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DEPARTMENT OF THE INTERIOR
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Remote-Reference Magnetotelluric Survey Nevada Test Site
and Vicinity, Nevada and California

by

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with an introduction by D. B. Hoover

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This report is preliminary and has not been
edited or reviewed for conformity with U.S.
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Introduction to the Report

The U.S. Geological Survey working under an Interagency agreement, DE-AI08-78 ET 44802, with the Department of Energy is engaged in a broad program to assess and identify potential repositories for high level nuclear waste on the Nevada Test Site (NTS). The Geological Survey's program consists of integrated geologic, hydrologic and geophysical studies which range in nature from regional to site specific. As part of the regional geophysical studies, a 50-station seismic network (about 200 km by 200 km) has been established in the region within and surrounding NTS. The principal purpose is to address the question of regional seismicity and to assess the potential for faulting and damaging earthquakes at repository sites under investigation.

In addition to the seismicity investigations, teleseismic p-delay studies are also being conducted using data from the seismic network. This phase of the study is to assist in understanding the regional crustal structure as it may relate to the potential for volcanism or the presence of potential geothermal resources in the area. Preliminary work has revealed variations in delay time of about 1 sec indicating significant variations in crustal velocities across the network (H. M. Iyer, written communication, 1981). The magnetotelluric (MT) work reported on in this paper was performed to complement the on going p-delay work.

In September 1980, on the basis of competitive bidding, a contract was awarded to Argonaut Enterprises, Denver, Colorado, for 15 remote reference MT soundings to be made as closely as possible to stations in the seismic network. The prior MT work at NTS was of relatively poor quality at least in part attributed to cultural noise. In order to get improved data quality for this survey, the relatively new remote reference MT method was required by the contract. The stations selected were those within NTS proper or in the immediate vicinity.

Previous single station MT work at NTS near Syncline Ridge had revealed a very conductive crust (less than 1 ohm-meter) beginning at depths of about 3-6 km. Syncline Ridge is near station 20 of this report and results from station 20 substantiate the presence of this crustal conductor.

An important question for siting a repository at NTS is what kind of rock and at what temperature can be identified with the electrical conductor? In the near surface, rock conductivity is principally due to ionic conductivity from water present in the pore spaces. Low resistivity rocks are those with high porosity and or very saline solutions in the pore spaces. Argillites, zeolitized tuff, clays, and saline-saturated sandstones are examples. In the near surface, resistivities near 1 ohm-meter are normally encountered only on saline playas where porosity and salinity are high, or in geothermal areas where porosity, salinity and temperatures are higher than normal. Basement rocks tend to have intermediate to high resistivities due to decreased porosity and their resistivity generally increases with depth due to reduction of fracture porosity, metamorphism, and loss of free water. However, as the rocks approach melting temperature at mantle depths, the resistivity decreases towards low values associated with melt. At elevated temperatures but below the melting point, amphibolites tend to have lower resistivities than other common plutonic rocks. This is presumably related to the hydroxyl present in amphibole minerals. The presence of material approaching sea water in conductivity at intermediate or shallow crustal depths is anomalous and may imply the presence of hot or molten rock.

Because electrical data by itself cannot tell if the rocks are at elevated temperatures, a multidisciplinary approach is planned to attempt to identify areas of increased temperature. On a regional basis this will be accomplished by integrating results from studies of teleseismic p-delays,

Curie isotherm depths, heat flow, and MT soundings. Should the electrical conductor in the crust be due to rocks at greater than normal temperature, then there should be associated low seismic velocities, shallow Curie isotherm depths, and increased heat flow. Should high correlation be found between these separate studies, then the potential for volcanism and blind geothermal systems in the region will be increased. Neither of these consequences are favorable for the siting of a nuclear waste repository.

The report which follows presents the results from the MT survey designed to address the problem discussed above.

References to Introduction

Hoover, D. B., Hanna, W. F., Anderson, L. A., Flanigan, V. J., and Pankratz, L. W., 1982, Geophysical studies of the Syncline Ridge area Nevada Test Site, Nye County, Nevada: U.S. Geological Survey Open-File rept. 82-145.

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Remote-Reference Magnetotelluric Survey Nevada Test Site and Vicinity,

Nevada and California

by

Robert B. Furgerson¹

INTRODUCTION

National plans for further development of nuclear energy are partially stalled and high level nuclear wastes are piling up in temporary storage sites due to lack of suitable repositories or other means for disposing of high level wastes. Recognition of this problem has led the Department of Energy to greatly accelerate their efforts to develop underground repositories in suitable geologic media. Much of this effort is being expended at the Nevada Test Site (NTS). The U.S. Geological Survey has assumed the major responsibility for geophysical investigations of various geologic media and possible repository locations at NTS.

There is a need to obtain additional deep electric data in various areas within and adjacent to the NTS. The NTS lies within the Great Basin which is one of the more tectonically active regions in the conterminous United States with a history of young volcanism and significant seismic activity. Prior to disposal of waste in the region a better understanding of crustal processes is needed. The presence of young volcanism and high heat flow in much of the area also suggests the possible existence of geothermal systems. Magnetotelluric (MT) soundings are required in the area to assist in defining the crustal geoelectric section.

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These data with other geological, geochemical, hydrological and geophysical data will help in assessing the potential for volcanism and presence of geothermal systems.

To this end, the U.S. Geological Survey contracted Argonaut Enterprises to perform a magnetotelluric survey consisting of 15 stations. The stations were located as closely as possible to stations in a 50 site seismic network. Because there is a high incidence of cultural electrical noise at various sites at the NTS, the USGS decided it was necessary that the MT stations be acquired using a remote reference which utilizes the horizontal magnetic components. Figure 1 is a regional index map showing the outline of the area covered by Plate 1; detailed site locations are presented in Appendix A.

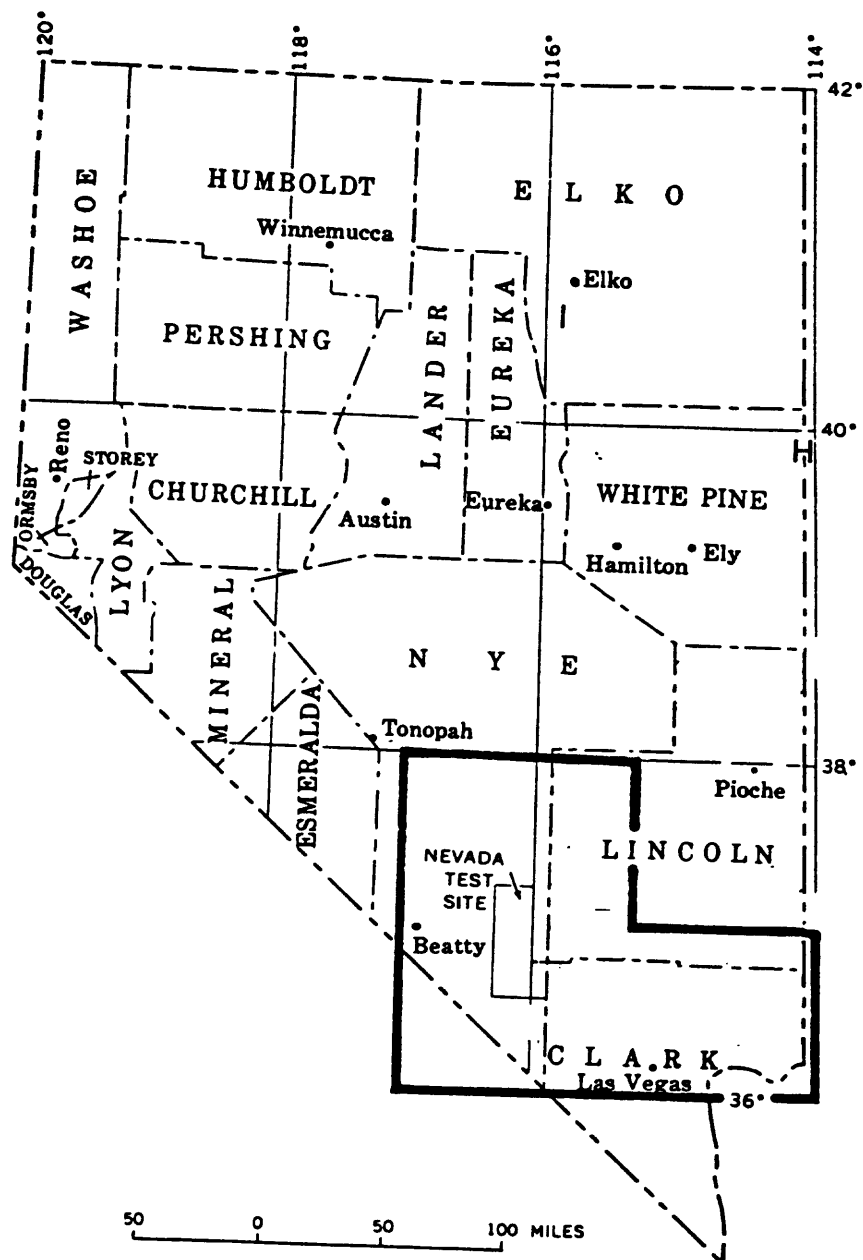


Figure 1: Index map of Nevada showing counties, principle cities, and area covered by Plate 1.

PREVIOUS WORK

Classical geological mapping in the study area is summarized by Cornwall (1972), Longwell and others (1965), Tschanz and Pampeyan (1970), and Jennings (1958). The major faults and at least six large caldera complexes from these reports are shown on Plate 1. Very little deep electric investigation in the project area was found in the open literature. Jackson (1966) describes a deep polar dipole sounding southeast of Las Vegas near Boulder City. Plouff (1966) gives interpretations for two scalar MT soundings in the present study area. His station 12 appears to be just east of Argonaut station 21; his station 11 appears to be 9 miles due east of Argonaut station 20. Because Plouff's stations were scalar and because the sounding curves were not reproduced, his interpretations were not used in this report.

THE THEORY OF THE MAGNETOTELLURIC METHOD

The magnetotelluric (often abbreviated as MT) method is a way of determining the electrical conductivity distribution of the subsurface from measurements of natural transient electric and magnetic fields on the surface. The MT method depends on the penetration of electromagnetic energy into the earth. Depth control comes as a natural consequence of the greater penetration of the lower frequencies.

Results interpreted from measurements at a single site are often considered analogous to an induction log, very heavily smoothed, obtained without drilling a well. Results from a line of measuring stations are interpreted to give underlying conductivity distribution and structure. That picture of the subsurface can in turn be related to porosity and salinity, since conductivity depends primarily on those

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This chapter summarizing the theory of the magnetotelluric method was produced largely by lifting sections from the papers of many of the authors, especially Vozoff (1972, 1976).

two factors in common sedimentary rocks. A third factor, temperature, is an important variable in geothermal areas. In the past few years the MT method has been applied increasingly to problems in exploration and in earth sciences generally. These problems range from studies of the interior of the earth (on a regional scale), to the search for oil and gas and geothermal energy (on an intermediate scale), to the search for minerals (on a small scale).

The time variations of the earth's electric and magnetic fields at a site are recorded simultaneously over a wide range of frequencies, usually on digital tape. The variations are analyzed by computer to obtain their spectra, and various parameters (such as apparent resistivity) are computed as functions of frequency from the spectra. Interpretation consists of matching the computed plots to curves calculated for simplified models.

The Signals

The time-varying magnetic (H) signal is the always present "noise" in the earth's magnetic field. When very large, it interferes with magnetic surveys. In the

conducting earth, the changing magnetic field induces telluric (eddy) currents and voltages; the latter are proportional to the electric (E) signals. They are very similar in appearance to the H signals. On chart records, both sets of variations look irregular and noise-like for the most part. At times, in certain frequency bands, the variations may appear sinusoidal, but the sinusoids are not an important part of the signal for MT purposes. Signal amplitudes fall off rapidly with increasing frequency over most of the range of frequencies used. Signal level can increase very rapidly at the onset of magnetic storms, an increase of a factor of 10 being common, and even a factor of 100 is not unusual.

Most of the magnetic noise reaching the earth below 1 Hz is due to current flow in the ionized layers surrounding the earth. The currents are powered by solar activity and by the relative motions of the earth, sun, and moon. At frequencies above 1 Hz, worldwide electrical thunderstorm activity within the atmosphere is the major contributor. The transient fields due to thunderstorms can be exceedingly large locally, while those associated with tornadoes are greater still.

In the low-frequency range, mean directional properties from the source are fairly random so that, given sufficient

recording time, all source directions are sampled. This is very fortunate since individual observations should then be reproducible even though the electric field does not always flow perpendicular to the source field, due to local anisotropy. At higher frequencies the source fields are not so uniform in direction, depending on the location of thunderstorm centers, and one can obtain sets of nonrepeatable data depending upon the relative directions of source field and lateral resistivity contrast.

Effect of Earth Conductivity on H

When the magnetic fluctuations reach the surface of the earth, reflection and refraction occur. It is now well established that the signals can be approximated by electromagnetic plane waves. This will not be true under all conditions, but holds for the vast majority of geological situations of interest in petroleum prospecting (Madden and Nelson, 1964; Rikitake, 1966; Vozoff and Ellis, 1966).

Although the majority of the incident energy is reflected, a small portion is transmitted into the earth and travels vertically downward. To the conducting rocks, this

energy appears as a magnetic field which is changing with time, and electric fields are induced so that telluric currents can flow. These telluric currents are completely analogous to the eddy currents which flow in transformers due to the changing magnetic fields caused by the alternating current in the primary windings.

Energy in the downgoing disturbance is quickly dissipated as heat. As a result the field penetration is relatively small in terms of its wavelength in air. The penetration mechanism in this situation is actually diffusion rather than wave propagation.

Current density in the earth depends on resistivity ρ , as might be expected. Within a rock, the normal relationship between the electric field and the current density at each point is

$$j = E/\rho.$$

This differential form of Ohm's law is really a definition of resistivity and is very similar to the Ohm's law definition of resistance,

$$I = V/R.$$

In mks units E is in volts/meter, j is in amperes/square

meter, ρ is in ohm-meters, and H is in amperes/meter. However, because the fields are so small, the more commonly used practical units are mv/km for E and gammas for H . The practical units will be used in later sections.

The E measurement is actually a voltage difference measurement between two electrodes. In a uniform earth, the voltage difference V between electrodes a distance l apart would be

$$V = lE.$$

In the MT method it is usually assumed that E is constant over the length of the wire; i. e.,

$$E = V/l.$$

The depth of penetration of the fields into the earth is inversely related to rock conductivity. In a uniform earth E and H weaken exponentially with depth; the more conductive the earth, the less the penetration. The depth at which the fields have fallen off to $(1/e)$ of their values at the surface is called the skin depth δ .

$$\begin{aligned}\delta &= \sqrt{2/\omega\mu\sigma} \text{ m} \\ &\approx \frac{1}{2}\sqrt{\rho/f} \text{ km,}\end{aligned}$$

where f is frequency, $\omega=2\pi f$, and μ is permeability.

(μ in the earth is taken equal to μ_0 except in highly magnetic materials.) Frequency enters into the equations because the magnitudes of the induced telluric currents depend on the time rate of change of the magnetic fields.

In a uniform or horizontally layered earth all currents, electric fields, and magnetic fields are practically horizontal, regardless of the direction from which these fields enter the earth. This comes about because of the high conductivity of earth relative to air. It can be thought of in terms of Snell's law in optics, with the velocity in the earth being orders of magnitude smaller than that outside. Furthermore, the currents and electric fields are at right angles to the associated magnetic fields at each point. If E is positive to the north, H is positive to the east. That is, viewed from above, E must be rotated 90 degrees clockwise to obtain the direction of positive H .

The mathematical description of the perpendicular E and H fields in a uniform isotropic conductor includes all these features in a concise form:

$$H_y = H_y^0 e^{-\omega t + (i-1)x/\delta},$$

$$E_x = E_x^0 e^{-\omega t + (i-1)x/\delta},$$

$$E_x^0 = (1 - i)\omega\mu\delta H_y^0/2.$$

The superscript indicates the value at the surface.

Particularly interesting is the ratio

$$\begin{aligned}\frac{E_z^0}{H_y^0} &= \frac{(1-i)\omega\mu\delta}{2} \text{ ohms} \\ &= (1-i)(\omega\mu/2\sigma)^{1/2}.\end{aligned}\quad (1)$$

Since E and H are recorded at frequencies which can be accurately measured and since μ varies little from μ_0 in most rocks, the ratio shows the relationship which exists between the conductivity and the measured fields. The equation can be solved for conductivity, giving

$$\sigma^{1/2} = (1-i)(\omega\mu/2)^{1/2} \frac{H_y^0}{E_z^0}. \quad (2)$$

Equation (2) is usually rewritten in mks units as

$$\rho = \frac{i}{\omega\mu} \left(\frac{E_z}{H_y} \right)^2$$

and the superscripts are omitted.

In practical units, where E is given in mv/km and H is in gammas, the magnitude of ρ is

$$\rho = \frac{1}{5f} \left(\frac{|E_z|}{|H_y|} \right)^2. \quad (3)$$

When ρ (or σ) is calculated from E and H values, it is called an apparent resistivity ρ_a (or apparent

conductivity σ_0). ρ and ρ_0 are related, but they must be clearly distinguished. ρ_0 is the resistivity that a uniform earth must have to give the measured value of the impedance Z . ρ is a property of the medium, whereas ρ_0 depends on how it is measured. The ratio of E_i to H_j at each frequency is the impedance Z_{ij} for those components at that frequency. Since E and H are usually not in phase Z_{ij} is taken to be a complex number.

In a uniform earth, ρ_0 has to be the same at every frequency, and E leads H in phase by 45 degrees at all frequencies. (This can be checked by substituting Equation (1) into Equation (3).) Thus, if we plot ρ_0 and phase against frequency, we see that both are constants.

In discussing kinds of electrical structure, it is useful to define two-dimensional and three-dimensional structures. In the two-dimensional case [$\sigma = \sigma(x, z)$], conductivity varies along one horizontal coordinate and with depth. The other horizontal direction is called the strike. When conductivity varies with both horizontal coordinates and with depth [$\sigma = \sigma(x, y, z)$], the structure is said to be three-dimensional and has no strike. If σ depends only on z , the structure is one-dimensional. In each case, σ at each point can depend on the direction of current flow;

if σ does depend on direction, the medium is anisotropic.

If the conductivity changes with depth, ρ_0 varies with frequency, since lower frequencies penetrate more deeply. Apparent resistivity can be written and computed exactly for any desired combination of horizontal layers, whether isotropic or arbitrarily anisotropic. It can be calculated approximately for any two-dimensional model structure. As might be expected, Z for horizontally isotropic and homogeneous layers does not depend on the directions used as long as E is measured perpendicular to H .

When faulting or jointing are present, σ varies laterally or with direction, and the j and E which are induced by a given H depend on their direction relative to strike. In order to sort out these effects, we record complete horizontal E and H fields (two perpendicular components of each) at every site. In addition, the vertical component of H is also recorded, for a total of five recorded signals in all. These are designated H_x , H_y , H_z , E_x , and E_y .

In general, ρ_0 at each frequency varies with measurement direction. We assume that there is a strike but that its direction is unknown. Then E_x is due partly to H_y , but also partly to currents induced by H_x , which have

been deflected by the structure. The same is true of E_y , so the relations are written

$$E_x = Z_{xx}H_x + Z_{xy}H_y, \quad (4)$$

$$E_y = Z_{yx}H_x + Z_{yy}H_y. \quad (5)$$

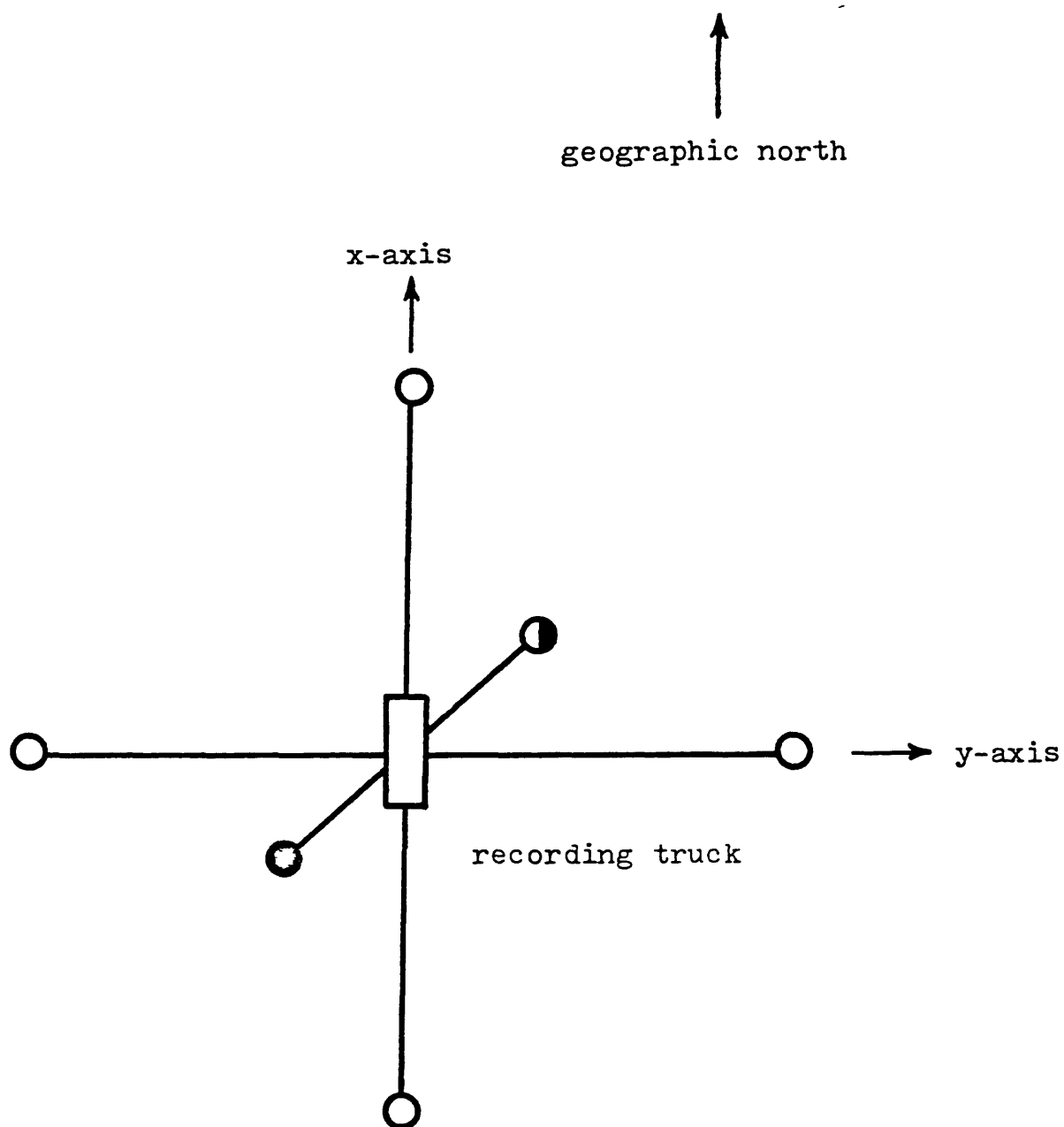
For example, Z_{yx} gives the part of E_y which is due to H_x , and so forth. Since E_y and H_x are generally not in phase, the Z 's are complex. E and H component amplitudes are obtained by computer-analyzing the records using methods described in the section on data analysis.

For the work which follows x is chosen as directed to the north and y is directed to the east (fig. 2).

FIELD PROCEDURE AND INSTRUMENTATION

Although basically simple, field procedures require a great deal of planning and attention to detail, since they dominate the costs; and the sensitivity of the measurement makes it highly vulnerable to disturbances at the measuring site. Sites must be chosen with care, to avoid possible sources of disturbance such as cathodic protection circuitry, power and fence lines, unprotected pipelines, and vehicle and pedestrian traffic. Two pairs of electrodes aligned at right angles must be laid out at each site, as must three mutually perpendicular magnetometer axes. A set-up is shown schematically in Figure 2.

For the E-field measurements, sheet lead electrodes provide low-resistance and low-noise electrical connections with the earth. The input to each of the E-field channels is the voltage difference between an electrode pair. (Although one usually thinks of the earth as being at zero potential, voltage differences must exist if telluric currents flow, because the earth has finite conductivity, and $j = E\sigma$.) The farther apart a pair of electrodes, the larger the signal voltage measured, so it is usually desirable to put the electrodes as far apart as possible, subject to other factors, such as obstructions, property



- lead electrodes
- ◐ 3-component cryogenic magnetometer
- * electric generator

Figure 2: Magnetotelluric sensor orientation.

boundaries, the time needed to lay out connecting wires, and the minimum spacing tolerable between adjacent measurement sites. For routine operations, it is desirable to use fixed wire lengths. Finally, since the wires must not be permitted to move in the earth's main magnetic field as this induces noise, clods of dirt must sometimes be placed every few feet along the wire to restrain it, a very time-consuming task.

The two electrode pairs are intended to measure two perpendicular components of an electric field vector which exists at each site. However, it is possible for the electric field on the surface to change in both direction and intensity over very short distances, due to large lateral resistivity changes near the surface. Large electrode spacings should be used in this situation to average over as much of the variation as possible, or the resulting data will apply to conditions which are too localized to be of use. For best averaging in these circumstances, it is also important that the two electrode pairs form a cross whose four arms are as nearly equal in length as possible, rather than being arranged to form an "L" or a "T", (Swift, 1967), and that the magnetometer be near the center. Although the cross is preferable, difficult terrain may require one of the other arrays.

Topographic features can cause distortions similar to those caused by resistive heterogeneities. While these can also be modeled, it is better to avoid them if possible, especially if the relief is more than 10 percent or so of the electrode spacing.

The H-field sensors consist of a three-axis cryogenic magnetometer with a 30 liter liquid helium reservoir. Since magnetometers are even more sensitive to motions than are the wires connecting the electrodes, the magnetometer is firmly seated in a 6 inch to 12 inch deep hole and covered with a wind screen.

The recording instrumentation contains amplifiers, filters, a multiplexer, an analog-to-digital converter, and a digital cassette drive controlled by software commands from a 32K word, 16 bit mini-computer and timed by a clock synchronized with the National Bureau of Standards WWVB time code. A block diagram is shown in Figure 3, and specifications are given in Table A .

Normalized system response curves calculated for the bands used are shown in Figure 4 . System calibrations were made at the beginning of the survey and at the end of the survey and were within 3% of the calculated responses from one decade below the lower corner frequency to one octave

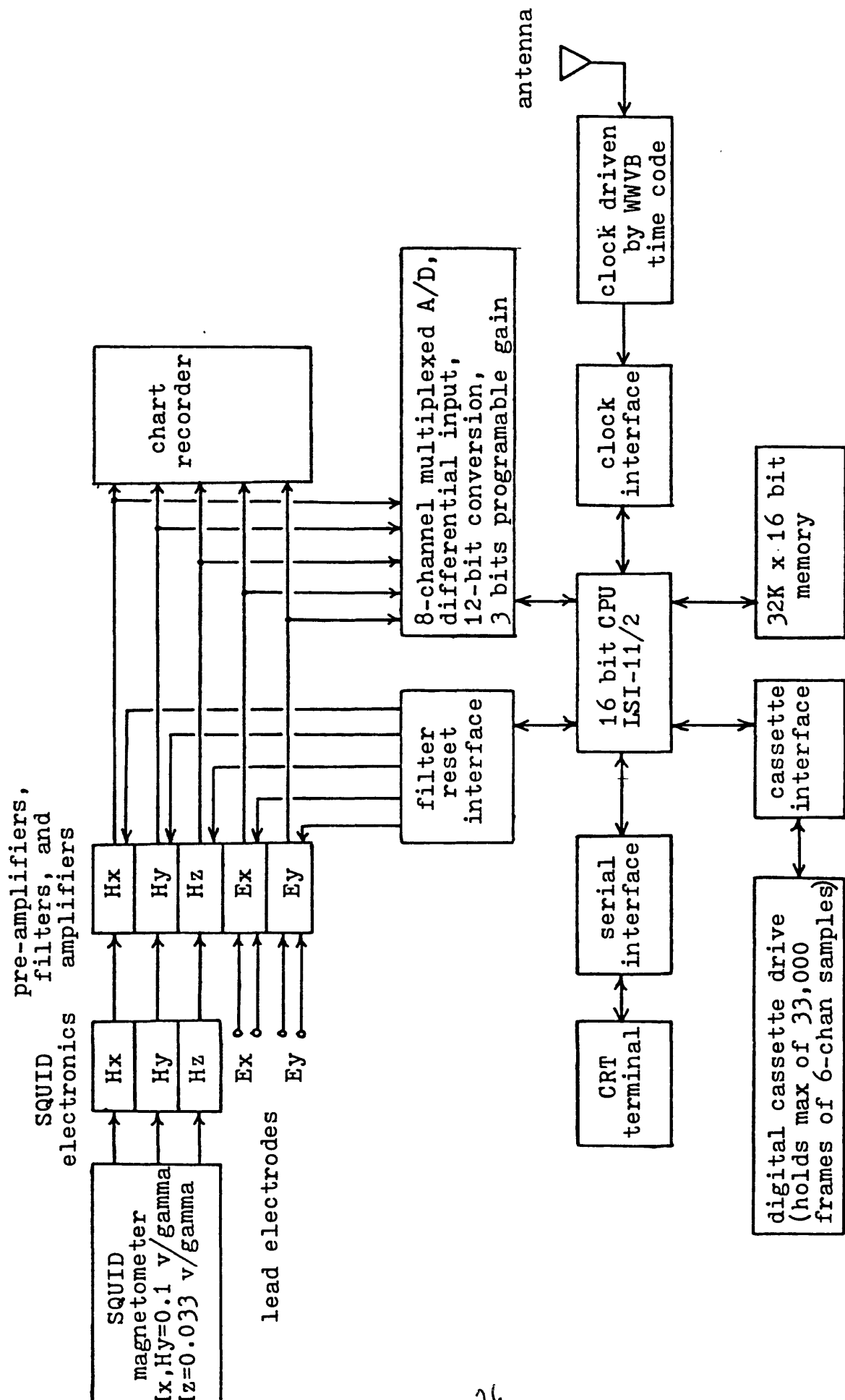


Figure 3: Argonaut Enterprises magnetotelluric data acquisition system

TABLE A : Specifications of Argonaut Enterprises MT data acquisition system as of October 9, 1979.

- (1) Electrical field detectors (2 component): four electrodes in a square array using 100 to 300 m lines.
- (2) Magnetic field detectors (3 component): three-axis super conducting quantum-interference device (SQUID) magnetometer with 30 liter dewar and sensitivity of better than 10 gammas.
- (3) Analog signal conditioners:
 - (a) instrumentation preamplifier gains of 2, 5, 10, 20, 50, and 100
 - (b) post amplifier gains of 2, 5, 10, 20, 50, 100, 200, 500, 1000, and 2000
 - (c) active 60 Hz notch filter with 45 db rejection and variable Q
 - (d) 2 stages of passive (RC) low pass filtering: 6 db/octave rolloff with corner frequencies of 0.16, 1.6, 16, and 160 Hz.
 - (e) active low pass filter: 12 db/octave rolloff with corner frequencies of 0.02, 0.06, 0.2, 0.6, 2, 6, 20, 40, and 200 Hz.
 - (f) active high pass filter: 12 db/octave rolloff with corner frequencies of 0.001, 0.002, 0.005, 0.01, 0.03, 0.1, 0.3, and 6 Hz.
 - (g) The filters in each channel can be independently reset to zero by (1) manual switch on the front of each amplifier-filter board or (2) by the mini-computer under software control.
- (4) 8-channel differential-input multiplexer and analog-to-digital converter with 12 bit conversion plus 3 bits of programmable gain on each sample.
- (5) Timing control unit:
 - (a) can be interrogated by the computer to give day of the year, hour, minute, and second.
 - (b) updated millisecond interrupt clock.
 - (c) accuracy to better than 1 millisecond when synchronized with WWVB.
- (6) Digital tape recording with complete information for processing contained in the tape header.
- (7) In-field monitoring of recording and playback processes by a 16 bit, 32K memory, mini-computer.

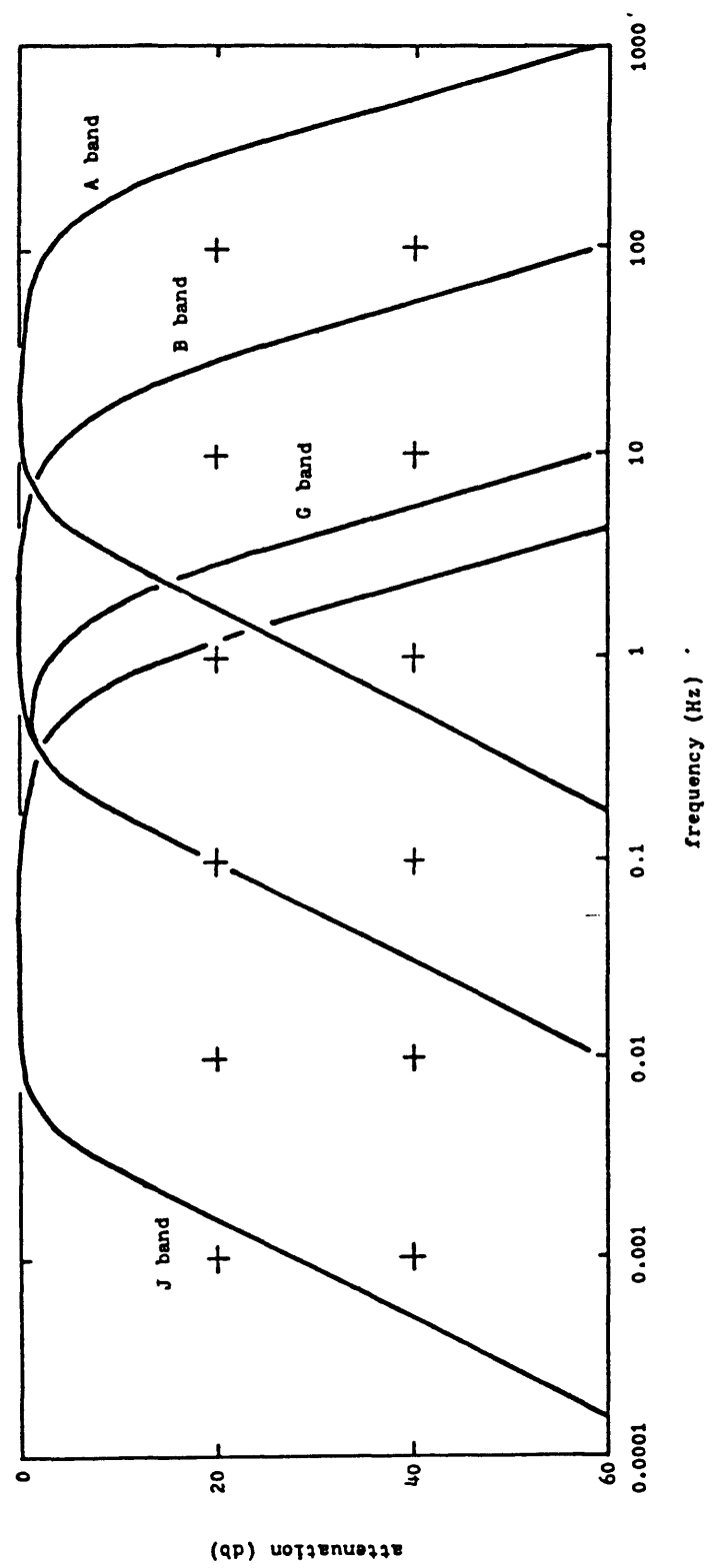


Figure 4: System response.

Table B: Magnetotelluric recording bands.

band	digitizing interval	3 db down corner frequencies			average number of points recorded
		active high pass	active low pass	passive low pass (two stages)	
I	0.0005	5.7	200	160	60,000
B	0.01	0.32	20	16	60,000
G	0.04	0.32	2	1.6	60,000
J	0.3	0.005	0.64	1.6	20,000

anticipated noise. Customarily, several recordings are obtained in each frequency band at different times of the day, because noise and signal are both variable and largely unpredictable.

DATA ANALYSIS

The purpose of data analysis is to extract reliable values of impedances, apparent resistivities, and the other earth response functions (ERF) from the field records, and to present them in a form convenient for interpretation. Operationally, data analysis consists of (a) manual editing of records to reject those judged to be contaminated by noise; (b) computer manipulation of tape-recorded data to transform all records into the frequency domain, to derive the ERF which are used for interpretations, to screen each value computed, and to plot in a form convenient for interpretation the values which pass the screening; and (c) manual evaluation of the results to reject suspect data and to attempt to extract useful portions of previously rejected data when necessary.

The first phase, manual editing, involves the examination of both recording log books and chart records for evidence the artificial or wind noise is large enough to downgrade a record. Records degraded by noise are not used if their use can be avoided, although it is sometimes necessary to reconsider using their quieter parts when insufficient quiet data exist.

A minimum of 8 data sets (each 2048 points long) per band are picked for processing. Each data set has its mean removed and then is tapered by a cosine bell so that harmonics as low as the second might be used. Then a FFT (Fast Fourier Transform) is performed and the resulting Fourier coefficients are used to compute power spectra. All power spectra in a band are then averaged.

It is helpful at this point to describe a few of the properties of the ERF, in order to explain some of the procedures which are used in data analysis. In two-dimensional structures when neither of the coordinate axes is along strike, all four elements of the impedance tensor Z_{ij} are nonzero and have different values. Magnetic field components in the x direction give rise to some currents along x , in addition to the y -directed currents, which would be the only ones if the earth were uniform or horizontally layered. Magnetic y components are likewise associated with both E_x and E_y , so that Z_{xx} , Z_{xy} , Z_{yx} , and Z_{yy} will all have some finite values. Now if the coordinate axes are rotated (either physically or by computation) until one of them is along strike, then currents due to H_x can no longer be deflected into the x direction and those due to H_y flow only in the x direction. In this situation, Z_{xx} and Z_{yy} must be zero. The other pair are nonzero and unequal,

since current densities will differ in the two directions, and the E components must also differ. If the coordinates are rotated a further 90 degrees, the same situation is found, except that the Z values are interchanged. Some of the other properties of the impedance elements are not so apparent. One of these is that

$$Z_{xx} = -Z_{yy} \quad (6)$$

regardless of the angle between the coordinate axes and strike. Equation (6) was also found by computation to be valid for an arbitrary number of horizontal layers, each of which is arbitrarily anisotropic. Another important property is that

$$Z_{xy} - Z_{yx} = \text{constant}$$

at all orientations.

In three-dimensional structures, the tensor elements are still well behaved, according to Sims and Bostick (1969). By plausibility arguments, they arrived at

$$Z_{xx} + Z_{yy} = \text{constant}$$

and

$$Z_{xy} - Z_{yx} = \text{constant.}$$

The Z_{ij} are first found from the transformed data by solving Equations (4) and (5) (see The Theory of the Magnetotelluric Method). This involves using two equations in four unknowns. The apparent discrepancy is resolved by taking advantage of the facts that the Z_{ij} change very slowly with frequency and can therefore be computed at far fewer frequencies than there are transform values. That is, the Z_{ij} are calculated as averages over frequency bands with each band including many points of the transform. There are six different ways of computing each of the four tensor components (Word and others, 1970; Sims and others, 1971; Vozoff, 1971). Two of the expressions tend to be relatively unstable for the one-dimensional earth, particularly when the incident fields are unpolarized. Another pair of the expressions are biased down by random noise on H and are not biased by random noise on E, while the remaining two are biased up by random noise on H. The six expressions are computed and checked to see if they are stable and fit a two-dimensional structure. The ones which pass the tests are then averaged and used to compute the impedance tensor.

Once the Z_{ij} have been found in the original (x,y,z) coordinate system, they can be rotated to any other system (x',y',z') by an angle θ in the clockwise direction. The principal axes of Z are the values of θ at which Z'_{xy} and

Z'_{yx} take on their largest and smallest values, respectively. One way of finding these directions is to compute Z for many values of θ and interpolate to find maxima and minima. It is preferable to use an analytical technique if possible, to reduce computation. However, the only such technique which has thus far been developed does not directly maximize either $Z'_{xy}(\theta)$ or $Z'_{yx}(\theta)$. Instead it solves for the angle θ_0 at which

$$|Z'_{xy}(\theta_0)|^2 + |Z'_{yz}(\theta_0)|^2 = \text{maximum.}$$

Setting the derivative with respect to θ of this sum equal to zero gives (Swift, 1967)

$$\tan 4\theta = \frac{(Z_{xx} - Z_{yy})(Z_{xy} + Z_{yz})^* + (Z_{xx} + Z_{yy})^*(Z_{xy} - Z_{yz})}{|Z_{xx} - Z_{yy}|^2 - |Z_{xy} + Z_{yz}|^2}.$$

This same value of θ_0 also satisfies

$$|Z'_{xx}(\theta_0)|^2 + |Z'_{yy}(\theta_0)|^2 = \text{minimum,}$$

so that in the case of two-dimensional structures the scheme finds the true principal axes. In the three-dimensional case, the method picks a slightly more general maximum, i. e.,

$$|Z'_{xy}(\theta) + Z'_{yz}(\theta)| = \text{maximum}$$

(Sims and Bostick, 1969). The results are seldom shown as impedance values. Instead, the Z'_{ij} are converted to apparent resistivities ρ' , with

$$\rho'_{ij} = \frac{1}{5f} |Z'_{ij}|^2.$$

Apparent resistivity has the phase of Z'_{ij} , that is, the phase difference between E_i and H_j .

Four different Z'_{ij} are extracted at each frequency: Z'_{xx} , Z'_{xy} , Z'_{yx} , and Z'_{yy} . The main purpose of analysis and plotting is to permit interpretation, which is now practically possible only for two-dimensional structures. Hence, only ρ'_{xy} and ρ'_{yx} are routinely plotted, since they are the only two which appear in two-dimensional models.

As noted above, both $(Z_{xx} + Z_{yy})$ and $(Z_{xy} - Z_{yx})$ are independent of θ , as is their ratio. The magnitude of the complex ratio of these quantities is called skewness,

$$S = \frac{|Z_{xx} + Z_{yy}|}{|Z_{xy} - Z_{yx}|}.$$

If S is large, structure at the site must appear to be three-dimensional in that frequency range.

The multiple coherence values are a result of analyzing the MT problem as a multiple input single output linear system. In particular it is a measure of the correlation between an electric field measured and one predicted by the radial magnetic fields.

There are two multiple coherence values corresponding to the different electric fields. The functions are computed from the power spectra according to the following formula

$$(MCE_x)^2 = \frac{H_y H_y^* |H_x E_x^*|^2 H_x H_x^* |H_y E_x^*|^2 - 2 \operatorname{Re}(H_x H_y^* H_y E_x^* E_x H_x^*)}{E_x E_x^* (H_x H_x^* H_y H_y^* - |H_x H_y^*|^2)}$$

A similar expression exists for the E_y function by substituting E_y for E_x above. (Reddy and Rankin, 1974).

The other ERF are designed to use the vertical magnetic component H_z to help determine which of the two principal impedance axes is the strike direction. At the same time, the remaining ERF aid the interpreter in understanding the cause of apparent anisotropy, point out distant lateral conductivity changes, and often provide additional warning when three-dimensional structural conditions occur.

From the field data, we want to find the horizontal direction in which the magnetic field is most highly coherent with H_z . In two-dimensional structures, that direction will be constant and perpendicular to strike.

The procedure, due to T. R. Madden (1968, unpublished), is to assume that H_z is linearly related to H_x and H_y and to write at each frequency

$$H_z = AH_x + BH_y,$$

where A and B are unknown complex coefficients.

Using a least-squares derivation, we can solve for A and B. This pair of coefficients can be thought of as operating on the horizontal magnetic field and tipping part of it into the vertical. For that reason, (A and B) is called the "tipper". Its magnitude in each frequency band,

$$\begin{aligned} |T| &= \{|A|^2 + |B|^2\}^{1/2} \\ &= (A_r^2 + A_i^2 + B_r^2 + B_i^2)^{1/2}, \end{aligned}$$

shows the relative strength of H_z . For a two-dimensional structure striking in the direction ($\phi \pm 90$) degrees from x, the tipper strike ϕ can be determined by a natural extension of the tensor rotation method, proposed by Sims

and Bostick (1969). Here ϕ is chosen to maximize

$$|A'|^2 = |A \cos \phi + B \sin \phi|^2,$$

and is denoted ϕ_2 .

We find the necessary condition to be

$$\tan(2\phi_2) = \frac{2(a_r b_r + a_i b_i)}{(a_r^2 + a_i^2) - (b_r^2 + b_i^2)}.$$

If we use the Fortran function ATAN, so that -90 degrees $\leq 2\phi_2 \leq 90$ degrees, then $|A'|^2$ is a maximum if $(a_r^2 + a_i^2) \geq (b_r^2 + b_i^2)$, and $|A'|^2$ is a minimum if $(a_r^2 + a_i^2) \leq (b_r^2 + b_i^2)$. If $|A'|^2$ is minimum, we need to add 180 degrees to $2\phi_2$. In either case, the final angle ϕ_2 is determined to within 180 degrees. A definite choice for ϕ_2 is made by taking ϕ_2 as the angle for which the phase of A' is in the range $(-90 \text{ degrees}, 90 \text{ degrees})$.

A single site recording is subject to biasing by noise on any of the measured fields. The recording of a remote pair of H-fields can be used to minimize uncorrelated noise. If we denote the remote channels by H_x^{R*} and H_y^{R*} and multiply through Equation (4), we have

$$\begin{aligned} \overline{E_x H_x^{R*}} &= Z_{xx} \overline{H_x H_x^{R*}} + Z_{xy} \overline{H_y H_x^{R*}} \\ \overline{E_x H_y^{R*}} &= Z_{xx} \overline{H_x H_y^{R*}} + Z_{xy} \overline{H_y H_y^{R*}} \end{aligned}$$

If we then solve simultaneously for Z_{xx} and Z_{xy} , we find

$$Z_{xx} = \frac{\overline{E_x H_x^{R*}} \overline{H_y H_y^{R*}} - \overline{E_x H_y^{R*}} \overline{H_y H_x^{R*}}}{D}$$

$$Z_{xy} = \frac{\overline{E_x H_y^{R*}} \overline{H_x H_x^{R*}} - \overline{E_x H_x^{R*}} \overline{H_x H_y^{R*}}}{D}$$

where $D = \overline{H_x H_x^{R*}} \overline{H_y H_y^{R*}} - \overline{H_x H_y^{R*}} \overline{H_y H_x^{R*}}$, and the bars denote averages. Similar treatment of Equation (5) yields estimates of Z_{yx} and Z_{yy} :

$$Z_{yx} = \frac{\overline{E_y H_x^{R*}} \overline{H_y H_y^{R*}} - \overline{E_y H_y^{R*}} \overline{H_y H_x^{R*}}}{D}$$

$$Z_{yy} = \frac{\overline{E_y H_y^{R*}} \overline{H_x H_x^{R*}} - \overline{E_y H_x^{R*}} \overline{H_x H_y^{R*}}}{D}$$

These solutions for the impedance elements contain no autopowers and include only crosspowers between the base and the remote station. The impedance estimate will then be unbiased by noise, provided the noise is uncorrelated. (Goubau and others, 1978)

Acquisition of the remote pair of H-fields is accomplished by use of two complete recording systems operating simultaneously. Time correlation is provided by recording clock signals synchronized to WWVB (see fig. 3).

INTERPRETATION

Probably the single most important step in MT interpretation is the systematic examination of the apparent resistivity verses frequency data for the survey area (Appendix B₁). This step, roughly equivalent to the familiar seismic "brute stack", yields (a) the approximate vertical sequence of resistive and conductive units, (b) approximate location of faults and structural trends, and (c), most important, the structural complexity as evidenced in the data, which will indicate which modeling route to take for the continuation of the interpretation. The above procedures involve examining all of the MT data with an eye to the interrelation between sites, as impressions gained from an individual site by itself or even a single profile may be misleading. It is most important to identify evidence of strong two and three-dimensional effects. While one is usually forewarned by preliminary geologic and regional geophysical (gravity, magnetics) studies, frequently the MT data will exhibit unanticipated effects. The qualitative examination step identifies these effects, and leads to the determination of the appropriate modeling procedures.

The interpretation of MT data as currently practiced by most geophysicists active in the field relies heavily on one-dimensional inversions of the parallel to strike (TE) component of apparent resistivity. Two-dimensional models are used as an aid to interpretation but final resistivity and geologic sections are most frequently seen as contoured or "picked" sections with the one-dimensional (TE) inversions as the base. This technique is applicable in many instances, and excellent MT interpretations have been produced as a result. There are, however, important geologic structures where the TE based, one-dimensional inversion interpretation will be seriously in error.

To avoid this the interpreter must learn to recognize those situations where the procedure is inappropriate, and to have available alternate procedures to follow in order to arrive at a successful interpretation.

