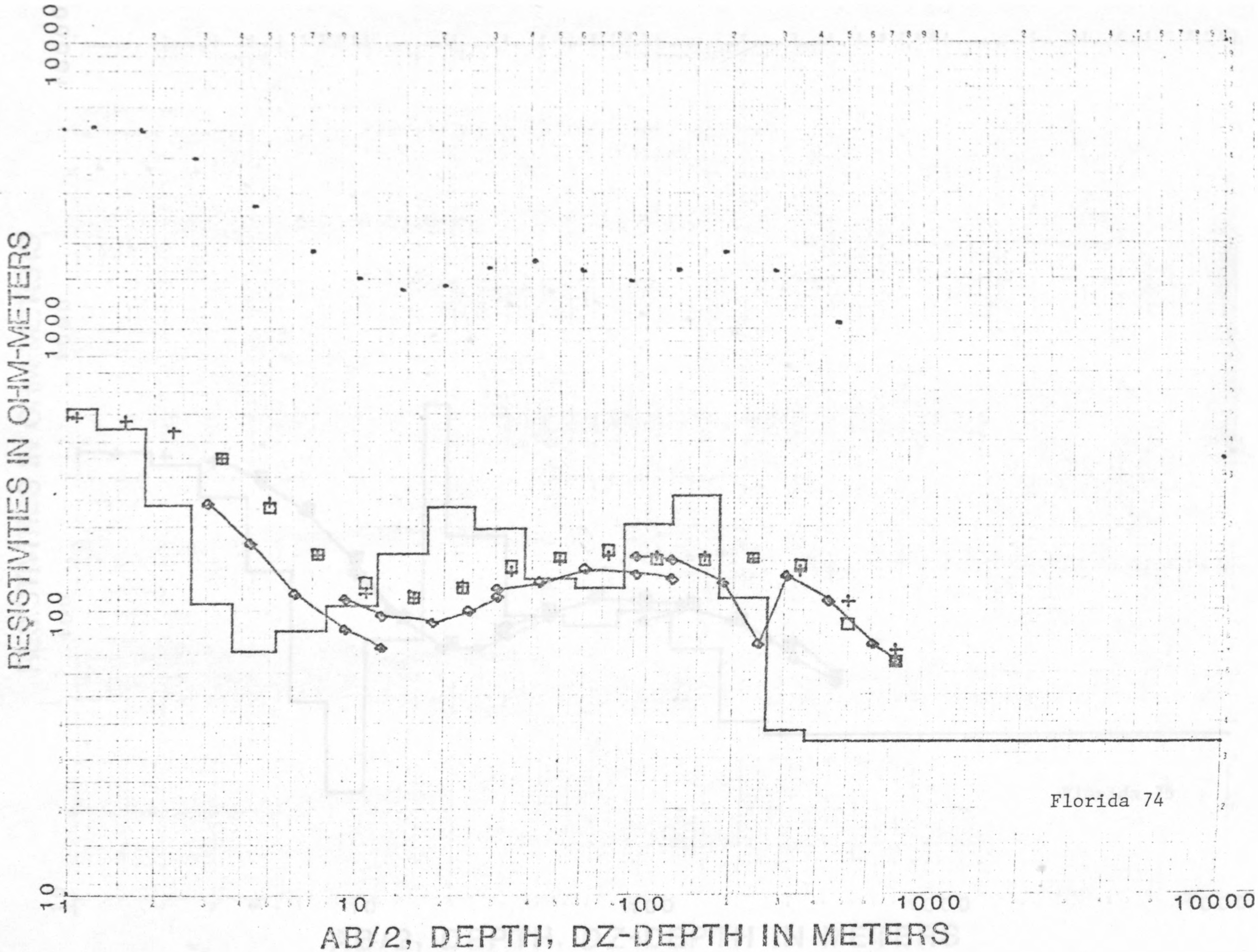


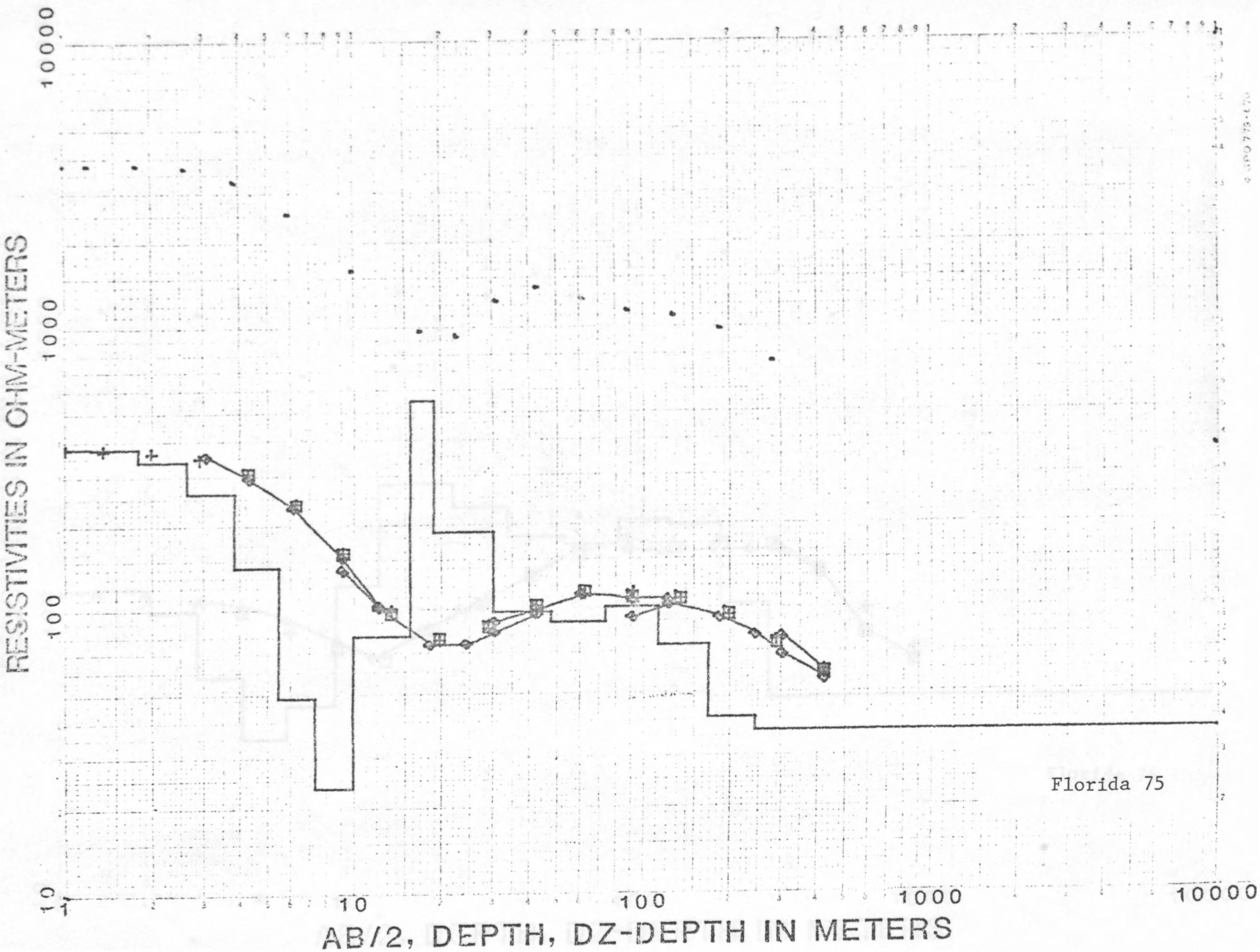
RESISTIVITIES IN OHM-METERS
10000
1000
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH IN METERS
Dar Zarrouk Curve for
Florida 71

