DIRECT CURRENT RESISTIVITY INVESTIGATION OF GROUNDWATER IN THE LOWER MESILLA VALLEY, NEW MEXICO AND TEXAS.

by

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ABSTRACT

The Lower Mesilla Valley, New Mexico and Texas, lies in the north-western part of Texas and the south-eastern part of New Mexico. A direct current resistivity survey comprised of 65 Schlumberger soundings was made by the USGS over an area of about 360 square kilometers to look for water and to evaluate the quality of that water. Minimum interpretation of the sounding curves was previously made by the USGS using an old interpretation program that occasionally created undesirable thin layers. Neither cross-sections nor maps were published.

The Schlumberger sounding curves were interpreted using a newer automatic interpretation program and then 6 color cross-sections and 8 color maps of interpreted resistivity at different depths were made using another computer program. Both programs were developed and published by the USGS. These cross-sections and maps were edited and annotated using a commercial program.

The field Schlumberger sounding curves were generally good quality curves. However, few sounding curves were affected by lateral geologic inhomogeneities and others may have been distorted by man-made objects. The interpreted resistivity sounding curves, cross-sections, and maps show a clear picture of the probable location of the water table, the water quality, and the possible geological structures in the studied area. The water quality in the studied area changes both areally and with depth. Materials with high resistivities (150 to > 300 ohm-m) probably represent dry alluvial fan deposits of sand, gravel, and cobbles. Materials with medium resistivities (70 to 150 ohm-m) may represent sedimentary deposits of coarse sand and gravel saturated with water of very good quality (total dissolved solids may be <500 mg/l). Materials with medium resistivities (30 to 70 ohm-m) may represent basin fill deposits composed of sand and gravel mixed with some clay and probably saturated with water of good quality (total

dissolved solids may be <1000 mg/l). Materials with low resistivities (10 to 30 ohm-m) may represent sedimentary deposits with a medium percentage of clay mixed with sand and gravel and saturated with good quality water. Materials with very low resistivities (3 to <10 ohm-m) probably represent sedimentary deposits with a very high percentage of clay (possibly saturated with good quality water) or may represent sand and gravel deposits saturated with brackish to saline water (total dissolved solid of 1000 to 10,000 mg/l).

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Last but not least my very special thanks to my parents who have given me their love since the first day of my life.

INTRODUCTION

With increasing dependence of the cities of El Paso, Conutillo, and Anthony, Texas, on ground water for public supply, industrial and irrigation use, research and exploration were needed to find new supplies of good quality water for those areas. In 1976, the USGS made a geophysical survey using the direct current resistivity method in the southern part of Mesilla Valley, New Mexico and Texas (Zohdy et al, 1976). The survey area extend from the town of Anthony, in the north, to the gorge of the Rio Grand river about 6 miles north west of El Paso, in the south. In general, the studied area covered the north-western part of Texas and the south-eastern part of New Mexico. The area is located between longitudes $106^{\circ}\ 30'$ W and $106^{\circ}\ 45'$ W and between latitudes $32^{\circ}\ 00'$ N and $31^{\circ}\ 45'$ N (see figure 1). The towns of Anthony and Canutillo are located near the east edge of Mesilla Valley in Texas. The valley is served by the Santa Fe Railway, by U.S. Highway 80, and by many county roads (Leggat et al, 1963).

The lower Mesilla Valley is cut into the unconsolidated deposits of the La Mesa bolson. The steep-walled valley slopes at the rate of 4.4 feet per mile from the town of Anthony to the gorge of the Rio Grande river. The relatively level valley floor ranges in width from less than a thousand feet at the gorge of the Rio Grand river to 4.5 miles at Anthony (Leggat et al, 1963). At the south of the valley, the Rio Grand river flows through a narrow gorge between the Franklin Mountains, which form the eastern boundary of the valley, and the Cerro de Muleros, a conical hill. The highest peak of the Franklin Mountains is about 3,400 ft above the Rio Grand river flood plain and the highest point of the Cerro de Muleros rises about 845 ft above the Rio Grand river (Leggat et al, 1963). The La Mesa surface is a board plain extends as a nearly unbroken surface from Las Cruces, New Mexico, southward into Mexico.

The direct current resistivity sounding method was specifically applied in the search for fresh ground water in the lower Mesilla Valley, New Mexico and Texas. A total of sixty five Schlumberger soundings were made by the United States Geological Survey (USGS) over an area of about 360 square kilometers (Zohdy et al, 1976). The maximum expansion of the current electrode spacings, AB/2, reached up to 8000 ft (2438 m) for some soundings. The original field sounding data were published in a USGS Open-File report (Zohdy et al, 1976) with a minimum interpretation based on using an old automatic interpretation program (Zohdy, 1973, 1975), but neither maps nor cross-sections of interpreted resistivity were published. The old program (Zohdy, 1973, 1975) was based on using modified Dar Zarrouk functions and occasionally generated undesirable thin layer which are mathematically acceptable but geologically unnecessary. In this thesis, I reinterpreted these sounding curves using a new automatic interpretation program (Zohdy, 1989; Zohdy and Bisdorf, 1989) which creates more realistic layering models, and I constructed several interpreted-resistivity cross-sections and several maps of interpreted resistivity at different depths. These cross-sections and maps are further interpreted as they relate to the water quality and geologic structures in that area. Such results in terms of layer thickness and probable lithology are useful to hydrologists in constraining the thickness and hydraulic conductivity parameters in modeling ground water flow.

The interpretation of the Schlumberger soundings using the old interpretation program (Zohdy, 1973) was used by Gates et al (1984) in a preliminary study of the aquifers in the studied area. The new interpretations presented in this thesis may offer better model constraints for future studies.

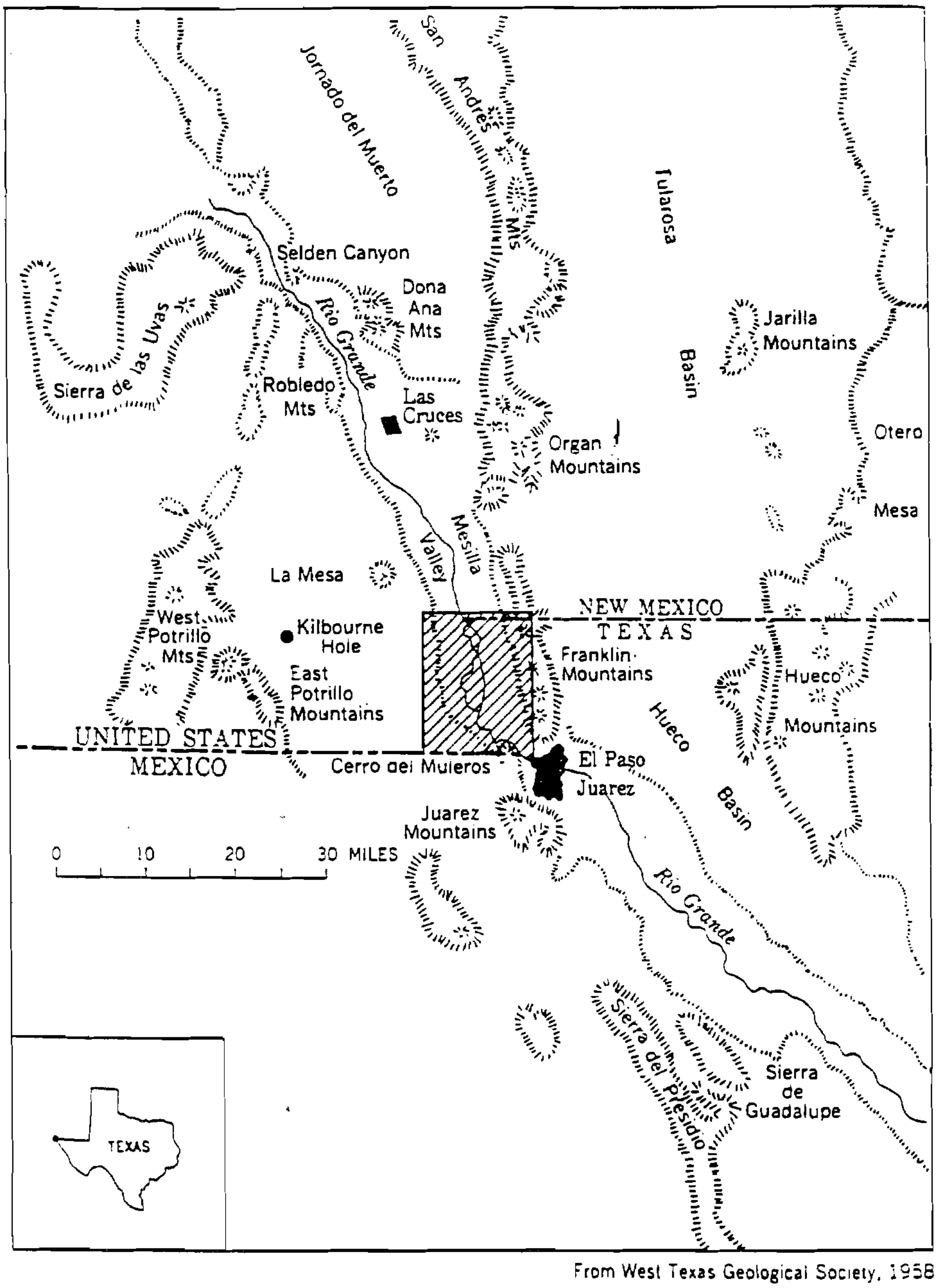

Figure 1. Map showing location of the studied area (after Leggat et al, 1963)

GEOLOGY

The Mesilla Valley was formed by downcutting of the Rio Grande river in the La Mesa bolson which is a basin filled with consolidated and unconsolidated deposits of Tertiary and Quaternary age derived from the erosion of the highlands. The Santa Fe group of middle (?) Miocene to Pleistocene age comprises the main sediments in the lower Mesilla Valley (Bryan, 1938; Spiegel and Baldwin, 1963). More recent deposits overlie the Santa Fe group as out-wash-fan deposits, windblown deposits, and alluvium deposited by the Rio Grande river.

Igneous and sedimentary rocks ranging in age from Precambrian to Tertiary form the consolidated rocks in and near the lower Mesilla Valley. Most of the igneous rocks are Precambrian or Tertiary in age; whereas, the sedimentary deposits are pre-Tertiary in age. The Franklin and Organ Mountains to the east and north of studied area comprise the largest area of outcrop of the igneous rocks. In the area between the Franklin Mountains and the Cerro de Muleros, andesite porphyry crops out. Cretaceous limestone and shale are exposed on the flanks of the igneous core of the Cerro de Muleros (Leggat et al, 1963).

Sand, clay, silt, caliche, and conglomerate deposits form the unconsolidated deposits in the lower Mesilla Valley. Shallow, medium, and deep aquifers exist in the unconsolidated deposits. The shallow aquifer exists in the near surface alluvial deposits and in the upper part of the underlying Santa Fe group. The medium and deep aquifers exist in the bulk of the Santa Fe group (Leggat et al, 1963).

The alluvium in the lower Mesilla Valley consists of poorly sorted sand, gravel, clay, and silt. It is the major source of ground water for irrigation and for industrial use. The top of Santa Fe group consists mostly of coarse sand and gravel containing some calchie-cemented boulders which may be correlated with the Pleistocene cap of the Santa

Fe group (Spiegel and Baldwin, 1963). Beneath the coarse sediments, is a thick series of red to brown silty clay and fine to medium sand and a thick bedded conglomerate. The upper unit of the Santa Fe group, which contains the medium aquifer and a part of the shallow aquifer, consists of alternating layers of varied thickness of fine to coarse sand, gravel, and reddish-brown silty clay. The lower unit of the Santa Fe group which contains the deep aquifer, consists of unconsolidated fine to medium sand and contains a lower percentage of clay than the upper unit. The medium and deep aquifers of the Santa Fe group are the major sources of ground water for public supply in the lower Mesilla Valley (Leggat et al, 1963).

GEOHYDROLOGY

The following description of geohydrology is mainly based on the work of Gates et al (1984). The lower Mesilla Valley is underlain by unconsolidated deposits of clay, silt, sand, and gravel to a depth at least of 366 m (1,200 ft). A well was drilled southwest of the valley flood plain into probably semiconsolidated deposits at 552 m (1,810 ft) (Gates et al, 1984).

The shallow aquifer, which is composed of gravel and coarse sand is located near the surface and has an average thickness of about 60 m (about 200 ft). The medium-depth aquifer, which is composed of finer sand and smaller amounts of gravel than the shallow aquifer, is located at a depth of about 50-80 m (about 160-260 ft) and has an average thickness of about 120 m (about 400 ft). The deep aquifer, which is composed of uniformly fine sand, is located at a depth of about 140-200 m (about 460-680 ft) and has an average thickness of about 180 m (about 600 ft).

In the shallow aquifer, ground water occurs under unconfined conditions. However, ground water in the medium-depth and deep aquifers is probably under confined conditions within the flood plain. The sediments to the west of the flood plain may either form one hydrogeologic unit under unconfined conditions, or the lower part of the unit may be under confined conditions. Water levels under natural conditions, are progressively higher under the La Mesa than under the flood plain because ground water moves from the Mesa toward the center of the Mesilla Valley and discharges to the Rio Grande river and the flood plain near the river (Gates et al, 1984).

Both the medium-depth and deep aquifers probably extend westward beyond the flood plain, even though few deep wells have been drilled outside the Canutillo well field. Along the eastern edge of the valley, the deep aquifer probably terminates sharply against a fault (see figure 2) that was inferred by Gates et al (1978, p.102) on the basis of data from electrical resistivity surveys made by Zohdy et al (1976).

Aquifer tests of the medium-depth and deep aquifers, in the lower Mesilla Valley, under and near the flood plain of the Rio Grande river, indicate that the water is under artesian conditions. In the medium-depth and deep aquifers, storage coefficients may vary from artesian range under the flood plain to water-table range under parts of La Mesa (where the medium-depth and deep aquifers, along with the lateral equivalents of the shallow aquifer, may form a single hydrologic unit).

The shallow aquifer is primarily recharged by seepage from canals, the Rio Grande river, and from infiltration of irrigation water. All three aquifers are probably recharged by lateral ground-water flow from the uplands to the east and the west and from the upstream part of the Mesilla Valley (Gates et al, 1984). Recharge from precipitation on the flood plain probably is insignificant and negligible because the potential annual evaporation (96 in.) greatly exceeds the average annual rainfall (8 in.) (Gates et al, 1984). Discharge of ground water mainly is from pumping, evapotranspiration from phyreatophyte areas in the flood plain, seepage to the Rio Grande river and to irrigation drains.

The water quality in all three aquifers of the lower Mesilla Valley changes both areally and with depth. In general, the water in the shallow aquifer is more saline than in the deeper aquifers. Water from the medium-depth and deep aquifers in the Canutillo-Anthony area is of good quality and the best aquifer is the deep aquifer which contains less than 300 mg/l (milligrams per liter) total dissolved solids (Gates et al, 1984).

The base of freshwater, which is defined as water with less than 1,000 mg/l total dissolved solids, in all three aquifers was observed in the Canutillo well field to be at a depth of about 366 m (1,200 ft) (Leggat et al, 1963). However, the base of freshwater becomes progressively shallower toward the south and east. South of Conutillo, the ground water quality decreases and the water contains from 1,000 to more than 20,000 mg/l of total dissolved solids which approaches sea water salinity. As pumping increases in the Conutillo well field and as the cone of depression in the potentiometric surface extends farther to the south of Canutillo, saline waters may move towards the well field.

Prior to 1957, movement of water in all three aquifers may have been toward the Rio Grande river which was the primary discharge zone for much of the Mesilla bolson's ground water system. Also, the ground water moved south from the northern part of Mesilla Valley and from uplands east and west of the lower Mesilla Valley and discharged into the river (Gates et al, 1984). Most of the ground water in the lower Mesilla Valley was obtained from the shallow aquifer and used for irrigation, even though some ground water was pumped for municipal supply and industrial use. In the late 1950's, pumping from the medium-depth and deep aquifers in the Canutillo well field started and increased to the early 1960's. In 1975, pumping from the Canutillo well field for municipal and industrial use was 12,726 acre-ft (15,697,521 m^3) from the deep aquifer, 1,438 acre-ft (1,773,773 m^3) from the medium-depth aquifer, and 4,968 acre-ft (6,128,028 m^3) from the shallow aquifer (Gates et al, 1984). In the entire Mesilla Valley, pumping from all three aquifers for municipal and industrial uses totaled 27,096 acre-ft (33,422,916 m^3), of which 13,192 acre-ft (16,272,332 m^3) was from the deep aquifer, 5,437 acre-ft (6,706,539 m^3) from the medium depth aquifer, and 8,467 acre-ft (10,444,044 m^3) from the shallow aquifer.

Water levels in the shallow aquifer in the lower Mesilla Valley have varied both seasonally and from year to year and have been most affected by the availability of surface water. Since the early 1950's, the water table declined seasonally and annually because of periods of insufficient surface water supplies and increases in pumping; however, the magnitude of the decline seldom exceeded 5 ft (Gates et al, 1984). During wet periods, the water table recovered completely, resulting in discharge of the ground water to the Rio Grande river and to irrigation drains. Water levels in the medium-depth and deep aquifers in the lower Mesilla Valley have declined as much as 21 m (about 68 ft) during 1957-1975.

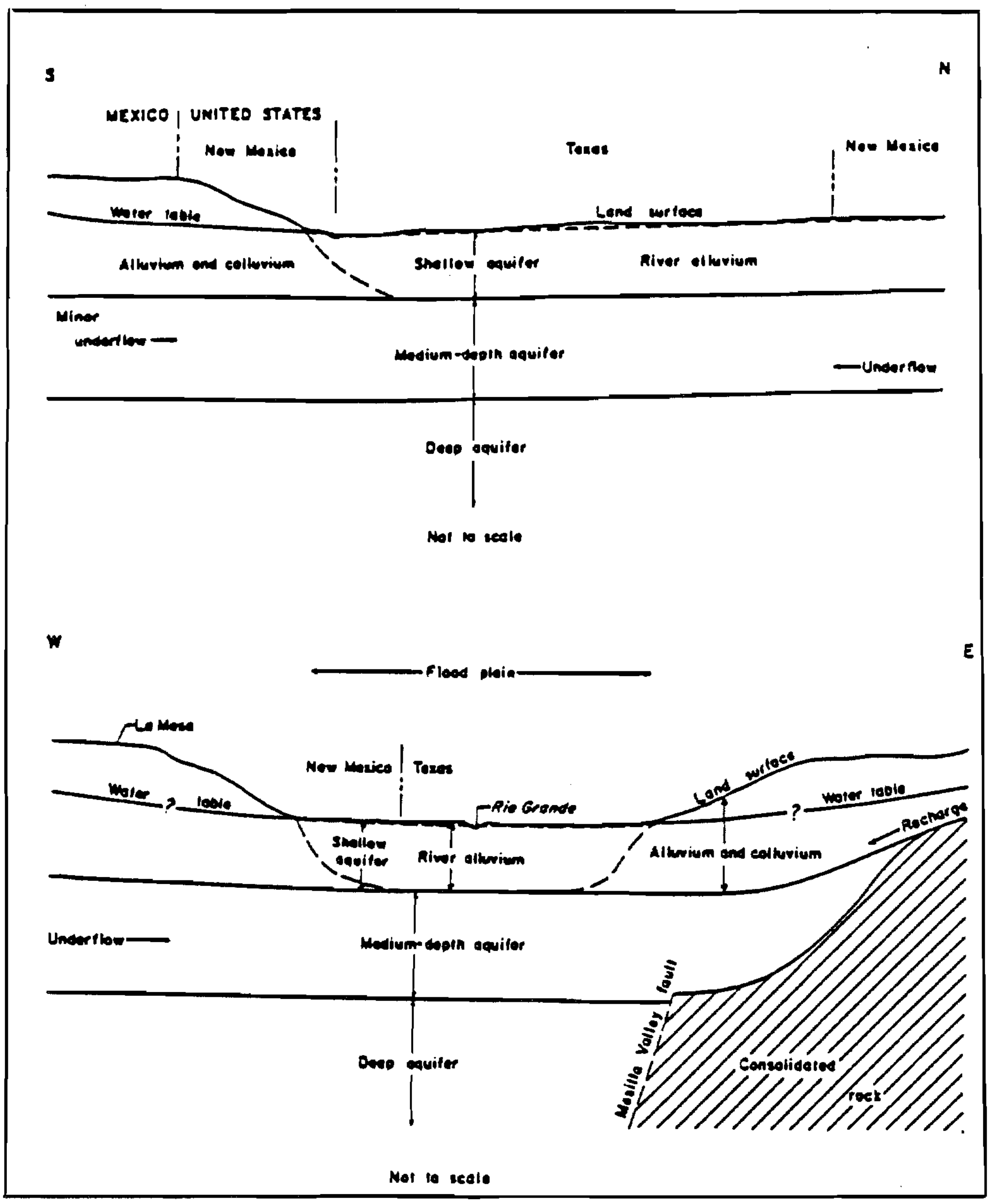

Figure 2. Sketch showing the three aquifers in the lower Mesilla Valley (after Gates et al, 1984).

THE SCHLUMBERGER SOUNDING METHOD

The resistivity method using the Schlumberger electrode configuration is based on injecting a direct current into the ground using two current electrodes, A and B, and on measuring the potential difference between two potential electrodes, M and N (figure 3). The principles of the method have been presented on several books on the subject (Bhattacharya and Patra, 1968; Kunetz, 1966; Keller and Frischknecht, 1966; Zohdy et. al, 1974). The current electrode spacing, AB/2, is half the distance between the current electrodes A and B, and the potential electrode spacing, MN/2, is half the distance between the potential electrodes M and N. Figure 3 shows a power supply of electric current, an ammeter for measuring the electric current and a potentiometric chart recorder for measuring the potential difference. The arrows show the direction of expanding the distance between the current electrodes.

Electrical Resistivity

The electrical resistivity, ρ, for the symmetric-Schlumberger configuration is calculated from the equation:

$$\rho = \pi \frac{(AB/2)^2 - (MN/2)^2}{MN} \frac{\Delta V}{I} \qquad (1)$$

where,

AB/2 = half the distance between current electrodes A and B,

MN/2 = half the distances between potential electrodes M and N,

ΔV = potential difference measured between the potential electrodes M and N,

I = electric current injected into the ground via the current electrodes A and B.

If the ground is composed of an infinity-thick, homogeneous, and isotropic medium, then the resistivity calculated from the above equation will be the true resistivity of that medium, otherwise the calculated resistivity is called an apparent resistivity (Zohdy et al, 1994). In general, for a heterogeneous medium, the apparent resistivity depends on the geometry, the spacing, and the orientation of the electrode array with respect to lateral inhomogeneities, and it also depends on the spatial distribution of materials with different electrical resistivities (Zohdy et al, 1994). An estimate of the distribution of the true resistivity of subsurface materials at various depths, can be calculated from the apparent resistivities and the electrode spacings using many different interpretation methods, as will be discussed in a later section.

Schlumberger Sounding Procedure

To make a symmetric Schlumberger sounding, the distance between the current electrodes, A and B, is increased at a succession of logarithmically-nearly-equal increments and the corresponding apparent resistivity is calculated from equation (1). The distance between the potential electrodes, M and N, is held fixed for a succession of expanding current electrode spacings. The expansion of the current electrode spacings is periodically stopped, and the distance between the potential electrodes is increased, and the apparent resistivity is recalculated at the expanded potential electrode spacing; then the expansion of the current electrode spacing is resumed. The main purpose of expanding the distance between potential electrodes is to increase the magnitude of the signal (potential difference) between the potential electrodes. To measure an approximation of the electric field (which is the gradient of the electric potential) at the center of the electrode configuration, the current electrode spacing, AB/2, must be greater than or equal to five times the potential electrode spacing, MN/2.

A sounding curve is drawn by plotting the apparent resistivity, ρ, versus the current electrode spacing, AB/2, on log-log scale. Each set of apparent resistivity points calculated at a fixed distance between the potential electrodes as the current electrode spacings are expanded, is called a segment. In practice, a field Schlumberger sounding curve is usually composed of two to four segments depending on the maximum expansion of the current electrode spacings (Zohdy et al, 1994). Overlapping segments may not coincide with each other either because of variation in probing depth, which is a result of changing the AB/MN ratio at the end of one segment and the beginning of another (Deppermann, 1954; Zohdy et al, 1974) or because of lateral inhomogeneities which is more common. The direction and magnitude of a discontinuity between two segments and the change in the ratio of AB/MN at the discontinuity often indicate the cause of the discontinuity (Zohdy et al, 1994). See Appendix A for details of electrode spacing measurements procedure and Appendix B for values of the current electrode spacings listed beneath the plot of each field sounding curve.

Principle of Sounding Interpretation

The interpretation of a sounding curve consists of finding an earth model composed of materials with different resistivities such that the computed sounding curve for the model fits the field sounding curve. Such a model is only one amongst many other models that can fit the observed curve equally well. This non-uniqueness is referred to as equivalence (Zohdy et al, 1994). Common sense and geologic constraints based on typical measured resistivities often help to eliminate many mathematically-equivalent models from being considered. In the next section, I discuss examples of equivalence among different types of earth models.

In this thesis, I used a method for the automatic interpretation of sounding curves (Zohdy, 1989; Zohdy and Bisdorf, 1989) that creates geologically realistic earth models composed of horizontal, laterally homogeneous and isotropic, layers. Using this method, the theoretical sounding curve computed for a layered-earth model will always fit the digitized sounding curve very well, provided the digitized sounding curve represents a horizontally layered medium. The derivation of a digitized-sounding curve from a field sounding curve is explained in the section on data processing and interpretation.

LIMITATIONS OF THE RESISTIVITY METHOD

In general, the interpretation of a multilayer sounding curve is not unique. A given sounding curve can correspond to different subsurface distributions of layers and resistivities.

Equivalence of K-type curves

Consider two three-layer sections of the K type curves ($\rho_1 < \rho_2 > \rho_3$). If ρ_1 and ρ_3 in one section equal $\rho_1^/$ and $\rho_3^/$ in another section, and $T_2 = \rho_2 h_2 = T_2^/ = \rho_2^/ h_2^/$; then the sounding curves for these two sections will be practically identical (figure 4,curves a and b) especially if the second layer is relatively thin. This type of equivalence is known as equivalence by T and it also can be approximately applied to Q-type curves ($\rho_1 > \rho_2 > \rho_3$) (Zohdy et al, 1974).

Equivalence of H-type curves

Consider two three-layer sections of the H type curves ($\rho_1 > \rho_2 < \rho_3$). If ρ_1 and ρ_3 in one section equal $\rho_1^/$ and $\rho_3^/$ in another section, and $S_2 = h_2 / \rho_2 = S_2^/ = h_2^/ / \rho_2^/$; then the sounding curves for these two sections will be practically identical (figure 4,curves c and d). This type of equivalence is known as equivalence by S and it also can be approximately applied to A-type curves ($\rho_1 < \rho_2 < \rho_3$) ((Zohdy et al, 1974).

Equivalence between laterally homogeneous and laterally inhomogeneous models

The form of sounding curves obtained over sections with both horizontal and vertical or inclined contacts can be very similar to sounding curves obtained over sections with only horizontal contacts. This particularly occurs if the sounding line is parallel to the strike of the vertical (or inclined) contact (figure 4, curves e and f) (Zohdy et al, 1974). This type of equivalence can be resolved by making crossed soundings. The forms of two sounding curves will be totally different from one another and it will be easy to realize the presence of lateral inhomogeneities in the ground (figure 4, curve e').

Equivalence among multilayer sections

A sounding curve obtained over a four- or five layer section may be equivalent to a sounding curve obtained over a three layers section. Generally this is attributed to the principle of suppression (Maillet, 1947). The error which is caused by the effect in interpreting the depth of contacts is sometimes referred to as pseudoanisotropy (Genslay and Rouget, 1937; Flathe, 1955, 1963). This type of equivalence is shown in figure 4, curves g and h. Further discussions of this type of equivalence were presented by Zohdy (1974 and 1989)

Equivalence between isotropic and anisotropic media

The equivalence between an isotropic layer and an anisotropic layer is exact when the anisotropic layer is vertically microanisotropic (Zohdy et al, 1974). That is, the resistivity along the x and y axes is the same but is different along the z-axis. This type of anisotropic model is sometimes referred to as azimuthally isotropic. Generally depths are overestimated by a factor equal to the coefficient of anisotropy $\lambda = \sqrt{\rho_{\perp} / \rho_{\parallel}}$, where $\rho_{\perp}$ and ρ are the transverse and longitudinal resistivities, respectively (figure 4, curves i and j). Generally values of λ range from 1.1 to 1.3 and rarely exceed 2 (Zohdy et al, 1974).

Monotonic change in resistivity

When the resistivity of subsurface materials decreases or increases monotonically (A-, AA, Q-, or QQ-type section), the sounding curve may resemble that of a simple two layer model (principle of suppression). This is particularly valid when the thickness of the layers do not increase significantly with depth. There are two methods for making differential soundings to improve the resolving power for A- and Q-type sections (Rabinovich, 1965; Zohdy, 1969).

Relative thickness of a layer

The delectability of a layer with a certain resistivity depends on its relative thickness, which is the ratio of the bed thickness to its depth of burial (Zohdy et al, 1974). For a given resistivity contrast, the smaller the relative thickness of the layer, the smaller the chance to detect it on a sounding curve. In four layer or more model, the "effective" relative thickness of the layer must be considered. The "effect" relative thickness is defined as the ratio of the layer thickness to the product of the pseudoanisotropy and the total thickness of the layers above it. For example, a layer 40 meters thick at a depth 10 meters has a relative thickness of 4, which can be detected on a sounding curve. However, if the top 10 meters are composed of two layers of thickness of 3 meters and 7 meters and resistivities of 20 ohm-m and 2,000 ohm-m, respectively, then the pseudoanisotropy λ of the top two layers is 4.6. Therefore, the effective relative thickness is $40/(4.6\times10)\approx 0.87$, which is considerably smaller than the calculated relative thickness of 4. The resistivity of the 40 meters third layer and underlying layers also play an important role in detecting the layer on the sounding curve (Zohdy et al, 1974).

All geophysical methods which are based on potential theory (electrical, gravity, and magnetic methods) do not have unique solutions. In practice, it is by correlation of several soundings curves, by making crossed soundings, by sounding with different arrays, by traversing the area with horizontal resistivity profiles, by knowledge of its geology, and by recognition of the electrical properties of rocks in the studied area that correct interpretation is achieved (Zohdy et al, 1974).

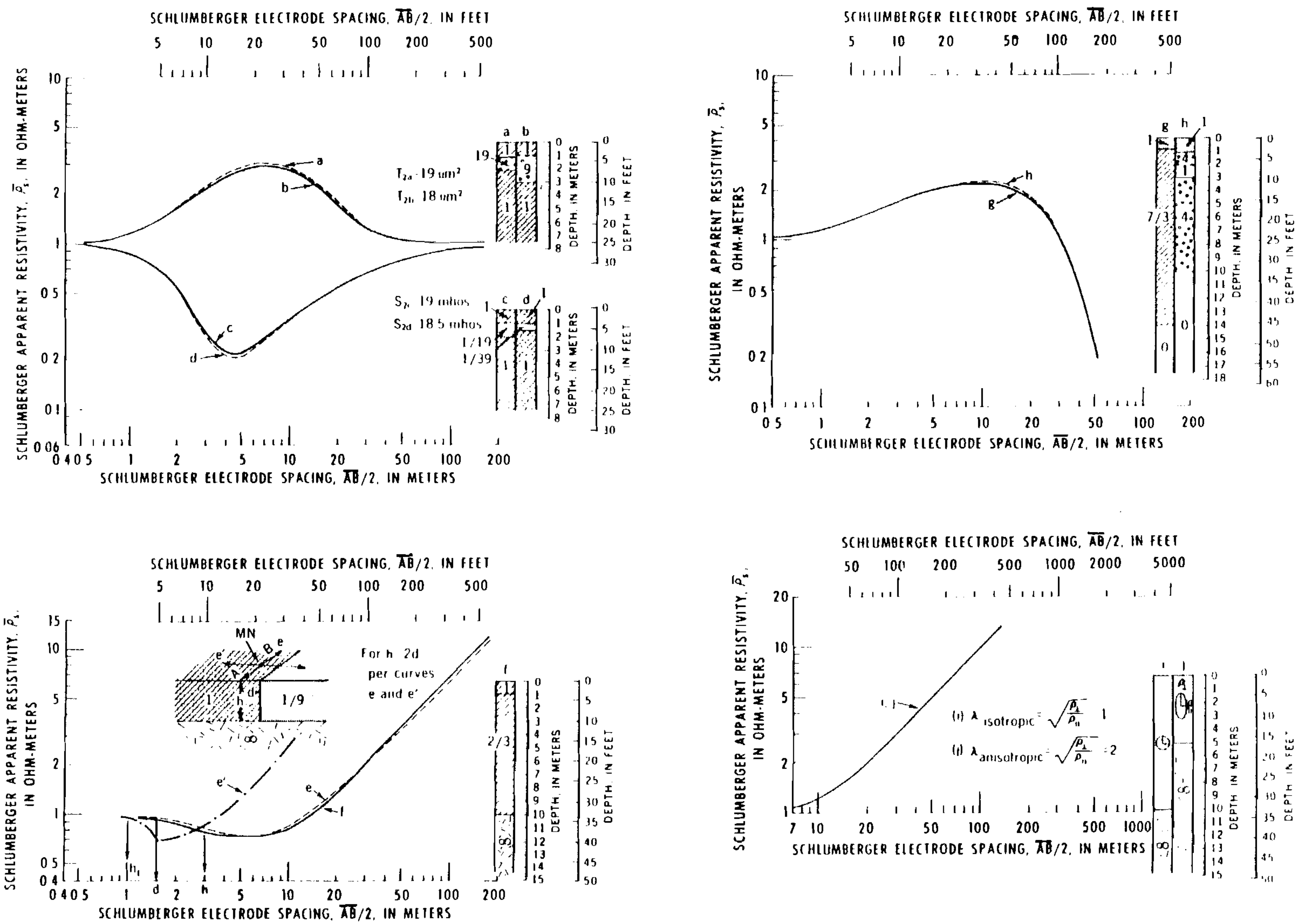

Figure 4. Example of different types of curve equivalence(after Zohdy et al, 1974).

DATA ACQUISITION PROCEDURE

In this survey, the field sounding curves were plotted as the measurements were taken in the field. This procedure was used by Zohdy et al (1974) to identify and correct errors that may be made by the operator or the crew, to identify readings that may be caused by man-made structures (fences, buried pipes, etc.), by current leakage from damaged cable insulation, or by equipment malfunction.

A test for current leakage (Zohdy, 1968) was made at the completion of each sounding. This test was made by disconnecting one of the current electrodes, at the site of the electrode, and then trying to make a reading using a high impressed voltage. Next, the disconnected current electrode was reconnected and the other current electrode was disconnected and the test was repeated. Neither a current flow nor a potential difference between the potential electrodes M and N should be measured during the leakage test of either current cable. If a reading of current or potential difference is observed while one of the current electrodes is disconnected then this indicates current leakage in that current line. At short current electrode spacing, it is usually possible to locate the source of the leakage and it can be fixed; but at large current electrode spacings it is often difficult to eliminate the leakage. A note regarding the magnitude of the leakage is made and the affected point(s) on the sounding curve should be marked. A minor current leakage was observed during some tests in the form of minor voltage spikes on the potentiometric chart recorder but with immeasurable current on ammeter. See section on sounding affected by man made objects for specifics on soundings affected by current leakage and see Appendix A for more details on data acquisition procedure that were used during this survey.

According to Zohdy et al (1994), the crew are always reminded of proper safety procedures to be followed at the beginning and the middle of the survey and during the current leakage tests. Clear radio communication is required during deep resistivity surveys for the purpose of safety.

DATA PROCESSING AND INTERPRETATION

Data processing of the field sounding curves consisted of:

a) Converting the current electrode spacing from feet to meters.

b) Shifting the various segments on the field curve (which were obtained at a fixed potential electrode spacings, MN/2) upward or downward in order to construct a continuous unsegmented curve. Usually the last segment, which is measured at the largest potential electrode spacings, is fixed and all other segments are moved up or down. The reason for keeping the last segment fixed is because the measurements at large potential-electrode spacings are not affected by small, near surface, lateral inhomogeneities such as boulders, which may affect the reading at short potential-electrode spacings.

c) Sampling the continuous unsegmented curve at the rate of 6 logarithmically equally spaced points per logarithmic cycle to obtain a digitized sounding curve. In general, sampling the apparent resistivity is done from right to left, that is starting at the largest current electrode spacings. The reason for this is that if the length of shifted sounding curve is not divisible by 6 then one of the points on the sounding curve will be dropped and therefore, to keep the last point on the sounding curve, which gives more information about the deep materials, one digitizes the curve from right to left.

In this survey, the shifted field curve was sampled at the rate of 6 logarithmically equally spaced points per decade in order to speed up the calculation of the various theoretical sounding curves during the iterative curve fitting process (Zohdy, 1973). Every point on the theoretical sounding curve, which is a continuous and unsegmented curve, is calculated by convolving a set of points on the kernel function curve (Ghosh, 1971; Zohdy, 1975) with a set of filter coefficients. For a given layering model, points on the kernel function curve are calculated using a recursive formula (Sunde, 1949; Crous, 1971). In the newer program (Zohdy and Bisdorf, 1989), the O'Neill filter coefficients (O'Neill, 1975) are used to calculate the sounding curve at the rate of 6 points per decade. There are 20 coefficients in this filter. At the sampling rate of 6 points per decade, the required number of kernel function evaluations, to be convolved with O'Neill's filter coefficients, are much smaller for a logarithmically equally spaced abscissas than the number required for an unequally spaced set of points. Specifically, the required number of n kernel function points for m equally spaced points on a sounding curve, is given by (Zohdy et al, 1994):

$$n = 20 + m - 1, \tag{2}$$

on the other hand, the required number of n kernel function points for m unequally spaced points on a sounding curve is given by:

$$n = 20 \times m. \tag{3}$$

where 20 is the number of coefficients in O'Neill's filter.

For example, to compute 25 equally spaced points on a theoretical sounding curve at the rate of 6 points per decade, only 44 kernel function points should be calculated. This result is obtained by using $m = 25$ in equation (2). On the other hand, to compute 25 unequally spaced points on a theoretical sounding curve at the rate of 6 points per decade, 500 kernel function points should be calculated (Zohdy et al, 1994). This result is obtained by using $m = 25$ in equation (3).

FIELD DATA

The field sounding curves and their interpretations are shown in Appendix B. The sounding curves are numbered successively from Mesilla 1 to Mesilla 65. The sounding curves were interpreted using an automatic interpretation computer program (Zohdy, 1989; Zohdy and Bisdorf, 1989). The layering models are shown as step function curves which represent the variation of resistivity with depth. This variation is assumed to be beneath the center of the electrode array (i.e. beneath the sounding station). This old convention is useful in constructing interpreted resistivity maps and cross-sections. Most of the sounding curves were readily interpretable using the assumption of horizontally stratified layers except for a few which were distorted by geologic lateral inhomogeneities or by man made objects, which are discussed in the next two sections.

The location of the sounding stations and the direction of the current electrode expansions are shown in figure 5. The maximum current electrode spacings, AB/2, ranged from 1,311 to 2,438 m (4,300 ft to 8,000 ft).

SOUNDINGS AFFECTED BY LATERAL GEOLOGIC INHOMOGENEITIES

By examining the field sounding curves I observed the formation of some minor and some significant cusps that were probably caused by lateral inhomogeneities; see for example soundings 1 and 5, respectively. On sounding 1 there is one minor cusp at the current electrode spacing (AB/2) of 455 m (1460 ft) and on sounding 5 there is a significant cusp at 6 m (22 ft). Other cusps are observed on soundings 9, 10, 11, 12, 16, 17, 20, 24, 25, 39, 45, 49 58, 59, 60 62, 64, 65. On Schlumberger sounding curves (that are measured using the symmetric AMNB array), cusps are developed when a current electrode crosses a lateral inhomogeneity. There are two types of cusps, upward pointing cusps and downward pointing cusps. For two different materials with different resistivities separated by a vertical contact (Zohdy, 1970 and 1980), a downward pointing cusp is formed when a current electrode crosses from high to low resistivity and an upward pointing cusp is formed when a current electrode crosses from low to high resistivity (Zohdy et al, 1994). As mentioned above, these observations are applicable to the symmetric Schlumberger array and not apply to other arrays, where more pronounced cusps and discontinuity can be formed as in the polar dipole-dipole array.

If the measurements are accurate, cusps at short current electrode spacings are mostly caused by small lateral inhomogeneities that are close to the earth surface such as boulders or buried stream channels. In contrast, cusps at large current electrode spacings are caused by much larger inhomogeneities such as buried ridges or faults. Small, near surface, lateral inhomogeneities with medium resistivity contrast, located at a large distance from the center of sounding, do not affect measurements measurably when they are crossed by one of the current electrodes. Also, large lateral inhomogeneities buried at depths larger than the current-electrode spacings do not cause the formation of cusps (Zohdy et al, 1994).

The sharp maxima on soundings 21, 24, and 40 most likely are caused by the limited lateral extent of a resistive layer beneath the sounding station (Alfano, 1959; Zohdy et al, 1974). The sharp maxima on these soundings can be fitted only approximately by horizontally layered models.

SOUNDINGS DISTORTED BY MAN-MADE OBJECTS

Sounding curves that are not similar to those measured over horizontally stratified media are often considered as distorted sounding curves, especially when they are affected by man made objects, by current leakage, or by measurement errors. A sounding curve can be distorted by metallic objects such as buried metallic pipelines, fences with metal posts or fences with wooden posts but with grounded wire mesh, or power lines with grounded posts. The effect of linear man made objects is larger or more noticeable when the objects (fences or pipelines) are discontinuous and are parallel to the direction of the sounding line expansion. On the other hand, when a sounding line is expanded perpendicular to a power line, 60 Hz noise will strongly affect the voltage measurements (Zohdy et al, 1994).

Sounding 14, see Appendix B is truncated beyond a spacing of about 30 m because from 30 m to about 300 m, the sounding curve is strongly distorted. A very similar distortion was observed on a sounding in a different survey (Zohdy et al, 1994) where a buried wire mesh was located near the sounding station, and extended from a distance of about 70 m to a distance of a bout 200 m from the center of the electrode array, and ran parallel to the sounding line at a distance of about 2 m. In this survey, on sounding 14, the sharp rise of the sounding curve (from AB/2 of about 80 m to about 200 m) and then the sudden drop at AB/2 = 305 m (1,000 ft) is probably caused by a fence or buried cable and not by geologic inhomogeneities. As the current electrodes were expanded from 80 m to 300 m, the suspected conductor (fence) progressively channeled a large portion of the electric current and deposited it close to the potential electrodes, thus generating much larger than normal potential-difference signals and thus generating higher apparent resistivity values. When the current electrodes were expanded to a distance far away from the end of the conductor, the apparent resistivity dropped. It is very interesting to note that the layout of a sounding line parallel to a discontinuous buried conductor can generate a high resistivity anomaly when the edge of the conductor is located away from the center of the sounding. On sounding 39, shown in Appendix B, the last three readings probably were affected by a metal fence located at a distance of about 300 m (1000 ft) from the center of the array. Similarly, sounding 60, shown in Appendix B, may have been affected by a discontinuous buried cable at AB/2 > 800m. When the current electrodes were expanded from 823 m to 1311 m, the buried cable (which must have been parallel to the sounding line at a current electrode spacing of AB/2 > 800 m and probably not before) progressively channeled a large portion of the electric current and deposited it at a point closer to the potential electrodes than the distance from the current electrode to the potential electrodes, thus generating much larger than normal potential-difference signals and thus higher apparent resistivities.

At the end of sounding 60, minor current leakage was noticed on the original sounding data and may have contributed to the higher apparent resistivity readings.

RELATIONSHIP BETWEEN RESISTIVITIES, LITHOLOGY AND WATER QUALITY

Materials with very low to low resistivities (3 to 10 ohm-m) generally represent sedimentary deposits with a high percentage of clay content and may contain good quality water (but rather unlikely) or may represent sand and gravel deposits saturated with brackish to saline water (TDS of 1000 to 10,000 mg/l).

Materials with medium low resistivities (10 to 30 ohm-m) generally represent sedimentary deposits with a lower percentage of clay mixed with sand and gravel and may be saturated with good quality water.

Materials with medium resistivities (30 to 70 ohm-m) may represent sedimentary deposits of fine sand and gravel mixed with some clay and saturated with water of good quality (<1000 mg/l of total dissolved solids).

Materials with medium high resistivities (70 to 150 ohm-m) may represent alluvial deposits with coarse sand and gravel saturated with water of very good quality (probably <500 mg/l total dissolved solids).

Materials with high resistivities (150 to >300 ohm-m) probably represent unsaturated near surface sand, gravel, and cobbles which are normally found in the top parts of alluvial fans.

GENERAL DESCRIPTION OF INTERPRETED RESISTIVITY CROSS-SECTIONS

Six interpreted resistivity cross sections were made using the Kolor-Map & Section computer program (Zohdy, 1993). These cross sections were edited and annotated using the commercial program Deluxe Paint III (Silva, 1989). All of these cross sections are oriented east-west and are based on straight line distances between the sounding stations. The title of each cross-section is based on the numbers of the sounding stations located at the beginning and at the end of each cross section. On the cross sections, there are triangles placed at the surface of a simplified topography to show the locations of sounding stations. The simplified topography is based on connecting the elevation of each sounding station by straight line. Note that although the cross sections are vertically exaggerated (x2), one can hardly notice the topography which is a measure of how flat the topography is in the survey area.

The interpreted resistivity contours which are shown on the cross sections are derived from the step function layering model of each sounding as follows:

1) The step function curve, which shows the variation of interpreted resistivity with depth, is sampled at the logarithmic center of each horizontal and vertical segment (Zohdy, 1989 and 1993). These sampled resistivities are taken as points on a curve representing a model of continuous variation of resistivity with depth. This model is assumed to be electrically equivalent to the original step function model because the width of each step on the logarithmic scale is reasonably small (Zohdy et al, 1994).

2) The points sampled on the continuous, interpreted resistivity, curve are used to calculate the contours on the cross sections.

On the cross sections (figure 7, 8, and 9), black points beneath each sounding station show depths at which the continuous interpreted resistivity function is sampled. For any particular sounding, the deepest sampled point, beneath that sounding station, shows the maximum probing depth. Here, the maximum probing depth is defined as 1.5 times the depth to the top of the last infinitely thick layer. Some of the sounding stations have shallow probing depth, that is they did not see very deep, and therefore white areas with question marks are shown beneath these sounding stations. An area beneath a shallow sounding may not be shown in white if that shallow sounding is located between two closely spaced sounding stations that see very deep and the interpolated data between them shows a laterally smooth pattern of contour lines.

The interpreted resistivity contours are selected to be approximately equally spaced on a logarithmic scale. The following contour levels: 3, 4.5, 7, 10, 15, 20, 30, 45, 70, 100, 150, 200, and 300 ohm-m were used. For interpreted resistivity maps at different depths (which will be discussed in more detail in a subsequent section), the same contour and the same color scheme were used as in making the cross sections.

All cross sections are presented with a vertical exaggeration of two times. On most cross sections, there is evidence on the detection of a geoelectric basement of high resistivity (possibility limestone). Here the deepest 30 to 70 ohm-m contours are assumed to represent the detection of the top of that resistive basement.

RESISTIVITY CROSS SECTIONS

The six cross sections starting on page 116 are oriented east-west and they are described in their order of location from north to south (see figure 6 for the location of these cross sections).

Cross Section 6-1

Cross section 6-1 is shown in the top part of figure 7. It is approximately 10 km long and a portion of it is located on the east-west border between New Mexico and Texas. Sounding 6, at the west, was made on the Mesa in New Mexico and sounding 1, at the east, was made very close to the foothills of the Franklin Mountains in Texas.

On the east side, beneath station 1 and station 2, there is a near surface layer of high resistivity material (200 to >300 ohm-m) with a thickness ranging from about 30 to 70 m. This layer may represent unconsolidated alluvial deposits of sand, gravel, and cobbles. It is underlain by materials having moderately-high resistivity (45-100 ohm-m) which may represent alluvial deposits, saturated with good quality water. This layer is underlain by medium low resistivity material (10-30 ohm-m), which may represent the saturated part of Santa Fe group. This medium low resistivity material may contain good quality water, with the quality of water being better at resistivities nearer to 30 ohm-m. The water levels beneath soundings 1 and 2 are estimated to be at a depth of 73 m beneath sounding 1 and 37 m beneath sounding 2 (Gates, 1977, written communication to Zohdy). The high resistivity material beneath sounding 1 at a depth of about 450 meters most probably represents geoelectric basement (limestone).

Beneath sounding 3, which is located very close to the town of Anthony, there is a low resistivity layer (about 7 ohm-m) with a thickness about 70 m and an uncertain width of about 800 m. This low resistivity material may represent a large clay lens. The water level is estimated to be < 4 m (Gates, 1977, written communication to Zohdy, 1977). According to Gates, 1977, the low resistivity materials are clay layers with salt water in them. This lens is underlain by layers of medium low resistivity (10 to 15 ohm-m and 10-15 ohm-m) materials, which have a total thickness of about 300 m. These layers may represent fresh water saturated basin deposits that contain substantial amounts of clay. Beneath sounding 4, all subsurface materials, having a thickness of about 500 m, have an interpreted resistivity of 15-30 ohm-m, which indicates layers with some clay content and ground water of good quality. At a depth of about 700 m, these layers are underlain by materials with resistivity of <10 ohm-m which indicates that the clay content increases and/or salty water exists at that depth. Here salty water is defined as water with greater than 10,000 mg/l total dissolved solids.

Beneath soundings 5 and 6, in the western part of the cross section, all subsurface materials have an interpreted resistivity of 15 to 45 ohm-m down to a depth of about 600 m. This part of the geoelectric section probably represent layers with moderate clay content and ground water of good quality. The low resistivity materials of less than 10 ohm-m (detected beneath sounding 4) may exist beneath these soundings at depths of >600 m.

Cross Section 23-10

Cross section 23-10 is shown in the middle part of figure 7. It is approximately 17 km long. Sounding 23, located at the west end, was made on the Mesa, in New Mexico, and sounding 10, located at the east end, was made near the foothills of the Franklin Mountains, Texas.

The upper 100 m in the eastern and western parts of the cross section are characterized by high and medium high resistivity materials of about 100 to >300 ohm-m. These materials most probably represent unsaturated sand and gravel deposits. The major part of the subsurface is characterized by medium and low resistivity materials (10 to 45 ohm-m and < 4.5 to 10 ohm-m). The medium resistivity (10-45 ohm-m) materials represent basin fill deposits of silt and sand saturated with good quality water. The low resistivity of <10 ohm-m zone probably represents clay-rich sediments and/or sediments saturated with poor-quality water in the Santa Fe group.

Beneath sounding 22 a thick zone with some medium interpreted resistivity materials of 10 to 45 ohm-m extends from a depth of about 105 to 750 m. This thick zone is interpreted as a zone with better quality water and/or as a zone with a larger percentage of sand and gravel layers than the zones with low resistivity. The water level beneath sounding 22 is estimated to be about 105 m, beneath sounding 21 to be about 100 m, and beneath sounding 20 to be 5 m (Gates, 1977, written communication to Zohdy).

Beneath sounding 10, in the east, a thick zone with medium resistivity of 45-70 ohm-m extends from a depth of about 500 m to the bottom of the cross section. This thick zone is interpreted as a zone with much better quality water and larger percentage of coarse sand and gravel or it may represent the geoelectric basement (limestone). This correlates with the resistivity high beneath sounding 1 to the north. The estimated water level beneath this sounding is about 100 m (Gates, 1977, written communication to Zohdy).

Cross Section 33-27

Cross section 33-27 is shown in the bottom part of figure 7. This short cross section is about 8.5 km long.

Beneath soundings 27 and 28, in the eastern part of the cross section, the top 100 meters materials have an interpreted resistivity of >45 ohm-m, which in this area typically indicates mostly dry layers with moderate amounts of clay, in sand and gravel deposits. The water level beneath sounding 27 is estimated to be about 100 m and beneath 28 it is about 40 m (Gates, 1977, written communication to Zohdy).

Beneath soundings 32 and 33, which are located close to the Mesa, most subsurface materials have interpreted resistivity of 10 to 15 ohm-m and <10 ohm-m. The <10 ohm-m material typically indicates a very large percentage of clay and/or brackish to salty water.

In general, the materials with higher resistivities are thicker in the eastern part of cross section, extending to depths of >500 m, than in western part of cross section, extending to depths of about 350 m. This cross section shows that the potential for thick sediments saturated with water of good quality is greater at a distance of about 1 kilometer to the east of the Rio Grand river.

Cross Section 45-35

Cross section 45-35 is shown in the top of figure 8. It is approximately 16.5 km long (see figure 5 for location).

Beneath soundings 35 and 36, which are located in the foothills of the Franklin Mountains, Texas, the interpreted resistivity in the top 10 m to 22 m is in the range of 150 to >300 ohm-m, which represents unsaturated alluvial deposits of sand, gravel, and cobbles. The water level beneath sounding 35 is about 75 m and beneath sounding 36 is about 22 m (Gates, 1977, written communication to Zohdy). These materials are underlain by materials having moderate resistivities (about 15 to 30 ohm-m) which may be represent alluvial deposits with moderate percentage of clay content and may be saturated with good quality water. Notice that the potential for better quality water increases with increasing depth. It is also possible, however, that the increase in resistivity is indicative of lower porosity.

In the middle of the cross section, the interpreted resistivity in the top 70 m is in the range of 10 to 30 ohm-m which probably represent unsaturated alluvial deposits with a high percentage of clay, silt and sand, and a low percentage of gravel. These materials are underlain by a thick section of low resistivity materials (3 to 10 ohm-m) which probably represent sedimentary deposits saturated with poor quality water. This low resistivity zone has a thickness of about 400 m to as much as 700 m and it extends to the western part of the cross section where it plunges beneath a thick layer of high resistivity material.

Beneath soundings 43, 44, and 45, which are located on the Mesa, New Mexico, the interpreted resistivity in the top 100 m is in the range of 100 to >300 ohm-m which most likely represent unsaturated alluvial deposits of sand, gravel and cobbles. These materials are underlain by materials of moderately high resistivity (45 to 100 ohm-m), having a thickness of about 200 m, which may be represent a substantial aquifer composed of sand and gravel deposits and saturated with very good quality water. These materials are underlain by moderately low resistivity (10 to 45 ohm-m) materials probably representing sand and gravel deposits with a medium percentage of clay and saturated with good quality water. The water levels beneath soundings 43, 44, and 45 are estimated to be about 95 m beneath sounding 43, and about 105 m beneath soundings 44 and 45 (Gates, 1977, written communication to Zohdy). Beneath sounding 45, at a depths of about 800 m, the interpreted resistivity is >10 ohm-m which is caused by rise in last segment of the sounding curve (Appendix B). The last segment may have been distorted by a grounded fence.

Cross Section 61-48

Cross section 61-48 is shown in the bottom part of figure 8. It is approximately 16.5 km long.

In the eastern part, in the foothills of the Franklin Mountains, Texas, the interpreted resistivity in the top 70 m is in the range of 70 to >100 ohm-m, which probably represents unsaturated alluvial deposits composed of sand and gravel with minor amounts of clay. The water level beneath sounding 48 is estimated at a depth of about 70 m and beneath sounding 49 it is estimated to be about of 27 m (Gates, 1977, written communication to Zohdy). These materials are underlain by materials having moderately low resistivities (10 to 30 ohm-m) which may represent alluvial deposits with a higher percentage of clay content. Notice that the quality of water is probably good to significant depths especially beneath sounding 49, where there is no indication of the presence of a very high resistivity basement (see Appendix B).

Beneath sounding 51, the low resistivity materials of 7 to 10 ohm-m probably represent alluvial deposits of sand and gravel saturated with poor quality water. These materials are underlain by a thick section of moderately low resistivities (10 to 30 ohm-m) which most likely represent sedimentary deposits of sand and gravel, low percentage of clay, and saturated with good quality water.

Beneath soundings 52, 53, 55, and 56, which are approximately located in the middle of the cross section, the interpreted resistivities in the top 25 m are in the range of 10 to 30 ohm-m and probably represent unsaturated sand and silt with a high percentage of clay and a low percentage of gravel. This interpretation of lithology is based on the location of these sounding (i.e. in the center of the valley) where finer materials are expected to be found. These materials are underlain by a thick section of low resistivity (4.5 to 10 ohm-m) which most likely represents sedimentary deposits saturated with poor quality water. This zone has a thickness ranging from about 300 to 750 m. These deposits are underlain by materials of higher resistivities (10 to 45 ohm-m) which may represent basin fill deposits with a lower percentage of clay and maybe saturated with good quality water. The shallowest depth for possible good quality water is about 550 m under sounding 52 and the deepest depth to the good quality water is about 750 m under sounding 55.

West of sounding 57, on the Mesa, New Mexico, the interpreted resistivity in the top 40 m is in the range of 100 to >300 ohm-m which probably represent unsaturated alluvial deposits of sand, gravel and cobbles. These are underlain by materials having a moderately high resistivities (45 to 100 ohm-m), having a thickness of about 300 m, which probably represent saturated alluvial deposits of sand and gravel with very good quality water. These deposits are underlain by layers with moderately low resistivity (10 to 45 ohm-m), having an average thickness of about 35 m which probably represent alluvial deposits of sand and gravel with a medium percentage of clay saturated with good quality water. These materials are underlain by materials with low resistivities (4.5 to10), having an average thickness about 350 m, which may represent saturated basin fill deposits most likely saturated with poor quality water quality. The water levels beneath soundings 57and 58 are estimated to be 35 m beneath sounding 57 and 45 m beneath soundings 58 (Gates, 1977, written communication to Zohdy).

The low resistivity layer beneath soundings 58 and 57 dips to the east at an angle of about 20 degrees (note the vertical exaggeration in the cross section). At this small dip angle, the interpretation in terms of horizontally stratified media is still permissible.

Beneath soundings 60, and 61 which are located on the Mesa, New Mexico, The interpreted resistivity of the top 100 m is in the range of 100 to >300 ohm-m which probably represent unsaturated alluvial deposits of sand, gravel and cobbles. These materials are underlain by materials having moderately high resistivities in the range of 45 to 70 ohm-m, and having a thickness of about 50 m under sounding 60 and about 100 m under sounding 61. These materials probably represent saturated alluvial deposits of sand and gravel with very good quality water. These materials are underlain by materials with moderately low resistivity (10 to 45 ohm-m), having a maximum thickness about 900 m under sounding 61 and a minimum thickness about 250 m under sounding 60. This zone probably represent sand and gravel deposits with some clay and saturated with good quality water.