Table C shows electrical strike determined for each station. It is readily apparent that except for three stations, the strike is southeast or east-southeast which agrees well with the major structural trends in the area: the Furnace Creek Fault Zone, the Walker Lane Mobile Belt (Cornwall, 1972), the Las Vegas Shear Zone, and the Arrowhead Mine Fault. Of the exceptions, station 18 appears to be aligned with the caldera complexes between Bullfrog

TABLE C: Magnetotelluric strike directions

<u>Station</u>	<u>Electrical Strike</u>
U011	125°
U012	90°
U013	160°
U014	150°
U016	145°
U017	145°
U018	70°
U019	100°
U020	155°
U021	80°
U022	130°
U023	130°
U024	100°
U025	135°
U026	130°

Hills and Silent Canyon. Station 12, the second exception, is in the complexly faulted Spring Mountains. The third exception, station 21, is very close to a major lateral change in resistivity structure as will be discussed below.

The station density of this survey is too sparse by at least a factor of three for a cross section of any confidence, but the attempt was made as it was a requirement of the contract. Therefore, a north-northeast section was drawn between stations 14 and 16 (Plate 2). Using the Bostick (1977) continuous inversion in Appendix D as a first start, analytic discrete layer inversions using a program by Anderson (1978) were made for the seven stations on the profile. These inversions show a strong conductor below a depth of 3 to 5 km at stations 14, 19, 21, and 20. Between these four stations; stations 22 and 26 show a more moderate conductor below a depth of 13 to 30 km. Station 16 at the northern end of the profile shows no resistivities less than 100 ohm-m and is probably strongly effected by nearby 2 or 3-dimensional structures. Because this cross section clearly shows the strong two-dimensional character of the structure, it should only be used as a starting point for a two-dimensional analysis.

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Word, D.R., Smith H.W., and Bostick F.X., Jr., 1970, An investigation of the magnetotelluric tensor impedance method: EERL Tech. Rep. no. 82, Univ of Texas at Austin.

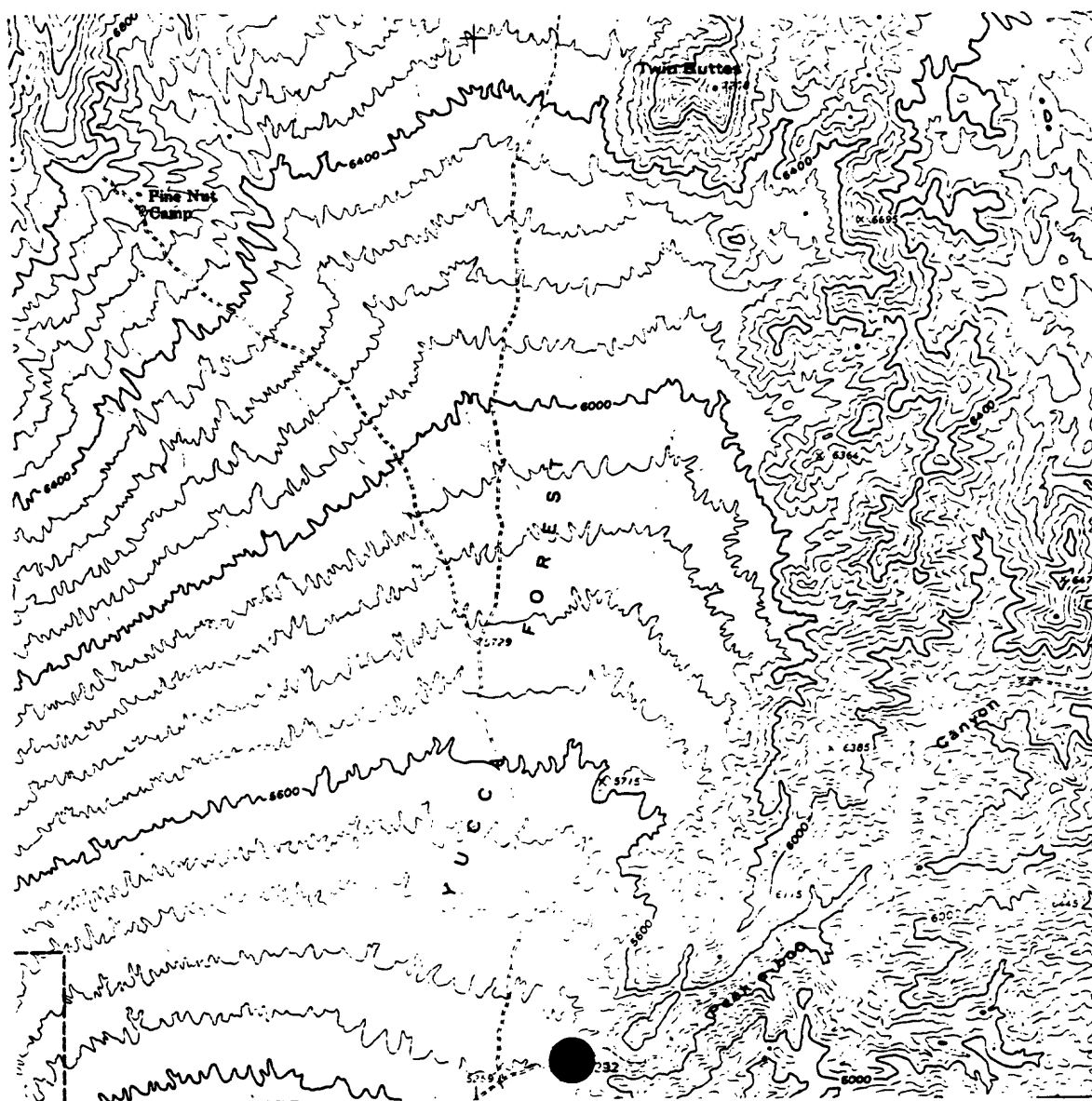
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Specific to this survey

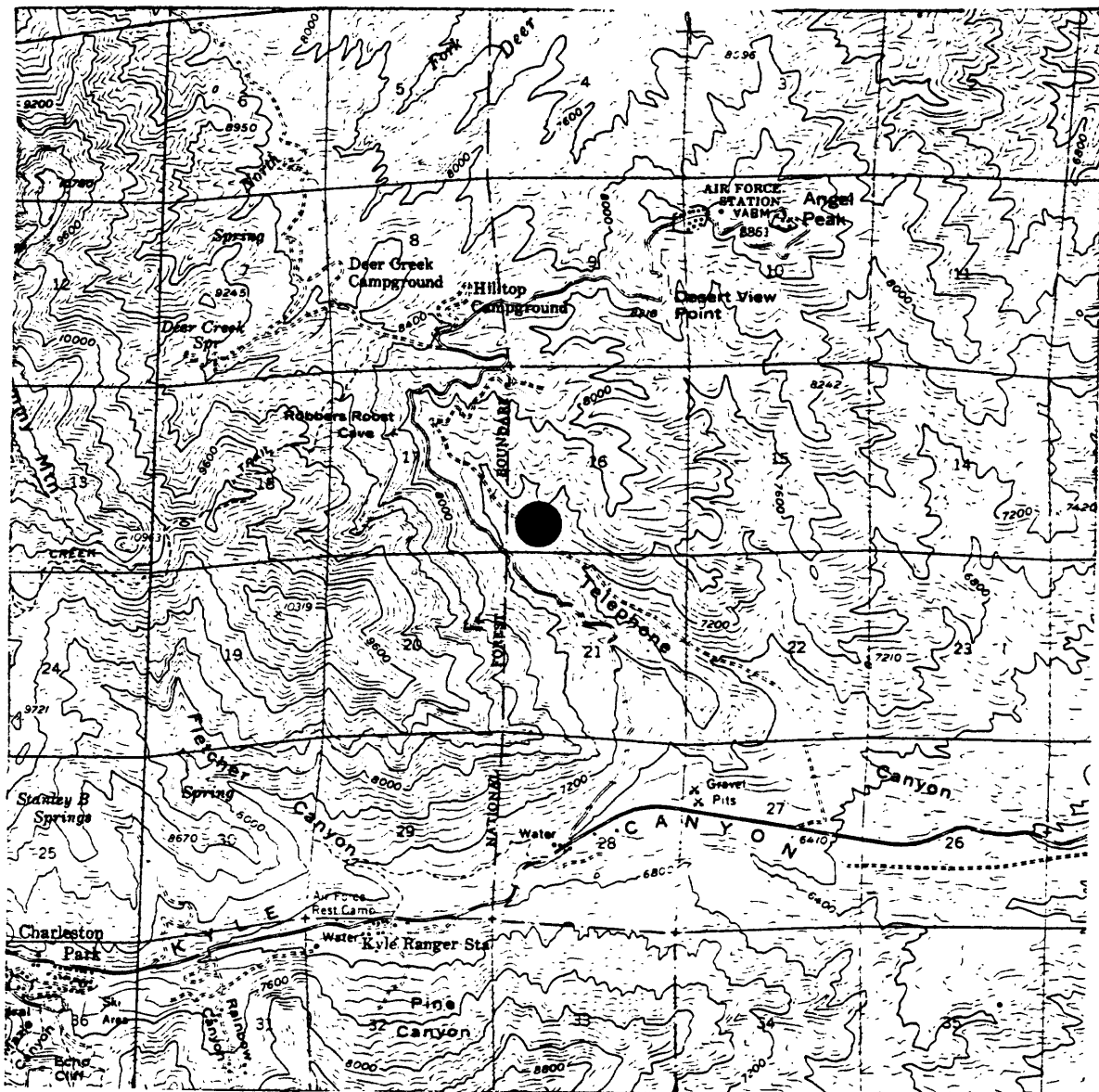
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APPENDIX A

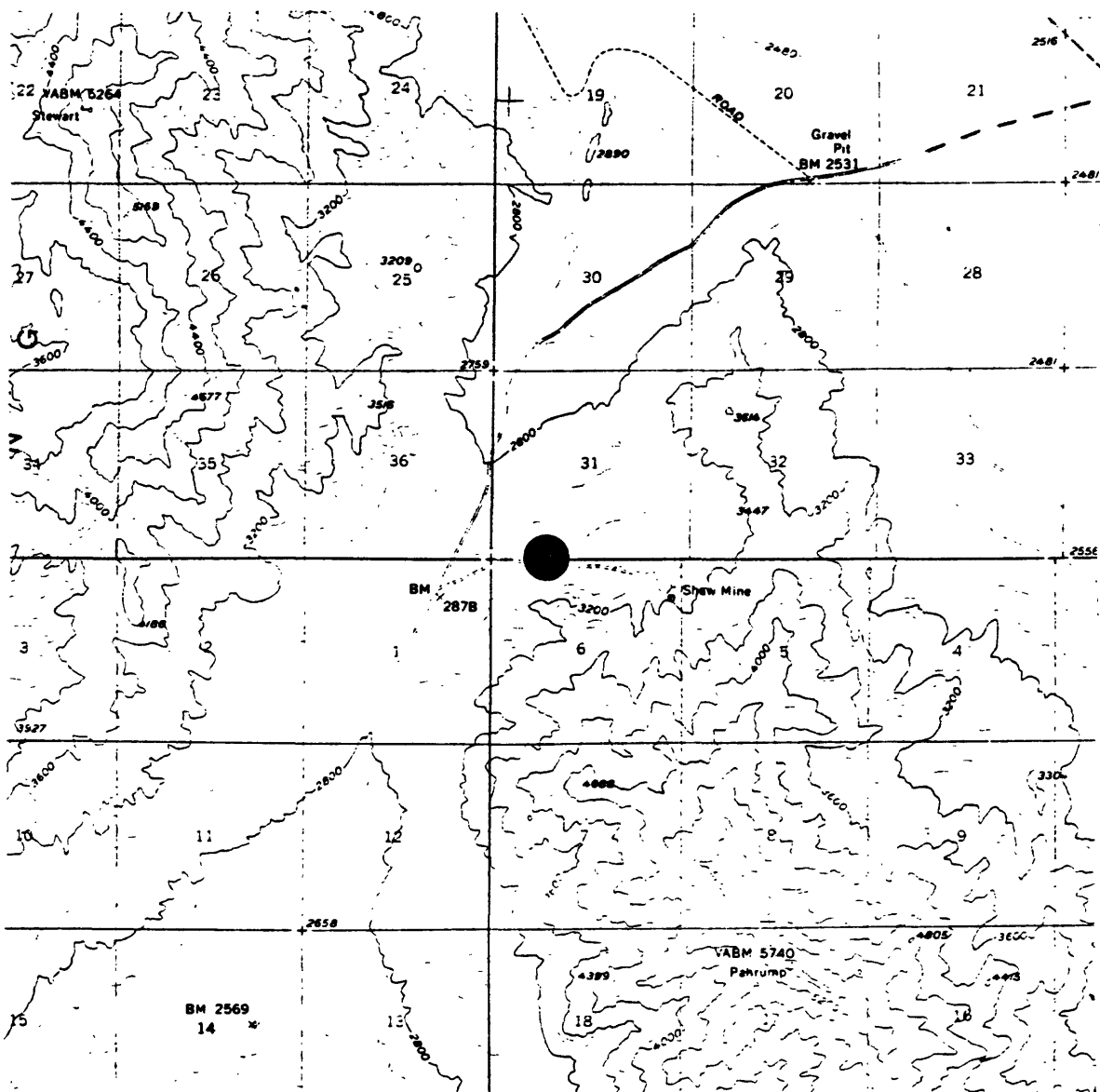
STATION LOCATIONS



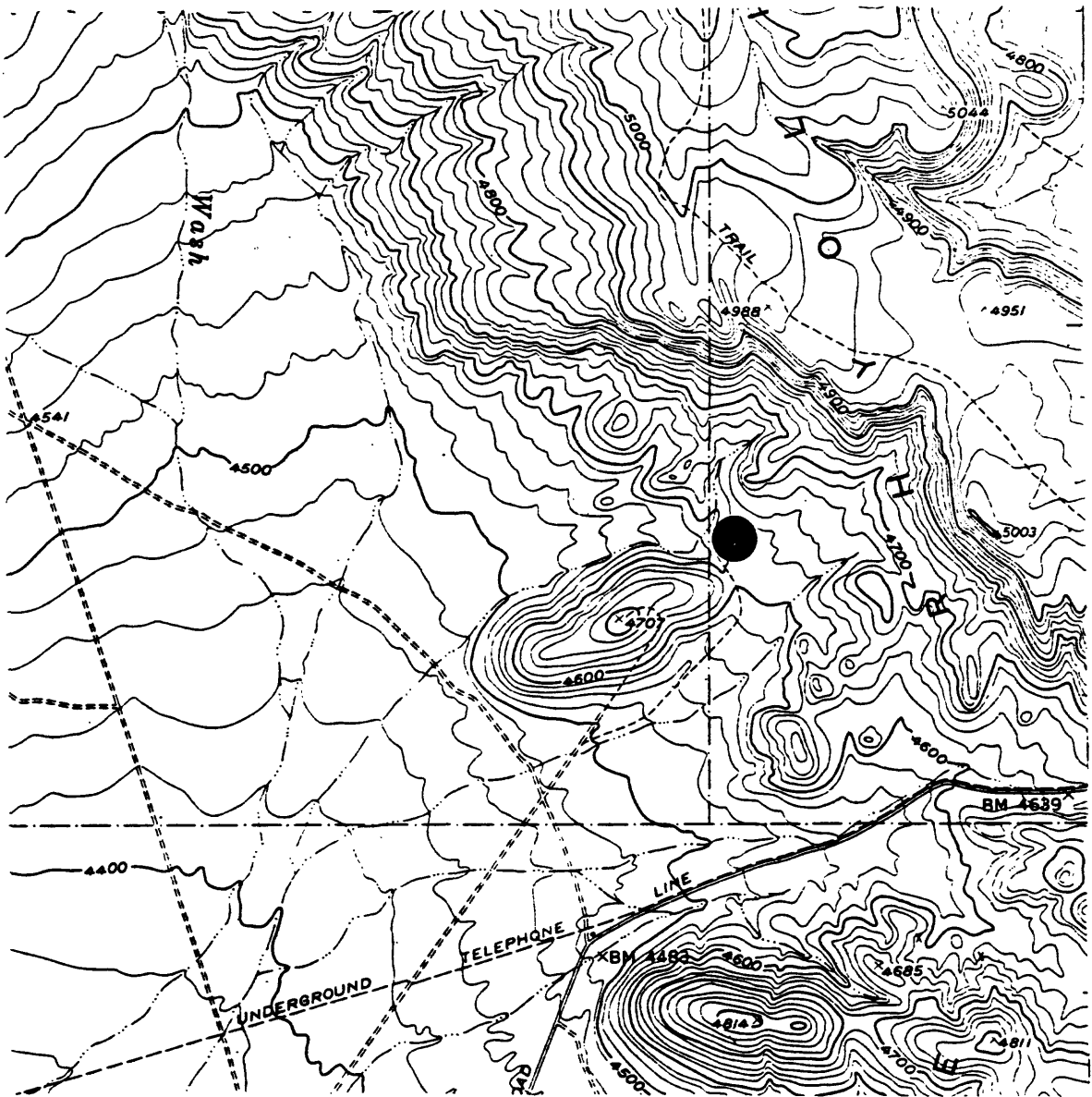
Station 11
Hayford Peak Quad.
Nevada
15 minute series
Section 4, T17S, R61E



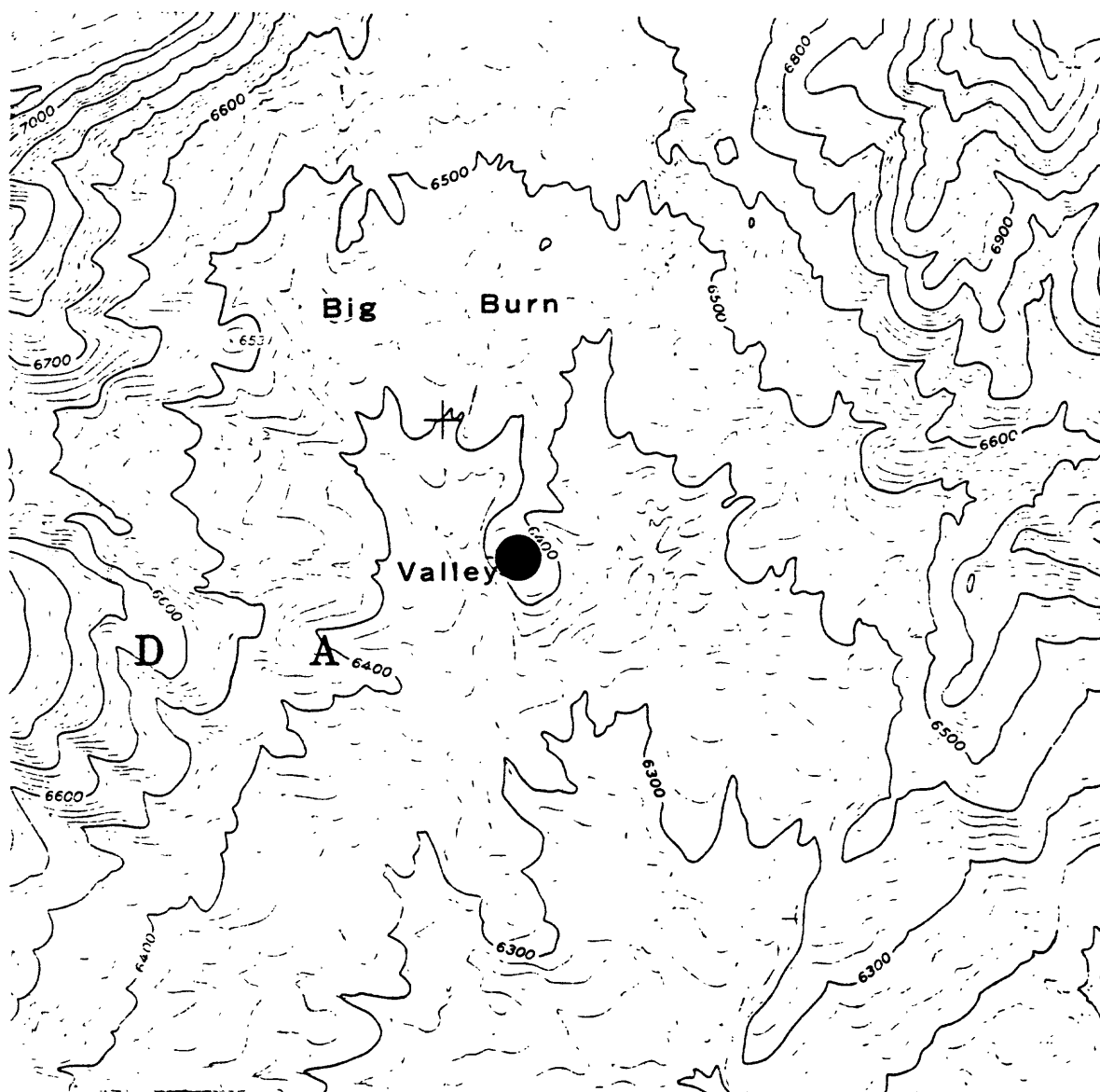
Station 12
 Charleston Peak Quad.
 Nevada
 15 minute series
 Section 16, T19S, R57E



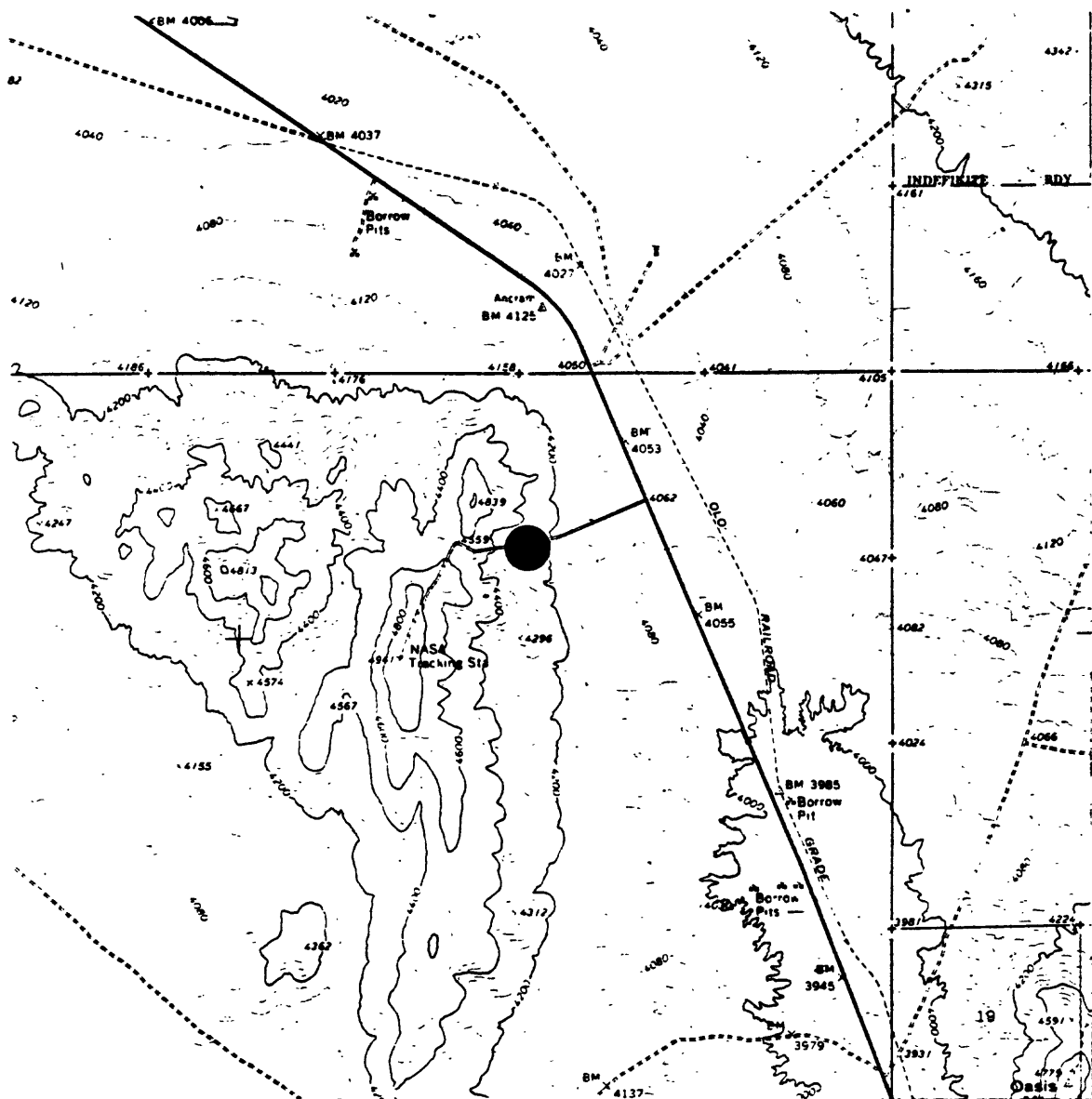
Station 13
 Stewart Valley Quad.
 California
 15 minute series
 Section 31, T24N, R8E



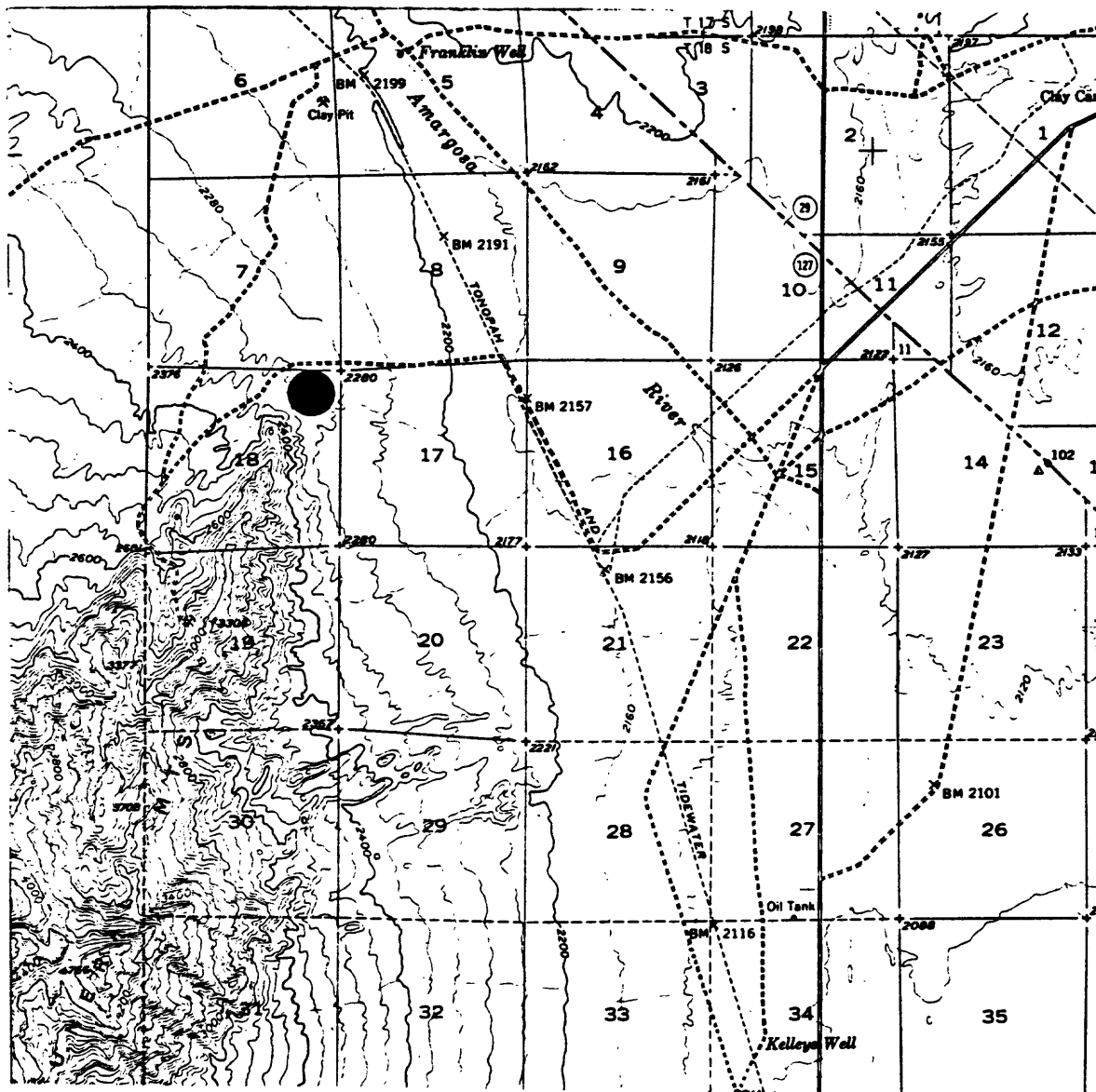
Station 16
Oak Spring Quad.
Nevada
7.5 minute series
Lat. $37^{\circ}12'17''$, Long. $116^{\circ}0'48''$



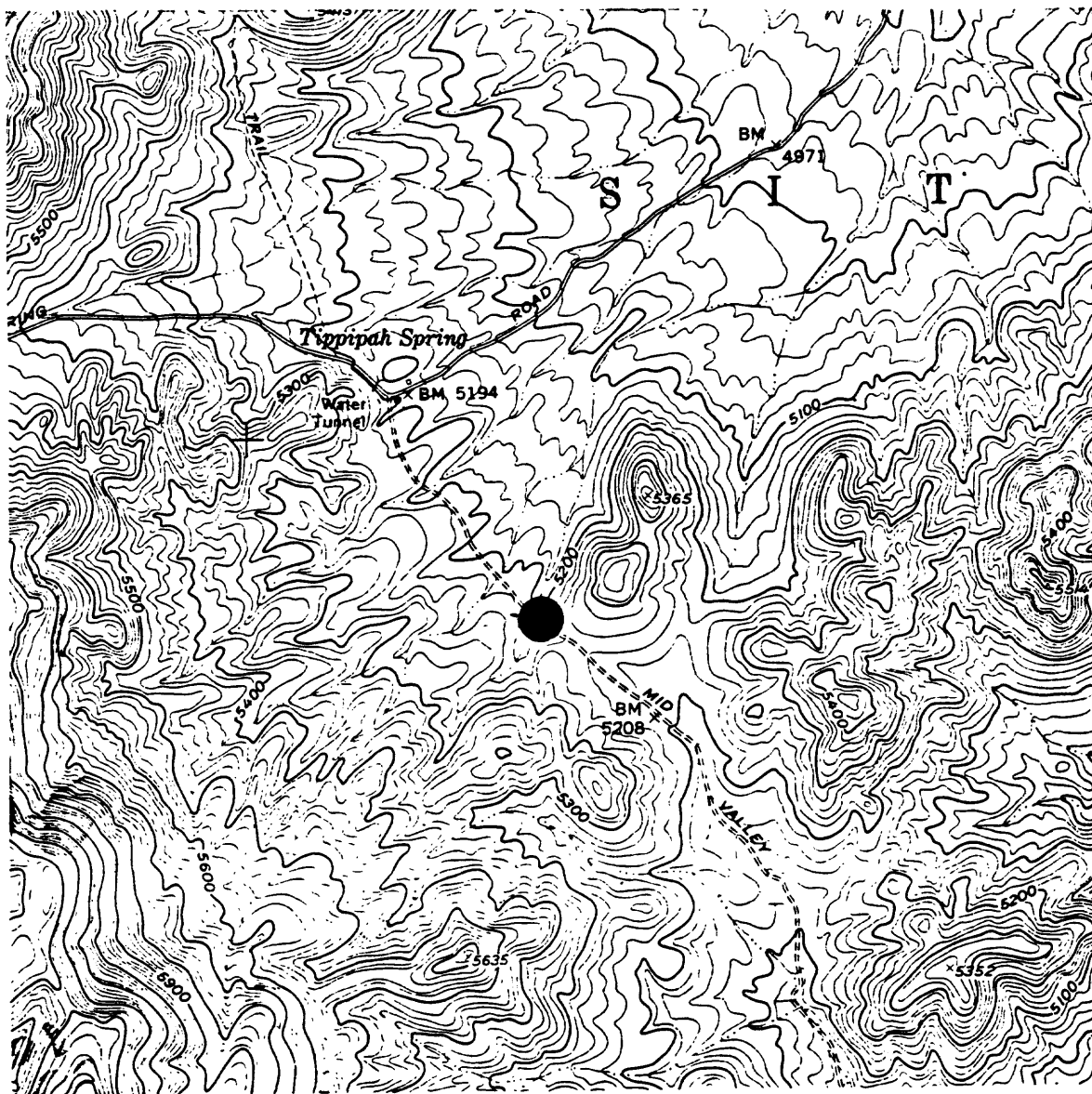
Station 17
Ammonia Tanks Quad.
Nevada
7.5 minute series
Lat. $37^{\circ}12'15''$, Long $116^{\circ}17'19''$



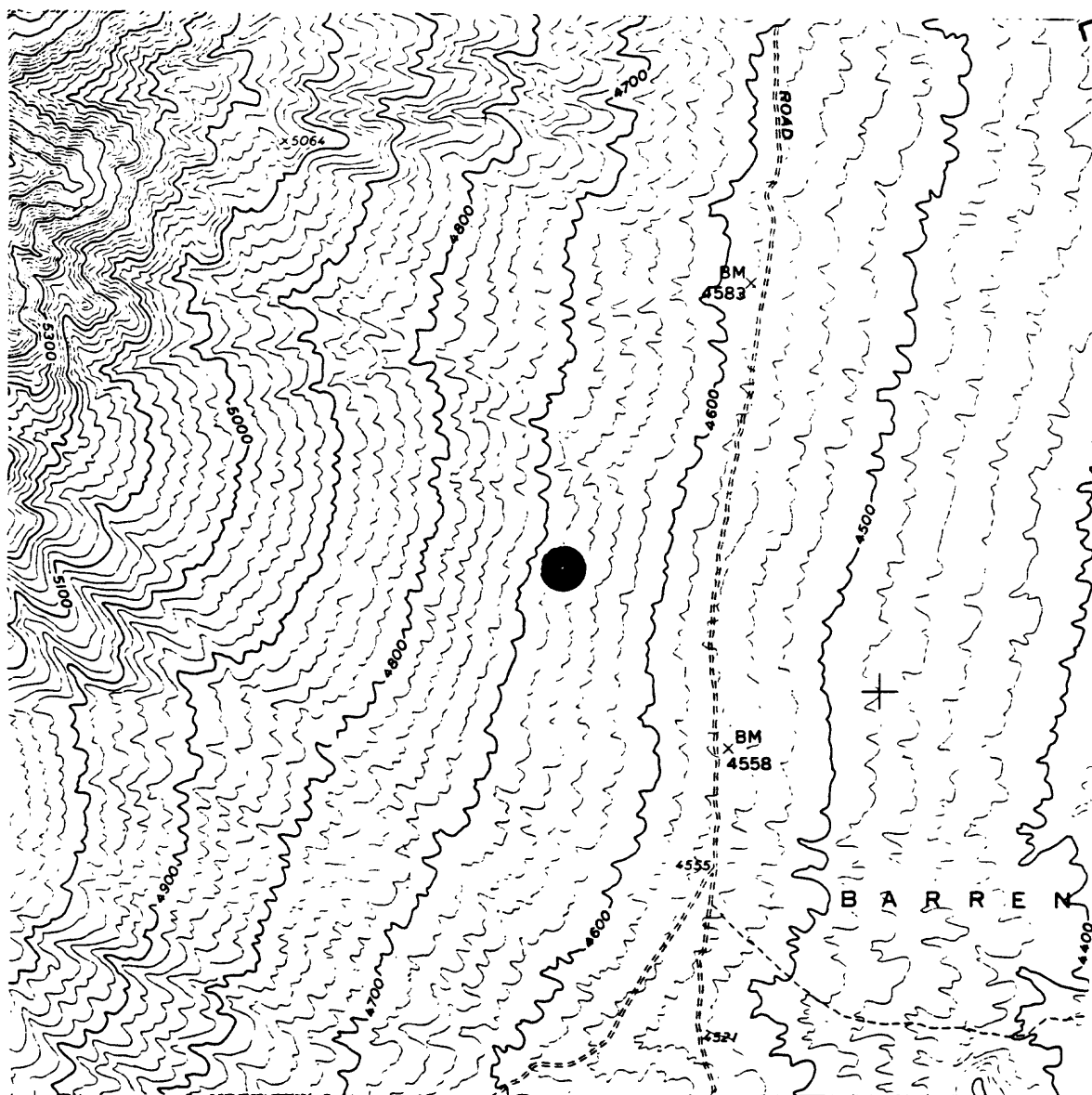
Station 18
 Springdale Quad.
 Nevada
 7.5 minute series
 Section 2, T10S, R46E



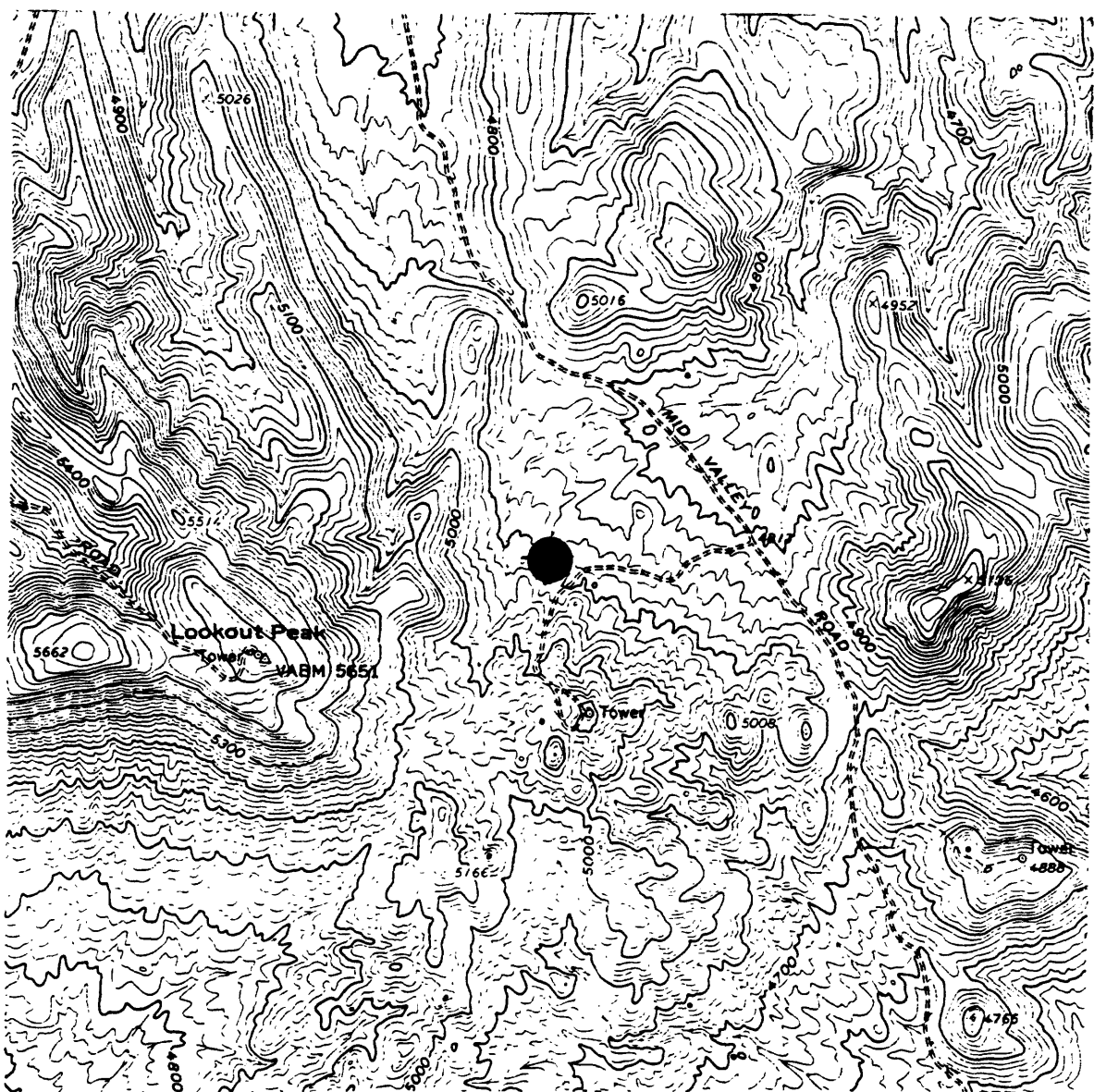
Station 19
 Ash Meadows Quad.
 California
 15 minute series
 Section 18, T26N, R5E



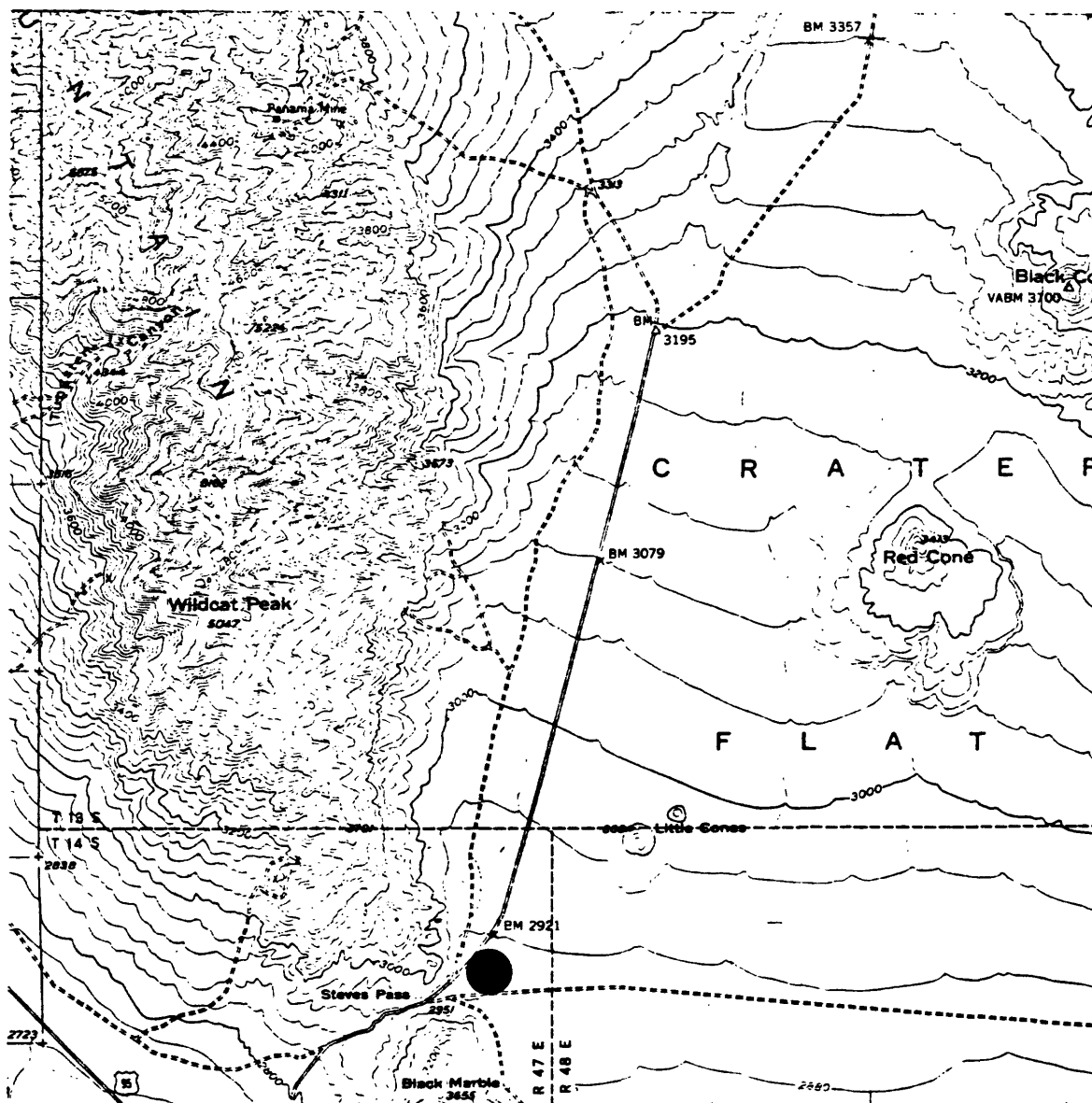
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Tippihah Spring Quad.
Nevada
7.5 minute series
Lat. 37°02'10", Long. 116°11'49"



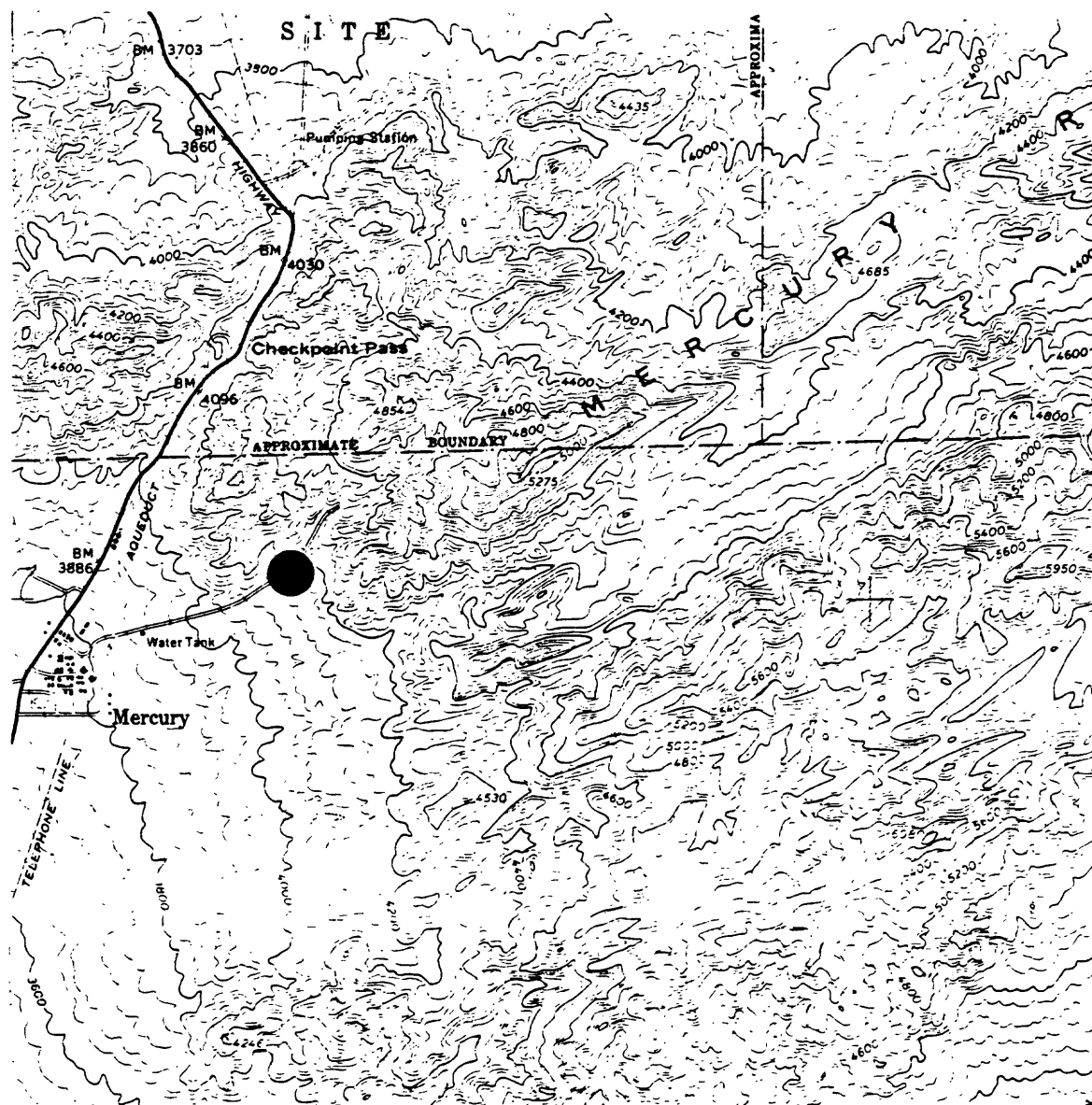
Station 21
Mine Mountain Quad.
Nevada
7.5 minute series
Lat. $36^{\circ}55'13''$, Long. $116^{\circ}10'43''$



