32D05SW0002 2.12955 CLIFFORD

010

CONTROLLED SOURCE AUDIOFREQUENCY MAGNETOTELLURIC SURVEY ON GRID C14

CLIFFORD TOWNSHIP, ONTARIO

LARDER LAKE MINING DIVISION

DISTRICT OF TIMISKAMING

2.12955

NTS 32D/5
Latitude 48° 17′N
Longitude 79° 80′W

2.10571

John Kovala
December 1989

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1.0 INTRODUCTION

A controlled source Audiofrequency magnetotelluric survey was carried out by Quantech Consulting Inc. for LAC Minerals Ltd. on a continuous block of 44 claims located 20Km north east of Kirkland Lake along the south central boundary of Clifford Township. The survey was conducted between November 1st and November 30th, 1987. The survey was completed in order to evaluate the effectiveness of this survey in outlining the low resistivity zone associated with a previously discovered ultramafic breccia.

Sections 1 through 4 of this report were written by J. Kovala. Sections 5 through 7, CSAMT Technique, Data Presentation and Interpretation Techniques were extracted fro a report written by G. Bogden of Quantech in October 1987 for LAC Minerals. P. Haloff, a consultant for LAC Minerals has interpreted the results of this survey, Section 8.

2.0 PROPERTY

The property consists of a continuous block of 44 unpatented mining claims located in Clifford Township, Larder Lake Mining Division, District of Timiskaming. The claims are given below:

L 803325 to 803331
803333 to 803342
983106 to 983108
918236 to 918238
1014621 to 1014627
1014635 to 1014640
1014648 to 1014655