Beneath sounding 60, at a depth of about 800 m, the interpreted resistivity is in the range of 45 to 100 ohm-m which may be created by the distortion of last segment of the sounding curve (Appendix B, note the sharp cusp at the AB/2 spacing of 655 m). The last segment may have be created by a fence or a buried cable that would be located at a distance of 650 to 950 m from the center of the electrode array and must have extended along the road where the sounding was made. This type of conductor would carry a large portion of the electric current and deposit it closer to the potential electrodes and generate a much larger than the normal potential difference signal, thus increasing the apparent resistivity. The net effect is similar to the effect of current leakage at a fixed distance from the center of the array (Zohdy, 1968). On the other hand, the cusp on sounding 60, at a spacing of about 650 m could have been caused by lateral inhomogeneity of low resistivity material located at that distance. This interpretation is not entirely unreasonable, because if one extends the dipping conductive material seen beneath sounding 58, to the surface, then it could intersect the earth surface at a distance of about 500 to 1000 m from the center of sounding 60, which would then cause the formation of a cusp. However, since the dipping low resistivity material beneath sounding 58 is to the east of sounding 60 and sounding 60 was expanded north west-south east, then this assumption postulate that the dipping layer extends to the south west. The 45 to >70 ohm-m material (if it exists) may represent volcanic materials.

Cross Section 65-62

Cross section 65-62 is shown in figure 9. This short cross section is about 9.7 km long and all of it lies in the state of New Mexico and was made in the southern-western part of the studied area.

Similar to other cross sections, the top 400 m beneath the Mesa, are dominated by high resistivity materials with resistivities of 45 to >300 ohm-m, and except for the top 100 m of this materials probably represents a substantial aquifer saturated with fresh water. Low resistivity materials ranging from about 3 to 10 ohm-m occurs beneath soundings 64 and 65 at depths ranging from about 64 to 600 m. The increase in resistivity from 15 to 20 ohm-m near the bottom of the cross section at an average depth of about 750 m may represent sedimentary deposits saturated with better quality water or may represent the first sign of the detection of a high resistivity basement rock. Indeed, the field curves of sounding 63, 64, and 65 show the possible formation of a minimum at the end of the curve. Without extrapolating the data along a line inclined to the abscissa at 45 (S-line, or total conductance line, Keller and Frischknecht, 1966; Zohdy et al, 1974) or without constraining the resistivity of the last layer in the automatic interpretation program to a much higher resistivity, the last layer resistivity is given by the automatic interpretation program as greater than that of the overlying layers, but not sufficiently greater to be interpreted as representing basement rocks.

The water levels beneath soundings 63 and 64 are estimated to be 93 m and 95m, respectively (Gates, 1977, written communication to Zohdy).

RESISTIVITY MAPS

Figures 10 and 11 show eight interpreted resistivity maps at depths of 10, 30, 50, 70, 100, 300, 500, and 700 m. Soundings that were expanded to sufficiently large current electrode spacings to probe to the depth indicated on a given map are named deep soundings and are represented by open squares. Soundings that were not expanded to sufficiently large current electrode spacings to probe to the depth indicated on a given map are named shallow soundings and are represented by small solid squares. On the 300 m depth map there are three shallow sounding stations and on the 700 m depth map there are several. Some areas on the 700 m depth map are shown in white because the shallow soundings in those areas do not probe to the 700 m depth and they are located far away from the nearest deep soundings.

On the 10 and 30 m depth maps (figure 10), there are high resistivity materials (100 to >300 ohm-m) which represent alluvial fan deposits of sand, gravel, and cobble in the east, and other sand and gravel deposits on the Mesa, in the west. These areas decrease and recede from the middle to the west and from the middle to the east at successively larger depths from 10 to 70 m. The thickness of the high resistivity materials is larger in the west than in the east which represent the thick sand and gravel deposits of the Mesa. This is reflected by the persistence of high resistivity materials of 45 to 150 ohm-m on the first 5 maps down to a depth of 100 m.

In general, the low resistivity materials in the middle of maps represent the abundance of clayey deposits and the poor quality water in the shallow aquifer. This is particularly evident on the 30, 50, and 70 m depth maps.

The 100 m depth map shows that the low resistivity materials of <10 ohm-m are particularly confined to area south of the town of Conutillo and that the Conutillo area, where a well field exists, lies in a favorable ground-water location where the interpreted resistivity forms a moderate high possibly representing a very large buried alluvial fan deposit.

The 300 m and 500 m depth maps show the extension of the low resistivity material to the north (about 7 km north of Conutillo). The resistivity high shown in the south western part of the 500 m depth map is basically based on a single sounding station (sounding 60) but it is also supported by soundings 58 and 57 as shown on cross section 61-48. The origin of this high resistivity material is uncertain but it may represents volcanic rocks.

On all maps: a) Materials with interpreted resistivity of less than 10 ohm-m probably represent clayey sediments with low permeability or sediments with a high percentage of clay saturated with average to poor quality water. b) Materials with 30 to 45 ohm-m probably represent sediments with low percentage of clay and with good quality water. c) Materials with interpreted resistivity of about 45 to 150 ohm-m probably represent sediments with greater amounts of sand and gravel having water of good quality.

Note on most of maps there are seemingly isolated anomalies with small diameters in comparison to the current electrode spacings that were used to detect them. These relatively small anomalies do not necessarily represent small isolated three dimensional bodies. Instead, they generally represent the sliced portion of the top (or the bottom) of a much larger low resistivity (or high resistivity) material of substantial thickness and width.

CONCLUSIONS

- The interpretation of the resistivity maps and cross sections showed that the eastern and the western parts of the studied area most probably contain substantial sand and gravel saturated with good quality water. The middle part of the studied area, the Mesilla Valley itself, most probably contains fine sand and clay deposits saturated with bad quality water.

- The interpretation of the resistivity data showed a consistent and reasonable picture of subsurface distributions of geoelectric layers.

- The resistivity survey showed that it is possible to infer the variation of water quality both laterally and vertically in the studied area.

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Zohdy, A.A.R. Bisdorf, R.J., and Gates, J.S., 1976, Schlumberger Soundings in the Lower Mesilla Valley of the Rio Grande, Texas and New Mexico: U.S. Geological Survey Open-File Report 76-324, 77 p.

Zohdy, A.A.R. Bisdorf, R.J., and Gates, J.S., 1994, A Direct Current Resistivity Survey of the Beaver Dam Wash Drainage in Southwest Utah, Southeast Nevada, and Northwest Arizona: U.S. Geological Survey Open-File Report 94-676, 87 p.

Zohdy, A.A.R., Eaton, G.P., and Mabey, D.R., 1974, Application of surface geophysics to Ground-water investigation: techniques os Water-resources Investigations of the United states geological Survey, book 2, Chapter D1, 116 p.

APPENDIX A

Electrode-Spacing Measurements

In this survey, the current and potential electrode spacings were measured in feet and then converted to meters during the data processing part of the automatic interpretation program (Zohdy and Bisdorf, 1989). A cloth tape was used to measure the current electrode spacings, AB/2, from 10 to 100 ft and cable counters were used to measure the larger distances.

In this survey, an unusual set of current electrode spacings were used. The AB/2 spacings were measured at: 6.8, 10, 14.6, 21.5, 31.5, 46.8, 68, 100, and so on. The reason for using this scheme was to approximates measurements at the rate of six points per decade. These electrode spacings would then be nearly the same as those to be used later in the data processing and interpretation. Such unusual electrode spacings were neither used before nor after this survey (Zohdy, oral communication, 1996).

Segments on each sounding were obtained by expanding the current electrode spacings, AB/2, from 10 ft to 31.5 ft with fixed potential electrode spacings, MN/2, at 2 ft. Later, the potential electrode spacings were moved from 2 ft to 20 ft and the second segment on the sounding curve was obtained by expanding the current electrode spacing from 31.5 ft to 100 ft. Then, the potential electrode spacings were moved from 20 ft to 60 ft and the third segment on the sounding curve was obtained by expanding the current electrode spacing from 100 ft to 315 ft. Then, the potential electrode spacings were moved from 60 ft to 200 ft and the forth, and other segments on the sounding curve were obtained by expanding the current electrode spacing from 315 ft to 1000 ft, from 1000 ft to 6000 ft, and from 6000 ft to the end of the line. Most soundings were expanded to maximum current electrode spacings that ranged from 4,300 ft to 8,000 ft. Wherever the discontinuity between two segments was more than about 5%, additional measurements were taken so that the two segments would overlap by two points instead of one.

Trucks and Other Equipment

Three trucks were used: an instrument truck which remained stationary at the center of sounding, and two pickup trucks which were used to lay out and pick up the current cable. FM radios were used for communication between the operator and the crew. A 5 kva generator was used for the current power supply and a potentiometric chart recorder was used for measuring the potential difference between the potential electrodes.

APPENDIX B

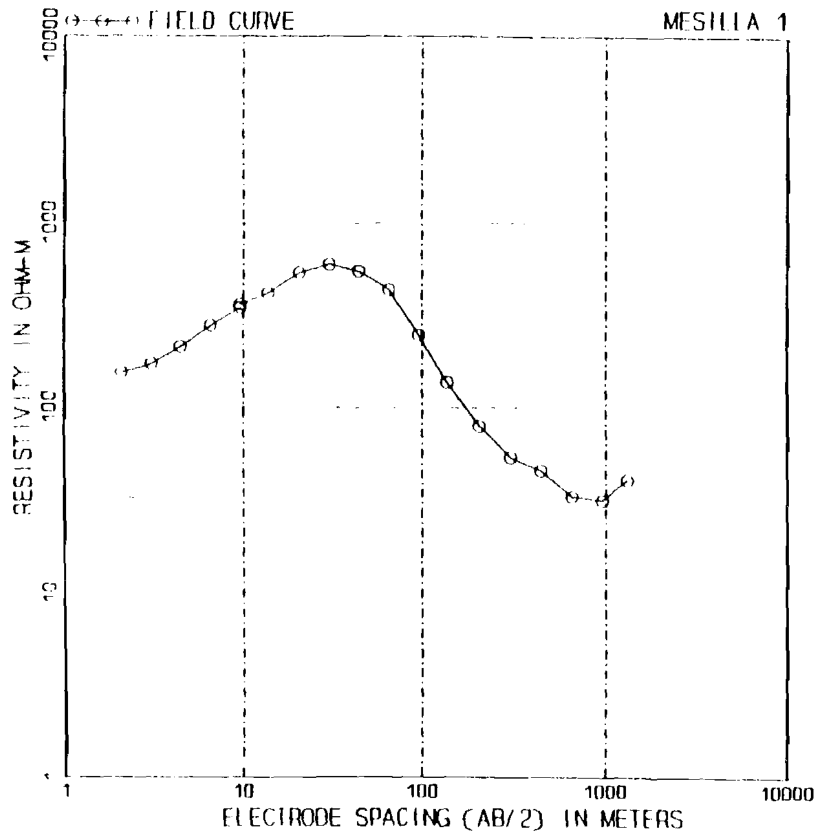
Field and Interpreted Sounding Curves

The data for each sounding curve includes:

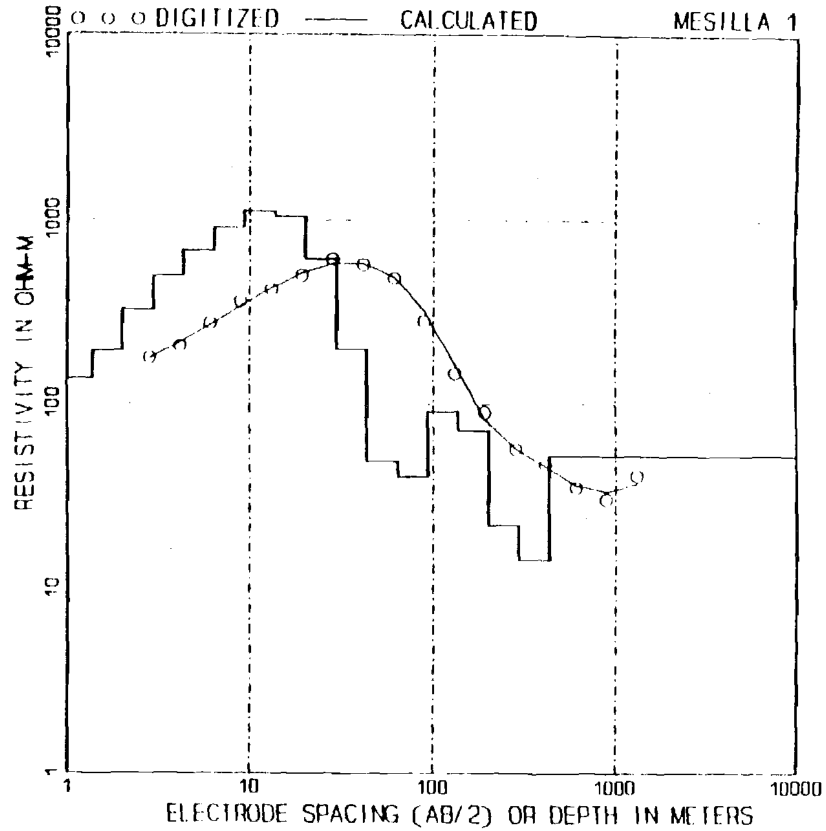
1) The title of the sounding (Mesilla), which is an abbreviation for the name of the survey area, followed by the number of the sounding. The letter T is used as a suffix for the title of sounding 14 to indicate that the sounding curve was truncated prior to interpretation.

2) The field sounding data were plotted on a log-log scale with the x-axis as the current electrode spacings (AB/2) in meters and the y-axis as the apparent resistivity in ohm-meters. Each set of data points, that were made using a fixed potential electrode spacing , are connected with a solid line to form a segment on the sounding curve.

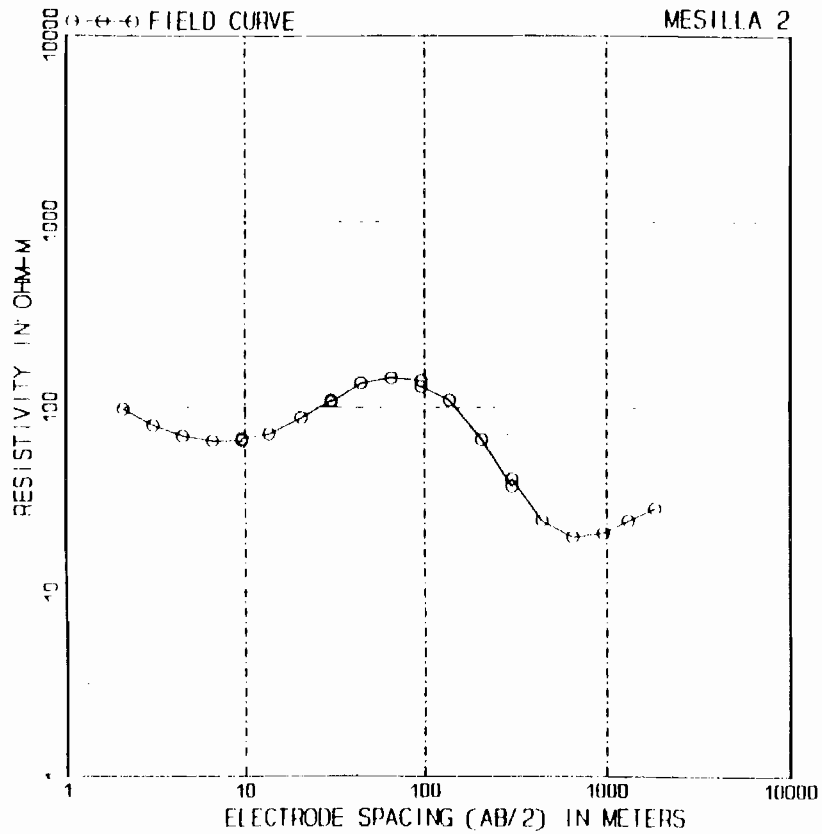
3) The results of the automatic interpretation program are plotted the on log-log scale. The shifted and digitized sounding curve is represented by circles. The calculated sounding curve is represented by curve. The interpreted layering model is represented by a step function curve. The current electrode spacings of the digitized sounding curve, the calculated sounding curve, and the interpreted depth to the various layers are represented on the abscissa; whereas, the digitized apparent resistivities, the calculated apparent resistivities, and the interpreted resistivity of the various layers (in the step function model) are plotted on the ordinate.



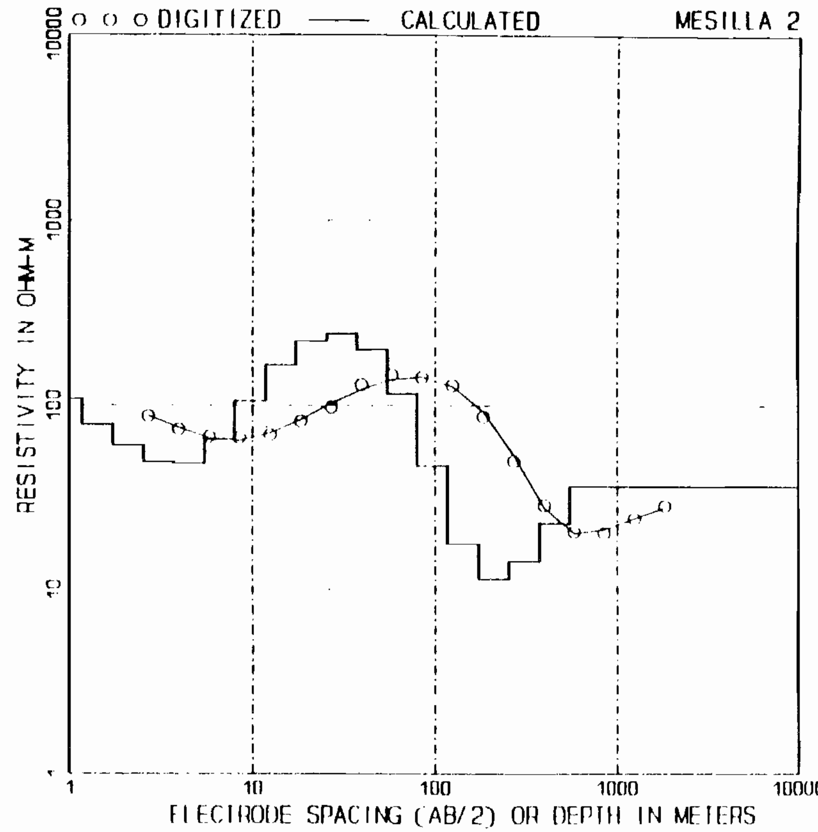
AB/2, m	(ft)	App. Res	AB/2, m	(ft)	App. Res
2.07	(6.80)	155.00	44.50	(146.00)	550.00
3.05	(10.00)	173.00	65.53	(215.00)	440.00
4.45	(14.60)	215.00	96.01	(315.00)	250.00
6.55	(21.50)	280.00	137.16	(450.00)	137.00
9.60	(31.50)	350.00	207.26	(680.00)	80.00
9.60	(31.50)	365.00	304.80	(1000.00)	54.00
13.72	(45.00)	420.00	445.01	(1460.00)	46.00
20.73	(68.00)	540.00	655.32	(2150.00)	33.00
30.48	(100.00)	600.00	960.12	(3150.00)	31.50
			1310.64	(4300.00)	41.00



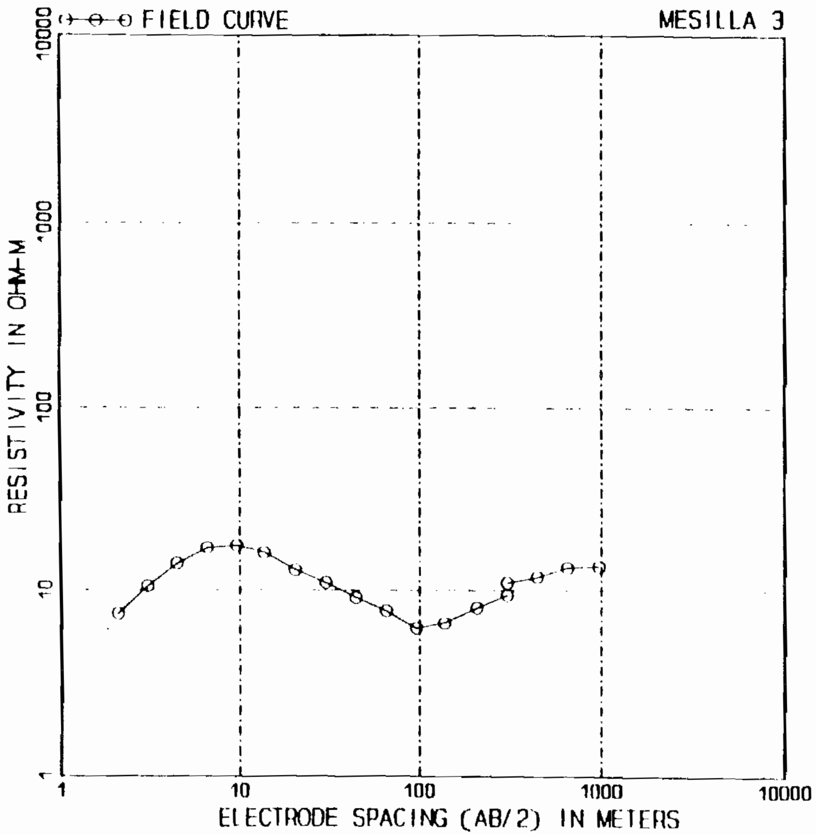
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.37	(4.50)	136.56	29.57	(97.00)	616.34
2.01	(6.61)	194.42	43.40	(142.38)	197.96
2.96	(9.70)	326.53	63.70	(208.98)	49.20
4.34	(14.24)	497.98	93.49	(306.74)	40.02
6.37	(20.90)	680.74	137.23	(450.23)	90.69
9.35	(30.67)	909.90	201.43	(660.85)	71.81
13.72	(45.02)	1121.03	295.66	(970.00)	21.83
20.14	(66.09)	1053.56	433.96	(1423.76)	14.34
			99999.00	(99999.00)	52.64



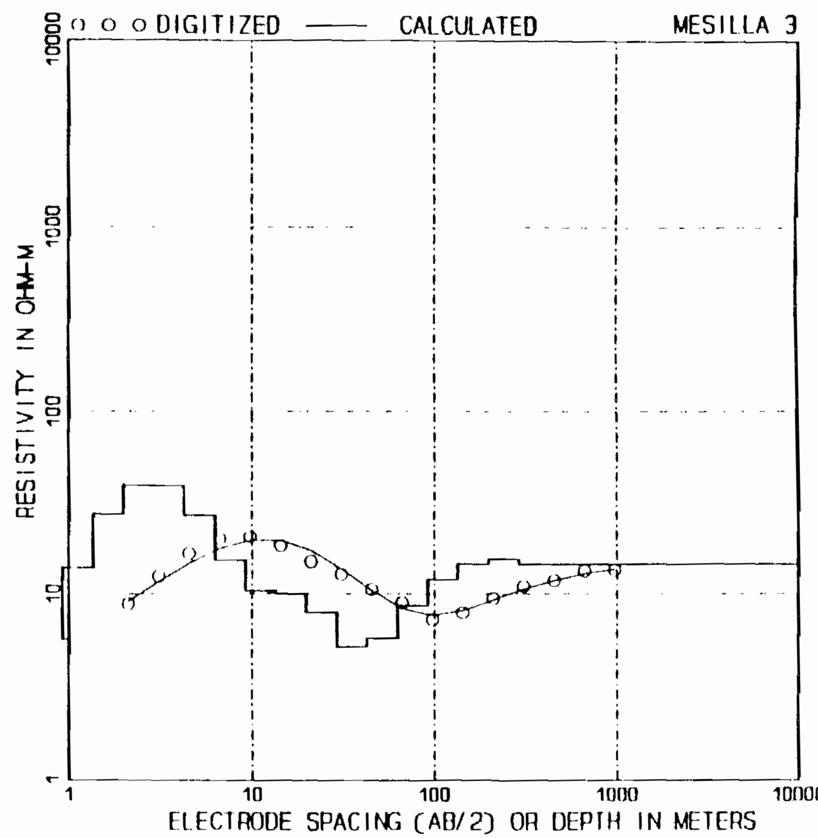
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	98.00	65.53	(215.00)	145.00
3.05	(10.00)	80.00	96.01	(315.00)	140.00
4.45	(14.60)	70.00	96.01	(315.00)	130.00
6.55	(21.50)	66.00	137.16	(450.00)	110.00
9.60	(31.50)	66.00	207.26	(680.00)	67.00
9.60	(31.50)	68.00	304.80	(1000.00)	37.50
13.72	(45.00)	72.00	304.80	(1000.00)	41.00
20.73	(68.00)	88.00	445.01	(1460.00)	24.50
30.48	(100.00)	110.00	655.32	(2150.00)	20.00
30.48	(100.00)	107.00	960.12	(3150.00)	21.00
44.50	(146.00)	136.00	1310.64	(4300.00)	24.50
			1828.80	(6000.00)	28.50



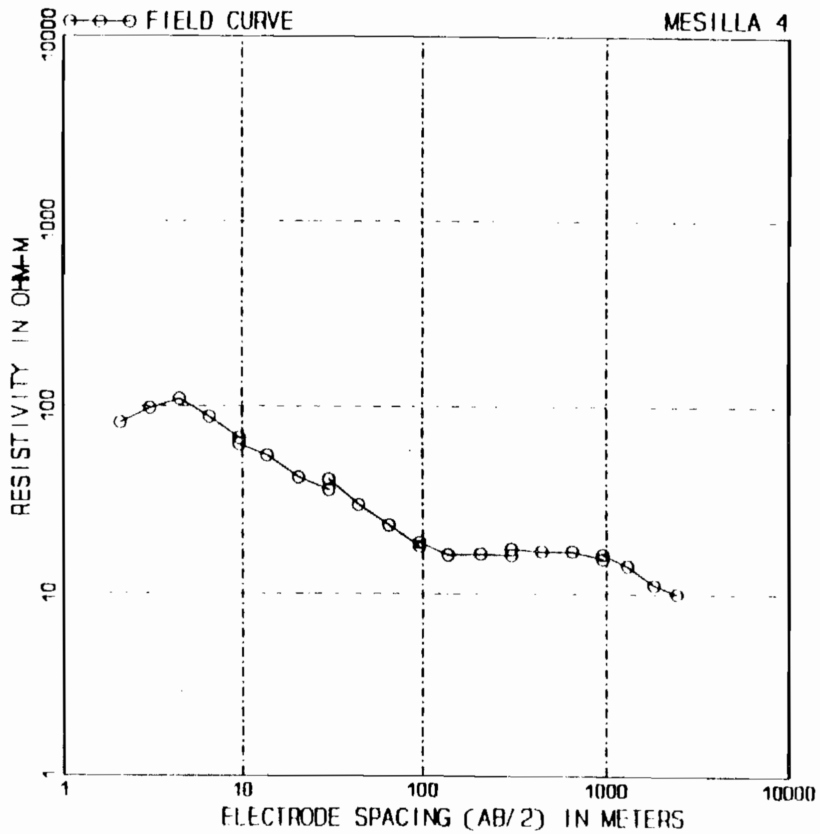
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.17	(3.85)	108.59	37.13	(121.81)	243.85
1.72	(5.65)	78.80	54.50	(178.80)	201.43
2.53	(8.30)	60.28	79.99	(262.44)	115.92
3.71	(12.18)	49.05	117.41	(385.21)	46.79
5.45	(17.88)	48.48	172.34	(565.41)	17.74
8.00	(26.24)	65.19	252.96	(829.91)	11.42
11.74	(38.52)	105.34	371.29	(1218.14)	14.29
17.23	(56.54)	165.37	544.98	(1787.98)	22.95
25.30	(82.99)	222.93	99999.00	(99999.00)	36.17



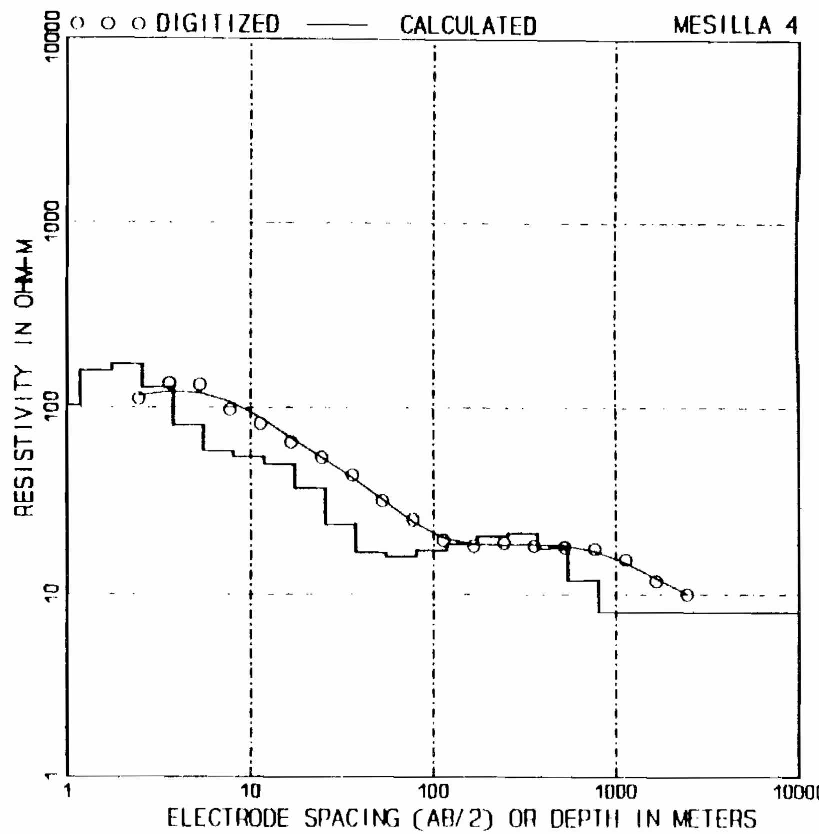
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	7.40	44.50	(146.00)	9.10
3.05	(10.00)	10.50	65.53	(215.00)	7.70
4.45	(14.60)	14.00	96.01	(315.00)	6.20
6.55	(21.50)	17.00	137.16	(450.00)	6.60
9.60	(31.50)	17.50	207.26	(680.00)	8.00
9.60	(31.50)	17.50	304.80	(1000.00)	9.40
13.72	(45.00)	16.00	304.80	(1000.00)	11.00
20.73	(68.00)	12.90	445.01	(1460.00)	11.80
30.48	(100.00)	11.00	655.32	(2150.00)	13.30
			975.36	(3200.00)	13.[illegible]



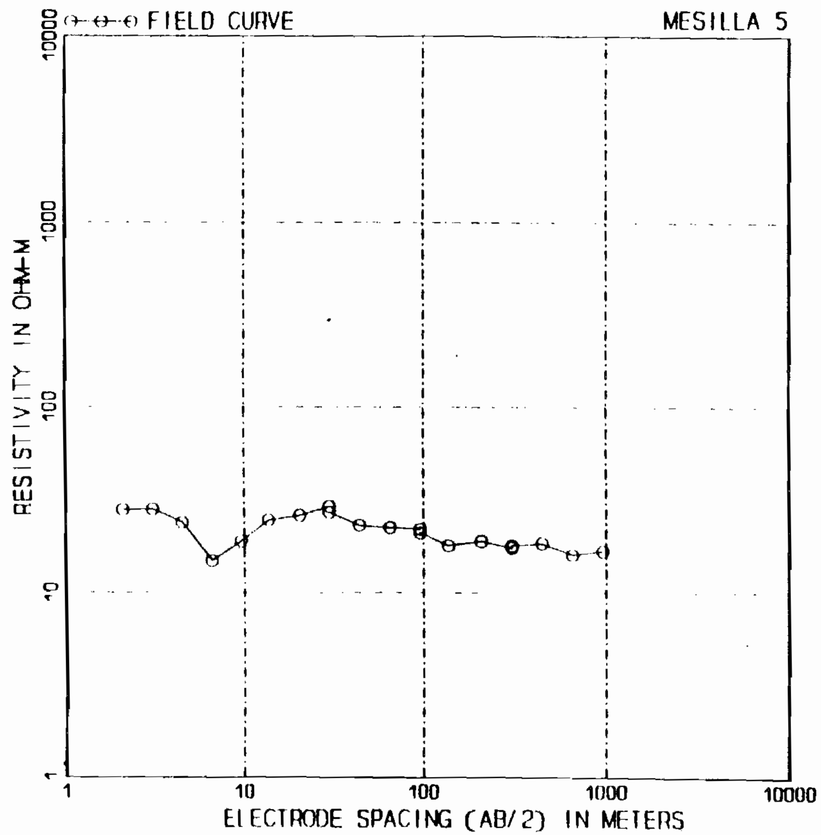
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
0.92	(3.02)	5.63	19.80	(64.97)	10.00
1.35	(4.43)	13.89	29.07	(95.36)	7.94
1.98	(6.50)	27.20	42.66	(139.97)	5.15
2.91	(9.54)	39.07	62.62	(205.44)	5.71
4.27	(14.00)	38.92	91.91	(301.55)	8.60
6.26	(20.54)	26.84	134.91	(442.62)	11.91
9.19	(30.16)	15.19	198.02	(649.67)	14.51
13.49	(44.26)	10.36	290.65	(953.59)	15.47
			99999.00	(99999.00)	14.54



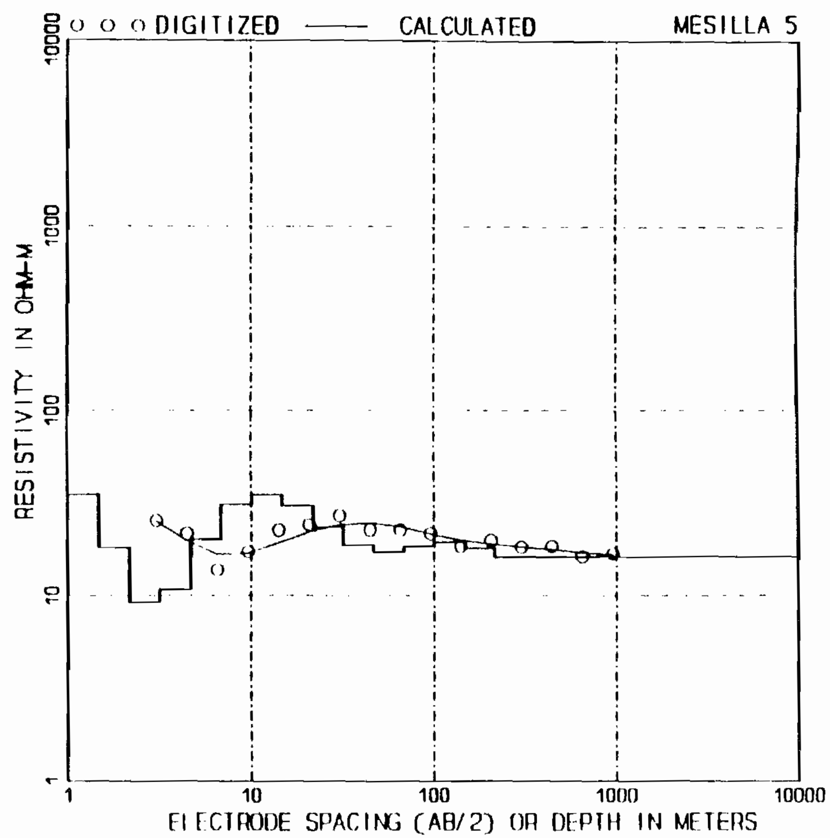
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	6.80	82.00	96.01	315.00	18.10
3.05	10.00	98.00	96.01	315.00	19.00
4.45	14.60	110.00	137.16	450.00	16.30
6.55	21.50	88.00	207.26	680.00	16.50
9.60	31.50	68.00	304.80	1000.00	16.20
9.60	31.50	63.00	304.80	1000.00	17.50
13.72	45.00	55.00	445.01	1460.00	17.00
20.73	68.00	42.00	655.32	2150.00	17.00
30.48	100.00	36.00	960.12	3150.00	15.50
30.48	100.00	41.00	960.12	3150.00	16.40
44.50	146.00	30.00	1310.64	4300.00	14.20
65.53	215.00	23.40	1828.80	6000.00	11.20
			2438.40	8000.00	10.00



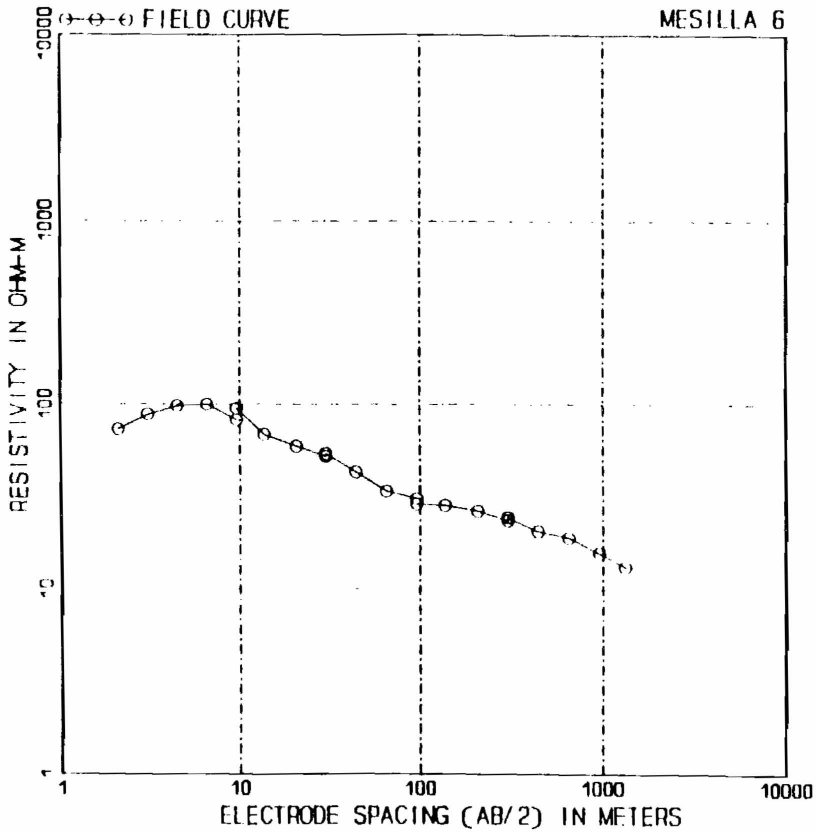
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.19	3.89	102.26	37.47	122.95	23.83
1.74	5.71	156.83	55.01	180.47	16.95
2.55	8.38	171.22	80.74	264.89	16.08
3.75	12.29	128.38	118.51	388.80	17.32
5.50	18.05	80.46	173.94	570.68	18.79
8.07	26.49	58.58	255.31	837.64	20.77
11.85	38.88	54.58	374.75	1229.49	21.39
17.39	57.07	49.85	550.06	1804.65	17.79
25.53	83.76	37.06	807.37	2648.86	11.95
			99999.00	99999.00	8.01



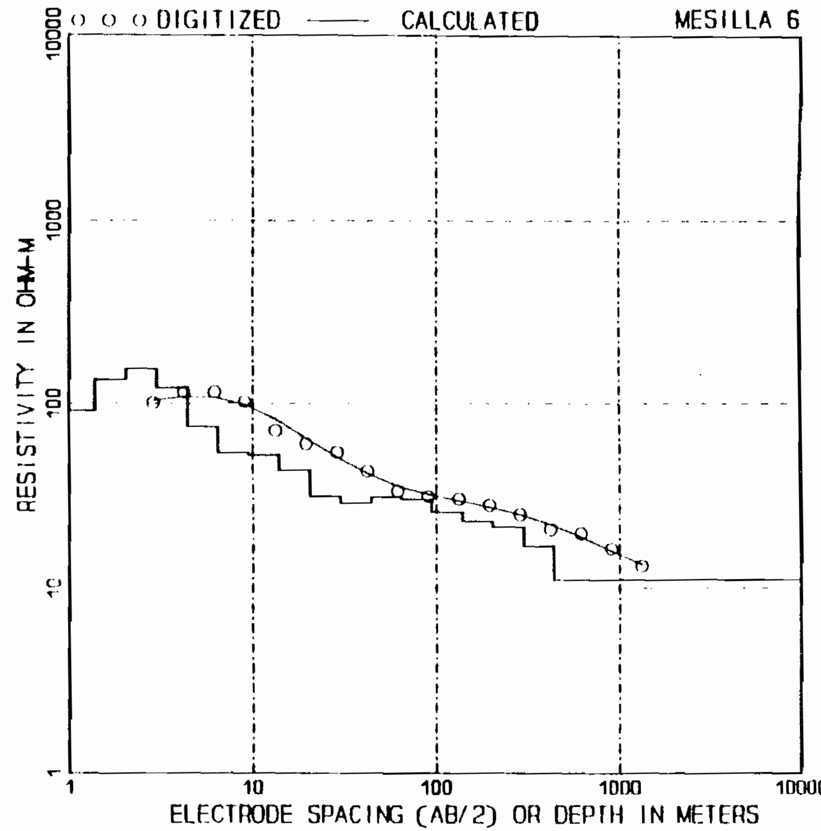
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	27.80	65.53	(215.00)	22.40
3.05	(10.00)	28.00	96.01	(315.00)	22.00
4.45	(14.60)	23.80	96.01	(315.00)	21.00
6.55	(21.50)	14.80	137.16	(450.00)	18.00
9.60	(31.50)	18.90	207.26	(680.00)	19.00
13.72	(45.00)	24.50	304.80	(1000.00)	17.50
20.73	(68.00)	26.00	304.80	(1000.00)	18.00
30.48	(100.00)	29.00	445.01	(1460.00)	18.50
30.48	(100.00)	27.00	655.32	(2150.00)	16.00
44.50	(146.00)	23.00	960.12	(3150.00)	16.80



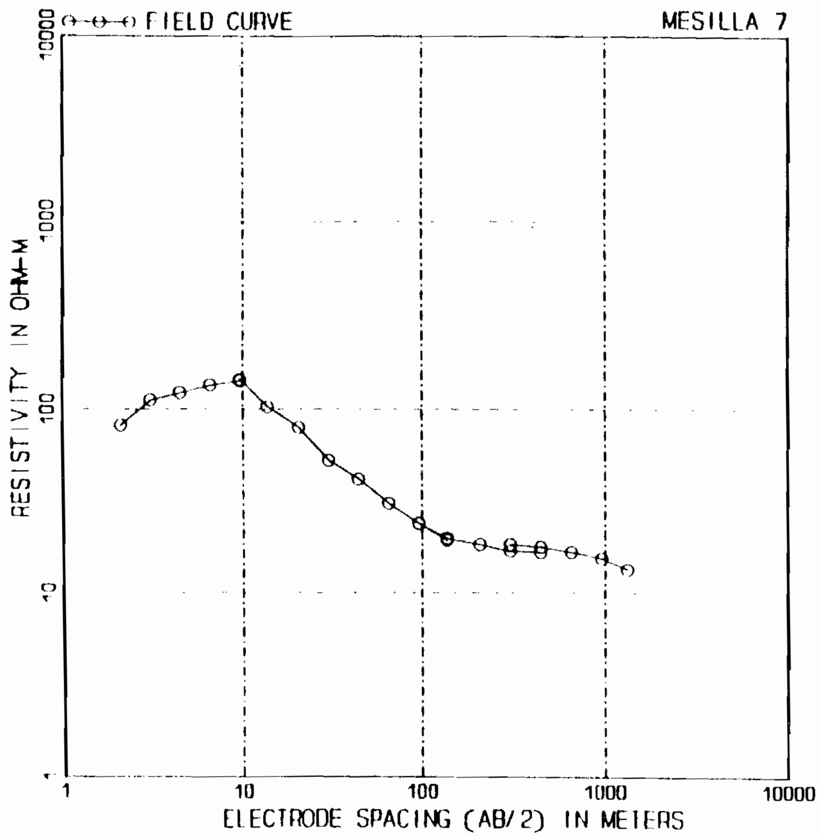
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.48	(4.84)	35.26	31.79	(104.30)	23.54
2.17	(7.11)	18.12	46.66	(153.09)	18.67
3.18	(10.43)	9.15	68.49	(224.71)	17.16
4.67	(15.31)	10.82	100.53	(329.82)	18.40
6.85	(22.47)	20.21	147.56	(484.11)	19.42
10.05	(32.98)	31.03	216.59	(710.58)	18.08
14.76	(48.41)	35.00	317.90	(1042.99)	16.24
21.66	(71.06)	30.52	99999.00	(99999.00)	16.18



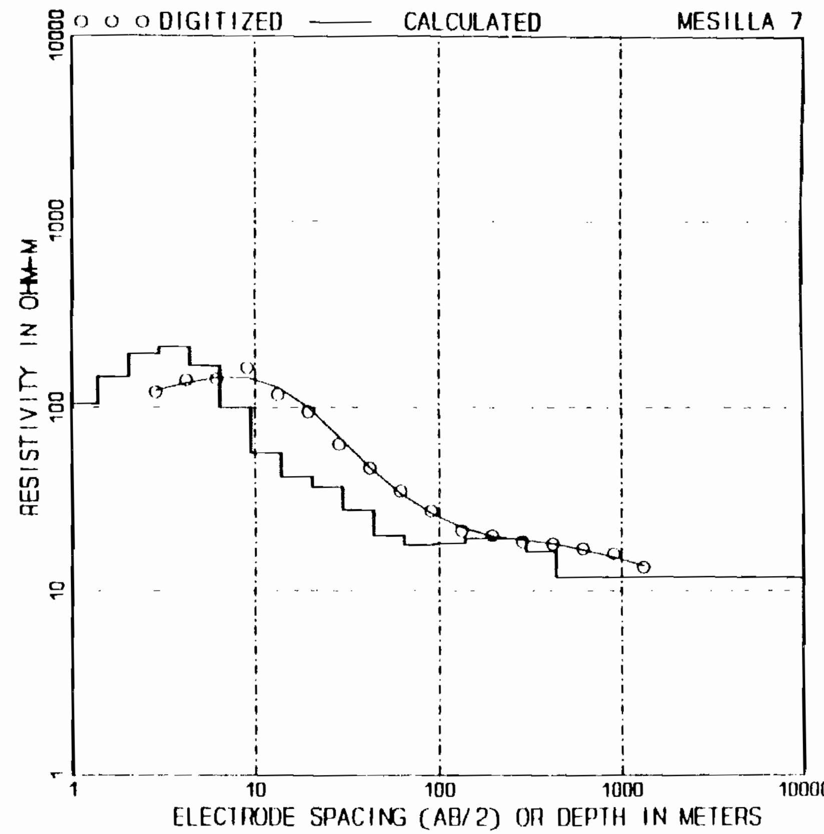
AB/2, m	ft	App. Res.	AB/2, m	ft	App. Res.
2.07	6.80	73.00	65.53	215.00	34.00
3.05	10.00	88.00	96.01	315.00	31.00
4.45	14.60	98.00	96.01	315.00	29.00
6.55	21.50	100.00	137.16	450.00	28.50
9.60	31.50	82.00	207.26	680.00	26.50
9.60	31.50	95.00	304.80	1000.00	23.50
13.72	45.00	68.00	304.80	1000.00	24.50
20.73	68.00	59.00	445.01	1460.00	20.60
30.48	100.00	52.00	655.32	2150.00	19.00
30.48	100.00	54.00	960.12	3150.00	15.70
44.50	146.00	43.00	1325.88	4350.00	13.20



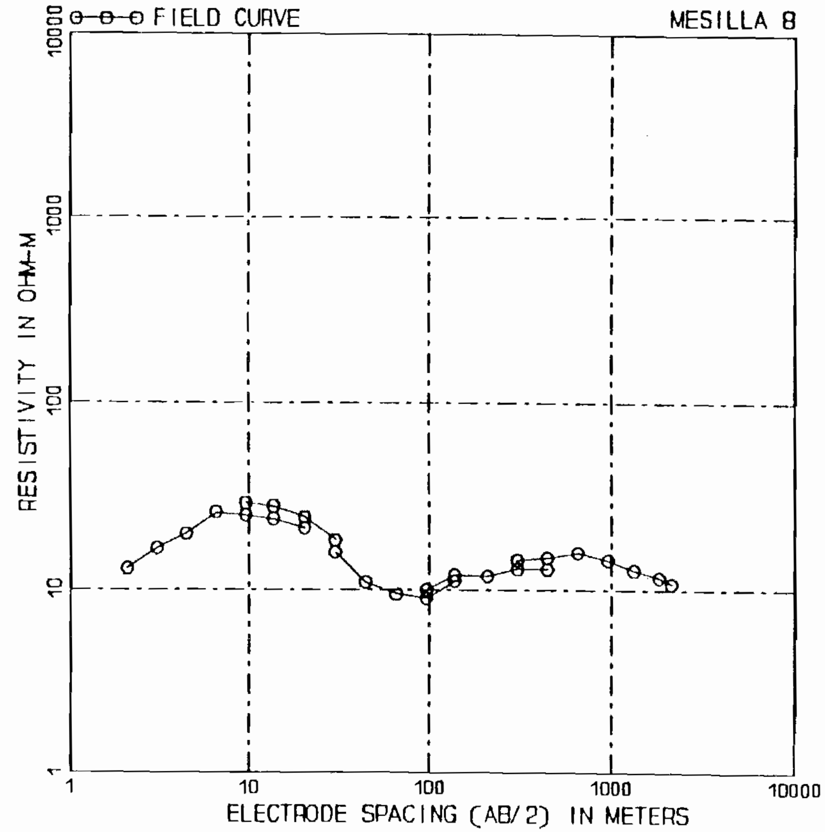
DEPTH, m	ft	RESIS.	DEPTH, m	ft	RESIS.
1.39	4.55	91.28	29.91	98.13	31.33
2.04	6.69	135.51	43.90	144.03	28.73
2.99	9.81	156.03	64.44	211.41	30.96
4.39	14.40	122.36	94.58	310.31	30.04
6.44	21.14	74.39	138.83	455.47	25.81
9.46	31.03	53.78	203.77	668.54	23.00
13.88	45.55	51.98	299.09	981.28	21.31
20.38	66.85	43.34	439.01	1440.32	16.76
			99999.00	99999.00	11.09



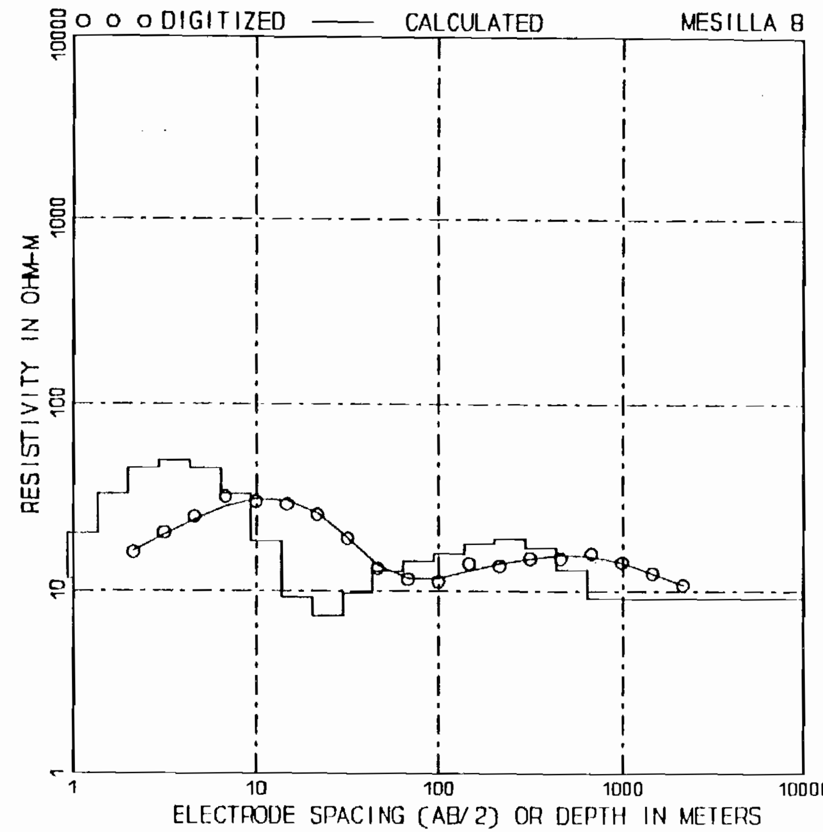
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	82.00	96.01	(315.00)	24.00
3.05	(10.00)	112.00	137.16	(450.00)	19.50
4.45	(14.60)	123.00	96.01	(315.00)	24.20
6.55	(21.50)	135.00	137.16	(450.00)	20.00
9.60	(31.50)	142.00	207.26	(680.00)	18.50
9.60	(31.50)	145.00	304.80	(1000.00)	17.00
13.72	(45.00)	103.00	445.01	(1460.00)	16.80
20.73	(68.00)	80.00	304.80	(1000.00)	18.50
30.48	(100.00)	53.00	445.01	(1460.00)	17.90
30.48	(100.00)	53.00	655.32	(2150.00)	16.80
44.50	(146.00)	42.00	960.12	(3150.00)	15.50
65.53	(215.00)	31.00	1325.88	(4350.00)	13.50



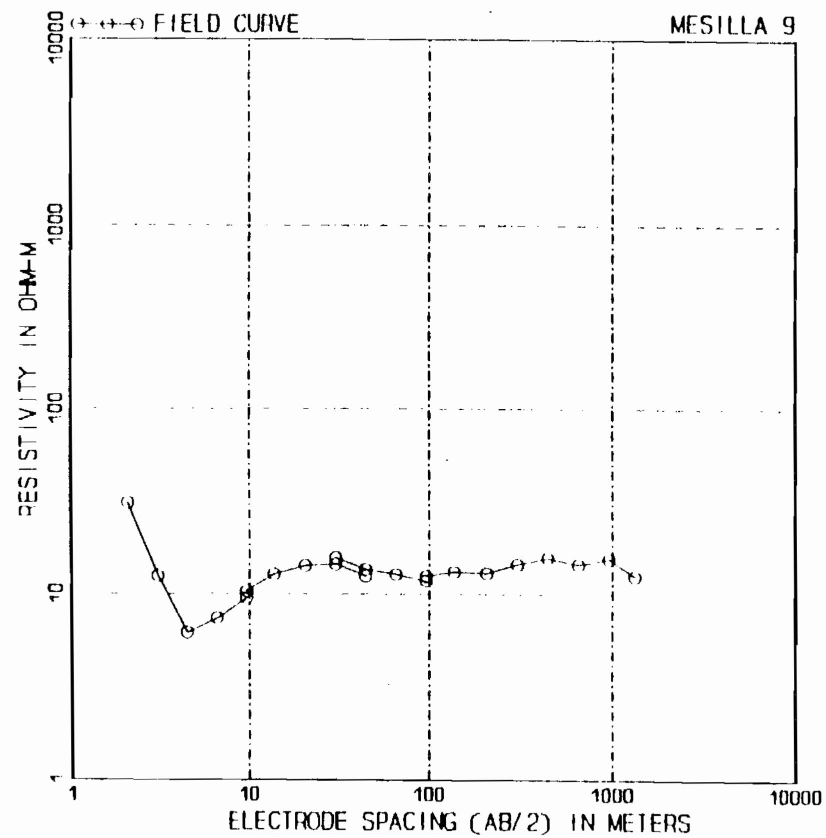
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.39	(4.55)	104.76	29.91	(98.13)	36.86
2.04	(6.69)	147.02	43.90	(144.03)	27.67
2.99	(9.81)	195.41	64.44	(211.41)	20.18
4.39	(14.40)	212.23	94.58	(310.31)	17.84
6.44	(21.14)	167.93	138.83	(455.47)	18.21
9.46	(31.03)	100.18	203.77	(668.54)	19.38
13.88	(45.55)	56.89	299.09	(981.28)	19.40
20.38	(66.85)	42.09	439.01	(1440.32)	16.39
			99999.00	(99999.00)	11.86



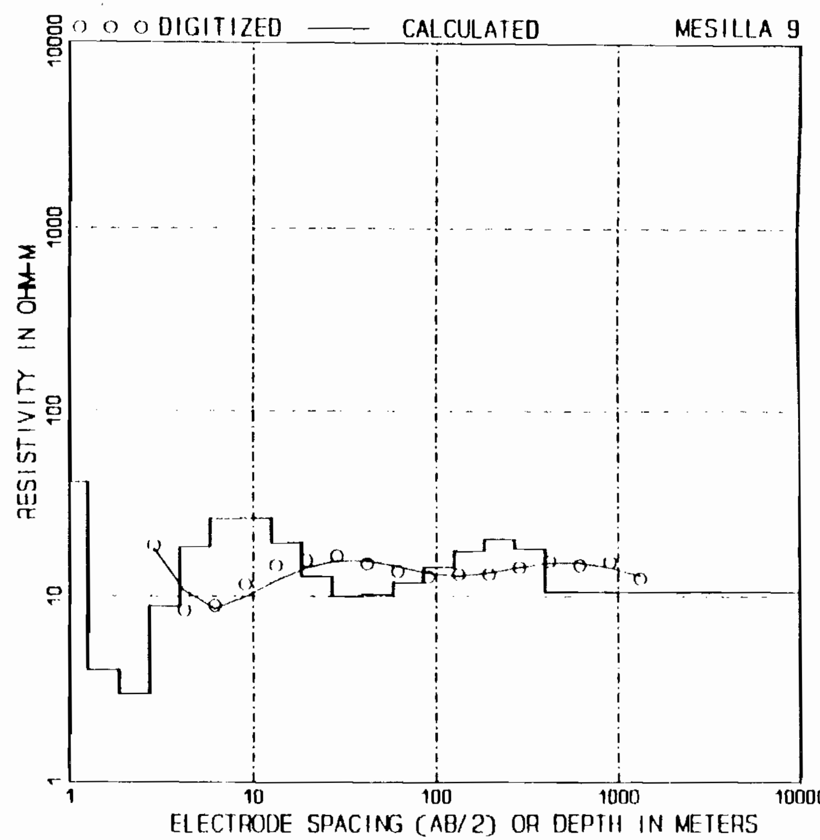
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	13.00	96.01	(315.00)	9.00
3.05	(10.00)	16.70	137.16	(450.00)	11.20
4.45	(14.60)	20.00	96.01	(315.00)	10.00
6.55	(21.50)	26.00	137.16	(450.00)	12.00
9.60	(31.50)	25.00	207.26	(680.00)	11.90
13.72	(45.00)	24.00	304.80	(1000.00)	13.00
20.73	(68.00)	21.50	445.01	(1460.00)	13.00
9.60	(31.50)	29.00	304.80	(1000.00)	14.50
13.72	(45.00)	28.00	445.01	(1460.00)	15.00
20.73	(68.00)	24.50	655.32	(2150.00)	16.00
30.48	(100.00)	18.50	960.12	(3150.00)	14.50
30.48	(100.00)	16.00	1325.88	(4350.00)	12.80
44.50	(146.00)	11.00	1828.80	(6000.00)	11.70
65.53	(215.00)	9.50	2133.60	(7000.00)	10.80