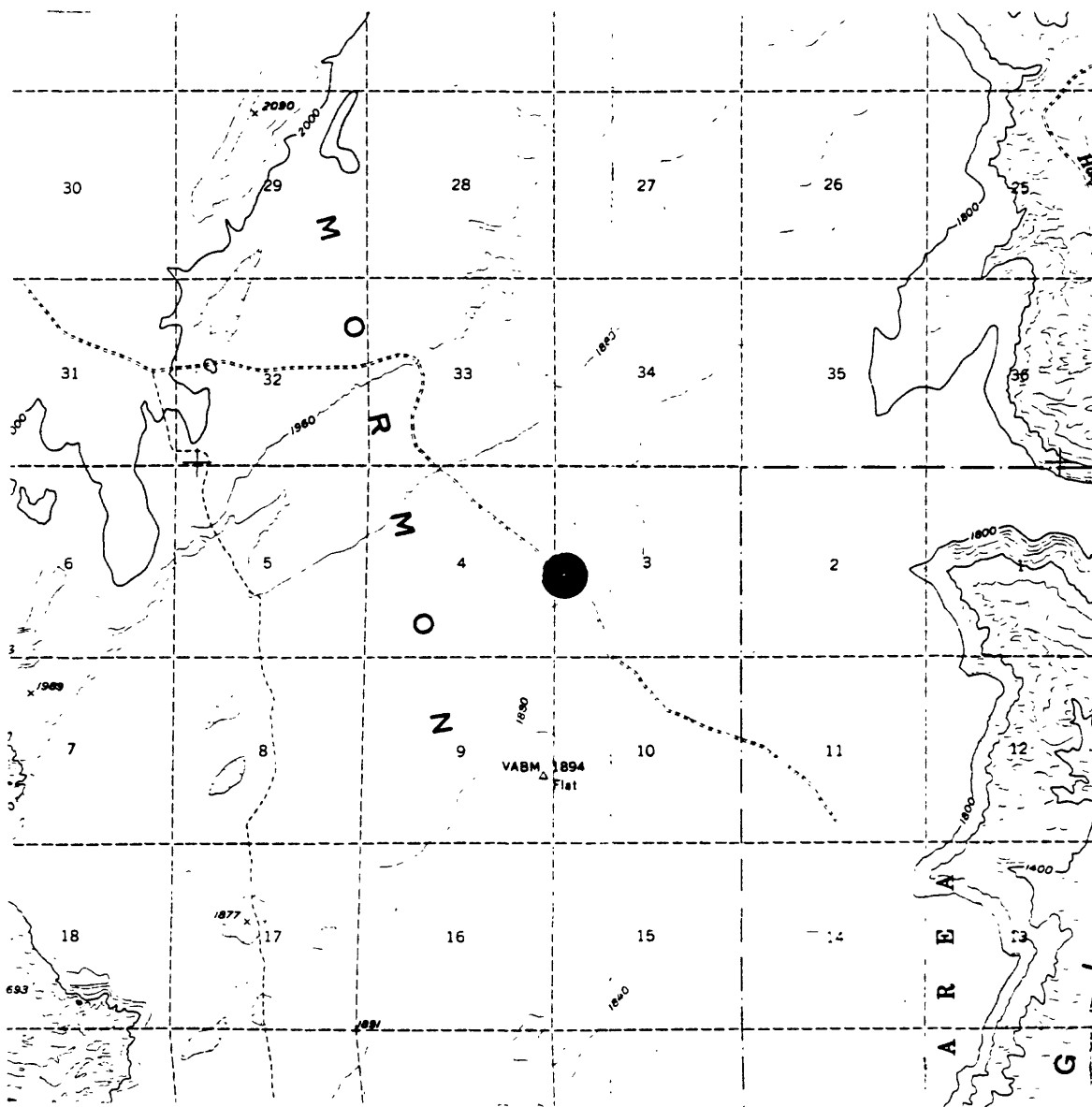
Station 22
Skull Mountain Quad.
Nevada
7.5 minute series
Lat. $36^{\circ}51'31''$, Long. $116^{\circ}09'22''$



Station 23
 Bare Mountain Quad.
 Nevada
 15 minute series
 Section 1, T14S, R47E



Station 24
Mercury Quad.
Nevada
15 minute series
Section 1, T15S, R53E

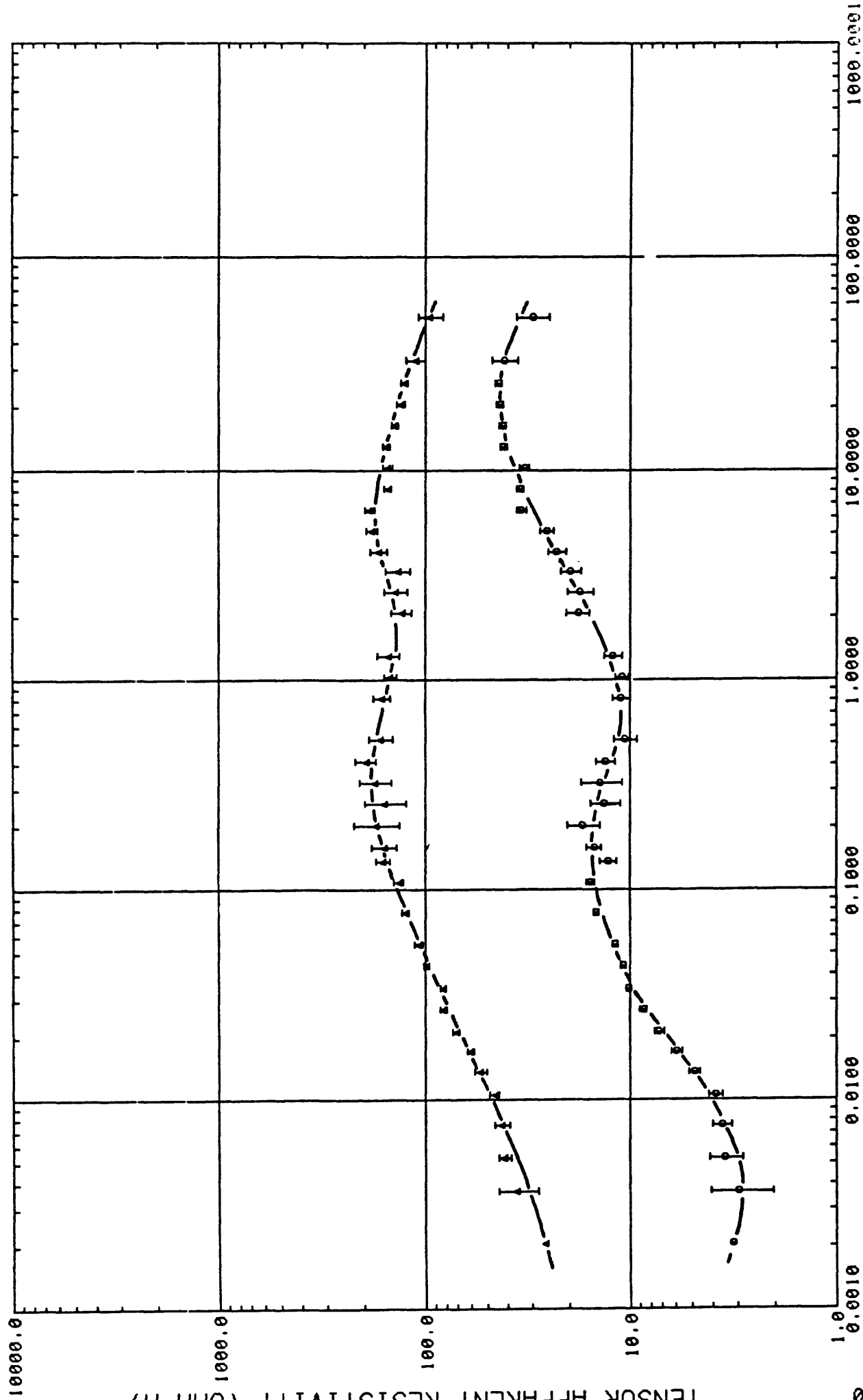


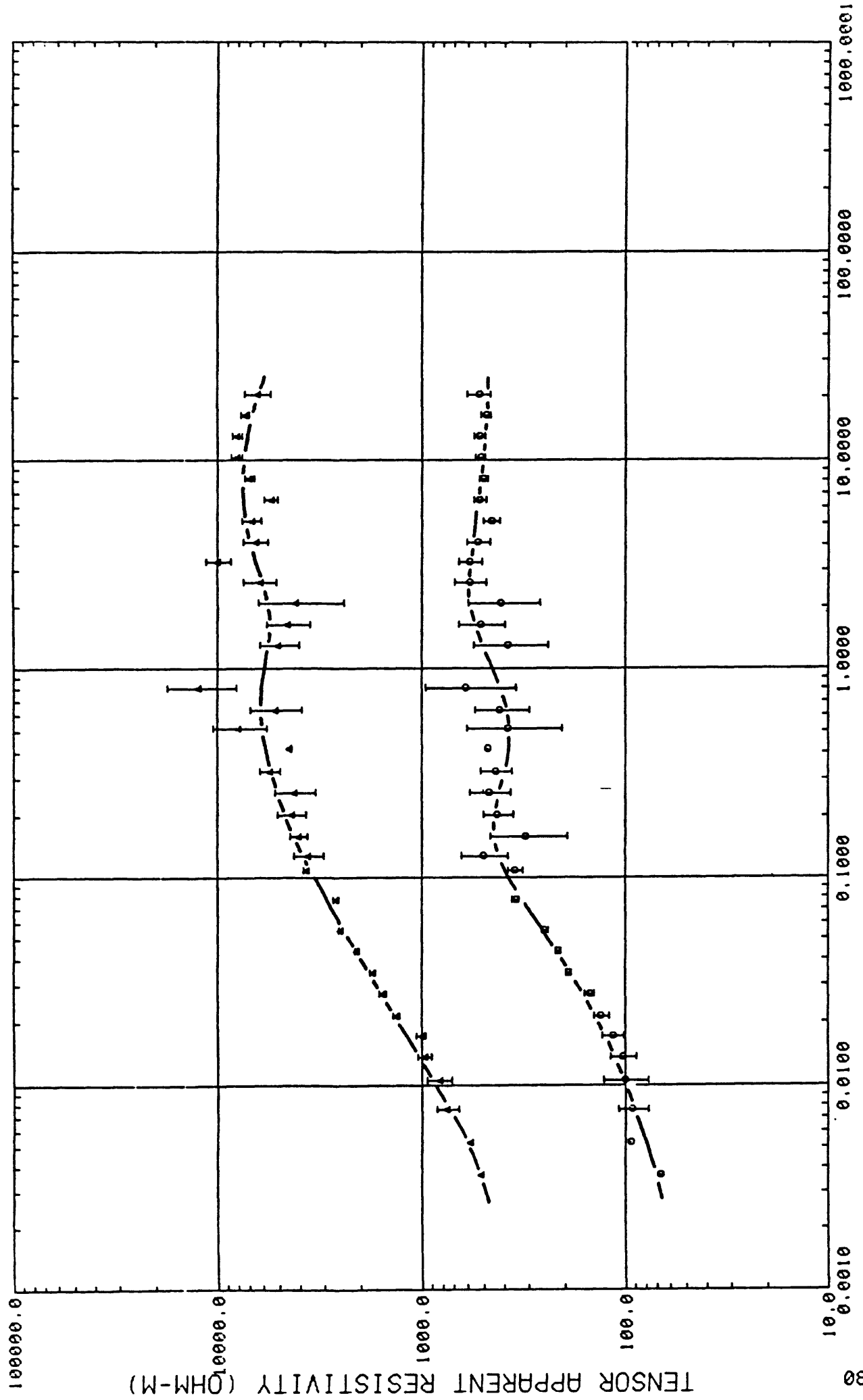
Station 27
 Overton Quad.
 Nevada
 15 minute series
 Section 3, T15S, R68E

APPENDIX B1

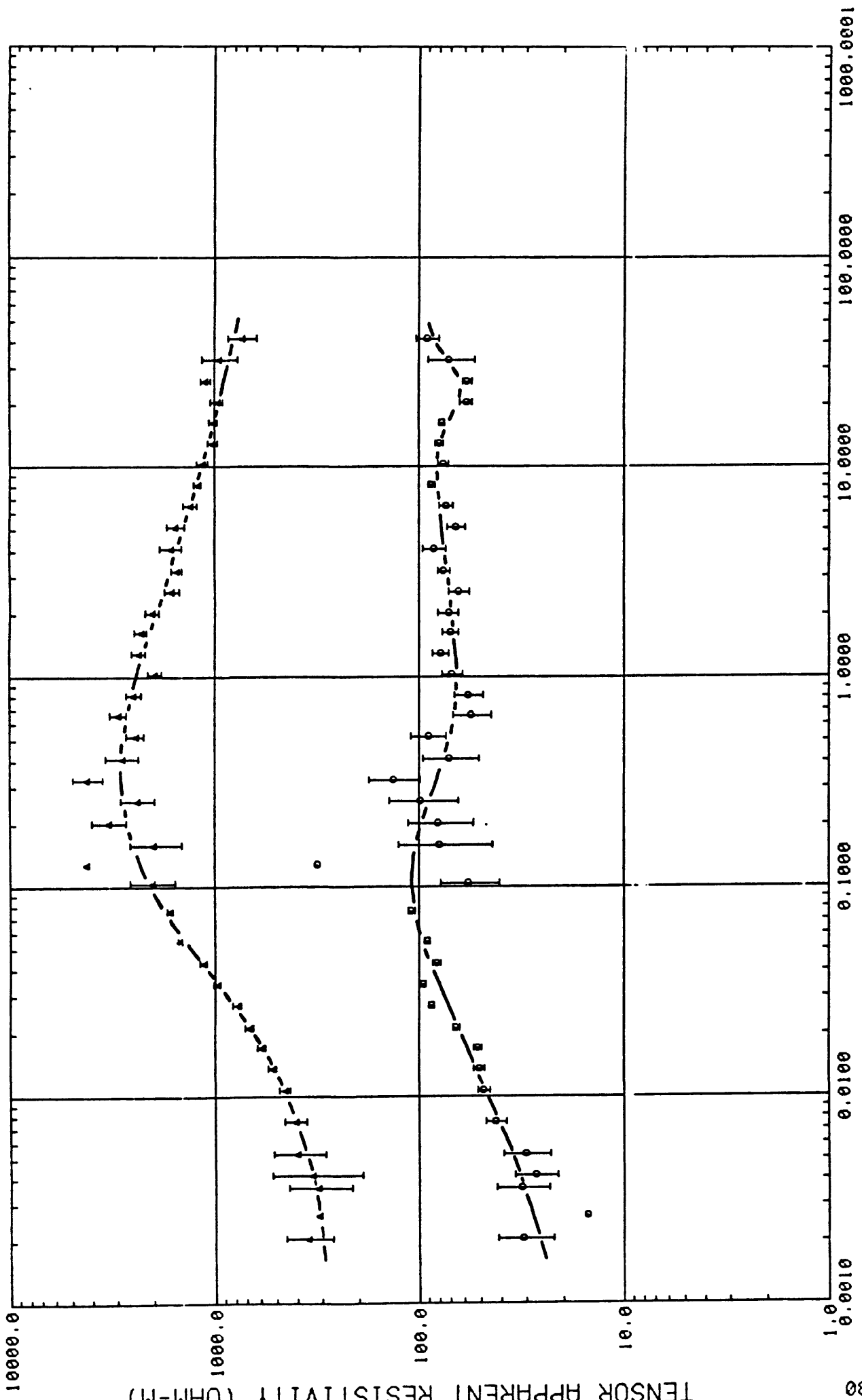
COMPUTER PLOTS OF DATA

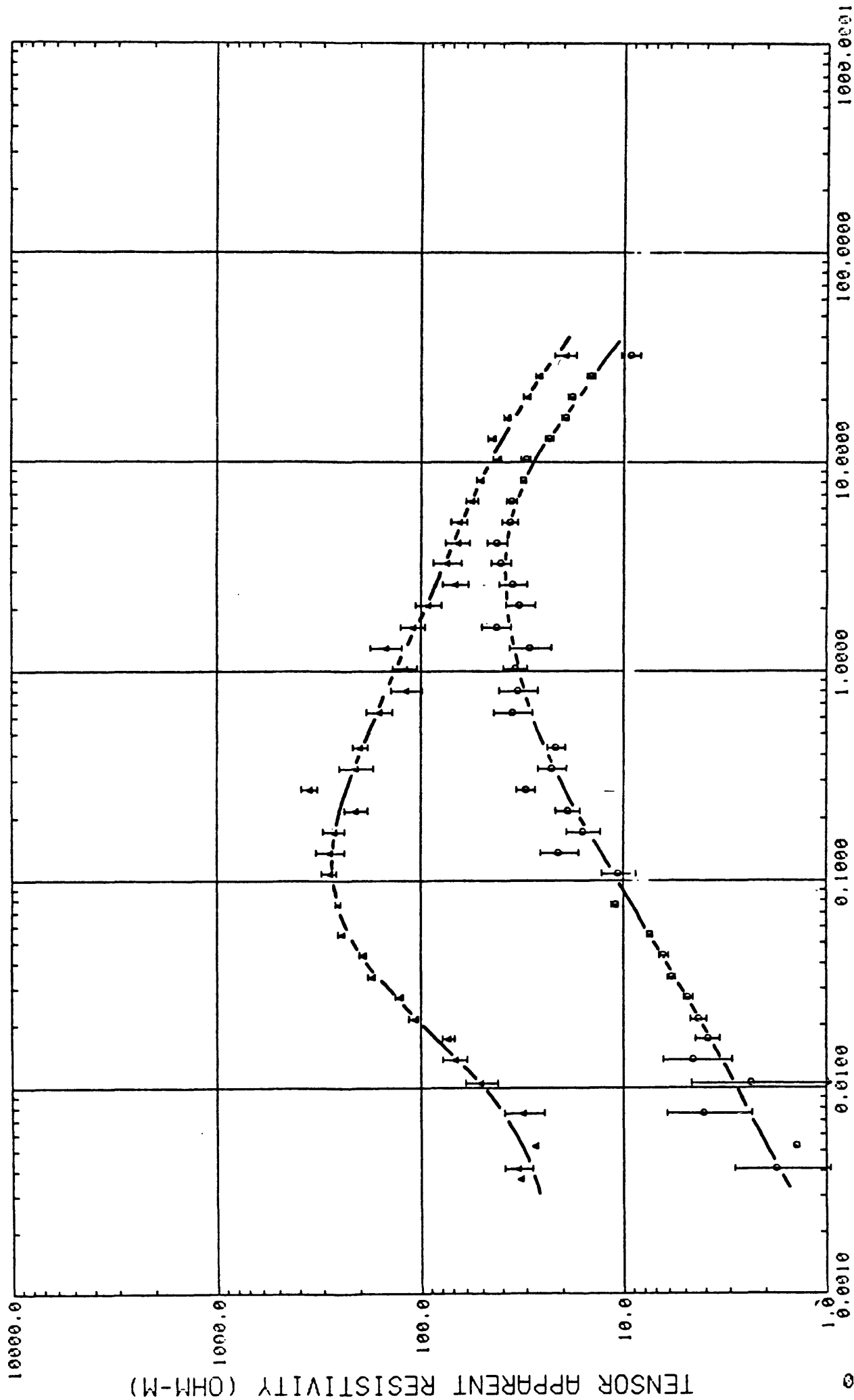
Tensor Apparent Resistivity

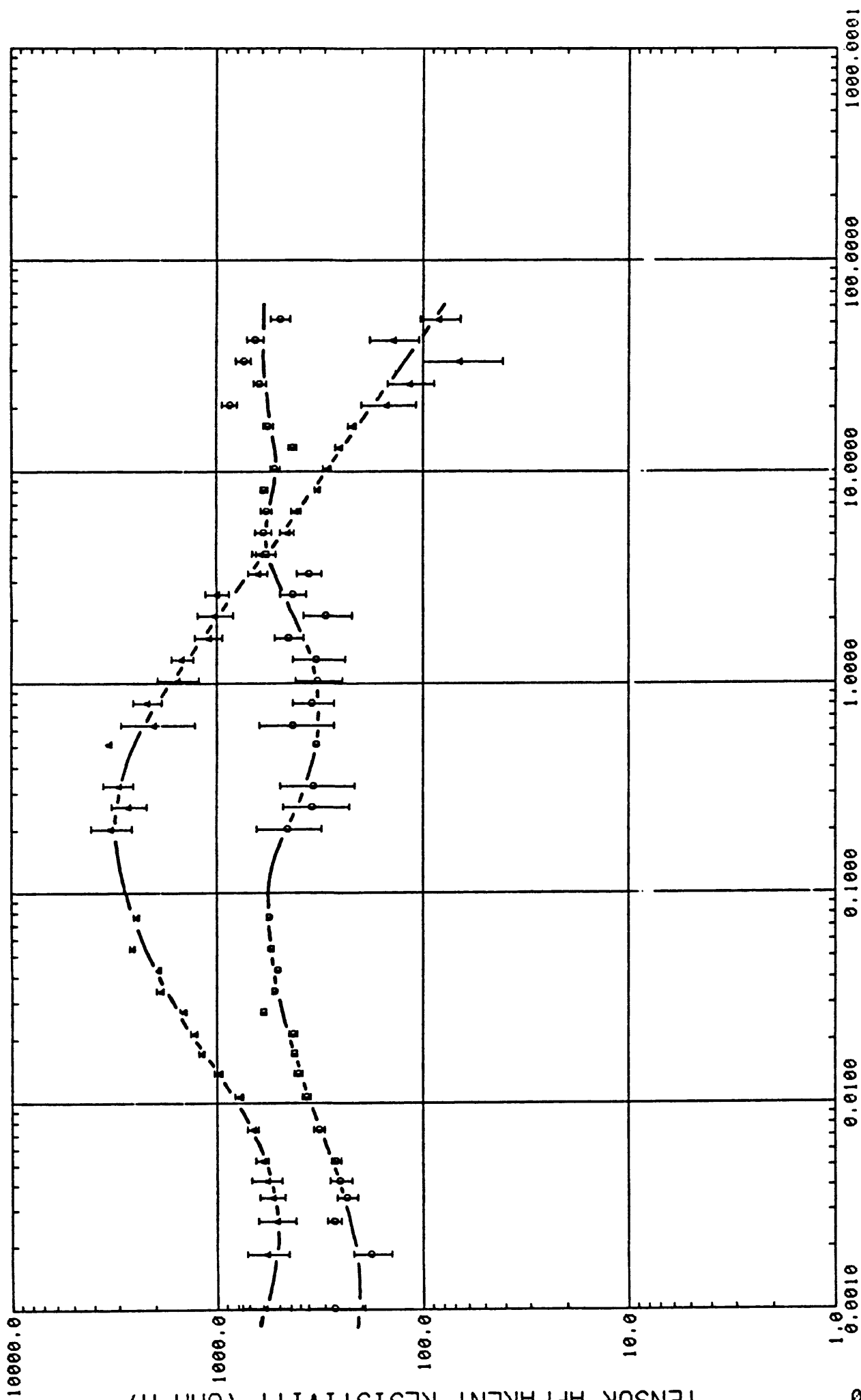




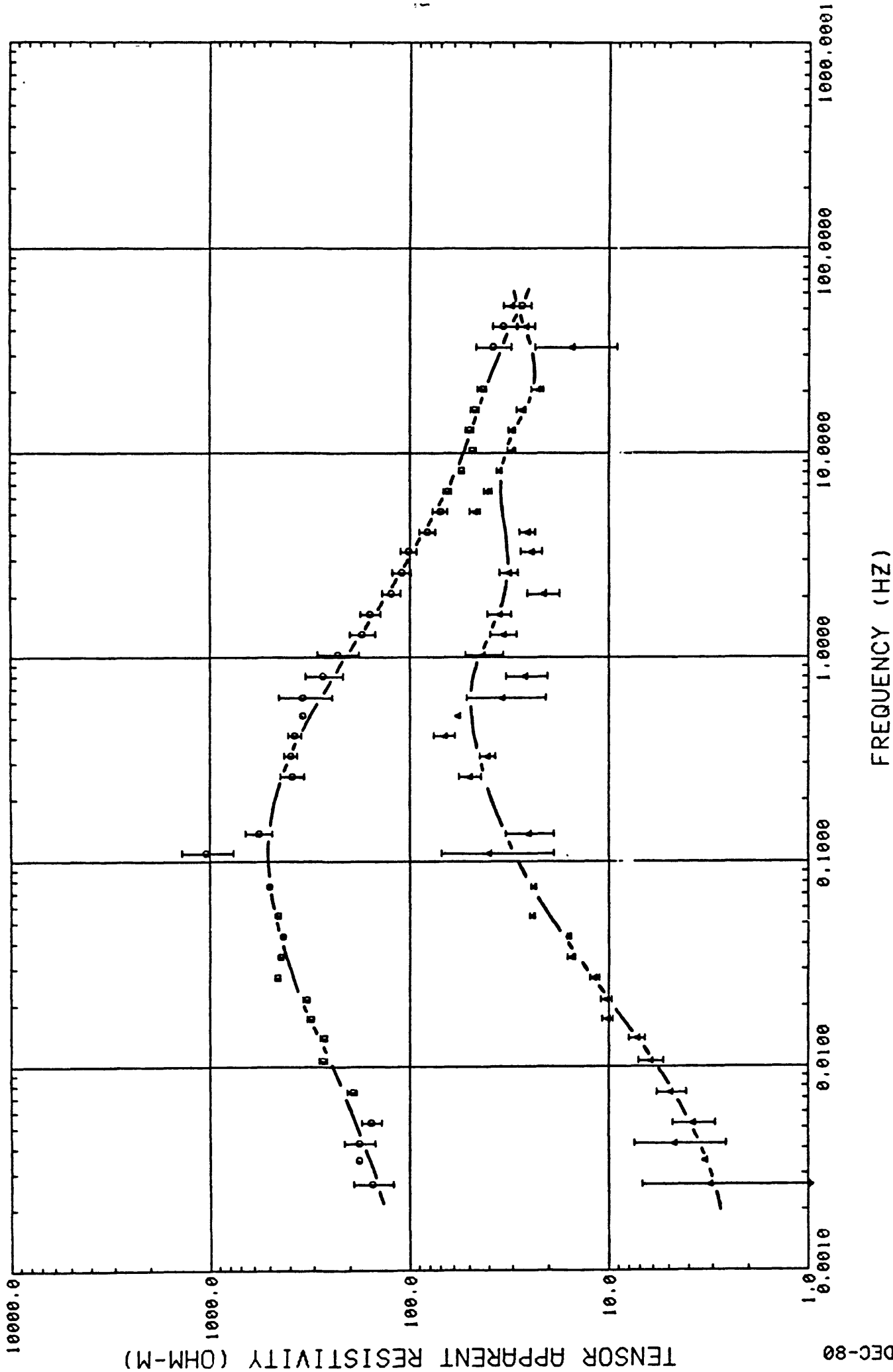
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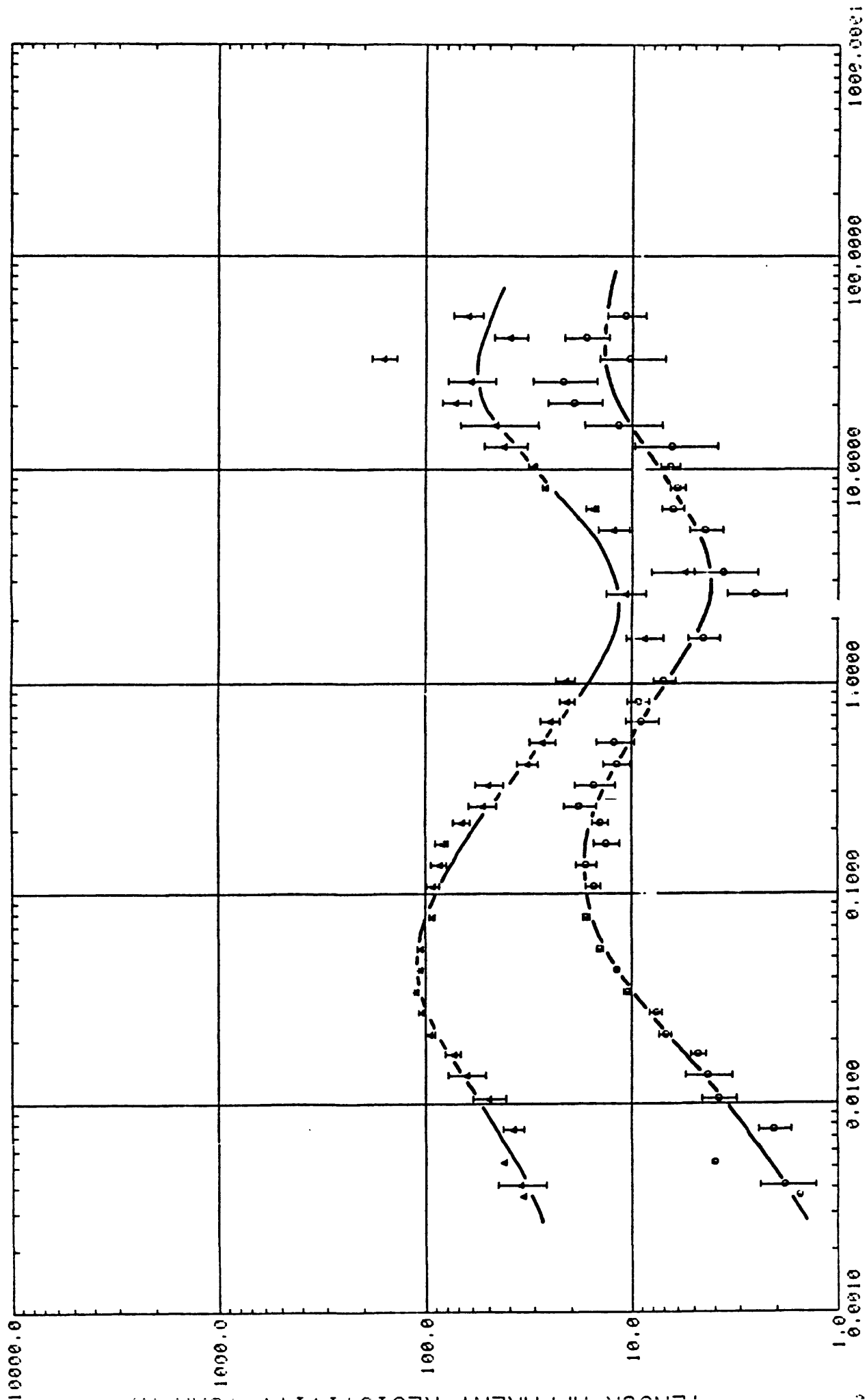




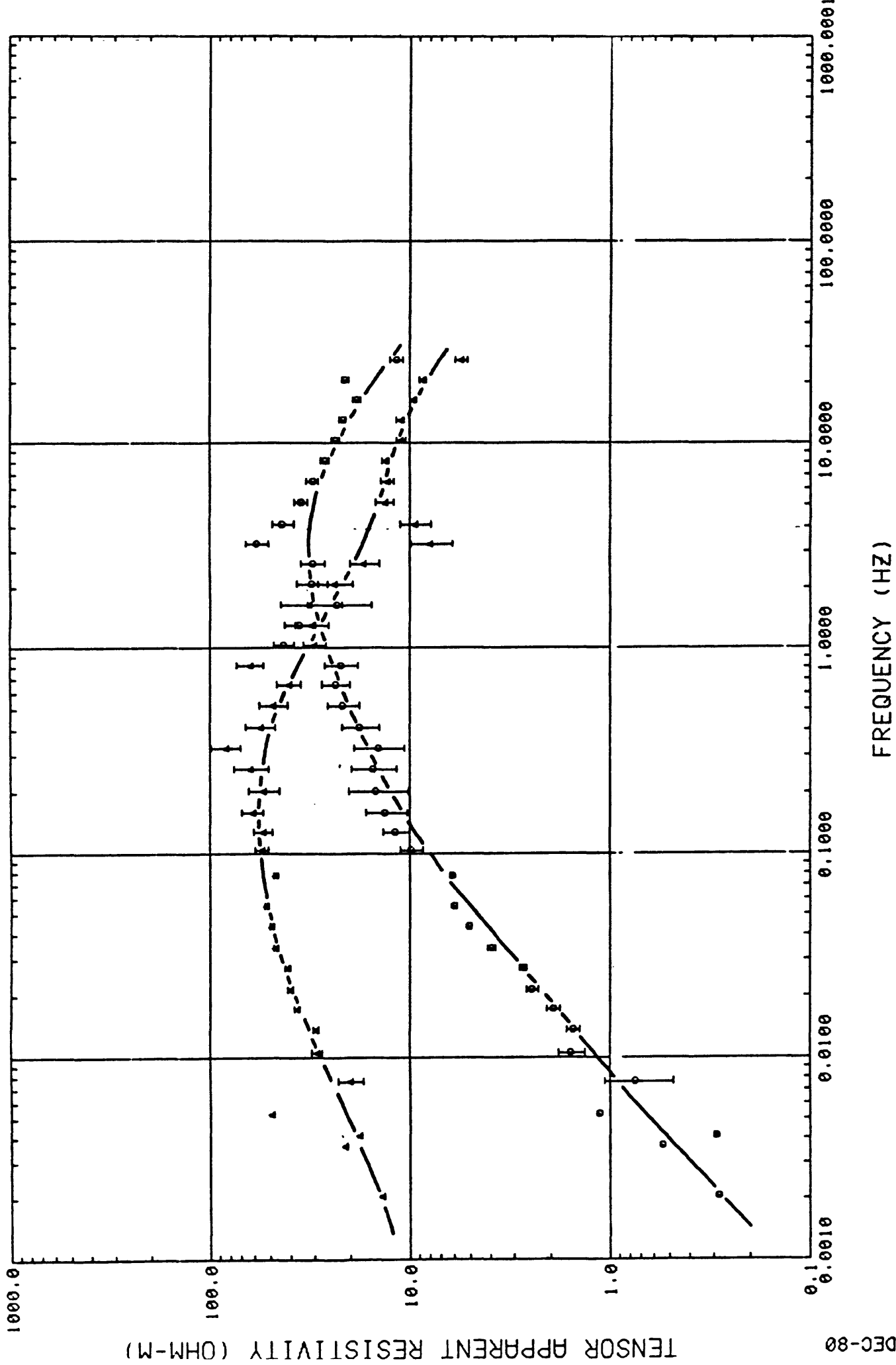


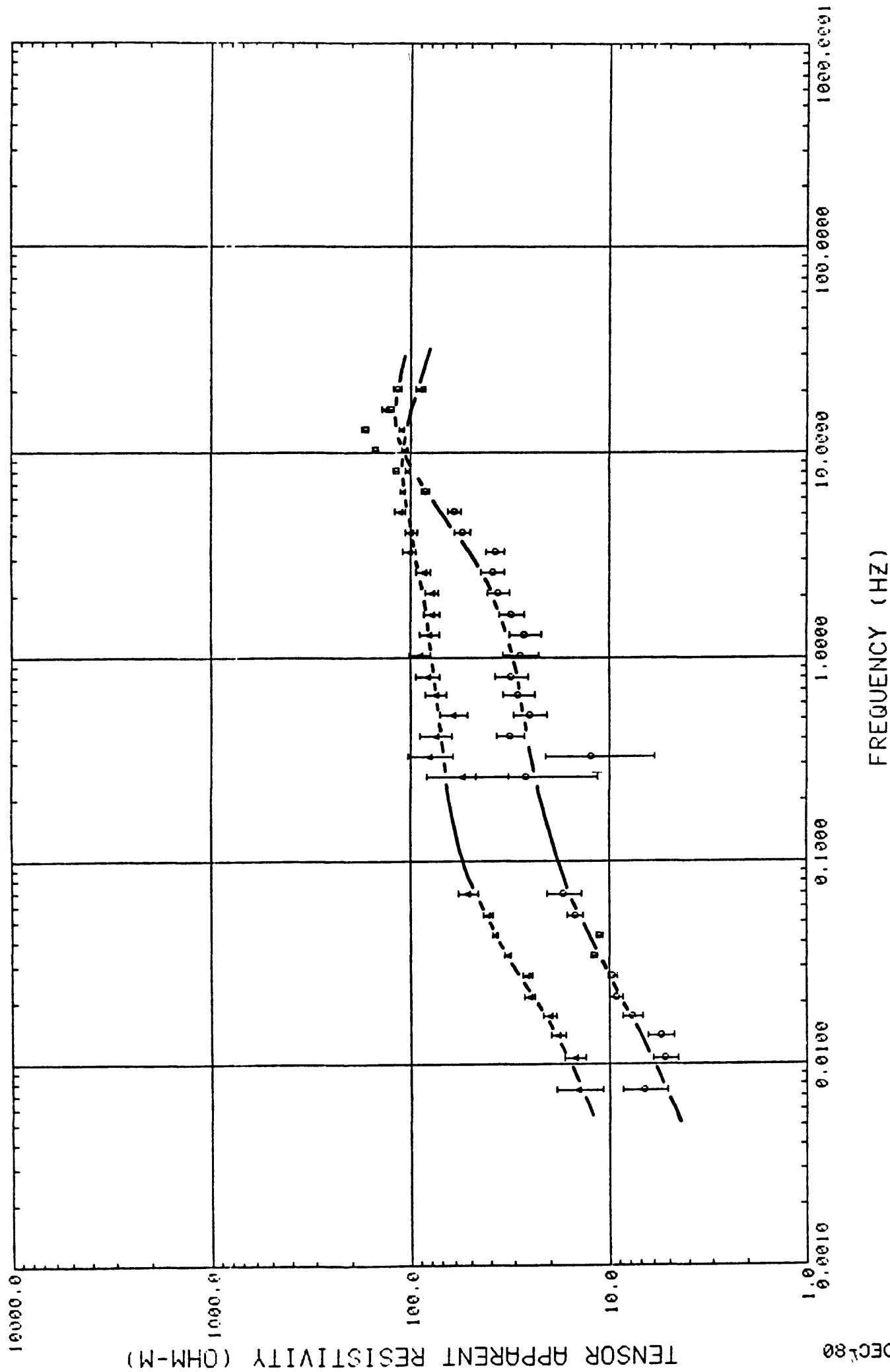
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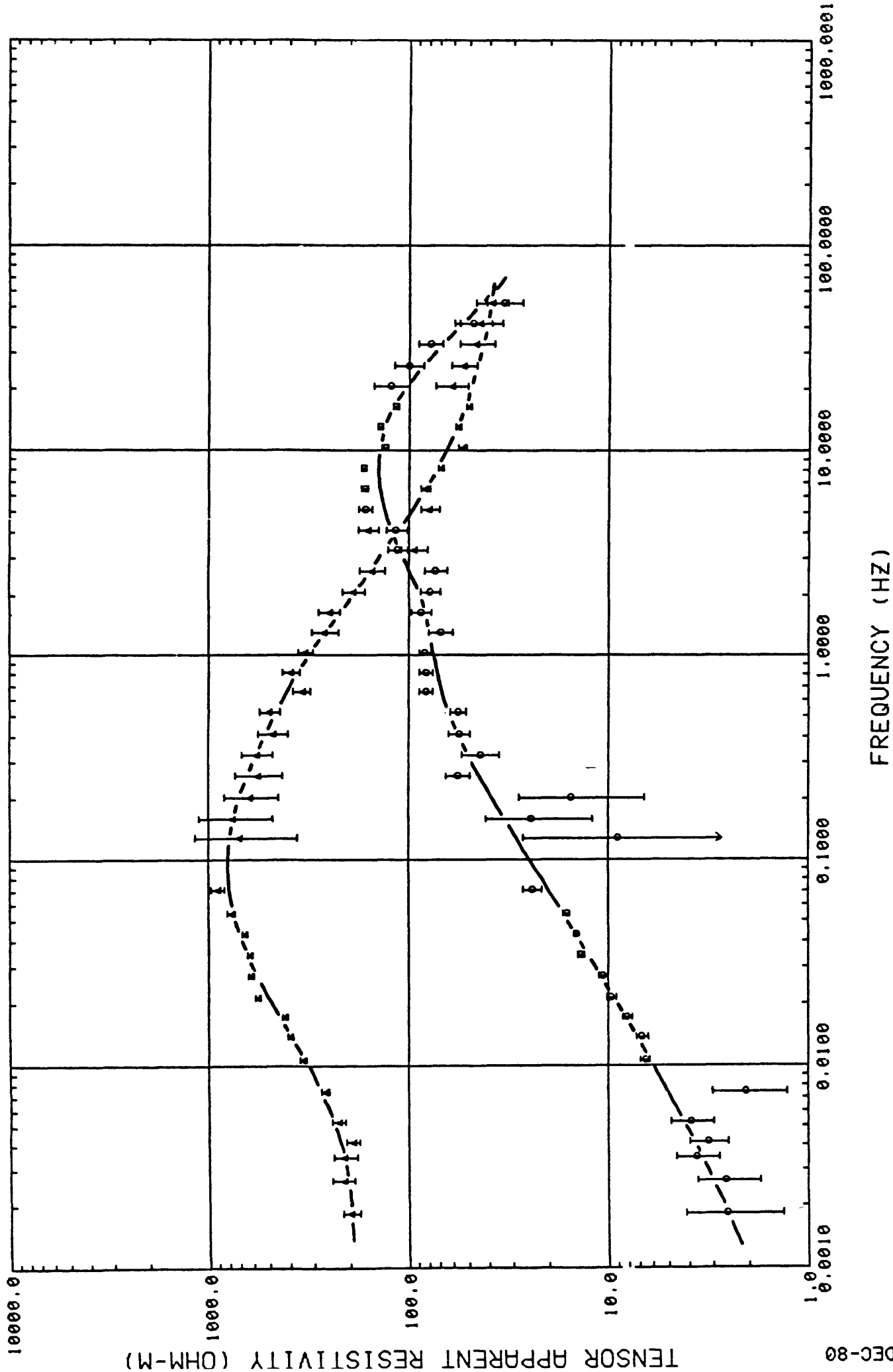


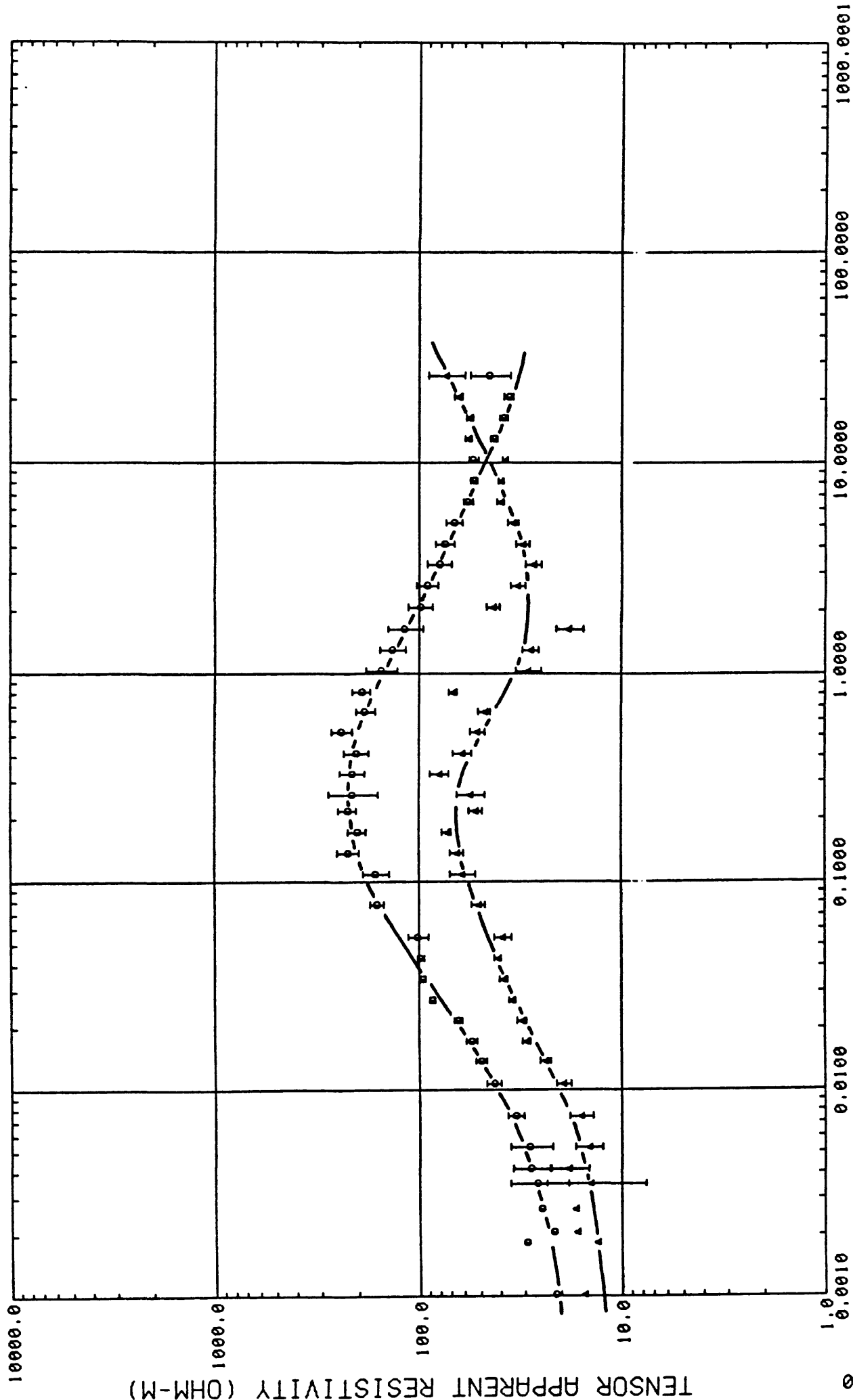


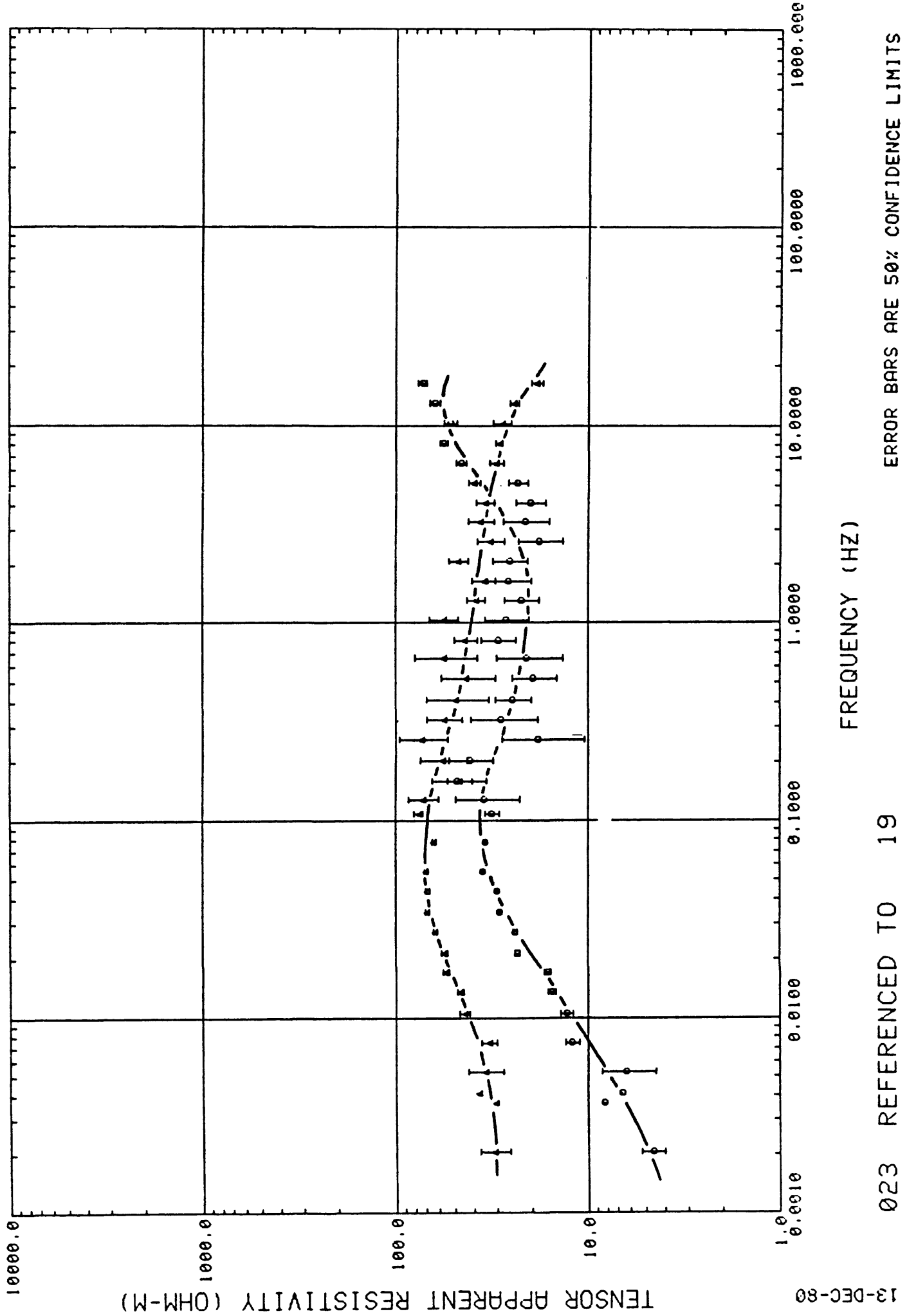
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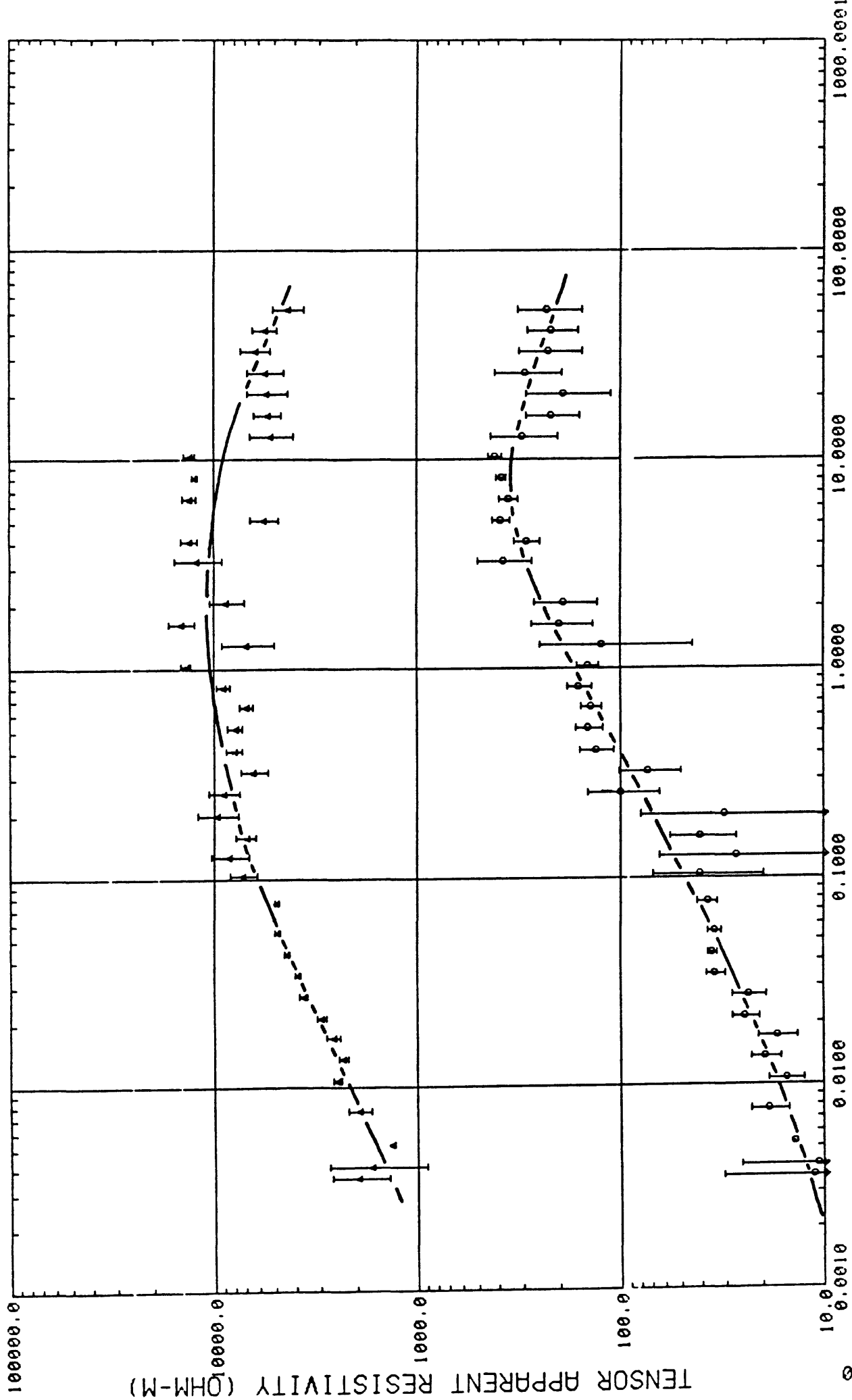