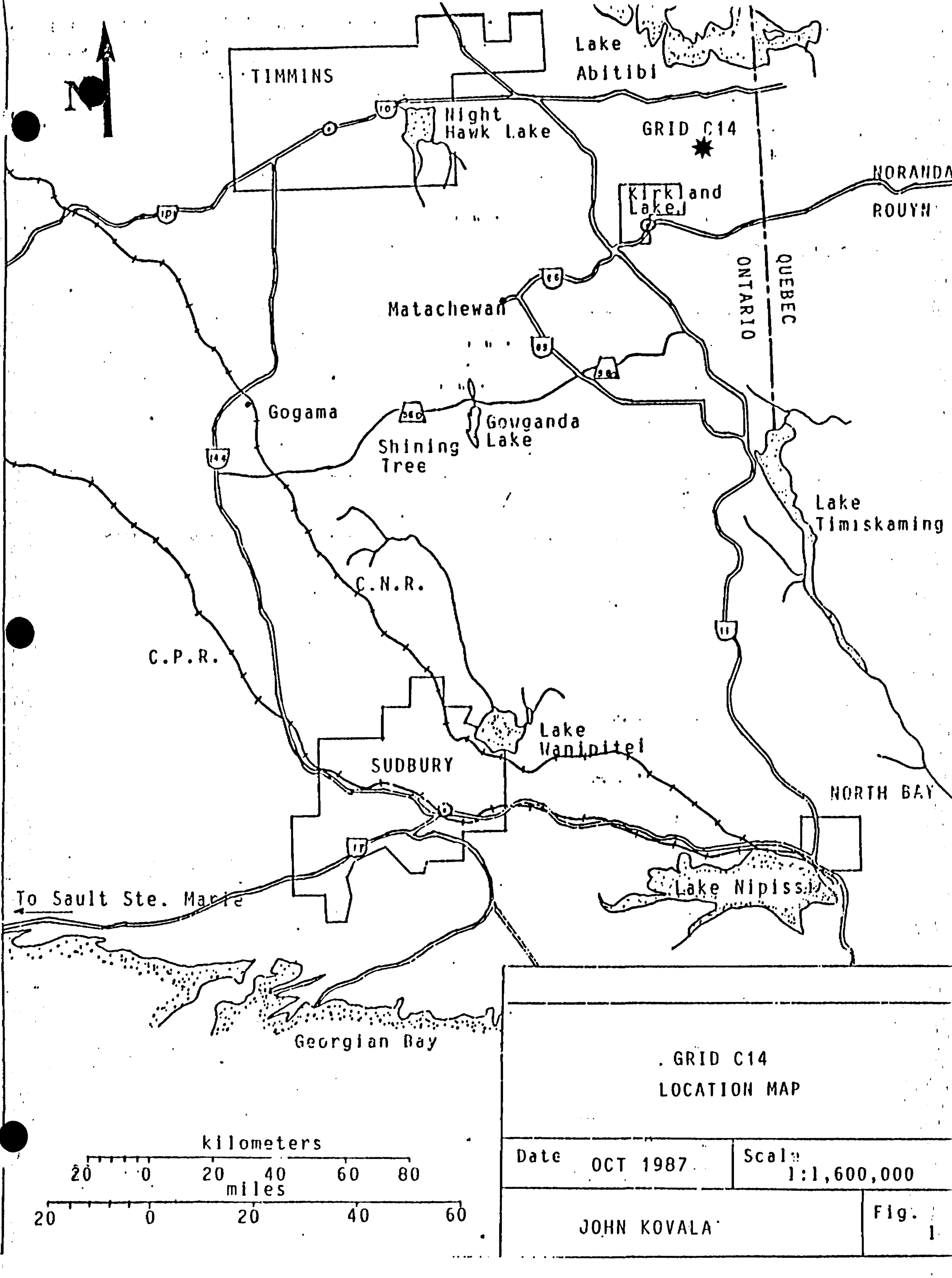
3.0 LOCATION AND ACCESS

The C14 property is located 20 kilometers northeast of Kirkland Lake in the south central portion of Clifford Township at longitude 79° 80′ W and latitude 48° 17′N (NTS 32D/5)

Bush roads originating at the Esker Park and Harker-Holloway roads lead to the south and north boundaries respectively.

4.0 GENERAL GEOLOGY

Regionally the property is located in the west central portion of the Blake River synclinorium. The Blake River group consists of dominantly calc-alkaline series intermediate to felsic volcanic rock occurring in the central portion of Clifford Township. Bodies and sills of mafic intermediate and felsic intrusive rocks cut the volcanics. All of the above are cut by dominantly NW striking diabase.