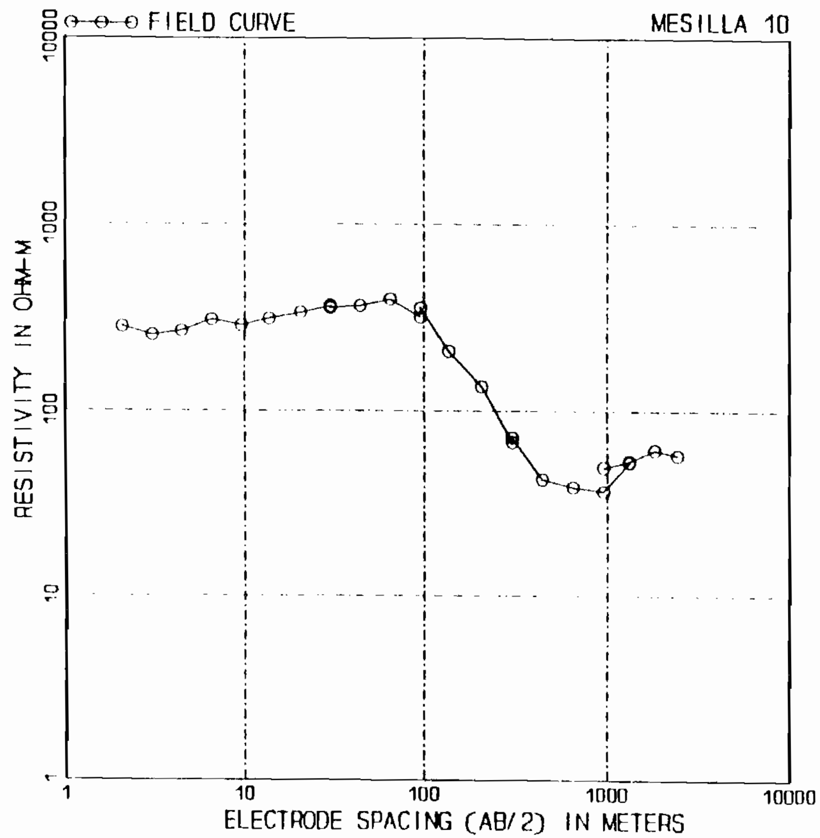
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
0.93	(3.06)	11.66	29.51	(96.82)	7.29
1.37	(4.49)	20.53	43.32	(142.12)	9.69
2.01	(6.60)	33.28	63.58	(208.60)	12.85
2.95	(9.68)	45.07	93.32	(306.18)	14.56
4.33	(14.21)	49.74	136.98	(449.41)	15.96
6.36	(20.86)	45.30	201.06	(659.65)	18.02
9.33	(30.62)	33.14	295.12	(968.23)	19.28
13.70	(44.94)	18.50	433.17	(1421.16)	17.37
20.11	(65.96)	9.29	635.81	(2085.98)	12.98
			99999.00	(99999.00)	9.07



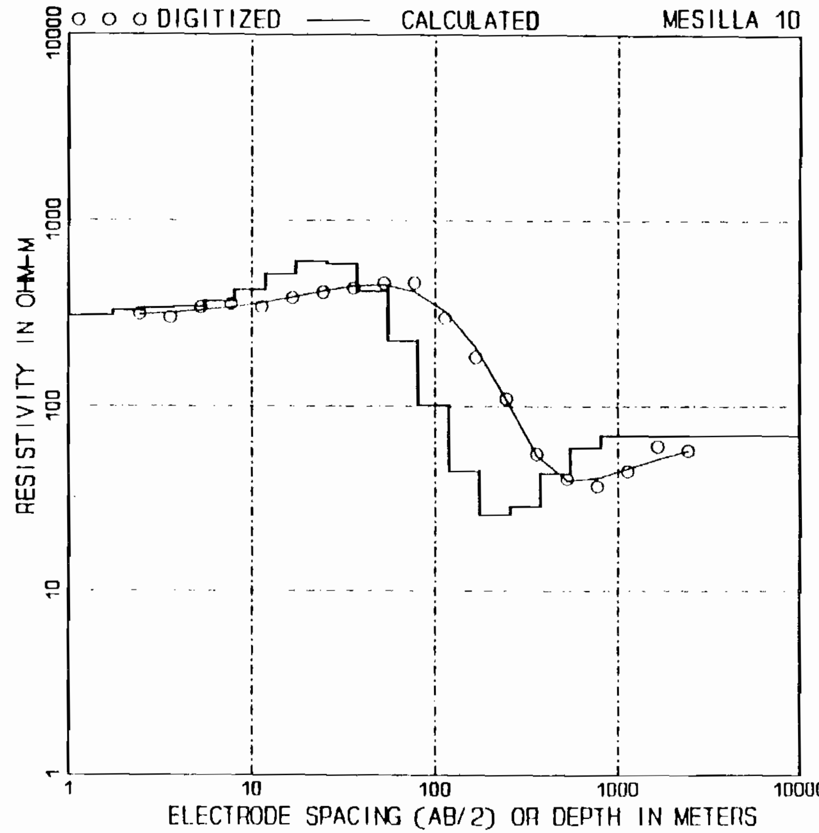
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	31.00	44.50	(146.00)	13.60
3.05	(10.00)	12.50	65.53	(215.00)	12.80
4.45	(14.60)	6.20	96.01	(315.00)	11.80
6.55	(21.50)	7.40	96.01	(315.00)	12.50
9.60	(31.50)	9.50	137.16	(450.00)	13.20
9.60	(31.50)	10.40	207.26	(680.00)	13.00
13.72	(45.00)	12.80	304.80	(1000.00)	14.50
20.73	(68.00)	14.20	445.01	(1460.00)	15.70
30.48	(100.00)	14.50	655.32	(2150.00)	14.50
44.50	(146.00)	12.50	960.12	(3150.00)	15.50
30.48	(100.00)	15.70	1325.88	(4350.00)	12.50



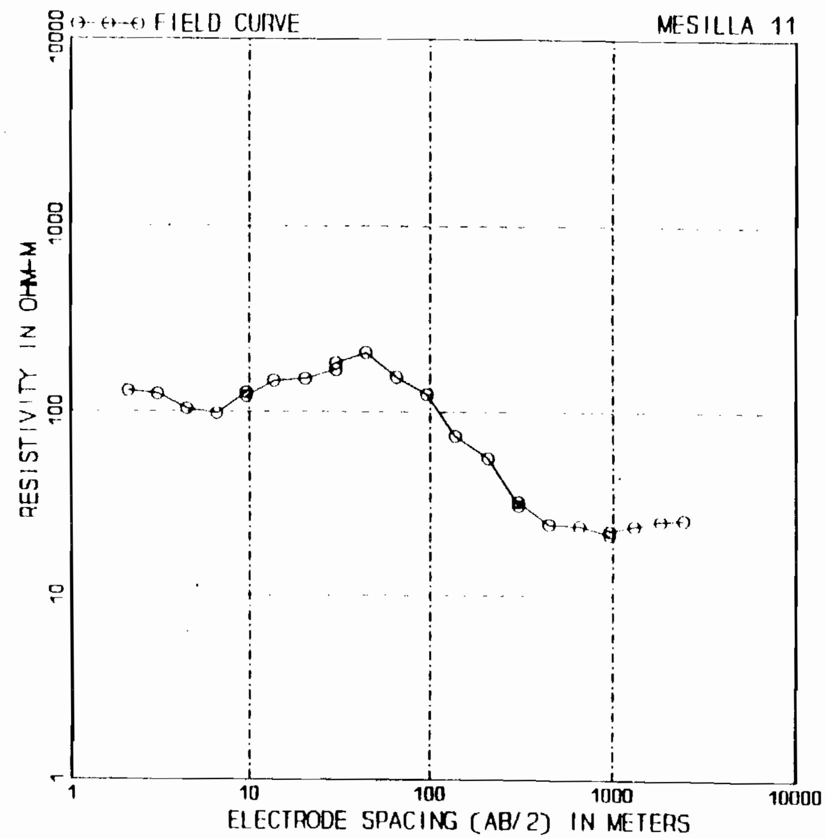
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.25	(4.10)	41.10	26.92	(88.32)	12.78
1.83	(6.02)	4.02	39.51	(129.63)	10.01
2.69	(8.83)	3.00	57.99	(190.27)	10.22
3.95	(12.96)	8.80	85.12	(279.28)	11.83
5.80	(19.03)	18.41	124.94	(409.92)	14.37
8.51	(27.93)	26.20	183.39	(601.68)	17.61
12.49	(40.99)	26.34	269.18	(883.15)	20.45
18.34	(60.17)	19.48	395.11	(1296.29)	18.18
			99999.00	(99999.00)	10.56



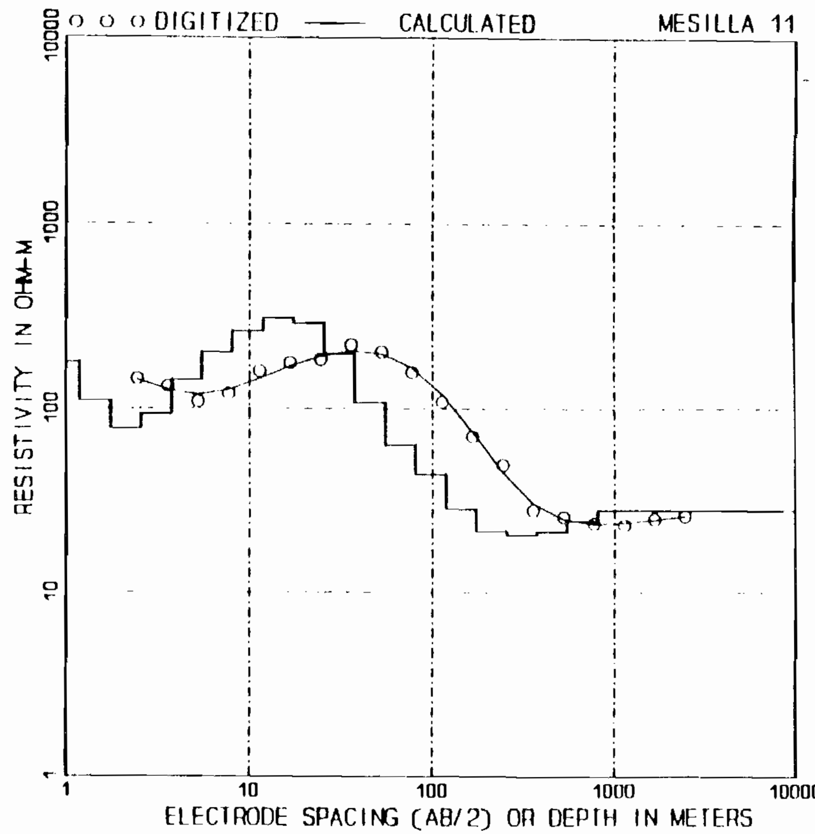
AB/2, m (	ft)	App. Res.	AB/2, m (	ft)	App. Res.
2.07 (	6.80)	285.00	96.01 (	315.00)	360.00
3.05 (	10.00)	257.00	137.16 (	450.00)	210.00
4.45 (	14.60)	270.00	207.26 (	680.00)	135.00
6.55 (	21.50)	310.00	304.80 (	1000.00)	68.00
9.60 (	31.50)	290.00	304.80 (	1000.00)	72.00
13.72 (	45.00)	315.00	445.01 (	1460.00)	43.00
20.73 (	68.00)	340.00	655.32 (	2150.00)	39.00
30.48 (	100.00)	370.00	960.12 (	3150.00)	37.00
30.48 (	100.00)	360.00	1325.88 (	4350.00)	53.00
44.50 (	146.00)	370.00	960.12 (	3150.00)	50.00
65.53 (	215.00)	400.00	1325.88 (	4350.00)	54.00
96.01 (	315.00)	320.00	1828.80 (	6000.00)	62.00
			2438.40 (	8000.00)	58.00



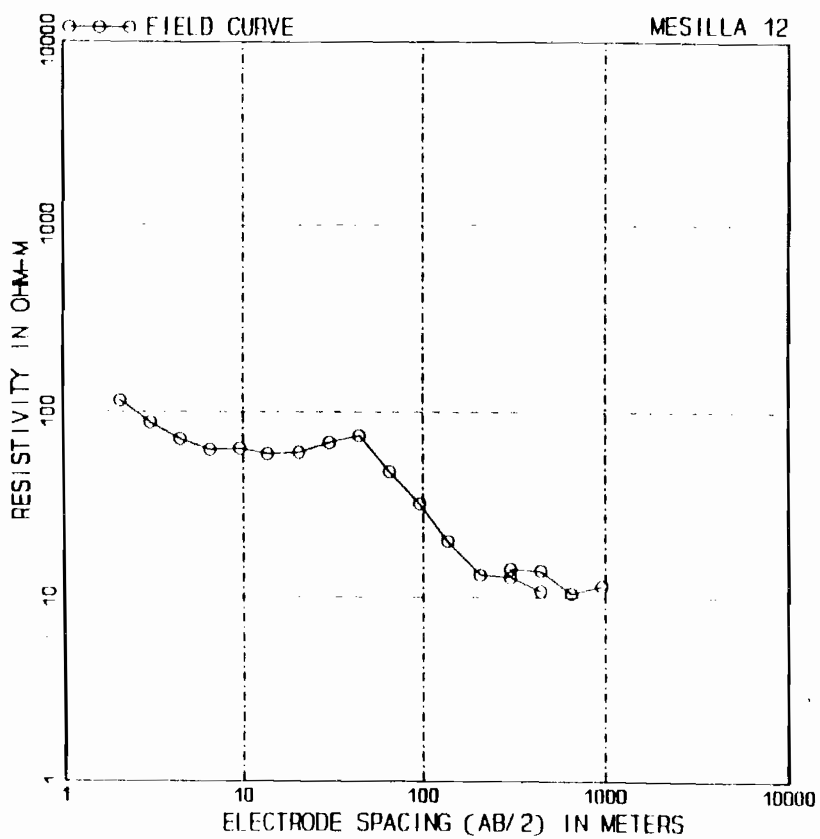
DEPTH, m (	ft)	RESIS.	DEPTH, m (	ft)	RESIS.
1.19 (	3.89)	307.36	37.47 (	122.95)	589.39
1.74 (	5.71)	310.95	55.01 (	180.47)	422.43
2.55 (	8.38)	331.77	80.74 (	264.89)	226.09
3.75 (	12.29)	342.75	118.51 (	388.80)	102.06
5.50 (	18.05)	347.22	173.94 (	570.68)	44.71
8.07 (	26.49)	370.56	255.31 (	837.64)	25.79
11.85 (	38.88)	426.16	374.75 (	1229.49)	28.70
17.39 (	57.07)	517.09	550.06 (	1804.65)	43.43
25.53 (	83.76)	606.65	807.37 (	2648.86)	59.91
			99999.00 (	99999.00)	69.83



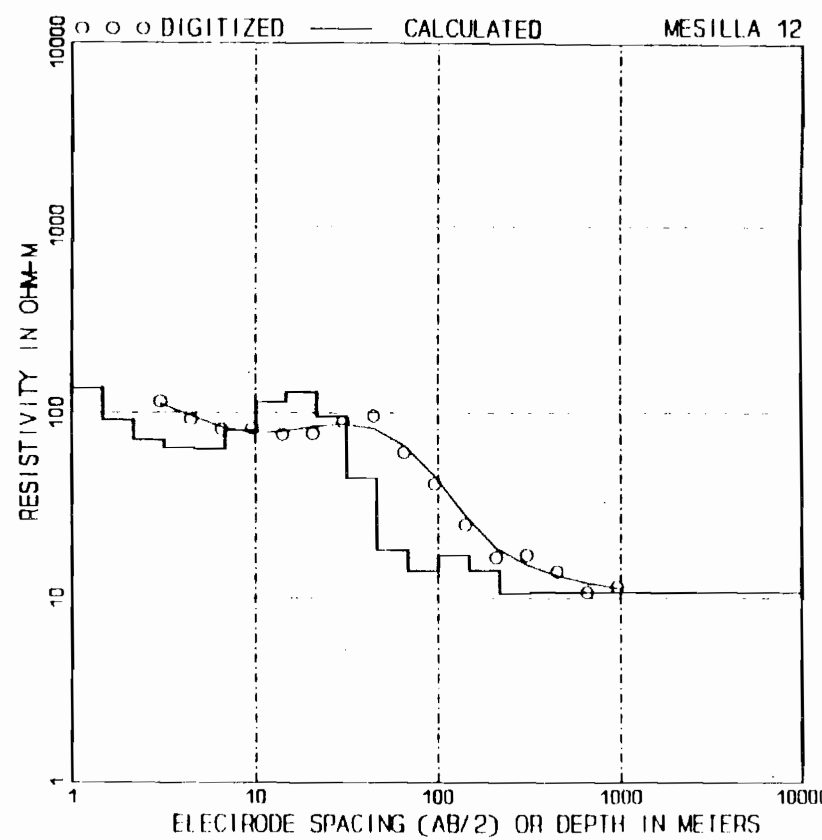
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	6.80	130.00	96.01	315.00	125.00
3.05	10.00	125.00	137.16	450.00	74.00
4.45	14.60	104.00	207.26	680.00	56.00
6.55	21.50	98.00	304.80	1000.00	31.00
9.60	31.50	128.00	304.80	1000.00	32.50
9.60	31.50	122.00	445.01	1460.00	24.50
13.72	45.00	148.00	655.32	2150.00	24.00
20.73	68.00	152.00	960.12	3150.00	21.50
30.48	100.00	170.00	960.12	3150.00	22.50
30.48	100.00	185.00	1310.64	4300.00	24.00
44.50	146.00	210.00	1828.80	6000.00	25.50
65.53	215.00	155.00	2438.40	8000.00	26.00



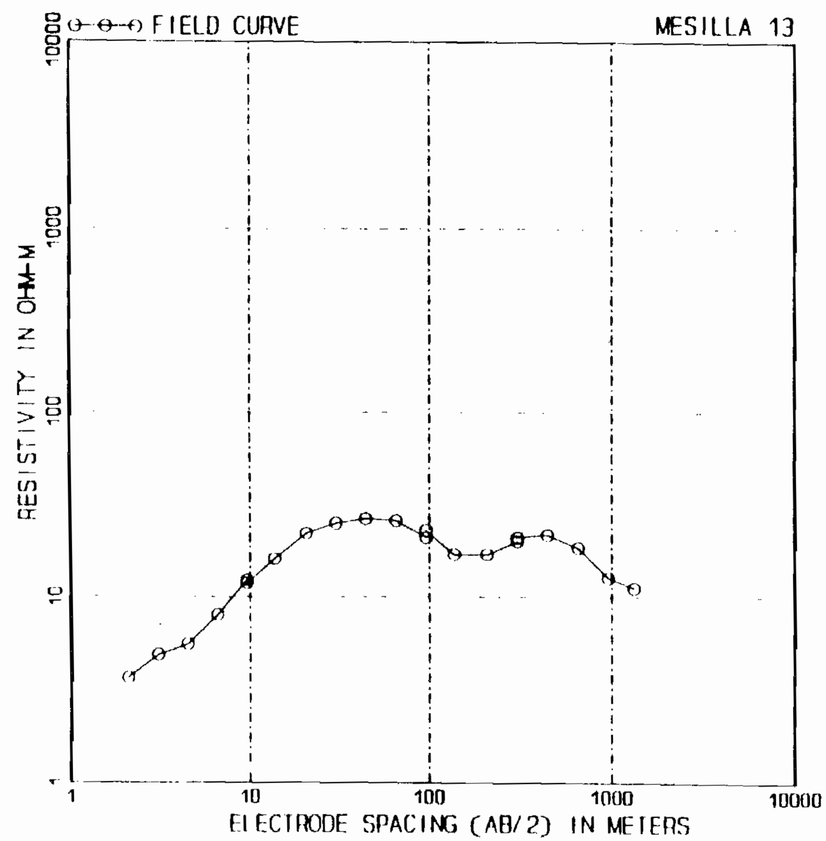
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS
1.19	3.89	179.74	37.47	122.95	199.93
1.74	5.71	111.00	55.01	180.47	108.15
2.55	8.38	77.52	80.74	264.89	62.79
3.75	12.29	93.74	118.51	388.80	43.72
5.50	18.05	144.82	173.94	570.68	28.19
8.07	26.49	203.55	255.31	837.64	21.57
11.85	38.88	263.86	374.75	1229.49	20.40
17.39	57.07	310.89	550.06	1804.65	21.36
25.53	83.76	292.34	807.37	2648.86	24.32
			99999.00	99999.00	27.81

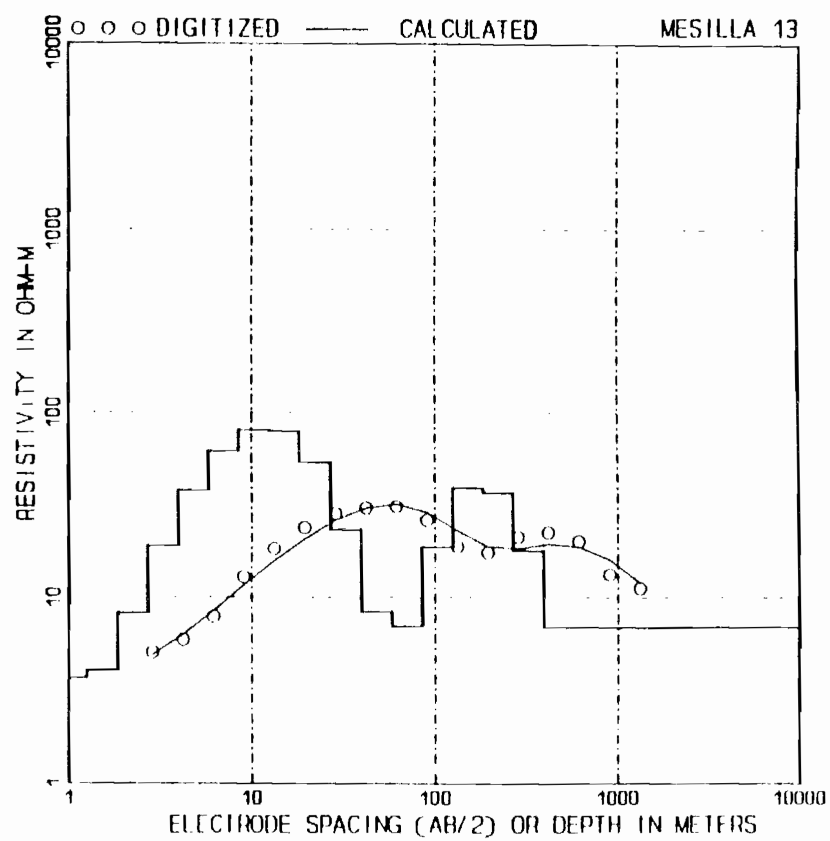


AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	6.80	115.00	44.50	146.00	75.00
3.05	10.00	88.00	65.53	215.00	48.00
4.45	14.60	72.00	96.01	315.00	32.00
6.55	21.50	63.00	137.16	450.00	20.00
9.60	31.50	64.00	207.26	680.00	13.20
9.60	31.50	64.00	304.80	1000.00	12.80
13.72	45.00	60.00	445.01	1460.00	10.80
20.73	68.00	61.00	304.80	1000.00	14.20
30.48	100.00	69.00	445.01	1460.00	13.90
30.48	100.00	69.00	655.32	2150.00	10.50
			960.12	3150.00	11.50



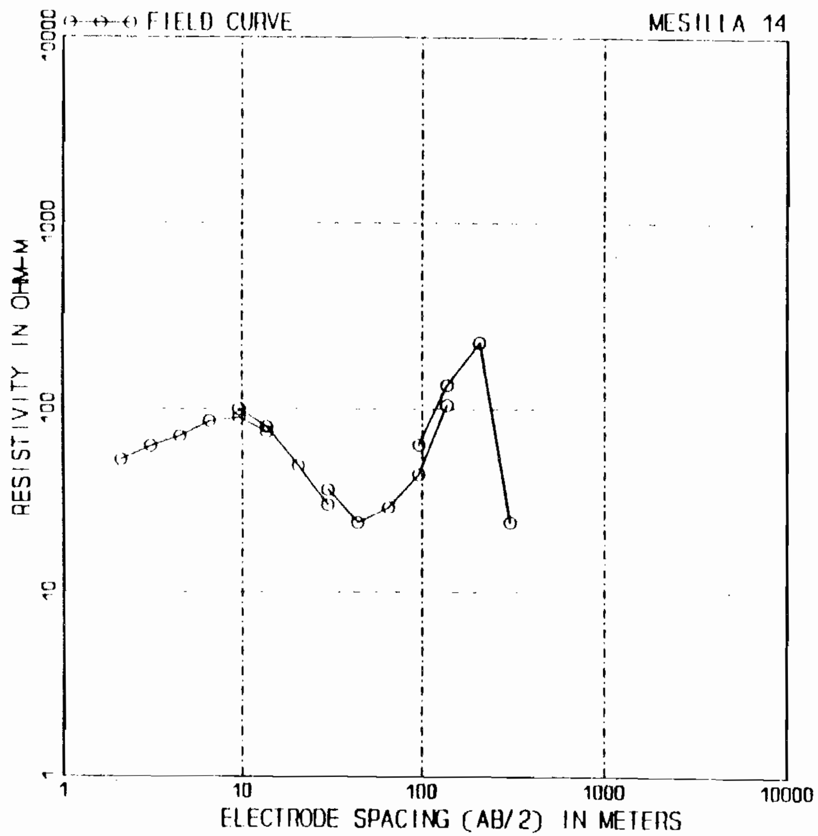
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.48	4.84	135.92	31.79	104.30	95.36
2.17	7.11	91.31	46.66	153.09	44.41
3.18	10.43	71.79	68.49	224.71	18.00
4.67	15.31	64.64	100.53	329.82	13.98
6.85	22.47	63.93	147.56	484.11	16.95
10.05	32.98	80.43	216.59	710.58	14.11
14.76	48.41	114.13	317.90	1042.99	10.58
21.66	71.06	129.60	99999.00	99999.00	10.73



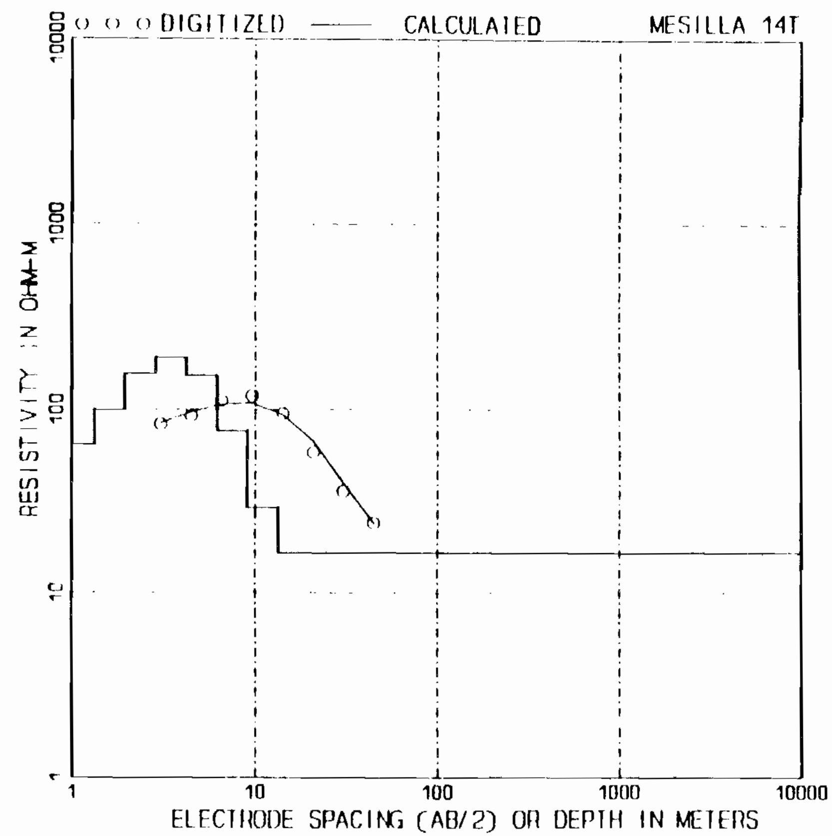


AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	3.70	65.53	(215.00)	26.00
3.05	(10.00)	4.90	96.01	(315.00)	21.00
4.45	(14.60)	5.60	96.01	(315.00)	23.00
6.55	(21.50)	8.00	137.16	(450.00)	17.00
9.60	(31.50)	12.30	207.26	(680.00)	17.00
9.60	(31.50)	11.80	304.80	(1000.00)	20.00
13.72	(45.00)	16.00	304.80	(1000.00)	21.00
20.73	(68.00)	22.00	445.01	(1460.00)	21.70
30.48	(100.00)	25.00	655.32	(2150.00)	18.50
44.50	(146.00)	26.50	960.12	(3150.00)	12.70
			1325.88	(4350.00)	11.20

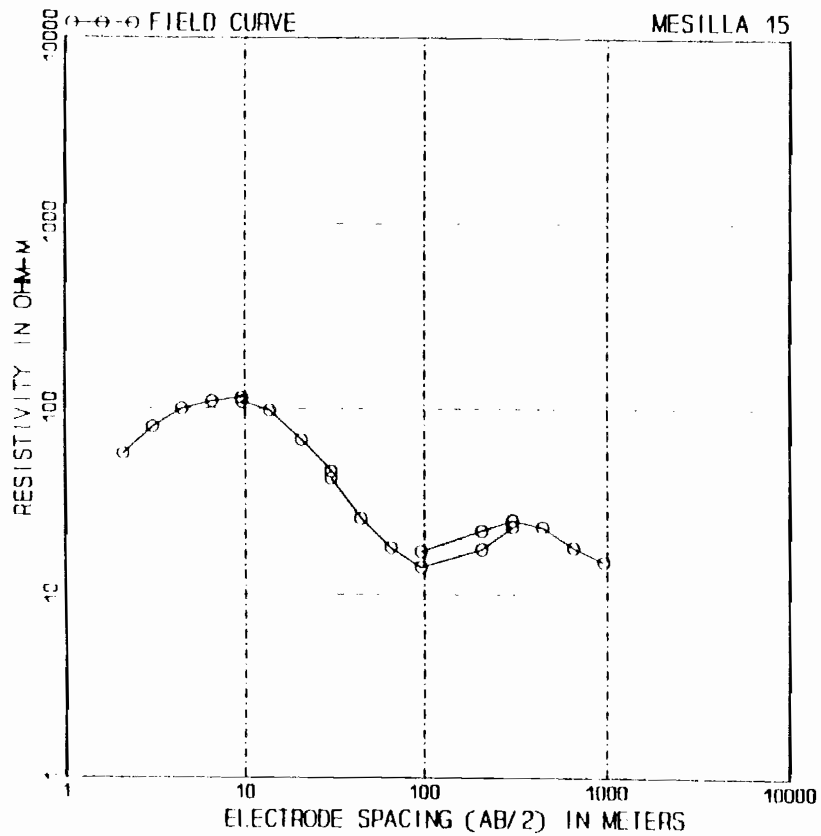
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.25	(4.10)	3.73	26.92	(88.32)	53.28
1.83	(6.02)	4.09	39.51	(129.63)	23.05
2.69	(8.83)	8.24	57.99	(190.27)	8.34
3.95	(12.96)	18.96	85.12	(279.28)	7.00
5.80	(19.03)	37.79	124.94	(409.92)	18.63
8.51	(27.93)	61.52	183.39	(601.68)	39.04
12.49	(40.99)	79.87	269.18	(883.15)	36.53
18.34	(60.17)	78.61	395.11	(1296.29)	17.75
			99999.00	(99999.00)	6.94



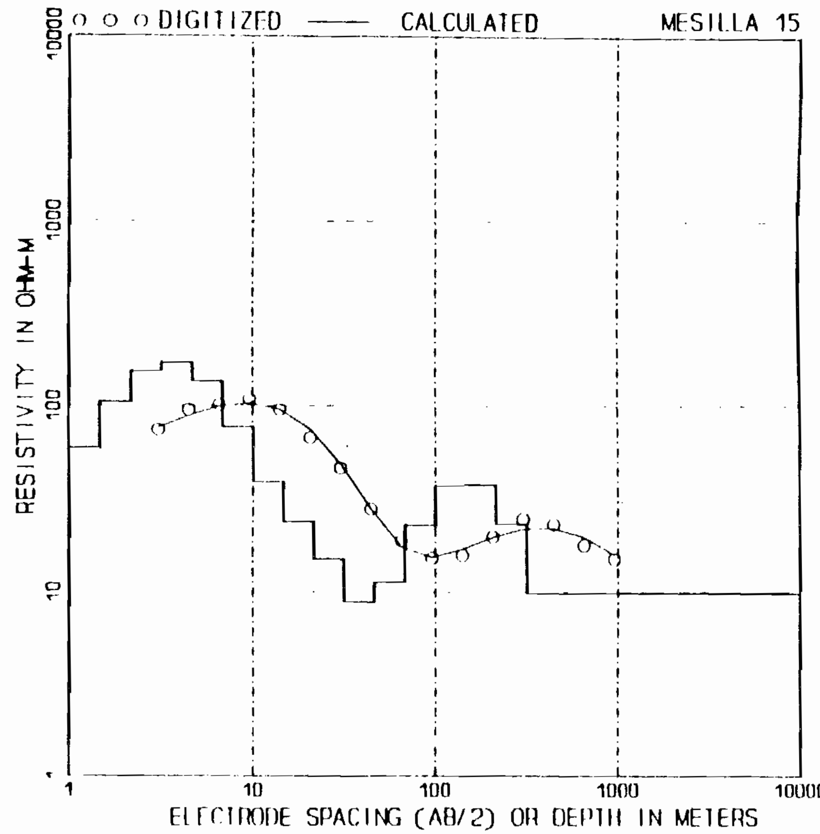
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res
2.07	(6.80)	53.00	30.48	(100.00)	30.00
3.05	(10.00)	63.00	30.48	(100.00)	36.50
4.45	(14.60)	71.00	44.50	(146.00)	24.00
6.55	(21.50)	86.00	65.53	(215.00)	29.00
9.60	(31.50)	90.00	96.01	(315.00)	44.00
13.72	(45.00)	75.00	137.16	(450.00)	105.00
9.60	(31.50)	100.00	96.01	(315.00)	64.00
13.72	(45.00)	80.00	137.16	(450.00)	135.00
20.73	(68.00)	49.00	207.26	(680.00)	230.00
			304.80	(1000.00)	24.20



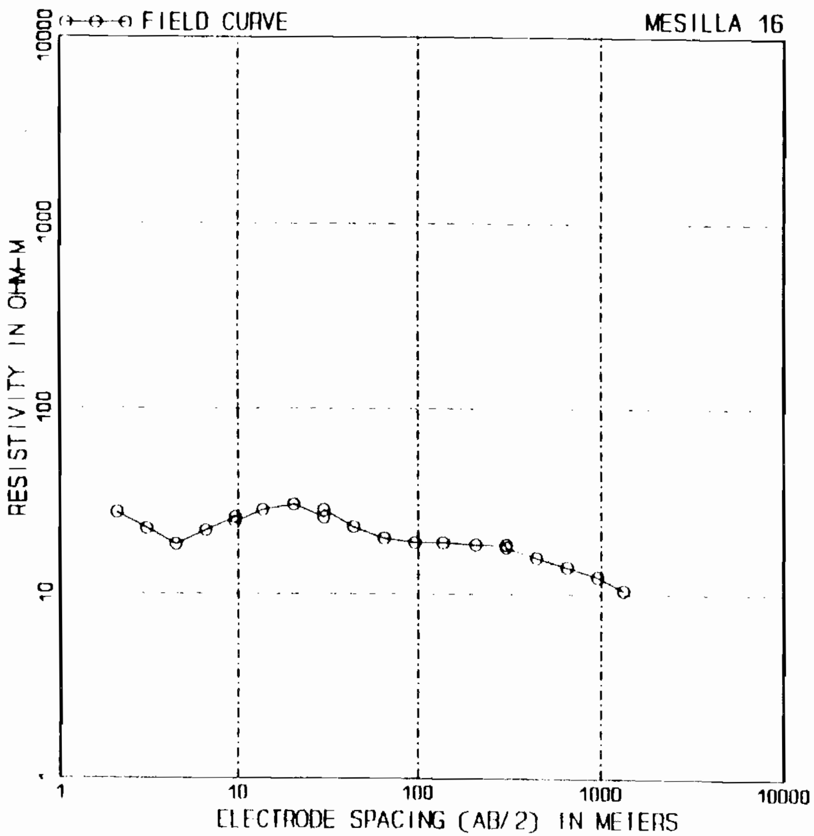
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.33	(4.35)	64.29	6.16	(20.19)	153.39
1.95	(6.39)	99.60	9.03	(29.64)	76.15
2.86	(9.37)	156.96	13.26	(43.51)	29.08
4.19	(13.76)	192.01	99999.00	(99999.00)	16.48



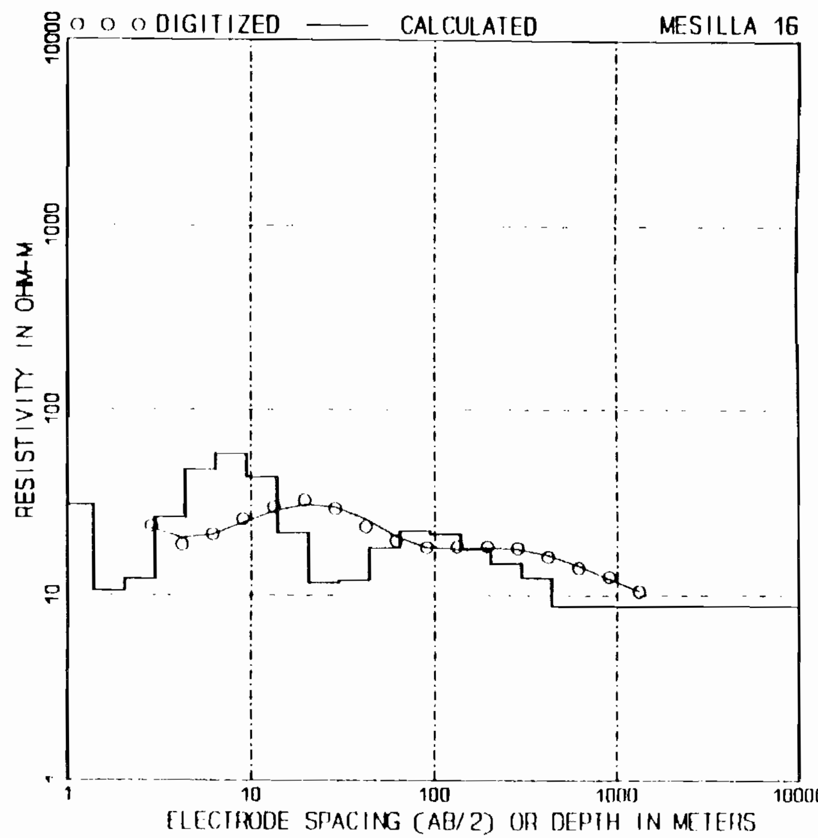
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	57.00	44.50	(146.00)	25.50
3.05	(10.00)	80.00	65.53	(215.00)	17.80
4.45	(14.60)	100.00	96.01	(315.00)	14.00
6.55	(21.50)	110.00	207.26	(680.00)	17.50
9.60	(31.50)	115.00	304.80	(1000.00)	23.00
9.60	(31.50)	110.00	96.01	(315.00)	17.00
13.72	(45.00)	98.00	207.26	(680.00)	22.00
20.73	(68.00)	68.00	304.80	(1000.00)	25.00
30.48	(100.00)	46.00	445.01	(1460.00)	23.00
30.48	(100.00)	42.00	655.32	(2150.00)	17.90
			960.12	(3150.00)	15.00



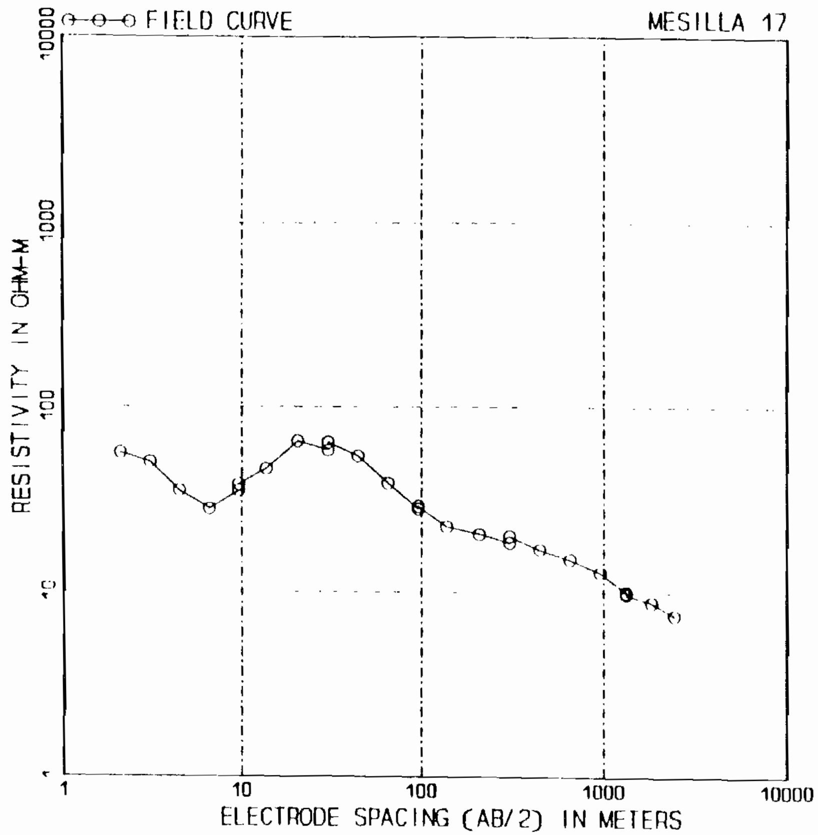
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.48	(4.84)	58.97	31.79	(104.30)	14.98
2.17	(7.11)	104.85	46.66	(153.09)	8.85
3.18	(10.43)	153.16	68.49	(224.71)	11.36
4.67	(15.31)	171.12	100.53	(329.82)	22.72
6.85	(22.47)	135.34	147.56	(484.11)	36.67
10.05	(32.98)	76.73	216.59	(710.58)	37.45
14.76	(48.41)	38.52	317.90	(1042.99)	23.09
21.66	(71.06)	23.59	99999.00	(99999.00)	9.84

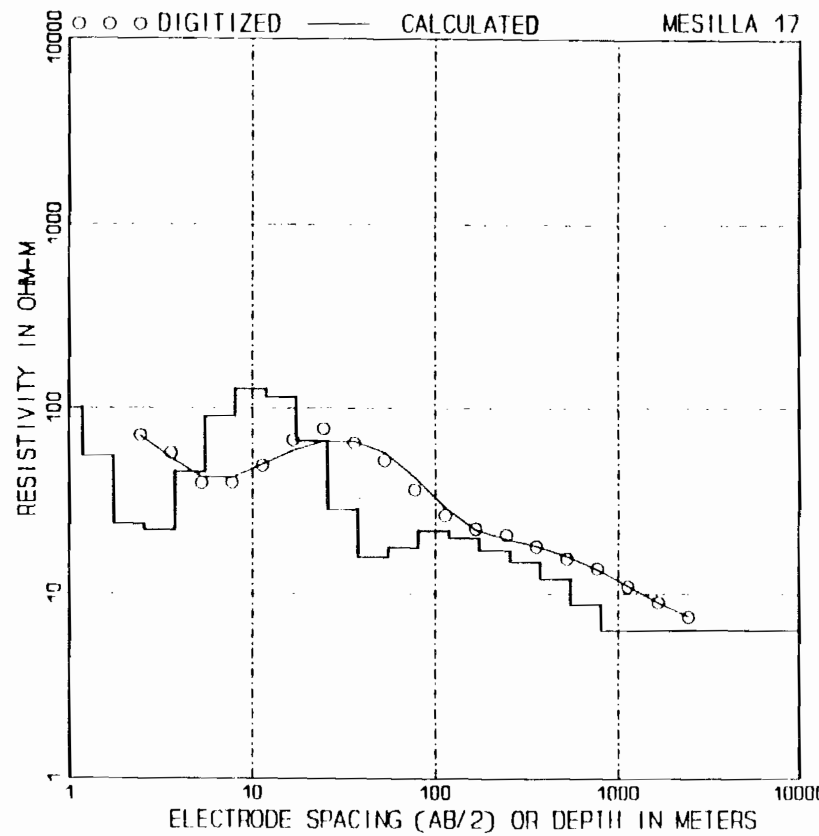


AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	27.50	44.50	(146.00)	23.00
3.05	(10.00)	22.50	65.53	(215.00)	20.00
4.45	(14.60)	18.50	96.01	(315.00)	19.00
6.55	(21.50)	22.00	137.16	(450.00)	19.00
9.60	(31.50)	26.00	207.26	(680.00)	18.50
9.60	(31.50)	24.50	304.80	(1000.00)	18.50
13.72	(45.00)	28.50	304.80	(1000.00)	17.80
20.73	(68.00)	30.50	445.01	(1460.00)	15.70
30.48	(100.00)	26.00	655.32	(2150.00)	14.00
30.48	(100.00)	28.50	960.12	(3150.00)	12.40
			1325.88	(4350.00)	10.50



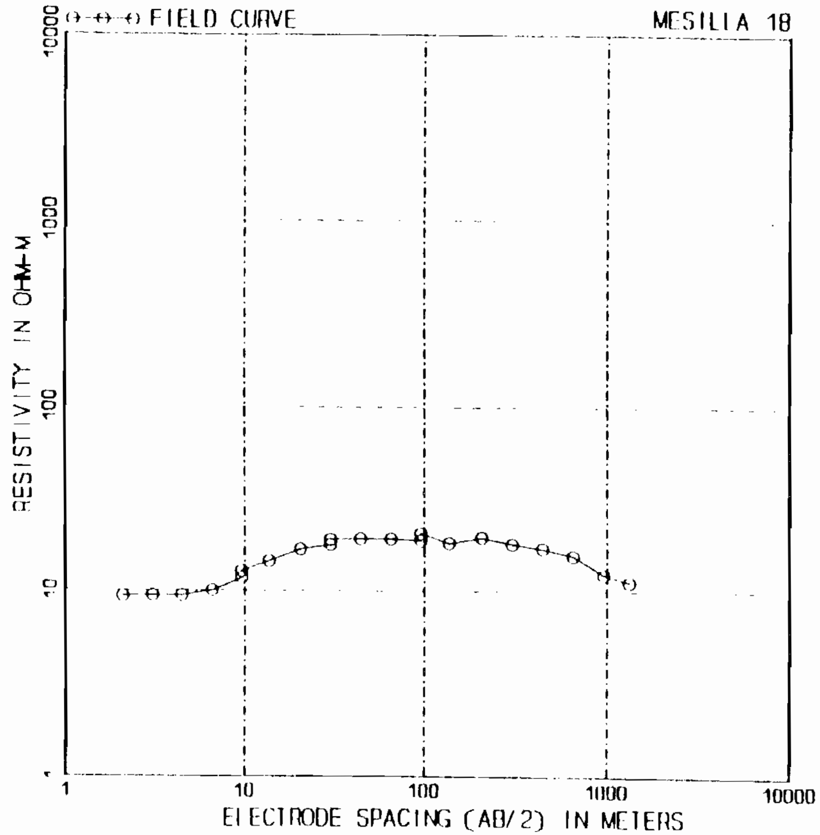
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.39	(4.55)	30.85	29.91	(98.13)	11.70
2.04	(6.69)	10.53	43.90	(144.03)	12.04
2.99	(9.81)	12.20	64.44	(211.41)	17.85
4.39	(14.40)	26.35	94.58	(310.31)	22.20
6.44	(21.14)	47.48	138.83	(455.47)	21.35
9.46	(31.03)	57.62	203.77	(668.54)	17.67
13.88	(45.55)	43.30	299.09	(981.28)	14.85
20.38	(66.85)	21.76	439.01	(1440.32)	12.38
			99999.00	(99999.00)	8.76



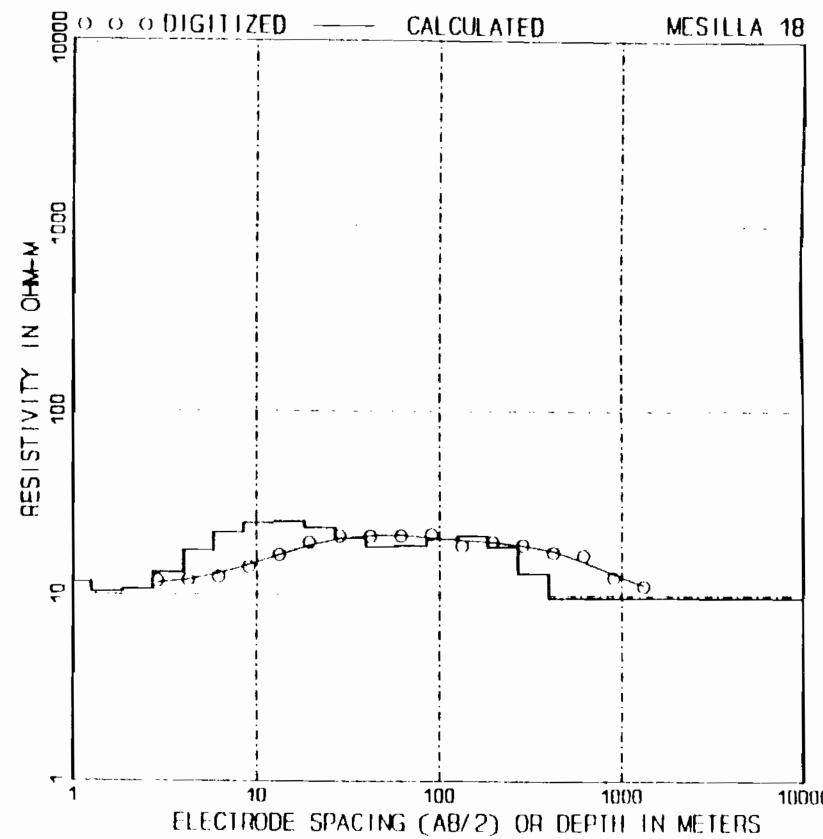


AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	56.00	96.01	(315.00)	28.00
3.05	(10.00)	50.00	96.01	(315.00)	29.00
4.45	(14.60)	35.00	137.16	(450.00)	22.50
6.55	(21.50)	28.00	207.26	(680.00)	20.50
9.60	(31.50)	35.00	304.80	(1000.00)	18.50
9.60	(31.50)	38.00	304.80	(1000.00)	20.00
13.72	(45.00)	46.00	445.01	(1460.00)	17.00
20.73	(68.00)	65.00	655.32	(2150.00)	15.00
30.48	(100.00)	58.00	960.12	(3150.00)	12.80
30.48	(100.00)	64.00	1325.88	(4350.00)	10.00
44.50	(146.00)	54.00	1325.88	(4350.00)	9.70
65.53	(215.00)	38.50	1828.80	(6000.00)	8.80
			2438.40	(8000.00)	7.50

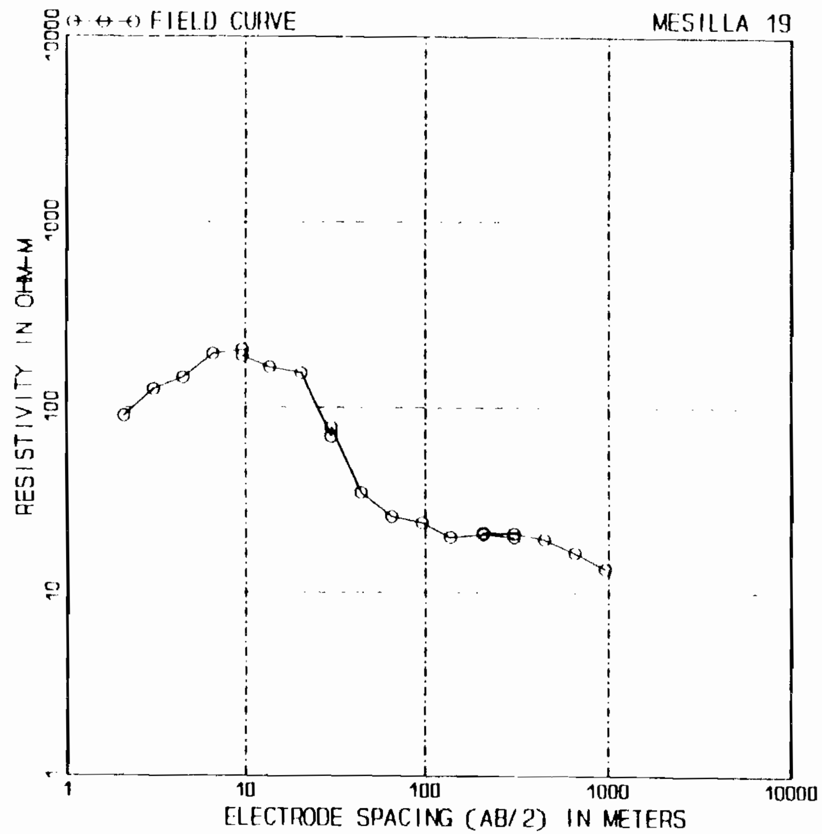
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.19	(3.89)	100.16	37.47	(122.95)	28.30
1.74	(5.71)	54.69	55.01	(180.47)	15.62
2.55	(8.38)	23.71	80.74	(264.89)	17.63
3.75	(12.29)	21.93	118.51	(388.80)	21.64
5.50	(18.05)	44.96	173.94	(570.68)	19.88
8.07	(26.49)	90.40	255.31	(837.64)	17.09
11.85	(38.88)	126.93	374.75	(1229.49)	14.86
17.39	(57.07)	115.02	550.06	(1804.65)	12.01
25.53	(83.76)	66.34	807.37	(2648.86)	8.79
			99999.00	(99999.00)	6.35



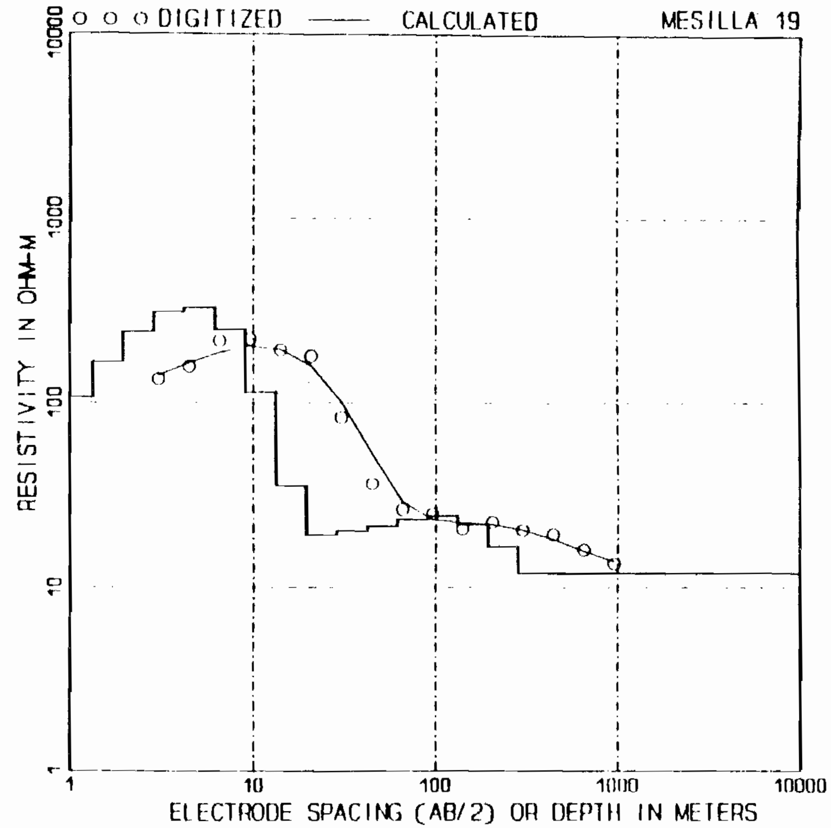
AB/2, m	(ft)	App Res	AB/2, m	(ft)	App. Res
2.07	(6.80)	9.30	44.50	(146.00)	19.20
3.05	(10.00)	9.40	65.53	(215.00)	19.20
4.45	(14.60)	9.40	96.01	(315.00)	18.80
6.55	(21.50)	10.00	96.01	(315.00)	20.50
9.60	(31.50)	11.70	137.16	(450.00)	18.20
9.60	(31.50)	12.80	207.26	(680.00)	19.50
13.72	(45.00)	14.50	304.80	(1000.00)	18.00
20.73	(68.00)	16.80	445.01	(1460.00)	17.00
30.48	(100.00)	17.80	655.32	(2150.00)	15.50
30.48	(100.00)	19.00	960.12	(3150.00)	12.30
			1325.88	(4350.00)	11.20



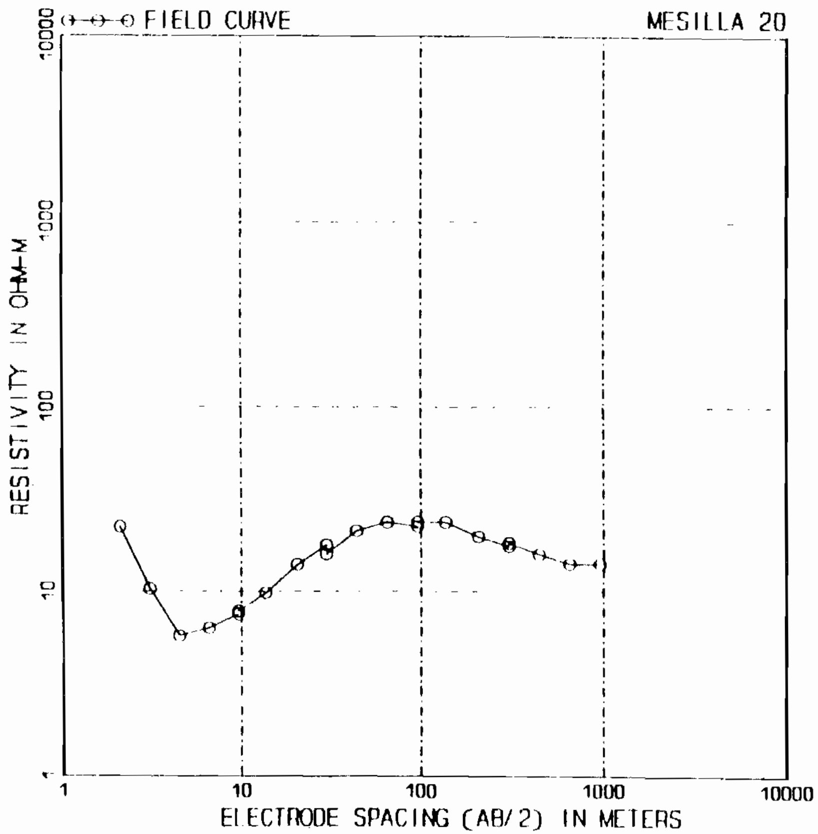
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.25	(4.10)	11.69	26.92	(88.32)	23.12
1.83	(6.02)	10.41	39.51	(129.63)	20.20
2.69	(8.83)	10.72	57.99	(190.27)	18.20
3.95	(12.96)	11.17	85.12	(279.28)	18.46
5.80	(19.03)	17.39	124.94	(409.92)	20.10
8.51	(27.93)	21.79	183.39	(601.68)	20.88
12.49	(40.99)	24.45	269.18	(883.15)	18.13
18.34	(60.17)	24.80	395.11	(1296.29)	11.14
			99999.00	(99999.00)	9.66