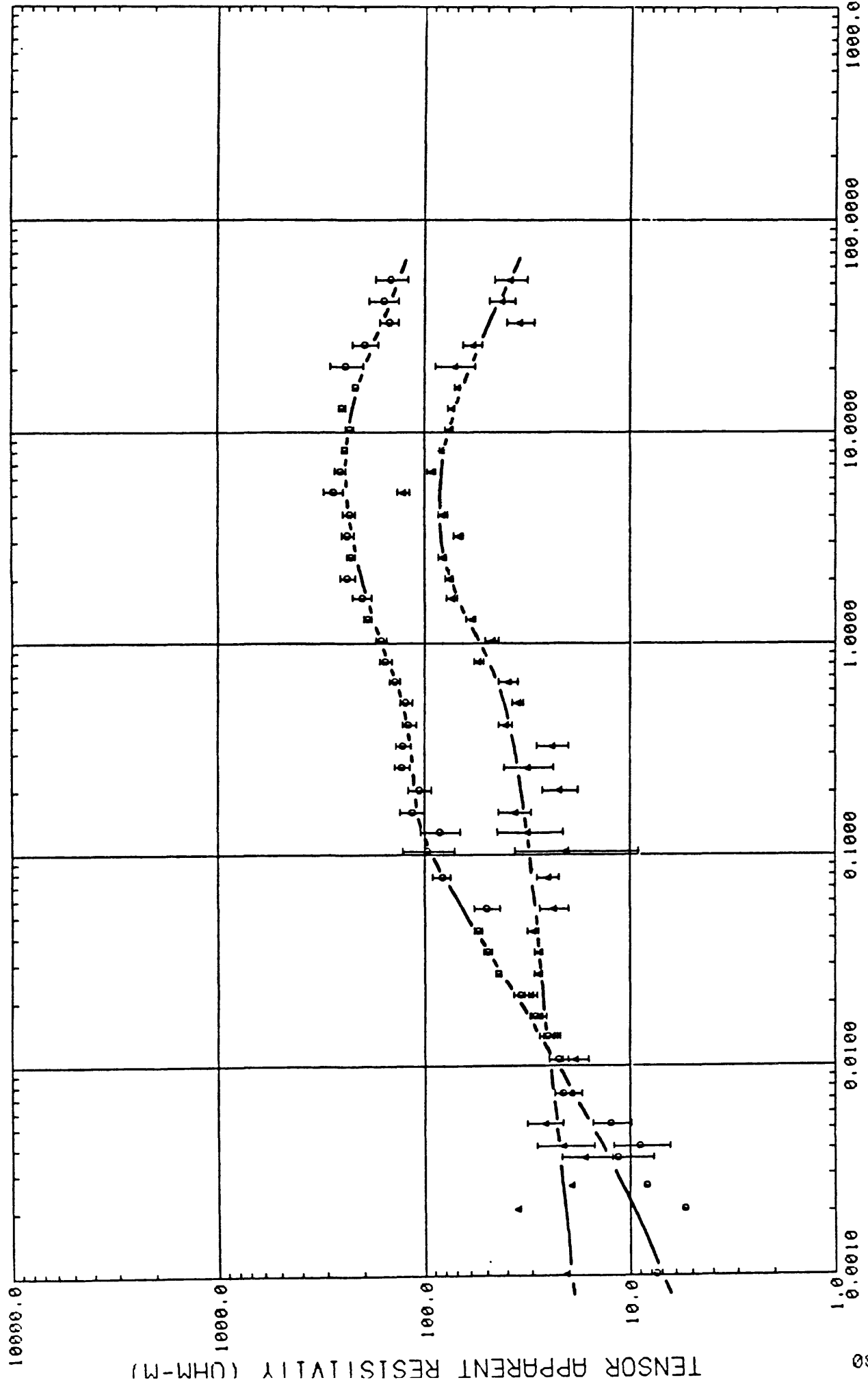




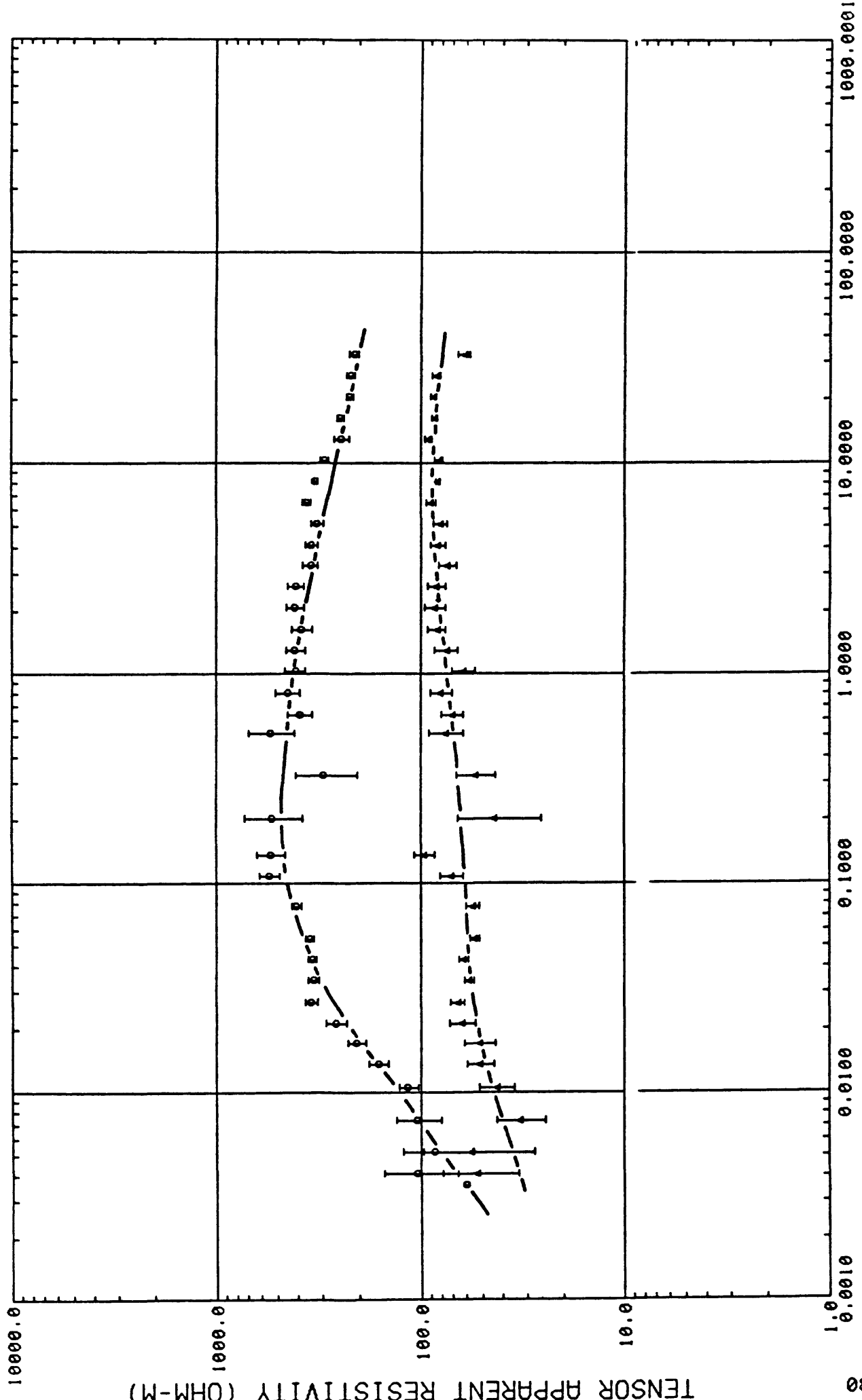




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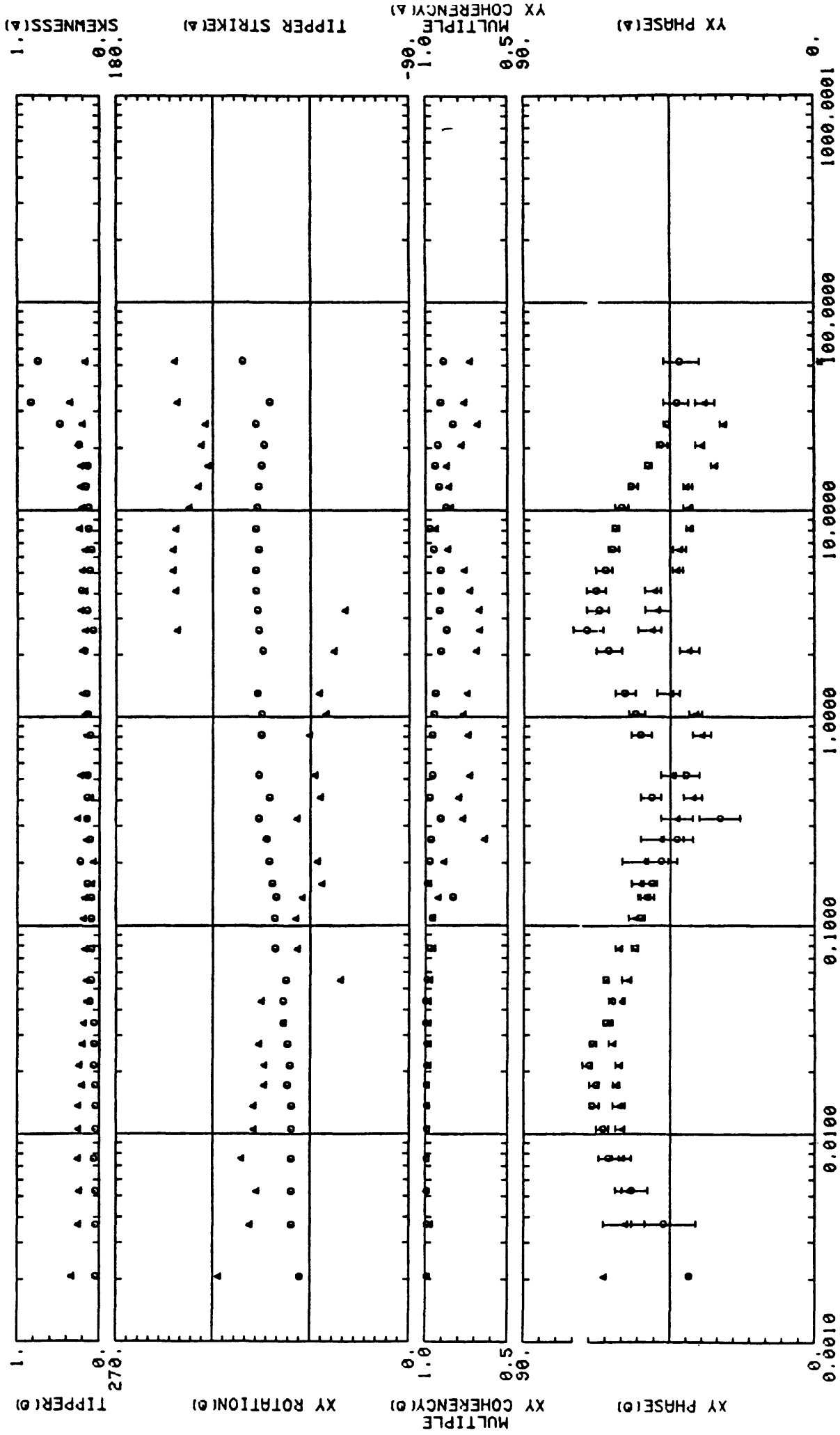
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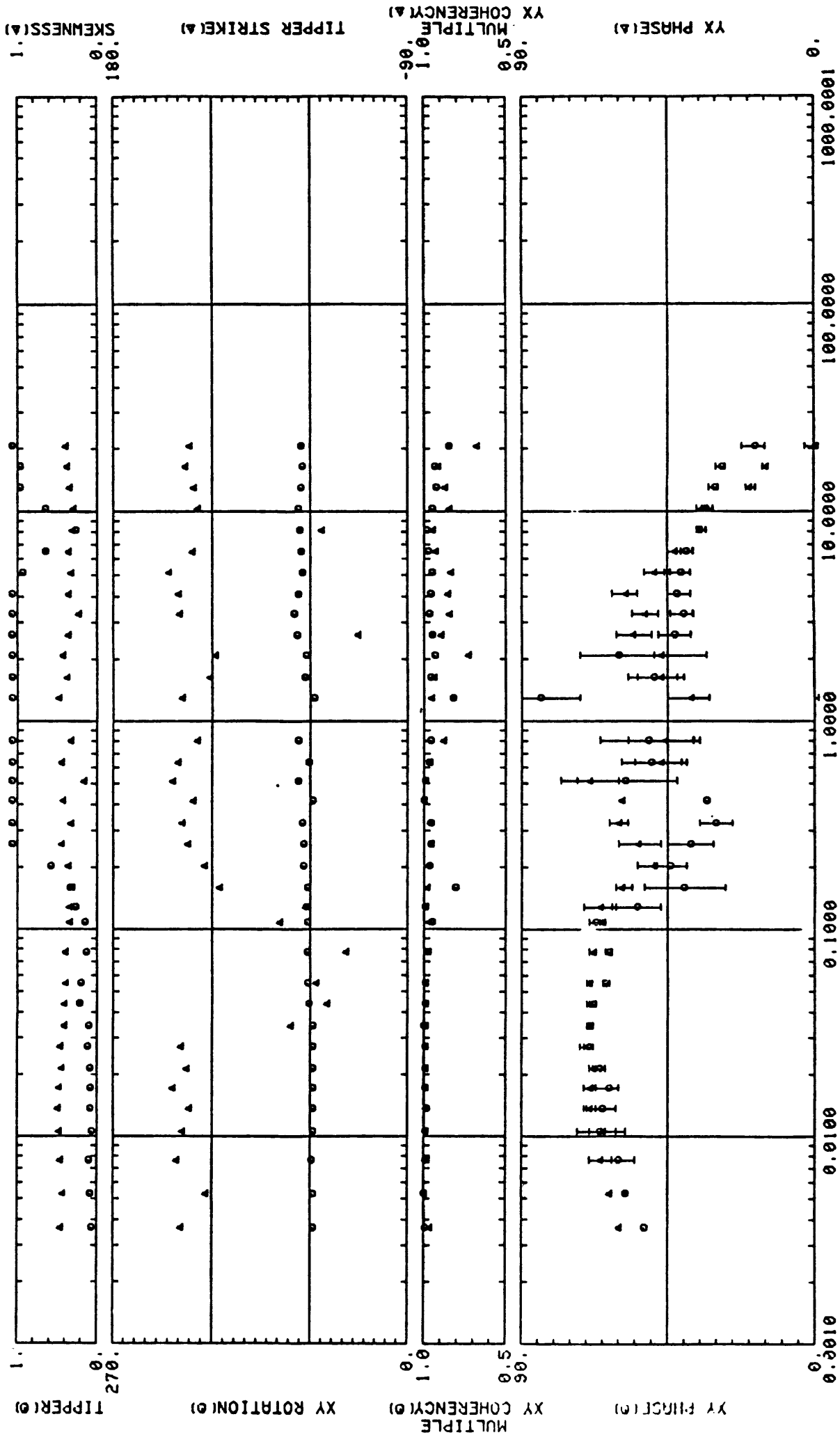
APPENDIX B2

COMPUTER PLOTS OF DATA

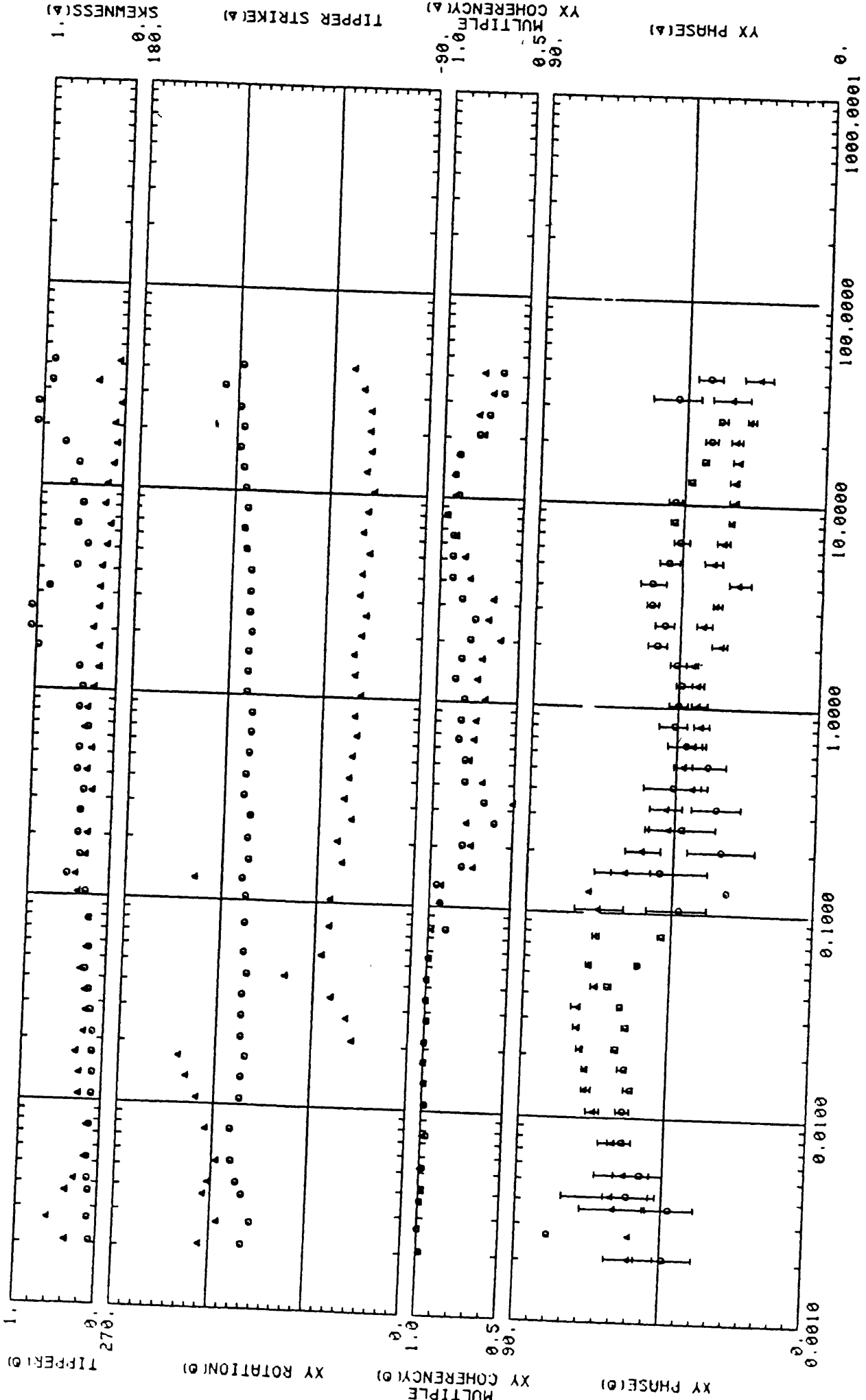
**Tensor Phase, Multiple Coherencies, Rotation,
Tipper "Strike", Tipper, Skewness**

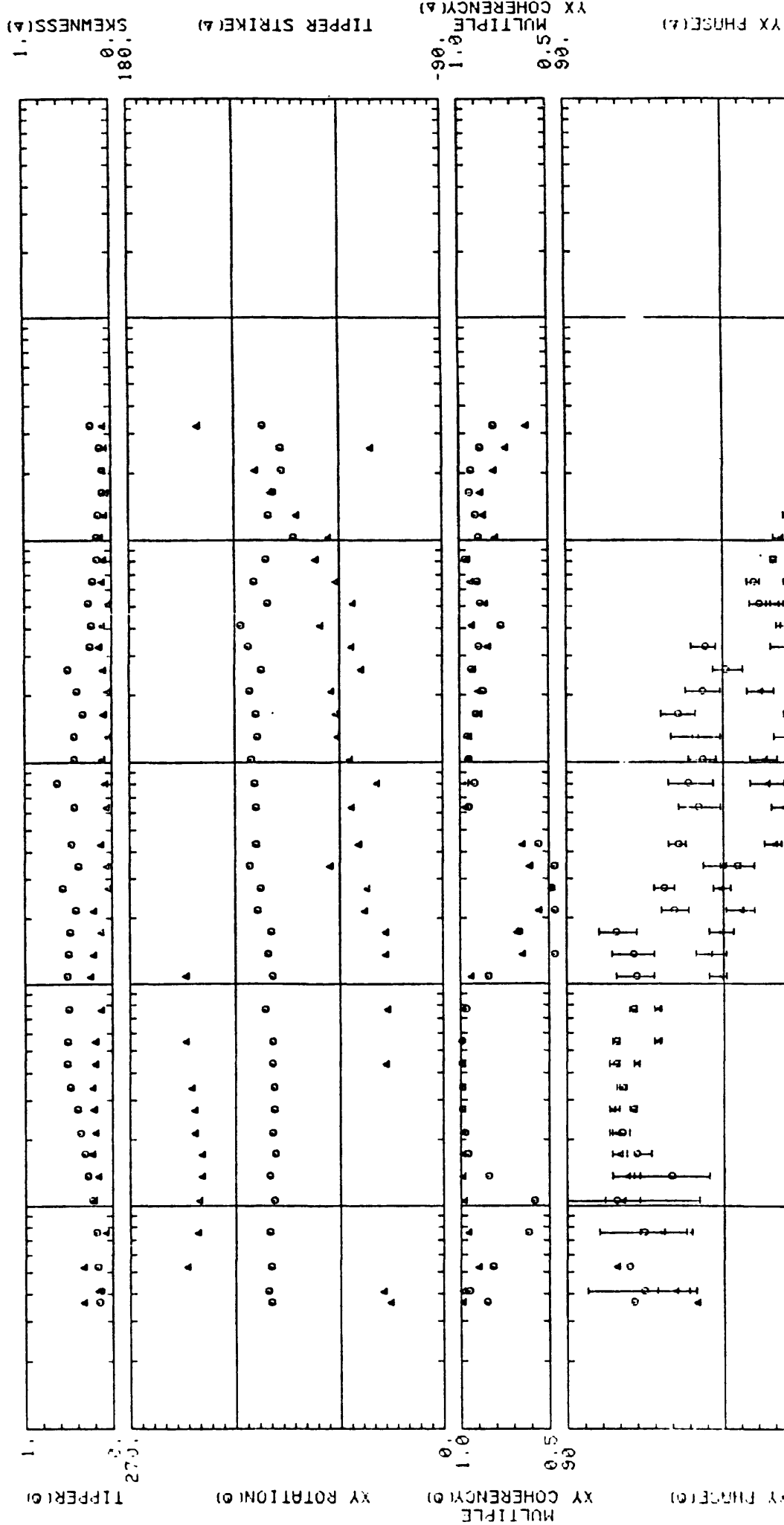


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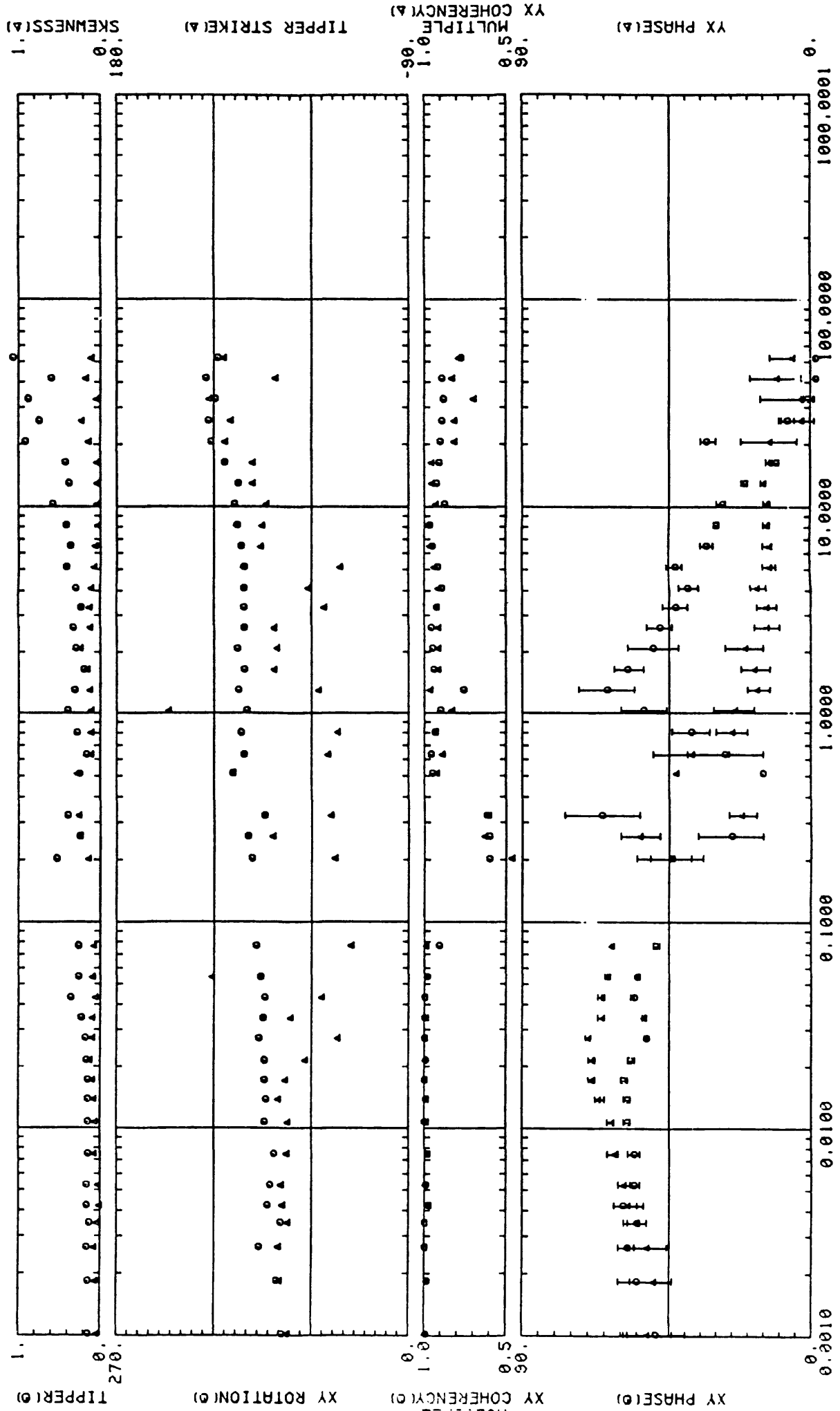




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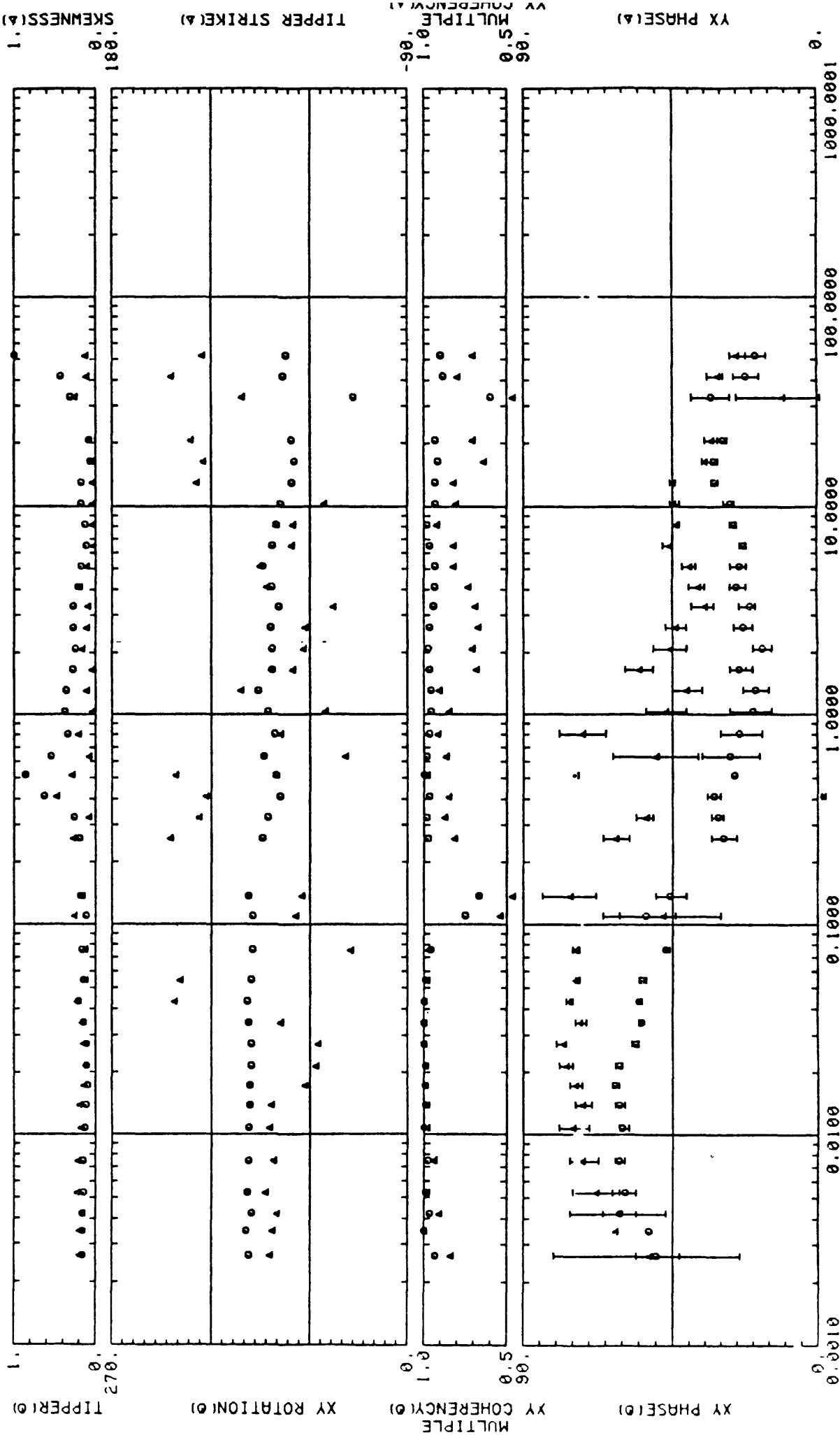
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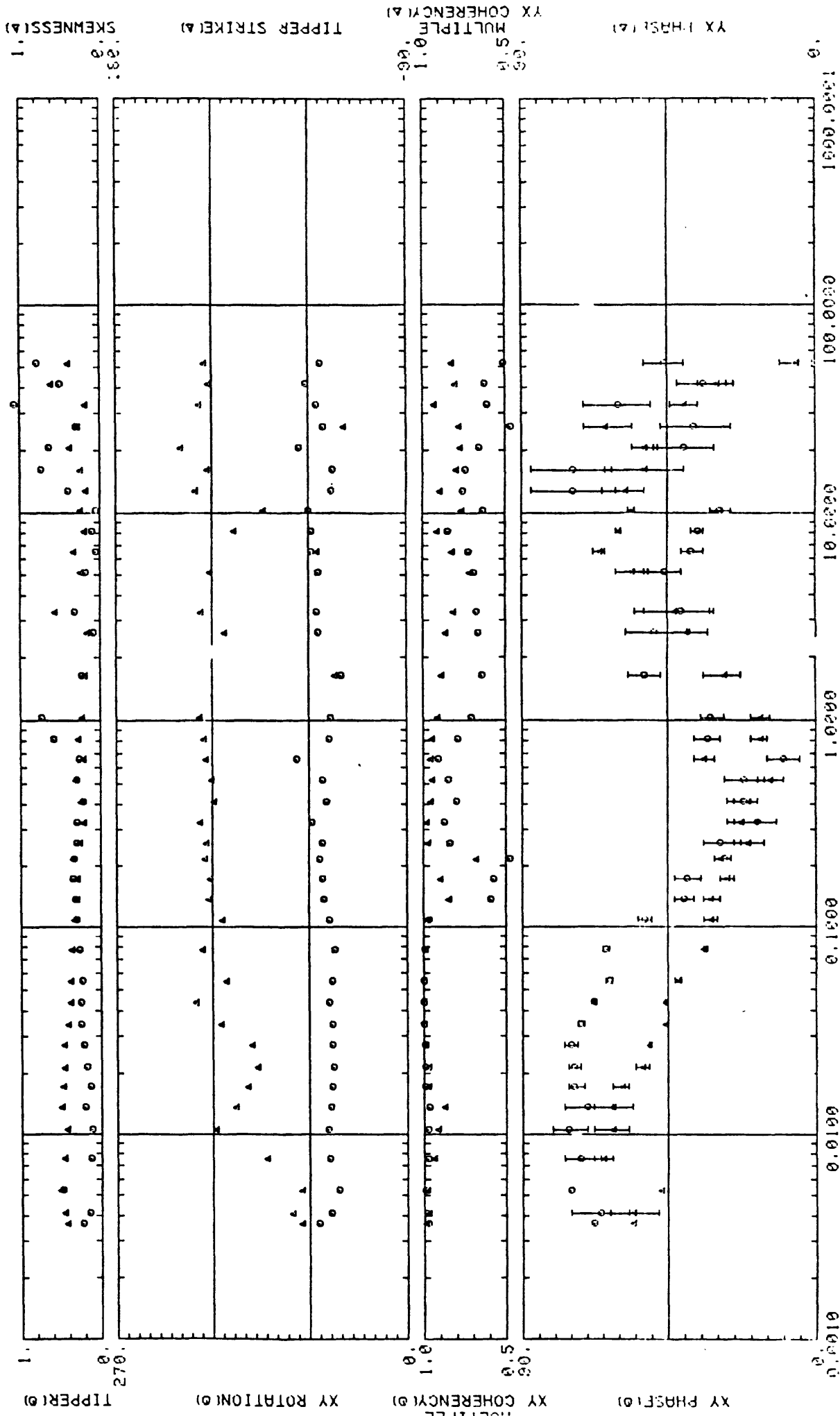
ERROR BARS ARE 50% CONFIDENCE LIMITS



FREQUENCY (HZ)

FREQUENCY (HZ)

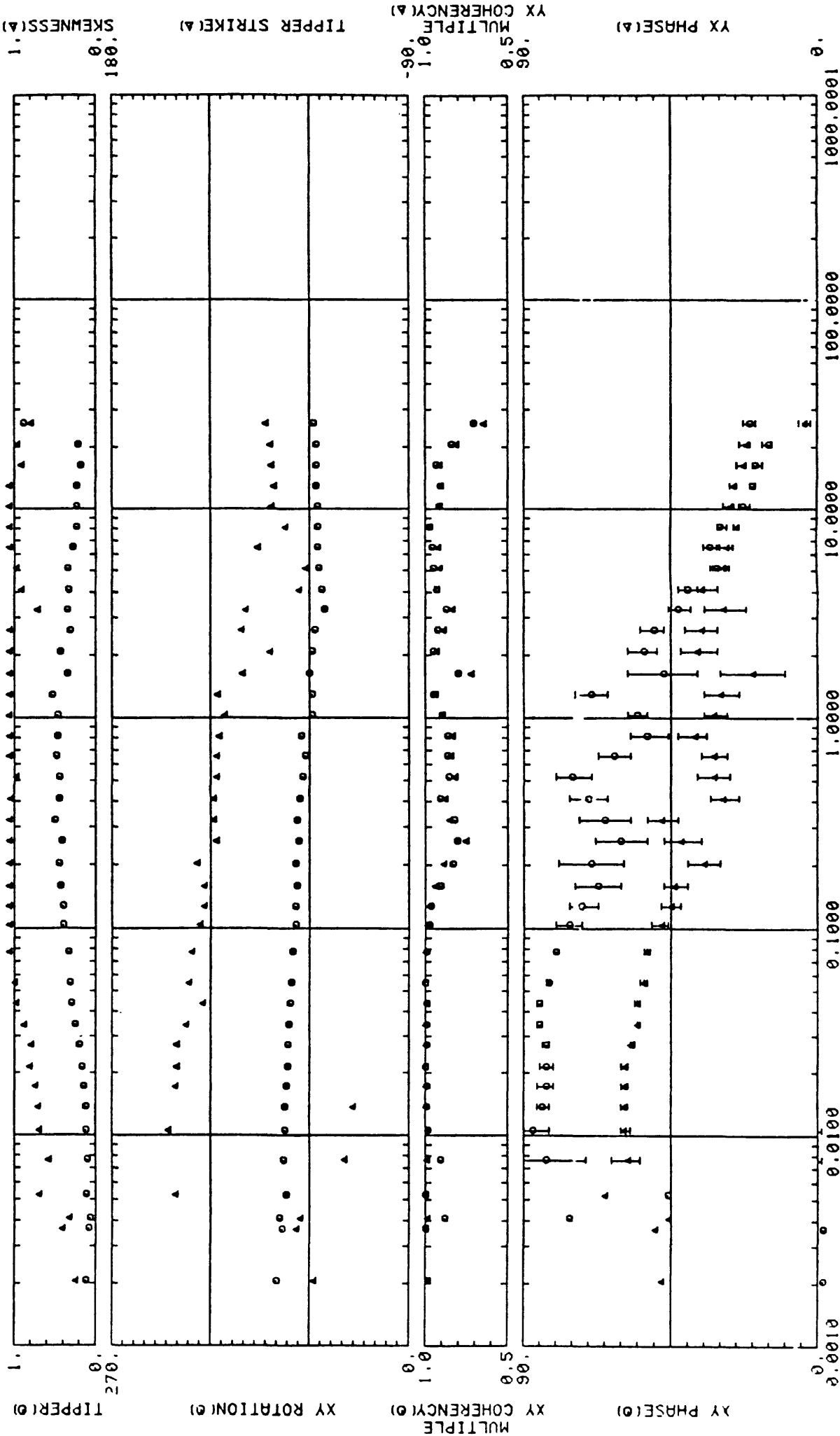




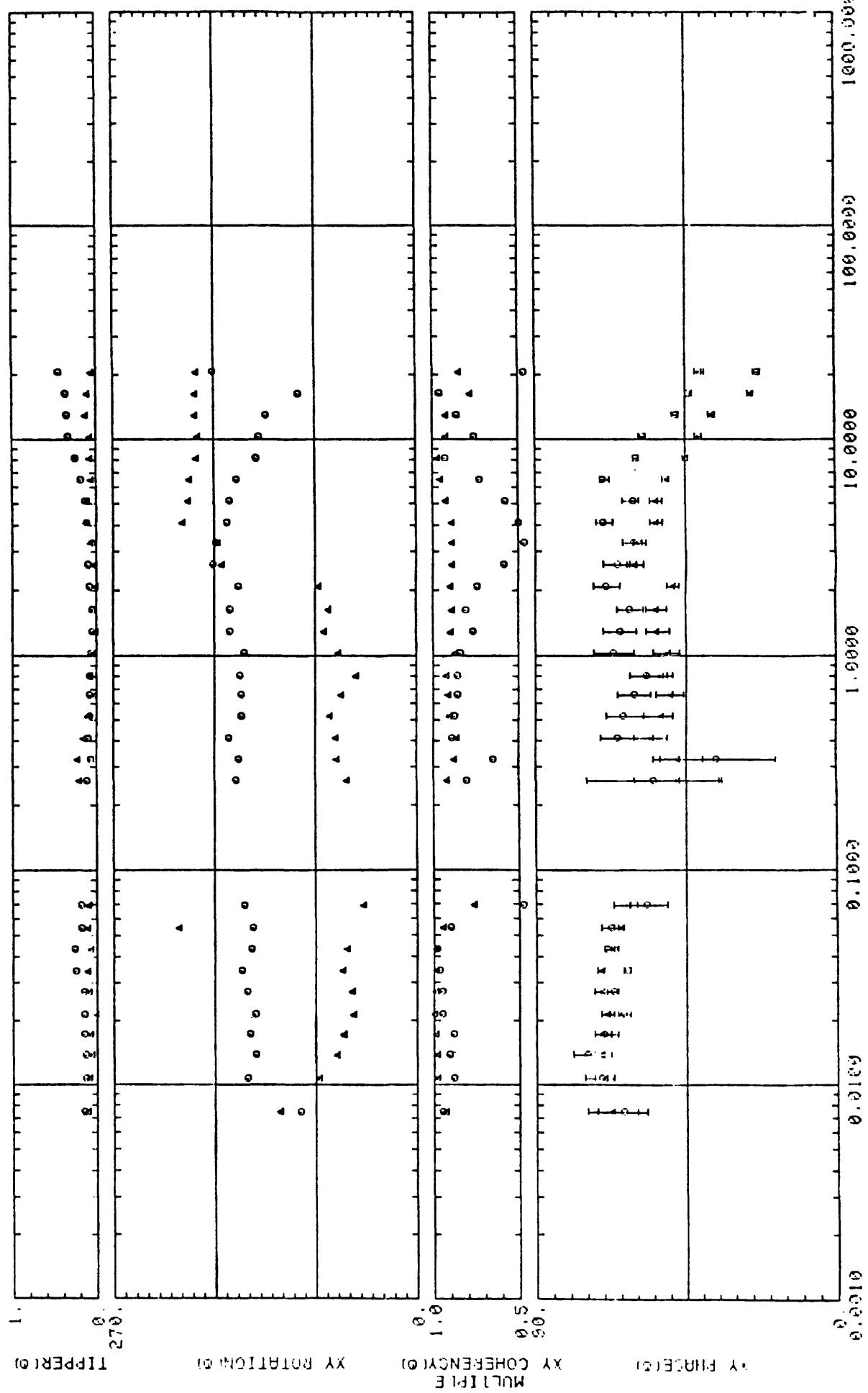
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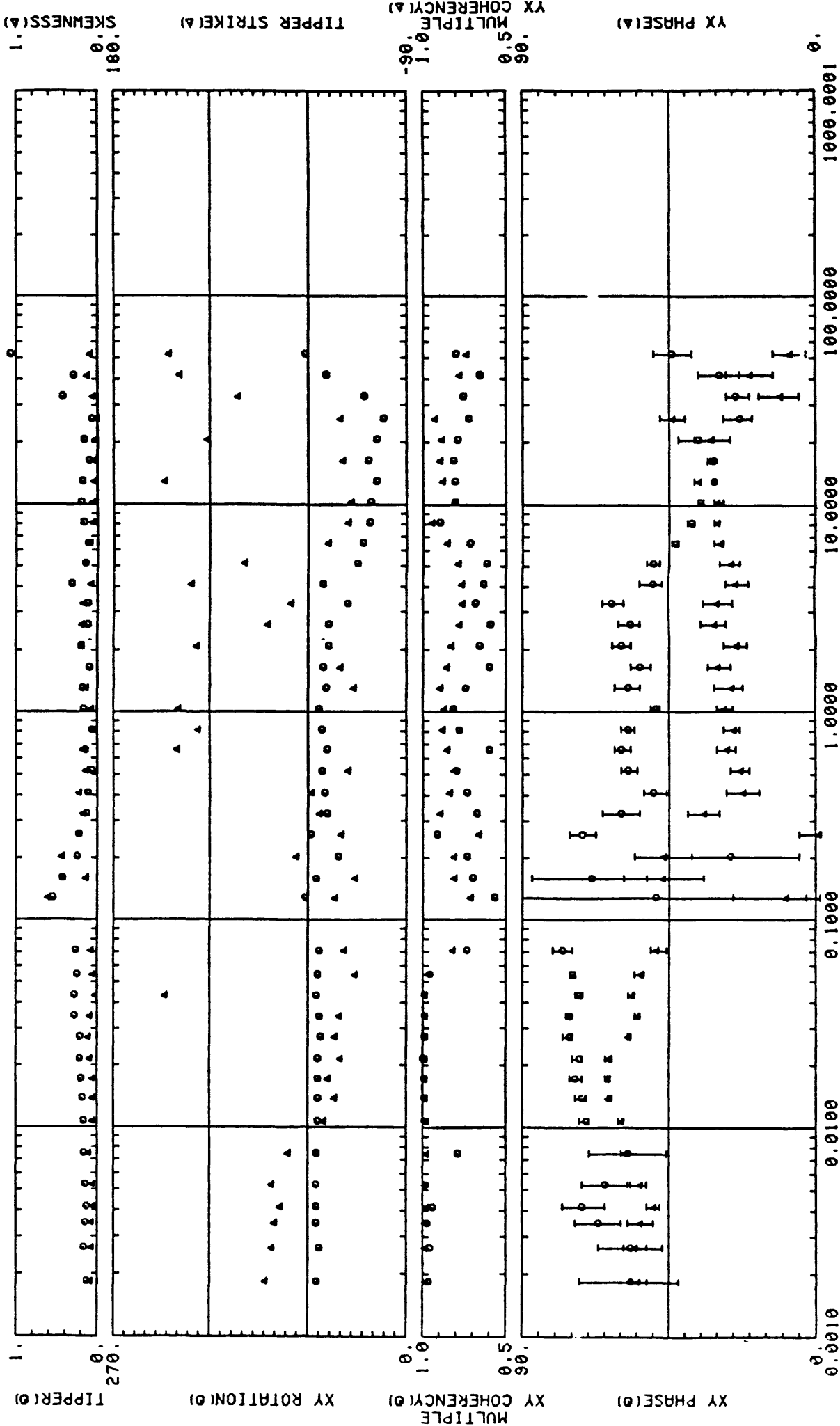
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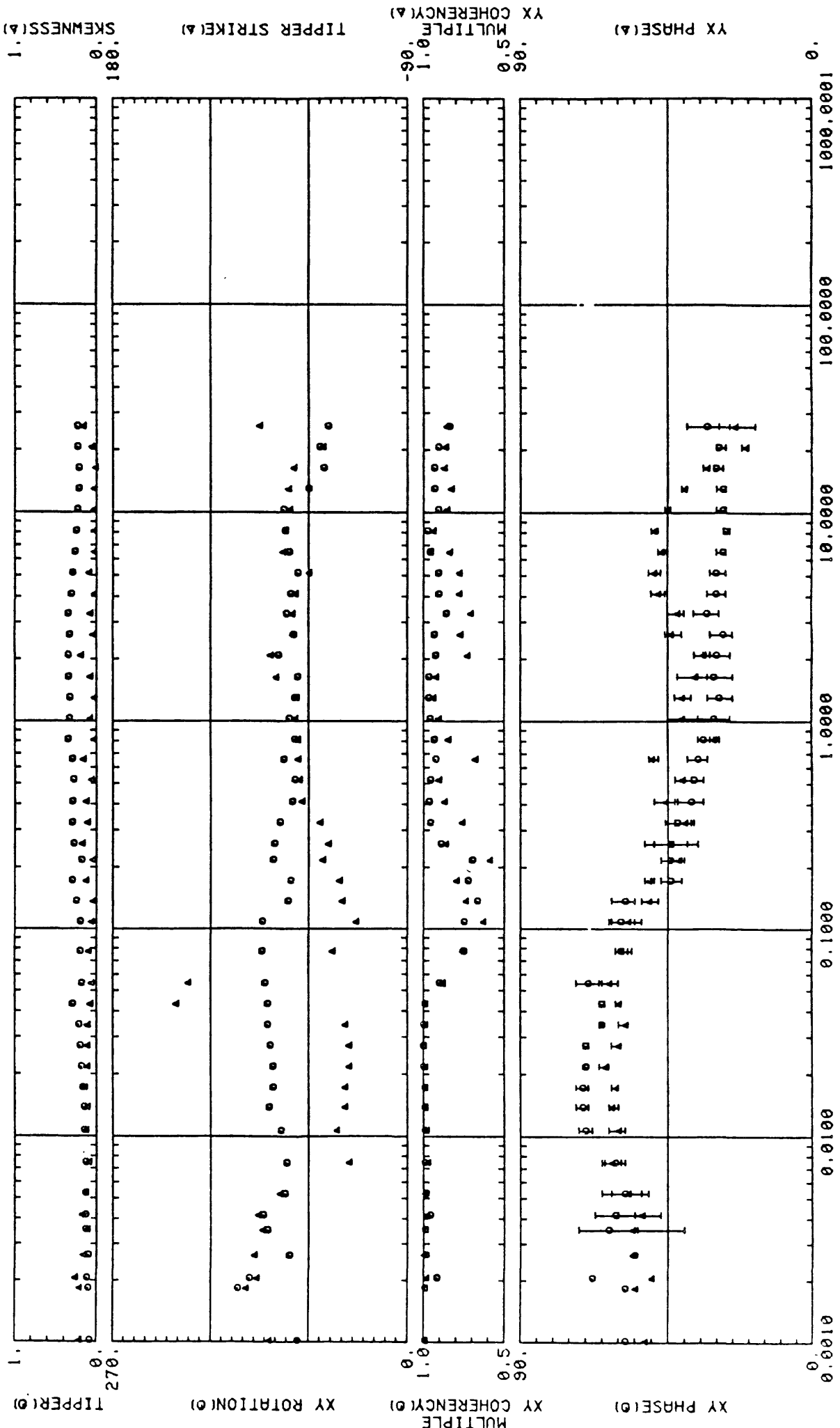
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 MULTIPLE 0.5
 XY COHERENCY(A) 1.0
 TIPPER STRIKE(A) 180.0
 SKEWNESS(A) 1.0