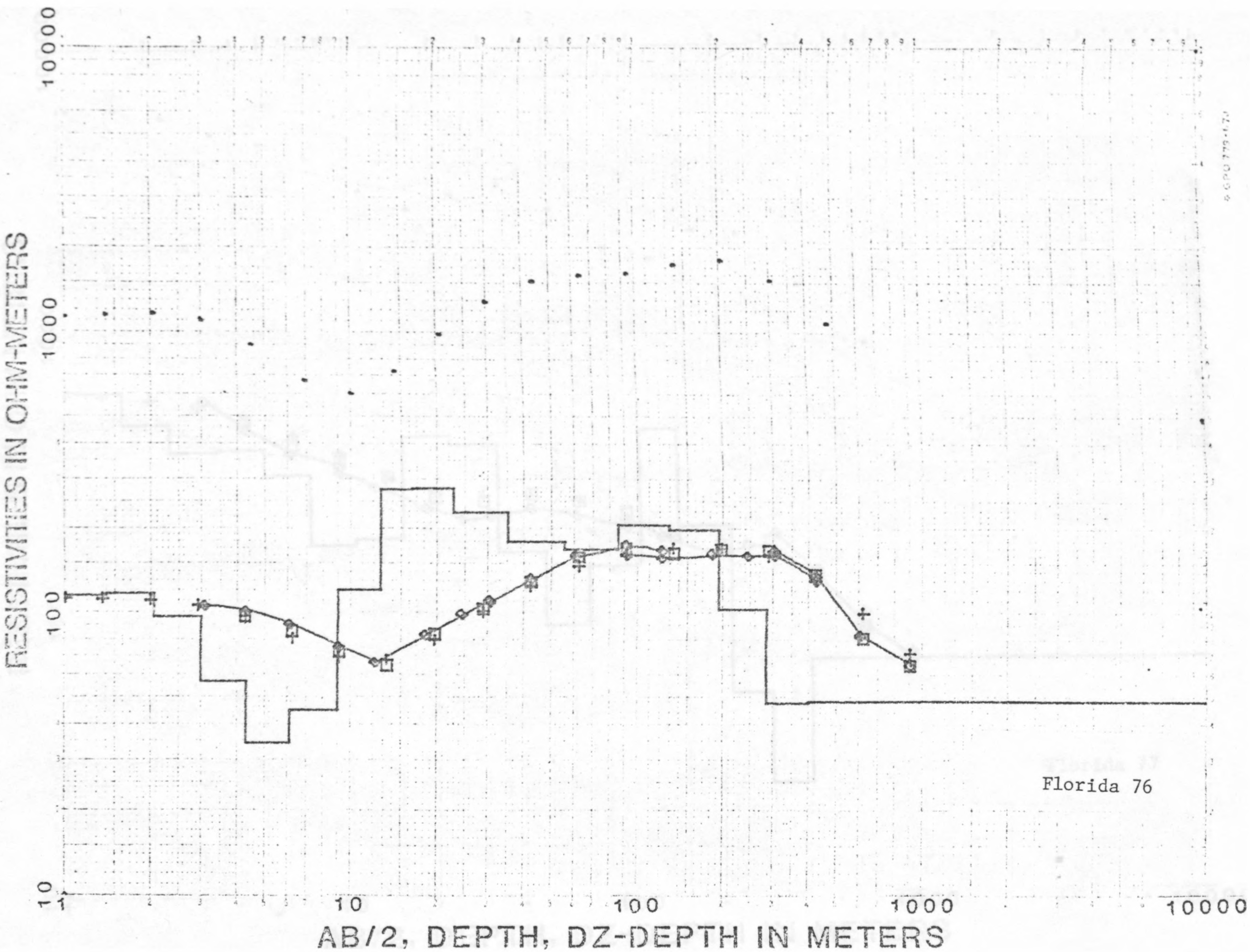

RESISTIVITIES IN OHM-METERS
10000
1000
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH IN METERS
Florida 72


RESISTIVITIES IN OHM-METERS
10000
1000
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH IN METERS
Dar Zarrouk Curve is on next page.
Florida 73