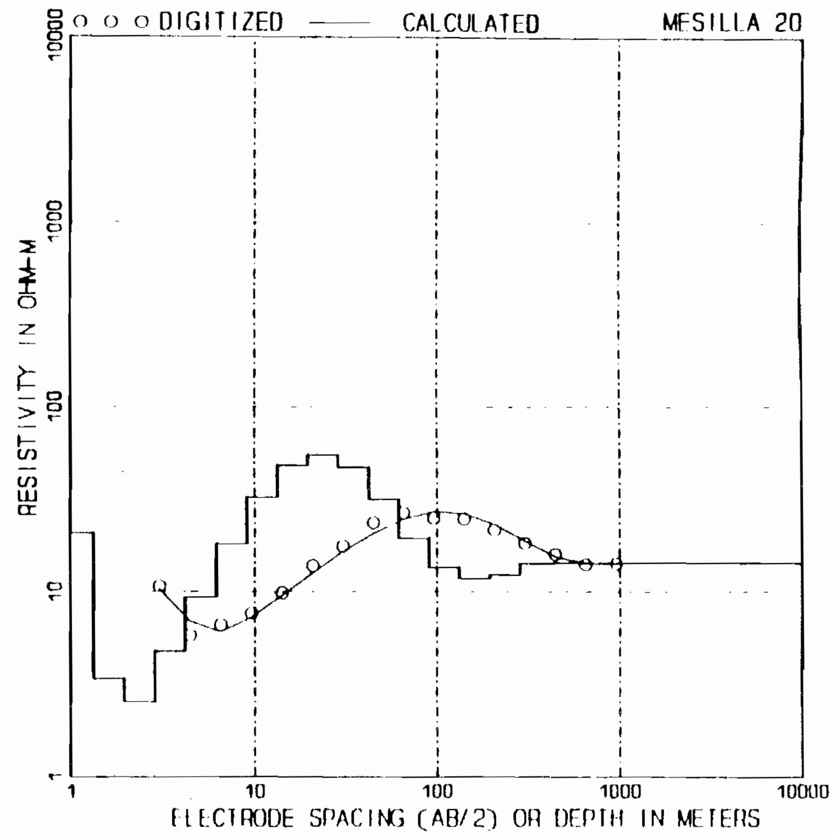


AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	90.00	65.53	(215.00)	26.00
3.05	(10.00)	125.00	96.01	(315.00)	24.00
4.45	(14.60)	145.00	96.01	(315.00)	24.00
6.55	(21.50)	195.00	137.16	(450.00)	20.00
9.60	(31.50)	205.00	207.26	(680.00)	20.80
9.60	(31.50)	190.00	304.80	(1000.00)	20.00
13.72	(45.00)	165.00	207.26	(680.00)	21.20
20.73	(68.00)	153.00	304.80	(1000.00)	21.00
30.48	(100.00)	70.00	445.01	(1460.00)	19.50
30.48	(100.00)	78.00	655.32	(2150.00)	16.50
44.50	(146.00)	35.00	960.12	(3150.00)	11.50



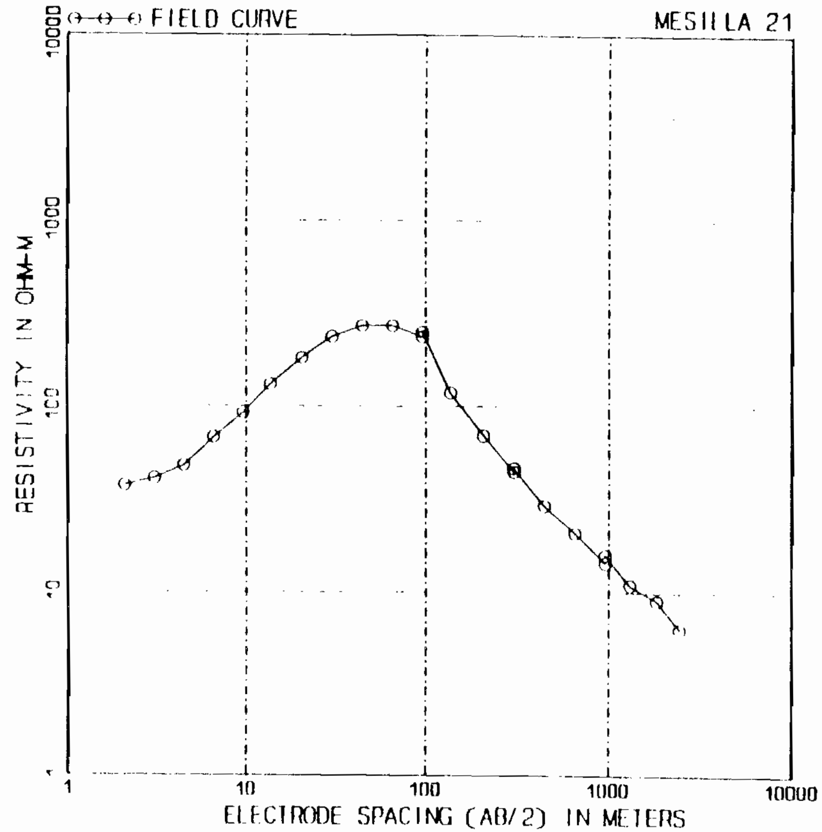
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.33	(4.36)	107.34	28.61	(93.87)	19.12
1.95	(6.40)	165.92	42.00	(137.78)	20.18
2.86	(9.39)	243.43	61.64	(202.23)	21.56
4.20	(13.78)	311.42	90.48	(296.84)	23.53
6.16	(20.22)	329.06	132.80	(435.70)	24.58
9.05	(29.68)	249.52	194.93	(639.52)	22.11
13.28	(43.57)	113.95	286.11	(938.69)	16.67
19.49	(63.95)	35.78	99999.00	(99999.00)	11.99



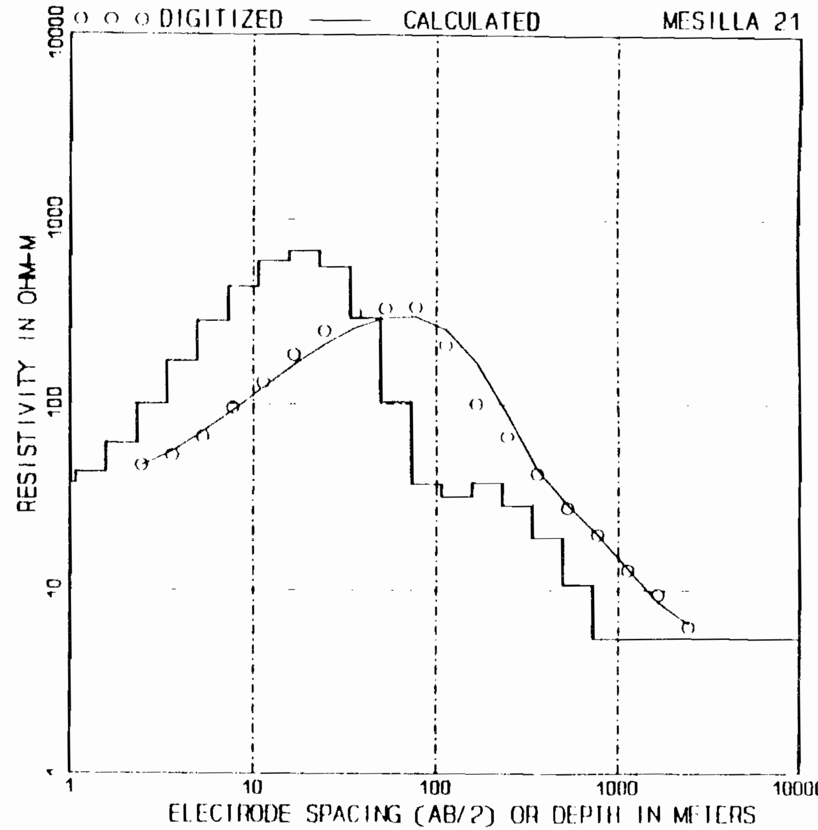


AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	22.60	44.50	(146.00)	21.50
3.05	(10.00)	10.30	65.53	(215.00)	24.00
4.45	(14.60)	5.70	96.01	(315.00)	22.80
6.55	(21.50)	6.30	96.01	(315.00)	24.00
9.60	(31.50)	7.50	137.16	(450.00)	24.00
9.60	(31.50)	7.80	207.26	(680.00)	20.00
13.72	(45.00)	9.80	304.80	(1000.00)	17.70
20.73	(68.00)	14.00	304.80	(1000.00)	18.50
30.48	(100.00)	18.00	445.01	(1460.00)	16.00
30.48	(100.00)	16.00	655.32	(2150.00)	14.20
			960.12	(3150.00)	14.20

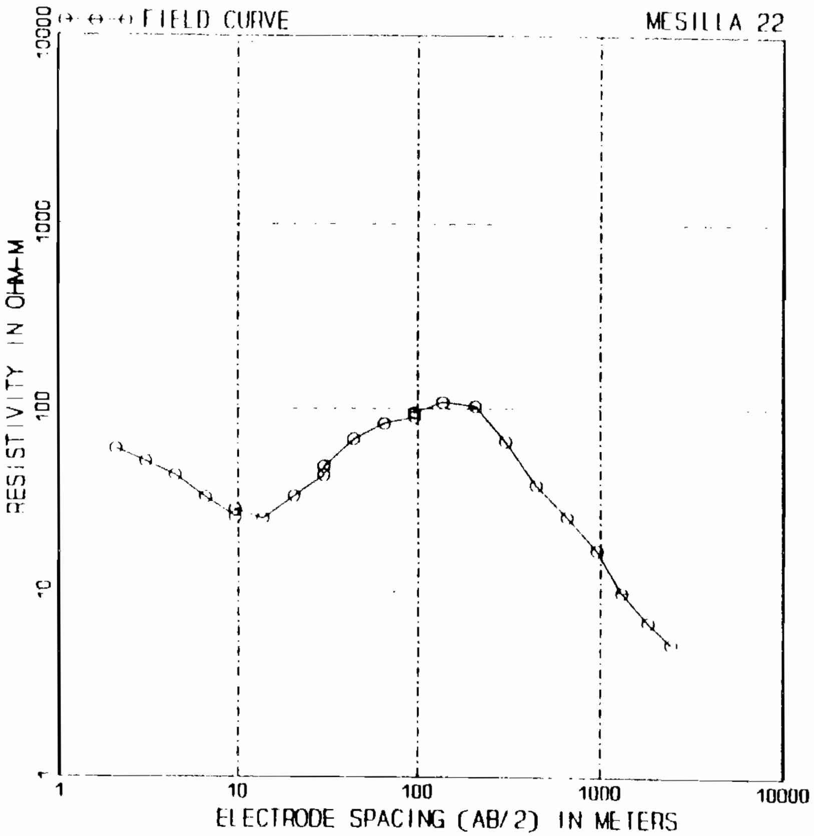
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.33	(4.36)	20.83	28.61	(93.87)	55.28
1.95	(6.40)	3.38	42.00	(137.78)	47.24
2.86	(9.39)	2.53	61.64	(202.23)	31.77
4.20	(13.78)	4.74	90.48	(296.84)	19.44
6.16	(20.22)	9.31	132.80	(435.70)	13.47
9.05	(29.68)	18.12	194.93	(639.52)	11.80
13.28	(43.57)	32.48	286.11	(938.69)	12.30
19.49	(63.95)	48.43	99999.00	(99999.00)	14.34



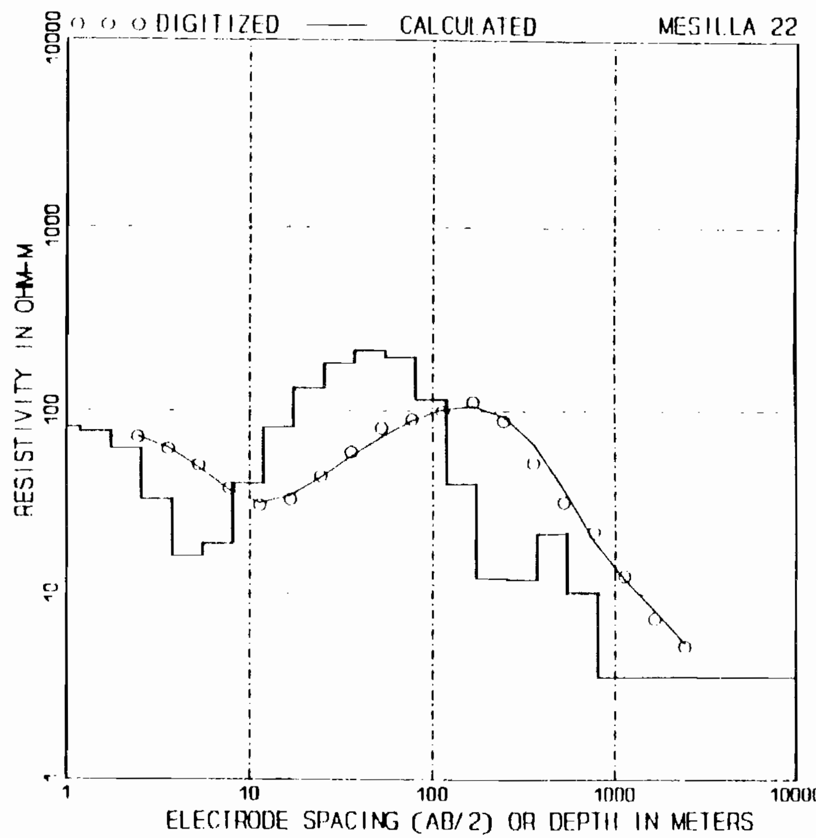
AB/2, m	(ft)	App. Res	AB/2, m	(ft)	App. Res.
2.07	(6.80)	37.50	96.01	(315.00)	250.00
3.05	(10.00)	41.00	137.16	(450.00)	118.00
4.45	(14.60)	48.00	207.26	(680.00)	70.00
6.55	(21.50)	68.00	304.80	(1000.00)	45.00
9.60	(31.50)	92.00	304.80	(1000.00)	47.00
13.72	(45.00)	130.00	445.01	(1460.00)	29.50
20.73	(68.00)	180.00	655.32	(2150.00)	21.00
30.48	(100.00)	235.00	960.12	(3150.00)	14.50
44.50	(146.00)	270.00	960.12	(3150.00)	16.00
65.53	(215.00)	270.00	1310.64	(4300.00)	11.00
96.01	(315.00)	235.00	1828.80	(6000.00)	9.00
			2438.40	(8000.00)	6.30



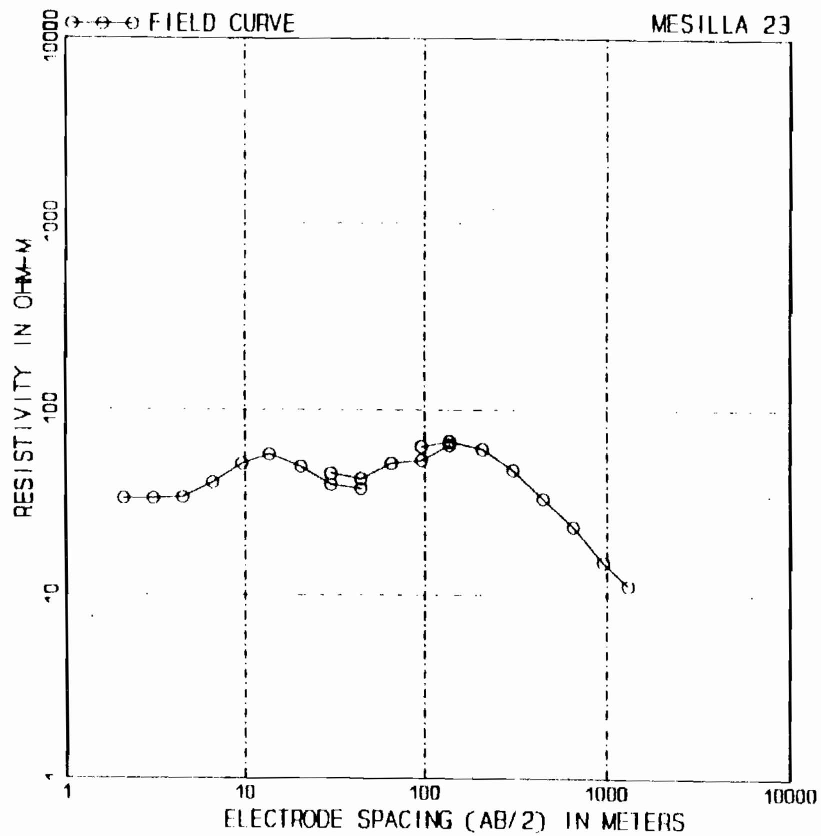
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.07	(3.50)	38.05	33.73	(110.65)	556.98
1.57	(5.14)	43.19	49.51	(162.42)	295.17
2.30	(7.54)	61.66	72.66	(238.40)	103.29
3.37	(11.07)	100.34	106.66	(349.92)	37.45
4.95	(16.24)	169.38	156.55	(513.61)	32.08
7.27	(23.84)	280.64	229.78	(753.88)	37.91
10.67	(34.99)	435.66	337.27	(1106.54)	28.70
15.65	(51.36)	600.87	495.05	(1624.19)	19.14
22.98	(75.39)	678.99	726.64	(2383.98)	10.71
			99999.00	(99999.00)	5.44



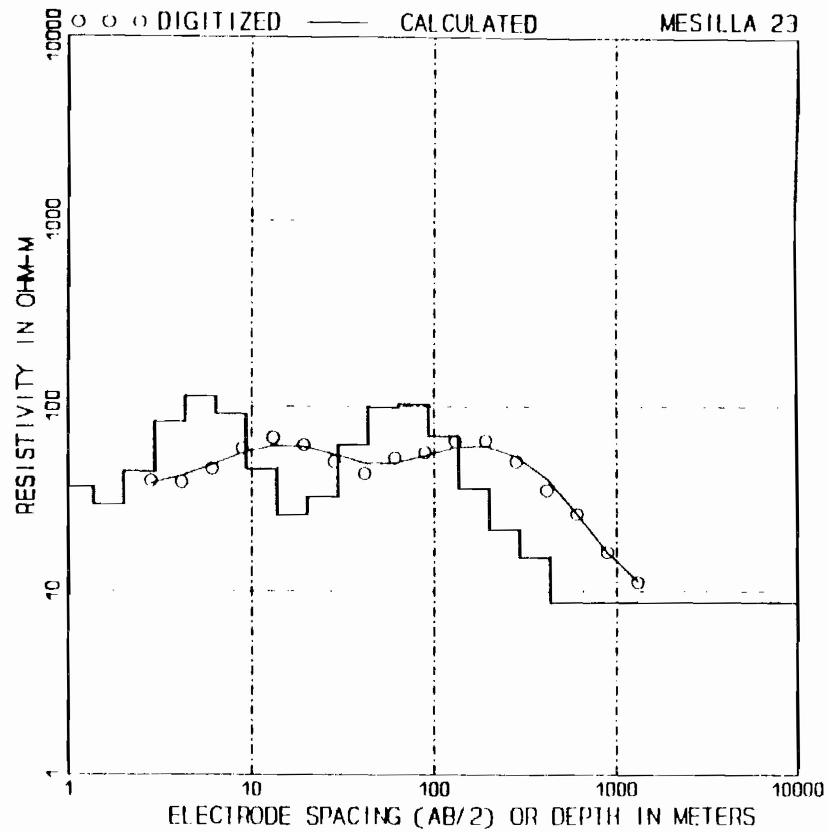
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	60.00	96.01	(315.00)	90.00
3.05	(10.00)	51.00	96.01	(315.00)	95.00
4.45	(14.60)	43.00	137.16	(450.00)	109.00
6.55	(21.50)	32.50	207.26	(680.00)	103.00
9.60	(31.50)	25.50	304.80	(1000.00)	66.00
9.60	(31.50)	28.00	445.01	(1460.00)	38.00
13.72	(45.00)	25.00	655.32	(2150.00)	25.50
20.73	(68.00)	33.00	960.12	(3150.00)	16.80
30.48	(100.00)	43.00	960.12	(3150.00)	16.80
30.48	(100.00)	48.00	1310.64	(4300.00)	9.90
44.50	(146.00)	68.00	1828.80	(6000.00)	6.80
65.53	(215.00)	83.00	2438.40	(8000.00)	5.20



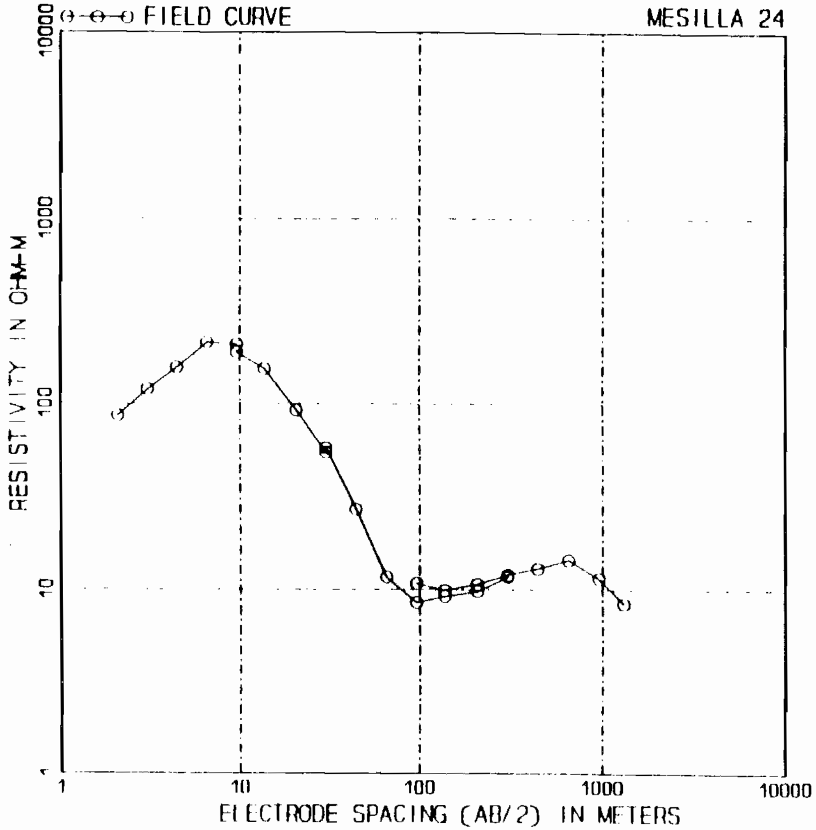
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.19	(3.89)	81.22	37.47	(122.95)	182.19
1.74	(5.71)	76.97	55.01	(180.47)	213.96
2.55	(8.38)	61.87	80.74	(264.89)	197.33
3.75	(12.29)	32.67	118.51	(388.80)	116.43
5.50	(18.05)	16.06	173.94	(570.68)	39.52
8.07	(26.49)	18.78	255.31	(837.64)	12.10
11.85	(38.88)	39.79	374.75	(1229.49)	11.94
17.39	(57.07)	81.11	550.06	(1804.65)	21.18
25.53	(83.76)	133.47	807.37	(2648.86)	10.26
			99999.00	(99999.00)	3.57



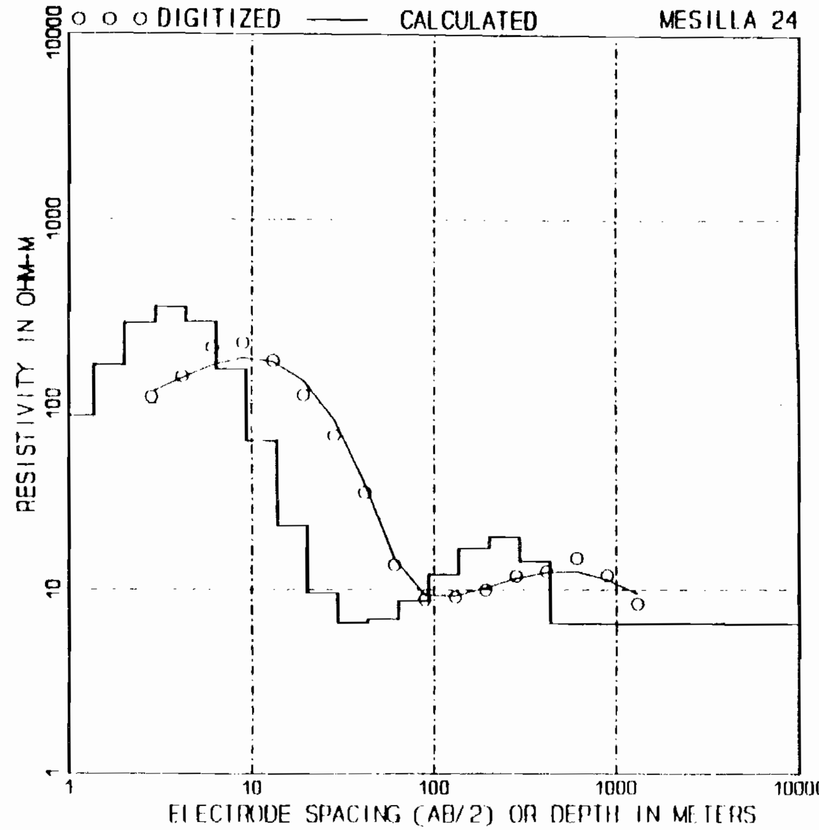
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	33.50	65.53	(215.00)	52.00
3.05	(10.00)	33.50	96.01	(315.00)	54.00
4.45	(14.60)	34.00	137.16	(450.00)	65.00
6.55	(21.50)	41.00	96.01	(315.00)	64.00
9.60	(31.50)	51.80	137.16	(450.00)	68.00
13.72	(45.00)	58.00	207.26	(680.00)	62.00
20.73	(68.00)	50.00	304.80	(1000.00)	48.00
30.48	(100.00)	40.00	445.01	(1460.00)	33.50
44.50	(146.00)	38.00	655.32	(2150.00)	23.50
30.48	(100.00)	46.00	960.12	(3150.00)	15.00
44.50	(146.00)	43.00	1310.64	(4300.00)	11.20



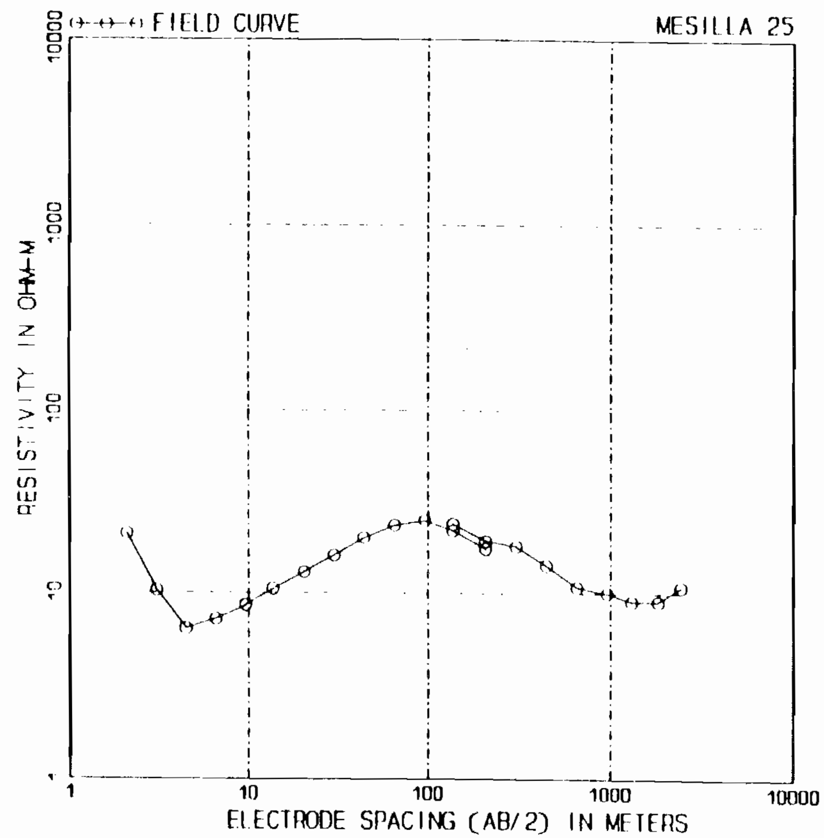
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.37	(4.50)	36.89	29.57	(97.00)	32.56
2.01	(6.61)	29.40	43.40	(142.38)	62.45
2.96	(9.70)	44.51	63.70	(208.98)	98.83
4.34	(14.24)	82.62	93.49	(306.74)	103.70
6.37	(20.90)	113.30	137.23	(450.23)	69.45
9.35	(30.67)	91.49	201.43	(660.85)	36.32
13.72	(45.02)	46.09	295.66	(970.00)	21.63
20.14	(66.09)	25.98	433.96	(1423.76)	15.20
			99999.00	(99999.00)	8.69



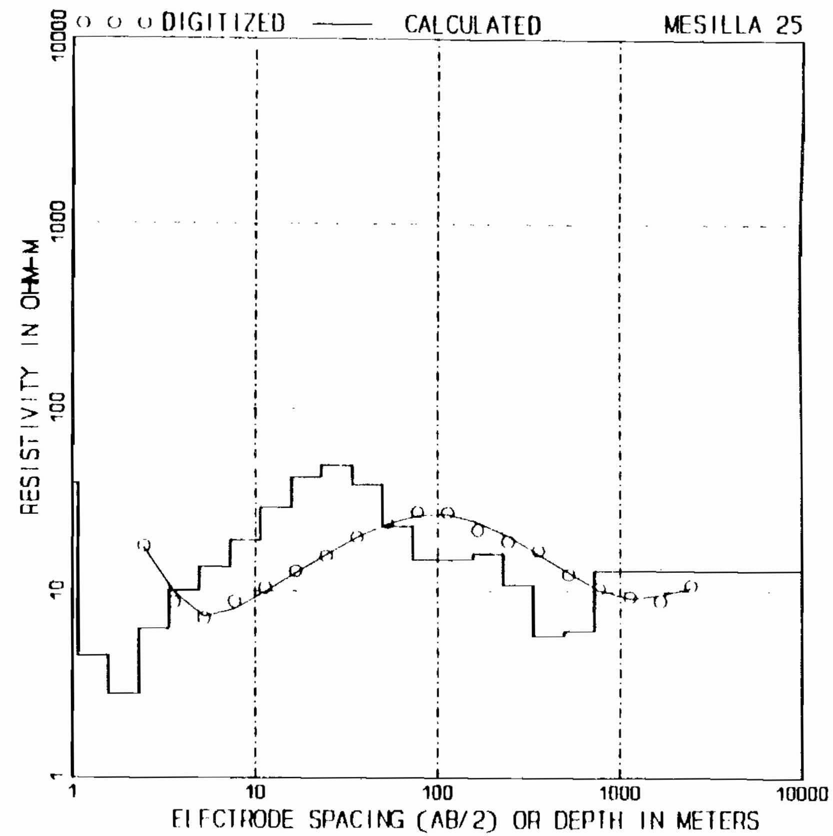
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res
2.07	6.80	86.00	96.01	315.00	8.50
3.05	10.00	120.00	137.16	450.00	9.20
4.45	14.60	157.00	207.26	680.00	9.80
6.55	21.50	215.00	304.80	1000.00	11.70
9.60	31.50	210.00	96.01	315.00	10.80
9.60	31.50	190.00	137.16	450.00	9.90
13.72	45.00	155.00	207.26	680.00	10.70
20.73	68.00	92.00	304.80	1000.00	12.00
30.48	100.00	54.00	445.01	1460.00	13.00
30.48	100.00	57.00	655.32	2150.00	14.50
44.50	146.00	26.80	960.12	3150.00	11.50
65.53	215.00	11.70	1310.64	4300.00	8.40



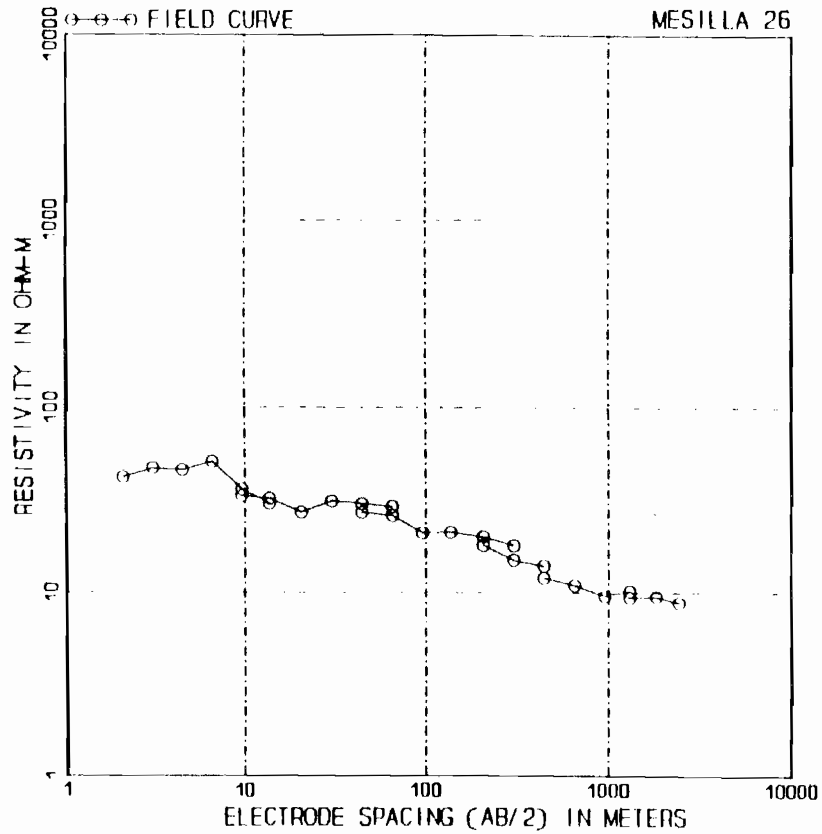
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.37	4.50	85.66	29.57	97.00	9.57
2.01	6.61	163.97	43.40	142.38	6.62
2.96	9.70	274.71	63.70	208.98	6.92
4.34	14.24	336.34	93.49	306.74	8.72
6.37	20.90	278.17	137.23	450.23	12.04
9.35	30.67	154.52	201.43	660.85	16.72
13.72	45.02	62.26	295.66	970.00	19.15
20.14	66.09	22.03	433.96	1423.76	14.34
			99999.00	99999.00	6.55



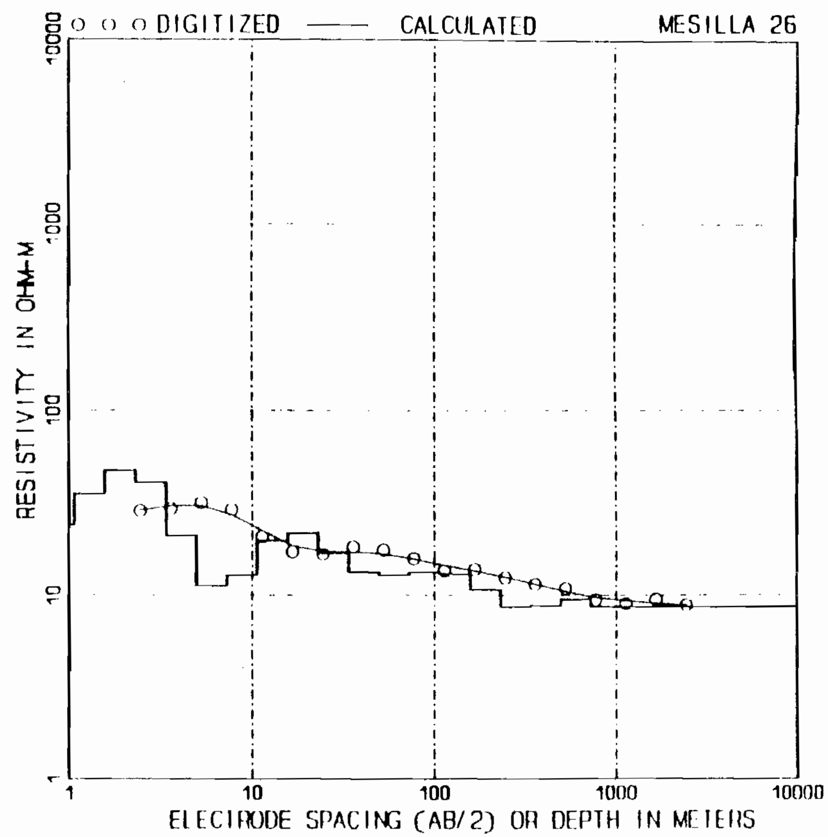
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res
2.07	(6.80)	21.00	96.01	(315.00)	25.00
3.05	(10.00)	10.30	137.16	(450.00)	22.00
4.45	(14.60)	6.40	207.26	(680.00)	17.50
6.55	(21.50)	7.20	137.16	(450.00)	24.00
9.60	(31.50)	8.50	207.26	(680.00)	19.30
9.60	(31.50)	8.60	304.80	(1000.00)	18.00
13.72	(45.00)	10.50	445.01	(1460.00)	14.20
20.73	(68.00)	13.00	655.32	(2150.00)	10.80
30.48	(100.00)	16.00	960.12	(3150.00)	10.60
44.50	(146.00)	20.00	1310.64	(4300.00)	9.00
65.53	(215.00)	21.50	1828.80	(6000.00)	9.00
			2438.40	(8000.00)	10.80



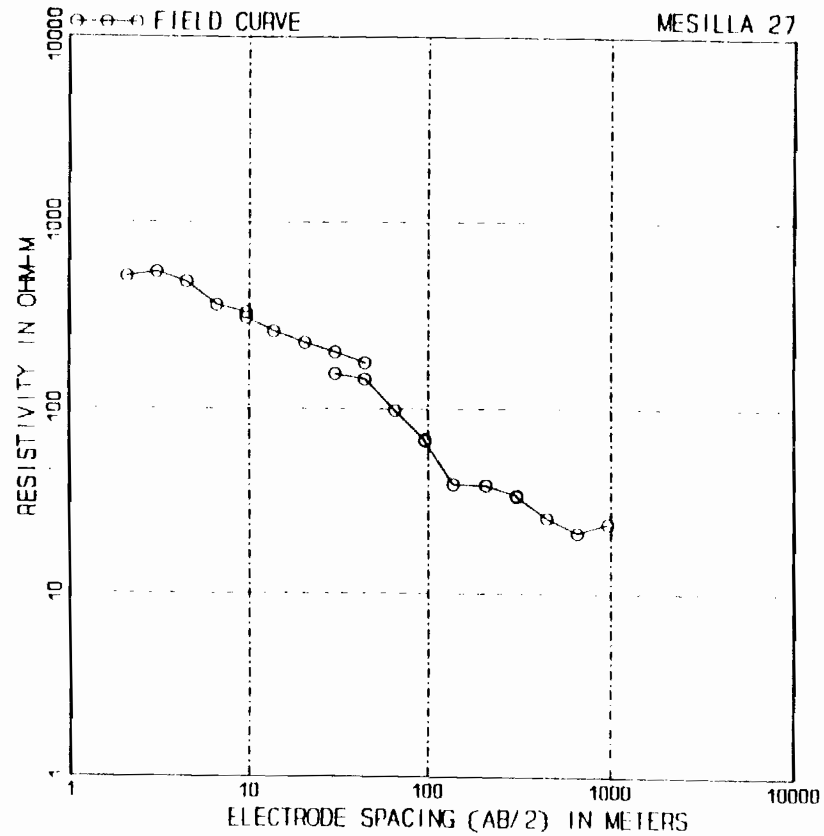
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.07	(3.50)	39.11	33.73	(110.65)	49.04
1.57	(5.14)	4.50	49.51	(162.42)	38.68
2.30	(7.54)	2.79	72.66	(238.40)	22.61
3.37	(11.07)	6.25	106.66	(349.92)	14.81
4.95	(16.24)	10.10	156.55	(513.61)	14.86
7.27	(23.84)	13.54	229.78	(753.88)	15.86
10.67	(34.99)	18.91	337.27	(1106.54)	10.82
15.65	(51.36)	28.76	495.05	(1624.19)	5.78
22.98	(75.39)	42.26	726.64	(2383.98)	6.12
			99999.00	(99999.00)	12.94



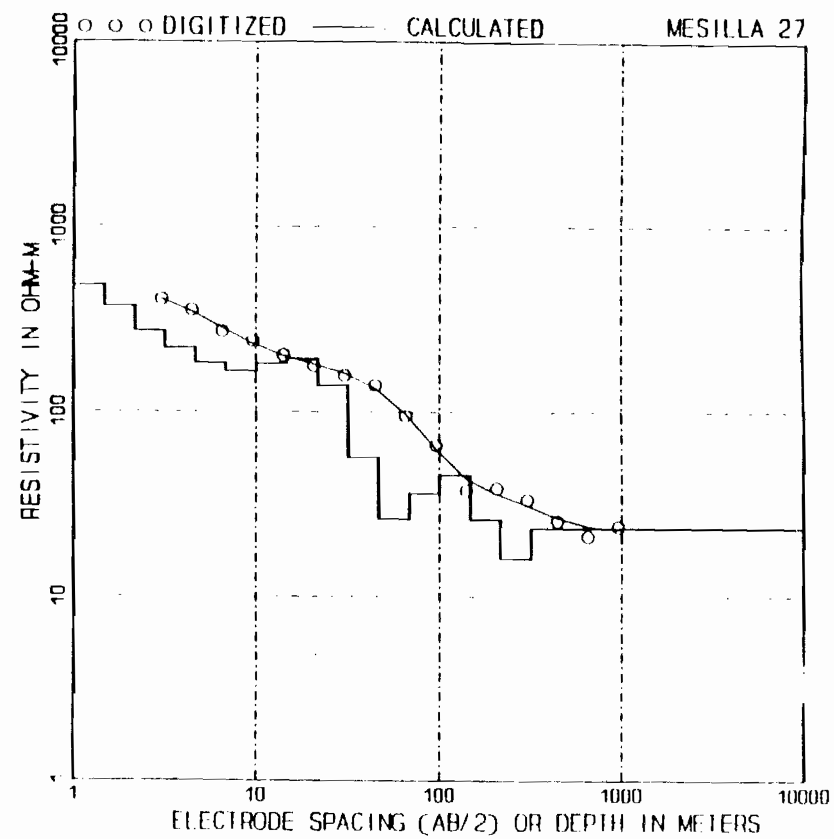
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	42.00	96.01	(315.00)	21.00
3.05	(10.00)	47.00	137.16	(450.00)	21.20
4.45	(14.60)	46.00	207.26	(680.00)	20.00
6.55	(21.50)	51.00	304.80	(1000.00)	18.00
9.60	(31.50)	36.00	207.26	(680.00)	18.00
13.72	(45.00)	30.00	304.80	(1000.00)	15.00
9.60	(31.50)	33.00	445.01	(1460.00)	14.00
13.72	(45.00)	32.00	445.01	(1460.00)	12.00
20.73	(68.00)	27.00	655.32	(2150.00)	11.00
30.48	(100.00)	31.00	960.12	(3150.00)	9.60
44.50	(146.00)	30.00	1310.64	(4300.00)	10.20
65.53	(215.00)	29.00	1310.64	(4300.00)	9.40
44.50	(146.00)	27.00	1828.80	(6000.00)	9.50
65.53	(215.00)	26.00	2438.40	(8000.00)	8.80



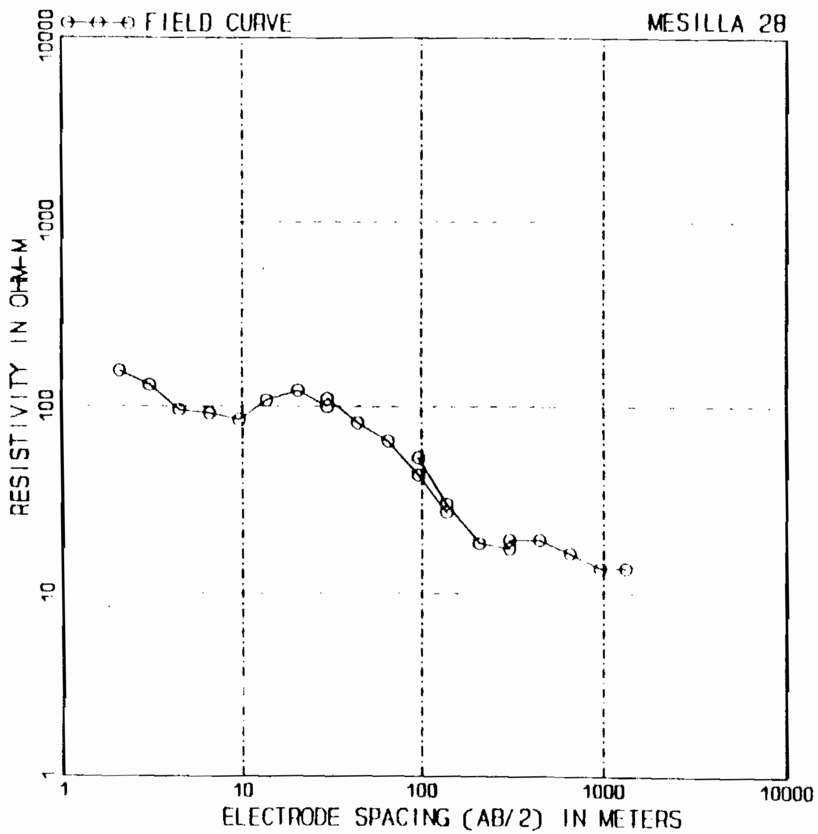
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.07	(3.50)	23.99	33.73	(110.65)	16.88
1.57	(5.14)	35.23	49.51	(162.42)	13.28
2.30	(7.54)	47.39	72.66	(238.40)	12.78
3.37	(11.07)	40.87	106.66	(349.92)	13.35
4.95	(16.24)	20.89	156.55	(513.61)	13.04
7.27	(23.84)	11.18	229.78	(753.88)	10.68
10.67	(34.99)	12.80	337.27	(1106.54)	8.61
15.65	(51.36)	19.70	495.05	(1624.19)	8.79
22.98	(75.19)	21.56	726.64	(2383.98)	9.44
			99999.00	(99999.00)	8.62



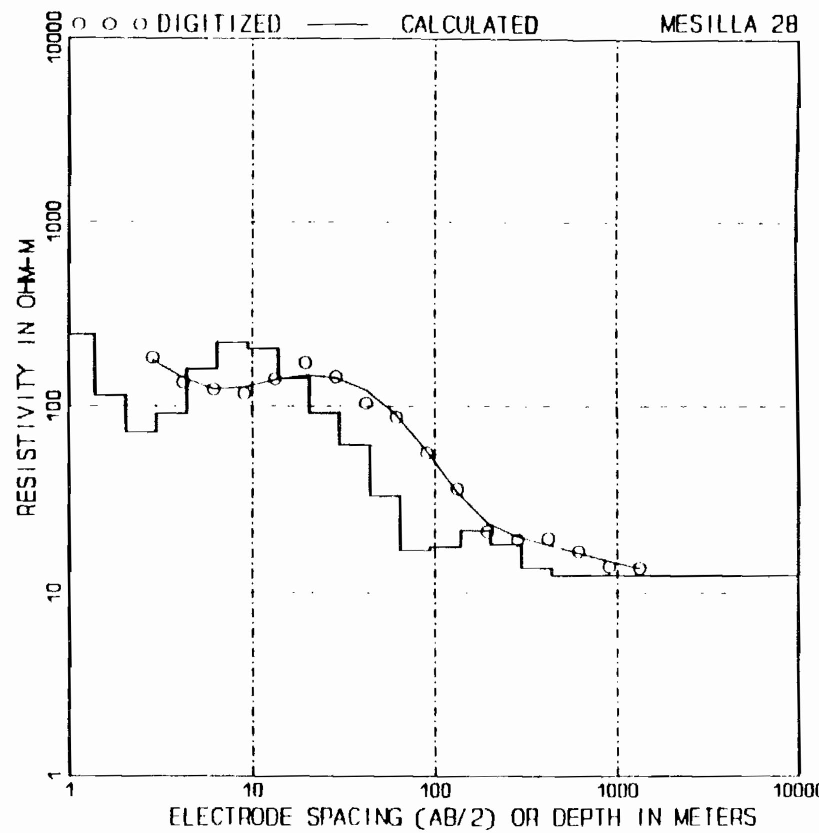
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	510.00	44.50	(146.00)	145.00
3.05	(10.00)	540.00	65.53	(215.00)	98.00
4.45	(14.60)	478.00	96.01	(315.00)	68.00
6.55	(21.50)	360.00	96.01	(315.00)	67.00
9.60	(31.50)	328.00	137.16	(450.00)	39.50
9.60	(31.50)	308.00	207.26	(680.00)	39.00
13.72	(45.00)	262.00	304.80	(1000.00)	34.50
20.73	(68.00)	228.00	304.80	(1000.00)	34.00
30.48	(100.00)	203.00	445.01	(1460.00)	26.00
44.50	(146.00)	178.00	655.32	(2150.00)	21.50
30.48	(100.00)	155.00	960.12	(3150.00)	24.20



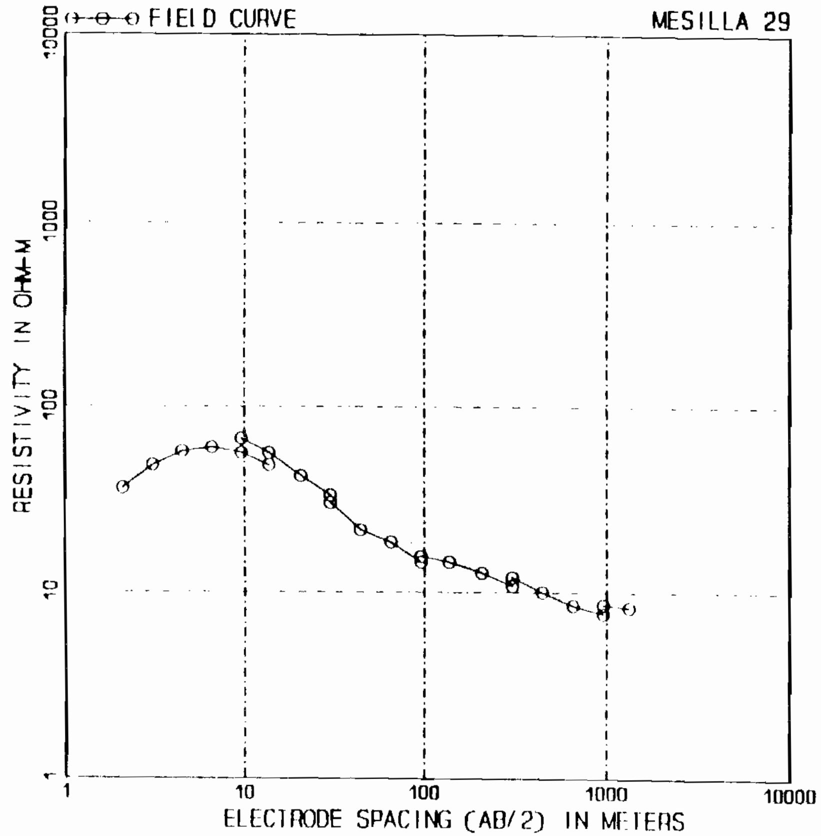
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.48	(4.84)	481.31	31.79	(104.30)	140.10
2.17	(7.11)	371.00	46.66	(153.09)	57.03
3.18	(10.43)	274.36	68.49	(224.71)	26.56
4.67	(15.31)	223.41	100.53	(329.82)	36.53
6.85	(22.47)	184.93	147.56	(484.11)	45.69
10.05	(32.98)	166.66	216.59	(710.58)	26.36
14.76	(48.41)	183.71	317.90	(1042.99)	16.17
21.66	(71.06)	194.62	99999.00	(99999.00)	23.61



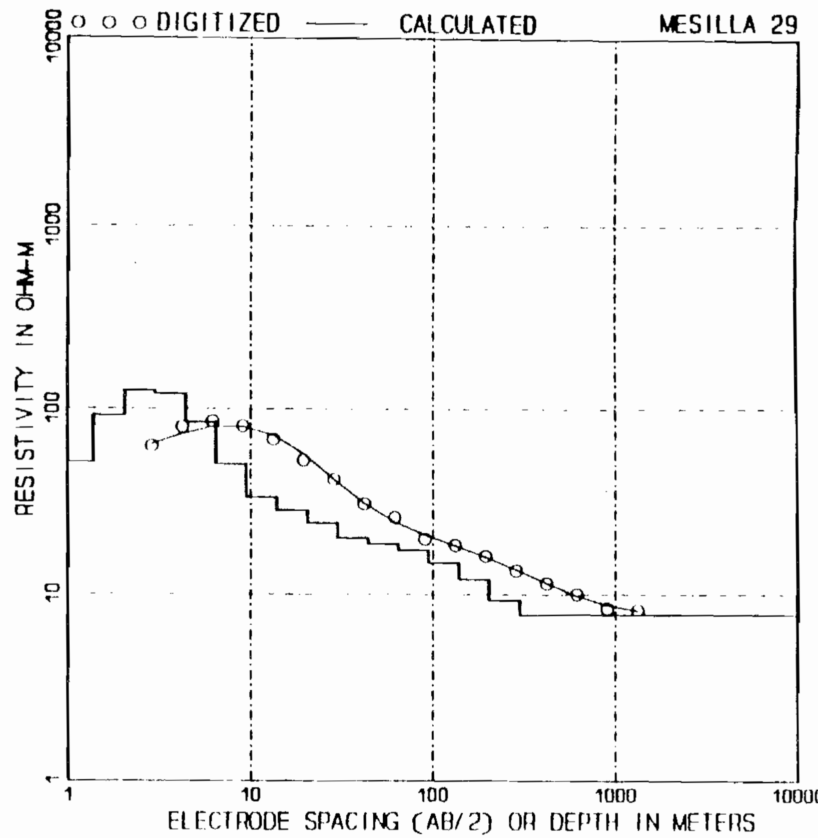
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	155.00	96.01	(315.00)	43.50
3.05	(10.00)	130.00	137.16	(450.00)	27.50
4.45	(14.60)	96.00	96.01	(315.00)	54.00
6.55	(21.50)	92.00	137.16	(450.00)	30.50
9.60	(31.50)	85.00	207.26	(680.00)	18.70
13.72	(45.00)	108.00	304.80	(1000.00)	17.50
20.73	(68.00)	122.00	304.80	(1000.00)	19.50
30.48	(100.00)	100.00	445.01	(1460.00)	19.50
30.48	(100.00)	110.00	655.32	(2150.00)	16.50
44.50	(146.00)	82.00	960.12	(3150.00)	13.70
65.53	(215.00)	66.00	1325.88	(4350.00)	13.70



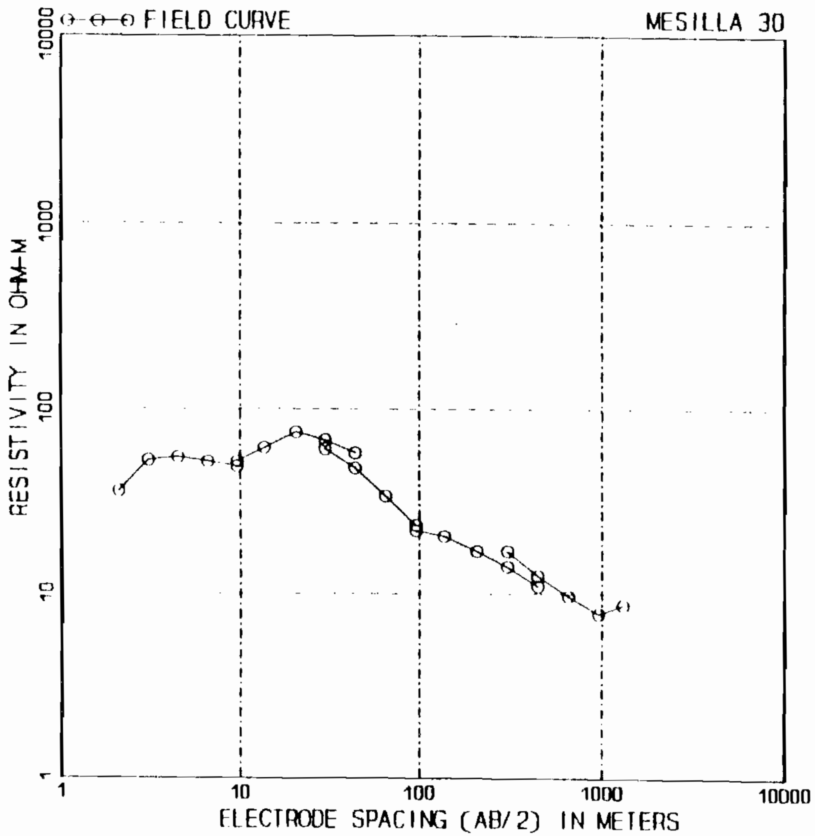
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.39	(4.55)	245.46	29.91	(98.13)	92.07
2.04	(6.69)	114.02	43.90	(144.03)	62.20
2.99	(9.81)	72.99	64.44	(211.41)	33.38
4.39	(14.40)	91.35	94.58	(310.31)	17.01
6.44	(21.14)	158.54	138.83	(455.47)	17.78
9.46	(31.03)	221.25	203.77	(668.54)	21.67
13.88	(45.55)	204.92	299.09	(981.28)	18.24
20.38	(66.85)	140.94	439.01	(1440.32)	13.67
			99999.00	(99999.00)	12.47



AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	6.80	36.00	65.53	215.00	18.50
3.05	10.00	48.00	96.01	315.00	14.50
4.45	14.60	57.00	96.01	315.00	15.50
6.55	21.50	60.00	137.16	450.00	14.50
9.60	31.50	56.00	207.26	680.00	12.70
13.72	45.00	48.00	304.80	1000.00	10.80
9.60	31.50	67.00	304.80	1000.00	12.00
13.72	45.00	56.00	445.01	1460.00	10.00
20.73	68.00	42.00	655.32	2150.00	8.50
30.48	100.00	33.00	960.12	3150.00	7.70
30.48	100.00	30.00	960.12	3150.00	8.60
44.50	146.00	21.50	1325.88	4150.00	8.30