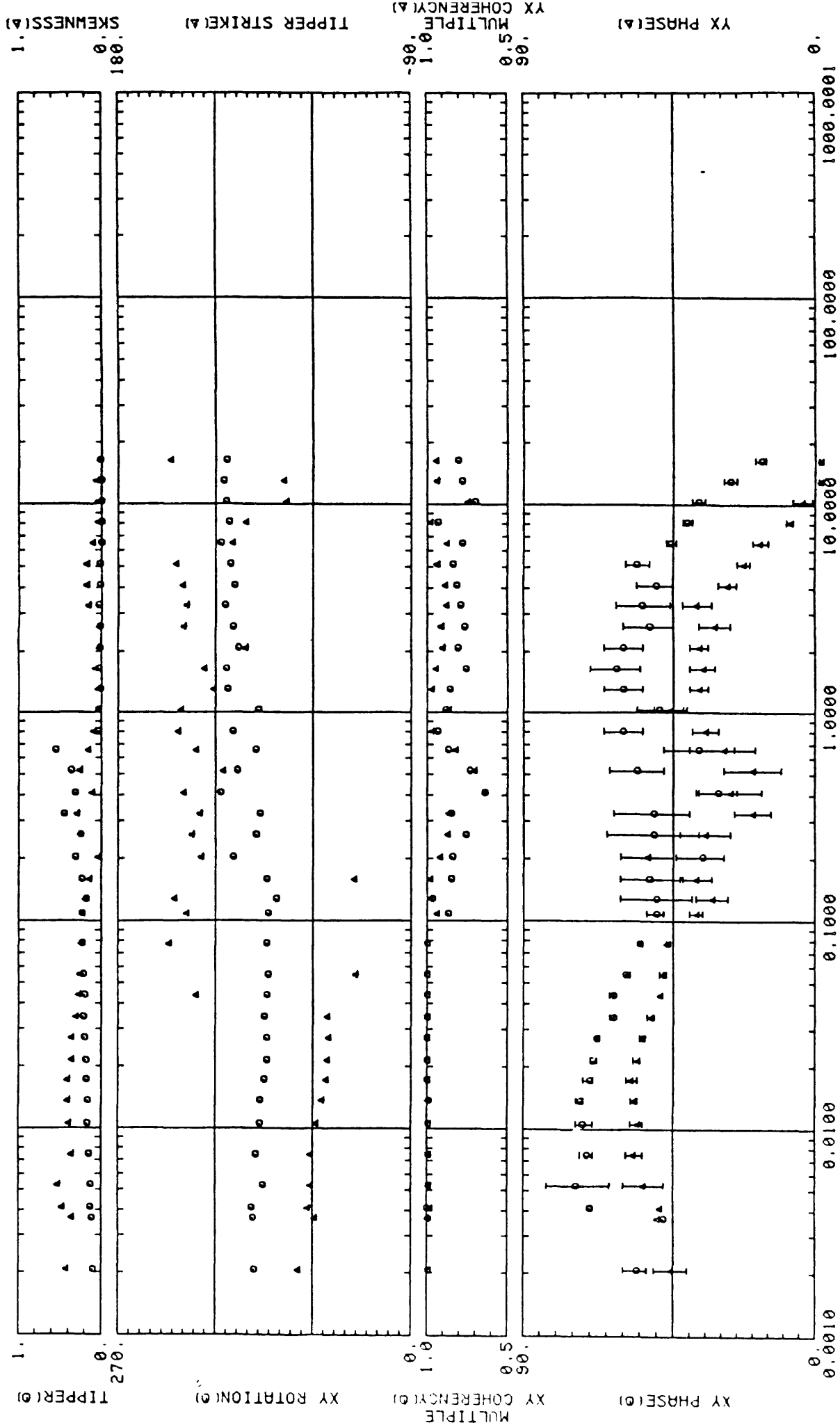


FREQUENCY (HZ)



FREQUENCY (HZ)

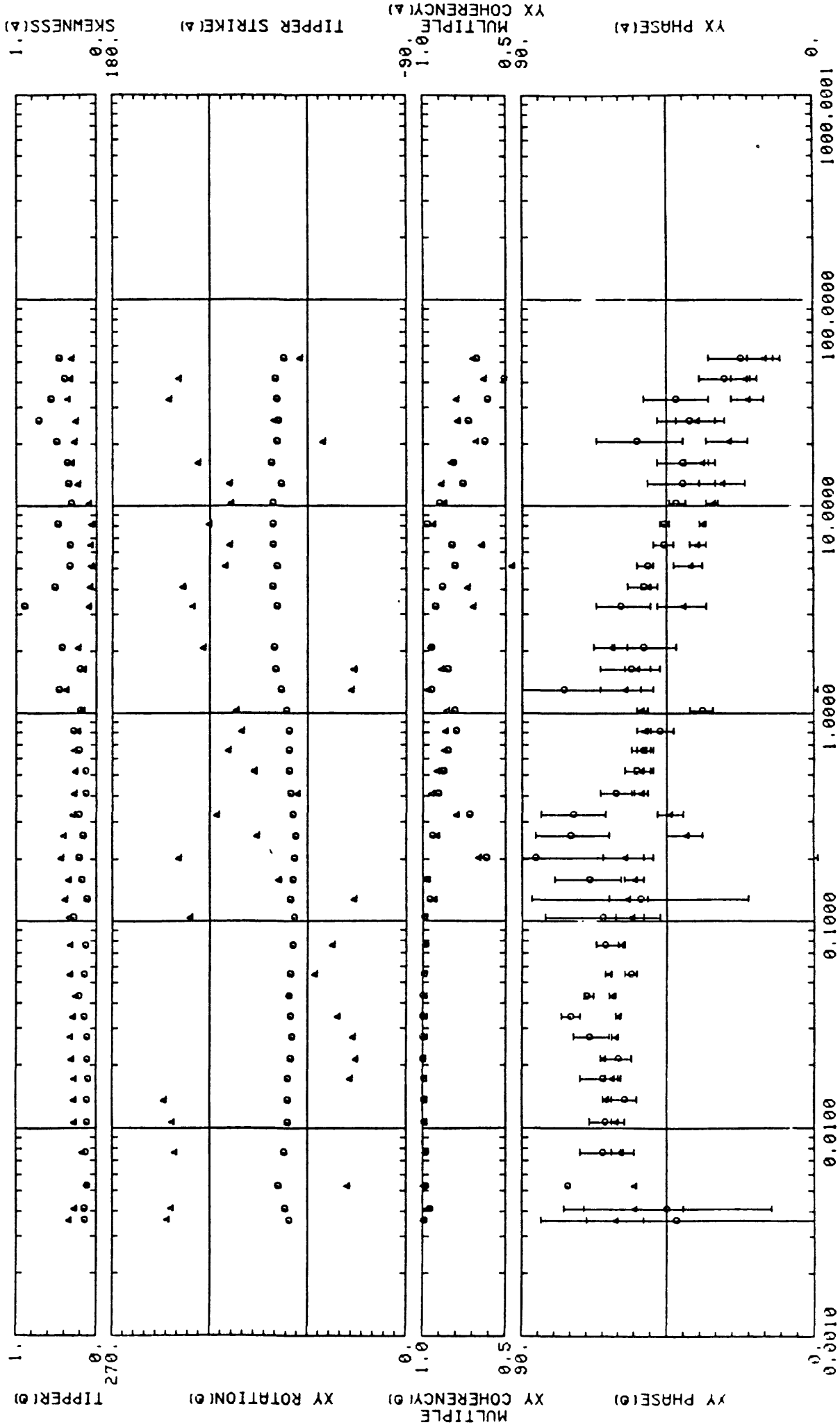


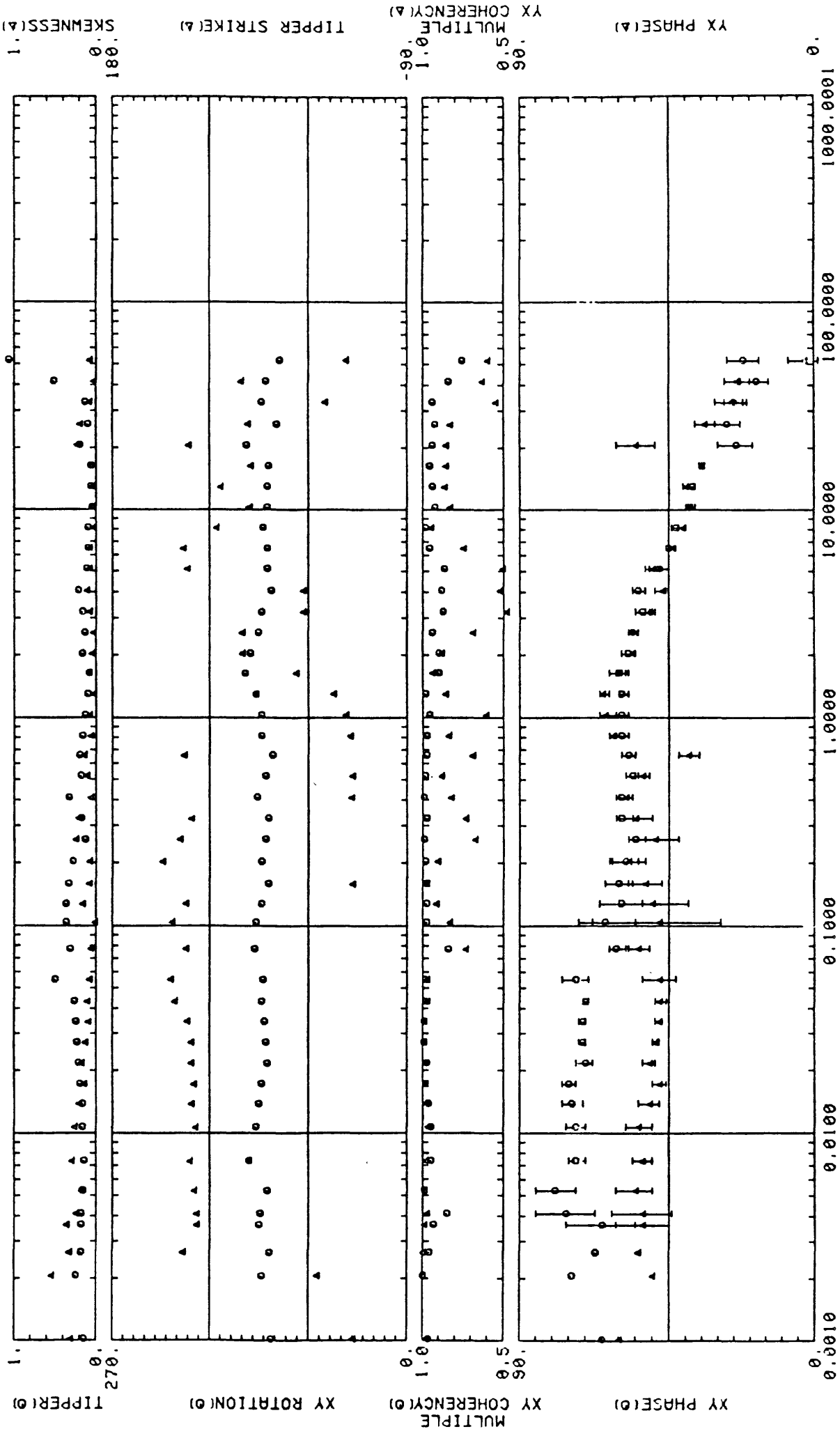


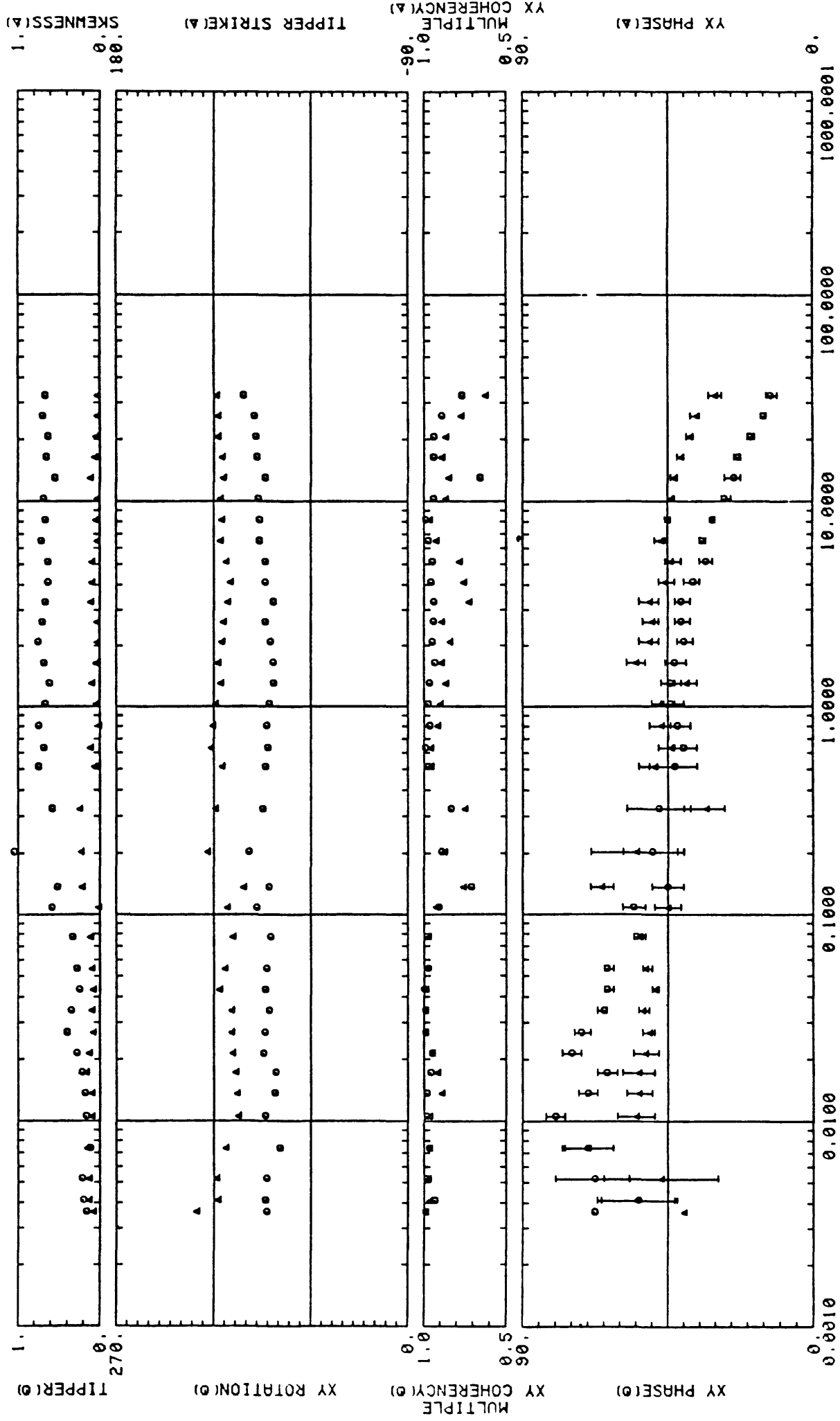
023 REFERENCED TO 19

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ERROR BARS ARE 50% CONFIDENCE LIMITS







FREQUENCY (HZ)

026 REFERENCED TO 27

ERROR BARS ARE 50% CONFIDENCE LIMITS

APPENDIX C

COMPUTER LISTINGS OF DATA

The calculated results are printed out for the power spectra averaged data sets. These include:

FREQ = frequency (hertz)

RHOXY = xy rotated apparent resistivity (ohm-m)

RHOYX = yx rotated apparent resistivity (ohm-m)

PHASEXY = xy rotated phase angle (degrees)

PHASEYX = yx rotated phase angle (degrees)

ROT ANG = rotation angle (degrees)

SKEWNESS = skewness

TIPPER = tipper magnitude

TIP STRIK = tipper strike as defined by Vozoff

(Geophysics, 1976, p. 327)

TIP PHASE = tipper phase

COHXY = xy multiple coherency

COHYX = yx multiple coherency

MAONETOTELLURIC STATION 011 REMOTE REFERENCED TO STATION 12

FREQ	RHOXY	RHOYX	PHASEXY	PHASEYX	ROT ANO	SKEWNESS	TIPPER	TIP STRIK	TIP PHASE	COHXY	COHYX
0.002035	3.16	25.78	39.	66.	100.	0.34	0.04	85.	79.	0.99	0.99
0.003662	2.97	35.49	47.	59.	108.	0.27	0.05	56.	82.	0.99	0.98
0.005290	3.46	40.78	57.	58.	108.	0.26	0.05	50.	58.	1.00	1.00
0.007346	3.60	42.18	64.	60.	108.	0.27	0.05	64.	38.	0.99	0.99
0.010979	3.89	46.06	66.	60.	108.	0.27	0.05	52.	38.	0.99	0.99
0.013670	4.87	53.99	69.	61.	108.	0.27	0.05	52.	40.	0.99	0.99
0.017090	5.97	59.90	68.	62.	111.	0.22	0.05	43.	32.	1.00	0.99
0.021321	7.23	70.59	70.	61.	109.	0.24	0.06	42.	30.	0.99	0.99
0.027017	8.60	81.46	69.	63.	111.	0.22	0.06	48.	26.	0.99	0.99
0.034342	10.15	82.48	65.	64.	115.	0.19	0.07	25.	-5.	1.00	0.99
0.043294	10.87	98.08	63.	60.	115.	0.17	0.11	45.	15.	1.00	0.98
0.054525	11.91	107.95	65.	58.	113.	0.17	0.10	-28.	-48.	0.99	0.97
0.077209	14.76	124.38	56.	61.	122.	0.19	0.10	12.	34.	0.98	0.96
0.108960	15.63	134.37	54.	56.	122.	0.20	0.11	14.	28.	0.96	0.96
0.136194	12.80	161.08	52.	52.	121.	0.19	0.10	7.	46.	0.83	0.93
0.158691	15.00	199.58	51.	54.	125.	0.10	0.15	-10.	7.	0.99	0.99
0.201416	16.98	175.08	48.	53.	128.	0.08	0.24	-6.	22.	0.97	0.89
0.256348	13.31	198.78	43.	48.	130.	0.17	0.11	41.	-10.	0.97	0.64
0.323486	14.00	176.85	29.	43.	138.	0.27	0.19	12.	16.	0.91	0.77
0.408935	13.18	194.85	51.	38.	128.	0.11	0.15	-9.	8.	0.97	0.80
0.518799	10.65	165.96	40.	44.	137.	0.24	0.14	-4.	-58.	0.96	0.73
0.817871	11.11	163.49	54.	35.	135.	0.16	0.12	1.	-71.	0.96	0.74
1.025391	11.01	148.29	56.	37.	135.	0.19	0.16	-14.	-73.	0.95	0.77
1.287842	12.15	191.85	59.	45.	139.	0.21	0.17	-8.	70.	0.94	0.75
2.075195	18.04	130.78	64.	39.	134.	0.22	0.18	-21.	12.	0.91	0.69
2.612304	17.57	139.92	71.	51.	137.	0.19	0.09	124.	-75.	0.87	0.68
3.271484	19.60	138.78	67.	49.	139.	0.24	0.15	-31.	8.	0.92	0.68
4.101563	22.84	168.90	68.	50.	140.	0.21	0.21	125.	-56.	0.91	0.73
5.151367	25.67	182.18	65.	43.	140.	0.18	0.10	127.	77.	0.90	0.77
6.469726	33.89	186.26	63.	42.	137.	0.18	0.10	127.	72.	0.95	0.87
8.129883	34.36	152.15	62.	39.	140.	0.25	0.13	125.	72.	0.97	0.94
10.229494	32.80	152.99	60.	39.	139.	0.22	0.13	112.	70.	0.87	0.85
12.866213	41.38	195.04	57.	40.	137.	0.23	0.17	104.	50.	0.92	0.86
16.186522	41.73	141.65	52.	31.	135.	0.24	0.15	95.	32.	0.94	0.87
20.385744	43.23	131.70	48.	35.	133.	0.27	0.25	101.	70.	0.92	0.78
25.659182	43.94	126.84	46.	34.	140.	0.21	0.28	97.	-3.	0.83	0.68
32.714840	40.95	112.15	43.	28.	128.	0.37	0.83	124.	-25.	0.91	0.77
0.000000	23.19	1478.44	21.	52.	128.	0.26	0.12	131.	40.	0.90	0.66
52.246094	29.81	95.02	42.	-15.	153.	0.19	0.75	126.	43.	0.90	0.73

MAGNETOTELLURIC STATION 012 REMOTE REFERENCED TO STATION 11

FREQ	RHOXY	RHOYX	PHASEXY	PHASEYX	ROT ANG	SKENNEB8	TIPPER TIP STRIK	CONXY	CONYX	ELLIPTIC	
0.003662	67.31	517.31	52.	60.	88.	0.46	0.06	0.99	0.97	-0.15	0.40
0.005290	93.74	581.33	58.	63.	88.	0.44	0.09	1.00	1.00	-0.33	0.20
0.007614	92.22	753.68	60.	66.	89.	0.47	0.09	0.99	0.99	-0.27	0.23
0.010379	100.65	819.80	66.	65.	88.	0.48	0.07	1.00	0.99	-0.42	0.26
0.013630	102.95	971.16	65.	69.	87.	0.50	0.08	0.99	0.99	-0.47	0.10
0.017090	115.56	1007.65	63.	69.	87.	0.48	0.09	0.99	0.99	-0.26	0.49
0.021311	131.84	1329.67	66.	68.	87.	0.45	0.09	0.99	0.99	-0.20	0.17
0.027038	149.62	1552.18	69.	70.	88.	0.47	0.11	0.99	0.99	-0.27	0.07
0.034315	190.77	1747.12	69.	69.	88.	0.42	0.11	1.00	0.99	-0.01	-0.27
0.043312	215.19	2099.94	68.	69.	91.	0.41	0.21	0.99	0.99	0.00	-0.22
0.054525	249.94	2500.61	64.	69.	92.	0.41	0.19	0.99	0.99	0.10	-0.15
0.077209	349.39	2635.33	63.	68.	93.	0.39	0.13	0.97	0.97	0.31	-0.44
0.108560	349.53	3684.48	67.	65.	92.	0.35	0.15	0.95	0.98	0.29	-0.43
0.128174	503.89	3619.98	54.	66.	94.	0.34	0.26	0.99	1.00	0.51	-0.27
0.158691	313.28	4023.22	40.	59.	92.	0.31	0.33	0.81	0.98	0.43	-0.09
0.201416	427.24	4354.06	44.	49.	96.	0.36	0.39	0.97	0.97	0.02	0.06
0.256348	470.74	4230.06	38.	54.	96.	0.44	1.91	0.96	0.96	-0.01	0.08
0.323486	438.33	5965.36	30.	60.	98.	0.33	1.62	0.96	0.97	0.10	0.08
0.415039	476.16	4489.38	33.	59.	88.	0.44	2.61	1.00	1.00	-0.02	0.16
0.512695	380.01	7950.40	58.	69.	101.	0.16	3.17	0.99	0.99	0.11	-0.07
0.634766	415.11	5262.06	50.	47.	91.	0.45	1.08	0.96	0.96	-0.07	0.07
0.805664	615.19	12340.90	51.	46.	101.	0.33	3.13	0.96	0.89	0.10	0.09
1.293945	582.75	5037.97	84.	38.	86.	0.48	3.32	0.83	0.96	-0.08	0.06
1.635742	518.95	4574.27	49.	47.	95.	0.39	1.70	0.96	0.94	-0.15	0.07
2.075195	411.11	4141.56	60.	47.	94.	0.44	2.70	0.93	0.73	-0.10	0.09
2.612304	582.49	6256.22	43.	56.	103.	0.37	2.75	0.95	0.90	-0.10	0.04
3.271484	583.17	9937.90	40.	52.	105.	0.23	1.78	0.97	0.85	-0.04	0.02
4.101563	531.14	6547.61	42.	58.	101.	0.37	2.85	0.96	0.86	-0.05	0.00
5.151367	457.42	6862.46	41.	49.	97.	0.33	0.94	0.95	0.84	0.00	0.01
6.469726	521.57	5481.61	39.	43.	99.	0.36	0.66	0.97	0.94	-0.11	0.09
8.129883	501.02	6978.27	35.	35.	100.	0.32	0.27	0.98	0.95	-0.24	0.14
10.229492	517.58	8042.60	33.	34.	101.	0.31	0.65	0.95	0.85	0.02	-0.08
12.866213	523.74	8012.41	30.	20.	99.	0.35	0.97	0.93	0.88	-0.04	-0.06
16.186522	488.36	7393.07	28.	15.	98.	0.38	0.97	0.94	0.92	-0.04	-0.04
20.385744	526.18	6423.54	18.	0.	99.	0.40	1.86	0.85	0.68	-0.16	-0.04

MAGNETOTELLURIC STATION 013 REMOTE REFERENCED TO STATION 24

FREQ	RHOXY	RHOYX	PHASEXY	PHASEYX	ROT ANO	SKENESS	TIPPER TIP	STRIK	TIP PHASE	COHXY	COHYX
1	0.002039	31.01	392.27	44.	55.	150.	0.38	-100.	21.	0.98	0.99
2	0.002643	15.19	310.41	80.	53.	142.	0.62	84.	28.	1.00	1.00
3	0.003393	31.78	316.96	43.	60.	151.	0.40	97.	21.	0.99	1.00
4	0.004119	27.21	337.93	56.	61.	157.	0.30	94.	4.	0.98	0.98
5	0.005290	30.21	395.17	52.	57.	162.	0.18	86.	3.	0.99	1.00
6	0.007579	42.22	406.31	58.	61.	164.	0.17	98.	14.	0.97	0.99
7	0.010596	48.32	455.78	58.	67.	156.	0.29	107.	25.	0.99	0.99
8	0.013667	50.86	524.93	56.	70.	156.	0.28	117.	32.	0.99	1.00
9	0.017108	51.98	595.03	58.	70.	153.	0.34	125.	34.	1.00	1.00
10	0.021344	65.72	682.05	61.	72.	157.	0.25	137.	44.	1.00	1.00
11	0.027024	87.32	782.85	58.	73.	158.	0.23	-38.	34.	1.00	1.00
12	0.034319	95.44	975.68	60.	73.	158.	0.23	-31.	40.	0.99	0.99
13	0.043250	81.87	1137.65	64.	68.	154.	0.25	-16.	45.	1.00	1.00
14	0.054474	90.97	1485.68	55.	70.	157.	0.32	28.	-81.	1.00	1.00
15	0.076735	109.55	1665.95	48.	68.	158.	0.25	-6.	46.	0.99	0.99
16	0.103760	57.51	2041.28	43.	68.	157.	0.24	-13.	44.	0.89	0.98
17	0.128174	316.49	4201.23	28.	71.	161.	0.38	-12.	58.	0.93	0.94
18	0.158691	79.26	1986.67	49.	60.	156.	0.41	116.	30.	0.96	0.94
19	0.201416	81.06	3321.56	30.	55.	157.	0.30	-23.	27.	0.81	0.74
20	0.256348	98.33	2393.07	43.	47.	156.	0.29	-18.	31.	0.81	0.76
21	0.323486	134.80	4207.83	32.	48.	162.	0.38	-30.	3.	0.62	0.79
22	0.408935	71.74	2859.99	46.	40.	161.	0.26	-23.	19.	0.68	0.51
23	0.518799	90.33	2453.90	35.	43.	159.	0.31	-26.	7.	0.81	0.70
24	0.653076	55.57	2982.99	42.	40.	158.	0.26	-29.	10.	0.81	0.78
25	0.817871	69.77	2501.82	46.	38.	158.	0.36	-33.	0.	0.85	0.76
26	1.025391	78.35	1977.32	43.	39.	162.	0.33	-30.	-5.	0.84	0.75
27	1.287842	70.24	2360.12	44.	39.	163.	0.27	-35.	-16.	0.83	0.70
28	1.617431	70.24	2294.82	46.	41.	163.	0.22	-29.	-30.	0.88	0.75
29	2.032470	71.88	2036.17	52.	41.	163.	0.21	-28.	-51.	0.85	0.73
30	2.597373	63.78	1630.07	50.	32.	160.	0.30	-34.	-62.	0.80	0.62
31	3.216552	75.36	1539.84	54.	38.	163.	0.24	-37.	86.	0.77	0.69
32	4.101563	84.14	1639.21	54.	34.	163.	0.24	-31.	67.	0.86	0.66
33	5.151367	65.77	1558.40	49.	27.	163.	0.22	-32.	47.	0.92	0.82
34	6.469726	73.20	1317.49	46.	35.	168.	0.16	-39.	37.	0.92	0.85
35	8.129883	86.54	1211.37	48.	32.	170.	0.13	-32.	17.	0.92	0.91
36	10.239492	76.04	1153.58	48.	30.	167.	0.20	-36.	16.	0.97	0.97
37	12.866213	79.58	1024.02	43.	29.	170.	0.13	-41.	27.	0.90	0.92
38	16.186522	77.06	1012.80	39.	28.	176.	0.08	-37.	-28.	0.92	0.94
39	20.385744	58.84	976.65	37.	29.	174.	0.12	-36.	28.	0.90	0.91
40	25.659191	58.03	1106.93	34.	25.	178.	0.05	-29.	24.	0.72	0.79
41	32.714840	70.81	949.70	48.	31.	193.	0.34	-29.	39.	0.64	0.71
42	41.303910	90.90	735.34	38.	22.	176.	0.08	-19.	44.	0.65	0.77

MAGNETOTELLURIC STATION 014 REMOTE REFERENCED TO STATION 18

	FREQ	RHOXY	RHOYX	PHASEXY	PHASEYX	ROT ANG	SKEWNESSB	TIPPER TIP STRIK	TIP PHASE	COHXY	COHXY	
1	0.003662	0.81	31.89	71.	53.	150.	0.33	0.15	-44.	43.	0.85	1.00
2	0.004069	1.77	32.95	68.	59.	152.	0.17	0.14	-38.	55.	0.95	0.99
3	0.005290	1.41	27.27	72.	76.	150.	0.33	0.16	131.	43.	0.82	0.90
4	0.007558	4.02	31.11	68.	63.	151.	0.08	0.18	123.	62.	0.62	0.96
5	0.010579	2.35	50.59	76.	74.	148.	0.22	0.24	121.	54.	0.58	0.98
6	0.013630	4.54	68.44	60.	73.	151.	0.16	0.28	119.	40.	0.84	0.99
7	0.017090	3.86	73.56	70.	75.	146.	0.24	0.31	119.	40.	0.96	0.99
8	0.021332	4.31	108.18	74.	76.	149.	0.20	0.37	125.	29.	0.97	0.99
9	0.026970	4.83	127.88	71.	77.	148.	0.21	0.41	125.	25.	0.99	0.99
10	0.034281	5.87	174.88	74.	74.	148.	0.23	0.48	127.	31.	1.00	1.00
11	0.043284	6.39	192.36	76.	70.	149.	0.20	0.52	-40.	44.	1.00	0.99
12	0.054525	7.51	245.38	76.	64.	149.	0.19	0.51	133.	-5.	0.99	1.00
13	0.076798	11.01	255.93	71.	64.	155.	0.14	0.51	-41.	-1.	0.96	0.99
14	0.108525	10.62	280.42	70.	46.	149.	0.24	0.52	132.	-9.	0.84	0.94
15	0.136107	20.88	278.52	71.	49.	153.	0.21	0.50	-40.	-9.	0.32	0.63
16	0.171304	15.95	267.24	76.	46.	150.	0.13	0.49	-40.	-13.	0.66	0.68
17	0.215413	18.89	207.70	59.	40.	161.	0.22	0.42	-21.	-11.	0.40	0.56
18	0.270588	30.31	350.86	62.	46.	159.	0.05	0.56	-24.	-4.	0.48	0.49
19	0.340983	22.45	209.12	41.	45.	168.	0.06	0.38	9.	26.	0.36	0.61
20	0.428568	21.46	198.02	58.	30.	162.	0.13	0.47	-16.	-23.	0.56	0.65
21	0.634766	35.43	160.16	52.	27.	162.	0.07	0.44	-10.	-18.	0.95	0.97
22	0.805664	33.20	118.58	55.	32.	164.	0.09	0.44	-33.	-22.	0.92	0.96
23	1.025391	34.14	120.47	51.	33.	166.	0.11	0.43	-9.	-20.	0.95	0.96
24	1.293945	29.04	149.05	53.	25.	161.	0.09	0.43	3.	24.	0.96	0.95
25	1.635742	42.57	109.96	58.	23.	162.	0.10	0.33	4.	-11.	0.91	0.89
26	2.075195	32.42	92.39	51.	34.	168.	0.09	0.41	7.	0.	0.86	0.90
27	2.612304	35.23	67.93	44.	22.	157.	0.11	0.50	-19.	-32.	0.93	0.93
28	3.271484	40.25	74.45	50.	26.	169.	0.16	0.25	-10.	19.	0.89	0.84
29	4.101563	42.28	66.41	24.	25.	175.	0.12	0.24	17.	-27.	0.77	0.93
30	5.151367	36.59	65.46	34.	29.	152.	0.06	0.26	-11.	-11.	0.88	0.86
31	6.469726	35.80	56.40	36.	25.	164.	0.12	0.21	4.	-6.	0.90	0.94
32	8.129883	31.09	51.19	30.	25.	154.	0.10	0.16	21.	-10.	0.97	0.96
33	10.229494	30.43	42.19	22.	28.	150.	0.14	0.17	10.	-23.	0.90	0.80
34	12.866213	23.39	44.83	26.	21.	151.	0.08	0.14	37.	-42.	0.91	0.86
35	16.186522	19.44	37.91	21.	19.	148.	0.07	0.11	60.	-33.	0.95	0.88
36	20.385744	18.02	29.90	19.	17.	140.	0.12	0.10	73.	-58.	0.93	0.81
37	25.659191	14.49	26.10	20.	12.	141.	0.09	0.13	-27.	-18.	0.88	0.74
38	32.275387	9.29	19.37	13.	21.	156.	0.11	0.24	121.	25.	0.81	0.62

MAGNETOTELLURIC STATION 016 REMOTE REFERENCED TO STATION 17

FREQ	RHOXY	RHOYX	PHASEXY	PHASEYX	ROT ANO	SKEWNESS	TIPPER	TIP STRIK	COHYX	COHYX ELLIPH	ELLIPSE	
1	0.001017	270.91	589.41	49.	52.	118.	0.05	0.14	0.99	1.00	-0.79	0.48
2	0.001831	178.80	574.73	55.	50.	123.	0.06	0.15	0.98	0.99	-0.39	0.26
3	0.002645	271.61	520.60	58.	52.	139.	0.08	0.16	1.00	1.00	-0.20	0.17
4	0.003459	234.85	540.71	55.	55.	119.	0.06	0.14	1.00	1.00	-0.18	0.19
5	0.004169	253.55	576.50	59.	58.	131.	0.02	0.17	0.98	0.98	-0.14	0.13
6	0.005290	265.47	605.76	56.	59.	129.	0.04	0.17	1.00	1.00	-0.16	-0.00
7	0.007466	321.11	671.99	56.	62.	125.	0.09	0.14	0.98	0.99	-0.31	0.28
8	0.010660	369.01	780.88	58.	63.	134.	0.06	0.14	1.00	0.99	-0.47	0.61
9	0.013753	404.11	982.72	58.	67.	133.	0.09	0.14	0.99	0.99	0.12	-0.03
10	0.017171	425.71	1184.54	59.	69.	134.	0.09	0.15	1.00	1.00	0.17	-0.13
11	0.021401	431.98	1284.78	57.	69.	134.	0.13	0.16	0.99	1.00	0.14	-0.09
12	0.027017	594.16	1457.92	52.	70.	139.	0.10	0.18	1.00	1.00	0.14	-0.17
13	0.034180	528.08	1881.94	53.	66.	135.	0.11	0.23	1.00	1.00	0.32	-0.39
14	0.043050	507.53	1921.33	56.	66.	134.	0.06	0.36	1.00	1.00	0.20	-0.37
15	0.054280	546.48	2609.93	53.	64.	138.	0.11	0.27	0.99	0.99	0.09	0.02
16	0.076328	558.74	2488.94	49.	63.	141.	0.08	0.26	0.91	0.99	0.23	-0.06
17	0.201416	459.49	3290.16	44.	44.	145.	0.16	0.53	0.60	0.38	-0.07	-0.13
18	0.236348	345.00	2703.79	25.	54.	149.	0.25	0.25	0.60	0.64	0.29	-0.19
19	0.323486	339.00	3035.90	66.	22.	134.	0.26	0.41	0.61	0.61	0.19	-0.14
20	0.512695	329.46	3364.19	15.	43.	163.	0.28	0.25	0.93	0.93	0.44	-0.09
21	0.634766	430.08	2014.20	27.	38.	153.	0.12	0.16	0.95	0.89	0.18	-0.11
22	0.805664	346.78	2184.33	38.	25.	155.	0.12	0.29	0.93	0.93	0.07	0.03
23	1.025391	325.27	1561.36	53.	24.	150.	0.11	0.40	0.90	0.83	0.21	-0.01
24	1.253945	328.90	1481.02	64.	17.	158.	0.14	0.31	0.76	0.97	0.09	0.13
25	1.635742	448.68	1096.87	58.	18.	153.	0.17	0.20	0.94	0.91	0.00	0.18
26	2.075195	297.07	1027.19	50.	21.	159.	0.25	0.29	0.95	0.91	0.15	0.04
27	2.612304	429.34	998.90	48.	14.	152.	0.14	0.34	0.96	0.92	-0.09	0.26
28	3.271484	358.58	633.04	43.	14.	153.	0.14	0.24	0.93	0.93	0.02	0.28
29	4.101563	576.74	611.43	39.	17.	152.	0.11	0.31	0.89	0.92	-0.01	0.30
30	5.151367	592.22	458.83	43.	13.	152.	0.08	0.41	0.92	0.94	-0.04	0.27
31	6.469726	577.61	415.14	33.	13.	155.	0.06	0.37	0.95	0.97	-0.16	0.40
32	8.129883	591.09	323.95	30.	14.	159.	0.04	0.41	0.97	0.98	-0.31	0.49
33	10.229494	523.72	293.74	28.	14.	161.	0.03	0.58	0.87	0.93	0.05	0.06
34	12.866213	428.12	255.82	21.	15.	157.	0.04	0.38	0.93	0.95	-0.04	0.10
35	16.186522	563.73	222.93	11.	13.	170.	0.03	0.44	0.90	0.96	-0.07	0.12
36	20.507809	863.58	150.49	33.	13.	182.	0.19	0.92	0.81	-0.15	0.45	0.43
37	25.878916	620.31	117.36	7.	3.	185.	0.24	0.75	0.89	0.82	0.00	0.43
38	32.714840	739.91	67.18	1.	3.	179.	0.06	0.89	0.88	0.70	-0.11	0.14
39	41.503918	652.46	140.25	-21.	11.	187.	0.18	0.60	0.89	0.83	-0.18	0.15
40	52.246094	495.74	83.86	-37.	6.	176.	0.11	2.68	0.77	0.79	-0.21	0.18

MAGNETOTELLURIC STATION 017 REMOTE REFERENCED TO STATION 16

FREQ	RHOXY	RHOYX	PHASEXY	PHASEYX	ROT ANG	SKEWNESS	TIPPER TIP STRIK	TIP PHASE	CONXY	CONYX
1 0.002645	154.22	3.12	50.	52.	146.	0.21	0.16	38.	0.93	0.84
2 0.003459	179.11	3.33	52.	62.	149.	0.21	0.16	35.	1.00	1.00
3 0.004204	179.61	4.71	61.	61.	144.	0.17	0.17	31.	0.97	0.91
4 0.005290	194.97	3.79	59.	68.	148.	0.23	0.15	41.	0.99	0.98
5 0.007490	194.01	4.93	61.	72.	146.	0.22	0.14	34.	0.97	0.95
6 0.010681	271.85	6.25	60.	75.	146.	0.18	0.13	37.	1.00	0.99
7 0.013744	267.84	7.28	61.	72.	143.	0.19	0.11	36.	0.99	0.98
8 0.017180	313.73	10.18	62.	74.	145.	0.14	0.11	5.	0.99	0.99
9 0.021401	328.39	10.39	61.	77.	144.	0.14	0.11	-5.	0.99	0.99
10 0.027017	456.92	11.75	56.	78.	144.	0.15	0.11	23.	1.00	1.00
11 0.034180	441.69	15.37	54.	73.	146.	0.17	0.15	16.	1.00	1.00
12 0.043050	429.91	15.92	55.	74.	148.	0.24	0.21	27.	1.00	1.00
13 0.054280	455.72	24.15	54.	74.	144.	0.13	0.15	124.	0.99	0.99
14 0.075802	501.10	23.77	47.	74.	143.	0.13	0.16	119.	1.00	1.00
15 0.109049	1049.33	40.03	53.	48.	142.	0.27	0.12	-38.	0.96	0.98
16 0.136106	569.30	25.25	46.	76.	146.	0.16	0.18	14.	0.75	0.94
17 0.256348	384.92	49.97	29.	62.	134.	0.28	0.20	8.	0.67	0.30
18 0.323486	394.16	40.49	31.	53.	129.	0.08	0.27	127.	0.97	0.81
19 0.408935	373.90	67.36	32.	-45.	117.	0.49	0.63	101.	0.98	0.87
20 0.512695	340.48	57.41	26.	74.	121.	0.30	0.84	95.	0.96	0.85
21 0.634766	339.71	34.20	27.	50.	133.	0.09	0.55	123.	1.00	0.98
22 0.805664	269.93	26.19	24.	72.	123.	0.21	0.35	-32.	0.99	0.87
23 1.025391	229.03	42.77	20.	47.	129.	0.04	0.38	27.	0.97	0.92
24 1.293945	173.98	33.80	19.	41.	138.	0.11	0.37	-14.	0.95	0.85
25 1.635742	157.74	35.32	24.	55.	125.	0.04	0.28	64.	0.96	0.90
26 2.075195	123.48	21.32	17.	46.	125.	0.16	0.25	16.	0.97	0.69
27 2.612304	110.06	31.69	23.	44.	126.	0.12	0.28	6.	0.96	0.67
28 3.271484	101.18	24.46	21.	35.	119.	0.09	0.28	5.	0.94	0.69
29 4.101563	82.13	25.50	25.	37.	125.	0.20	0.21	-21.	0.93	0.73
30 5.151367	70.77	47.04	24.	40.	134.	0.11	0.19	40.	0.93	0.83
31 6.469726	65.14	40.74	23.	46.	125.	0.03	0.12	46.	0.97	0.82
32 8.129883	54.97	35.45	26.	44.	121.	0.04	0.13	17.	0.98	0.93
33 10.229494	48.35	30.67	27.	45.	117.	0.05	0.18	16.	0.94	0.93
34 12.866213	50.15	30.46	32.	45.	108.	0.05	0.18	-13.	0.94	0.80
35 16.186522	47.24	27.18	32.	35.	105.	0.07	0.07	104.	0.93	0.82
36 20.385744	43.24	22.73	29.	33.	107.	0.08	0.08	97.	0.92	0.64
37 32.714840	38.27	15.35	33.	11.	50.	0.27	0.31	109.	0.93	0.71
38 41.503910	33.38	25.75	23.	31.	115.	0.11	0.44	62.	0.60	0.44
39 52.246094	27.10	30.75	19.	25.	112.	0.14	1.01	126.	0.89	0.80
								99.	0.90	0.71

MAGNETOTELLURIC STATION 018 REMOTE REFERENCED TO STATION 14

FREQ	RHOXY	RHOYX	PHASEXY	PHASEYX	ROT ANO	SKEWNESS	TIPPER TIP STRIK	TIP PHASE	COHXY	COHYX
0.003662	1.34	34.36	68.	56.	81.	0.43	0.23	7.	0.98	0.99
0.004049	1.81	35.12	66.	56.	70.	0.47	0.15	16.	0.98	0.97
0.005270	3.99	42.10	75.	47.	62.	0.52	0.48	8.	1.00	0.98
0.007504	2.05	37.91	72.	63.	71.	0.47	0.13	40.	0.97	0.94
0.010579	3.81	49.79	76.	62.	73.	0.44	0.12	88.	0.98	0.91
0.013670	4.33	64.21	70.	62.	70.	0.49	0.20	88.	0.97	0.87
0.017090	4.75	74.10	74.	59.	69.	0.48	0.14	58.	0.99	0.98
0.021294	6.86	94.79	74.	53.	68.	0.46	0.19	49.	0.99	0.98
0.026990	7.64	104.88	75.	51.	69.	0.47	0.22	54.	0.99	0.98
0.034315	10.53	110.85	72.	46.	69.	0.41	0.24	83.	1.00	1.00
0.043267	11.84	106.95	68.	46.	71.	0.38	0.26	29.	1.00	1.00
0.054525	14.38	106.78	63.	42.	69.	0.39	0.24	106.	1.00	1.00
0.077275	16.73	92.50	64.	34.	66.	0.37	0.26	100.	0.99	0.99
0.108641	15.48	92.11	52.	32.	71.	0.34	0.30	81.	0.97	0.98
0.136194	16.73	86.36	40.	32.	76.	0.30	0.31	94.	0.59	0.85
0.171304	13.34	83.67	39.	27.	78.	0.31	0.35	92.	0.57	0.90
0.215199	14.24	67.10	28.	29.	80.	0.35	0.33	98.	0.48	0.68
0.256348	18.17	53.34	29.	21.	77.	0.27	0.30	96.	0.84	0.98
0.323486	15.43	49.95	18.	23.	87.	0.21	0.30	103.	0.88	0.98
0.408935	11.96	32.63	22.	21.	74.	0.24	0.21	89.	0.80	0.96
0.518799	12.17	27.49	22.	14.	78.	0.31	0.30	91.	0.85	0.95
0.653076	8.91	25.23	10.	34.	101.	0.22	0.27	96.	0.90	0.95
0.817871	9.32	20.74	33.	17.	71.	0.28	0.39	99.	0.79	0.95
1.025391	6.99	21.28	32.	17.	70.	0.24	0.74	103.	0.71	0.91
1.635742	4.51	-8.77	52.	28.	60.	0.20	0.23	-24.	0.64	0.89
2.075195	2.12	4.63	12.	64.	106.	0.52	0.22	91.	0.54	0.75
2.612304	2.57	10.86	49.	39.	81.	0.17	0.09	79.	0.67	0.87
3.271494	3.64	5.60	41.	43.	83.	0.57	0.31	101.	0.67	0.82
5.151367	4.44	12.40	46.	56.	81.	0.24	0.18	93.	0.67	0.71
6.469726	6.33	15.69	38.	66.	88.	0.33	0.04	-8.	0.72	0.83
8.129883	6.02	26.68	36.	60.	87.	0.21	0.10	70.	0.85	0.91
10.229494	6.52	30.85	29.	56.	90.	0.25	0.05	43.	0.63	0.77
12.695313	6.42	42.07	74	58.	69.	0.18	0.39	106.	0.76	0.90
16.113279	11.62	46.28	74.	52.	67.	0.25	0.73	95.	0.74	0.80
20.507809	19.43	71.90	40.	52.	99.	0.39	0.63	120.	0.66	0.78
25.878922	22.02	61.52	37.	64.	76.	0.28	0.31	-33.	0.44	0.79
32.714840	10.35	160.14	60.	40.	82.	0.18	3.44	103.	0.60	0.93
41.503918	16.94	39.60	34.	30.	93.	0.62	0.51	94.	0.62	0.81
52.246094	10.77	63.01	46.	6.	79.	0.40	0.78	97.	0.51	0.83

MAGNETOTELLURIC STATION 019 REMOTE REFERENCED TO STATION 23

FREQ	RHOXY	RHOYX	PHASEXY	PHASEYX	ROT ANG	SKEWNESS	TIPPER	TIP STRIK	TIP PHASE	COHXY	COHYY
1	0.002035	13.72	-84.	48.	120.	0.24	0.12	-4.	-8.	0.98	0.99
2	0.003662	21.34	-78.	50.	115.	0.42	0.08	13.	-44.	1.00	1.00
3	0.004069	18.00	76.	46.	118.	0.33	0.07	-9.	-62.	0.88	0.99
4	0.005290	49.26	46.	63.	111.	0.71	0.12	122.	26.	1.00	1.00
5	0.007650	19.88	83.	58.	114.	0.58	0.10	-31.	20.	0.91	0.99
6	0.010579	29.27	87.	59.	112.	0.71	0.11	129.	-8.	0.98	0.99
7	0.013630	29.84	84.	59.	112.	0.71	0.12	-39.	-39.	0.99	1.00
8	0.017090	36.91	83.	59.	111.	0.75	0.15	123.	66.	1.00	1.00
9	0.021332	39.65	83.	59.	110.	0.82	0.17	121.	56.	1.00	1.00
10	0.027036	41.32	83.	57.	110.	0.81	0.19	121.	51.	1.00	1.00
11	0.034360	46.82	85.	55.	109.	0.88	0.24	112.	60.	0.99	1.00
12	0.043312	49.56	85.	55.	107.	0.98	0.29	98.	38.	1.00	1.00
13	0.054525	52.30	82.	53.	106.	1.00	0.31	110.	33.	1.00	1.00
14	0.077164	47.39	80.	52.	105.	1.07	0.34	107.	16.	0.98	0.99
15	0.103760	54.84	76.	48.	103.	1.25	0.41	100.	22.	0.97	0.98
16	0.128174	54.20	72.	45.	102.	1.33	0.41	96.	8.	0.91	0.95
17	0.158691	61.29	67.	44.	101.	1.38	0.44	96.	22.	0.91	0.98
18	0.201416	54.35	69.	35.	102.	1.30	0.46	103.	3.	0.83	0.90
19	0.256348	63.06	60.	42.	100.	1.27	0.42	85.	0.	0.83	0.86
20	0.323486	83.54	65.	48.	101.	1.32	0.50	88.	7.	0.91	0.88
21	0.408935	17.96	70.	29.	99.	1.05	0.44	87.	2.	0.86	0.82
22	0.518799	48.50	75.	32.	96.	0.98	0.45	85.	8.	0.87	0.85
23	0.63076	40.56	62.	32.	94.	1.48	0.48	82.	2.	0.87	0.85
24	0.817871	63.51	52.	38.	98.	1.68	0.46	78.	-3.	0.90	0.90
25	1.025391	42.87	55.	32.	87.	2.20	0.47	84.	-2.	0.93	0.94
26	1.293945	35.77	69.	30.	88.	1.31	0.54	61.	7.	0.93	0.89
27	1.635742	32.19	47.	20.	90.	2.21	0.35	36.	-30.	0.87	0.84
28	2.075195	23.93	53.	37.	87.	2.68	0.44	59.	1.	0.93	0.93
29	2.612305	17.07	50.	29.	85.	2.42	0.32	10.	-2.	0.93	0.91
30	3.271484	7.88	43.	29.	76.	0.71	0.35	48.	-39.	0.96	0.92
31	4.101563	9.39	40.	36.	79.	0.92	0.33	23.	-37.	0.98	0.97
32	5.151367	13.38	31.	29.	81.	0.98	0.35	35.	-34.	0.91	0.91
33	6.469727	13.05	33.	28.	82.	1.23	0.28	33.	-40.	0.90	0.91
34	8.129883	26.69	30.	25.	83.	1.38	0.23	35.	-35.	0.93	0.91
35	10.229494	11.12	23.	27.	83.	1.23	0.23	36.	-16.	0.85	0.82
36	12.866208	11.13	20.	26.	84.	1.19	0.23	40.	-3.	0.71	0.65
37	16.186518	9.63	20.	23.	84.	0.92	0.18	35.			
38	20.385744	8.69	15.	22.	84.	0.97	0.22	36.			
39	25.659191	5.55	21.	4.	86.	0.80	0.89	40.			