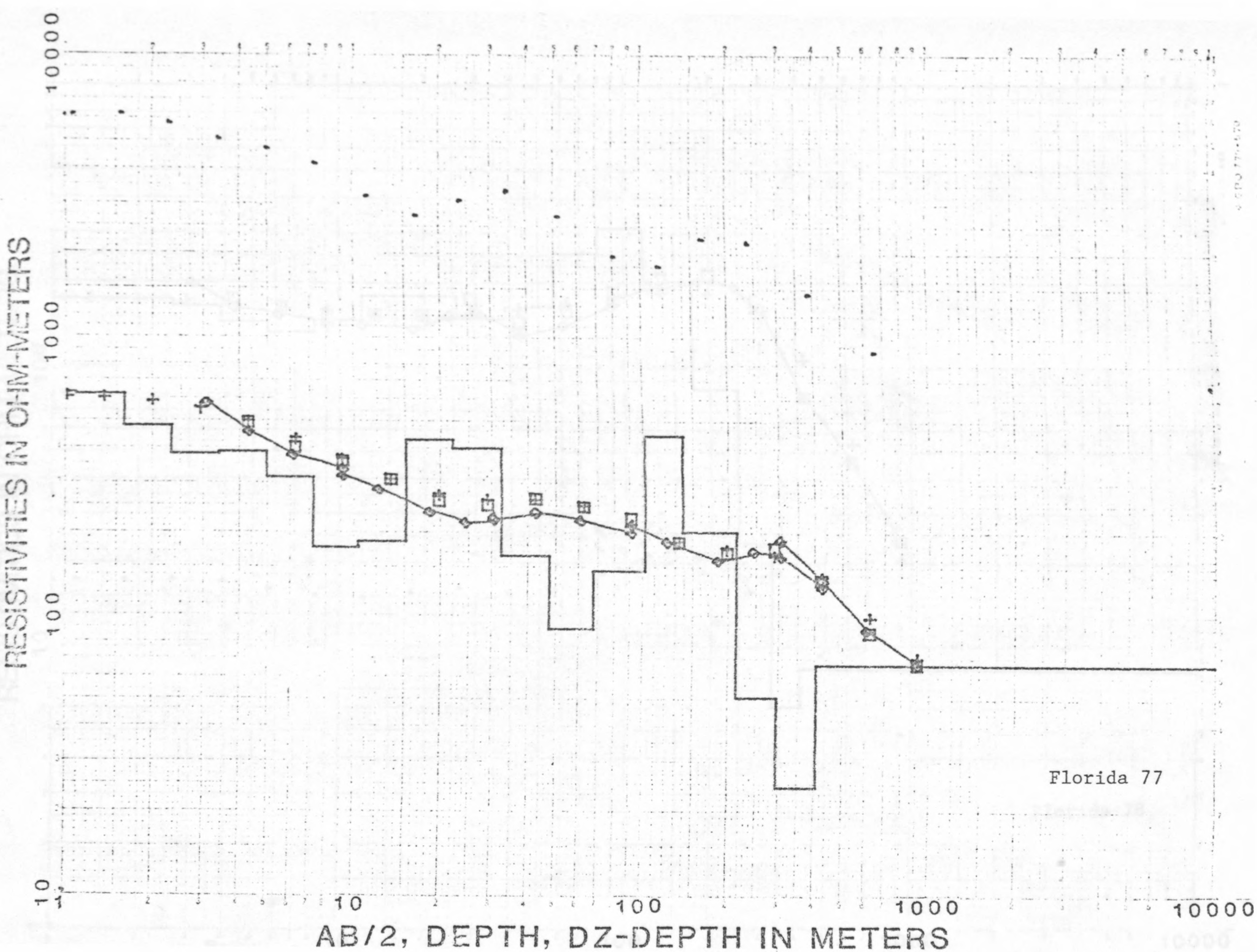

RESISTIVITIES IN OHM-METERS
10000
1000
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH IN METERS
Dar Zarrouk Curve for
Florida 73