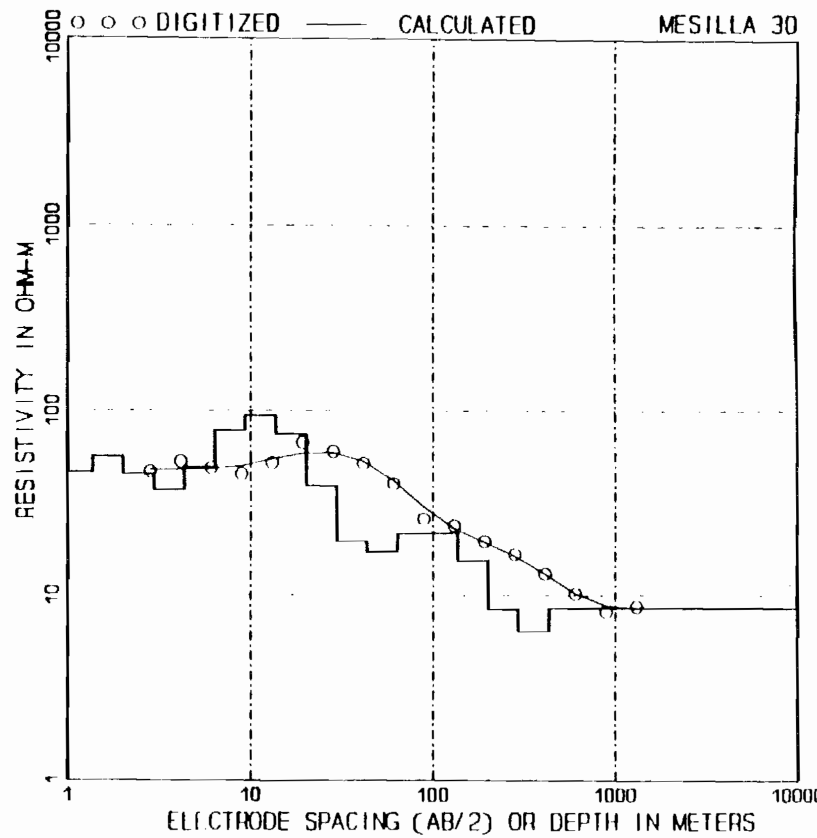


DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.39	4.55	50.80	29.91	98.11	24.07
2.04	6.69	91.75	43.90	144.03	19.89
2.99	9.81	125.10	64.44	211.41	18.53
4.39	14.40	120.68	94.58	310.31	17.21
6.44	21.14	84.49	138.83	455.47	14.74
9.46	31.03	49.99	203.77	668.54	12.03
13.88	45.55	33.16	299.09	981.28	9.32
20.38	66.85	28.06	439.01	1440.32	7.74
			99999.00	99999.00	7.80



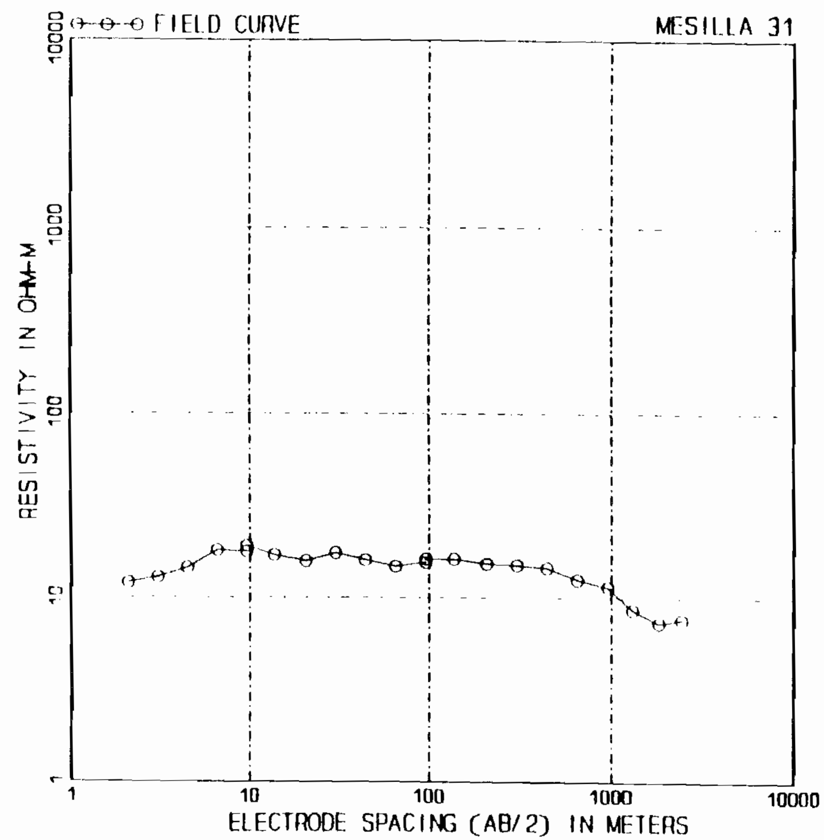
AB/2, m	(ft)	App. Res.
2.07	6.80	36.00
3.05	10.00	53.00
4.45	14.60	55.00
6.55	21.50	52.00
9.60	31.50	49.00
9.60	31.50	52.00
13.72	45.00	62.00
20.73	68.00	75.00
30.48	100.00	68.00
44.50	146.00	58.00
30.48	100.00	61.00
44.50	146.00	48.00

AB/2, m	(ft)	App. Res.
65.53	215.00	34.00
96.01	315.00	23.50
96.01	315.00	22.00
137.16	450.00	20.50
207.26	680.00	17.00
304.80	1000.00	14.00
445.01	1460.00	11.00
304.80	1000.00	17.00
445.01	1460.00	12.50
655.32	2150.00	9.70
960.12	3150.00	7.80
1310.64	4300.00	8.70

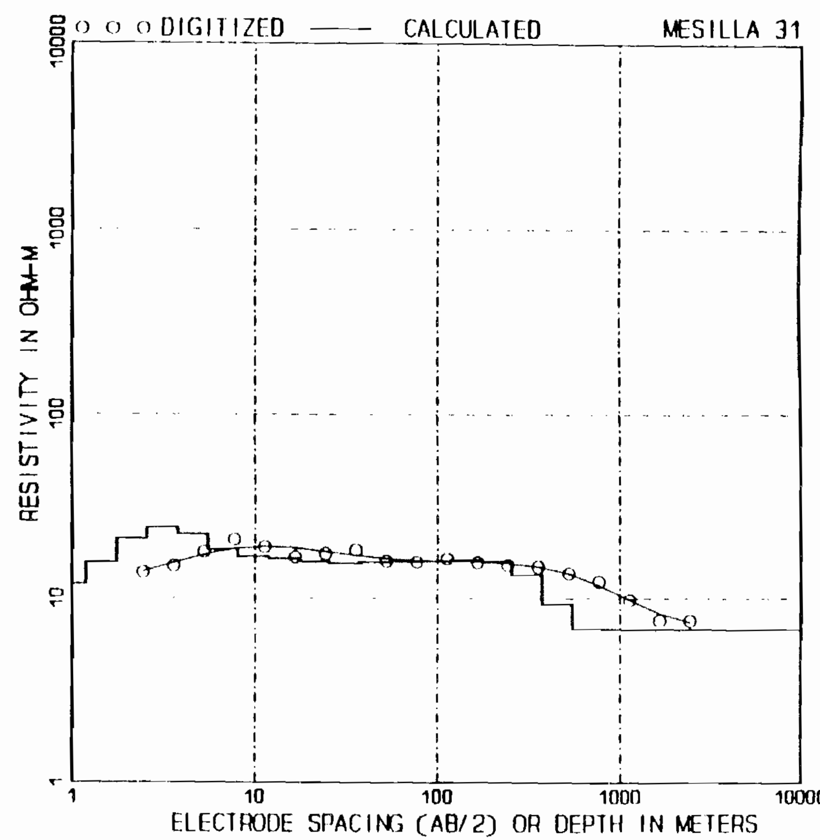


DEPTH, m	(ft)	RESIS.
1.37	4.50	46.66
2.01	6.61	56.31
2.96	9.70	45.29
4.34	14.24	37.34
6.37	20.90	49.50
9.35	30.67	78.39
13.72	45.02	94.31
20.14	66.09	74.62

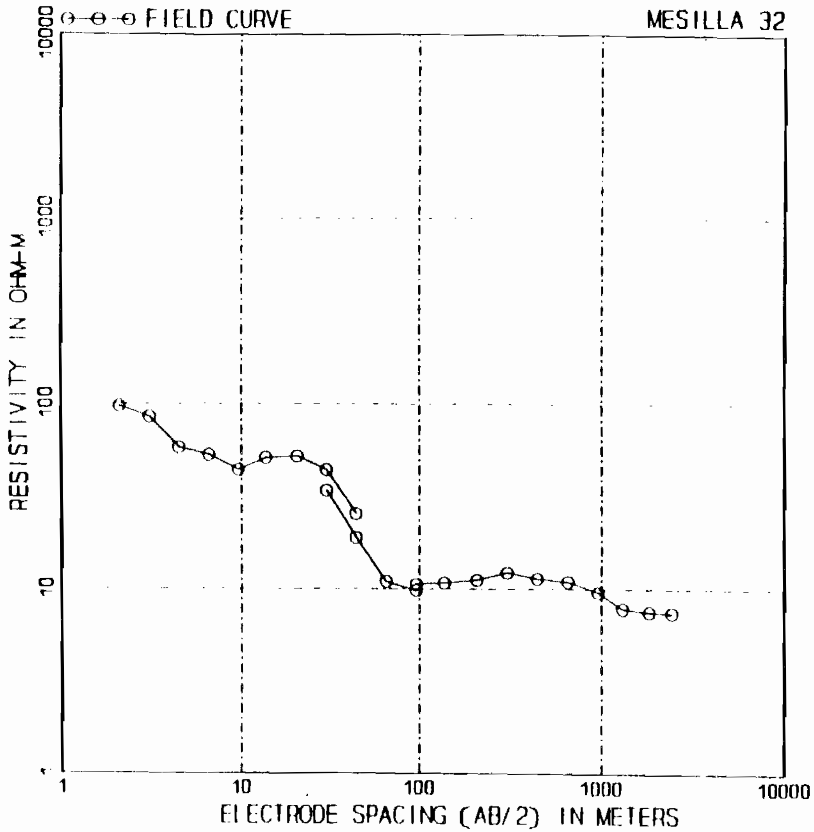
DEPTH, m	(ft)	RESIS.
29.57	97.00	39.33
43.40	142.38	19.57
63.70	208.98	17.16
93.49	306.74	21.56
137.23	450.23	21.76
201.43	660.85	15.27
295.66	970.00	8.42
433.96	1423.76	6.41
99999.00	99999.00	8.53



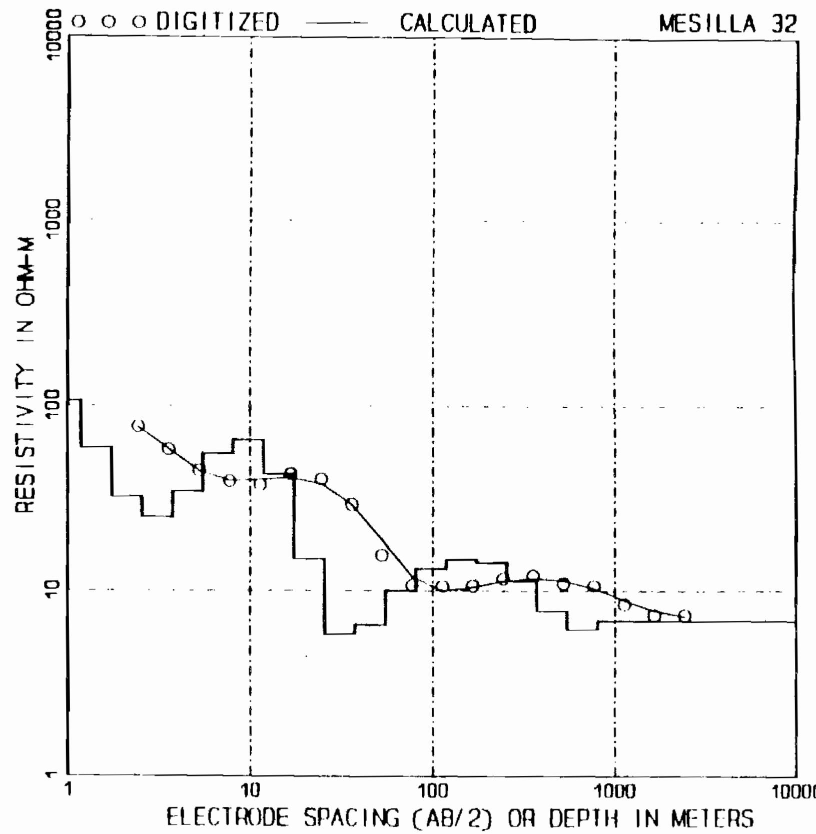
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	12.00	96.01	(315.00)	15.50
3.05	(10.00)	12.90	96.01	(315.00)	16.20
4.45	(14.60)	14.50	137.16	(450.00)	16.20
6.55	(21.50)	18.00	207.26	(680.00)	15.30
9.60	(31.50)	17.70	304.80	(1000.00)	15.00
9.60	(31.50)	19.00	445.01	(1460.00)	14.50
13.72	(45.00)	17.00	655.32	(2150.00)	12.50
20.73	(68.00)	15.80	960.12	(3150.00)	11.40
30.48	(100.00)	17.50	1310.64	(4300.00)	8.[illegible]
44.50	(146.00)	16.00	1828.80	(6000.00)	7.30
65.53	(215.00)	14.80	2438.40	(8000.00)	7.60



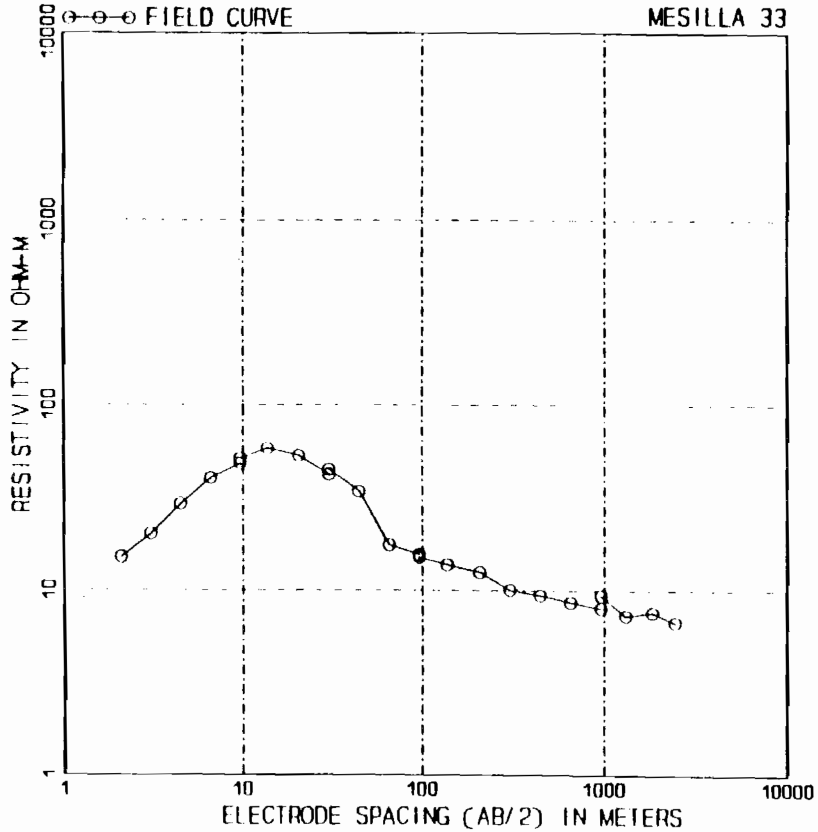
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.19	(3.89)	11.93	37.47	(122.95)	15.48
1.74	(5.71)	15.72	55.01	(180.47)	15.70
2.55	(8.38)	21.13	80.74	(264.89)	15.78
3.75	(12.29)	24.25	118.51	(388.80)	15.86
5.50	(18.05)	22.23	173.94	(570.68)	16.19
8.07	(26.49)	18.48	255.31	(837.64)	15.90
11.85	(38.88)	16.77	374.75	(1229.49)	13.36
17.39	(57.07)	16.47	550.06	(1804.65)	9.32
25.53	(83.76)	15.84	807.37	(2648.86)	6.86
			99999.00	(99999.00)	6.78



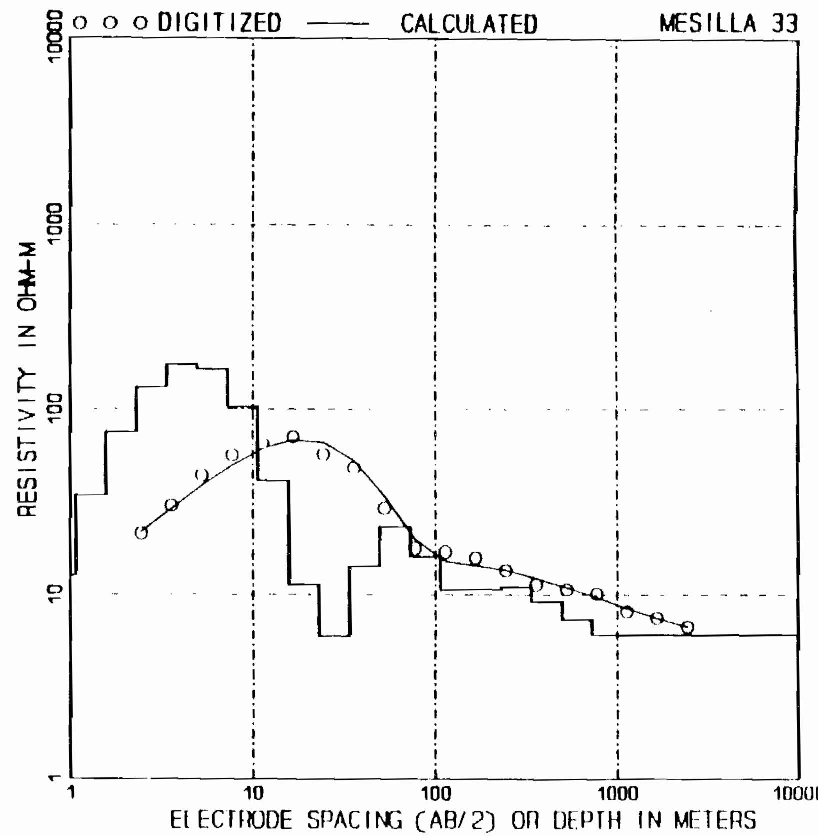
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	6.80	97.00	96.01	315.00	9.80
3.05	10.00	85.00	96.01	315.00	10.60
4.45	14.60	58.00	137.16	450.00	10.80
6.55	21.50	53.00	207.26	680.00	11.20
9.60	31.50	44.00	304.80	1000.00	12.30
13.72	45.00	51.00	445.01	1460.00	11.40
20.73	68.00	52.00	655.32	2150.00	11.00
30.48	100.00	44.00	960.12	3150.00	9.60
44.50	146.00	25.50	960.12	3150.00	9.60
30.48	100.00	34.00	1310.64	4300.00	7.80
44.50	146.00	19.00	1828.80	6000.00	7.50
65.53	215.00	11.00	2438.40	8000.00	7.40



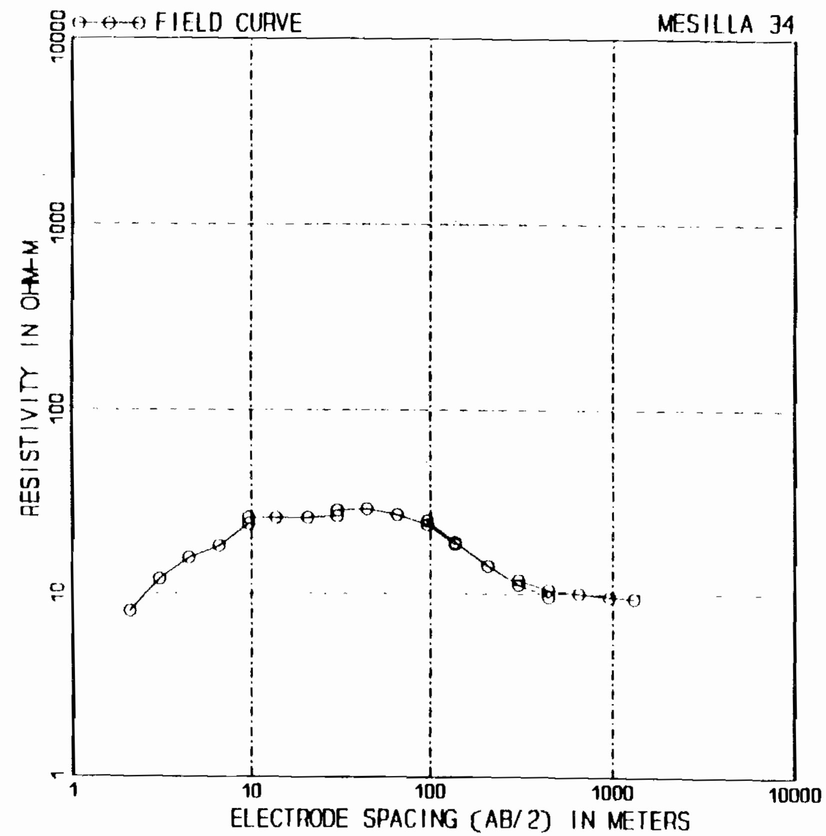
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.19	3.89	106.49	37.47	122.95	5.80
1.74	5.71	59.12	55.01	180.47	6.52
2.55	8.38	32.00	80.74	264.89	10.02
3.75	12.29	24.94	118.51	388.80	13.17
5.50	18.05	34.24	173.94	570.68	14.83
8.07	26.49	55.35	255.31	837.64	14.30
11.85	38.88	65.17	374.75	1229.49	11.37
17.39	57.07	42.66	550.06	1804.65	7.77
25.53	83.76	14.91	807.37	2648.86	6.17
			99999.00	99999.00	6.91



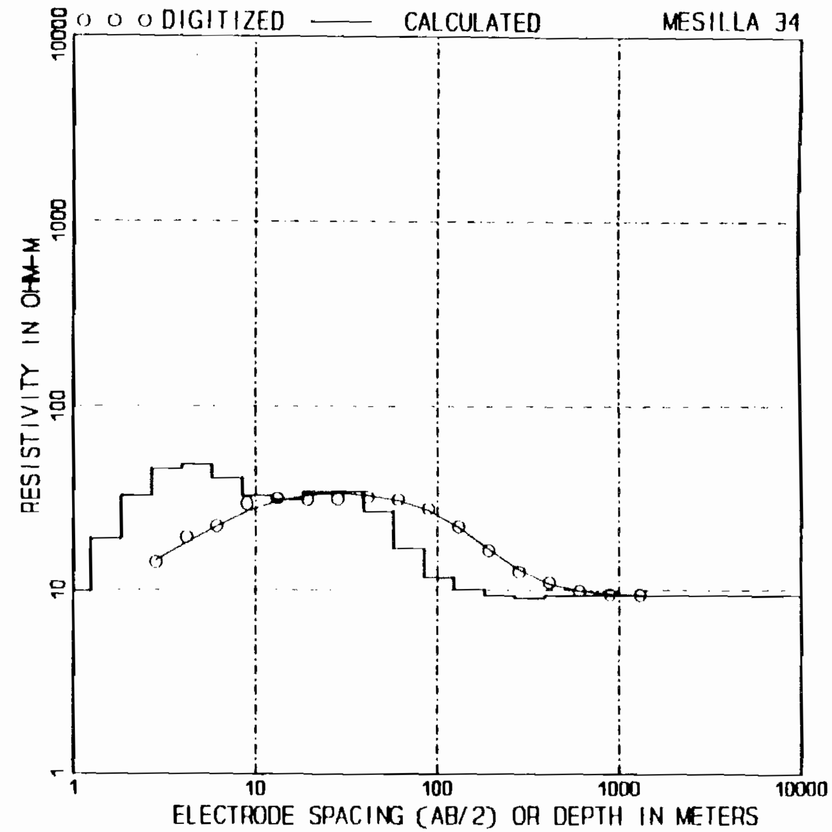
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	15.00	96.01	(315.00)	15.50
3.05	(10.00)	20.00	96.01	(315.00)	15.00
4.45	(14.60)	29.00	137.16	(450.00)	13.70
6.55	(21.50)	40.00	207.26	(680.00)	12.50
9.60	(31.50)	48.00	304.80	(1000.00)	10.00
9.60	(31.50)	51.00	445.01	(1460.00)	9.40
13.72	(45.00)	58.00	655.32	(2150.00)	8.60
20.73	(68.00)	53.00	960.12	(3150.00)	8.00
30.48	(100.00)	42.00	960.12	(3150.00)	9.40
30.48	(100.00)	44.50	1310.64	(4300.00)	7.30
44.50	(146.00)	34.00	1828.80	(6000.00)	7.60
65.53	(215.00)	17.50	2438.40	(8000.00)	6.70



DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.07	(3.50)	12.67	33.73	(110.65)	5.96
1.57	(5.14)	33.76	49.51	(162.42)	14.15
2.30	(7.54)	75.13	72.66	(238.40)	23.00
3.37	(11.07)	131.70	106.66	(349.92)	15.85
4.95	(16.24)	174.79	156.55	(513.61)	10.64
7.27	(23.84)	164.95	229.78	(753.88)	10.61
10.67	(34.99)	103.55	337.27	(1106.54)	10.94
15.65	(51.36)	40.70	495.05	(1624.19)	9.16
22.98	(75.39)	11.30	726.64	(2383.98)	7.35
			99999.00	(99999.00)	6.04

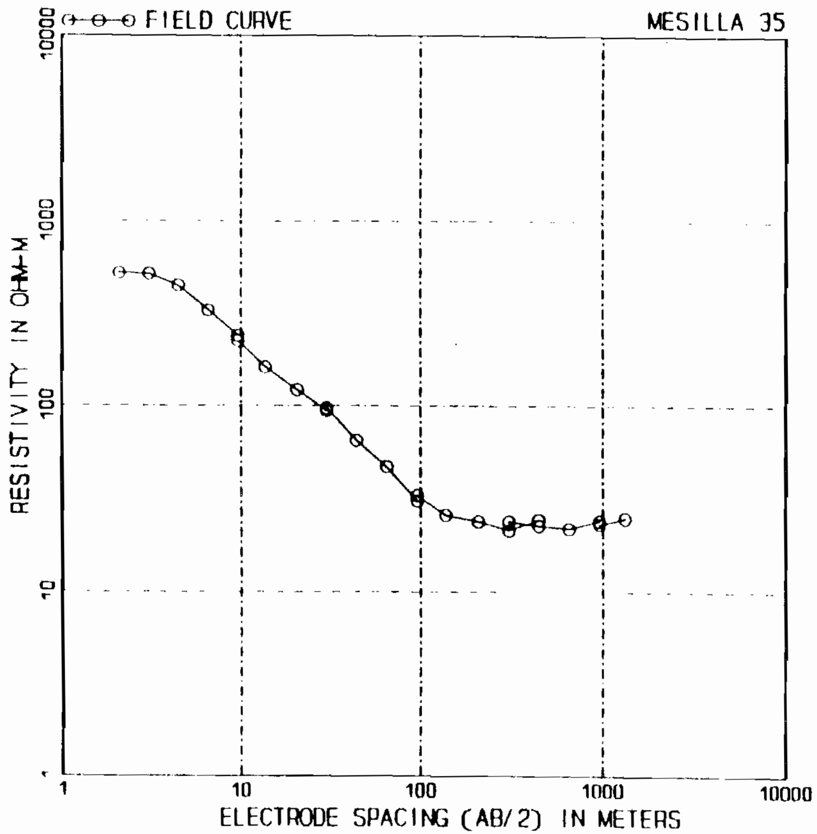


AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	8.00	96.01	(315.00)	23.80
3.05	(10.00)	12.00	137.16	(450.00)	18.70
4.45	(14.60)	15.70	96.01	(315.00)	25.00
6.55	(21.50)	18.20	137.16	(450.00)	19.10
9.60	(31.50)	24.00	207.26	(680.00)	14.20
9.60	(31.50)	26.00	304.80	(1000.00)	11.20
13.72	(45.00)	26.00	445.01	(1460.00)	9.60
20.73	(68.00)	26.00	304.80	(1000.00)	11.90
30.48	(100.00)	26.50	445.01	(1460.00)	10.50
30.48	(100.00)	28.50	655.32	(2150.00)	10.00
44.50	(146.00)	29.00	960.12	(3150.00)	9.60
65.53	(215.00)	27.00	1310.64	(4300.00)	9.40

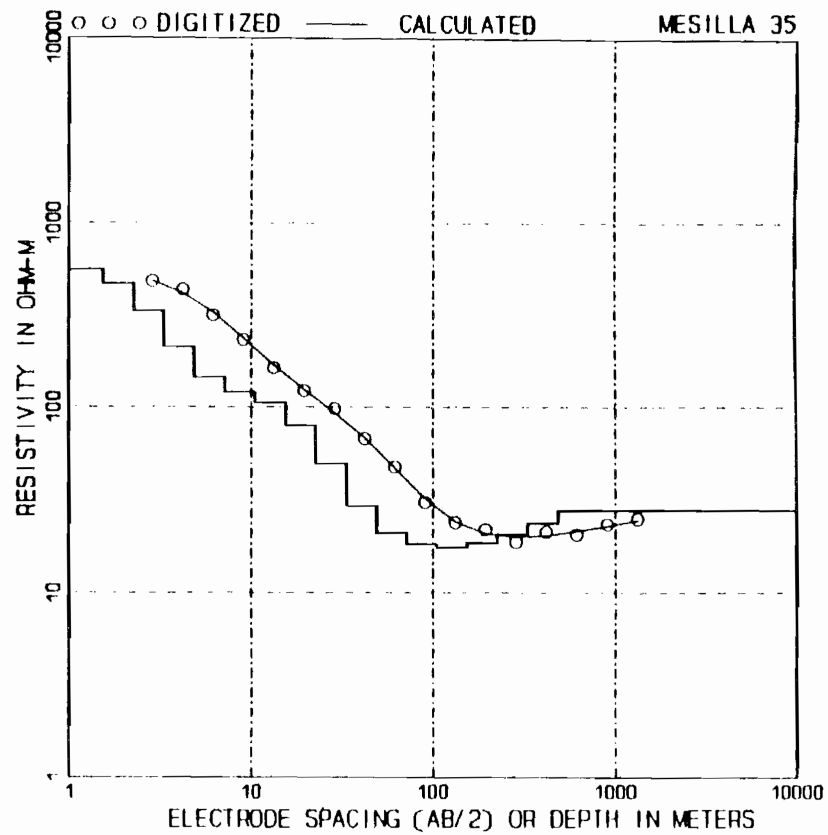


DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.24	(4.05)	9.82	26.61	(87.30)	34.10
1.81	(5.95)	19.00	39.06	(128.14)	34.32
2.66	(8.73)	32.41	57.33	(188.08)	26.55
3.91	(12.81)	45.22	84.15	(276.07)	16.76
5.73	(18.81)	47.98	123.51	(405.21)	11.66
8.41	(27.61)	40.34	181.29	(594.77)	10.06
12.35	(40.52)	32.56	266.09	(873.00)	9.30
18.13	(59.48)	31.04	390.57	(1281.39)	9.06
			99999.00	(99999.00)	9.29

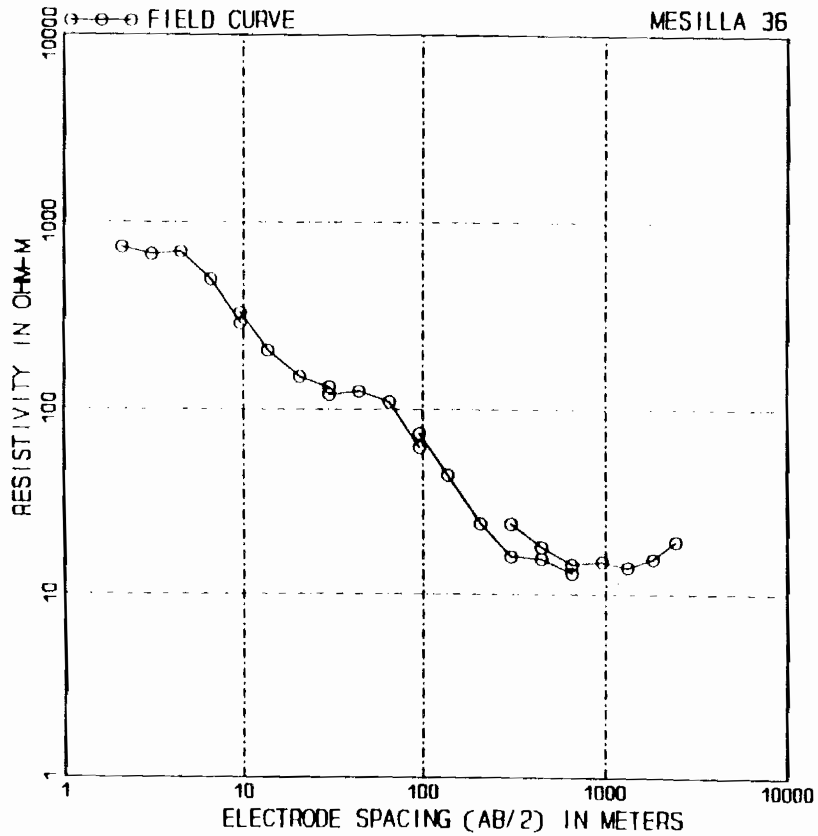
82



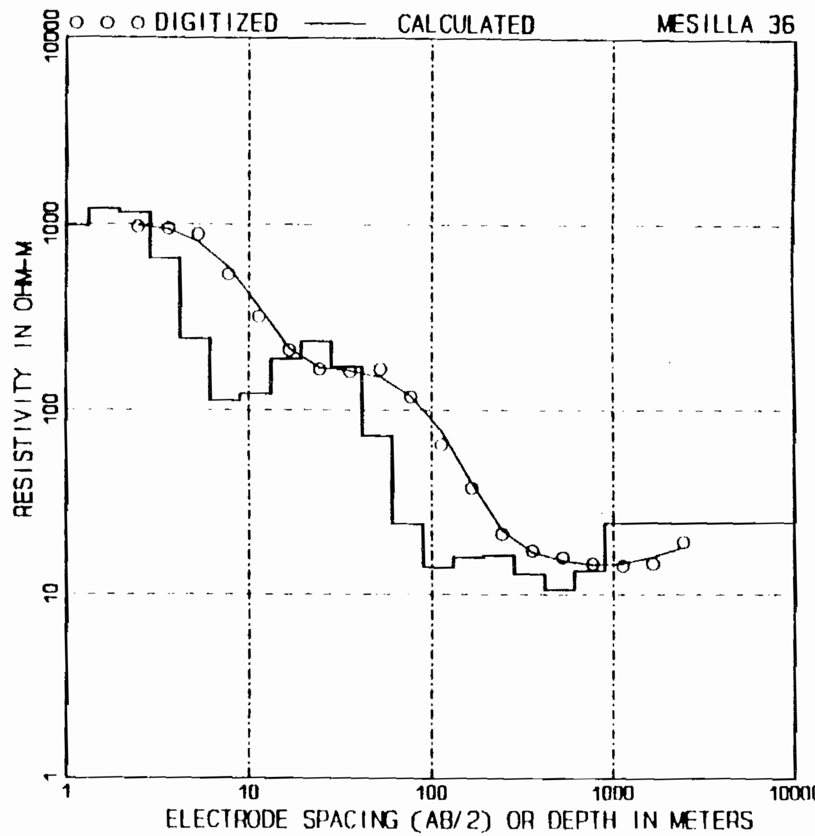
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	525.00	96.01	(315.00)	31.00
3.05	(10.00)	520.00	96.01	(315.00)	33.00
4.45	(14.60)	450.00	137.16	(450.00)	26.00
6.55	(21.50)	330.00	207.26	(680.00)	24.00
9.60	(31.50)	240.00	304.80	(1000.00)	21.50
9.60	(31.50)	225.00	445.01	(1460.00)	24.50
13.72	(45.00)	162.00	304.80	(1000.00)	24.00
20.73	(68.00)	122.00	445.01	(1460.00)	22.80
30.48	(100.00)	94.00	655.32	(2150.00)	22.00
30.48	(100.00)	97.00	960.12	(3150.00)	24.20
44.50	(146.00)	65.00	960.12	(3150.00)	23.20
65.53	(215.00)	47.00	1325.88	(4350.00)	25.00



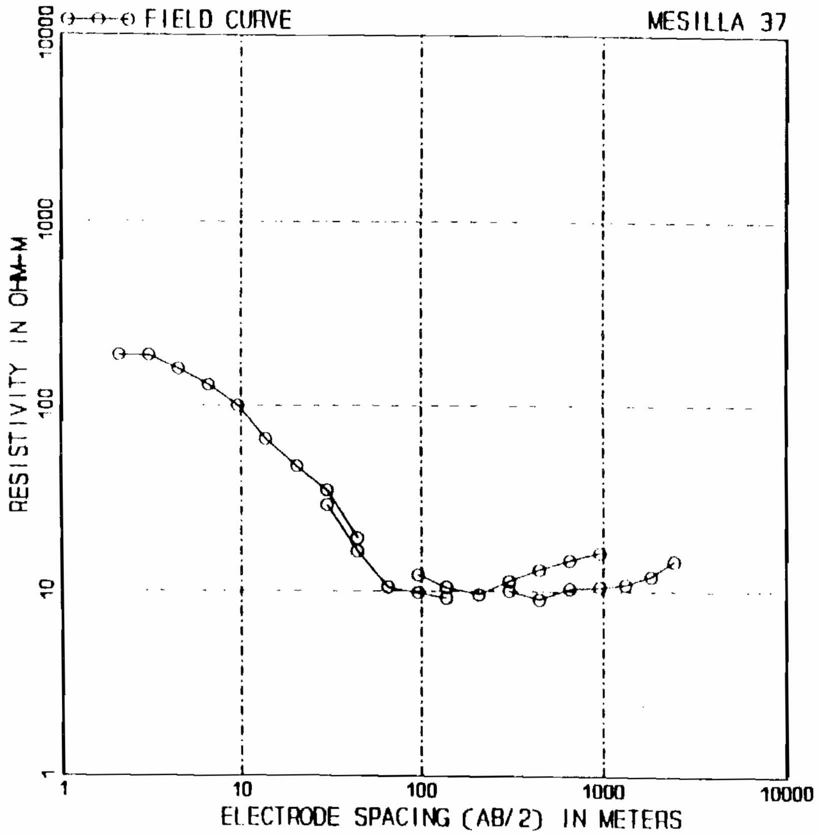
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.54	(5.06)	559.24	33.23	(109.03)	49.41
2.26	(7.43)	470.30	48.78	(160.04)	29.33
3.32	(10.90)	333.62	71.60	(234.90)	21.11
4.88	(16.00)	212.21	105.09	(344.79)	18.29
7.16	(23.49)	145.43	154.25	(506.08)	17.55
10.51	(34.48)	121.05	226.41	(742.82)	18.52
15.43	(50.61)	105.94	332.33	(1090.31)	20.67
22.64	(74.28)	79.56	487.79	(1600.36)	23.91
			99999.00	(99999.00)	27.78



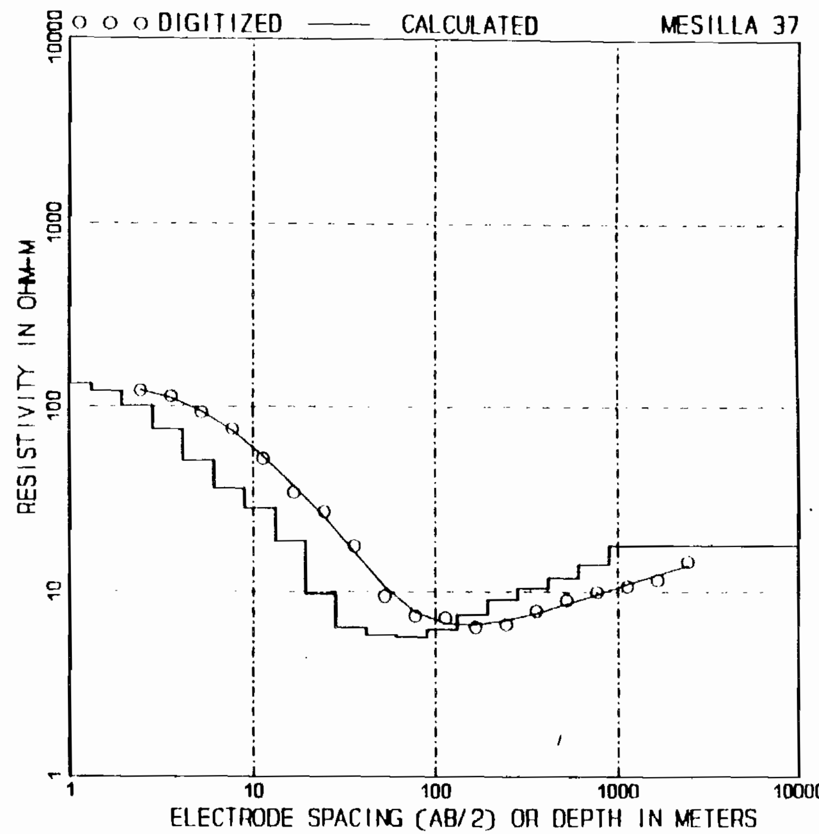
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	740.00	96.01	(315.00)	74.00
3.05	(10.00)	680.00	137.16	(450.00)	44.00
4.45	(14.60)	700.00	207.26	(680.00)	24.00
6.55	(21.50)	500.00	304.80	(1000.00)	16.00
9.60	(31.50)	290.00	445.01	(1460.00)	15.50
9.60	(31.50)	330.00	655.32	(2150.00)	13.00
13.72	(45.00)	207.00	304.80	(1000.00)	24.00
20.73	(68.00)	150.00	445.01	(1460.00)	18.00
30.48	(100.00)	132.00	655.32	(2150.00)	14.50
30.48	(100.00)	120.00	960.12	(3150.00)	15.00
44.50	(146.00)	125.00	1325.88	(4350.00)	14.00
65.53	(215.00)	110.00	1828.80	(6000.00)	15.50
96.01	(315.00)	62.00	2438.40	(8000.00)	19.30



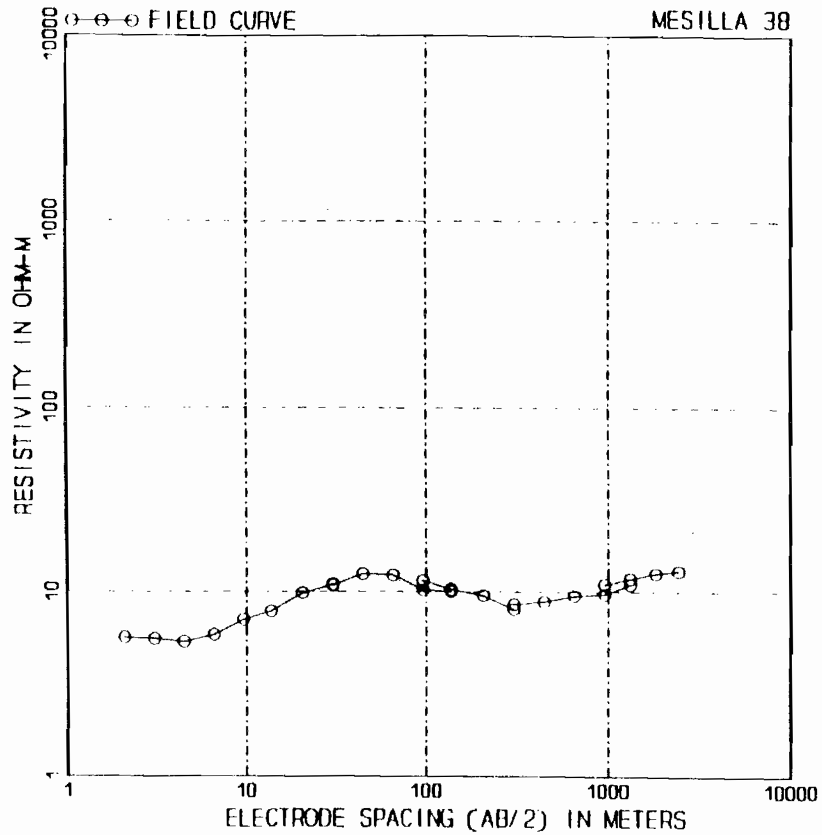
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.32	(4.32)	982.93	41.64	(136.61)	173.06
1.93	(6.34)	1208.84	61.12	(200.52)	72.13
2.84	(9.31)	1155.47	89.71	(294.32)	24.01
4.16	(13.66)	661.24	131.67	(432.00)	14.12
6.11	(20.05)	241.84	193.27	(634.09)	15.95
8.97	(29.43)	112.57	283.68	(930.72)	16.30
13.17	(43.20)	122.66	416.39	(1366.10)	12.88
19.33	(63.41)	189.78	611.17	(2005.17)	10.64
28.37	(93.07)	235.89	897.08	(2943.18)	13.43
			99999.00	(99999.00)	24.48



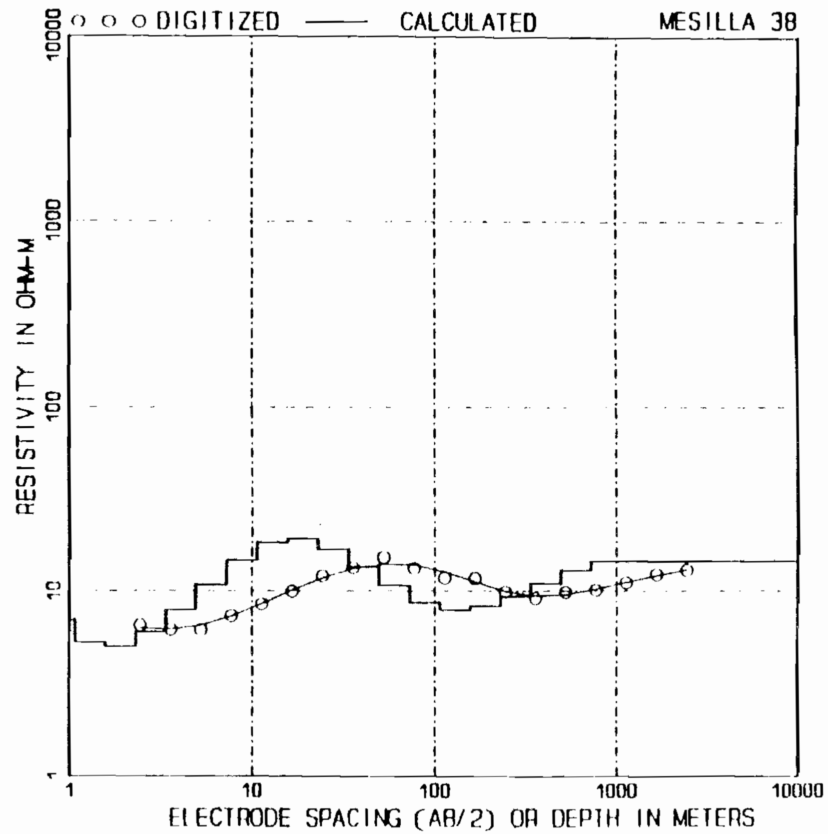
AB/2, m (	ft)	App. Res.	AB/2, m (	ft)	App. Res.
2.07 (	6.80)	190.00	96.01 (	315.00)	12.20
3.05 (	10.00)	190.00	137.16 (	450.00)	10.50
4.45 (	14.60)	160.00	207.26 (	680.00)	9.60
6.55 (	21.50)	130.00	304.80 (	1000.00)	11.30
9.60 (	31.50)	100.00	445.01 (	1460.00)	13.00
13.72 (	45.00)	66.00	655.32 (	2150.00)	14.60
20.73 (	68.00)	47.00	960.12 (	3150.00)	16.00
30.48 (	100.00)	35.00	304.80 (	1000.00)	10.00
44.50 (	146.00)	19.20	445.01 (	1460.00)	9.00
30.48 (	100.00)	29.00	655.32 (	2150.00)	10.30
44.50 (	146.00)	16.30	960.12 (	3150.00)	10.50
65.53 (	215.00)	10.50	1325.88 (	4350.00)	10.90
96.01 (	315.00)	9.80	1828.80 (	6000.00)	12.00
137.16 (	450.00)	9.20	2438.40 (	8000.00)	14.50



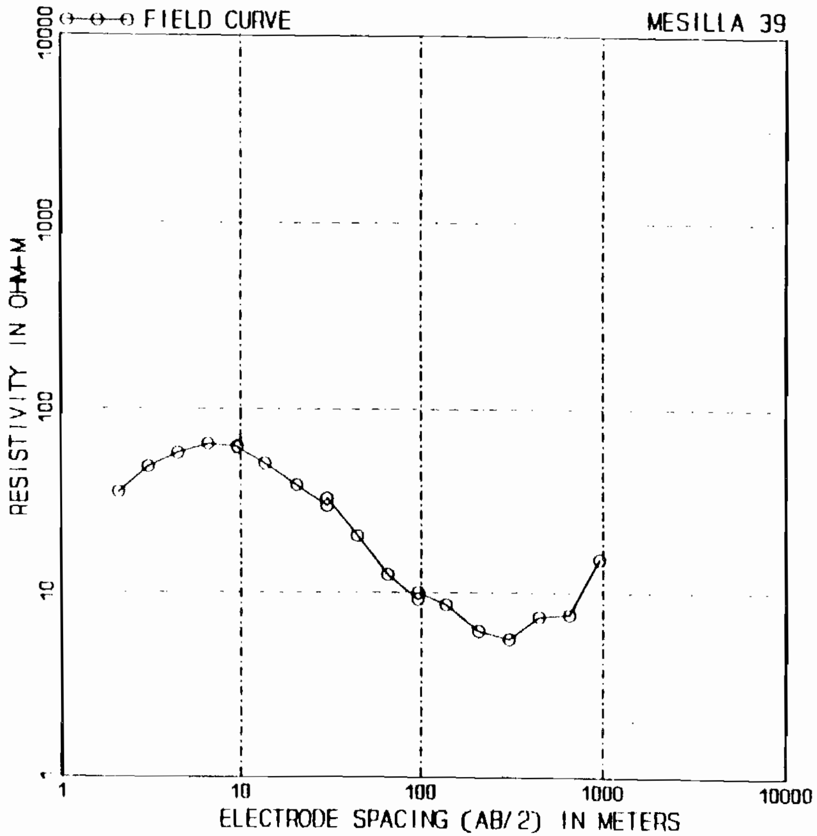
DEPTH, m (	ft)	RESIS.	DEPTH, m (	ft)	RESIS.
1.32 (	4.32)	133.93	41.64 (	136.61)	6.43
1.93 (	6.34)	121.74	61.12 (	200.52)	5.84
2.84 (	9.31)	101.20	89.71 (	294.32)	5.72
4.16 (	13.66)	75.22	131.67 (	432.00)	6.25
6.11 (	20.05)	50.96	193.27 (	634.09)	7.56
8.97 (	29.43)	36.05	283.68 (	930.72)	9.12
13.17 (	43.20)	28.16	416.39 (	1366.10)	10.48
19.33 (	63.41)	18.58	611.17 (	2005.17)	11.83
28.37 (	91.07)	9.72	897.08 (	2943.18)	13.98
			99999.00 (	99999.00)	17.58

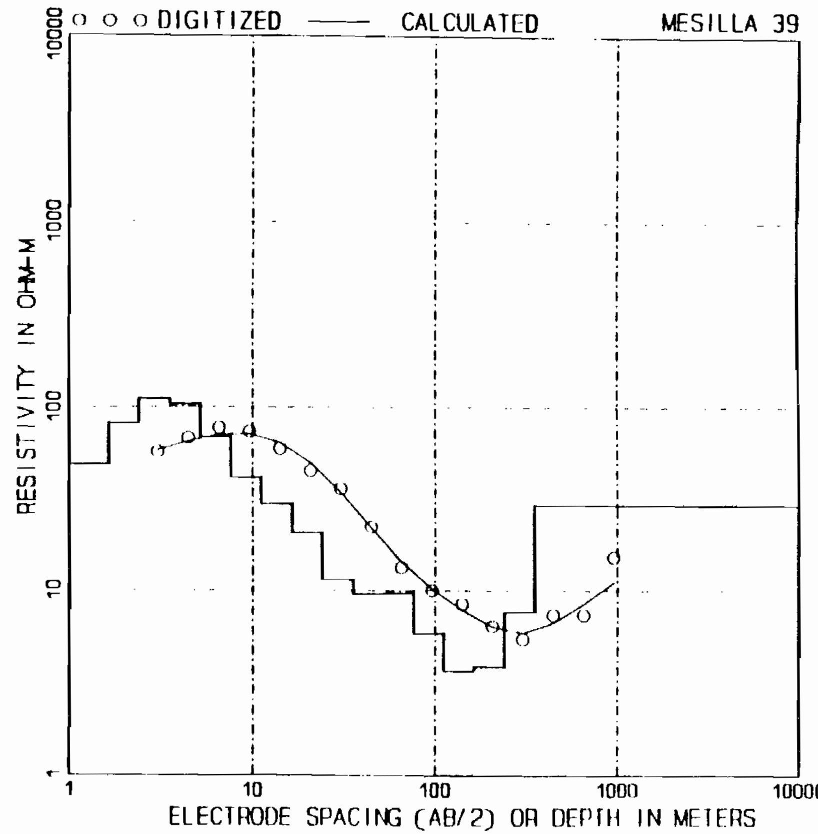


AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	5.60	96.01	(315.00)	11.50
3.05	(10.00)	5.50	137.16	(450.00)	10.30
4.45	(14.60)	5.30	207.26	(680.00)	9.50
6.55	(21.50)	5.80	304.80	(1000.00)	8.00
9.60	(31.50)	7.00	304.80	(1000.00)	8.50
13.72	(45.00)	7.80	445.01	(1460.00)	8.80
20.73	(68.00)	9.80	655.32	(2150.00)	9.50
30.48	(100.00)	11.00	960.12	(3150.00)	9.70
30.48	(100.00)	10.80	1325.88	(4350.00)	11.00
44.50	(146.00)	12.50	960.12	(3150.00)	11.00
65.53	(215.00)	12.30	1325.88	(4350.00)	11.80
96.01	(315.00)	10.20	1828.80	(6000.00)	12.60
137.16	(450.00)	10.00	2438.40	(8000.00)	13.00



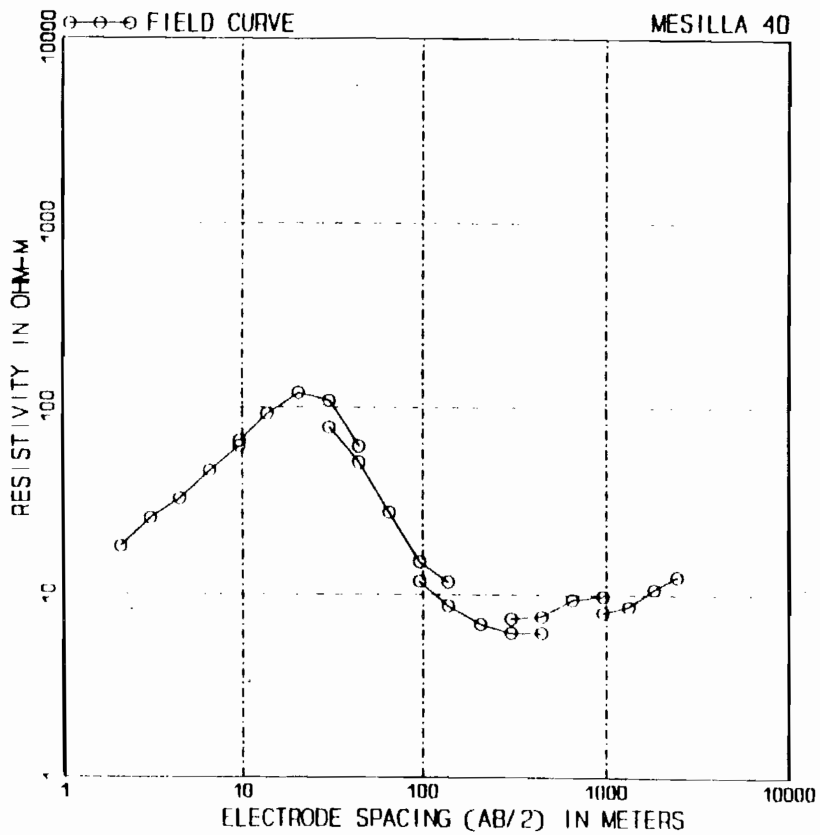
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.07	(3.50)	6.93	33.73	(110.65)	16.85
1.57	(5.14)	5.24	49.51	(162.42)	13.48
2.30	(7.54)	4.99	72.66	(238.40)	10.67
3.37	(11.07)	5.95	106.66	(349.92)	8.65
4.95	(16.24)	7.85	156.55	(513.61)	7.84
7.27	(23.84)	10.78	229.78	(753.88)	8.21
10.67	(34.99)	14.68	337.27	(1106.54)	9.32
15.65	(51.36)	18.31	495.05	(1624.19)	10.99
22.98	(75.39)	19.23	726.64	(2383.98)	12.87
			99999.00	(99999.00)	14.53



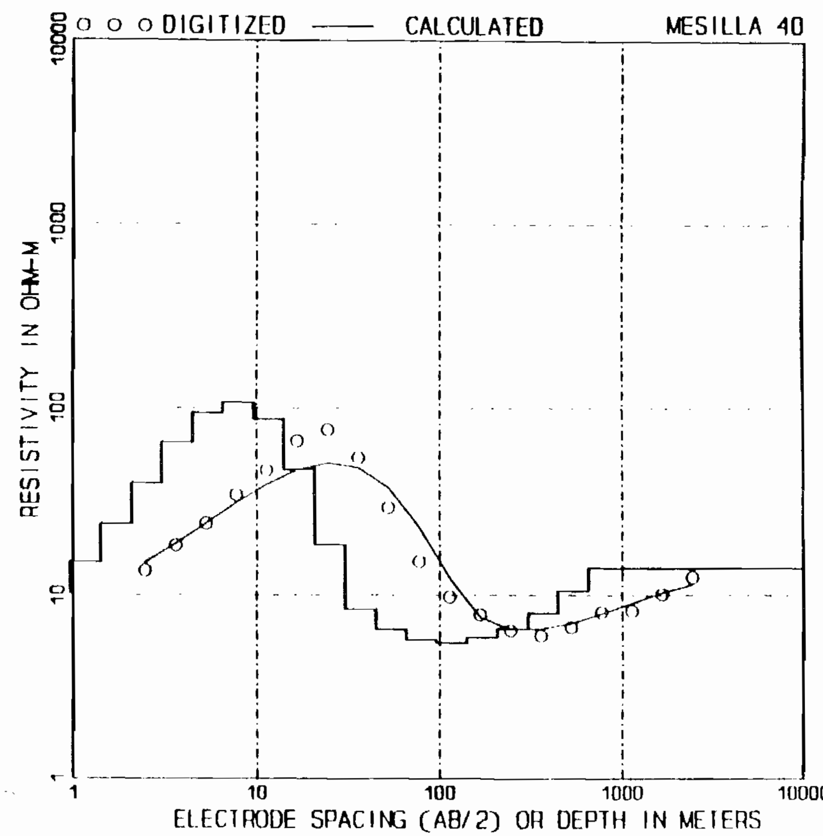


AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	35.50	44.50	(146.00)	20.50
3.05	(10.00)	49.00	65.53	(215.00)	12.50
4.45	(14.60)	58.00	96.01	(315.00)	9.20
6.55	(21.50)	65.00	96.01	(315.00)	10.00
9.60	(31.50)	63.00	137.16	(450.00)	8.60
9.60	(31.50)	62.00	207.26	(680.00)	6.20
13.72	(45.00)	51.00	304.80	(1000.00)	5.50
20.73	(68.00)	39.00	445.01	(1460.00)	7.40
30.48	(100.00)	30.00	655.32	(2150.00)	7.60
30.48	(100.00)	33.00	960.12	(3150.00)	15.20