MAGNETOTELLURIC STATION 020

FREQ	RHOXY	RHOYZ	PHASEXY	PHASEYZ	ROT ANG	SKEWNESS	TIPPER	TIP STRIK	TIP PHASE	CONKX	CONKY
1	0.007448	6.74	14.39	64.	104.	0.12	0.16	33.	-28.	0.93	0.93
2	0.010647	5.27	14.96	64.	151.	0.11	0.13	-3.	24.	0.88	0.98
3	0.013760	5.34	18.08	75.	144.	0.07	0.14	-19.	14.	0.90	0.99
4	0.017171	7.73	19.94	70.	149.	0.08	0.15	-35.	10.	0.88	0.99
5	0.021401	9.26	25.21	64.	144.	0.02	0.15	-35.	1.	0.93	1.00
6	0.026990	9.66	25.88	67.	151.	0.10	0.15	-33.	-3.	0.99	0.99
7	0.034180	11.95	32.28	63.	156.	0.11	0.25	-24.	-15.	0.96	1.00
8	0.043073	11.27	37.71	69.	147.	0.09	0.27	-27.	-41.	0.98	0.99
9	0.054302	14.96	40.76	68.	146.	0.12	0.19	123.	-22.	0.90	0.99
10	0.068854	17.06	51.55	57.	154.	0.11	0.18	-43.	-25.	0.48	0.77
11	0.096348	26.34	54.85	59.	161.	0.22	0.12	-48.	44.	0.81	0.92
12	0.323486	12.33	80.84	36.	159.	0.23	0.07	-19.	39.	0.63	0.89
13	0.408935	31.61	75.24	66.	167.	0.16	0.10	-17.	30.	0.87	0.87
14	0.318799	25.07	61.08	64.	156.	0.11	0.08	-13.	34.	0.88	0.91
15	0.653076	28.70	75.04	50.	156.	0.03	0.08	-22.	21.	0.86	0.92
16	0.805664	31.17	82.38	57.	137.	0.09	0.09	-26.	25.	0.83	0.93
17	1.025391	27.92	90.06	67.	154.	0.05	0.07	-20.	9.	0.84	0.88
18	1.273943	26.64	80.23	65.	166.	0.02	0.06	-8.	-45.	0.77	0.90
19	1.635742	30.98	78.09	54.	166.	0.05	0.05	-11.	19.	0.81	0.89
20	2.075195	36.09	78.12	69.	159.	0.02	0.08	-3.	1.	0.75	0.90
21	2.612305	38.57	86.26	66.	181.	0.03	0.10	84.	66.	0.58	0.89
22	3.271484	37.59	101.63	61.	179.	0.09	0.05	88.	38.	0.42	0.90
23	4.101563	54.98	99.55	60.	169.	0.14	0.12	119.	51.	0.50	0.89
24	5.131367	60.68	113.01	54.	166.	0.11	0.13	114.	41.	0.57	0.92
25	6.469729	84.32	109.87	70.	160.	0.07	0.19	112.	25.	0.72	0.96
26	8.129887	118.66	103.57	51.	142.	0.08	0.25	106.	20.	0.92	0.97
27	10.259494	151.37	107.51	45.	140.	0.08	0.33	105.	3.	0.76	0.93
28	12.866208	169.37	110.93	37.	134.	0.13	0.34	107.	-7.	0.86	0.93
29	16.186318	126.51	136.51	25.	105.	0.12	0.36	105.	-1.	0.96	0.78
30	20.385744	117.02	89.67	23.	181.	0.07	0.46	106.	-31.	0.31	0.85

MAGNETOTELLURIC STATION 021 REMOTE REFERENCED TO STATION 20

	FREQ	RHOXY	RHOYX	PHASEXY	PHASEYX	ROT ANG	SKEMNESB	TIPPER TIP STRIK	TIP PHASE	COHXY	COHYX
1	0.001831	2.54	193.92	57	55	82	0.09	0.13	40	0.96	0.99
2	0.002645	2.59	213.70	57	56	80	0.08	0.16	13	0.96	0.99
3	0.003459	3.65	211.42	67	54	82	0.08	0.15	10	0.97	0.99
4	0.004142	3.17	190.84	72	50	83	0.07	0.14	7	0.94	0.98
5	0.005290	3.88	227.06	65	54	82	0.06	0.14	26	0.98	0.99
6	0.007479	2.06	263.49	58	59	82	0.12	0.17	-10	0.79	0.98
7	0.010647	6.55	340.53	71	60	81	0.07	0.17	-15	0.99	0.98
8	0.013760	6.79	394.22	72	64	81	0.07	0.19	35	0.99	0.98
9	0.017157	8.03	419.68	74	64	81	0.06	0.21	29	0.99	0.99
10	0.021360	9.63	567.82	73	64	81	0.09	0.21	27	1.00	0.99
11	0.027003	10.57	613.35	76	58	79	0.11	0.22	17	0.99	0.99
12	0.034180	13.75	622.61	76	58	80	0.10	0.28	15	0.99	0.99
13	0.043064	14.54	664.91	73	55	83	0.04	0.29	8	1.00	0.99
14	0.054302	16.19	773.69	73	54	81	0.07	0.26	-1	0.94	0.97
15	0.070475	24.11	899.42	78	49	80	0.08	0.27	-2	0.74	0.83
16	0.128174	9.04	704.36	49	9	92	0.62	0.55	-7	0.97	0.72
17	0.158691	24.27	762.44	69	47	83	0.16	0.43	57	0.70	0.82
18	0.201416	15.45	625.47	26	47	63	0.44	0.25	18	0.73	0.82
19	0.256348	56.99	570.84	72	-1	87	0.24	0.24	-73	0.92	0.67
20	0.323486	43.98	574.66	60	34	73	0.18	0.13	-34	0.67	0.84
21	0.408935	55.82	480.92	50	22	75	0.23	0.11	-10	0.80	0.82
22	0.518799	56.91	501.37	58	23	77	0.16	0.07	-63	0.60	0.86
23	0.653076	82.13	343.44	60	27	72	0.19	0.15	7	0.78	0.88
24	0.817871	82.24	391.65	58	25	77	0.05	0.07	-29	0.82	0.86
25	1.025391	82.77	330.98	49	28	80	0.08	0.17	34	0.74	0.90
26	1.293945	69.68	265.53	58	26	74	0.16	0.18	8	0.60	0.86
27	1.635742	86.77	251.38	54	30	76	0.10	0.10	26	0.66	0.83
28	2.075195	77.71	190.77	60	24	71	0.21	0.20	15	0.59	0.79
29	2.612305	73.37	152.68	57	31	71	0.08	0.12	39	0.68	0.76
30	3.271484	114.40	94.34	63	31	54	0.16	0.32	6	0.63	0.77
31	4.101563	115.77	160.40	50	24	76	0.11	0.15	-42	0.61	0.79
32	5.151367	166.59	78.93	50	26	45	0.11	0.11	38	0.72	0.86
33	6.469730	167.19	82.95	43	29	40	0.07	0.16	31	0.90	0.95
34	8.129887	168.65	69.29	38	30	34	0.06	0.20	6	0.81	0.81
35	10.229494	132.24	54.29	35	30	33	0.05	0.18	22	0.81	0.88
36	12.866208	139.87	56.66	31	36	28	0.04	0.16	-1	0.82	0.90
37	16.186522	116.59	50.11	31	32	35	0.02	0.06	-11	0.79	0.89
38	20.507809	124.28	61.44	36	32	27	0.04	0.16	-1	0.72	0.94
39	25.878722	100.47	53.10	23	44	21	0.06	0.43	-16	0.76	0.76
40	32.714840	78.09	46.20	24	11	39	0.11	0.30	43	0.65	0.78
41	41.503918	48.12	44.26	24	20	74	0.11	2.51	61	0.80	0.74
42	52.246094	33.71	38.89	29	8	92	0.11		21		

MAGNETOTELLURIC STATION 022 REMOTE REFERENCED TO STATION 25

FREQ	RHOXY	RHOYZ	PHASEXY	PHASEYZ	ROT ANO	SKEWNESS	TIPPER TIP STRIK	TIP PHASE	CONVY	CONVZ
1	0.001017	21.26	19.44	58.	52.	100.	0.09	-12.	0.99	0.99
2	0.001831	29.49	13.25	58.	55.	155.	0.09	14.	0.99	0.99
3	0.002035	21.43	16.49	68.	50.	144.	0.12	45.	0.92	0.98
4	0.002645	24.83	16.95	55.	56.	108.	0.10	30.	0.98	1.00
5	0.003525	26.03	14.32	63.	56.	128.	0.13	22.	0.99	0.99
6	0.004136	27.78	18.34	61.	53.	131.	0.13	46.	0.96	0.98
7	0.005290	28.34	14.97	58.	57.	111.	0.14	-3.	0.99	0.99
8	0.007496	33.23	15.78	61.	62.	110.	0.14	-36.	0.99	0.98
9	0.010637	42.61	19.21	70.	60.	115.	0.15	43.	0.99	0.99
10	0.013681	49.11	23.58	71.	62.	126.	0.15	30.	0.99	0.99
11	0.017140	55.34	29.32	71.	61.	122.	0.17	19.	0.99	1.00
12	0.021412	64.18	30.89	70.	64.	123.	0.18	13.	1.00	1.00
13	0.027058	85.37	34.47	70.	60.	125.	0.20	4.	1.00	1.00
14	0.034281	95.67	38.11	65.	58.	128.	0.22	-4.	1.00	0.99
15	0.043182	97.84	40.66	65.	60.	128.	0.31	122.	1.00	0.99
16	0.054372	101.32	38.44	69.	63.	130.	0.19	111.	0.90	0.88
17	0.077902	161.56	59.	59.	59.	133.	0.20	-21.	0.75	0.77
18	0.108560	163.08	61.25	59.	57.	133.	0.20	43.	0.75	0.63
19	0.136003	223.48	64.95	58.	51.	109.	0.24	-30.	0.67	0.74
20	0.170999	200.30	72.92	52.	51.	122.	0.29	-12.	0.73	0.80
21	0.214944	222.99	55.90	44.	44.	121.	0.19	-75.	0.70	0.59
22	0.256348	212.74	55.90	44.	44.	116.	0.28	60.	0.89	0.87
23	0.323486	213.48	79.75	42.	40.	116.	0.30	-10.	0.96	0.77
24	0.408935	203.86	61.65	38.	46.	105.	0.13	6.	0.97	0.87
25	0.518799	240.55	51.53	37.	41.	102.	0.29	49.	0.93	0.91
26	0.693076	183.80	47.38	36.	50.	113.	0.31	15.	0.92	0.68
27	0.817871	191.66	68.15	34.	31.	103.	0.34	47.	0.94	0.85
28	1.025391	153.12	28.69	31.	41.	107.	0.34	23.	0.97	0.94
29	1.293945	135.49	28.05	29.	41.	103.	0.34	36.	0.97	0.92
30	1.635742	118.18	18.15	31.	37.	100.	0.35	11.	0.93	0.74
31	2.075195	98.62	42.91	30.	36.	118.	0.21	-23.	0.86	0.71
32	2.612304	91.14	32.64	28.	44.	104.	0.34	0.	0.91	0.78
33	3.271484	79.98	27.19	33.	42.	110.	0.31	-9.	0.96	0.84
34	4.101563	75.27	30.90	30.	48.	106.	0.30	-14.	0.96	0.84
35	5.151367	67.56	34.22	30.	49.	100.	0.30	-17.	0.97	0.94
36	6.469726	57.21	39.36	28.	47.	107.	0.25	-19.	0.91	0.86
37	8.129883	53.57	39.28	27.	49.	111.	0.23	-13.	0.94	0.83
38	10.229494	53.87	37.57	28.	45.	113.	0.22	-15.	0.93	0.88
39	12.866213	42.62	37.16	28.	40.	90.	0.22	-7.	0.91	0.87
40	16.186522	38.17	56.32	30.	33.	76.	0.24	-23.	0.84	0.86
41	20.385744	36.02	64.04	29.	21.	80.	0.24	-23.	0.84	0.86
42	25.878916	45.12	73.97	33	24.	73.	0.24	-23.	0.84	0.86

MAGNETOTELLURIC STATION 023 REMOTE REFERENCED TO STATION 19

FREQ	RHOX	RHOY	PHASEY	PHASEX	ROT ANG	SKEWNESS	TIPPER TIP STRIK	TIP PHASE	COHY	CONY
1	0.002035	4.60	31.22	56.	144.	0.44	0.11	14.	0.99	0.99
2	0.003662	8.23	30.64	48.	145.	0.37	0.12	31.	0.99	1.00
3	0.004069	6.60	37.66	70.	146.	0.48	0.13	28.	1.00	0.98
4	0.005290	6.29	34.76	74.	136.	0.53	0.13	24.	1.00	0.99
5	0.007497	12.16	33.33	71.	142.	0.37	0.15	10.	0.99	0.99
6	0.010579	13.03	44.43	56.	139.	0.41	0.17	7.	0.99	0.99
7	0.013652	15.55	47.15	73.	139.	0.41	0.17	9.	1.00	1.00
8	0.017090	16.39	55.32	70.	135.	0.42	0.18	9.	1.00	1.00
9	0.021339	23.54	56.40	69.	133.	0.37	0.18	10.	1.00	1.00
10	0.027036	24.30	62.70	68.	133.	0.37	0.19	7.	1.00	1.00
11	0.034360	29.14	68.89	63.	135.	0.31	0.21	0.	1.00	1.00
12	0.043312	30.27	69.60	63.	133.	0.29	0.20	12.	1.00	1.00
13	0.054523	35.72	70.06	59.	131.	0.27	0.21	23.	1.00	1.00
14	0.077164	34.52	63.93	55.	132.	0.25	0.23	23.	1.00	1.00
15	0.108303	31.97	76.27	50.	131.	0.24	0.24	28.	0.87	0.94
16	0.128174	35.04	72.60	50.	124.	0.20	0.19	10.	0.97	0.98
17	0.158691	48.57	47.21	52.	133.	0.15	0.23	1.	0.85	0.99
18	0.201416	41.78	57.56	36.	164.	0.06	0.31	13.	0.84	0.93
19	0.256348	18.35	73.33	31.	142.	0.27	0.26	52.	0.76	0.87
20	0.323486	28.62	56.85	31.	139.	0.30	0.43	44.	0.85	0.86
21	0.408935	25.08	49.56	31.	175.	0.11	0.31	16.	0.65	0.64
22	0.518799	19.54	43.32	36.	160.	0.27	0.36	31.	0.73	0.71
23	0.653076	21.18	56.55	37.	143.	0.17	0.55	19.	0.87	0.83
24	0.805664	29.80	44.01	60.	164.	0.10	0.04	125.	0.93	0.98
25	1.025391	27.20	57.03	49.	140.	0.03	0.03	80.	0.89	0.87
26	1.293945	22.63	38.86	60.	169.	0.05	0.02	93.	0.86	0.97
27	1.639742	26.33	35.33	62.	170.	0.09	0.04	101.	0.76	0.95
28	2.075195	25.95	47.70	60.	159.	0.04	0.01	63.	0.81	0.90
29	2.612304	18.13	32.82	52.	164.	0.03	0.01	120.	0.76	0.92
30	3.271484	21.51	36.60	54.	171.	0.17	0.03	81.	0.79	0.89
31	4.101563	20.22	34.67	50.	162.	0.19	0.02	121.	0.81	0.89
32	5.151367	23.55	39.68	56.	166.	0.18	0.02	127.	0.84	0.94
33	6.469726	46.37	30.57	46.	175.	0.11	0.01	75.	0.78	0.89
34	8.129883	56.73	29.49	41.	168.	0.05	0.00	43.	0.93	0.98
35	10.229492	52.32	28.31	37.	170.	0.05	0.00	63.	0.70	0.75
36	12.866213	63.23	24.66	27.	172.	0.06	0.00	48.	0.79	0.94
37	16.186523	72.80	18.63	17.	170.	0.03	0.01	15.	0.81	0.95

MAGNETOTELLURIC STATION 024 REMOTE REFERENCED TO STATION 13

FREQ	RHOXY	RHOYX	PHASEXY	PHASEYX	ROT ANG	SKEWNESS	TIPPER TIP	STRIK	TIP PHASE	COHXY	COHYX
1	0.003593	11.08	1935.94	42.	61.	107.	0.35	130.	8.	0.99	1.00
2	0.004069	10.67	1679.27	45.	55.	111.	0.28	126.	3.	0.96	0.98
3	0.005290	13.72	1338.44	76.	55.	118.	0.13	-36.	-7.	0.98	1.00
4	0.007619	18.36	1932.58	65.	59.	113.	0.18	122.	-1.	0.99	0.99
5	0.010608	15.24	2479.09	64.	61.	109.	0.28	125.	6.	0.99	1.00
6	0.013681	19.30	2321.92	58.	64.	109.	0.28	133.	9.	0.99	1.00
7	0.017112	16.90	2594.30	65.	62.	109.	0.29	-39.	13.	1.00	0.99
8	0.021381	24.21	2953.30	60.	65.	106.	0.32	-44.	18.	1.00	1.00
9	0.027040	23.22	3634.58	69.	61.	103.	0.34	-41.	16.	1.00	0.99
10	0.034327	33.89	3874.76	75.	60.	106.	0.31	-27.	10.	1.00	1.00
11	0.043290	35.09	4392.88	70.	62.	108.	0.28	19.	4.	1.00	0.99
12	0.054474	34.06	4840.67	56.	63.	106.	0.33	-6.	-14.	0.99	0.99
13	0.076609	37.09	4898.14	64.	59.	104.	0.34	-22.	-20.	0.98	0.99
14	0.103760	40.48	7212.01	65.	56.	103.	0.35	109.	-16.	0.99	0.99
15	0.138174	26.65	8401.08	53.	57.	106.	0.40	-42.	-34.	0.96	0.93
16	0.158691	40.33	6960.36	69.	55.	104.	0.39	27.	-23.	0.97	0.98
17	0.201416	30.69	9659.93	86.	58.	102.	0.41	119.	-44.	0.62	0.66
18	0.256348	99.88	9003.67	75.	39.	101.	0.41	48.	-4.	0.94	0.92
19	0.323486	73.33	6378.84	74.	44.	104.	0.31	84.	-23.	0.72	0.80
20	0.408935	131.71	7992.57	61.	53.	106.	0.29	10.	27.	0.91	0.95
21	0.518799	143.47	7848.91	54.	53.	108.	0.27	90.	22.	0.88	0.92
22	0.653076	139.28	6928.54	52.	52.	108.	0.28	74.	30.	0.85	0.87
23	0.817871	160.23	8953.68	47.	52.	108.	0.24	61.	24.	0.80	0.86
24	1.025391	145.03	13646.97	34.	53.	110.	0.19	66.	20.	0.81	0.86
25	1.293945	124.75	6935.45	77.	58.	115.	0.38	-40.	27.	0.95	0.97
26	1.635742	198.60	14449.70	56.	54.	120.	0.16	-42.	37.	0.85	0.89
27	2.075195	190.78	8659.64	52.	62.	121.	0.24	96.	-21.	0.93	0.96
28	3.271484	376.72	12191.53	59.	40.	119.	0.10	106.	29.	0.93	0.70
29	4.101563	288.54	13206.34	52.	51.	122.	0.08	115.	-36.	0.88	0.73
30	5.151367	385.40	5644.03	51.	38.	119.	0.07	76.	-33.	0.81	0.29
31	6.469726	354.59	13265.36	46.	36.	123.	0.08	73.	0.	0.83	0.65
32	8.129883	383.03	12381.01	46.	34.	122.	0.07	91.	-3.	0.97	0.94
33	10.229492	409.55	13148.04	42.	31.	122.	0.09	71.	-54.	0.90	0.88
34	12.695313	304.32	5216.22	40.	28.	115.	0.23	72.	17.	0.76	0.89
35	16.113279	219.00	5429.90	40.	34.	124.	0.32	101.	28.	0.82	0.83
36	20.507809	190.54	5476.89	54.	26.	119.	0.29	-14.	58.	0.62	0.68
37	25.878922	292.16	5616.03	38.	36.	119.	0.27	31.	46.	0.73	0.79
38	32.714840	225.87	6258.31	42.	20.	119.	0.42	127.	37.	0.61	0.80
39	41.303910	217.66	5576.26	27.	21.	120.	0.33	119.	-58.	0.51	0.63
40	52.246094	227.37	4269.85	22.	15.	113.	0.31	8.	-52.	0.57	0.70

MAGNETOTELLURIC STATION 025 REMOTE REFERENCED TO STATION 22

FREQ	RHOXY	PHASEYX	PHASEYX	ROT ANO	SKENESS	TIPPER TIP STRIK	TIP PHASE	COHXY	COHXY
0.001017	7.45	65.	60.	124.	0.32	-40.	28.	0.96	0.99
0.002035	5.39	74.	50.	133.	0.55	-7.	-31.	1.00	1.00
0.002645	8.27	67.	54.	125.	0.18	115.	22.	0.96	1.00
0.003593	11.50	65.	53.	135.	0.37	103.	23.	0.93	0.99
0.004109	8.99	76.	53.	134.	0.25	102.	21.	0.85	0.97
0.005290	12.37	78.	55.	127.	0.19	105.	7.	0.99	1.00
0.007395	21.24	73.	53.	144.	0.29	109.	18.	0.95	0.98
0.010637	22.34	73.	54.	138.	0.17	104.	20.	0.95	0.97
0.013681	24.99	74.	51.	135.	0.27	107.	28.	0.96	0.98
0.017140	28.76	75.	48.	132.	0.15	105.	27.	0.98	0.98
0.021448	34.03	70.	51.	128.	0.19	107.	28.	0.97	0.99
0.027058	43.78	71.	49.	129.	0.13	108.	26.	0.99	0.99
0.034281	49.49	71.	48.	130.	0.10	111.	26.	0.99	0.99
0.043182	55.20	70.	48.	132.	0.11	123.	38.	0.99	0.98
0.050000	77.45	68.	48.	129.	0.15	124.	21.	0.94	0.85
0.054932	49.95	73.	48.	131.	0.08	126.	39.	0.99	0.97
0.077209	82.45	61.	54.	139.	0.07	113.	22.	0.85	0.73
0.103740	97.66	64.	48.	137.	0.02	125.	-9.	0.97	0.92
0.128174	84.81	59.	50.	132.	0.16	113.	-7.	0.97	0.98
0.158691	115.53	60.	52.	126.	0.08	-40.	-25.	0.99	0.90
0.201416	105.96	58.	57.	132.	0.08	134.	-8.	0.99	0.68
0.253348	129.25	55.	49.	129.	0.25	117.	-54.	0.98	0.74
0.323486	127.48	59.	55.	126.	0.19	108.	-15.	0.99	0.82
0.408935	119.43	59.	58.	136.	0.07	-39.	-40.	0.99	0.88
0.518799	123.37	56.	53.	129.	0.12	-40.	56.	0.98	0.69
0.653076	139.77	57.	39.	122.	0.15	114.	-68.	0.96	0.61
0.817871	155.32	59.	62.	132.	0.07	-37.	-65.	0.98	0.86
1.025391	163.41	59.	64.	133.	0.09	-34.	-65.	0.90	0.94
1.287842	191.02	59.	65.	137.	0.03	-22.	-65.	0.90	0.94
1.617431	202.56	60.	60.	148.	0.08	11.	15.	0.95	0.69
2.032470	238.79	57.	56.	143.	0.08	60.	0.	0.87	0.48
2.597373	229.05	56.	55.	139.	0.04	5.	-17.	0.88	0.53
3.216552	238.48	53.	51.	132.	0.08	111.	-22.	0.87	0.51
4.046430	233.40	54.	47.	124.	0.12	5.	-34.	0.96	0.75
5.151367	278.82	48.	50.	128.	0.09	84.	-2.	0.99	0.95
6.469726	260.09	45.	44.	127.	0.08	54.	1.	0.92	0.83
8.129883	248.57	43.	41.	131.	0.03	80.	-44.	0.94	0.87
10.229494	233.56	39.	39.	127.	0.04	53.	-51.	0.96	0.86
12.866213	254.52	38.	40.	128.	0.06	110.	47.	0.92	0.86
16.186522	218.90	35.	35.	126.	0.07	95.	-6.	0.92	0.83
20.507809	242.34	24.	55.	146.	0.24	-15.	73.	0.95	0.55
25.878916	195.72	27.	34.	119.	0.20	61.	28.	0.84	0.43
32.714840	149.85	25.	26.	132.	0.03	-34.	-35.	0.76	0.60
41.503918	159.02	18.	24.	129.	0.08				
52.246094	146.23	22.	3.	116.	0.08				

MAGNETOTELLURIC STATION 026 REMOTE REFERENCED TO STATION 27

FREQ	RHOXY	RHOVX	PHASEXY	PHASEVX	ROT ANG	SKEWNESS	TIPPER	TIP STRIK	TIP PHASE	CONVY	CONVX
0.003577	60.67	60.52	68.	40.	131.	0.08	0.17	106.	11.	0.99	0.99
0.004069	104.18	53.06	54.	55.	133.	0.13	0.21	86.	11.	0.93	0.97
0.005207	85.92	36.96	68.	47.	131.	0.13	0.22	87.	8.	0.98	0.98
0.007398	104.55	32.70	70.	70.	119.	0.15	0.11	79.	30.	0.97	0.97
0.010524	116.01	42.49	80.	55.	133.	0.10	0.16	67.	34.	0.98	0.97
0.013626	160.77	51.33	70.	54.	124.	0.10	0.19	69.	23.	0.98	0.89
0.017009	204.26	51.68	64.	54.	123.	0.14	0.22	70.	18.	0.96	0.92
0.021137	257.34	62.72	75.	52.	134.	0.14	0.29	73.	20.	0.95	0.95
0.026798	340.31	66.51	72.	51.	133.	0.09	0.39	74.	6.	0.99	0.99
0.034123	332.57	58.12	65.	53.	129.	0.10	0.35	74.	6.	1.00	0.99
0.043049	336.36	61.77	64.	49.	133.	0.09	0.25	85.	27.	1.00	0.99
0.054268	348.49	54.61	64.	52.	131.	0.09	0.28	80.	31.	0.98	0.98
0.077404	403.78	55.84	55.	54.	128.	0.11	0.34	73.	33.	0.99	0.98
0.107790	546.61	71.17	56.	45.	140.	0.01	0.58	77.	19.	0.91	0.93
0.136474	540.43	96.84	45.	66.	129.	0.22	0.52	62.	-10.	0.71	0.76
0.201416	536.52	43.39	50.	55.	147.	0.23	1.04	96.	-7.	0.89	0.88
0.323486	595.82	54.33	48.	33.	135.	0.26	0.59	89.	51.	0.98	0.75
0.512695	543.77	76.01	43.	49.	132.	0.07	0.75	83.	3.	0.98	0.96
0.634766	386.84	70.44	40.	44.	130.	0.11	0.69	93.	8.	0.99	0.96
0.805664	446.40	80.19	42.	47.	131.	0.02	0.74	91.	2.	0.97	0.92
1.025391	407.58	62.19	44.	47.	129.	0.06	0.67	89.	-1.	0.97	0.90
1.253945	408.25	75.28	44.	39.	125.	0.09	0.61	84.	5.	0.97	0.87
1.635742	377.42	83.67	43.	55.	125.	0.04	0.69	86.	2.	0.94	0.89
2.075195	408.62	85.56	40.	51.	128.	0.03	0.75	82.	9.	0.95	0.84
2.612305	404.99	84.20	41.	50.	133.	0.03	0.69	81.	2.	0.94	0.89
3.271484	343.75	74.77	41.	51.	125.	0.12	0.66	77.	1.	0.94	0.72
4.101563	339.91	83.17	37.	46.	132.	0.10	0.63	75.	7.	0.96	0.76
5.151367	318.95	80.83	33.	44.	132.	0.10	0.63	79.	9.	0.95	0.78
6.469726	357.55	89.13	34.	47.	137.	0.04	0.72	84.	6.	0.97	0.93
8.129883	323.75	82.55	31.	45.	137.	0.05	0.66	82.	2.	0.99	0.97
10.229494	293.55	82.18	27.	44.	139.	0.03	0.68	84.	3.	0.94	0.87
12.866213	241.89	92.23	24.	43.	132.	0.12	0.55	81.	7.	0.66	0.85
16.186522	245.50	86.03	23.	41.	140.	0.07	0.64	83.	3.	0.95	0.89
20.385744	220.78	87.47	19.	38.	141.	0.05	0.64	86.	4.	0.94	0.87
25.659182	218.79	84.49	19.	36.	143.	0.04	0.70	86.	5.	0.89	0.78
32.275387	209.99	61.64	13.	30.	153.	0.03	0.67	87.	-20.	0.76	0.62

APPENDIX D

ONE-DIMENSIONAL "BOSTICK" INVERSIONS

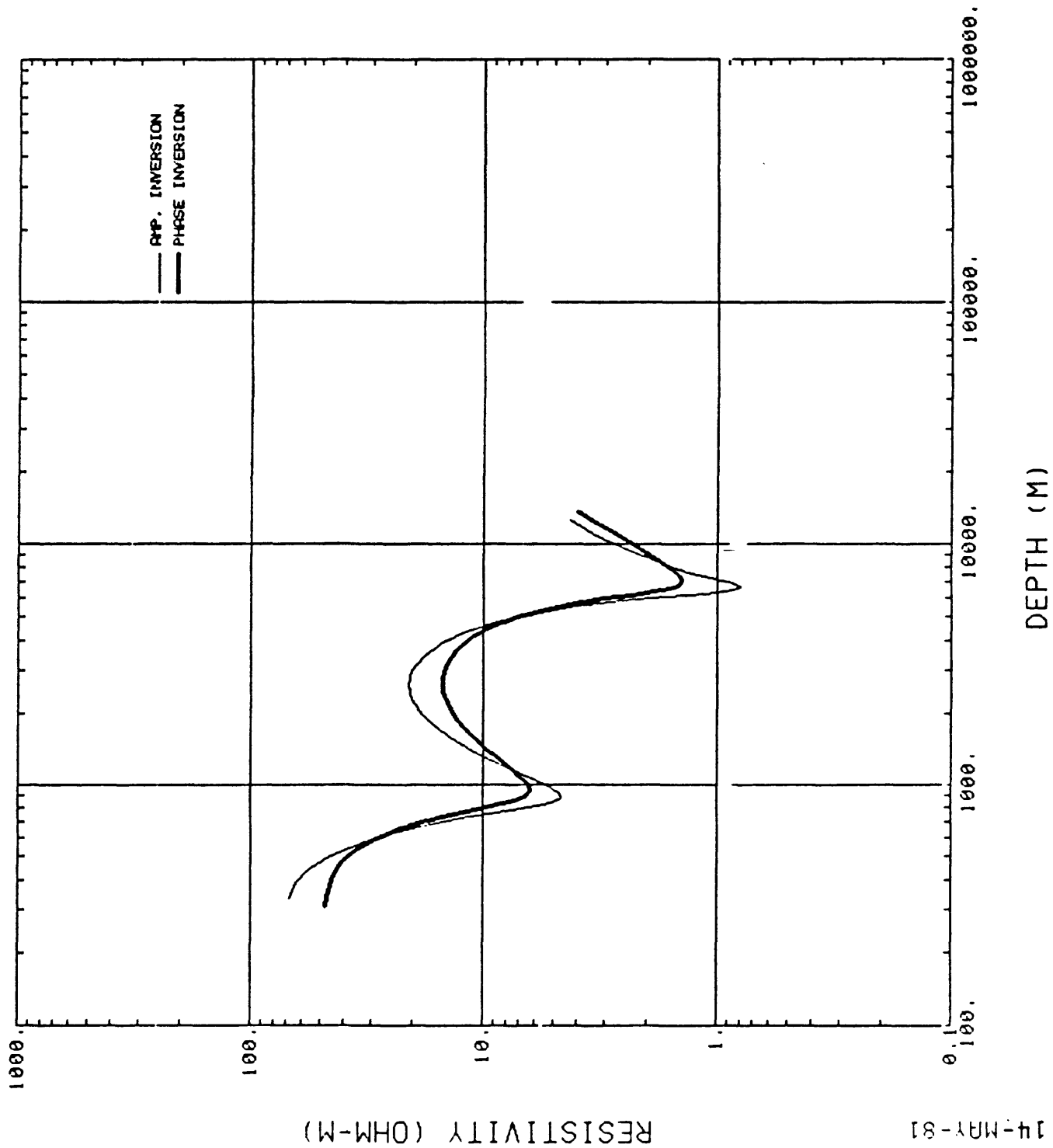
The following plots are "continuous" inversions following the approximation by Bostick (1977). Inversions are given for both modes of resistivity and phase, because the selection of TE and TM is not always obvious and both modes may be useful in structurally complex areas. Because the "Bostick" inversion is an approximation for ONE DIMENSION, caution is recommended in its utilization. Some characteristics are:

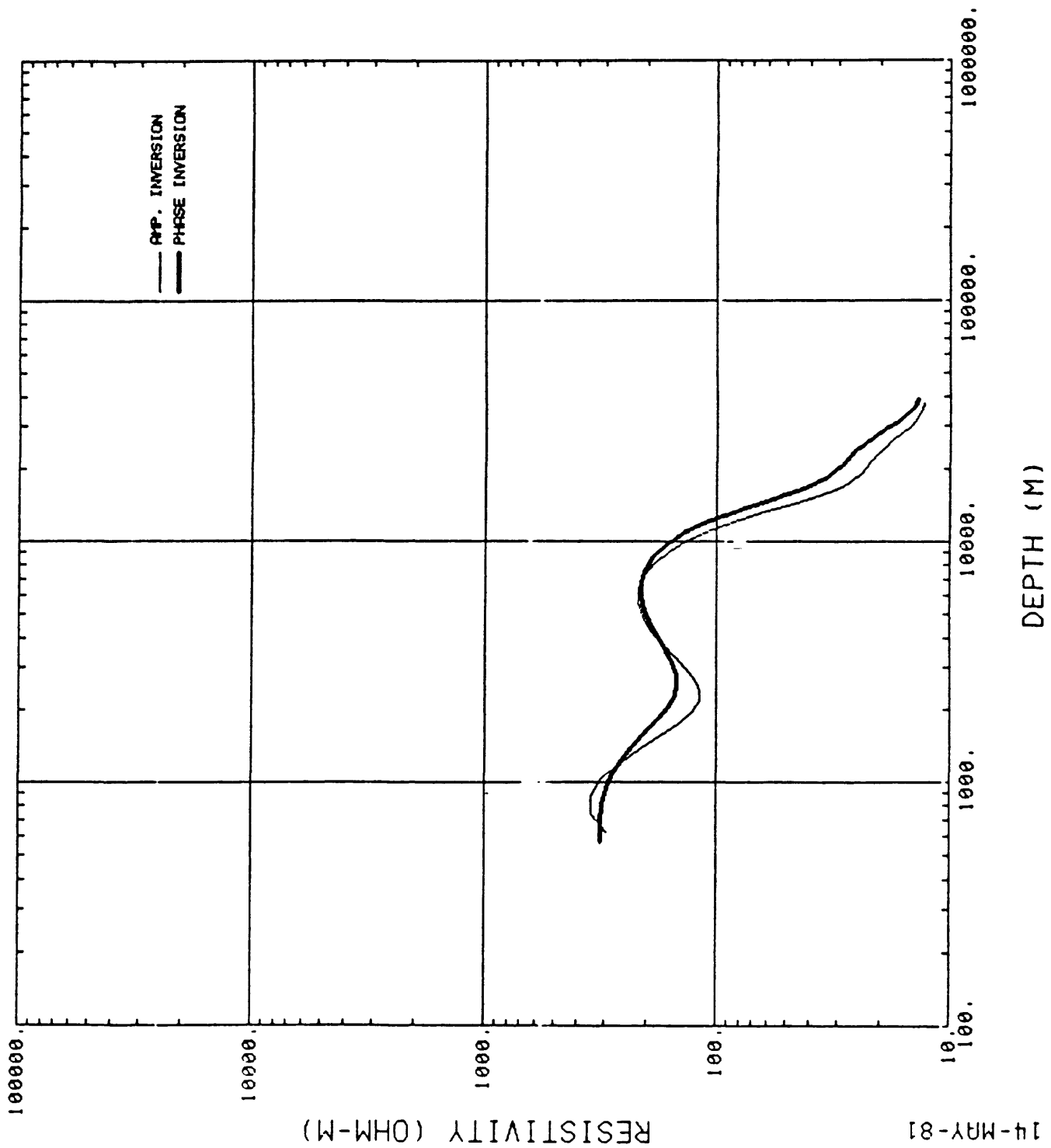
- (1) the tendency to overshoot maxima
- (2) the tendency to undershoot minima
- (3) the tendency to omit the surface layer

Specific examples are discussed in the text.