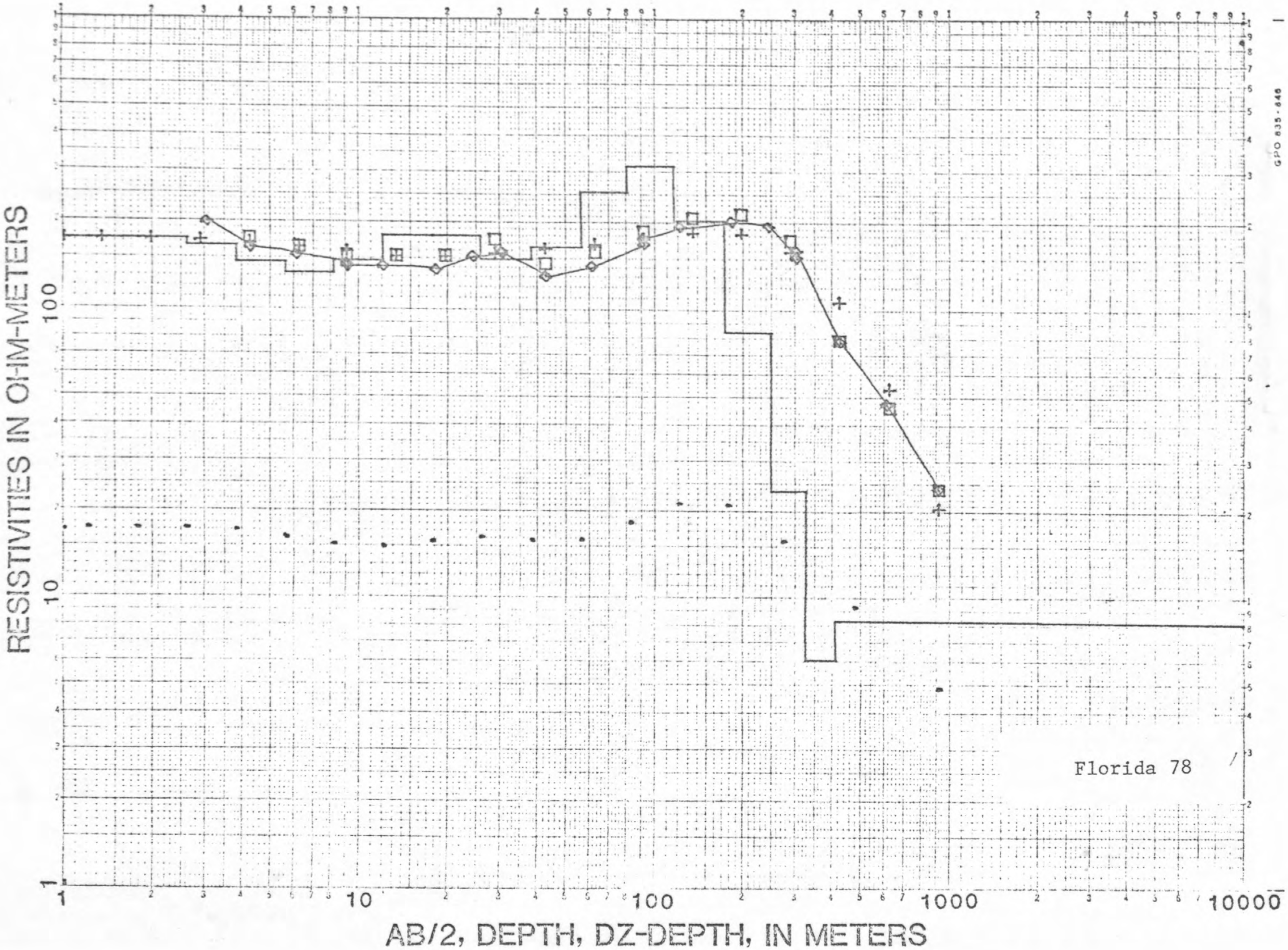

RESISTIVITIES IN OHM-METERS
10000
1000
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH IN METERS
Florida 74


RESISTIVITIES IN OHM-METERS
10000
1000
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH IN METERS
Florida 75



RESISTIVITIES IN OHM-METERS
10000
1000
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH IN METERS
Florida 76


RESISTIVITIES IN OHM-METERS
10000
1000
100
10
1
10
100
1000
10000
AB/2, DEPTH, DZ-DEPTH IN METERS
Florida 77


RESISTIVITIES IN OHM-METERS
AB/2, DEPTH, DZ-DEPTH, IN METERS
1
10
100
1000
10000
Florida 78