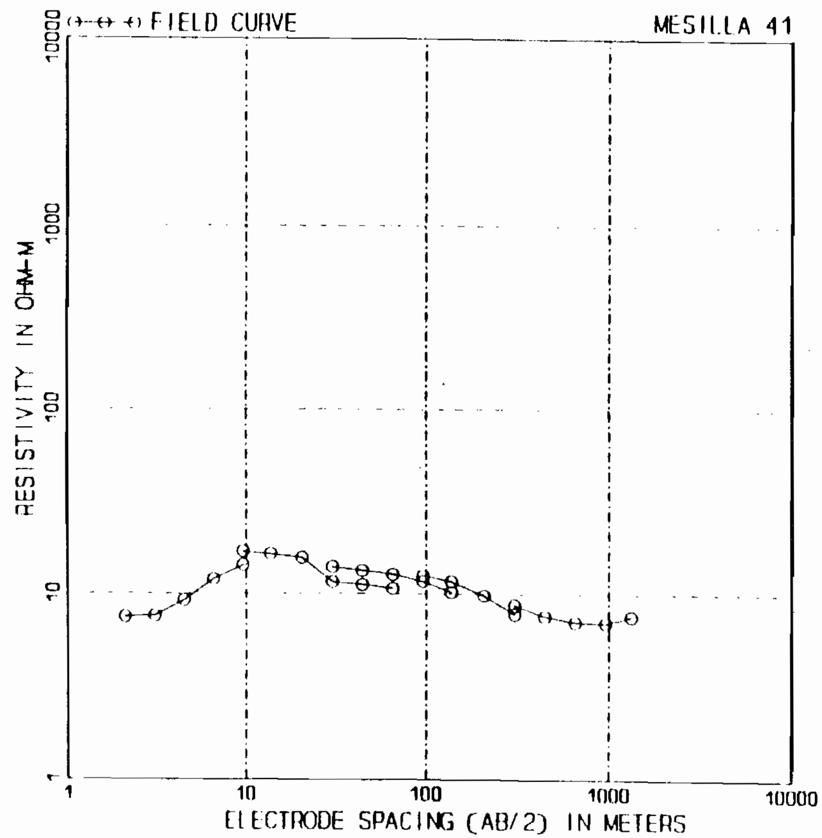
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.64	(5.38)	49.16	35.32	(115.89)	11.37
2.41	(7.90)	81.78	51.85	(170.10)	9.54
3.53	(11.59)	111.30	76.10	(249.67)	9.60
5.18	(17.01)	104.51	111.70	(366.47)	5.85
7.61	(24.97)	69.19	163.95	(537.90)	3.63
11.17	(36.65)	41.61	240.65	(789.53)	3.84
16.40	(53.79)	29.78	353.23	(1158.88)	7.66
24.07	(78.95)	20.64	99999.00	(99999.00)	29.46



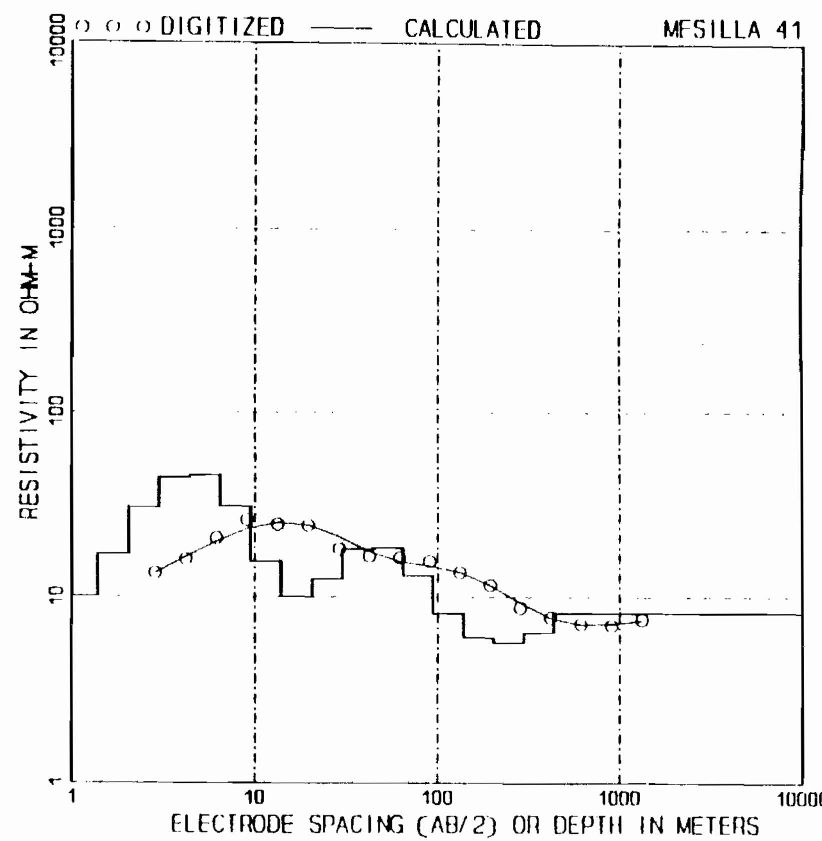
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	6.80	18.00	137.16	450.00	11.70
3.05	10.00	25.50	96.01	315.00	11.80
4.45	14.60	32.50	137.16	450.00	8.70
6.55	21.50	46.00	207.26	680.00	6.90
9.60	31.50	62.00	304.80	1000.00	6.20
9.60	31.50	66.00	445.01	1460.00	6.20
13.72	45.00	92.00	304.80	1000.00	7.40
20.73	68.00	120.00	445.01	1460.00	7.60
30.48	100.00	109.00	655.32	2150.00	9.40
44.50	146.00	62.00	960.12	3150.00	9.80
30.48	100.00	78.00	960.12	3150.00	8.00
44.50	146.00	51.00	1325.88	4350.00	8.60
65.53	215.00	27.50	1828.80	6000.00	10.70
96.01	315.00	15.00	2438.40	8000.00	12.50



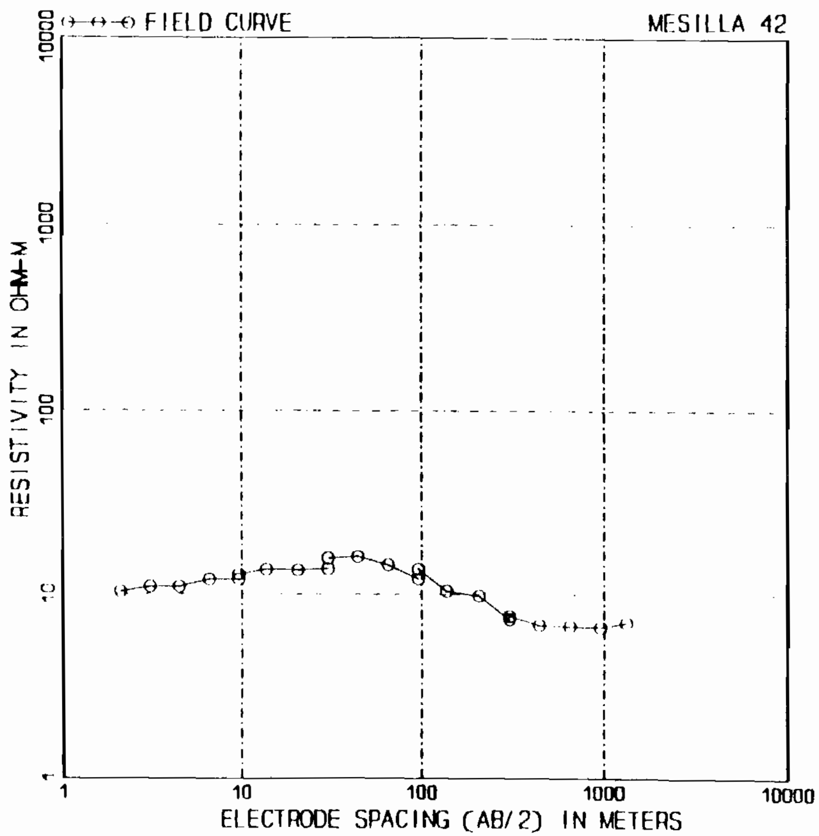
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
0.96	3.15	10.24	30.35	99.59	18.62
1.41	4.62	15.12	44.55	146.18	8.35
2.07	6.78	23.99	65.40	214.56	6.53
3.04	9.96	39.91	95.99	314.93	5.71
4.46	14.62	65.13	140.89	462.25	5.51
6.54	21.46	93.99	206.80	678.49	5.90
9.60	31.49	107.15	303.55	995.89	6.57
14.09	46.23	87.16	445.55	1461.77	8.00
20.68	67.85	47.37	653.97	2145.58	10.54
			99999.00	99999.00	13.95



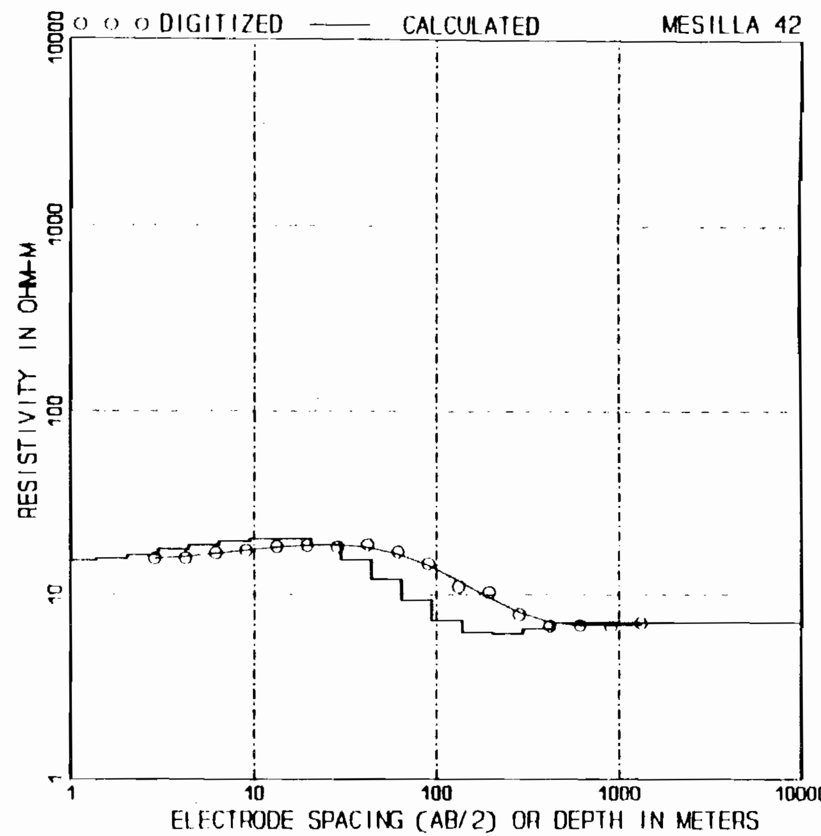
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	7.50	44.50	(146.00)	13.40
3.05	(10.00)	7.60	65.53	(215.00)	12.80
4.45	(14.60)	9.20	96.01	(315.00)	11.70
6.55	(21.50)	12.00	137.16	(450.00)	10.20
9.60	(31.50)	14.30	96.01	(315.00)	12.60
9.60	(31.50)	17.00	137.16	(450.00)	11.70
13.72	(45.00)	16.50	207.26	(680.00)	9.80
20.73	(68.00)	15.70	304.80	(1000.00)	7.80
30.48	(100.00)	11.60	304.80	(1000.00)	8.70
44.50	(146.00)	11.20	445.01	(1460.00)	7.60
65.53	(215.00)	10.70	655.32	(2150.00)	7.10
30.48	(100.00)	14.00	960.12	(3150.00)	7.00
			1325.88	(4350.00)	7.60



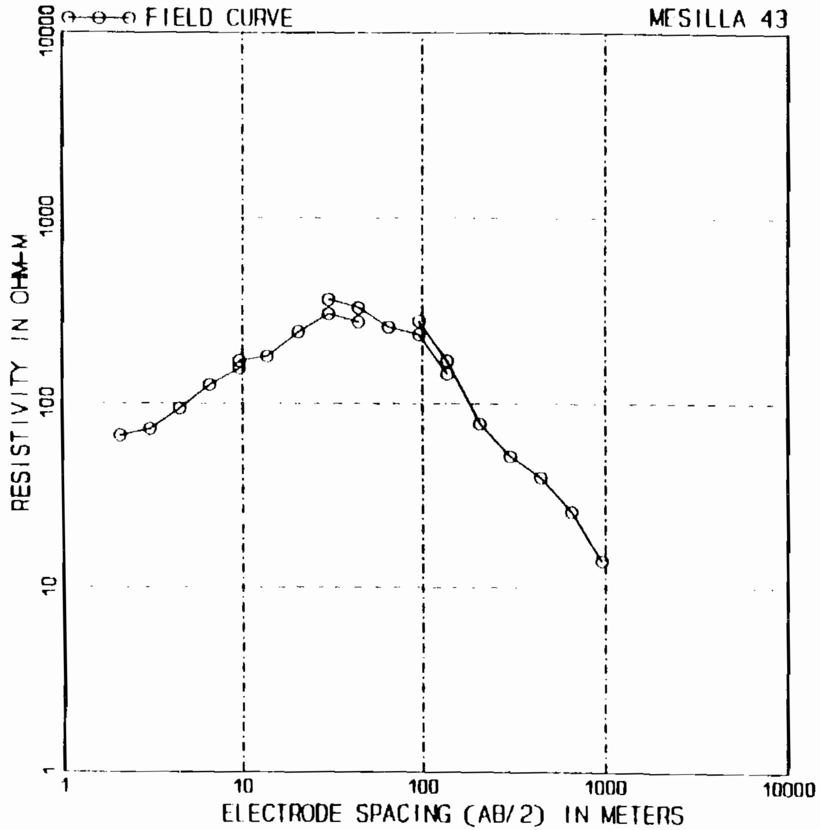
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.39	(4.55)	10.04	29.91	(98.13)	12.55
2.04	(6.69)	17.02	43.90	(144.03)	18.23
2.99	(9.81)	30.35	64.44	(211.41)	18.43
4.39	(14.40)	44.16	94.58	(310.31)	13.09
6.44	(21.14)	45.26	138.83	(455.47)	8.17
9.46	(31.03)	30.70	203.77	(668.54)	6.10
13.88	(45.55)	15.52	299.09	(981.28)	5.73
20.38	(66.85)	9.97	439.01	(1440.32)	6.45
			99999.00	(99999.00)	8.24



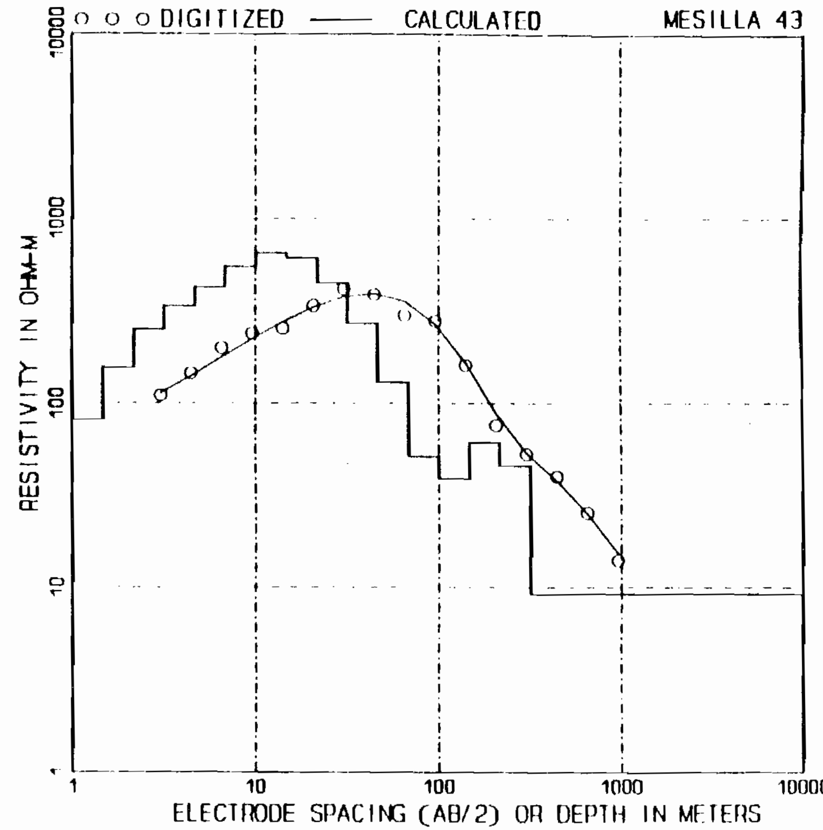
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	10.30	65.53	(215.00)	14.40
3.05	(10.00)	11.00	96.01	(315.00)	12.10
4.45	(14.60)	11.00	96.01	(315.00)	13.70
6.55	(21.50)	12.00	137.16	(450.00)	10.40
9.60	(31.50)	12.00	207.26	(680.00)	9.80
9.60	(31.50)	12.80	304.80	(1000.00)	7.30
13.72	(45.00)	13.60	304.80	(1000.00)	7.60
20.73	(68.00)	13.50	445.01	(1460.00)	6.80
30.48	(100.00)	13.70	655.32	(2150.00)	6.70
30.48	(100.00)	15.70	960.12	(3150.00)	6.60
44.50	(146.00)	16.00	1325.88	(4350.00)	7.00



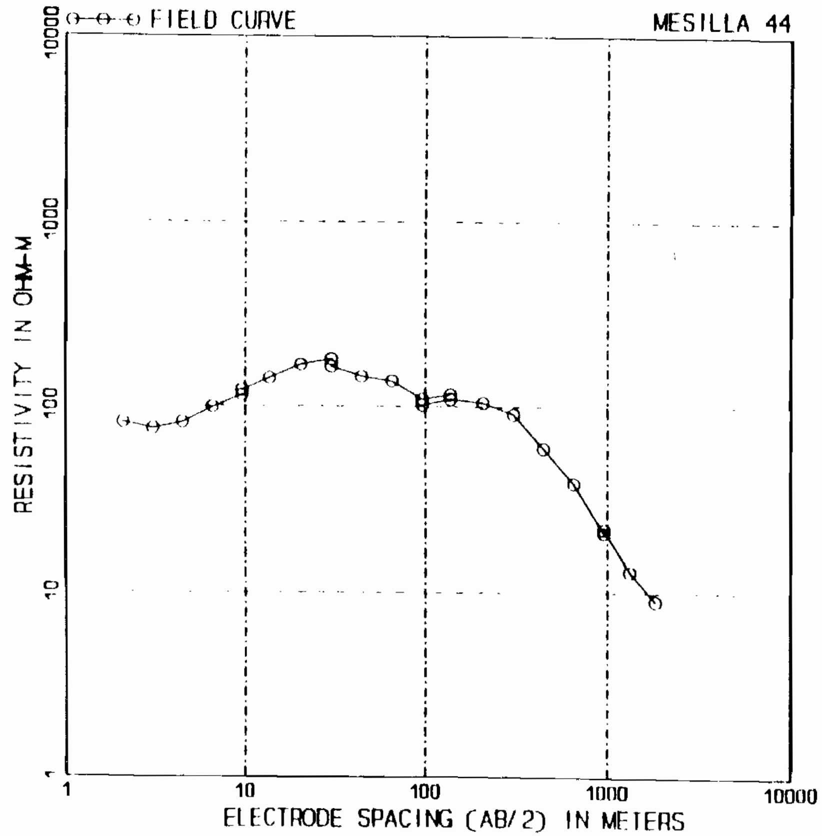
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.39	(4.55)	15.31	29.91	(98.13)	18.60
2.04	(6.69)	15.69	43.90	(144.03)	15.47
2.99	(9.81)	16.50	64.44	(211.41)	12.09
4.39	(14.40)	17.55	94.58	(310.31)	9.30
6.44	(21.14)	18.57	138.83	(455.47)	7.23
9.46	(31.03)	19.43	203.77	(668.54)	6.21
13.88	(45.55)	20.13	299.09	(981.28)	6.14
20.38	(66.85)	20.17	439.01	(1440.32)	6.53
			99999.00	(99999.00)	7.04



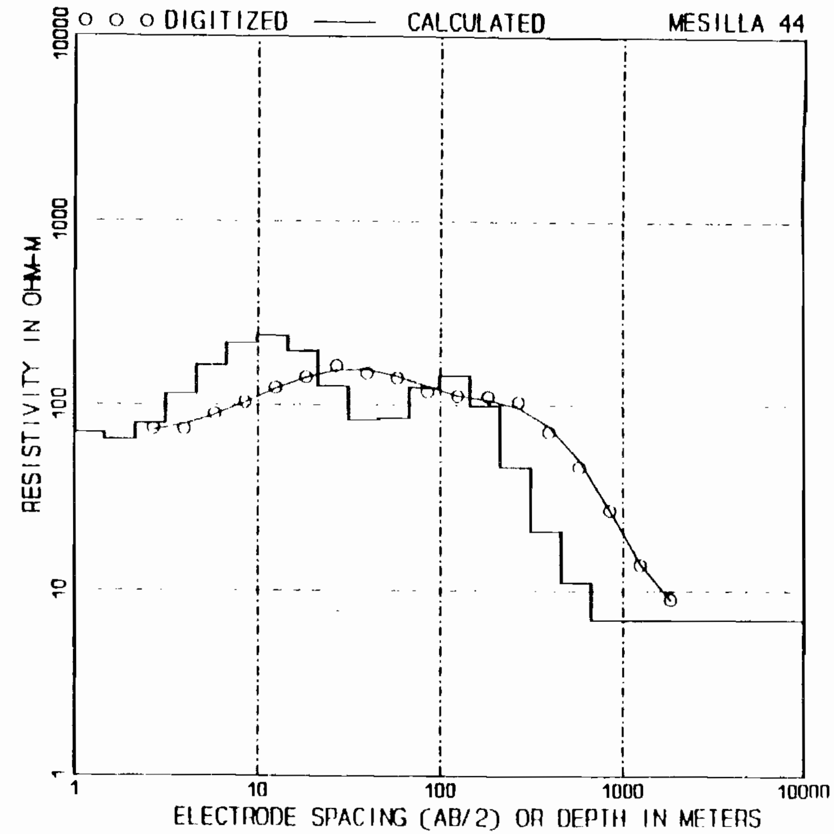
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	6.80	67.00	44.50	146.00	330.00
3.05	10.00	73.00	65.53	215.00	260.00
4.45	14.60	94.00	96.01	315.00	237.00
6.55	21.50	126.00	137.16	450.00	145.00
9.60	31.50	155.00	96.01	315.00	280.00
9.60	31.50	171.00	137.16	450.00	171.00
13.72	45.00	180.00	207.26	680.00	78.00
20.73	68.00	245.00	304.80	1000.00	[illegible].00
30.48	100.00	305.00	304.80	1000.00	52.00
44.50	146.00	277.00	445.01	1460.00	40.00
30.48	100.00	365.00	655.32	2150.00	26.00
			960.12	3150.00	14.00



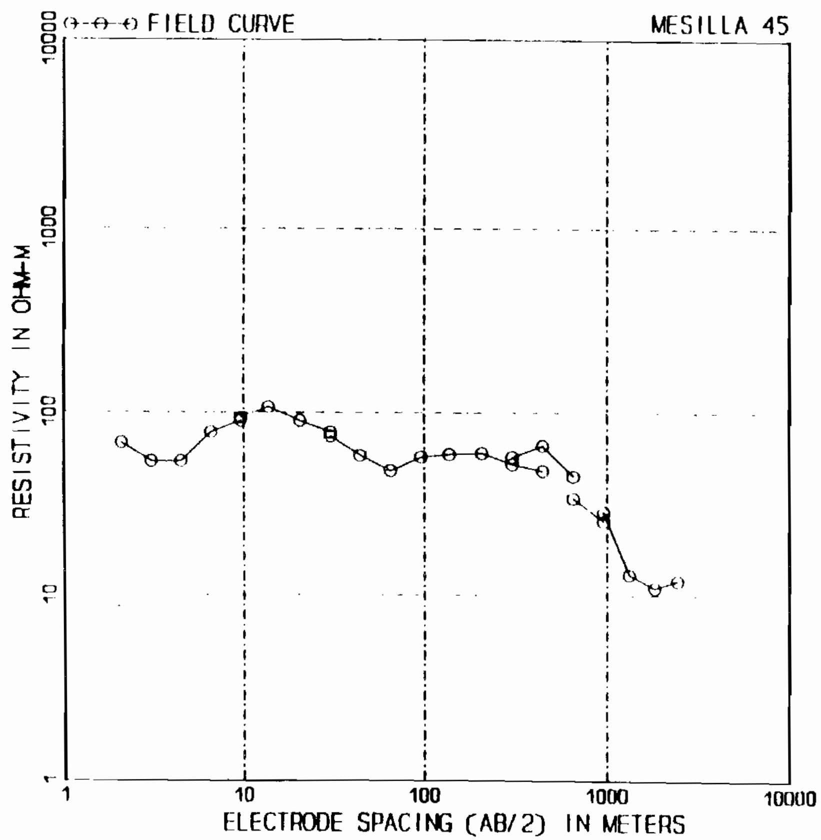
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.48	4.84	81.42	31.79	104.30	448.09
2.17	7.11	155.84	46.66	153.09	271.76
3.18	10.43	251.55	68.49	224.71	130.70
4.67	15.31	336.56	100.53	329.82	51.34
6.85	22.47	425.02	147.56	484.11	39.03
10.05	32.98	547.64	216.59	710.58	61.66
14.76	48.41	650.09	317.90	1042.99	45.73
21.66	71.06	611.94	99999.00	99999.00	9.14



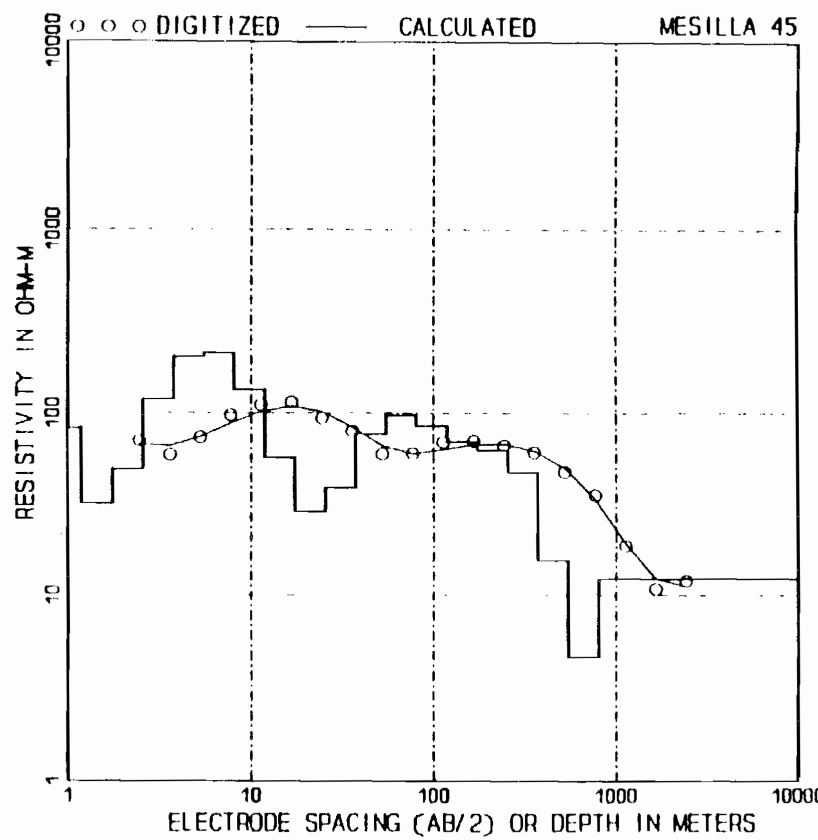
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res
2.07	(6.80)	82.00	96.01	(315.00)	110.00
3.05	(10.00)	76.00	137.16	(450.00)	116.00
4.45	(14.60)	82.00	96.01	(315.00)	102.00
6.55	(21.50)	99.00	137.16	(450.00)	110.00
9.60	(31.50)	115.00	207.26	(680.00)	105.00
9.60	(31.50)	122.00	304.80	(1000.00)	91.00
13.72	(45.00)	142.00	445.01	(1460.00)	60.00
20.73	(68.00)	168.00	655.32	(2150.00)	39.00
30.48	(100.00)	180.00	960.12	(3150.00)	21.00
30.48	(100.00)	164.00	960.12	(3150.00)	22.00
44.50	(146.00)	145.00	1325.88	(4350.00)	13.00
65.53	(215.00)	137.00	1828.80	(6000.00)	9.00



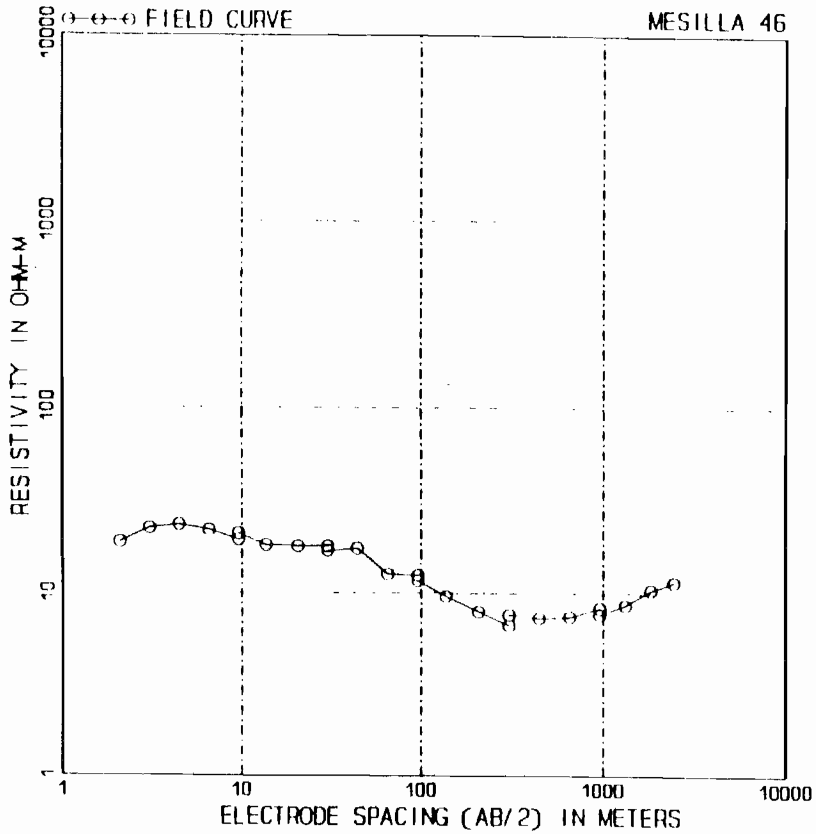
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS
1.45	(4.76)	71.01	45.84	(150.39)	83.13
2.13	(6.98)	65.09	67.28	(220.74)	85.12
3.12	(10.25)	80.24	98.76	(324.00)	124.39
4.58	(15.04)	114.97	144.95	(475.57)	143.81
6.73	(22.07)	164.58	212.76	(698.04)	98.59
9.88	(32.40)	217.44	312.29	(1024.58)	46.39
14.50	(47.56)	238.32	458.38	(1503.88)	20.92
21.28	(69.80)	196.74	672.81	(2207.39)	11.05
31.23	(102.46)	126.17	99999.00	(99999.00)	6.96



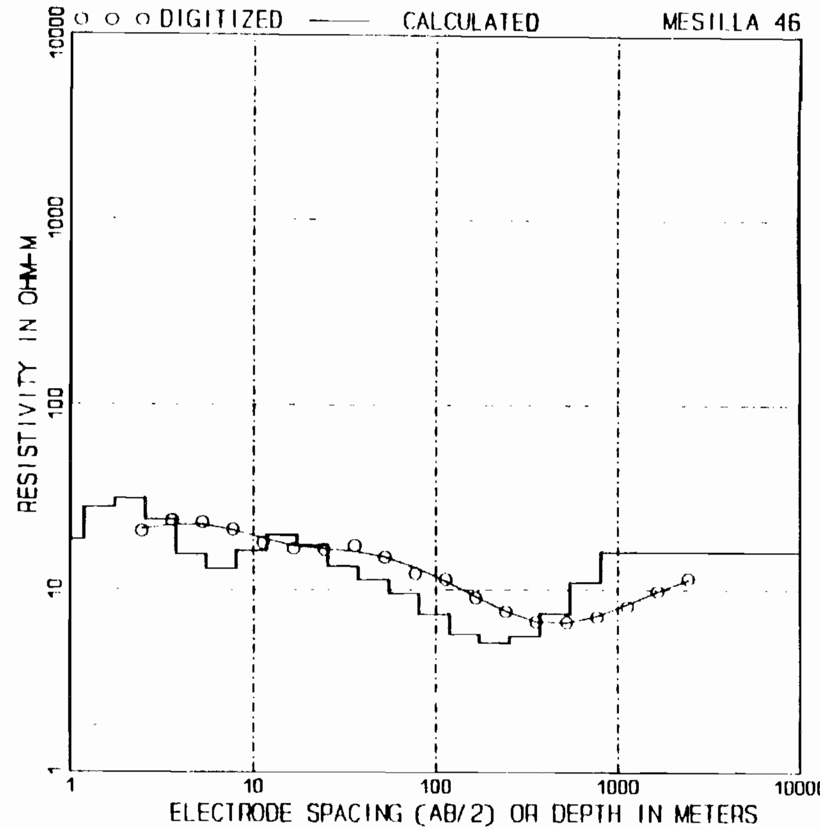
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	68.00	96.01	(315.00)	57.00
3.05	(10.00)	54.00	137.16	(450.00)	59.00
4.45	(14.60)	54.00	207.26	(680.00)	60.00
6.55	(21.50)	78.00	304.80	(1000.00)	52.00
9.60	(31.50)	90.00	445.01	(1460.00)	48.00
9.60	(31.50)	94.00	304.80	(1000.00)	57.00
13.72	(45.00)	107.00	445.01	(1460.00)	66.00
20.73	(68.00)	90.00	655.32	(2150.00)	45.00
30.48	(100.00)	78.00	655.32	(2150.00)	34.00
30.48	(100.00)	74.00	960.12	(3150.00)	25.50
44.50	(146.00)	58.00	960.12	(3150.00)	28.70
65.53	(215.00)	48.00	1325.88	(4350.00)	13.00
96.01	(315.00)	57.00	1828.80	(6000.00)	11.00
			2438.40	(8000.00)	12.00



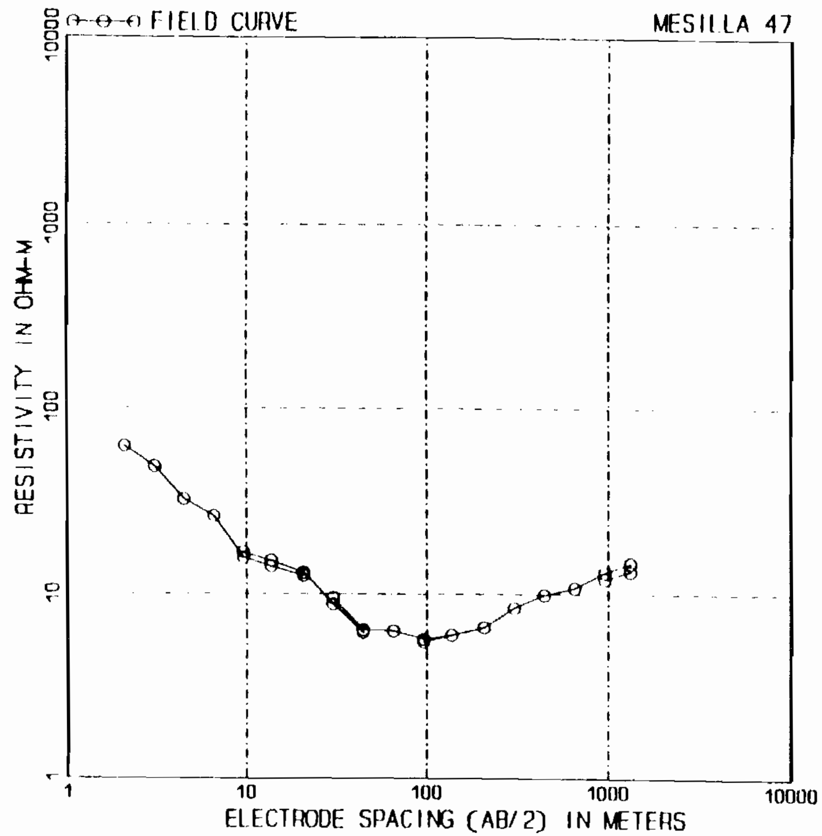
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.19	(3.89)	82.31	37.47	(122.95)	38.87
1.74	(5.71)	31.83	55.01	(180.47)	77.08
2.55	(8.38)	48.89	80.74	(264.89)	96.80
3.75	(12.29)	118.75	118.51	(388.80)	84.95
5.50	(18.05)	203.09	173.94	(570.68)	69.56
8.07	(26.49)	213.08	255.31	(837.64)	62.20
11.85	(38.88)	134.95	374.75	(1229.49)	47.17
17.39	(57.07)	57.05	550.06	(1804.65)	15.59
25.53	(83.76)	28.71	807.37	(2648.86)	4.63
			99999.00	(99999.00)	12.34



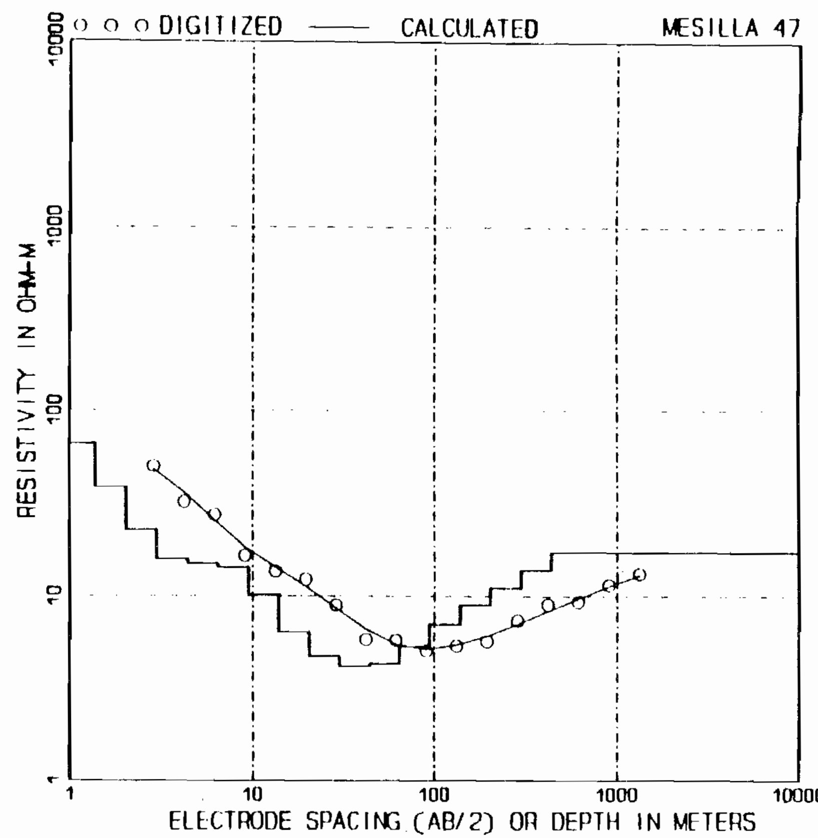
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	19.00	96.01	(315.00)	12.50
3.05	(10.00)	22.50	96.01	(315.00)	11.70
4.45	(14.60)	23.50	137.16	(450.00)	9.60
6.55	(21.50)	22.00	207.26	(680.00)	7.90
9.60	(31.50)	19.50	304.80	(1000.00)	6.60
9.60	(31.50)	21.10	304.80	(1000.00)	7.60
13.72	(45.00)	18.20	445.01	(1460.00)	7.30
20.73	(68.00)	18.00	655.32	(2150.00)	7.40
30.48	(100.00)	18.00	960.12	(3150.00)	8.30
30.48	(100.00)	17.00	960.12	(3150.00)	7.60
44.50	(146.00)	17.50	1325.88	(4350.00)	8.60
65.53	(215.00)	12.70	1828.80	(6000.00)	10.40
			2438.40	(8000.00)	11.50



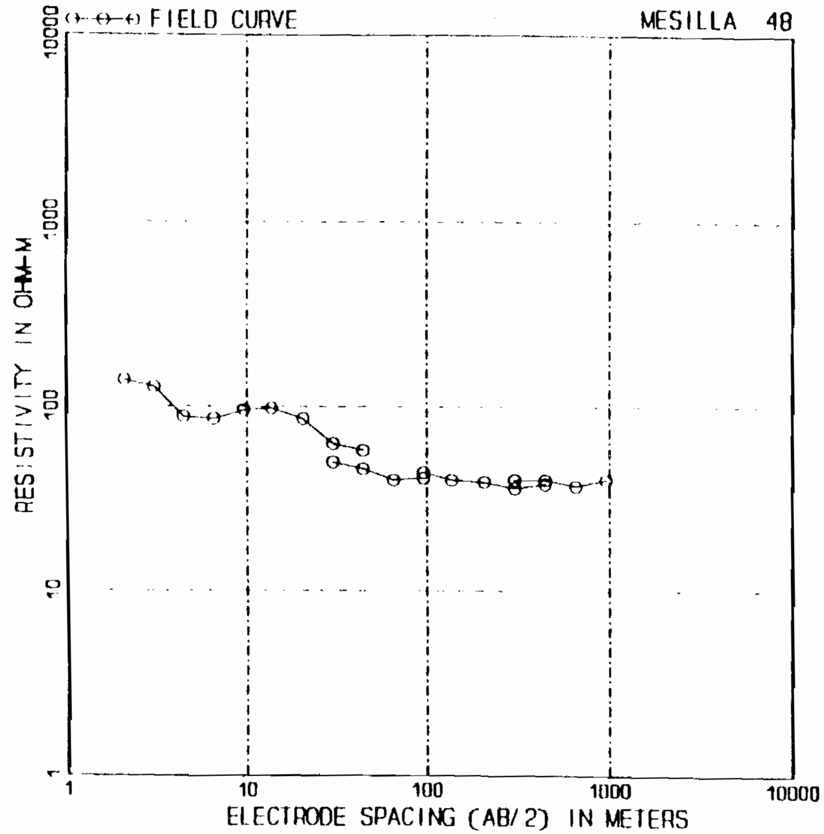
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.19	(3.89)	18.71	37.47	(122.95)	13.44
1.74	(5.71)	28.13	55.01	(180.47)	11.35
2.55	(8.38)	31.25	80.74	(264.89)	9.58
3.75	(12.29)	24.12	118.51	(388.80)	7.33
5.50	(18.05)	15.53	173.94	(570.68)	5.69
8.07	(26.49)	12.97	255.31	(837.64)	5.08
11.85	(38.88)	16.28	374.75	(1229.49)	5.55
17.39	(57.07)	19.77	550.06	(1804.65)	7.40
25.53	(83.76)	17.43	807.37	(2648.86)	10.95
			99999.00	(99999.00)	16.11



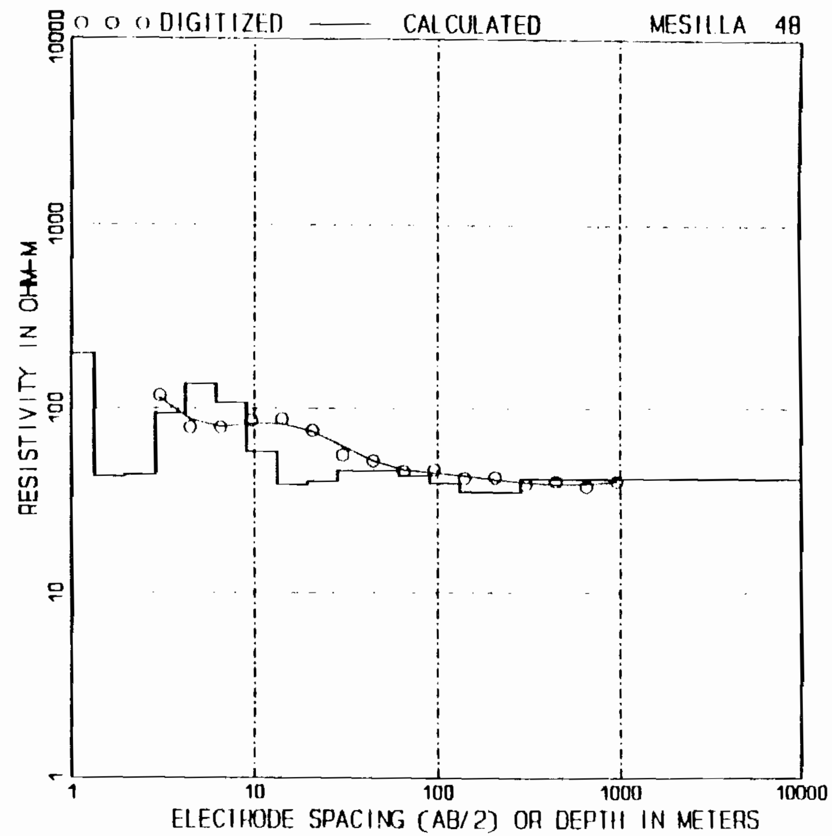
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res
2.07	(6.80)	62.00	44.50	(146.00)	6.40
3.05	(10.00)	48.00	65.53	(215.00)	6.30
4.45	(14.60)	32.00	96.01	(315.00)	5.70
6.55	(21.50)	26.00	137.16	(450.00)	6.00
9.60	(31.50)	15.60	96.01	(315.00)	5.50
13.72	(45.00)	14.00	137.16	(450.00)	6.00
20.73	(68.00)	12.50	207.26	(680.00)	6.60
9.60	(31.50)	16.60	304.80	(1000.00)	8.40
13.72	(45.00)	15.00	445.01	(1460.00)	9.30
20.73	(68.00)	13.00	655.32	(2150.00)	10.80
30.48	(100.00)	8.80	960.12	(3150.00)	13.10
44.50	(146.00)	6.20	1325.88	(4350.00)	14.60
30.48	(100.00)	9.50	960.12	(3150.00)	12.00
			1325.88	(4350.00)	13.20



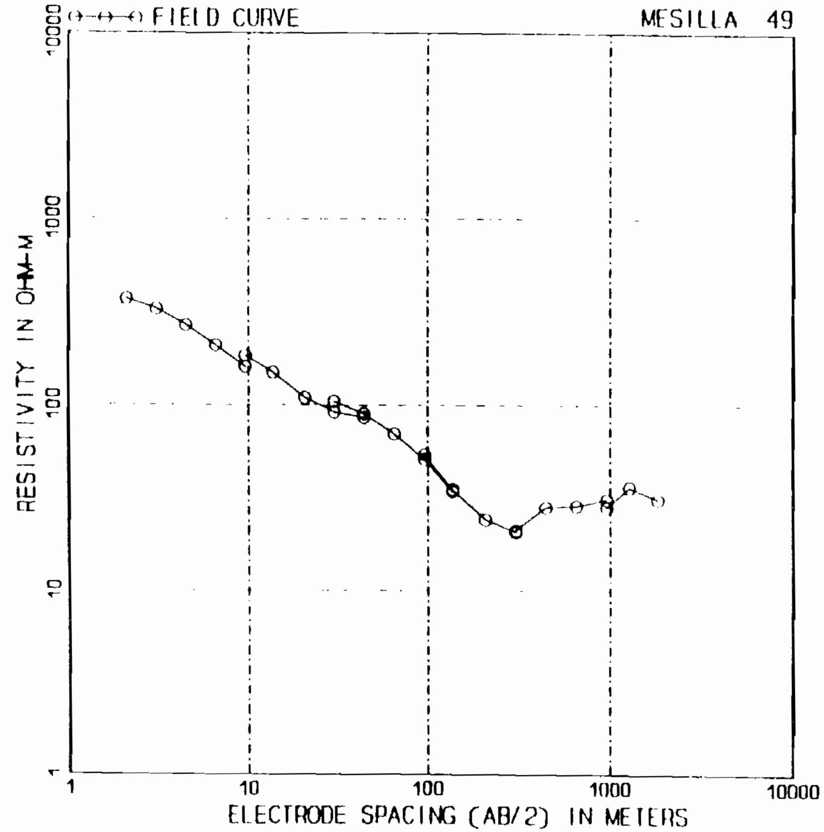
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.39	(4.55)	65.79	29.91	(98.13)	4.76
2.04	(6.69)	38.13	43.90	(144.03)	4.20
2.99	(9.81)	22.43	64.44	(211.41)	4.34
4.39	(14.40)	15.70	94.58	(310.31)	5.34
6.44	(21.14)	14.83	138.83	(455.47)	7.04
9.46	(31.03)	14.22	203.77	(668.54)	8.97
13.88	(45.55)	10.14	299.09	(981.28)	11.08
20.38	(66.85)	6.37	439.01	(1440.32)	13.75
			99999.00	(99999.00)	17.02



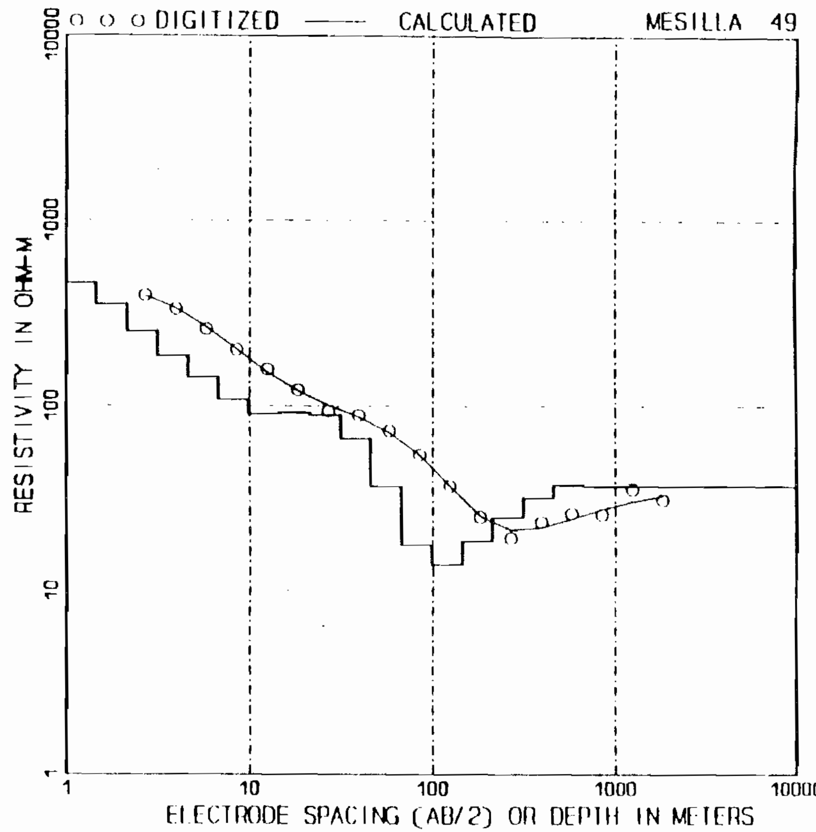
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	140.00	65.53	(215.00)	40.00
3.05	(10.00)	128.00	96.01	(315.00)	41.00
4.45	(14.60)	88.00	96.01	(315.00)	44.00
6.55	(21.50)	86.00	137.16	(450.00)	40.00
9.60	(31.50)	96.00	207.26	(680.00)	39.00
13.72	(45.00)	98.00	304.80	(1000.00)	36.00
20.73	(68.00)	86.00	445.01	(1460.00)	38.00
30.48	(100.00)	63.00	304.80	(1000.00)	40.00
44.50	(146.00)	58.00	445.01	(1460.00)	40.00
30.48	(100.00)	50.00	655.32	(2150.00)	37.00
44.50	(146.00)	46.00	960.12	(3150.00)	40.00



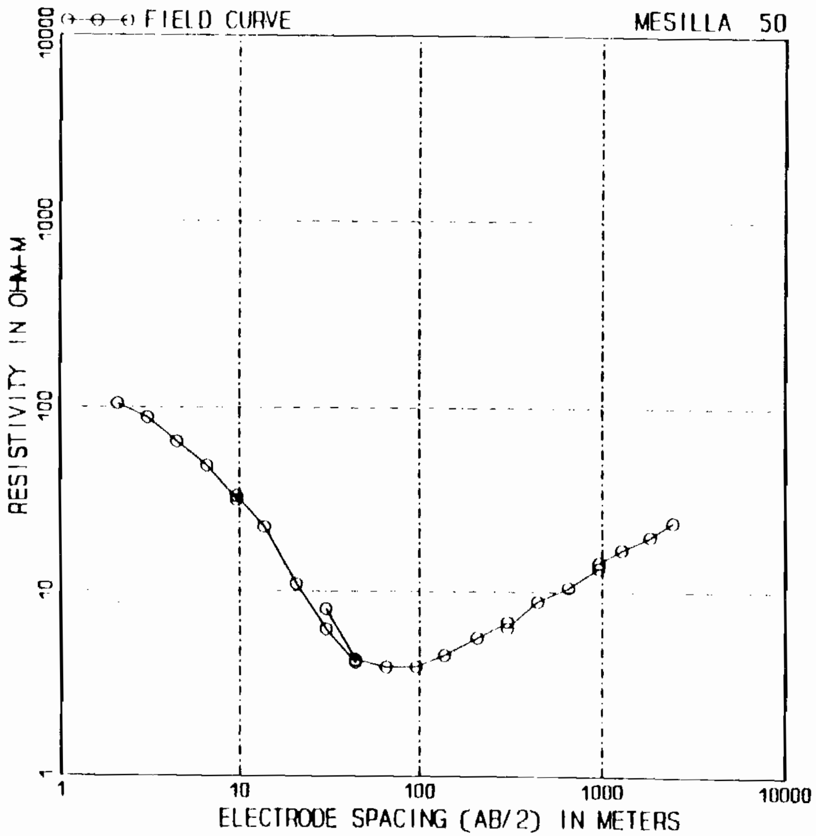
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.33	(4.36)	201.11	28.61	(93.87)	40.16
1.95	(6.40)	42.81	42.00	(137.78)	45.59
2.86	(9.39)	43.55	61.64	(202.23)	45.84
4.20	(13.78)	94.24	90.48	(296.84)	42.98
6.16	(20.22)	136.30	132.80	(435.70)	39.17
9.05	(29.68)	107.11	194.93	(639.52)	35.11
13.28	(43.57)	58.02	286.11	(938.69)	34.80
19.49	(63.95)	38.49	99999.00	(99999.00)	41.52



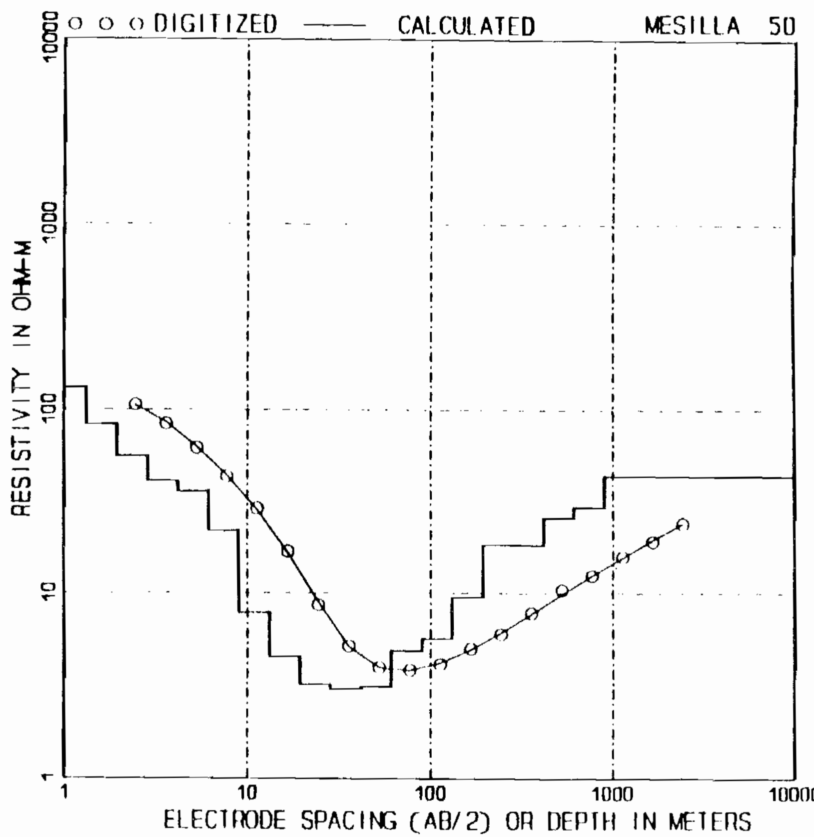
AB/2, m	(ft)	App Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	375.00	96.01	(315.00)	51.00
3.05	(10.00)	330.00	137.16	(450.00)	34.00
4.45	(14.60)	270.00	96.01	(315.00)	54.00
6.55	(21.50)	210.00	137.16	(450.00)	35.00
9.60	(31.50)	161.00	207.26	(680.00)	24.00
9.60	(31.50)	185.00	304.80	(1000.00)	20.50
13.72	(45.00)	[illegible]	304.80	(1000.00)	21.00
20.73	(68.00)	[illegible]	445.01	(1460.00)	28.00
30.48	(100.00)	92.00	655.32	(2150.00)	28.50
44.50	(146.00)	86.00	960.12	(3150.00)	31.00
30.48	(100.00)	105.00	960.12	(3150.00)	28.00
44.50	(146.00)	90.00	1280.16	(4200.00)	36.00
65.53	(215.00)	70.00	1828.80	(6000.00)	31.00