GRID C14
LOCATION MAP

Date OCT 1987	Scale 1:1,600,000
JOHN KOVALA	Fig. 1

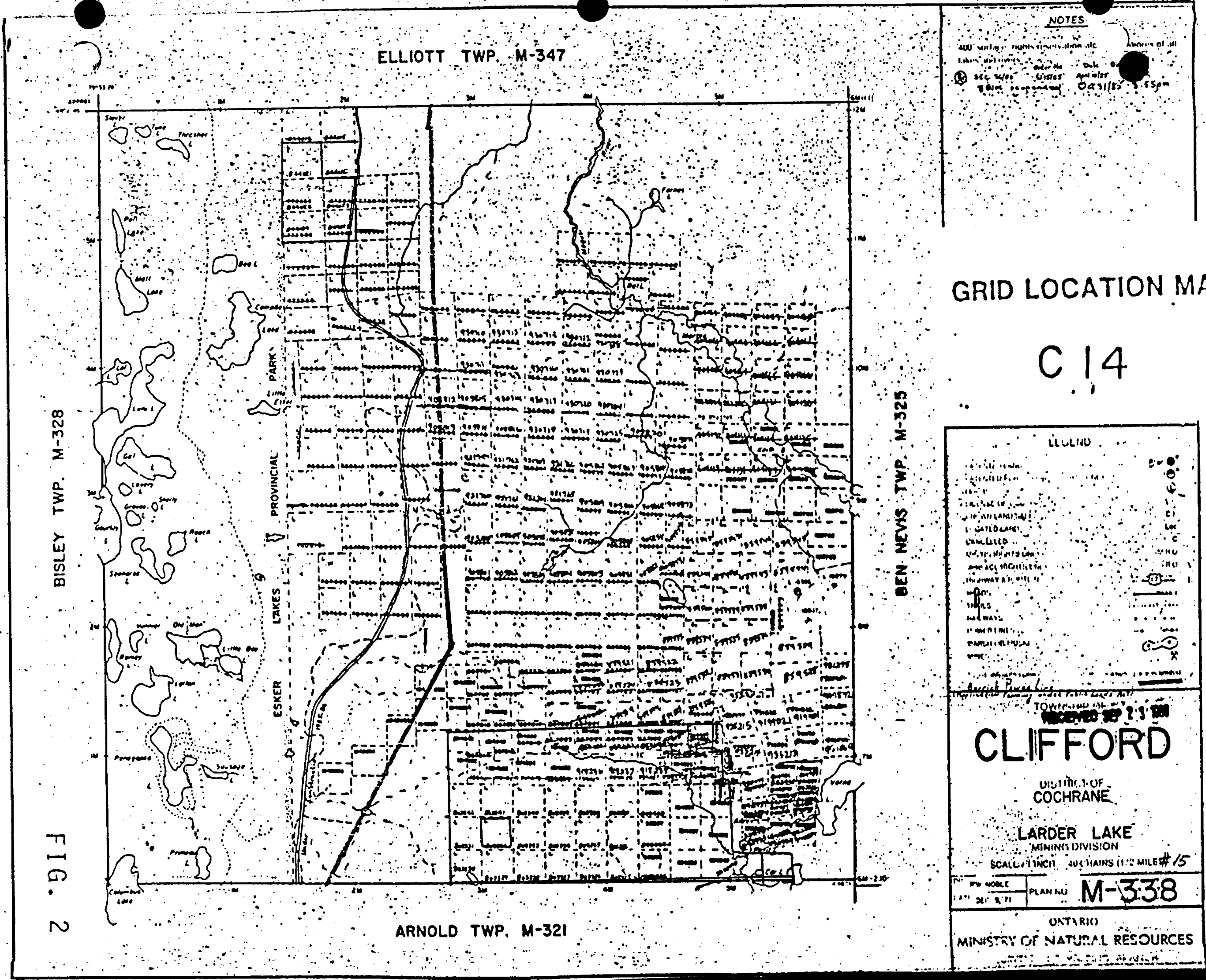

NOTES
ELLIOTT TWP. M-347
BISLEY TWP. M-328
ESKER LAKES PROVINCIAL PARK
BEN NEVIS TWP. M-325
ARNOLD TWP. M-321
GRID LOCATION MAP
C 14
LEGEND
TOWNSHIP OF
CLIFFORD
DISTRICT OF
COCHRANE
LARDER LAKE
MINING DIVISION
PLAN NO. M-338
ONTARIO
MINISTRY OF NATURAL RESOURCES

FIG. 2

In the central portion of the synclinorium in Clifford Township occurs a domal anticline intruded by a granodiorite stock 1 1/4 miles wide. The survey area is located 2 miles south of the above domal anticline over a complimentary WNW syncline. The syncline is centered by felsic volcanics and flanked to the NNE and SSW by intermediate volcanics. A large quartz gabbro intrusive is located along the southeastern boundary of the property.

5.0 CSAMT TECHNIQUE

5.1 Advantages and Disadvantages Over Natural Signal Systems

Natural source electromagnetic (EM) sounding methods such as magnetotellurics (MT) and audiomagnetotellurics (AMT) have been widely used for the exploration of hydrocarbons, groundwater and geothermal sources, but with little application to mineral exploration. The MT method measures fluctuations in the earth's natural electric and magnetic fields over a broad range of frequencies between 10 Hz and 10,000 Hz; the AMT band is slightly higher between 10 Hz and 10,000 Hz. The source of these fluctuations originate in the ionosphere for frequencies less than 1 Hz and from thunderstorms for the higher frequencies. The field strength and polarization of the signals vary with the time of day and the season.

The CSAMT technique was introduced to overcome problems and limitations encountered by these natural source methods (Goldstein and Strangeway, 1975). Rather than a natural signal source, CSAMT uses a fixed grounded bipole or current loop on the surface of the earth to produce an EM signal. Some of the advantages of the CSAMT technique over the natural source methods which make CSAMT a viable mineral exploration tool are:

1. The polarization of the fields can be selected by the orientation of the transmitting antenna.

2. The signal strength does not depend on the time of day or the season.

3. Because the signals are stronger, the receiving equipment does not need to be as sensitive as that of MT or AMT.

4. Because of the coherent signal, the usual signal processing and enhancement techniques are far more effective.

5. CSAMT surveys are much faster and therefore more cost effective than natural source EM surveys.

The primary disadvantage of the CSAMT method over natural source EM methods is the closeness of the signal source. For natural source techniques, the signal source is, in effect, infinite such that the EM field is a "plane wave". This assumption greatly simplifies processing and interpretation for MT and AMT data. For CSAMT data, if the transmitting antenna is too close to the survey area, the resistivity of the deep layers cannot be determined accurately since they are no longer energized by this plane wave. Readings measured at the plane wave distance are considered to be in the "far-field", while readings measured at the non-plane wave distance are considered in the "near-field". In order that resistivities of the deep layers be calculated correctly, the measurements must be corrected for this near-field, non-plane wave effect.

5.2 Theory and Instrumentation

The survey was executed using the V4 multichannel universal receiver console, the T30 transmitter and the MG30 (30 kilowatt) motor generator, all manufactured by Phoenix Geophysics Limited, Markham, Ontario. A complete description of the equipment along with technical specifications are contained in Appendix B.

The transmitter operates at sixteen (16), selectable, binary step base frequencies which range from 0.25 Hz to 8192 Hz. An optional alternate frequency set at 2/3 the base frequency set, ranges from 0.17 Hz to 5461 Hz to provide a total of 32 transmitting frequencies. The length of the bipole (or loop edge) may be varied from several hundred meters to several kilometers, depending upon signal strength, the minimum transmitter-receiver distance and the size of the area to be surveyed. Normally a grounded bipole is preferred to a current loop because the bipole requires less wire to produce a comparable signal. The bipole is constructed with lengths of #10 gauge copper wire, which has a resistance of approximately 1 ohm per 1000 feet.

Orthogonal components of the electric field (E) and the magnetic field (H) are measured over the survey area. The E-field components are measured with a dipole using non-polarizable (steel rod) electrodes in the same manner as induced polarization (IP) measurements. The dipole length is a function of the scale of the survey but may also be influenced by the E-field signal strength, which in turn is a function of the transmitter-receiver distance, the transmitter bipole current, the earth resistivity and noise conditions. The H-field components are measured using a magnetic sensor coil placed on the ground. The V4 has the advantage of multiple channels which permits the measurement of six (6) or seven (7) dipoles and one (1) H-field component simultaneously.