14-MAY-81

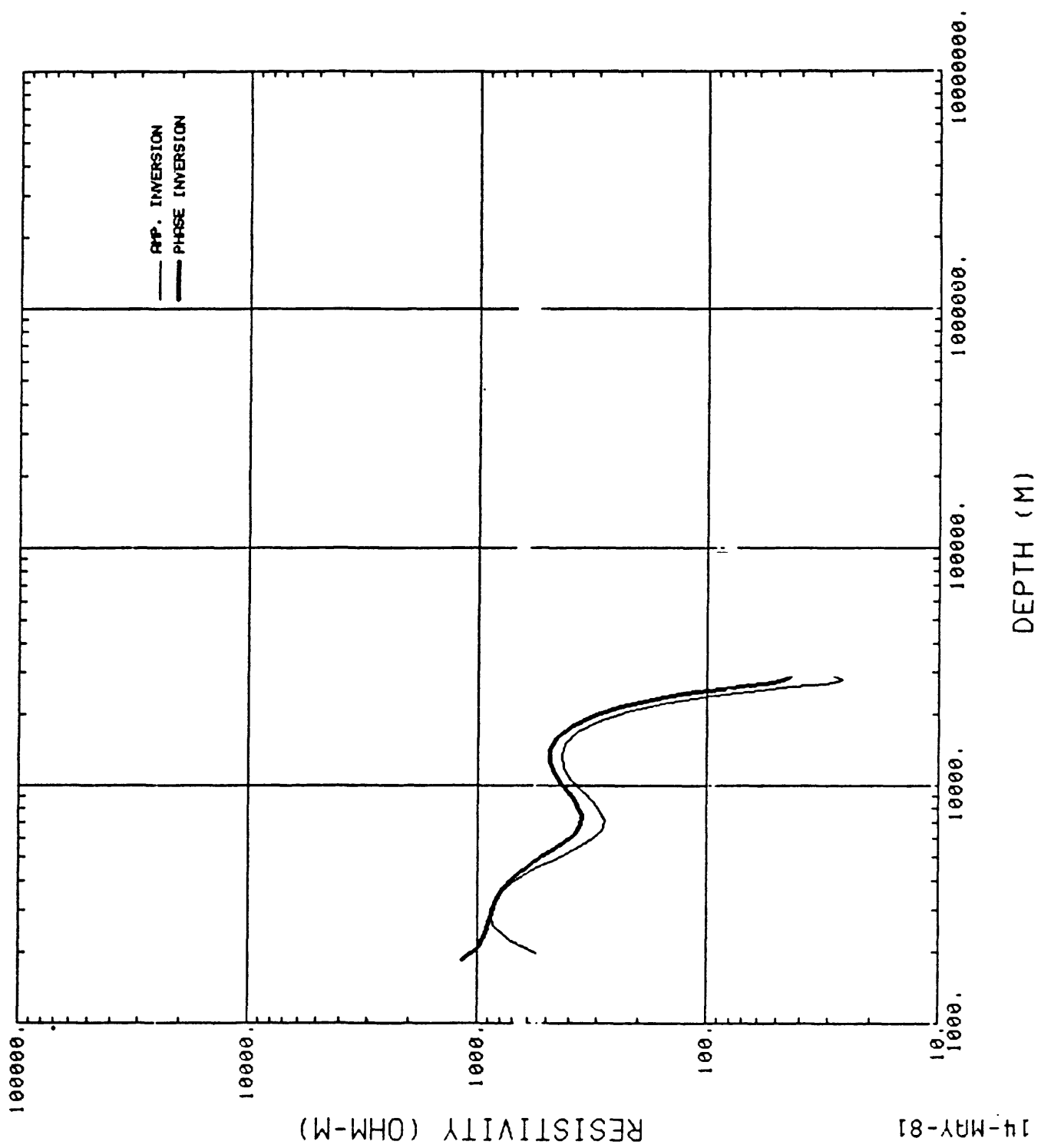
U011X1

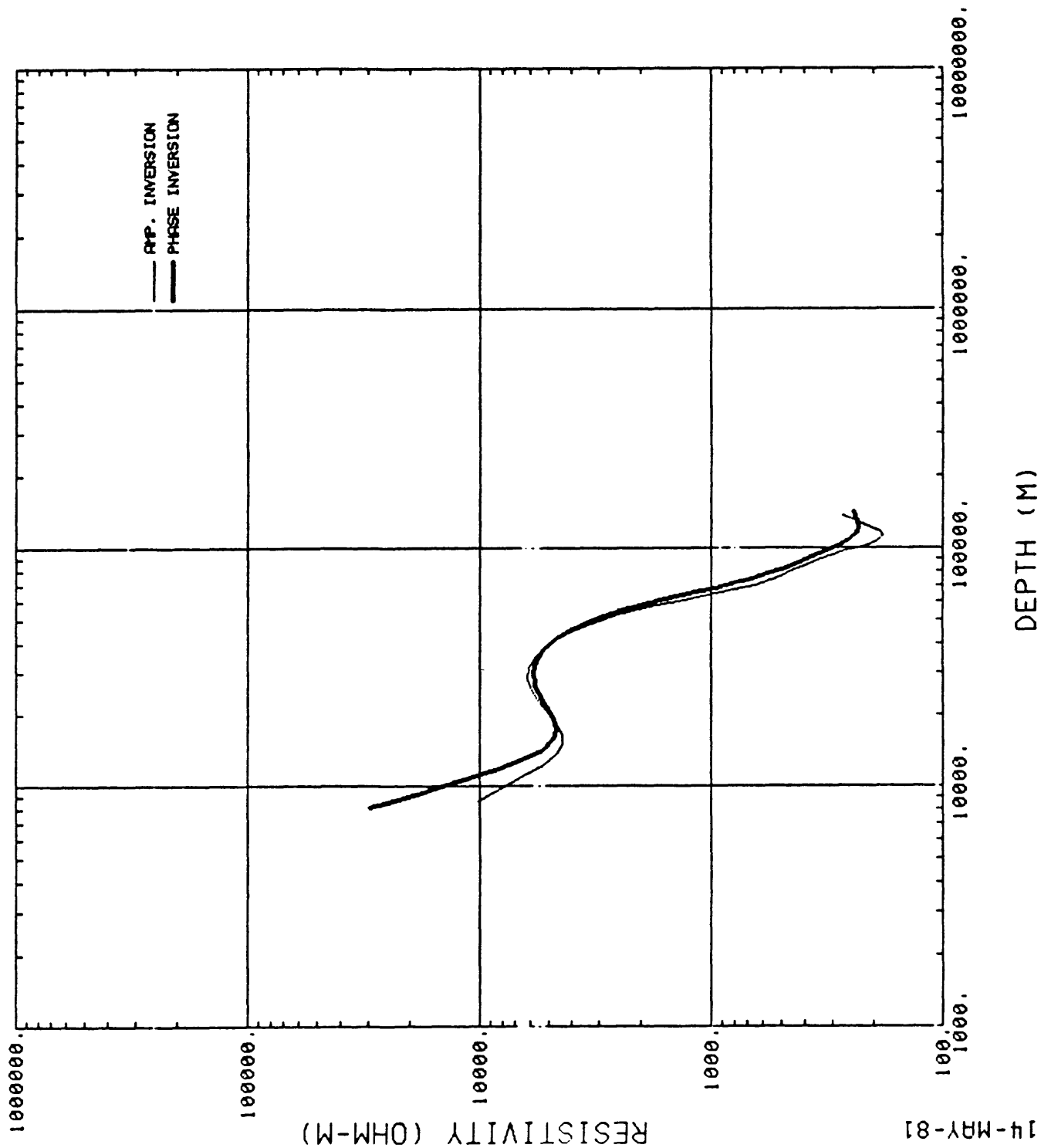




14-MAY-81

U012X1

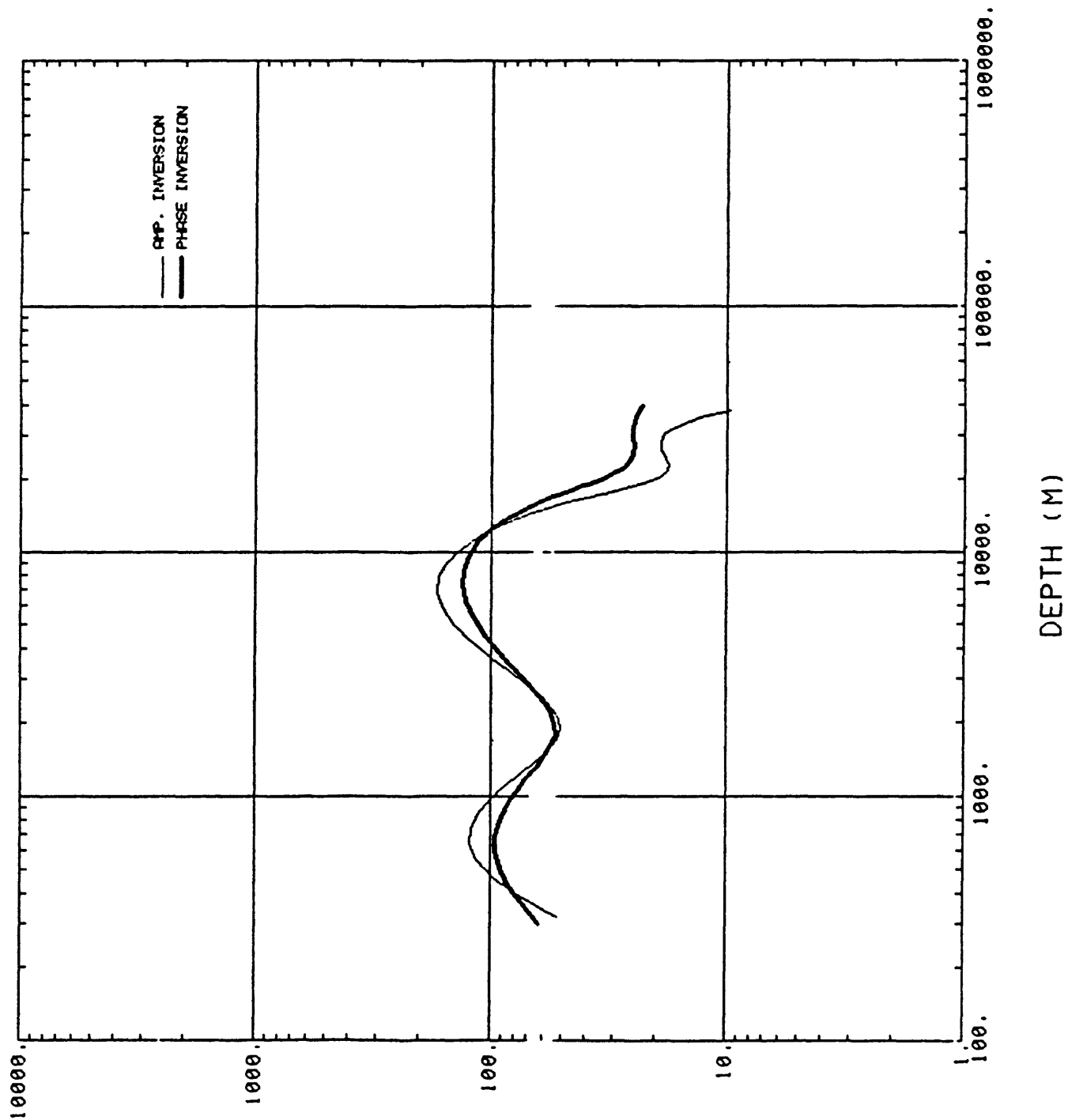


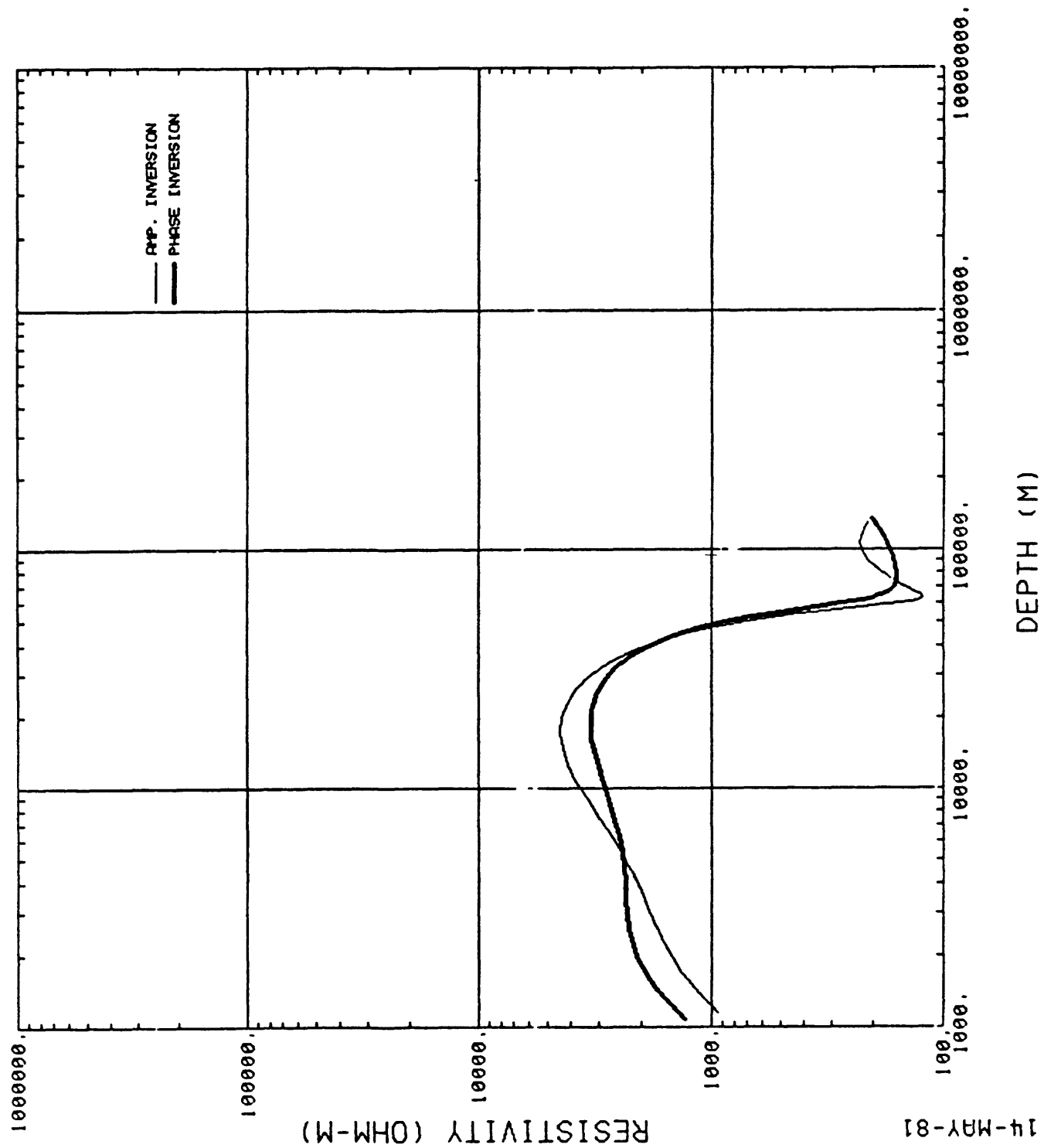


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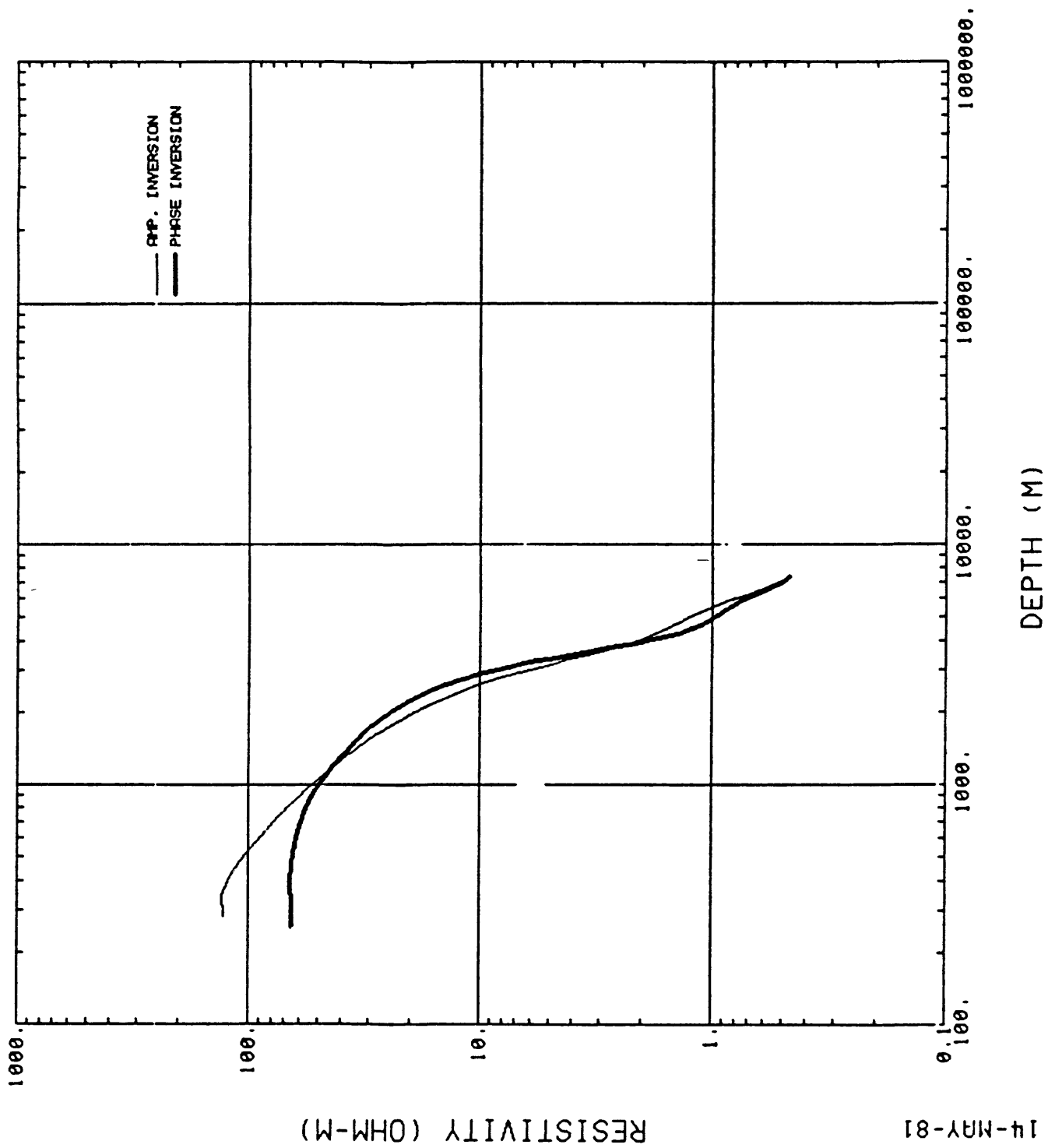
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U013X3





U013Y3

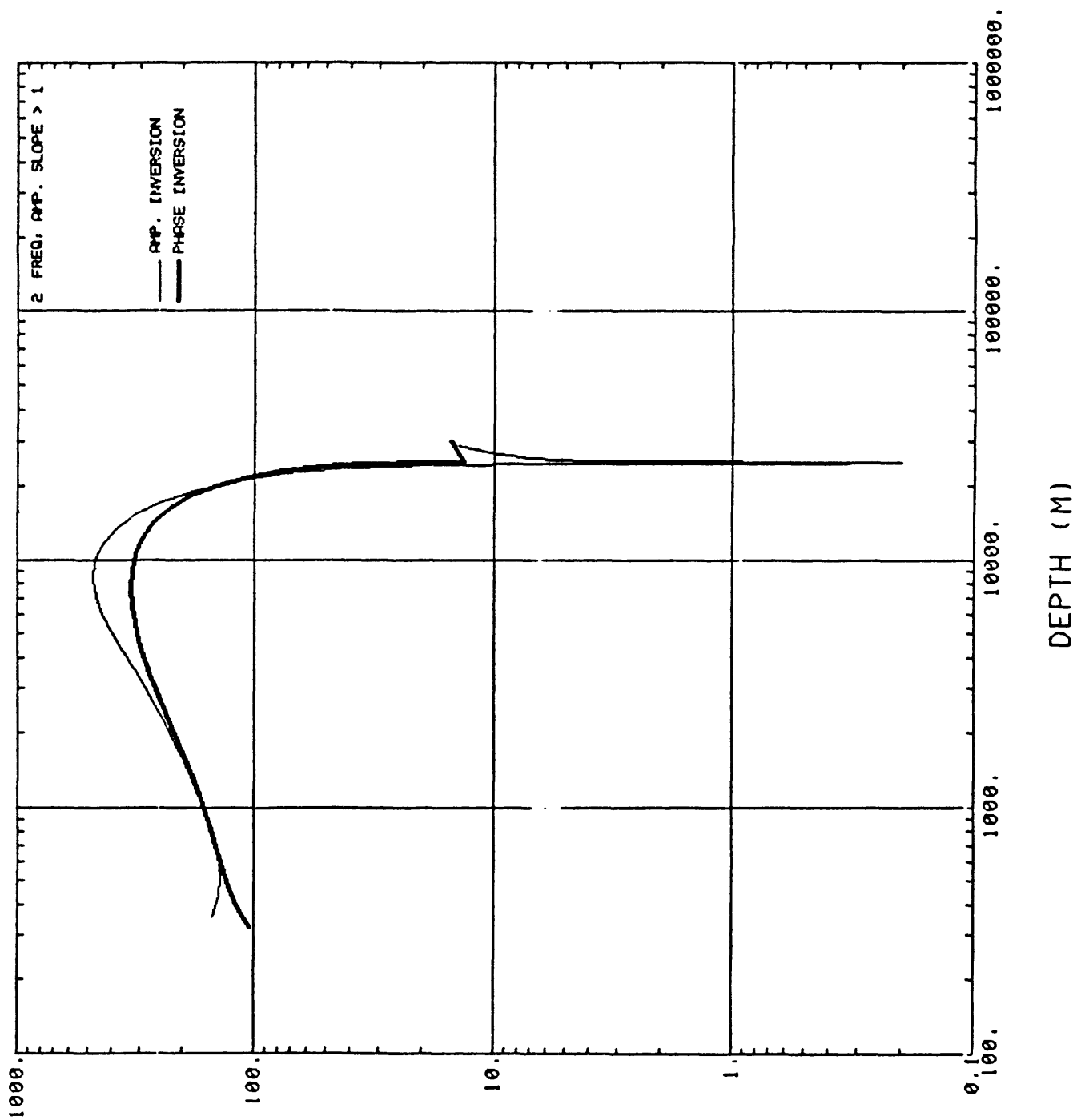


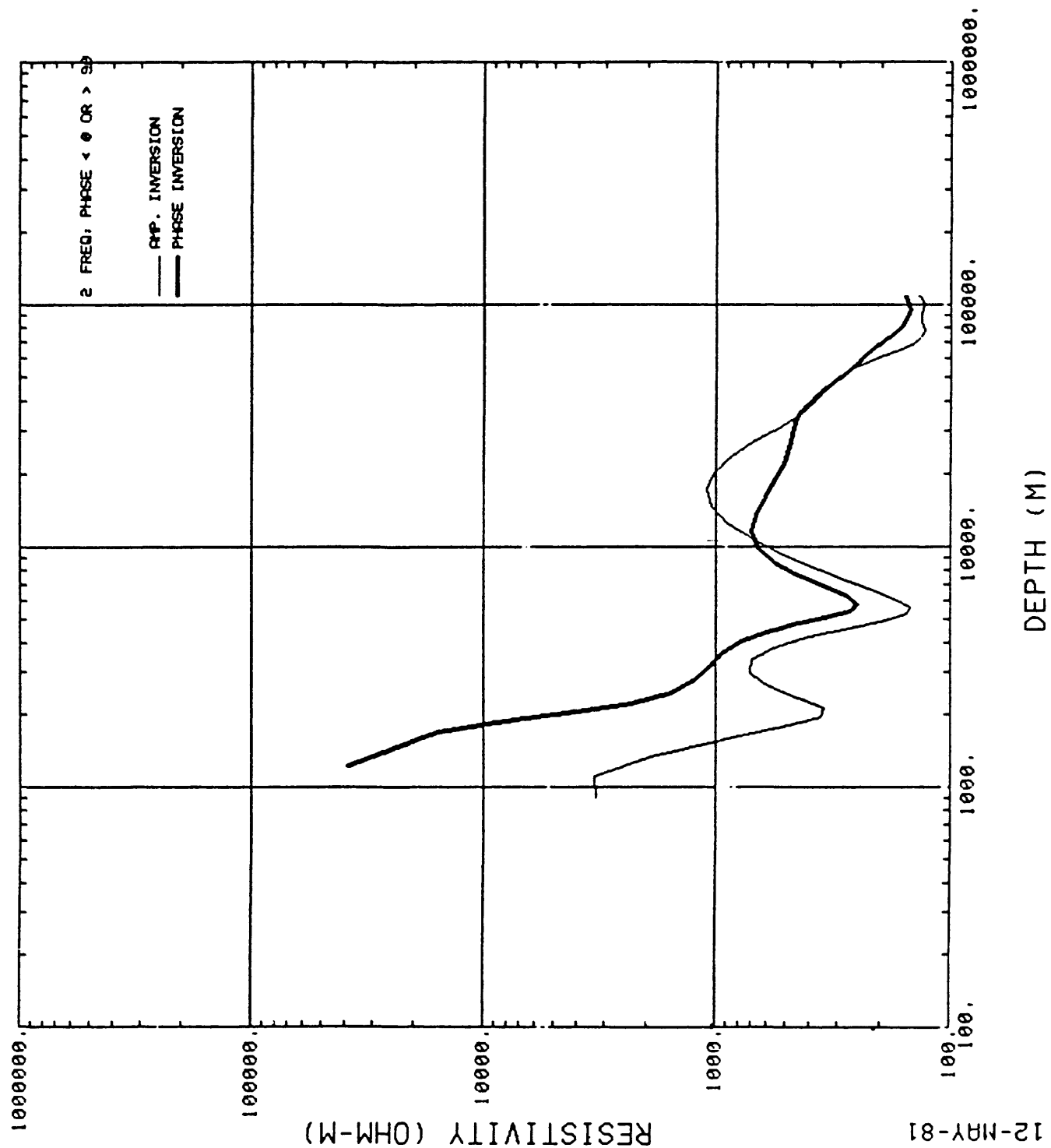
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RESISTIVITY (OHM-M)

14-MAY-81

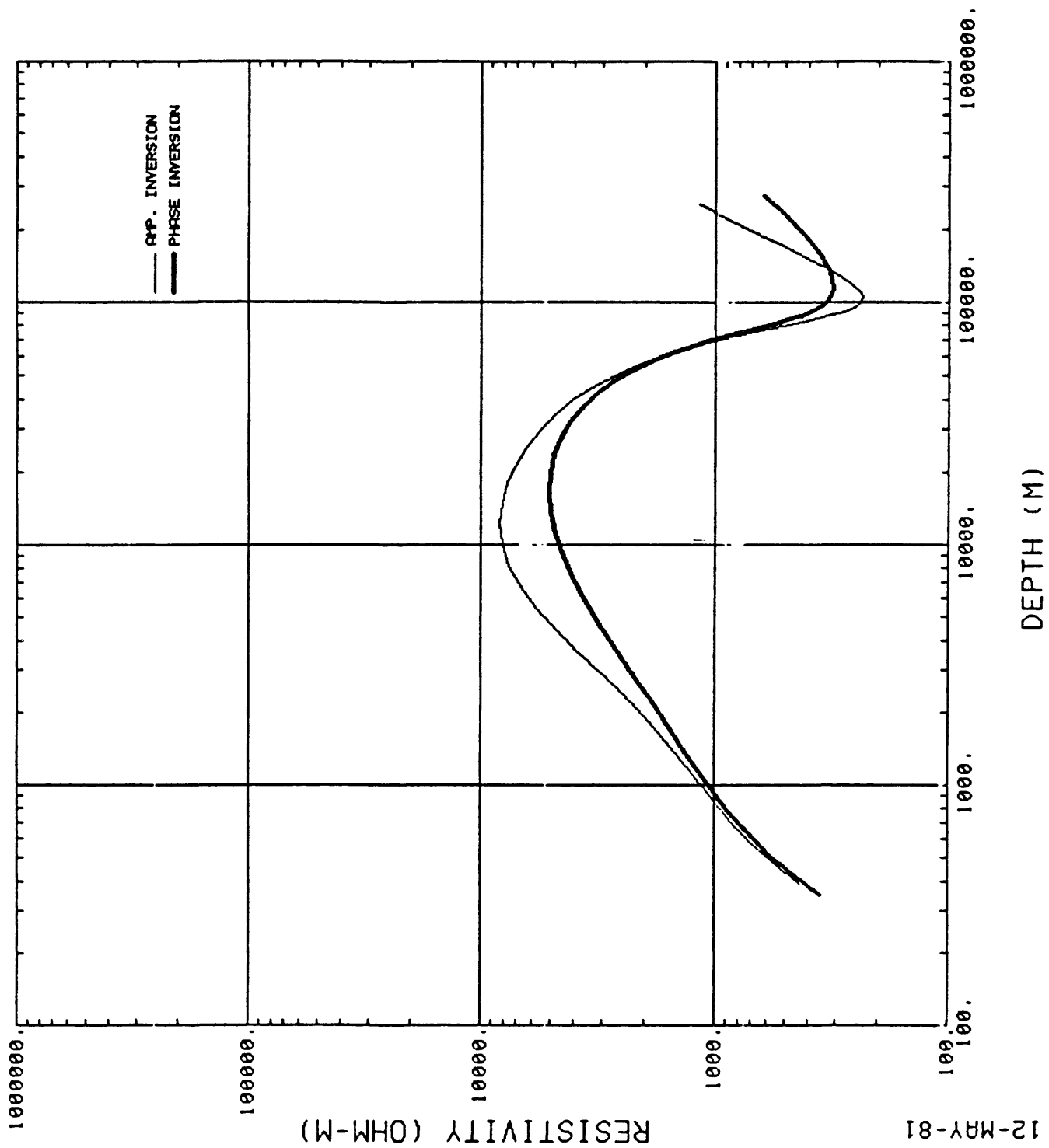
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12-MAY-81

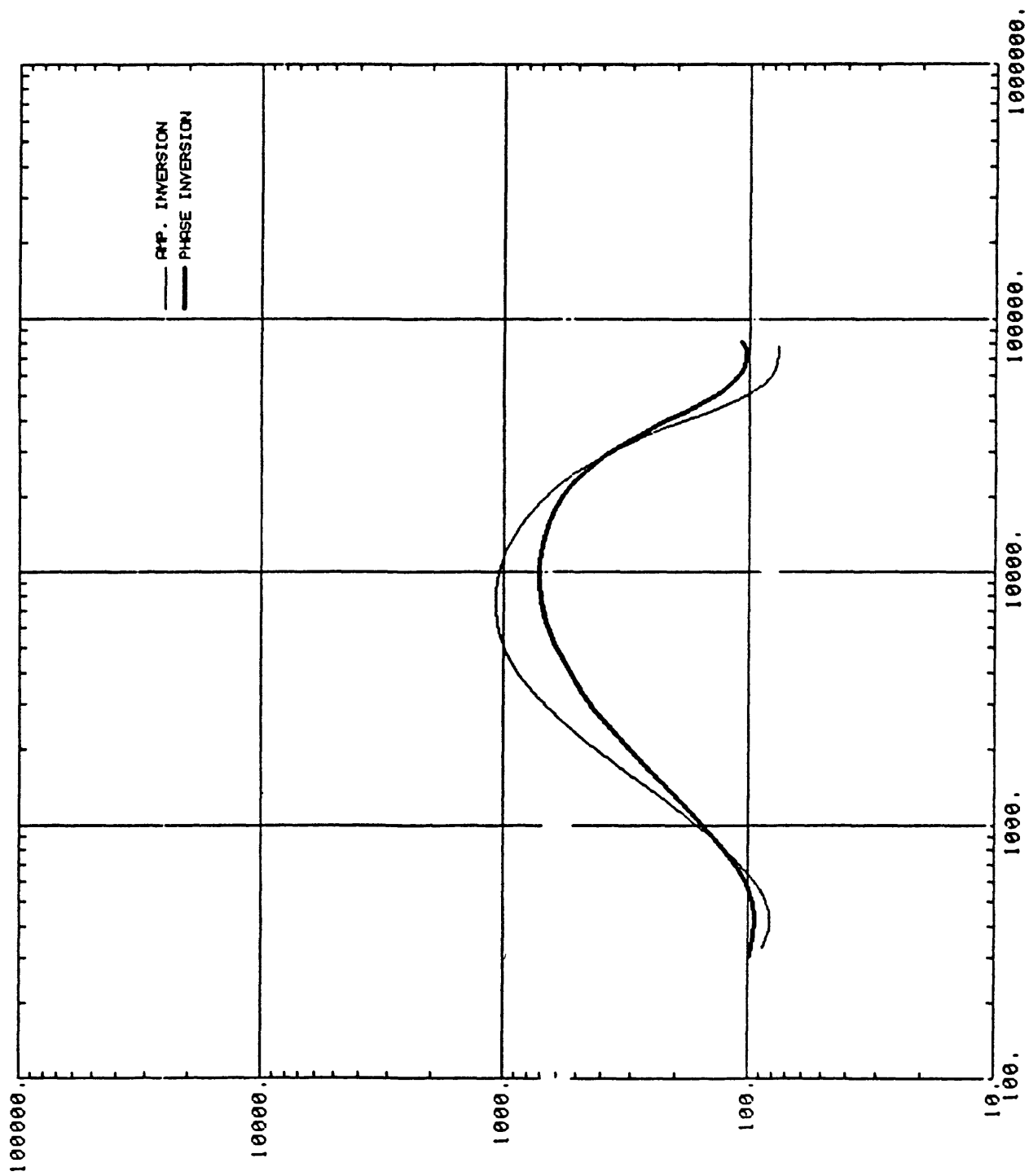
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14-MAY-81

U017X1

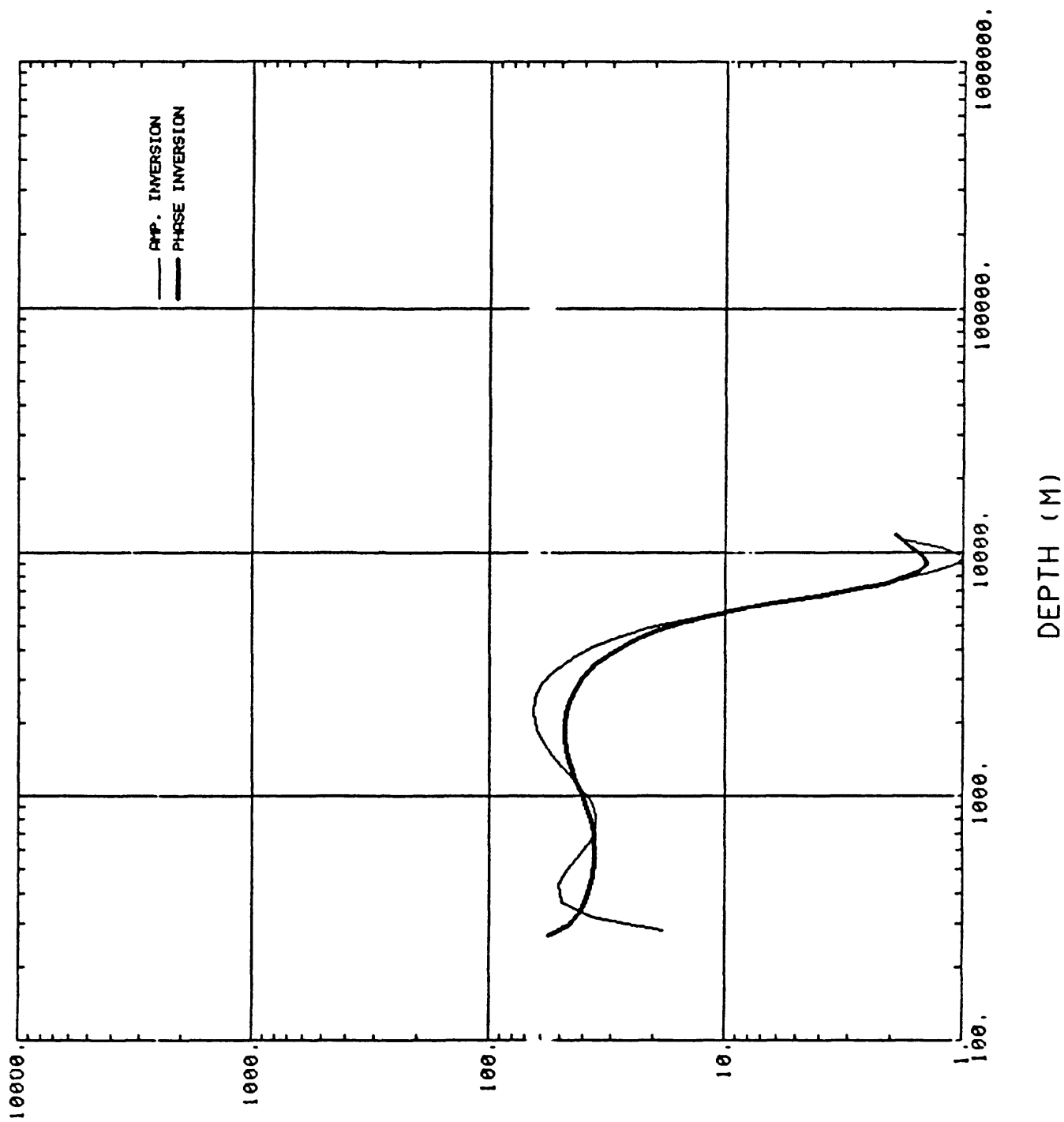
DEPTH (M)



RESISTIVITY (OHM-M)

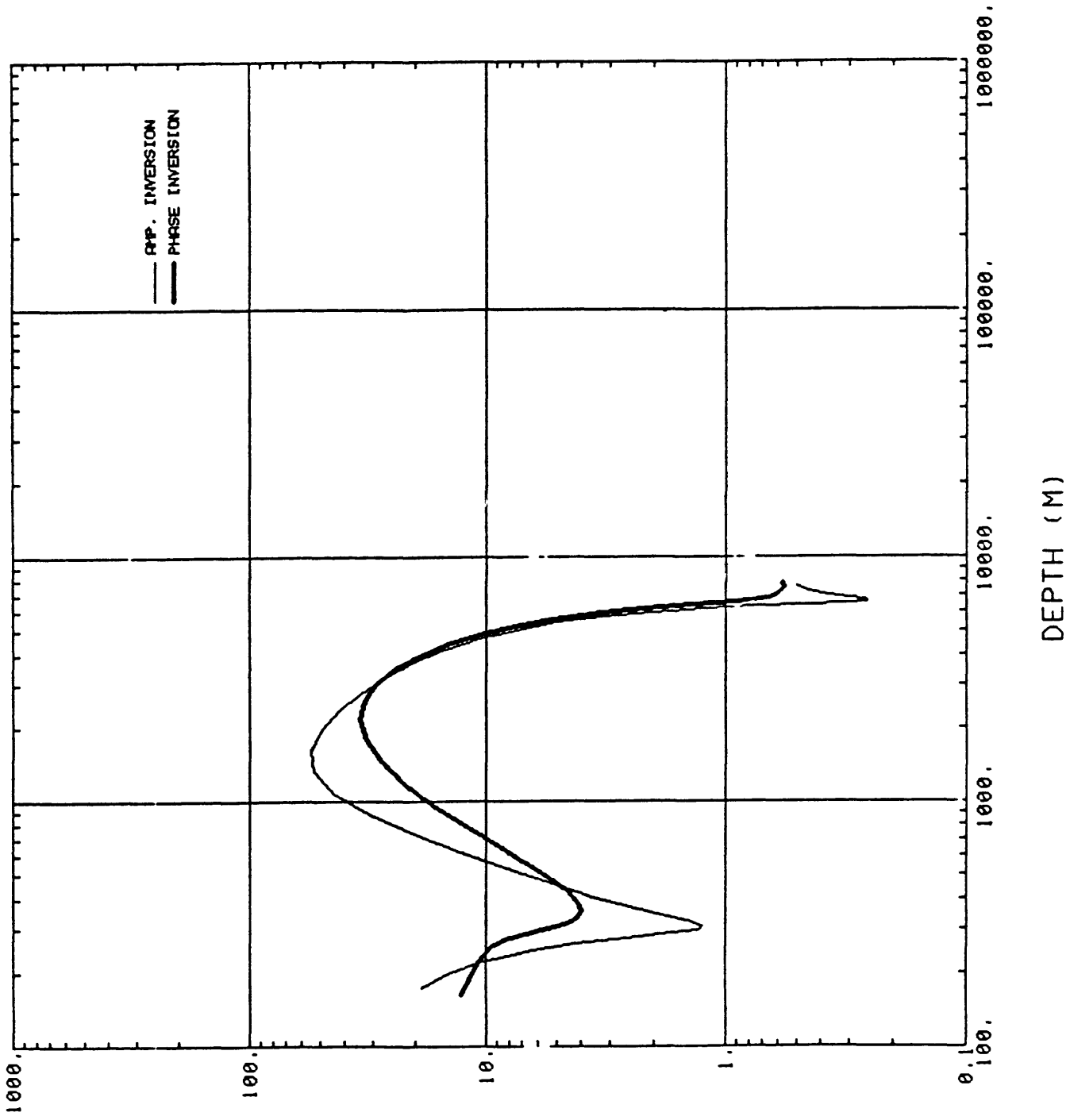
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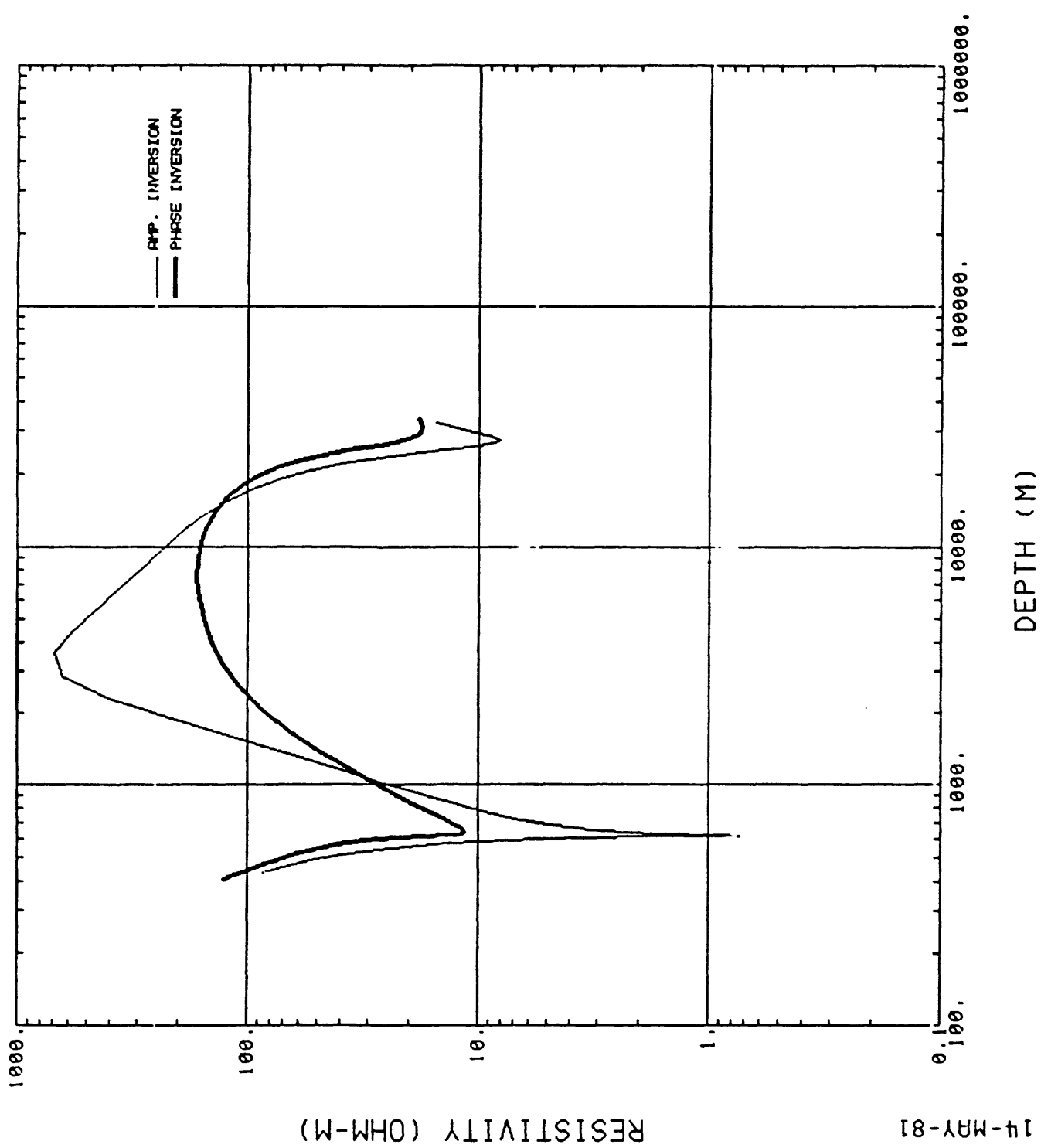
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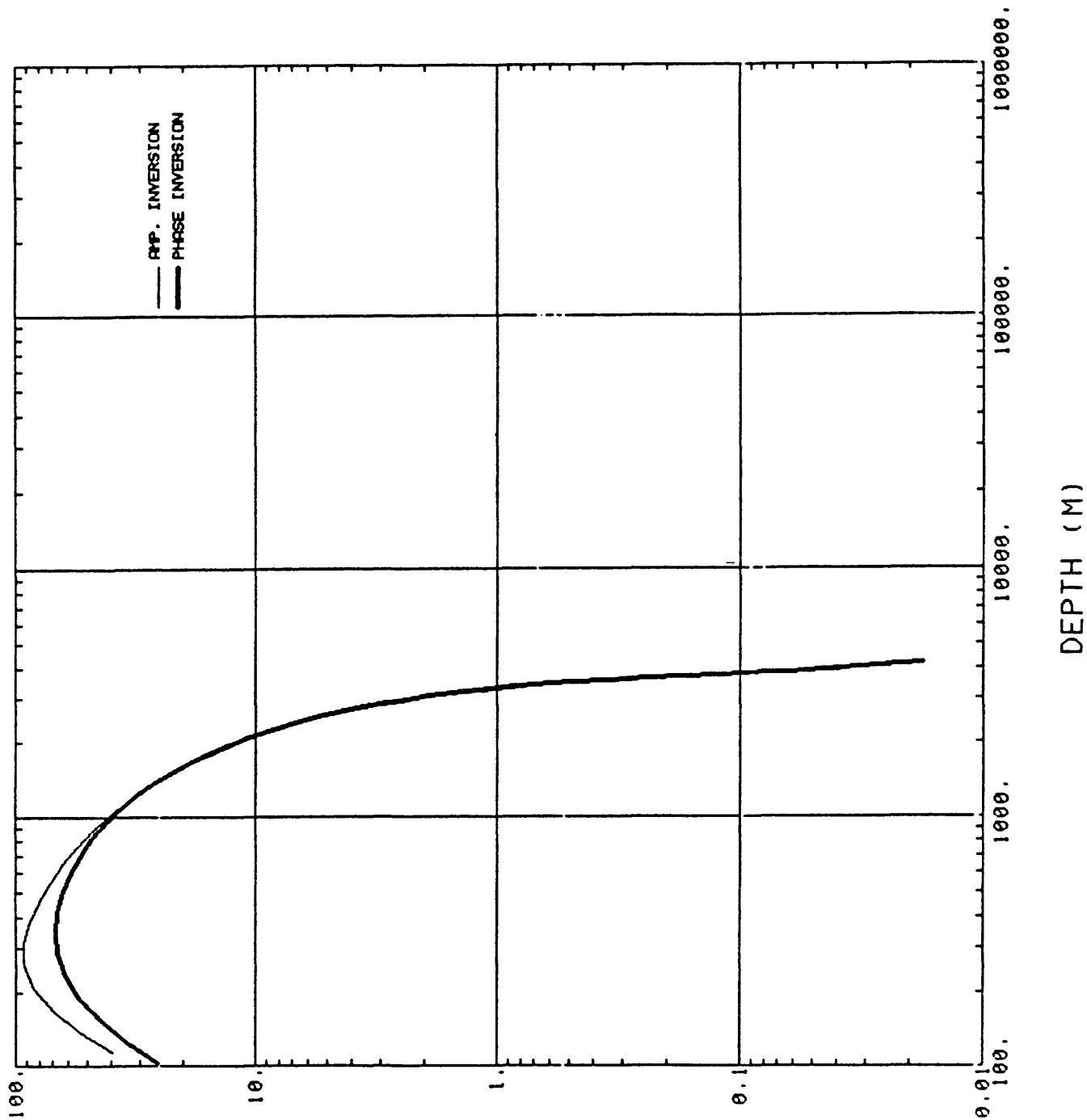
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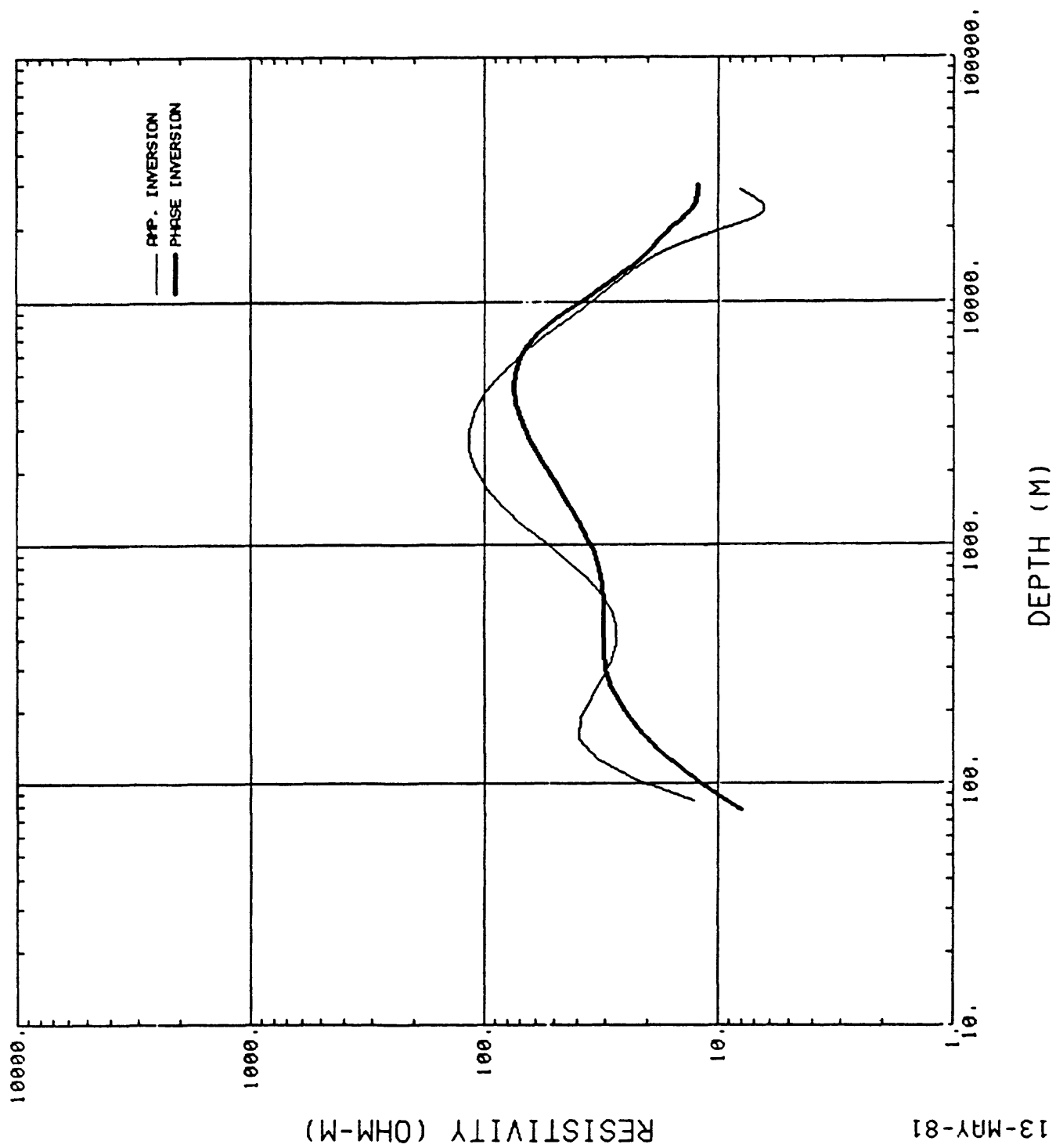
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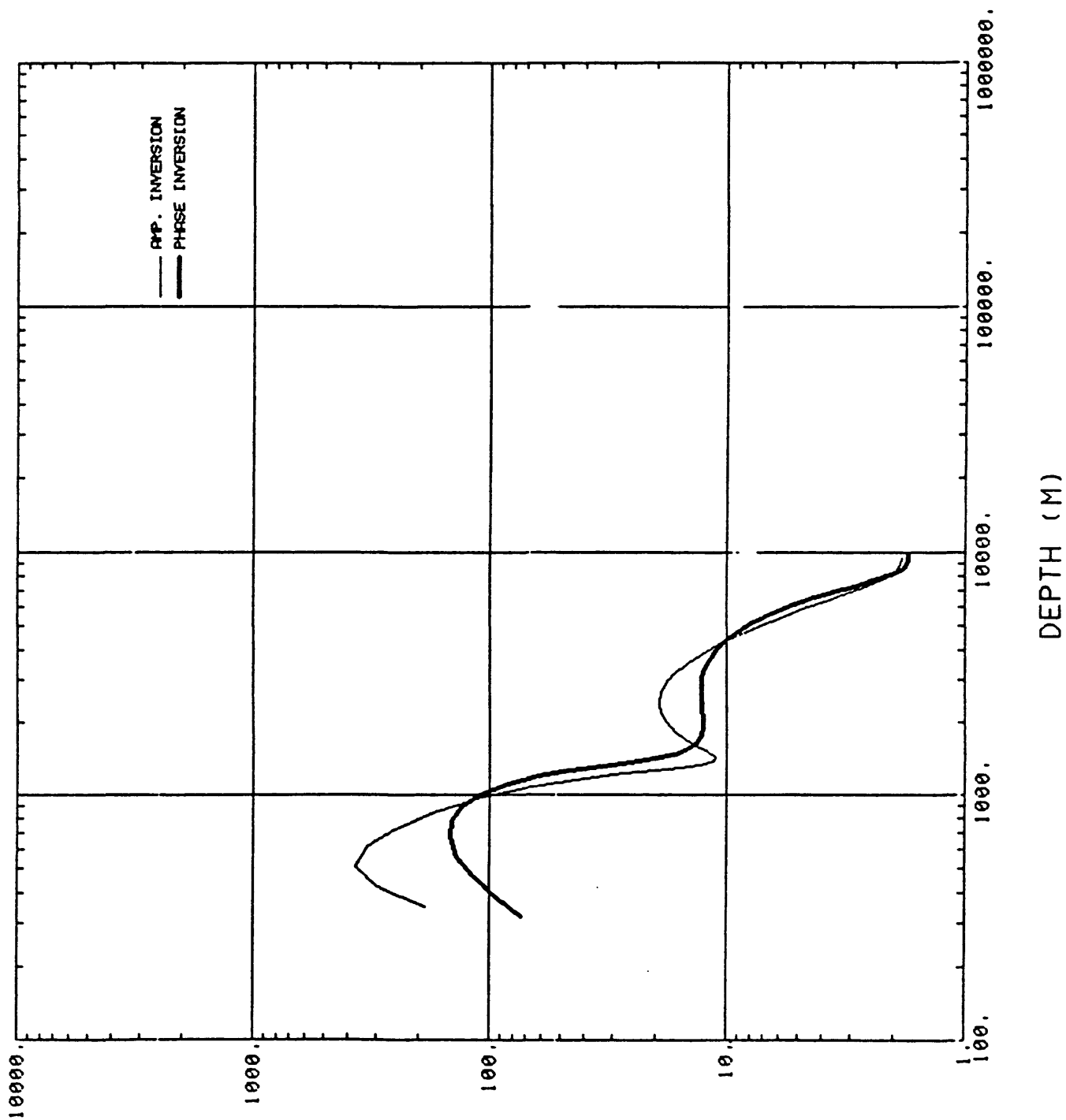