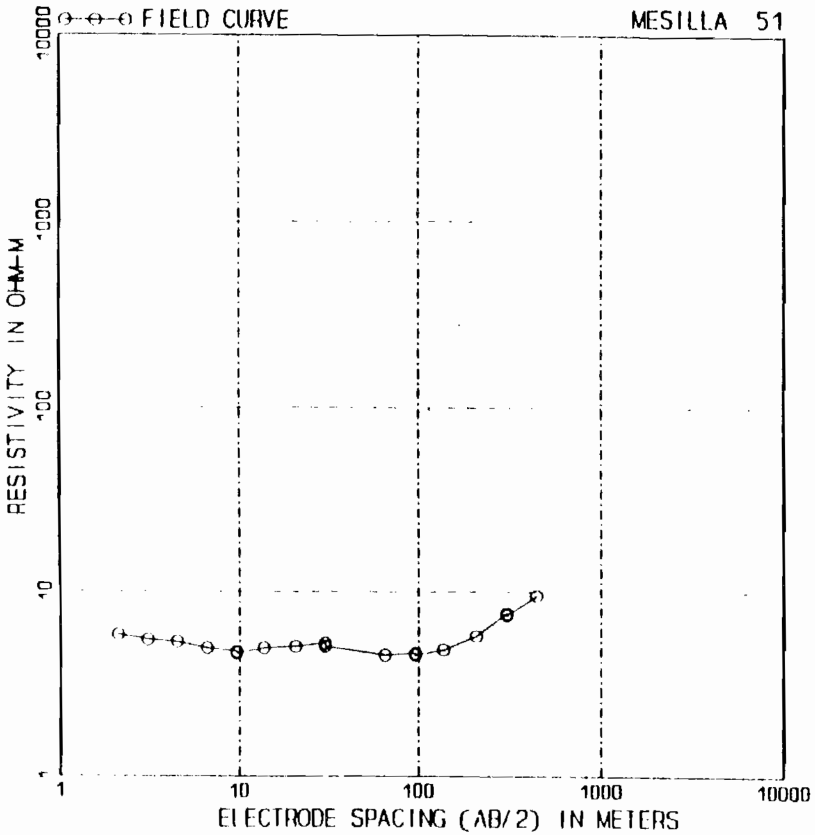
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.45	(4.76)	461.92	45.84	(150.39)	66.64
2.13	(6.98)	354.91	67.28	(220.74)	36.53
3.12	(10.25)	253.79	98.76	(324.00)	17.65
4.58	(15.04)	186.28	144.95	(475.57)	13.89
6.73	(22.07)	142.91	212.76	(698.04)	18.41
9.88	(32.40)	107.91	312.29	(1024.58)	24.84
14.50	(47.56)	90.83	458.38	(1503.88)	31.66
21.28	(69.80)	92.08	672.81	(2207.39)	37.38
31.21	(102.46)	88.82	99999.00	(99999.00)	36.66



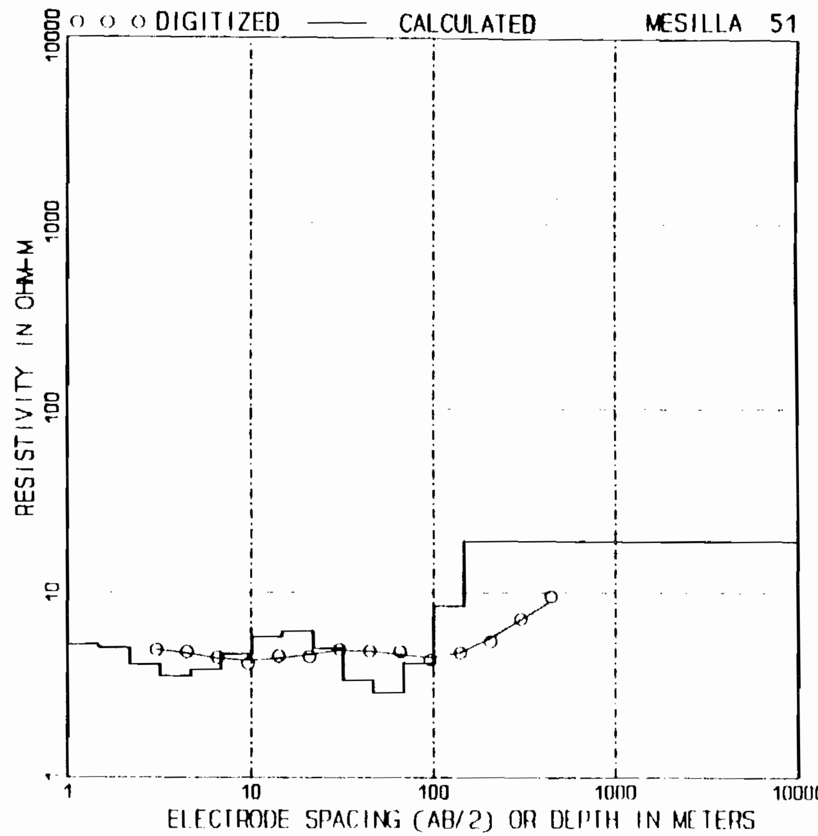
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	105.00	96.01	(315.00)	3.90
3.05	(10.00)	88.00	96.01	(315.00)	3.90
4.45	(14.60)	65.00	137.16	(450.00)	4.50
6.55	(21.50)	48.00	207.26	(680.00)	5.60
9.60	(31.50)	31.50	304.80	(1000.00)	6.80
9.60	(31.50)	33.00	304.80	(1000.00)	6.30
13.72	(45.00)	22.50	445.01	(1460.00)	8.80
20.73	(68.00)	11.00	655.32	(2150.00)	10.50
30.48	(100.00)	6.20	960.12	(3150.00)	13.50
44.50	(146.00)	4.10	960.12	(3150.00)	14.50
30.48	(100.00)	8.00	1280.16	(4200.00)	17.00
44.50	(146.00)	4.25	1828.80	(6000.00)	20.00
65.53	(215.00)	3.88	2438.40	(8000.00)	24.00



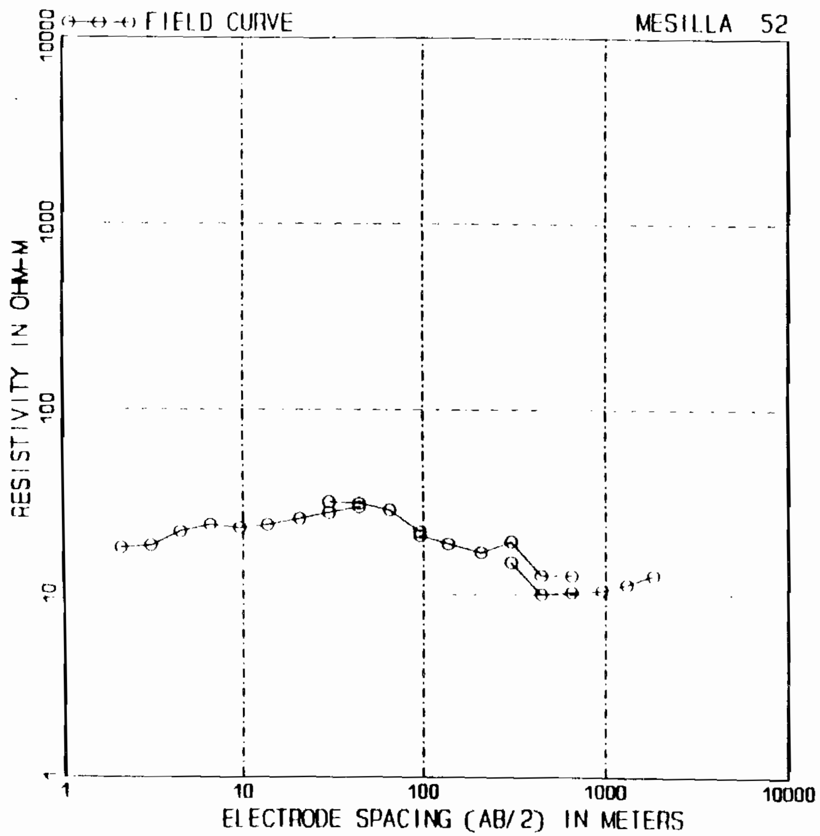
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.32	(4.32)	132.66	41.64	(136.61)	3.03
1.93	(6.34)	83.12	61.12	(200.52)	3.11
2.84	(9.31)	55.40	89.71	(294.32)	4.87
4.16	(13.66)	40.63	131.67	(432.00)	5.60
6.11	(20.05)	35.62	193.27	(634.09)	9.47
8.97	(29.43)	21.84	283.68	(930.72)	18.47
13.17	(43.20)	7.80	416.39	(1366.10)	18.31
19.33	(63.41)	4.51	611.17	(2005.17)	25.78
28.37	(93.07)	3.18	897.08	(2943.18)	29.32
			99999.00	(99999.00)	43.33



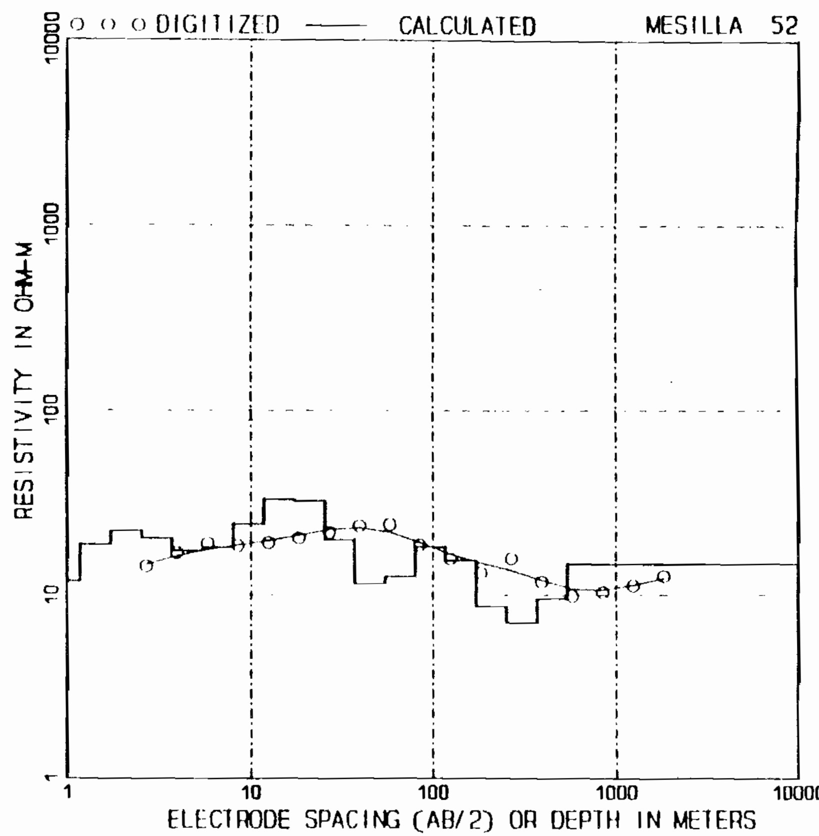
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	5.80	30.48	(100.00)	5.00
3.05	(10.00)	5.45	65.53	(215.00)	4.50
4.45	(14.60)	5.30	96.01	(315.00)	4.60
6.55	(21.50)	4.90	96.01	(315.00)	4.50
9.60	(31.50)	4.70	137.16	(450.00)	4.80
9.60	(31.50)	4.60	207.26	(680.00)	5.70
13.72	(45.00)	4.90	304.80	(1000.00)	7.60
20.73	(68.00)	5.00	304.80	(1000.00)	7.40
30.48	(100.00)	5.20	445.01	(1460.00)	9.50



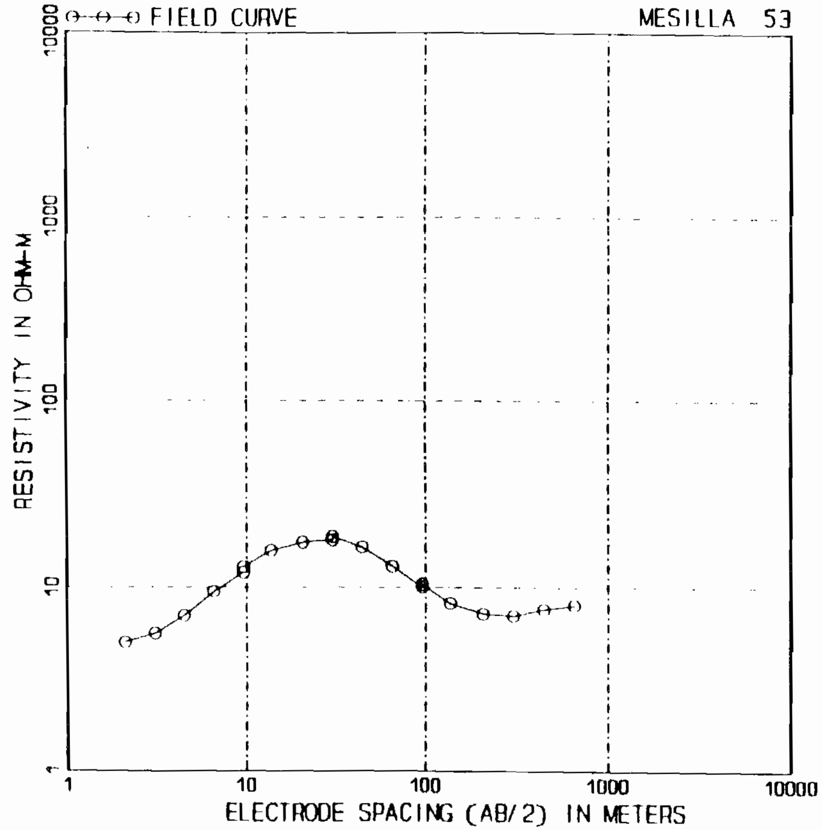
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.47	(4.83)	5.21	21.63	(70.96)	6.14
2.16	(7.10)	5.00	31.74	(104.15)	4.98
3.17	(10.41)	4.09	46.59	(152.87)	3.36
4.66	(15.29)	3.54	68.39	(224.38)	2.86
6.84	(22.44)	3.81	100.39	(329.35)	4.12
10.04	(32.93)	4.65	147.35	(483.42)	8.44
14.73	(48.34)	5.73	99999.00	(99999.00)	19.07



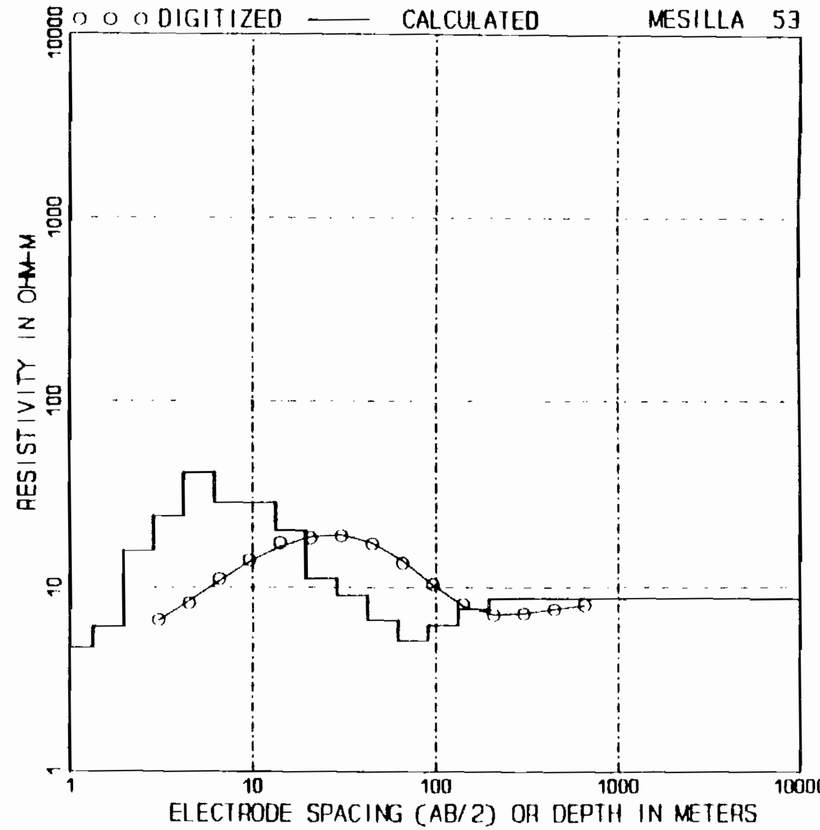
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	18.00	96.01	(315.00)	22.00
3.05	(10.00)	18.50	96.01	(315.00)	21.00
4.45	(14.60)	22.00	137.16	(450.00)	19.00
6.55	(21.50)	24.00	207.26	(680.00)	17.00
9.60	(31.50)	23.00	304.80	(1000.00)	19.50
13.72	(45.00)	24.00	445.01	(1460.00)	12.70
20.73	(68.00)	26.00	655.32	(2150.00)	12.70
30.48	(100.00)	28.00	304.80	(1000.00)	15.00
44.50	(146.00)	30.00	445.01	(1460.00)	10.00
30.48	(100.00)	32.00	655.32	(2150.00)	10.30
44.50	(146.00)	31.50	960.12	(3150.00)	10.50
65.53	(215.00)	29.00	1310.64	(4300.00)	11.30
			1828.80	(6000.00)	12.70



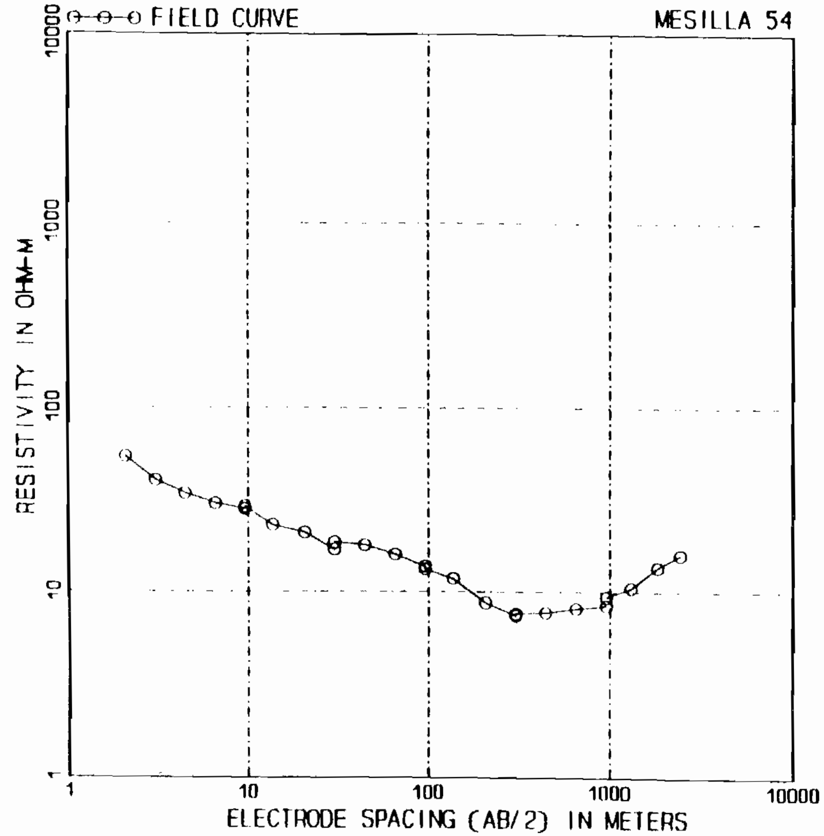
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.17	(3.85)	11.93	37.13	(121.81)	19.98
1.72	(5.65)	18.94	54.50	(178.80)	11.54
2.53	(8.30)	22.47	79.99	(262.44)	12.64
3.71	(12.18)	20.38	117.41	(385.21)	18.33
5.45	(17.88)	17.47	172.34	(565.41)	15.38
8.00	(26.24)	18.15	252.96	(829.91)	8.68
11.74	(38.52)	24.32	371.29	(1218.14)	7.06
17.23	(56.54)	33.22	544.98	(1787.98)	9.55
25.30	(82.99)	32.60	99999.00	(99999.00)	14.75



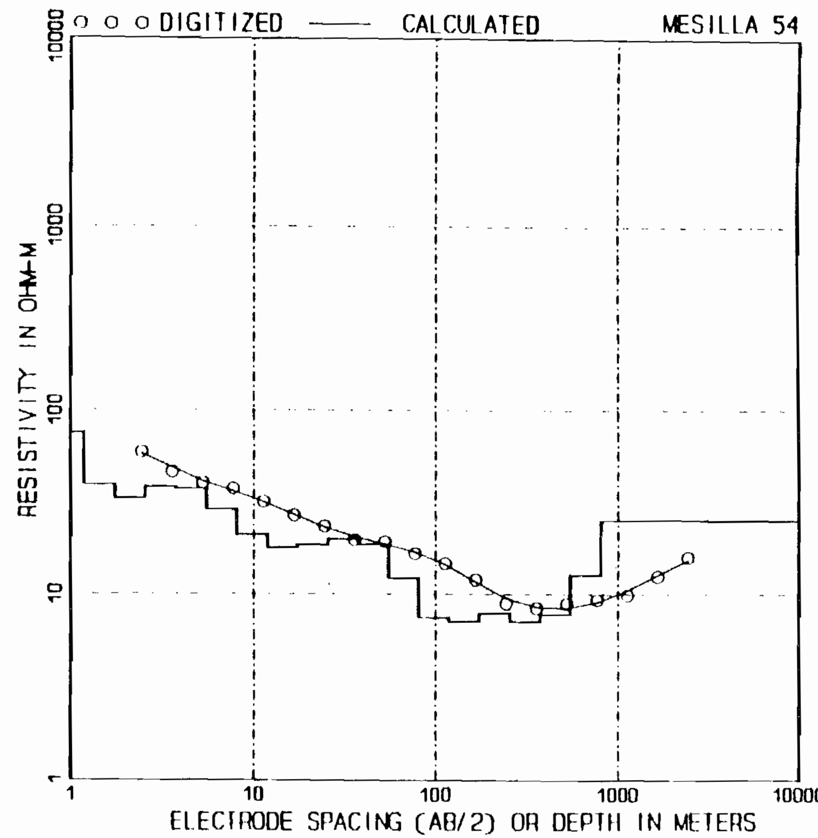
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	6.80	5.00	44.50	146.00	16.50
3.05	10.00	5.60	65.53	215.00	13.00
4.45	14.60	7.00	96.01	315.00	10.00
6.55	21.50	9.50	96.01	315.00	10.40
9.60	31.50	12.00	137.16	450.00	8.20
9.60	31.50	12.90	207.26	680.00	7.20
13.72	45.00	15.80	304.80	1000.00	7.00
20.73	68.00	17.50	304.80	1000.00	7.00
30.48	100.00	18.00	445.01	1460.00	7.60
30.48	100.00	18.80	655.32	2150.00	8.00



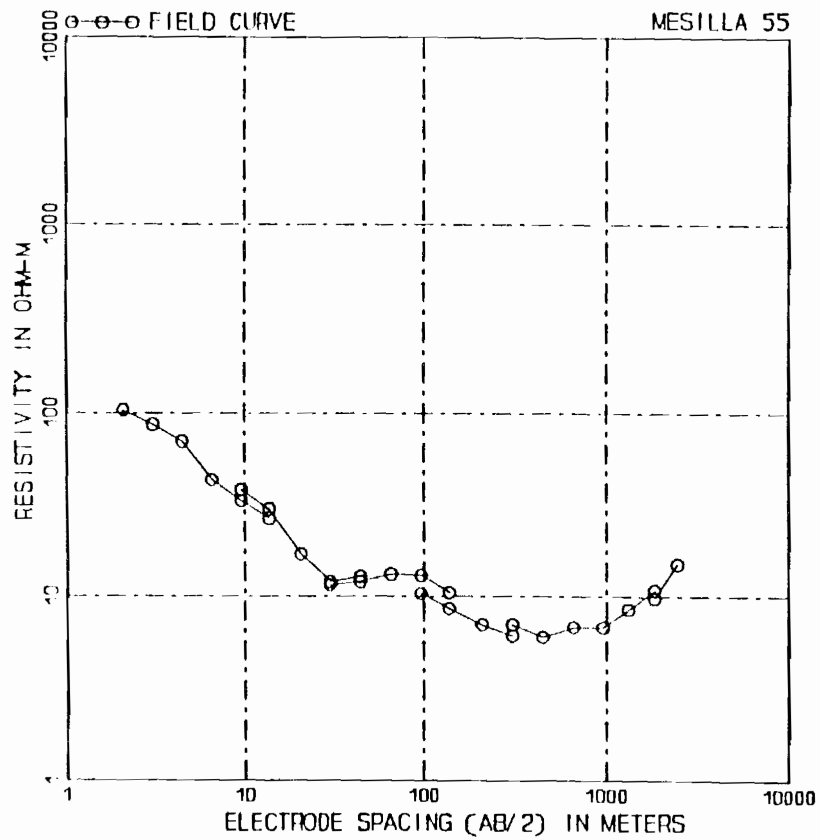
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.33	4.36	4.69	19.53	64.07	20.32
1.95	6.41	6.12	28.66	94.04	11.15
2.87	9.40	15.68	42.07	138.03	9.05
4.21	13.80	24.13	61.75	202.61	6.61
6.18	20.26	41.45	90.64	297.38	5.15
9.06	29.74	28.58	133.05	436.50	6.24
13.30	43.65	28.57	195.28	640.69	7.59
			99999.00	99999.00	8.72



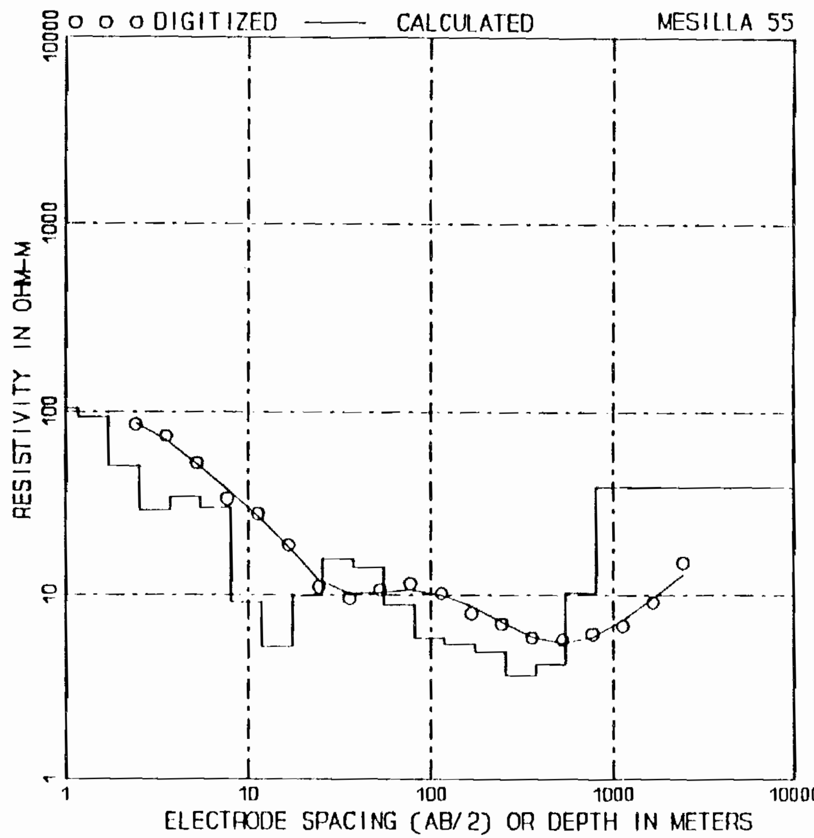
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	54.00	96.01	(315.00)	13.80
3.05	(10.00)	40.00	96.01	(315.00)	13.30
4.45	(14.60)	34.00	137.16	(450.00)	11.80
6.55	(21.50)	30.00	207.26	(680.00)	8.70
9.60	(31.50)	28.00	304.80	(1000.00)	7.40
9.60	(31.50)	29.00	304.80	(1000.00)	7.60
13.72	(45.00)	23.00	445.01	(1460.00)	7.70
20.73	(68.00)	21.00	655.32	(2150.00)	8.10
30.48	(100.00)	17.00	960.12	(3150.00)	8.40
30.48	(100.00)	18.60	960.12	(3150.00)	9.40
44.50	(146.00)	18.00	1310.64	(4300.00)	10.50
65.53	(215.00)	16.00	1828.80	(6000.00)	13.60
			2438.40	(8000.00)	15.90



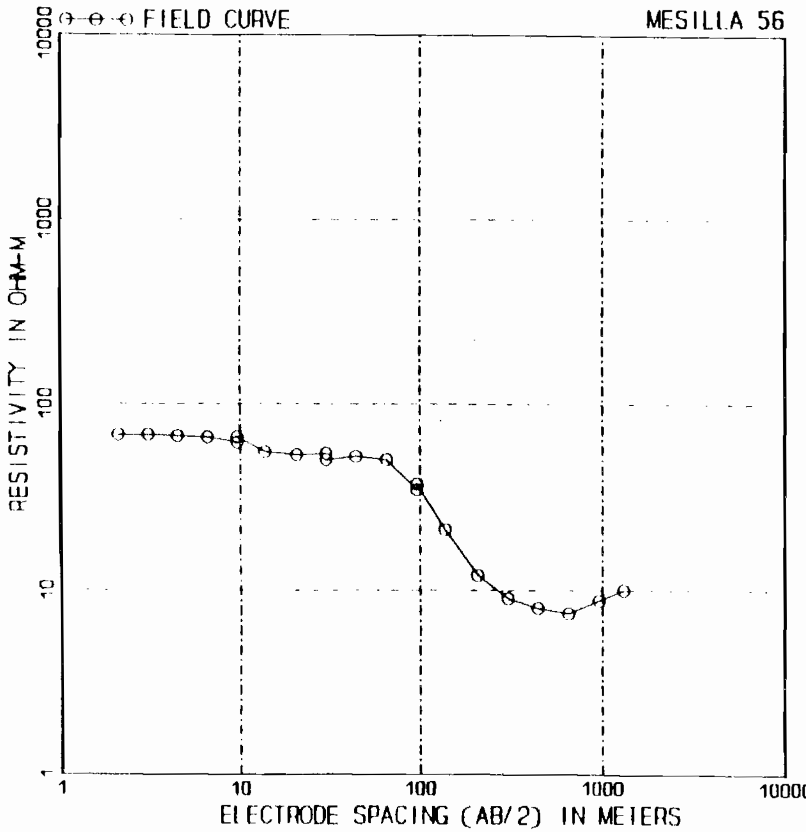
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.19	(3.89)	75.31	37.47	(122.95)	19.92
1.74	(5.71)	39.28	55.01	(180.47)	18.52
2.55	(8.38)	33.10	80.74	(264.89)	12.27
3.75	(12.29)	38.08	118.51	(388.80)	7.43
5.50	(18.05)	36.99	173.94	(570.68)	7.10
8.07	(26.49)	28.76	255.31	(837.64)	7.87
11.85	(38.88)	21.04	374.75	(1229.49)	7.13
17.39	(57.07)	17.93	550.06	(1804.65)	7.76
25.53	(83.76)	18.57	807.37	(2648.86)	12.71
			99999.00	(99999.00)	25.20



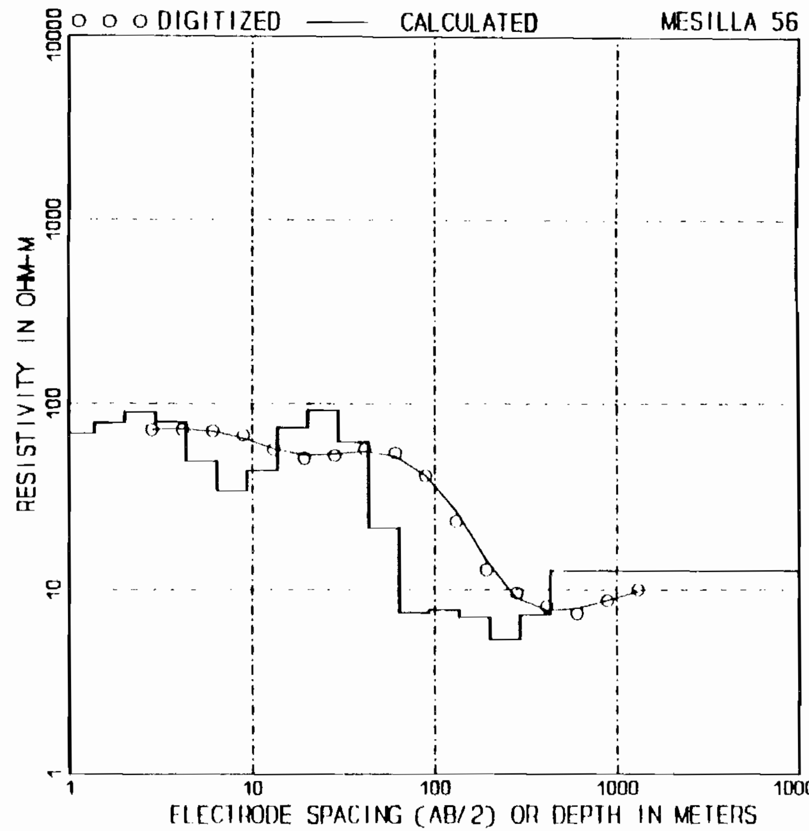
AB/2, m	ft	App. Res.	AB/2, m	ft	App. Res.
2.07	6.80	103.00	96.01	315.00	13.00
3.05	10.00	86.00	137.16	450.00	10.50
4.45	14.60	70.00	96.01	315.00	10.30
6.55	21.50	43.00	137.16	450.00	8.60
9.60	31.50	33.00	207.26	680.00	7.00
13.72	45.00	26.50	304.80	1000.00	6.10
9.60	31.50	38.00	304.80	1000.00	7.00
13.72	45.00	29.80	445.01	1460.00	6.00
20.73	68.00	17.00	655.32	2150.00	6.80
30.48	100.00	12.00	960.12	3150.00	6.80
44.50	146.00	12.80	1310.64	4300.00	8.50
30.48	100.00	11.50	1828.80	6000.00	10.80
44.50	146.00	12.00	1828.80	6000.00	9.80
65.53	215.00	13.20	2438.40	8000.00	15.00



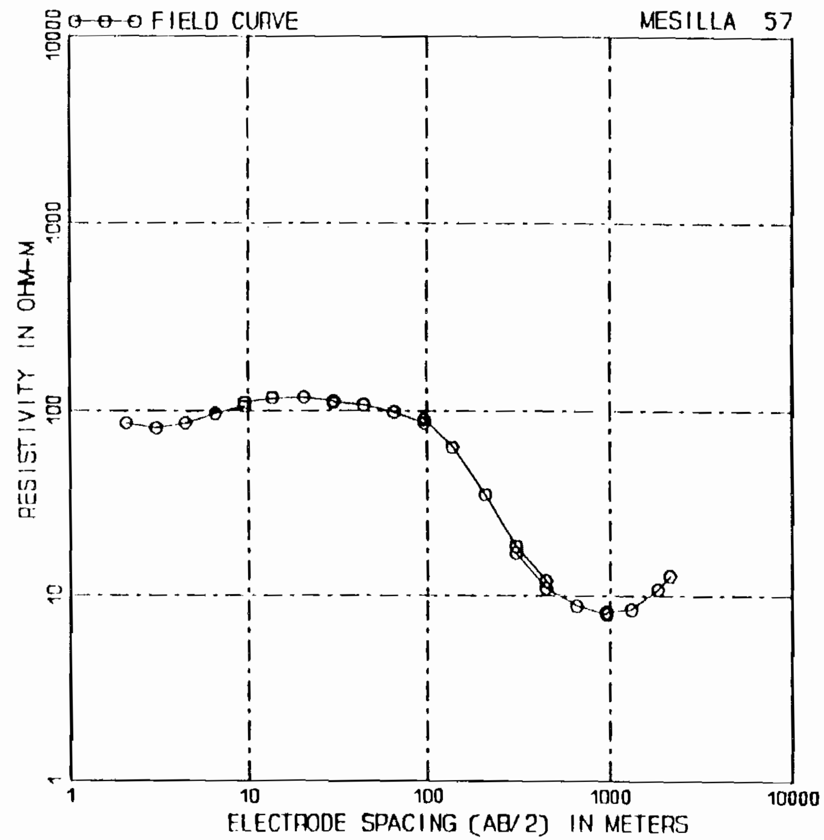
DEPTH, m	ft	RESIS.	DEPTH, m	ft	RESIS.
1.19	3.89	103.57	37.47	122.95	15.71
1.74	5.71	93.49	55.01	180.47	14.11
2.55	8.38	50.13	80.74	264.89	8.80
3.75	12.29	28.75	118.51	388.80	5.86
5.50	18.05	34.06	173.94	570.68	5.35
8.07	26.49	29.54	255.31	837.64	4.92
11.85	38.88	9.08	374.75	1229.49	3.65
17.39	57.07	5.24	550.06	1804.65	4.17
25.53	83.76	9.86	807.37	2648.86	10.37
			99999.00	99999.00	38.47



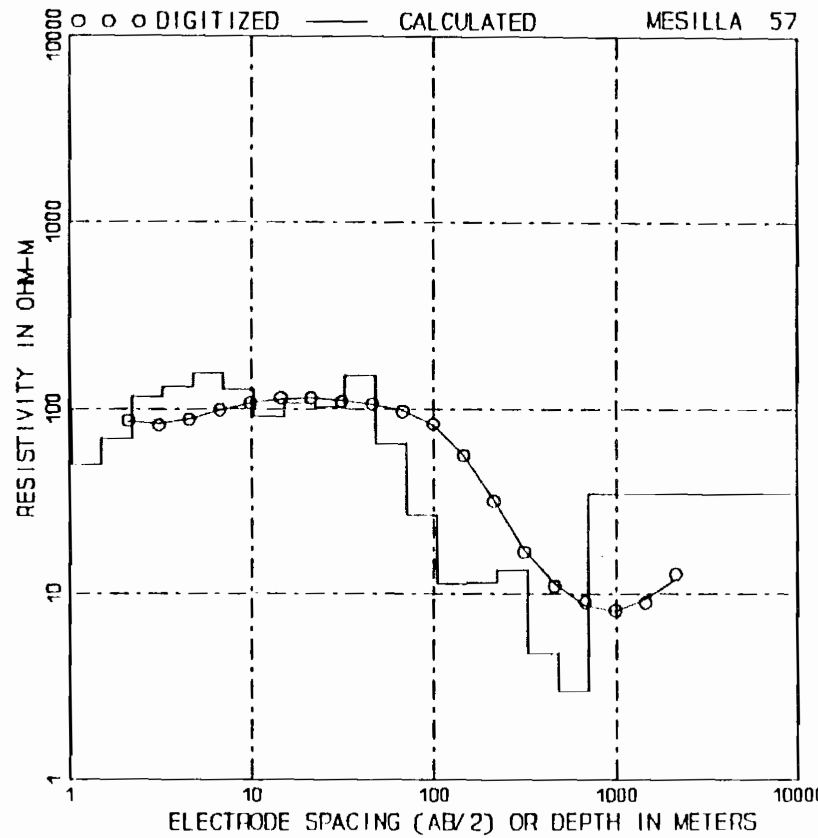
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	68.00	65.53	(215.00)	50.00
3.05	(10.00)	68.00	96.01	(315.00)	34.50
4.45	(14.60)	67.00	96.01	(315.00)	37.00
6.55	(21.50)	66.00	137.16	(450.00)	21.00
9.60	(31.50)	62.00	207.26	(680.00)	12.00
9.60	(31.50)	66.00	304.80	(1000.00)	9.00
13.72	(45.00)	55.00	304.80	(1000.00)	9.00
20.73	(68.00)	53.00	445.01	(1460.00)	8.00
30.48	(100.00)	54.00	655.32	(2150.00)	7.50
30.48	(100.00)	50.00	960.12	(3150.00)	8.80
44.50	(146.00)	52.00	1310.64	(4300.00)	10.00



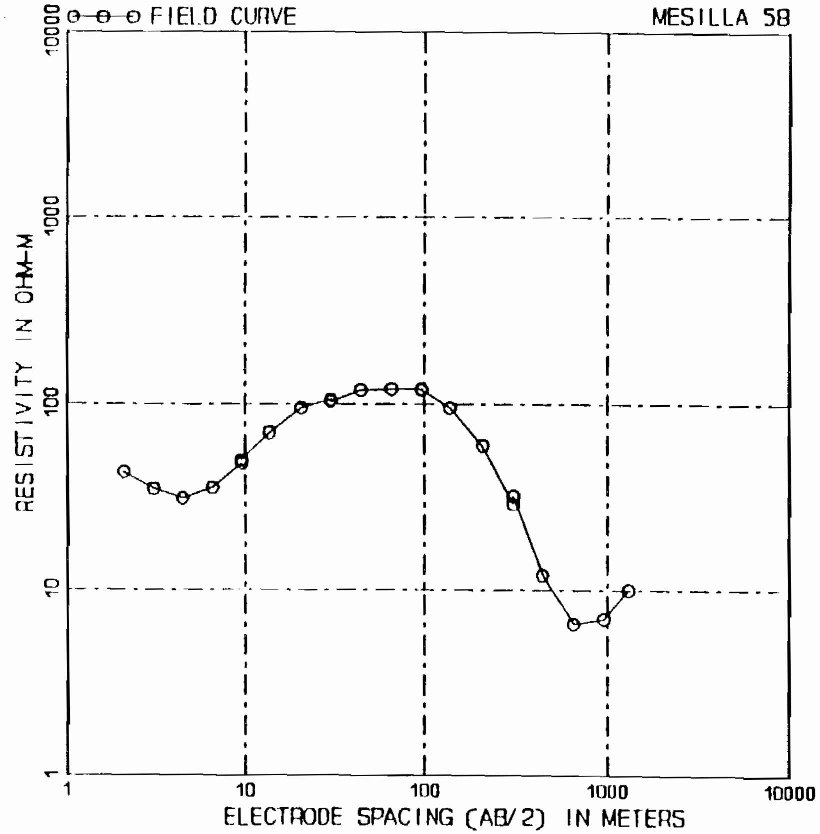
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.37	(4.50)	68.67	29.57	(97.00)	92.25
2.01	(6.61)	78.62	43.40	(142.38)	61.85
2.96	(9.70)	90.02	63.70	(208.98)	21.22
4.34	(14.24)	79.45	93.49	(306.74)	7.49
6.37	(20.90)	48.71	137.23	(450.23)	7.78
9.35	(30.67)	33.55	201.43	(660.85)	7.10
13.72	(45.02)	43.47	295.66	(970.00)	5.39
20.14	(66.09)	73.95	433.96	(1423.76)	7.31
			99999.00	(99999.00)	12.62



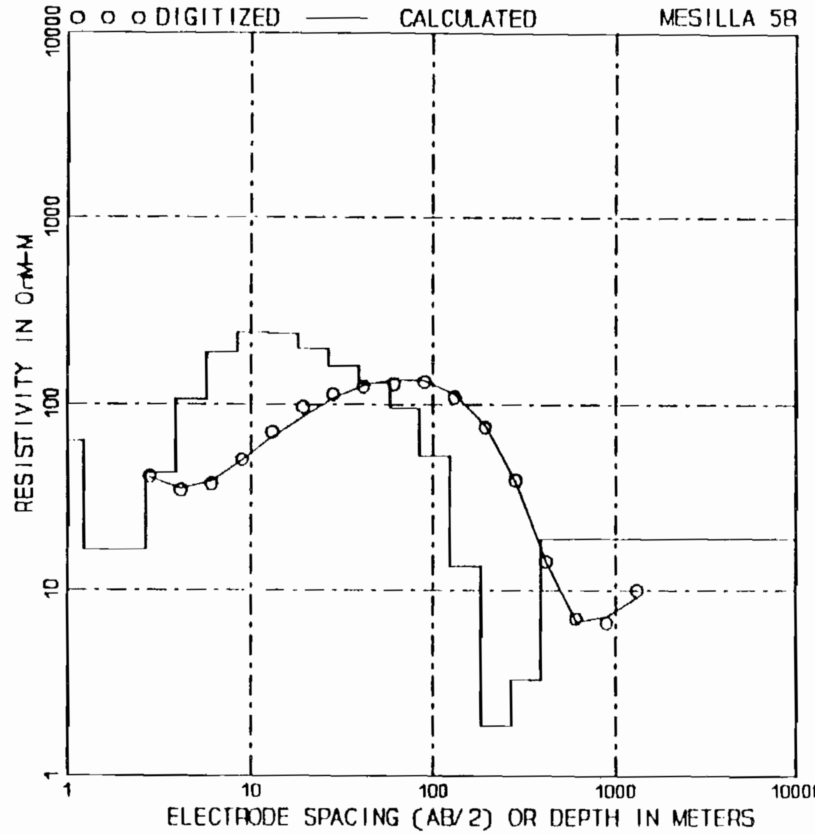
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	85.00	96.01	(315.00)	89.00
3.05	(10.00)	80.00	137.16	(450.00)	63.00
4.45	(14.60)	85.00	207.26	(680.00)	35.00
6.55	(21.50)	96.00	304.80	(1000.00)	18.50
9.60	(31.50)	105.00	445.01	(1460.00)	12.00
9.60	(31.50)	110.00	304.80	(1000.00)	17.00
13.72	(45.00)	117.00	445.01	(1460.00)	11.00
20.73	(68.00)	118.00	655.32	(2150.00)	8.80
30.48	(100.00)	113.00	960.12	(3150.00)	7.90
30.48	(100.00)	110.00	960.12	(3150.00)	8.20
44.50	(146.00)	107.00	1310.64	(4300.00)	8.40
65.53	(215.00)	98.00	1828.80	(6000.00)	10.80
96.01	(315.00)	85.00	2133.60	(7000.00)	12.80



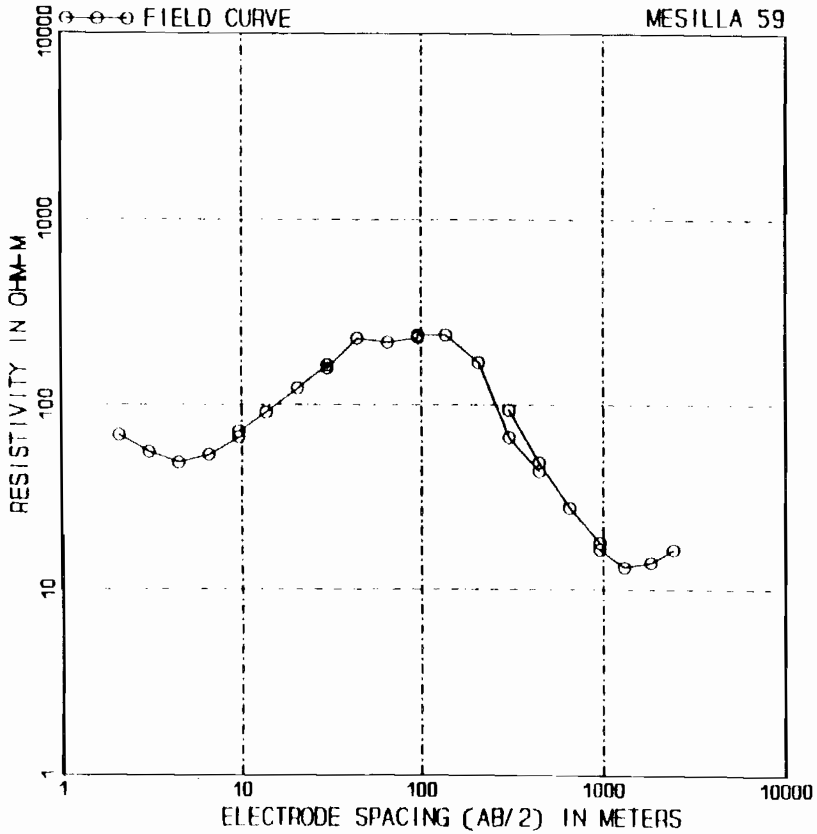
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.04	(3.40)	99.61	32.79	(107.58)	103.05
1.52	(4.99)	49.36	48.13	(157.91)	151.69
2.23	(7.33)	68.68	70.65	(231.78)	64.33
3.28	(10.76)	115.81	103.69	(340.20)	26.66
4.81	(15.79)	131.35	152.20	(499.35)	11.34
7.06	(23.18)	156.27	223.40	(732.94)	11.44
10.37	(34.02)	126.56	327.91	(1075.81)	13.35
15.22	(49.93)	90.26	481.30	(1579.07)	4.82
22.34	(73.29)	106.84	706.45	(2317.76)	3.05
			99999.00	(99999.00)	34.48



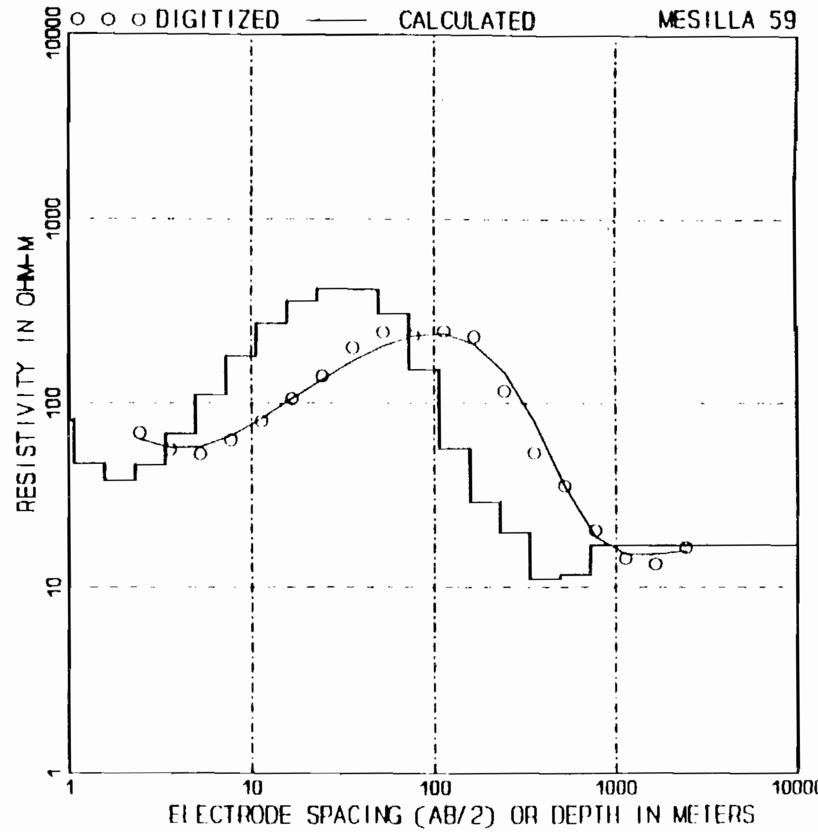
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	6.80	43.00	65.53	215.00	120.00
3.05	10.00	35.00	96.01	315.00	120.00
4.45	14.60	31.00	96.01	315.00	118.00
6.55	21.50	35.50	137.16	450.00	95.00
9.60	31.50	48.00	207.26	680.00	60.00
9.60	31.50	50.00	304.80	1000.00	29.00
13.72	45.00	70.00	304.80	1000.00	32.00
20.73	68.00	95.00	445.01	1460.00	12.00
30.48	100.00	105.00	655.32	2150.00	6.60
30.48	100.00	103.00	960.12	3150.00	7.00
44.50	146.00	118.00	1310.64	4300.00	10.00



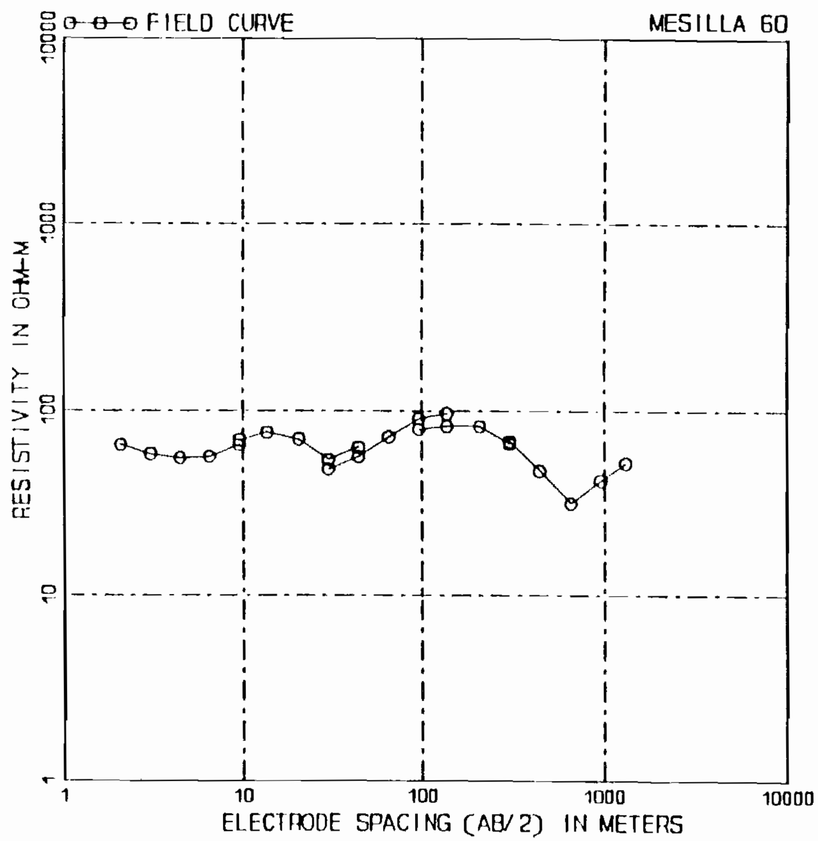
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.24	4.05	63.27	26.61	87.30	200.56
1.81	5.95	16.35	39.06	128.14	161.80
2.66	8.73	16.54	57.33	188.08	128.85
3.91	12.81	42.89	84.15	276.07	94.54
5.73	18.81	106.00	123.51	405.21	52.46
8.41	27.61	190.22	181.29	594.77	13.42
12.35	40.52	244.46	266.09	873.00	1.89
18.13	59.48	239.01	390.57	1281.39	3.34
			99999.00	99999.00	18.99



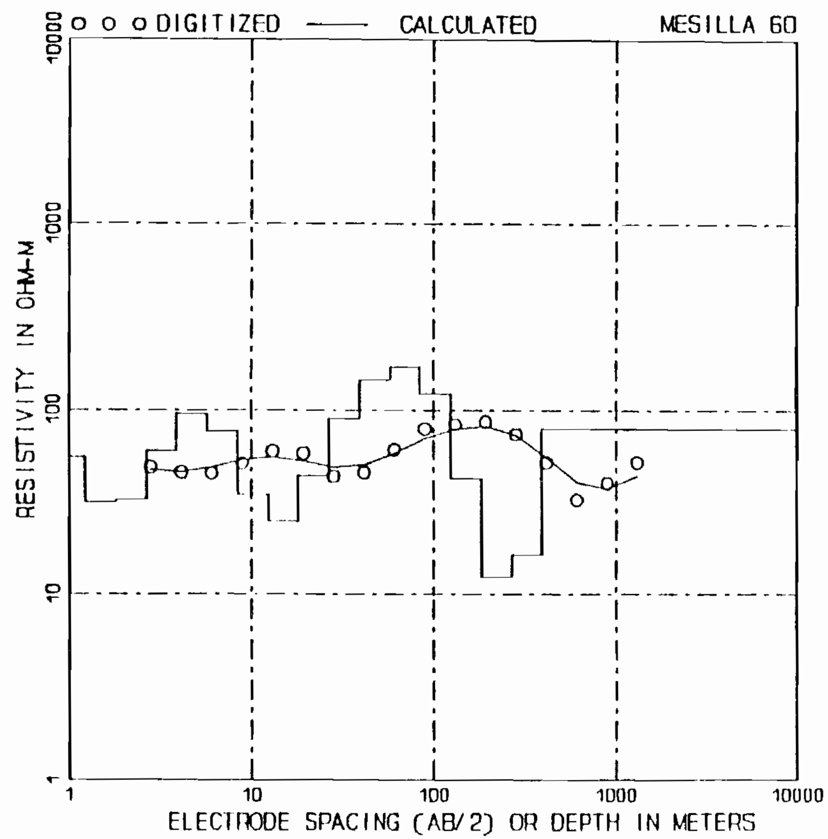
AB/2, m (	ft)	App. Res.	AB/2, m (	ft)	App. Res.
2.07 (	6.80)	69.00	96.01 (	315.00)	240.00
3.05 (	10.00)	56.00	137.16 (	450.00)	240.00
4.45 (	14.60)	49.00	207.26 (	680.00)	170.00
6.55 (	21.50)	54.00	304.80 (	1000.00)	67.00
9.60 (	31.50)	67.00	445.01 (	1460.00)	44.00
9.60 (	31.50)	72.00	304.80 (	1000.00)	94.00
13.72 (	45.00)	91.00	445.01 (	1460.00)	49.00
20.73 (	68.00)	123.00	655.32 (	2150.00)	28.00
30.48 (	100.00)	165.00	960.12 (	3150.00)	18.00
30.48 (	100.00)	158.00	960.12 (	3150.00)	16.50
44.50 (	146.00)	230.00	1310.64 (	4300.00)	13.20
65.53 (	215.00)	220.00	1828.80 (	6000.00)	14.00
96.01 (	315.00)	232.00	2438.40 (	8000.00)	16.50



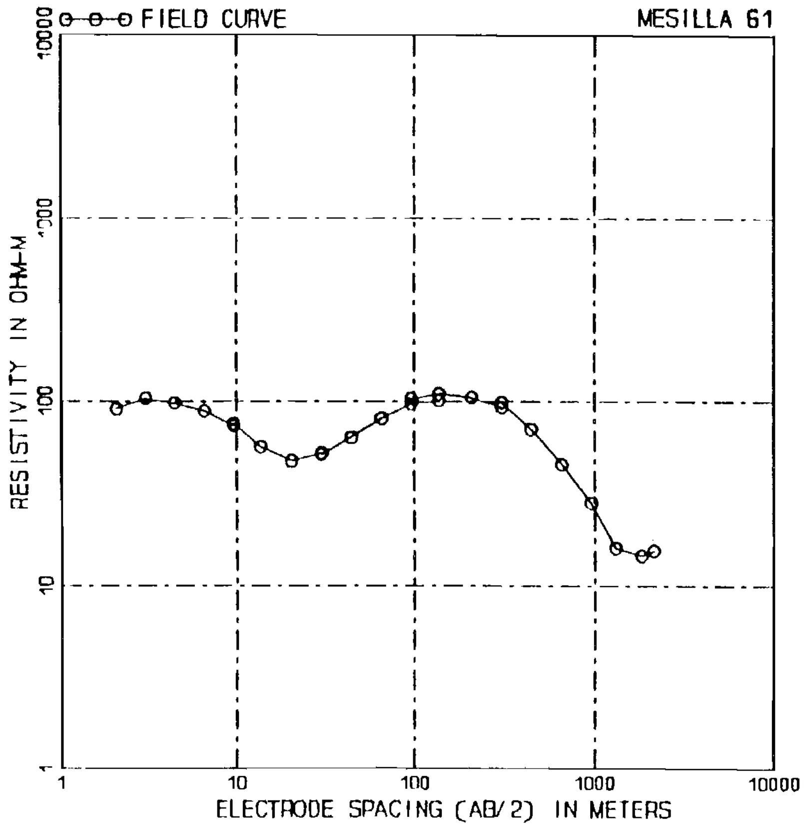
DEPTH, m (	ft)	RESIS.	DEPTH, m (	ft)	RESIS.
1.07 (	3.50)	81.36	33.73 (	110.65)	420.55
1.57 (	5.14)	47.06	49.51 (	162.42)	416.76
2.30 (	7.54)	38.28	72.66 (	238.40)	308.80
3.37 (	11.07)	46.38	106.66 (	349.92)	151.89
4.95 (	16.24)	68.63	156.55 (	513.61)	56.92
7.27 (	23.84)	110.91	229.78 (	753.88)	29.15
10.67 (	34.99)	181.08	337.27 (	1106.54)	19.93
15.65 (	51.36)	272.39	495.05 (	1624.19)	11.06
22.98 (	75.39)	360.48	726.64 (	2383.98)	11.71
			99999.00 (	99999.00)	16.97



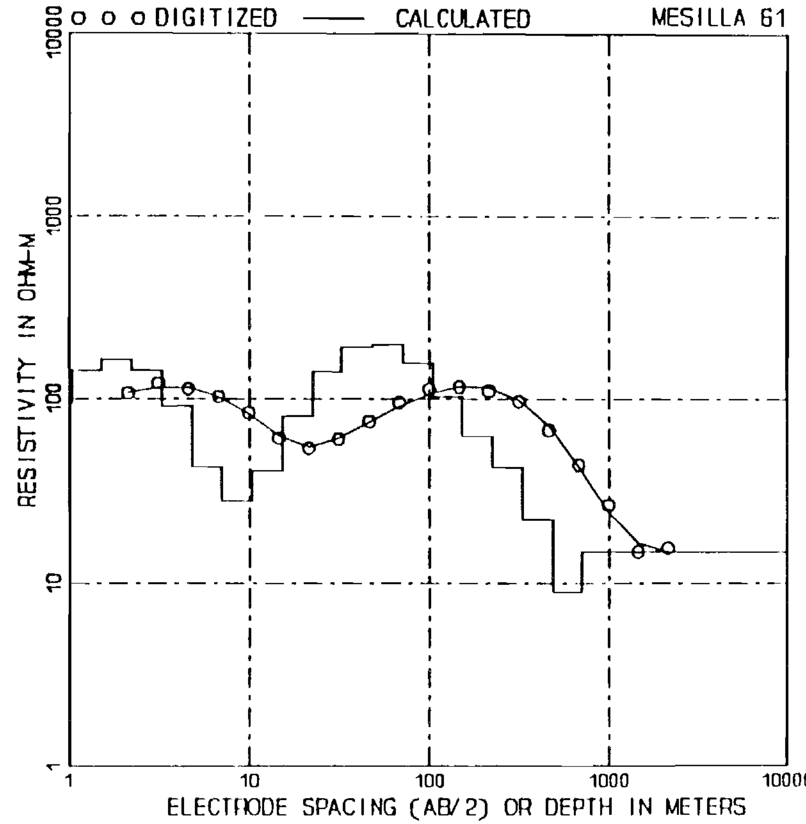
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	6.80	65.00	65.53	215.00	72.00
3.05	10.00	58.00	96.01	315.00	90.00
4.45	14.60	55.00	137.16	450.00	96.00
6.55	21.50	56.00	96.01	315.00	79.00
9.60	31.50	65.00	137.16	450.00	82.00
9.60	31.50	69.00	207.26	680.00	82.00
13.72	45.00	76.00	304.80	1000.00	66.00
20.73	68.00	70.00	304.80	1000.00	68.00
30.48	100.00	54.00	445.01	1460.00	47.00
44.50	146.00	63.00	655.32	2150.00	31.50
30.48	100.00	48.00	960.12	3150.00	42.00
44.50	146.00	56.00	1310.64	4300.00	52.00



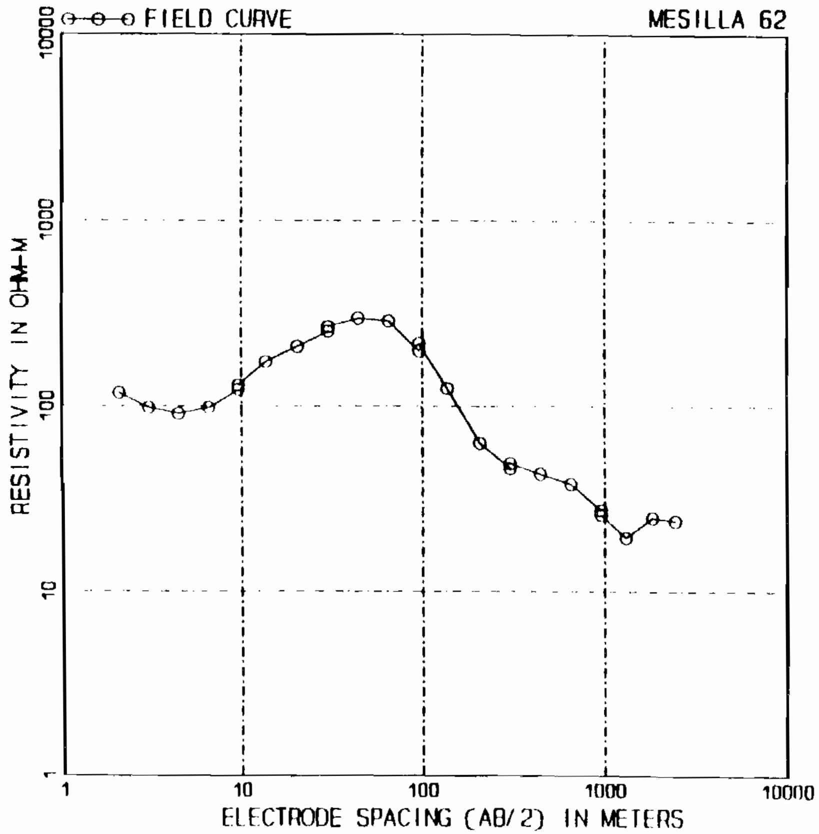
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.24	4.05	55.57	26.61	87.30	43.62
1.81	5.95	31.41	39.06	128.14	89.09
2.66	8.73	32.52	57.33	188.08	143.26
3.91	12.81	59.84	84.15	276.07	168.82
5.73	18.81	95.20	123.51	405.21	121.06
8.41	27.61	75.92	181.29	594.77	42.65
12.35	40.52	34.65	266.09	873.00	12.46
18.13	59.48	24.82	390.57	1281.39	16.54
			99999.00	99999.00	78.67



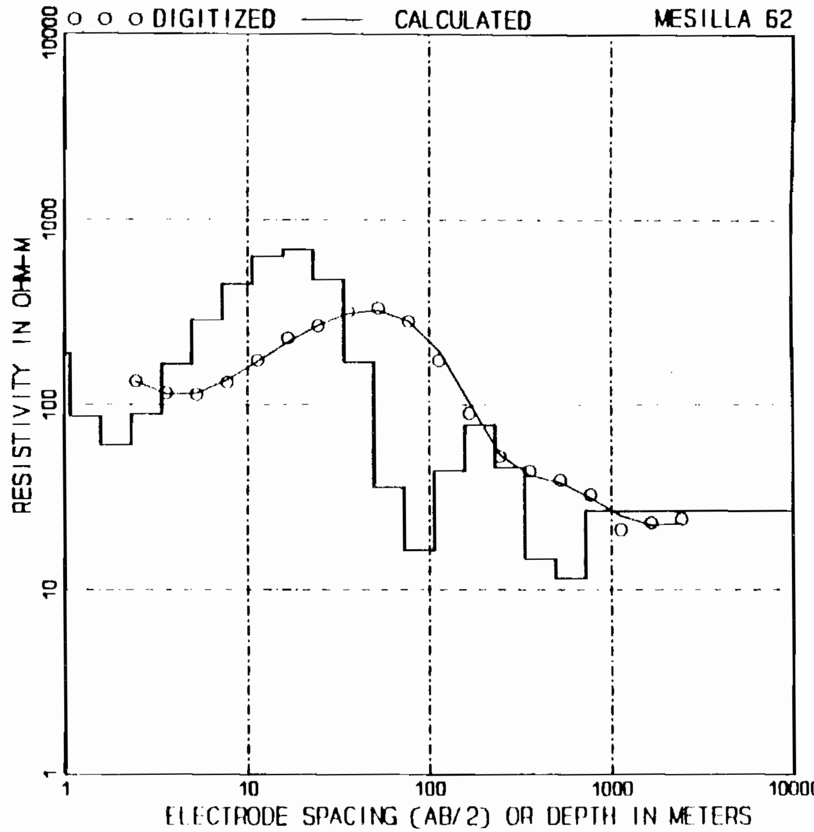
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	6.80	90.00	96.01	315.00	96.00
3.05	10.00	103.00	137.16	450.00	100.00
4.45	14.60	97.00	96.01	315.00	103.00
6.55	21.50	88.00	137.16	450.00	109.00
9.60	31.50	73.00	207.26	680.00	104.00
9.60	31.50	75.00	304.80	1000.00	92.00
13.72	45.00	56.00	304.80	1000.00	98.00
20.73	68.00	47.00	445.01	1460.00	70.00
30.48	100.00	52.00	655.32	2150.00	45.00
30.48	100.00	51.00	960.12	3150.00	28.00
44.50	146.00	63.00	1310.64	4300.00	16.00
65.53	215.00	80.00	1828.80	6000.00	14.50
			2133.60	7000.00	15.50



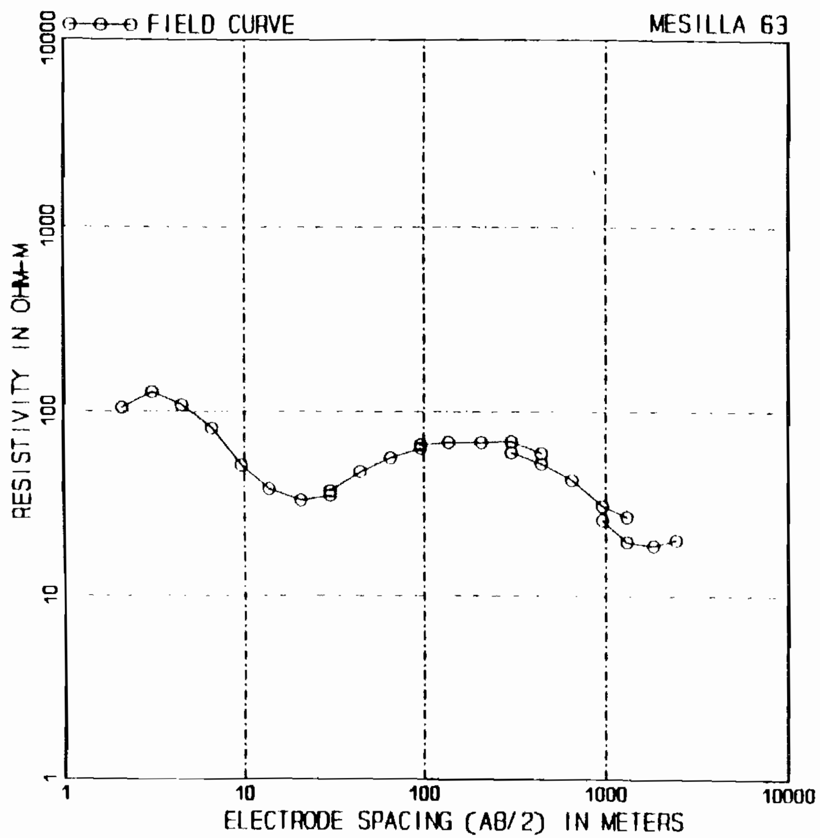
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.04	3.40	93.94	32.79	107.58	139.57
1.52	4.99	141.59	48.13	157.91	189.48
2.23	7.33	161.96	70.65	231.78	195.02
3.28	10.76	142.34	103.69	340.20	156.09
4.81	15.79	89.88	152.20	499.35	102.36
7.06	23.18	42.19	223.40	732.94	62.67
10.37	34.02	27.77	327.91	1075.81	42.06
15.22	49.93	40.72	481.30	1579.07	22.21
22.34	73.29	79.97	706.45	2317.76	9.01
			99999.00	99999.00	14.87



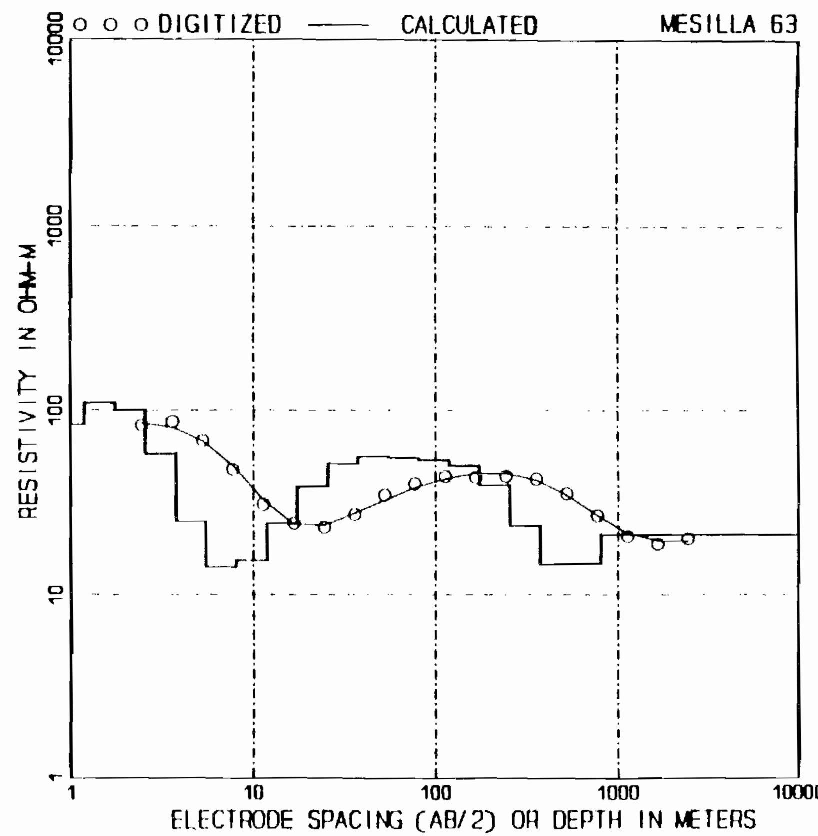
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2 07	6.80	118.00	96.01	315.00	200.00
3 05	10.00	98.00	96.01	315.00	220.00
4.45	14.60	91.00	137.16	450.00	125.00
6 55	21.50	98.00	207.26	680.00	63.00
9 60	31 50	123.00	304.80	1000.00	46.00
9 60	31 50	130 00	304.80	1000.00	49.00
13.72	45.00	175.00	445.01	1460.00	43.00
20 73	68.00	211.00	655.32	2150.00	38.00
30.48	100.00	255.00	960.12	3150.00	27.50
30 48	100.00	270.00	960.12	3150.00	26 00
44 50	146.00	300.00	1310.64	4300.00	19.50
65 53	215.00	290.00	1828.80	6000.00	25.00
			2438.40	8000.00	24.00



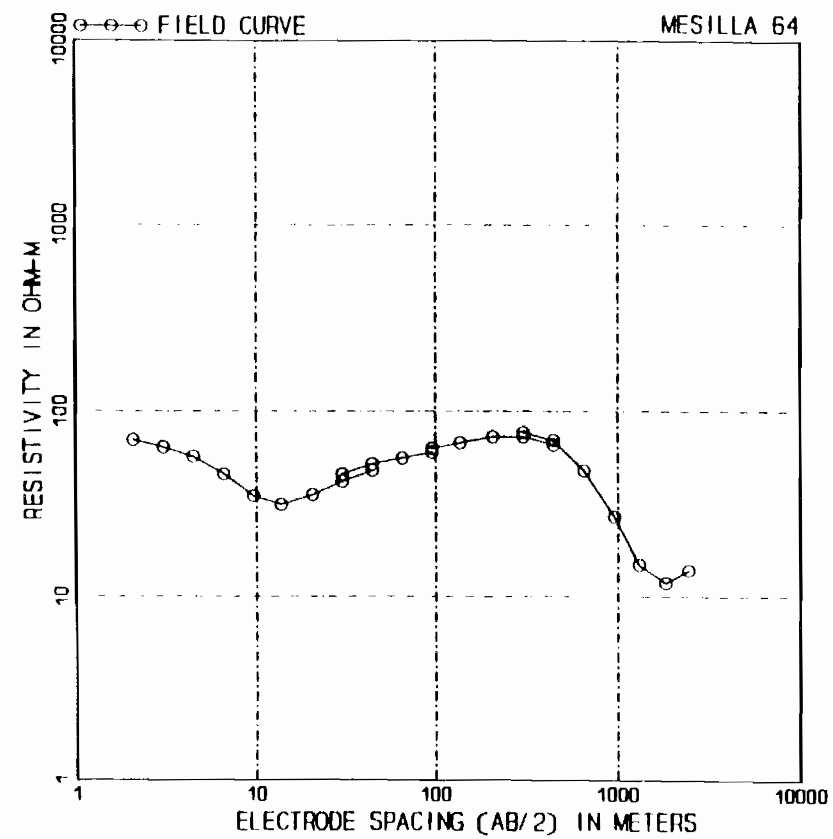
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.07	3.50	190.64	33 73	110.65	475.91
1.57	5.14	86.59	49.51	162.42	171 56
2.30	7.54	60.45	72.66	238.40	35 48
3.37	11.07	89.28	106.66	349.92	16.36
4.95	16.24	167.54	156 55	513.61	43 61
7 27	23 84	287.10	229.78	753.88	77.27
10 67	34.99	450.86	337.27	1106.54	45 42
15.65	51.36	633.89	495.05	1624.19	14.63
22.98	75.39	690.82	726.64	2383.98	11.50
			99999.00	99999.00	26.58



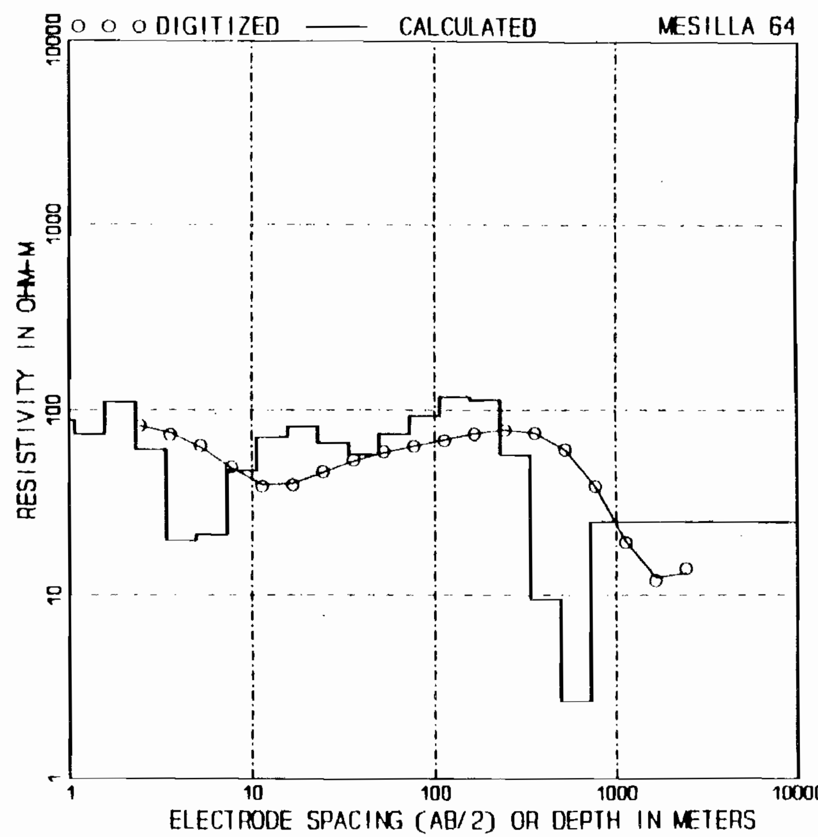
AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	105.00	137.16	(450.00)	68.00
3.05	(10.00)	128.00	207.26	(680.00)	68.00
4.45	(14.60)	109.00	304.80	(1000.00)	69.00
6.55	(21.50)	81.00	445.01	(1460.00)	59.50
9.60	(31.50)	51.00	304.80	(1000.00)	60.00
13.72	(45.00)	38.00	445.01	(1460.00)	52.[illegible]
20.73	(68.00)	33.00	655.32	(2150.00)	42.50
30.48	(100.00)	35.00	960.12	(3150.00)	31.00
30.48	(100.00)	37.00	1310.64	(4300.00)	27.00
44.50	(146.00)	47.00	960.12	(3150.00)	26.00
65.53	(215.00)	56.00	1310.64	(4300.00)	19.70
96.01	(315.00)	63.00	1828.80	(6000.00)	18.80
96.01	(315.00)	66.00	2438.40	(8000.00)	20.20



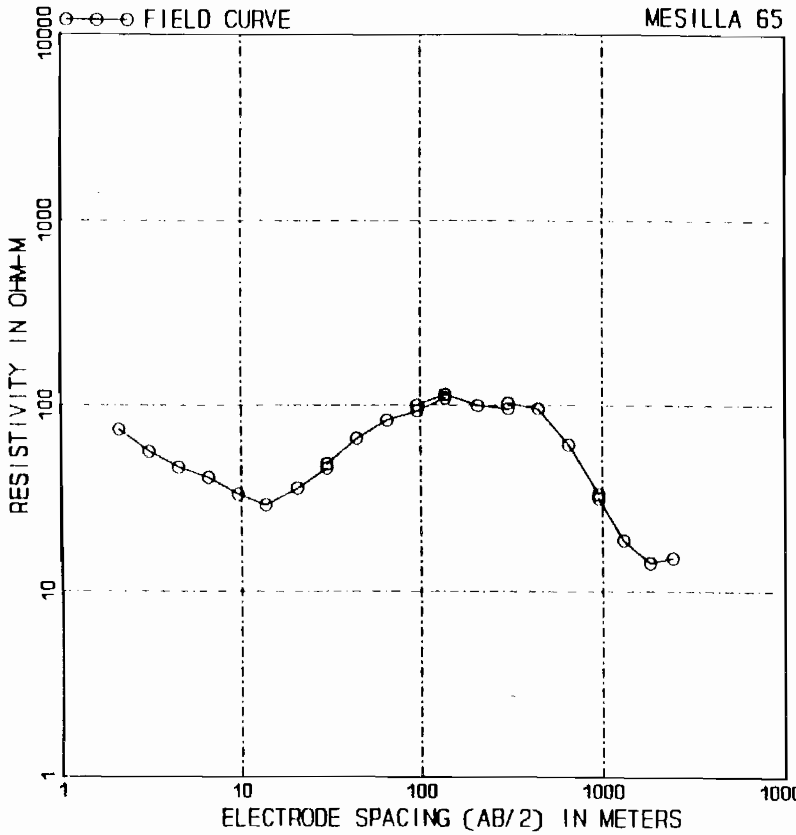
DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.19	(3.89)	83.39	37.47	(122.95)	51.07
1.74	(5.71)	109.85	55.01	(180.47)	56.05
2.55	(8.38)	99.82	80.74	(264.89)	55.15
3.75	(12.29)	57.67	118.51	(388.80)	53.41
5.50	(18.05)	24.98	173.94	(570.68)	49.96
8.07	(26.49)	14.07	255.31	(837.64)	39.13
11.85	(38.88)	15.36	374.75	(1229.49)	23.70
17.39	(57.07)	24.49	550.06	(1804.65)	14.58
25.53	(83.76)	38.61	807.37	(2648.86)	14.68
			99999.00	(99999.00)	21.25

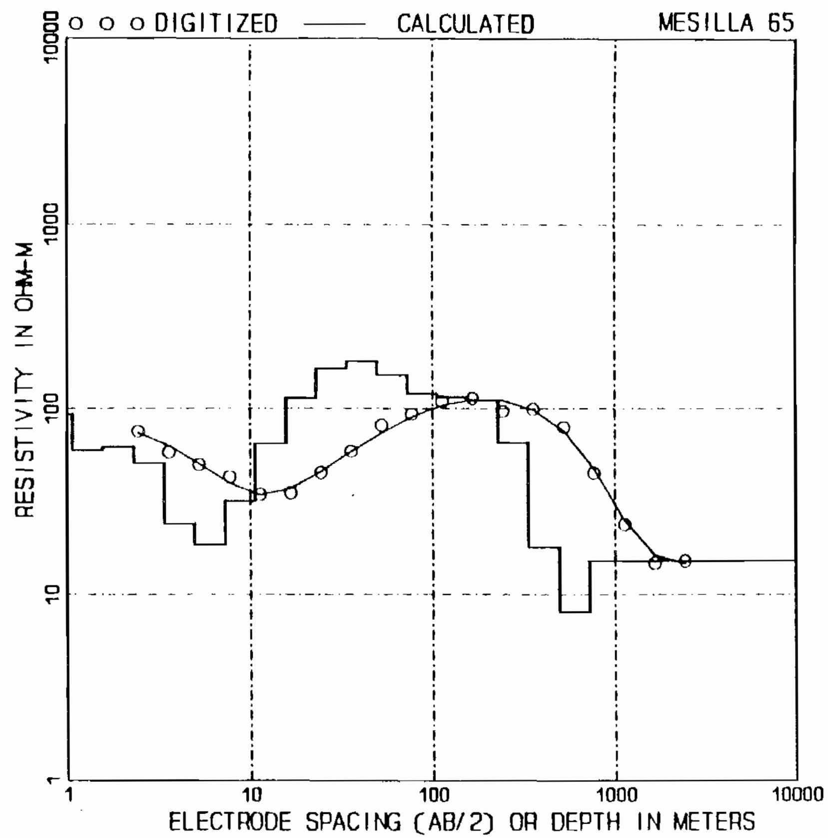


AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	70.00	96.01	(315.00)	60.00
3.05	(10.00)	64.00	96.01	(315.00)	63.00
4.45	(14.60)	57.00	137.16	(450.00)	67.50
6.55	(21.50)	46.00	207.26	(680.00)	73.00
9.60	(31.50)	35.00	304.80	(1000.00)	73.00
13.72	(45.00)	31.50	445.01	(1460.00)	66.00
20.73	(68.00)	35.50	304.80	(1000.00)	77.00
30.48	(100.00)	42.00	445.01	(1460.00)	69.70
44.50	(146.00)	48.00	655.32	(2150.00)	48.00
30.48	(100.00)	46.00	960.12	(3150.00)	27.00
44.50	(146.00)	52.00	1310.64	(4300.00)	14.90
65.53	(215.00)	56.00	1828.80	(6000.00)	11.90
			2438.40	(8000.00)	13.90



DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.07	(3.50)	87.67	33.73	(110.65)	66.35
1.57	(5.14)	74.07	49.51	(162.42)	57.97
2.30	(7.54)	110.83	72.66	(238.40)	73.79
3.37	(11.07)	60.74	106.66	(349.92)	92.60
4.95	(16.24)	19.82	156.55	(513.61)	117.90
7.27	(23.84)	21.28	229.78	(753.88)	113.43
10.67	(34.99)	47.07	337.27	(1106.54)	57.40
15.65	(51.36)	71.06	495.05	(1624.19)	9.46
22.98	(75.39)	81.52	726.64	(2383.98)	2.65
			99999.00	(99999.00)	24.83





AB/2, m	(ft)	App. Res.	AB/2, m	(ft)	App. Res.
2.07	(6.80)	74.00	137.16	(450.00)	110.00
3.05	(10.00)	56.00	96.01	(315.00)	100.00
4.45	(14.60)	46.00	137.16	(450.00)	115.00
6.55	(21.50)	40.50	207.26	(680.00)	99.90
9.60	(31.50)	33.00	304.80	(1000.00)	96.00
13.72	(45.00)	29.00	304.80	(1000.00)	103.00
20.73	(68.00)	35.50	445.01	(1460.00)	96.00
30.48	(100.00)	45.50	655.32	(2150.00)	61.00
30.48	(100.00)	48.00	960.12	(3150.00)	33.00
44.50	(146.00)	66.00	960.12	(3150.00)	31.50
65.53	(215.00)	83.00	1310.64	(4300.00)	18.80
96.01	(315.00)	93.00	1828.80	(6000.00)	14.20
			2438.40	(8000.00)	15.10

DEPTH, m	(ft)	RESIS.	DEPTH, m	(ft)	RESIS.
1.07	(3.50)	92.97	33.73	(110.65)	165.04
1.57	(5.14)	59.09	49.51	(162.42)	180.24
2.30	(7.54)	61.36	72.66	(238.40)	151.72
3.37	(11.07)	50.41	106.66	(349.92)	121.10
4.95	(16.24)	23.80	156.55	(513.61)	114.89
7.27	(23.84)	18.49	229.78	(753.88)	110.65
10.67	(34.99)	31.54	337.27	(1106.54)	64.99
15.65	(51.36)	64.26	495.05	(1624.19)	17.94
22.98	(75.39)	114.77	726.64	(2383.98)	8.04
			99999.00	(99999.00)	15.02

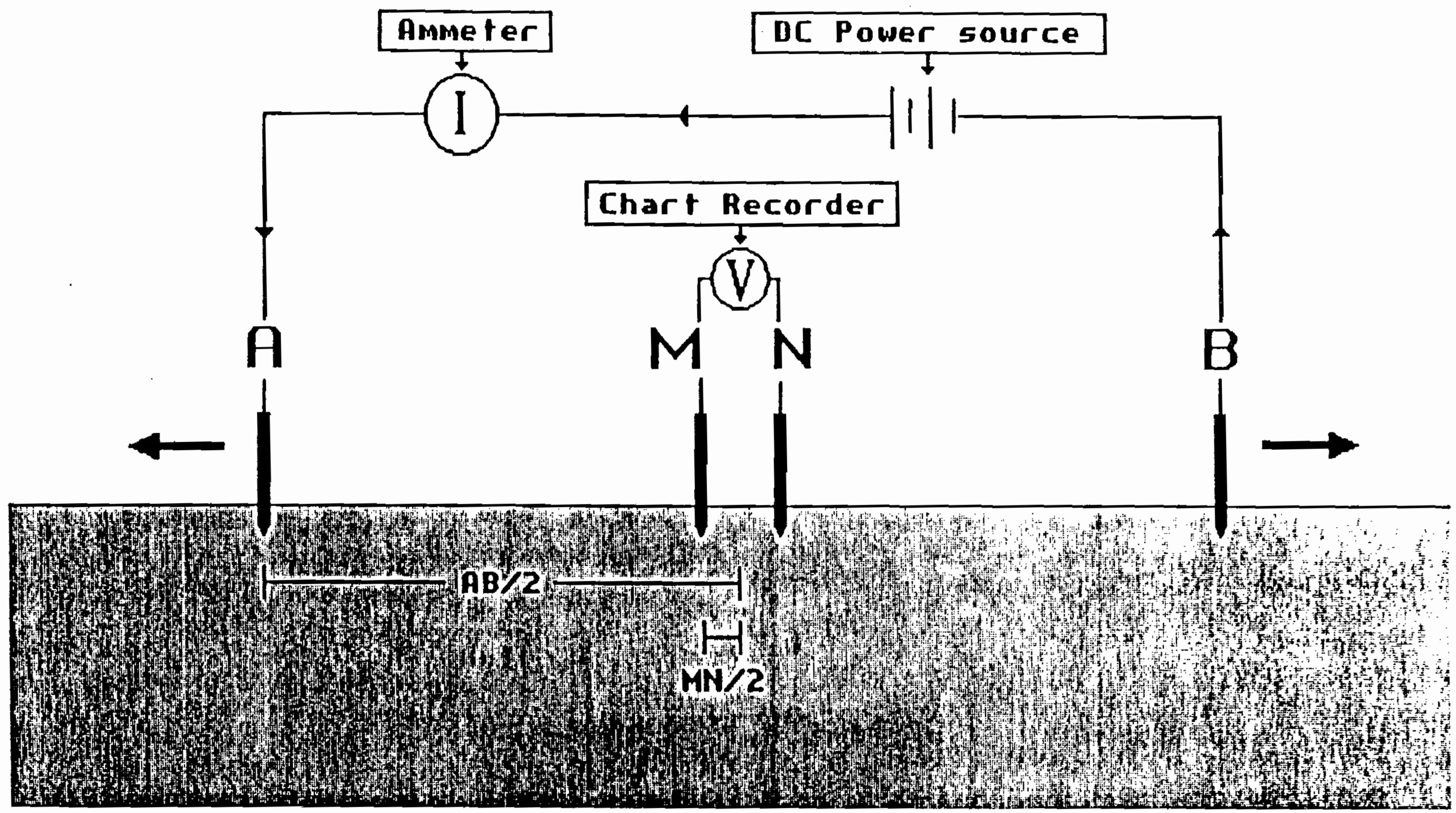


Figure 3. Schlumberger electrode array. A and B, current electrodes; M and N, potential electrodes. Arrows show direction of expansion.

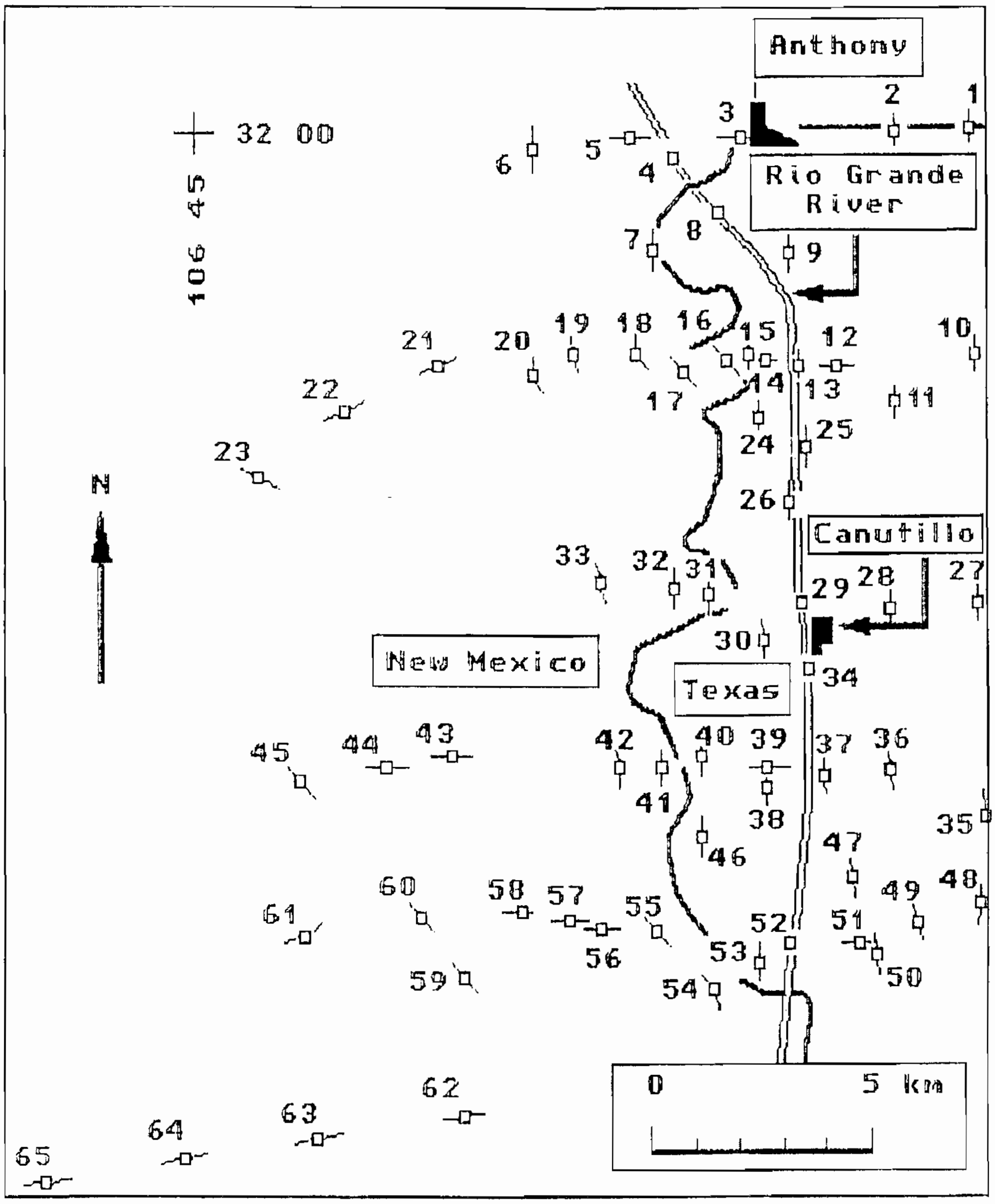


Figure 5. Map showing location of Schlumberger sounding stations in lower Mesilla Valley, New Mexico and Texas.

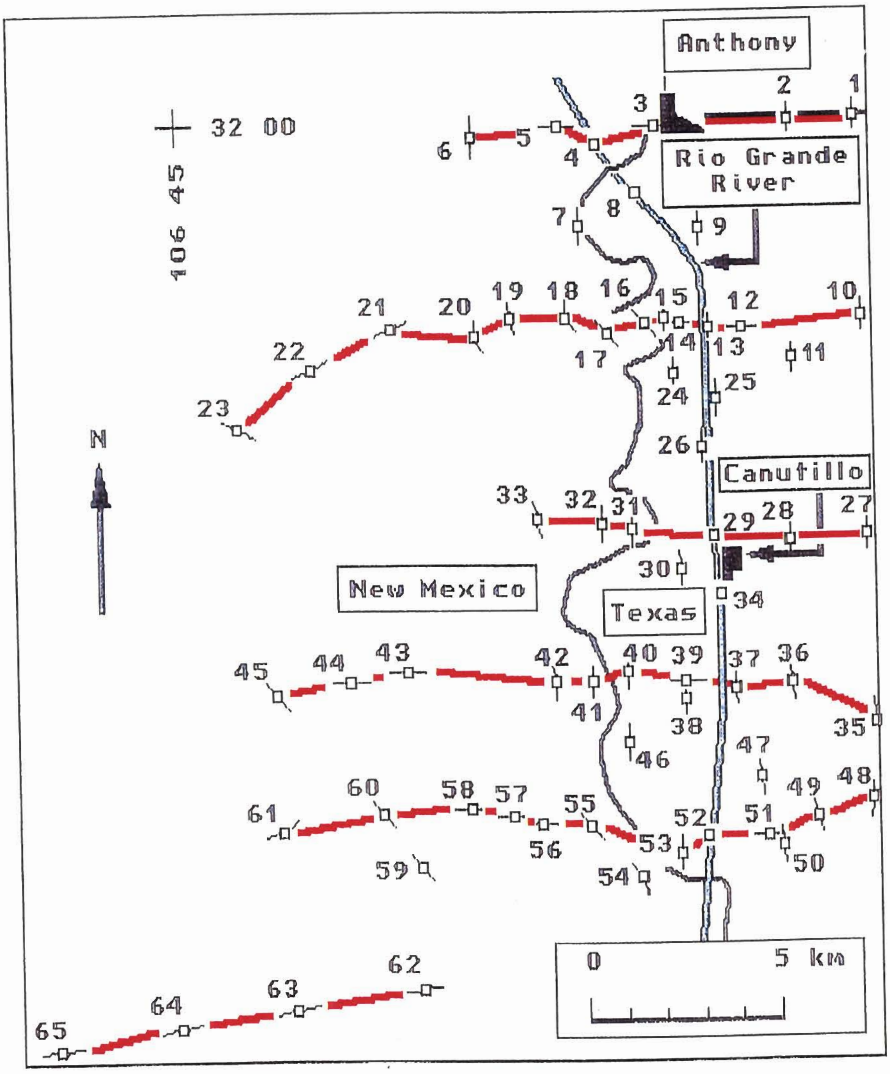


Figure 6. Map showing location of cross sections in lower Mesilla Valley, New Mexico and Texas.

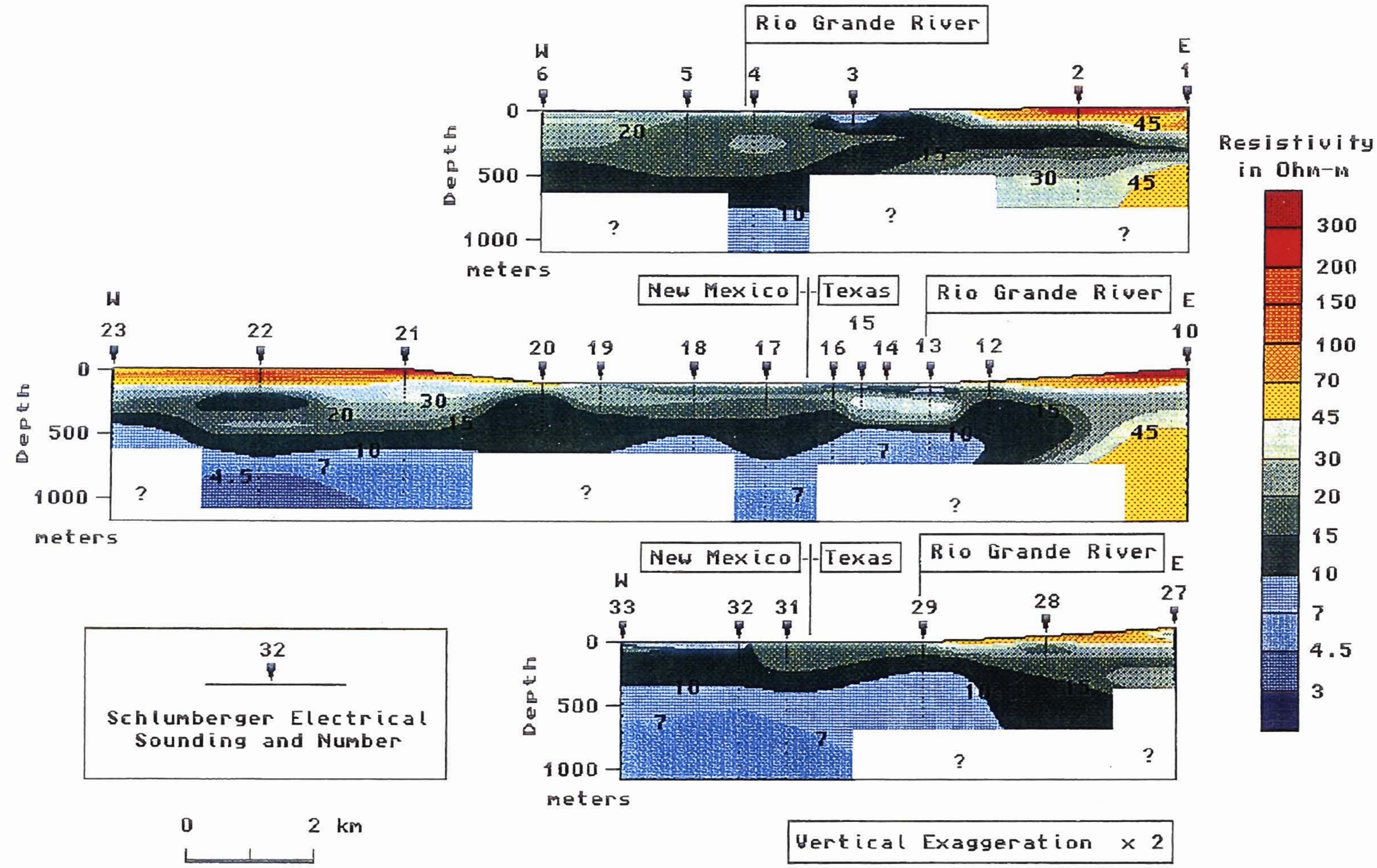


Figure 7. Northern cross sections: 6-1, 23-10, and 33-27.

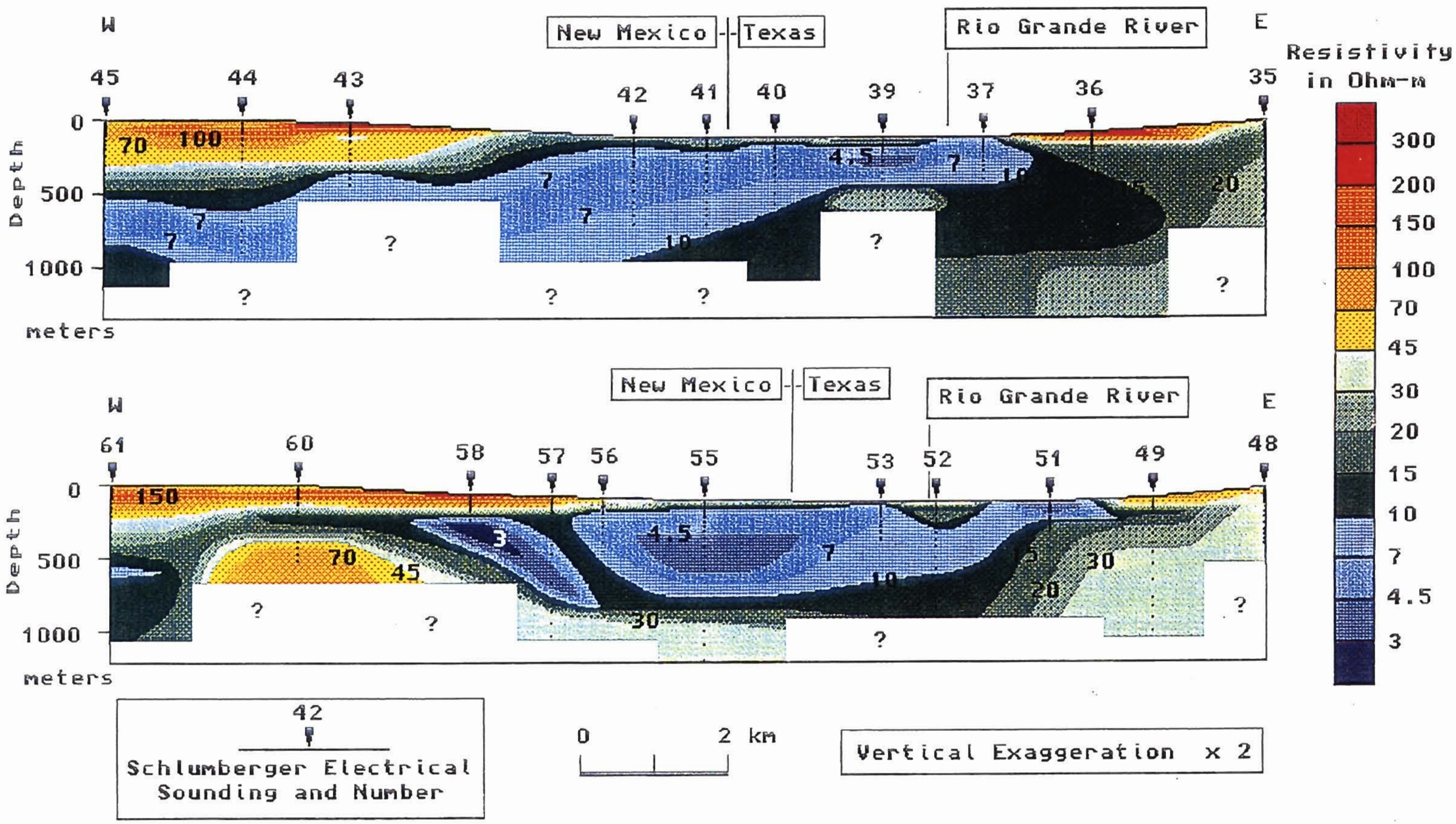


Figure 8. Central cross sections: 45-35 and 61-48.

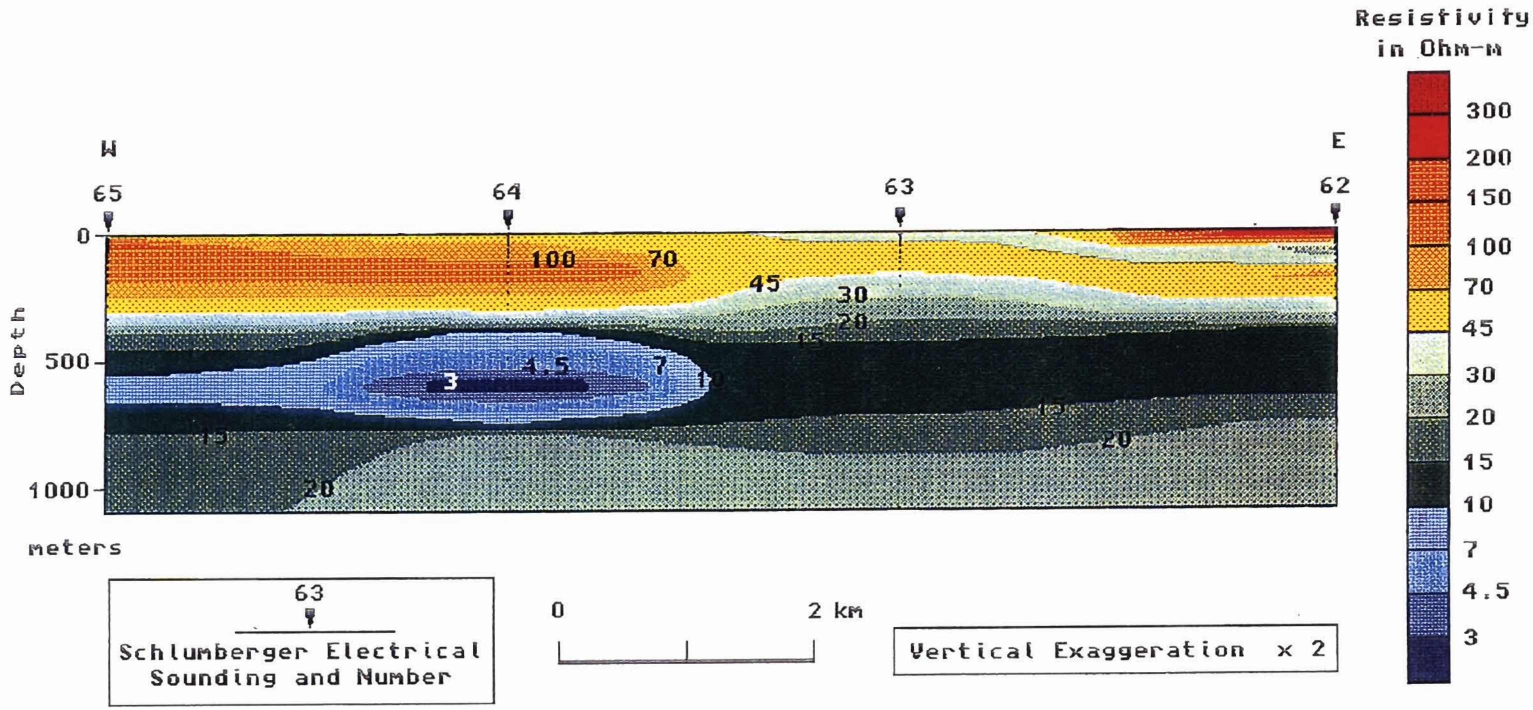


Figure 9. Southern cross section: 65-62.

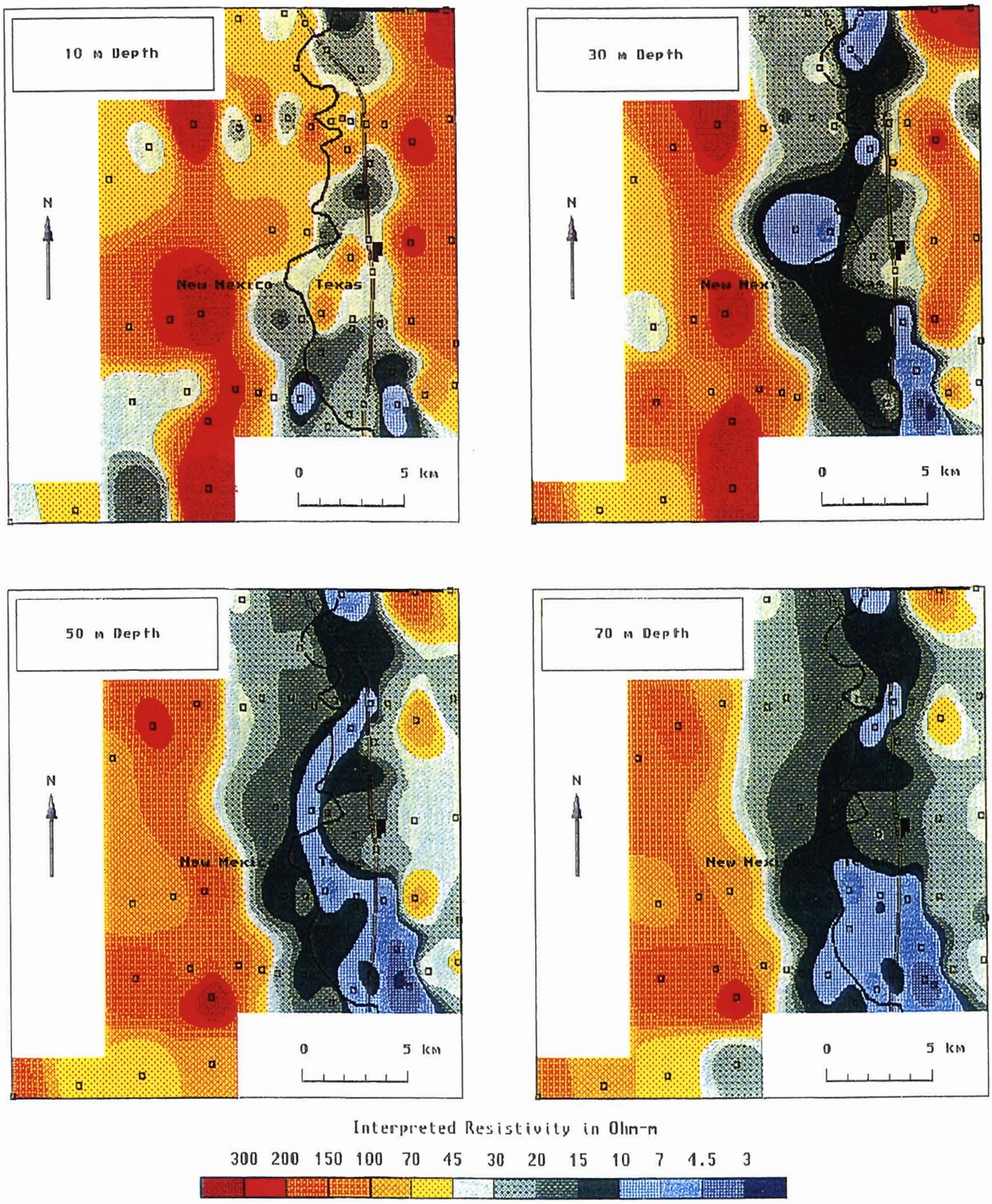


Figure 10. Interpreted resistivity maps at 10, 30, 50, and 70 meter depths.

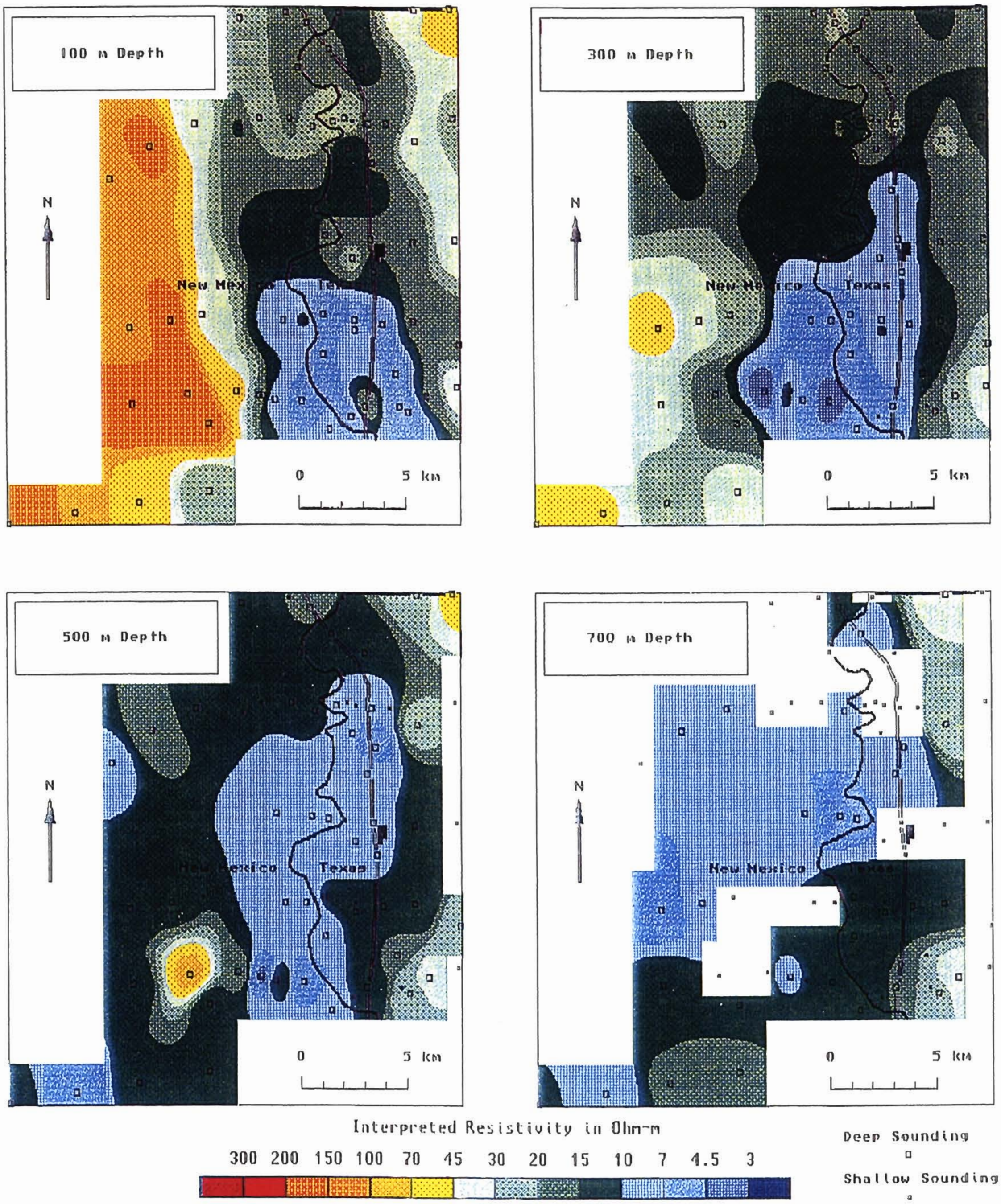


Figure 11. Interpreted resistivity maps at 100, 300, 500, and 700 meter depths.