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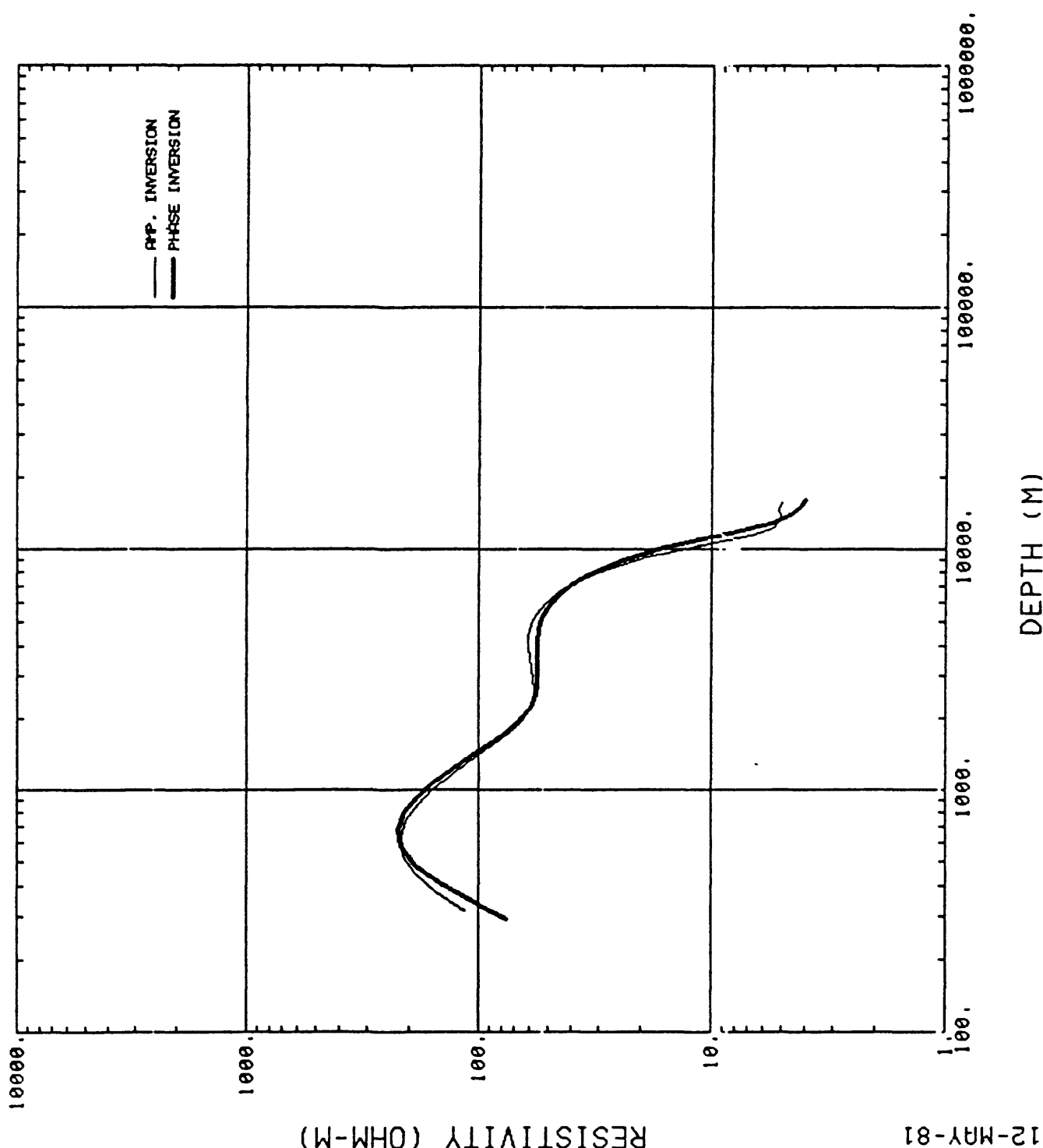
RESISTIVITY (OHM-M)



U020X3

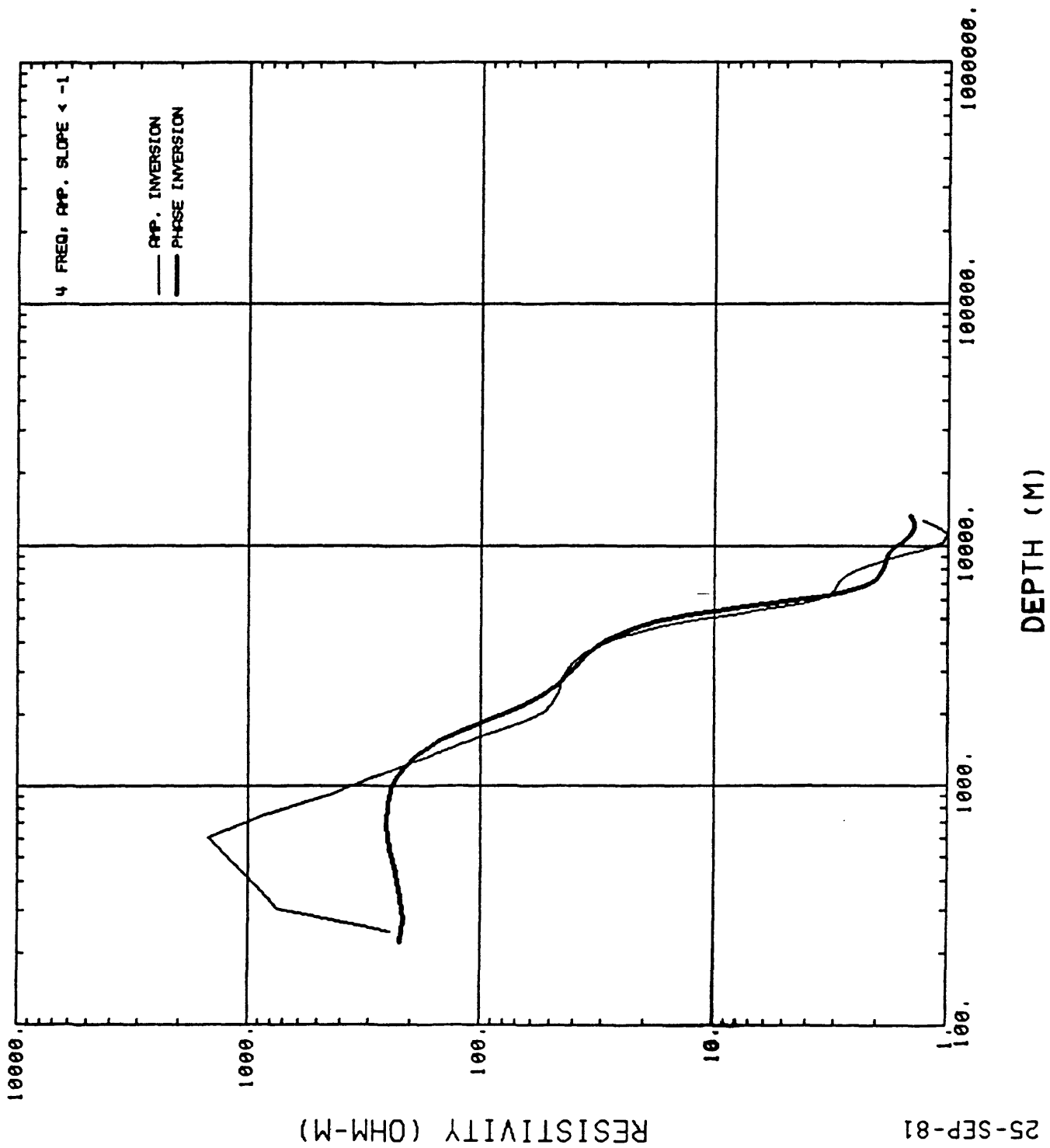
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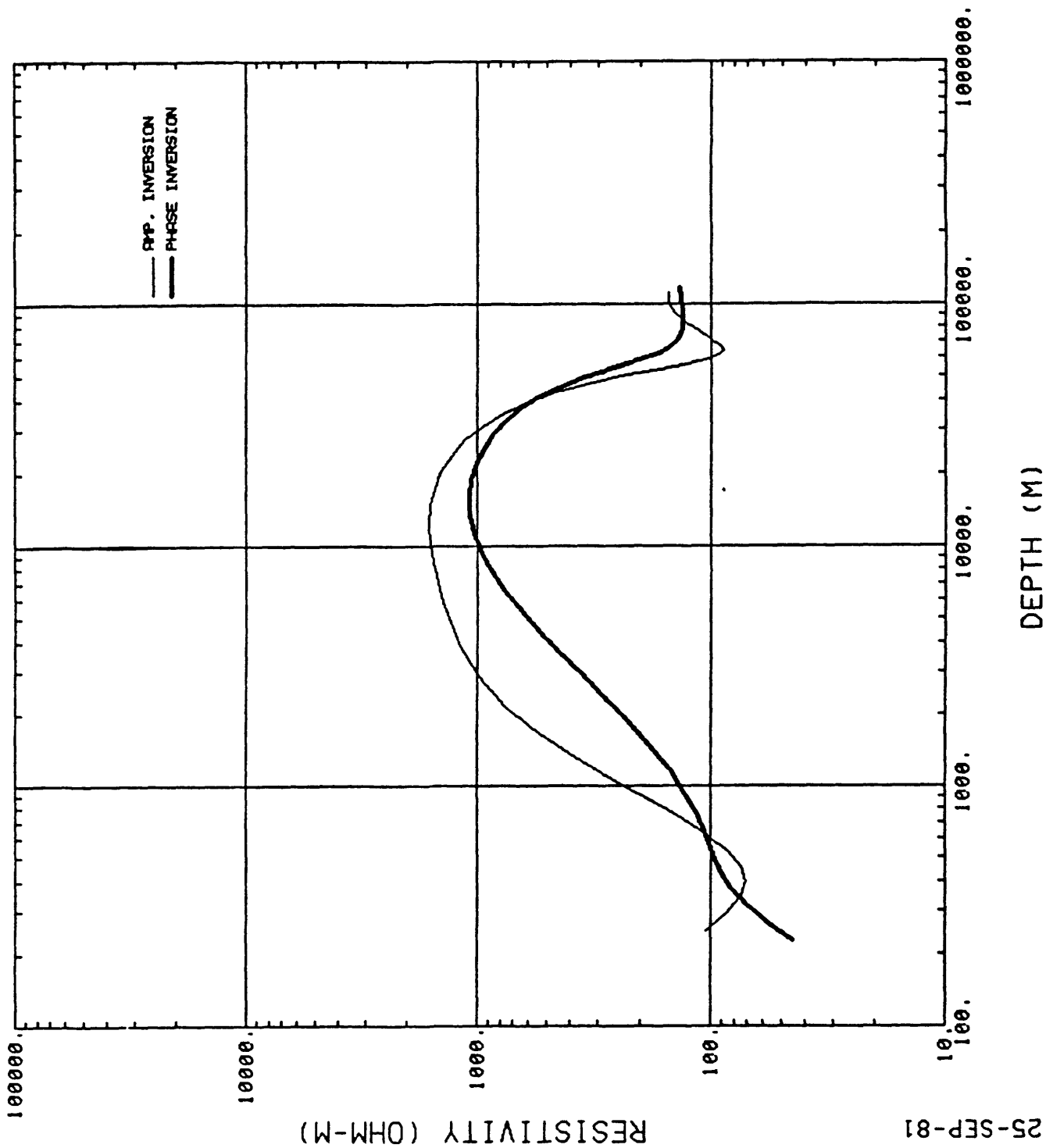
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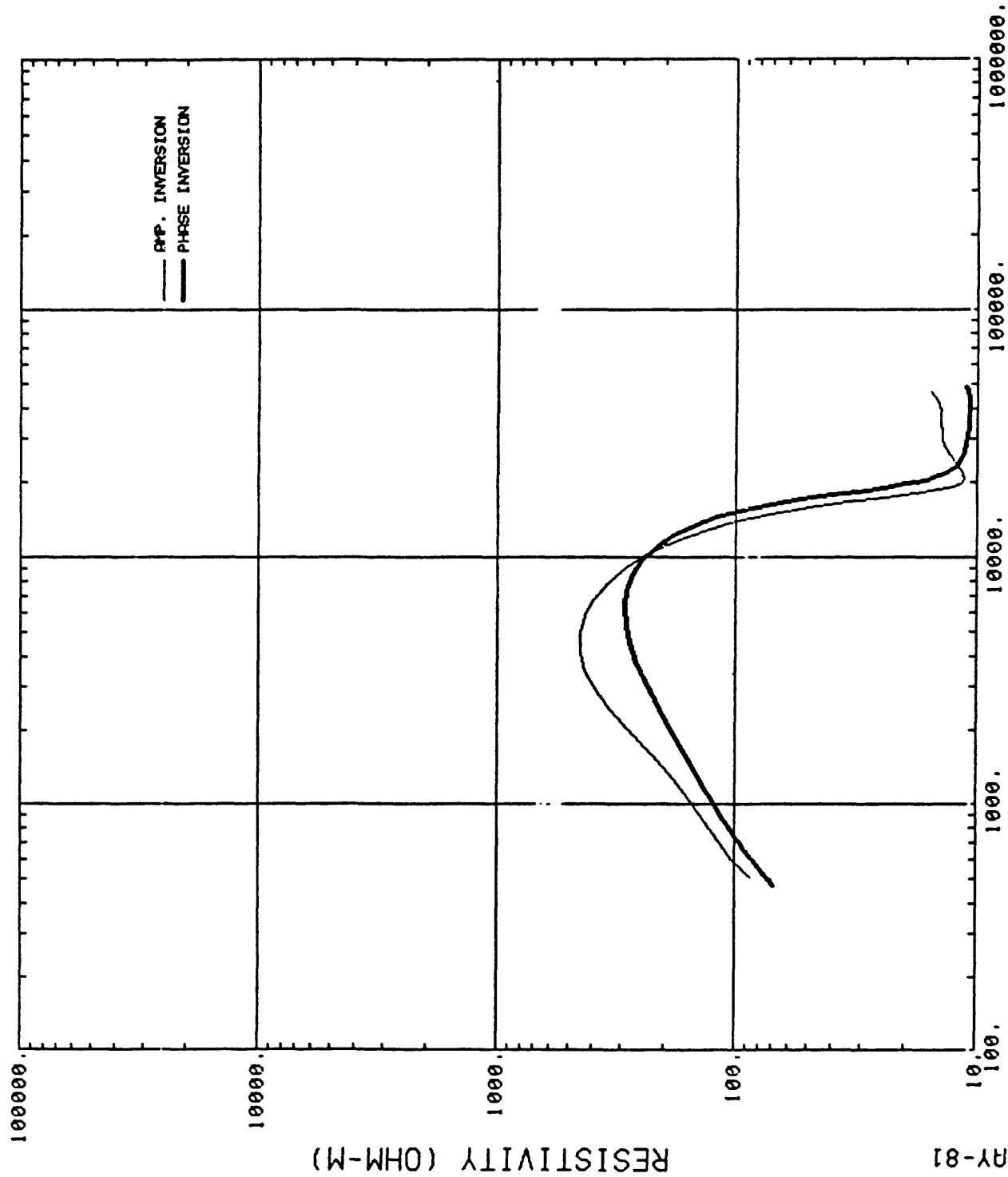


25-SEP-81

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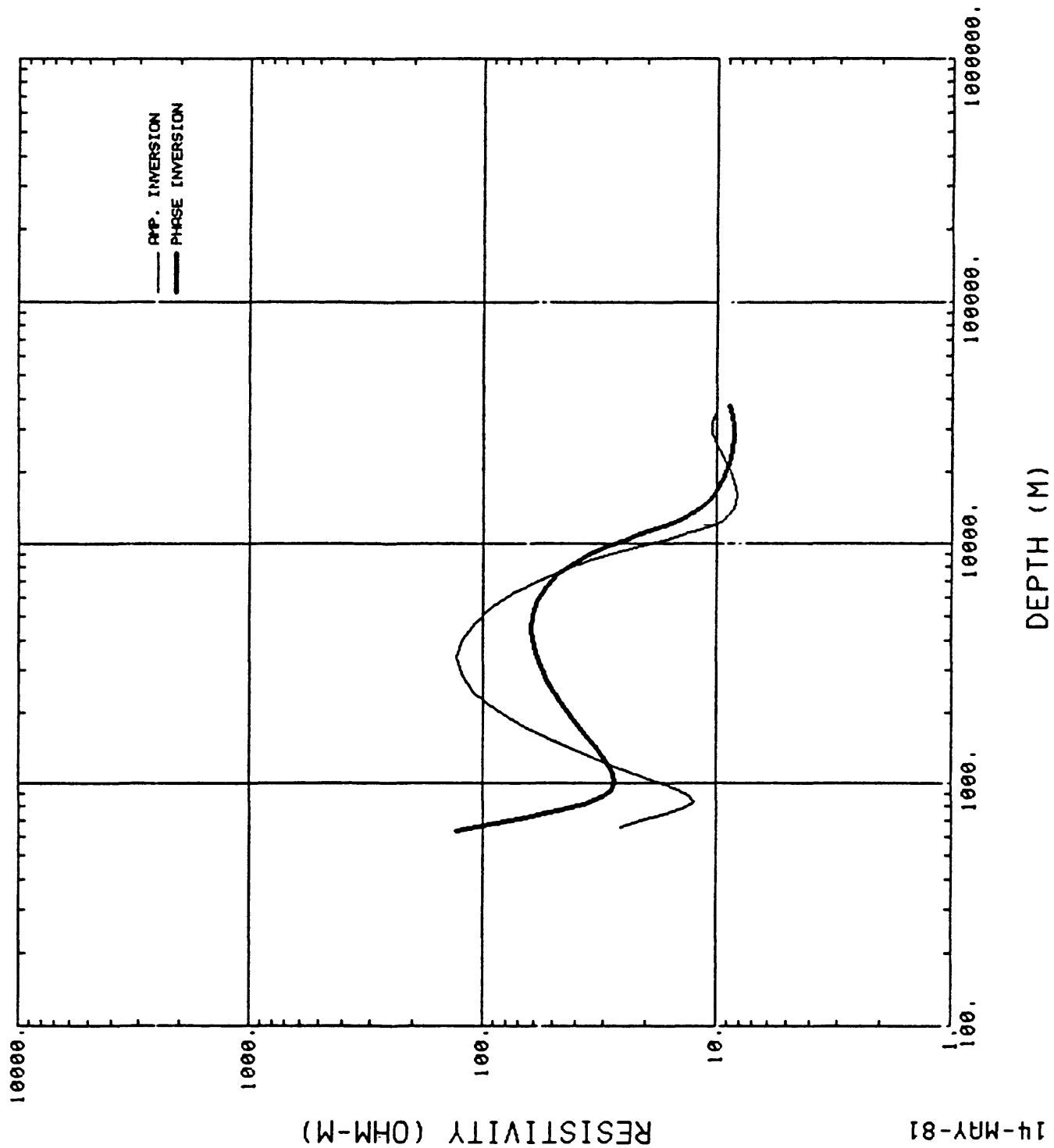




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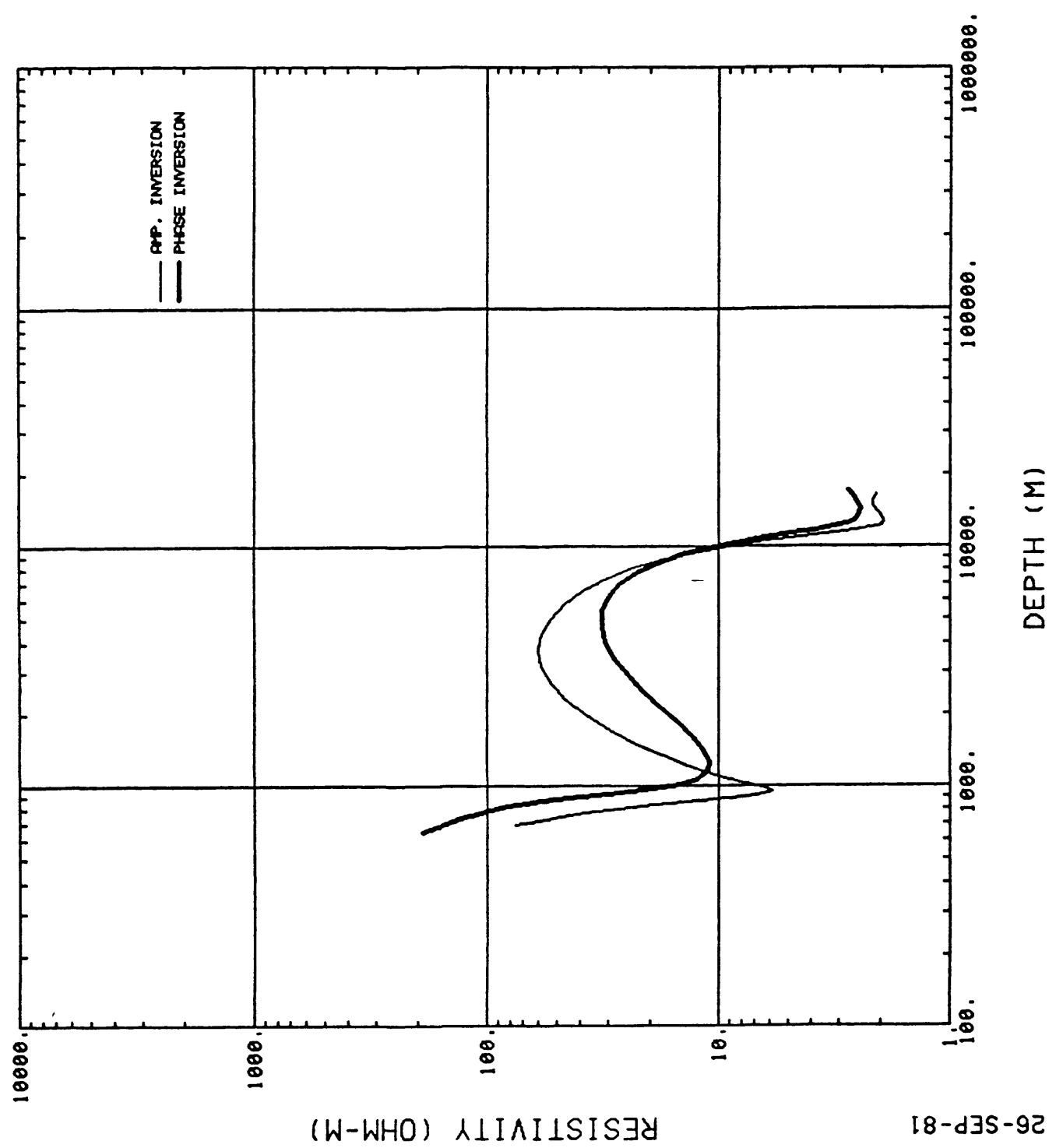
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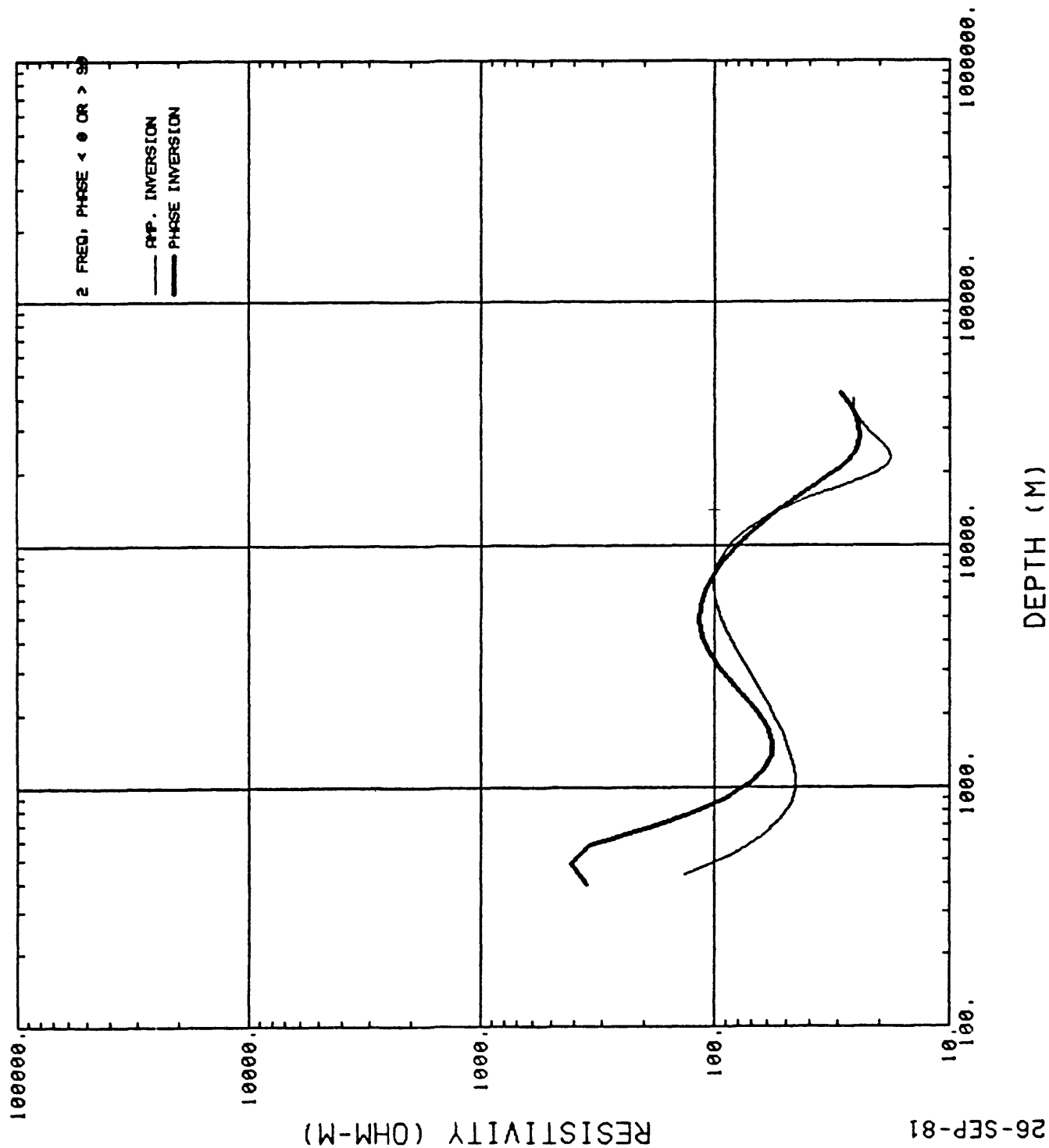
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26-SEP-81

U023X3

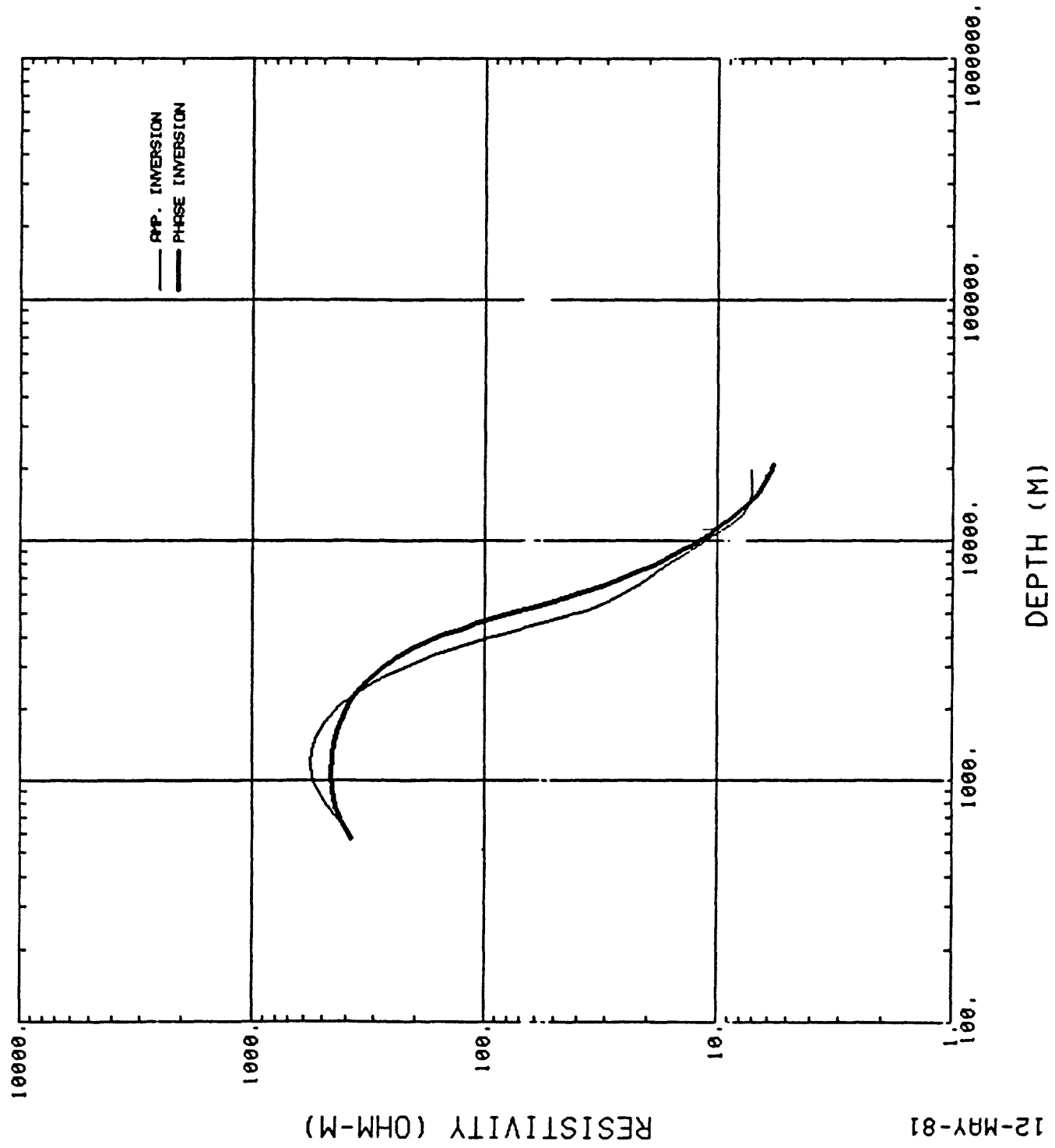


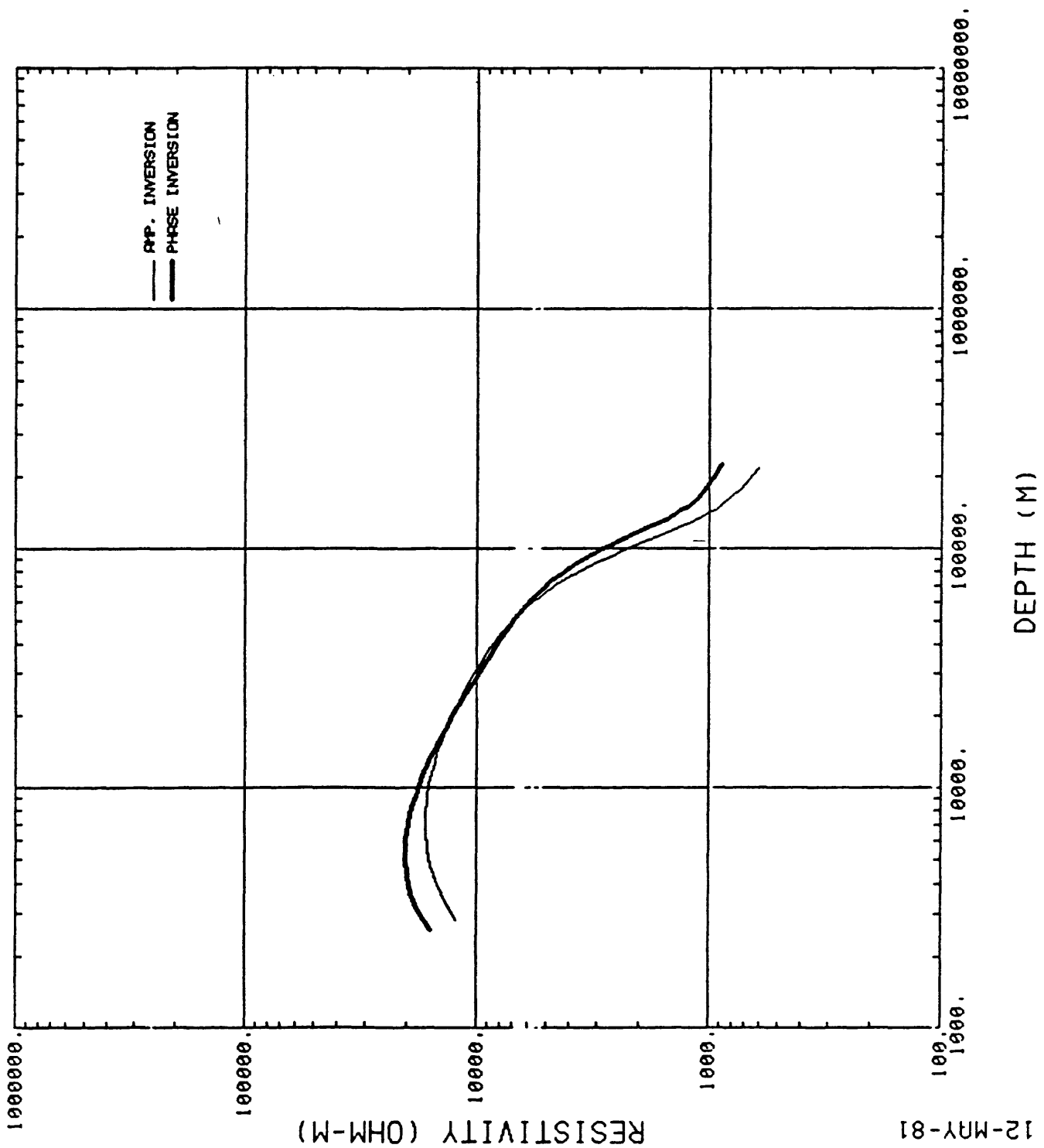


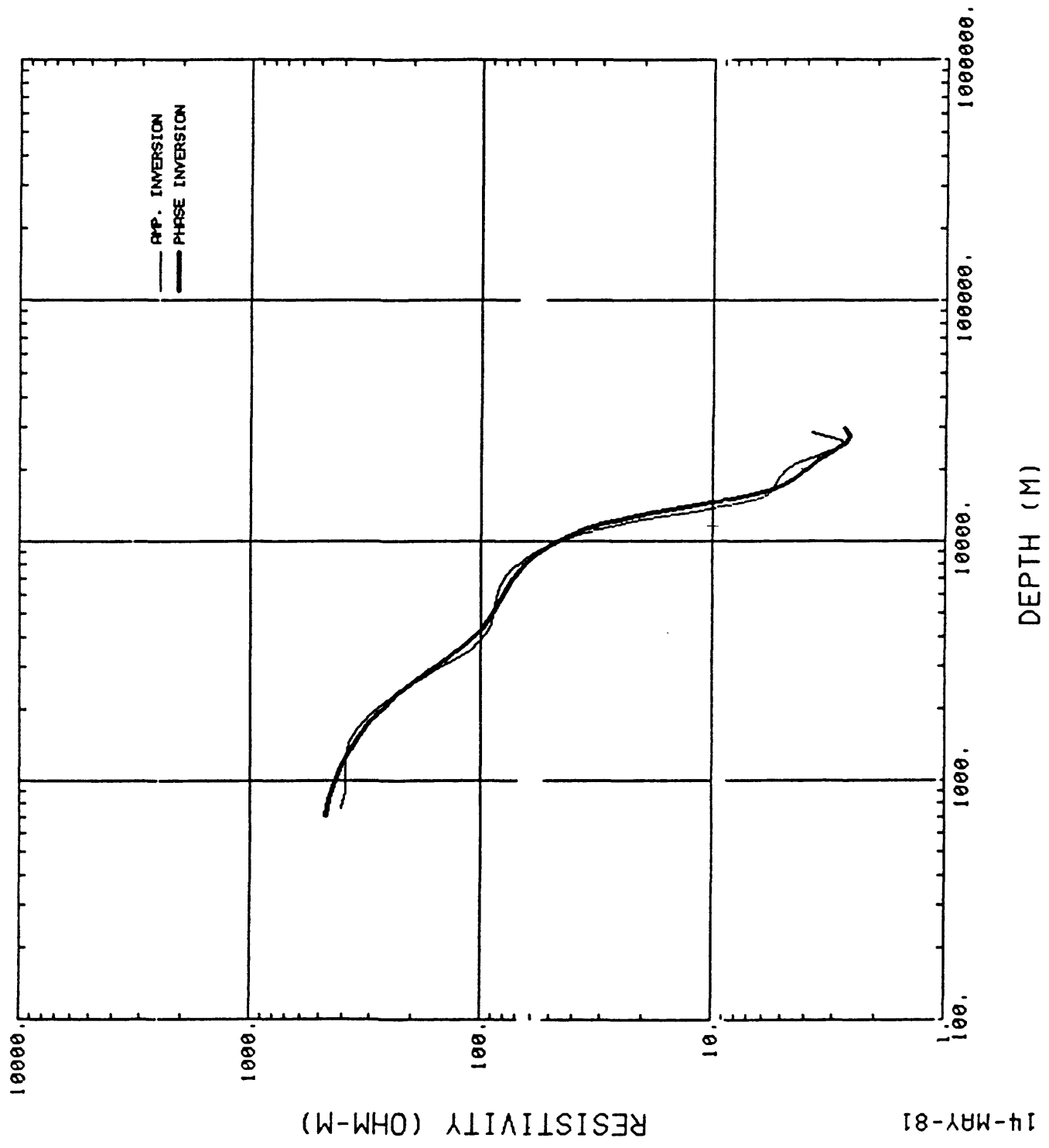
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12-MAY-81

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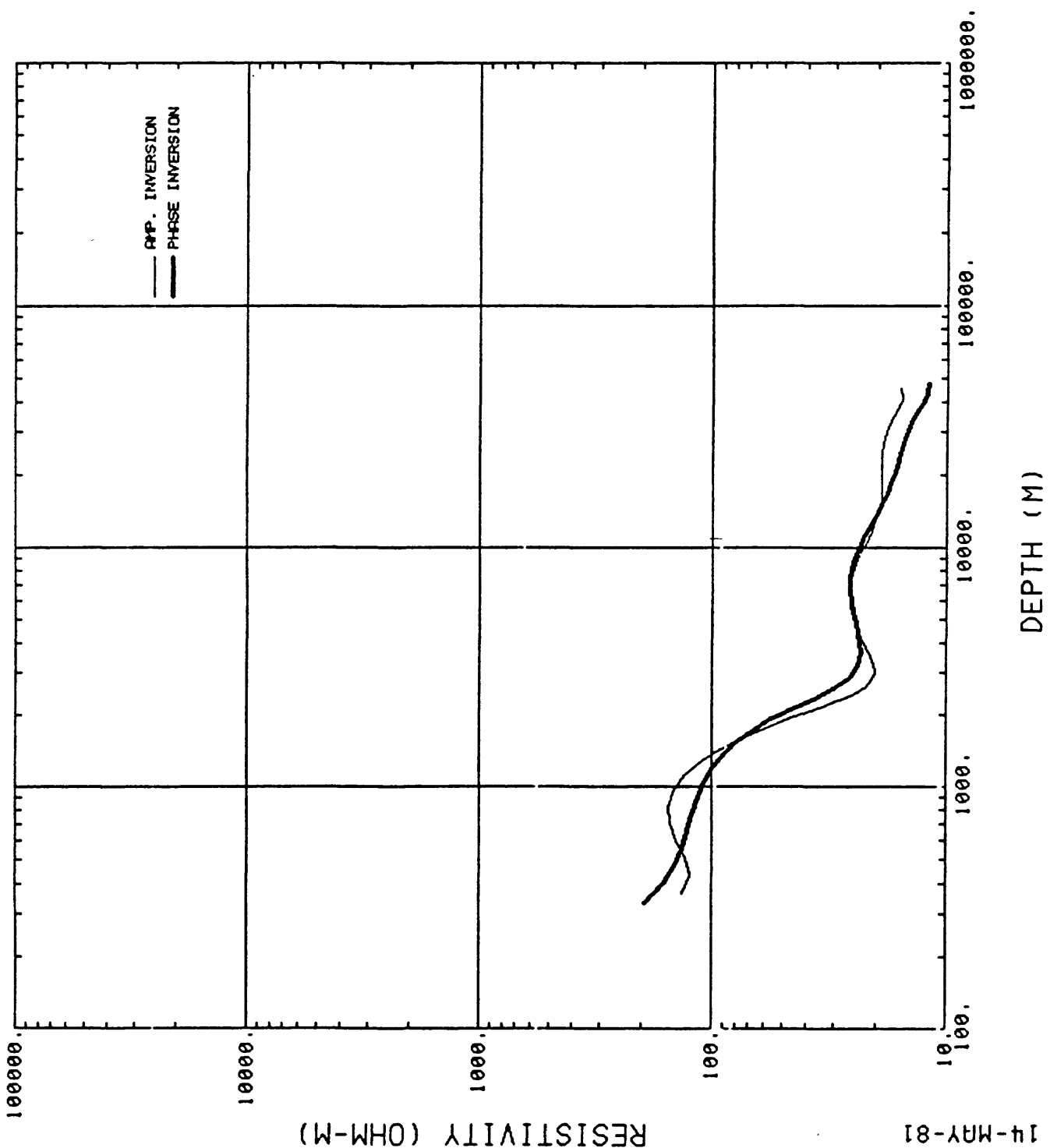




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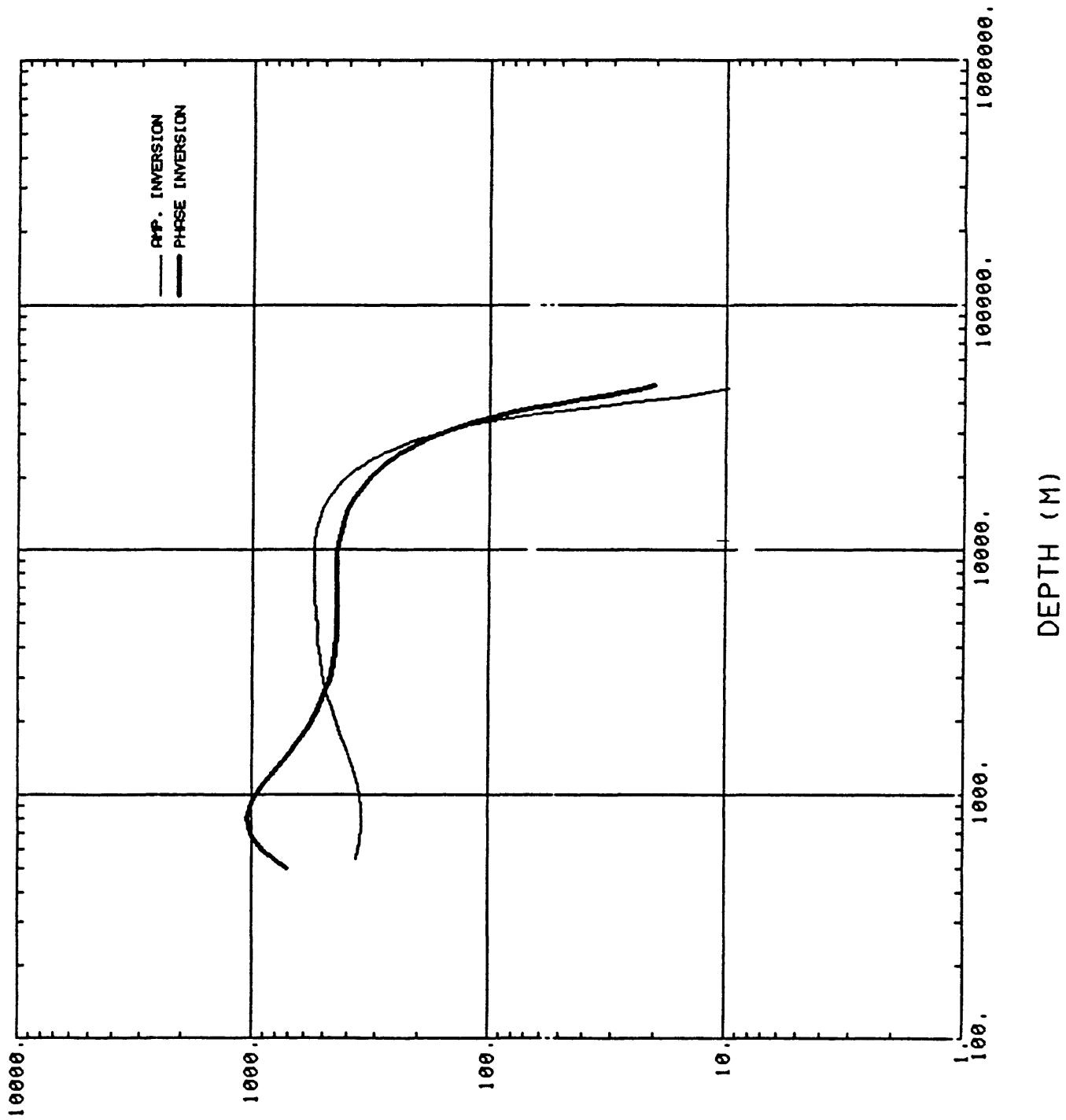
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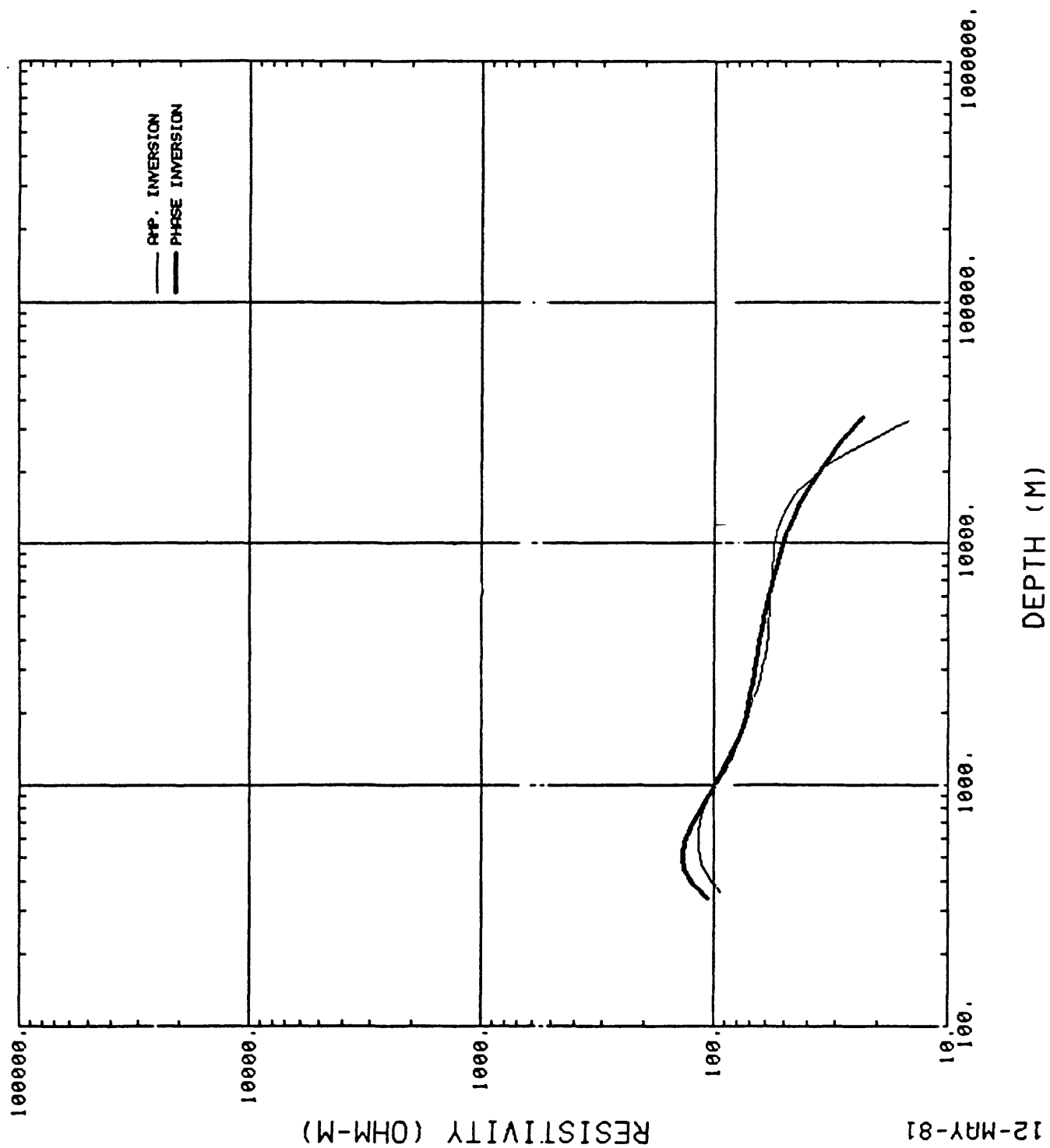
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12-MAY-81

U026X3





U026Y3