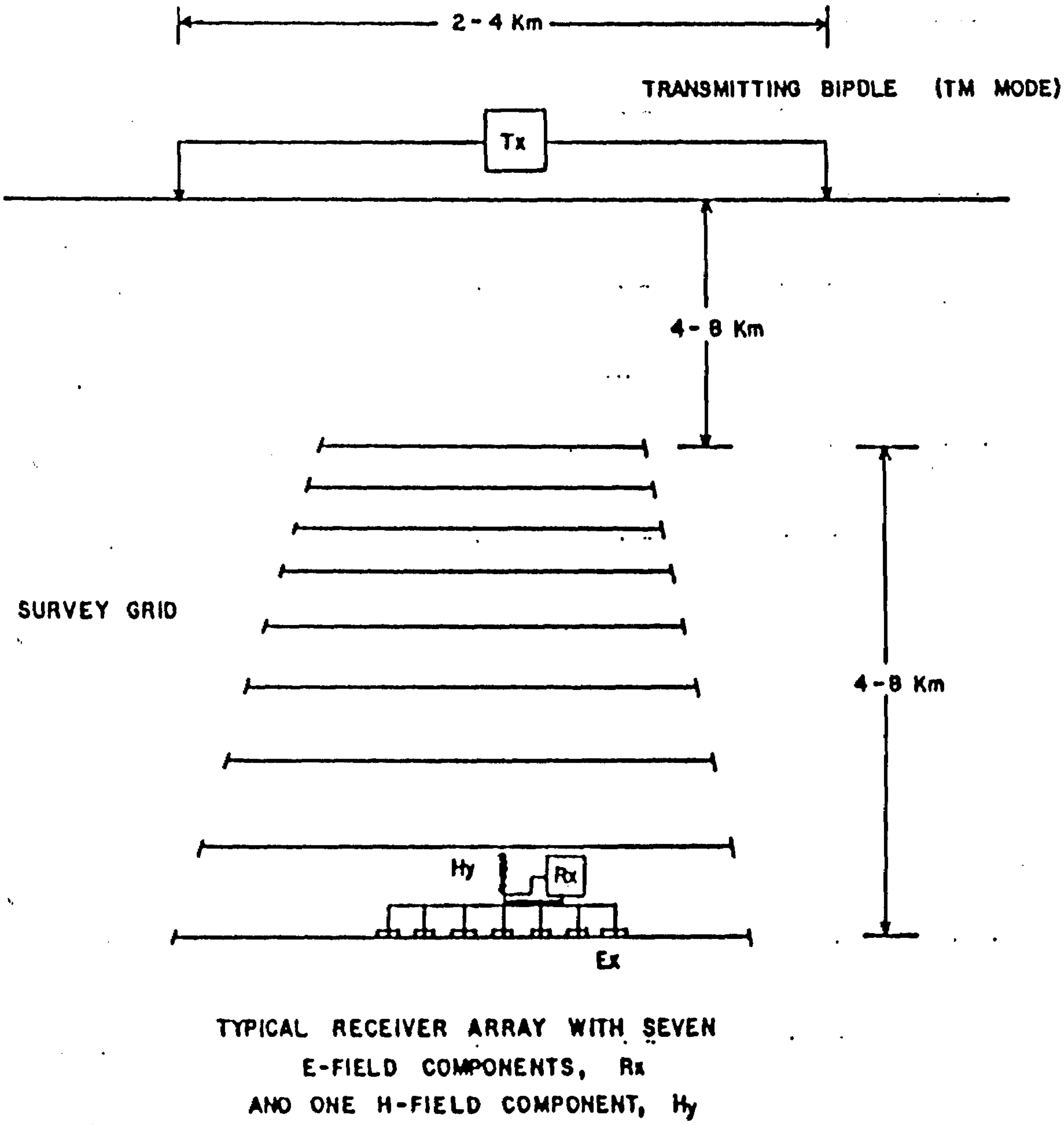


FIGURE 5.1 : TYPICAL CSAMT SURVEY CONFIGURATION

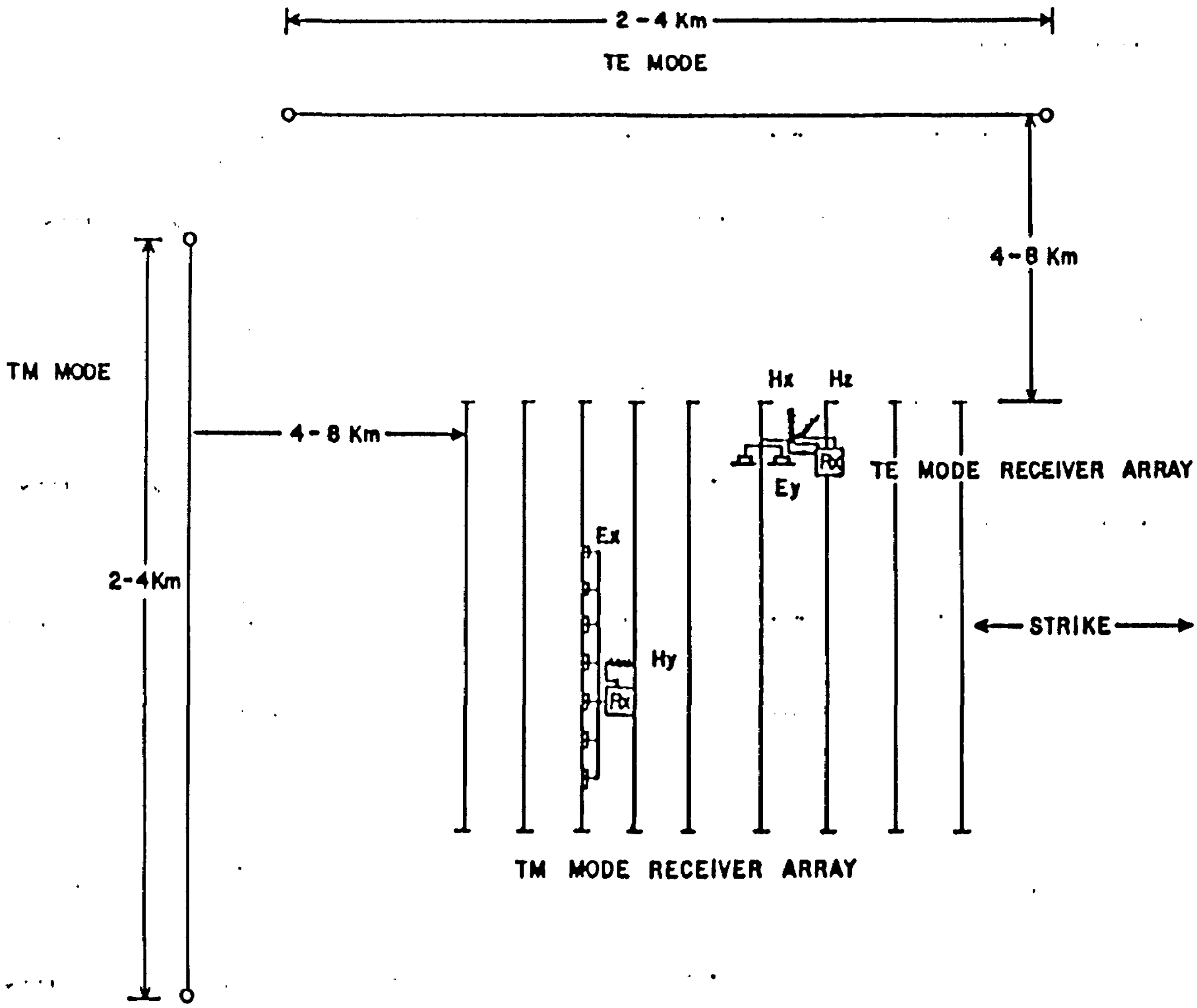


FIGURE 5.2 : TM MODE AND TE MODE ARRAYS

The survey may be conducted in two survey modes: the transverse magnetic (TM) mode where the transmitting bipole is perpendicular to geologic strike and the transverse electric (TE) mode where the transmitting bipole is parallel to geologic strike. The TM mode is most sensitive to lateral changes in resistivity and is therefore more suitable as a reconnaissance mapping tool whereas the TE mode is preferred as a detailing method because it provides greater resolution of horizontal resistive boundaries. A TM mode survey is also much faster from a logistics standpoint, than a TE mode survey.

Up to three H-field components, Hx, Hy and Hz and two E-field components, Ex and Ey can be measured at each station along with the E-field phase and H-field phase for both modes. The apparent resistivity is calculated from the ratio of orthogonal components of the electric and magnetic fields (eg. Ex/Hy or Ey/Hx) using the following Cagniard equation:

$$\rho_a = \frac{1}{2\pi f \mu_0}\left(\frac{E}{H}\right)^2, \quad \phi = E_\phi - H_\phi \quad (1)$$

Where μ_0 = $4\pi \times 10^{-7}$ H/m
ρ_a = apparent resistivity in ohm-meters
E = E-field magnitude in mv/km
H = H-field magnitude in gammas
ϕ = phase difference in radians

Should only the Ex and Hy components of the electric and magnetic fields respectively be required for the TM mode then only one H-field measurement is necessary for each receiver array since Hy is essentially constant over a significant distance, even for very strong conductors (Yamashita, 1987). Figure 5.1 illustrates a typical configuration for a reconnaissance TM mode and TE mode.

The measured components of the electric and magnetic fields and the calculated apparent resistivity are stored in solid-state memory in the V4 receiver and later transferred to a microcomputer for processing at the end of the field day.

5.3 <u>Computer Software</u>

Data dumping, editing, reduction and presentation was controlled by the CSAMT processing and interpretation programs provided by Phoenix. The software is written in HPBASIC and executes only on a Hewlett Packard HP9845 or HP9000 series machine. Figure 5.3 illustrates the software package structure.

Contours of apparent resistivity values for selected frequencies for the survey grids were prepared using the MAPPLOT system developed by Geosoft Inc., Toronto. The software was controlled by DOS 3.1 written by Compaq Computer Corporation.

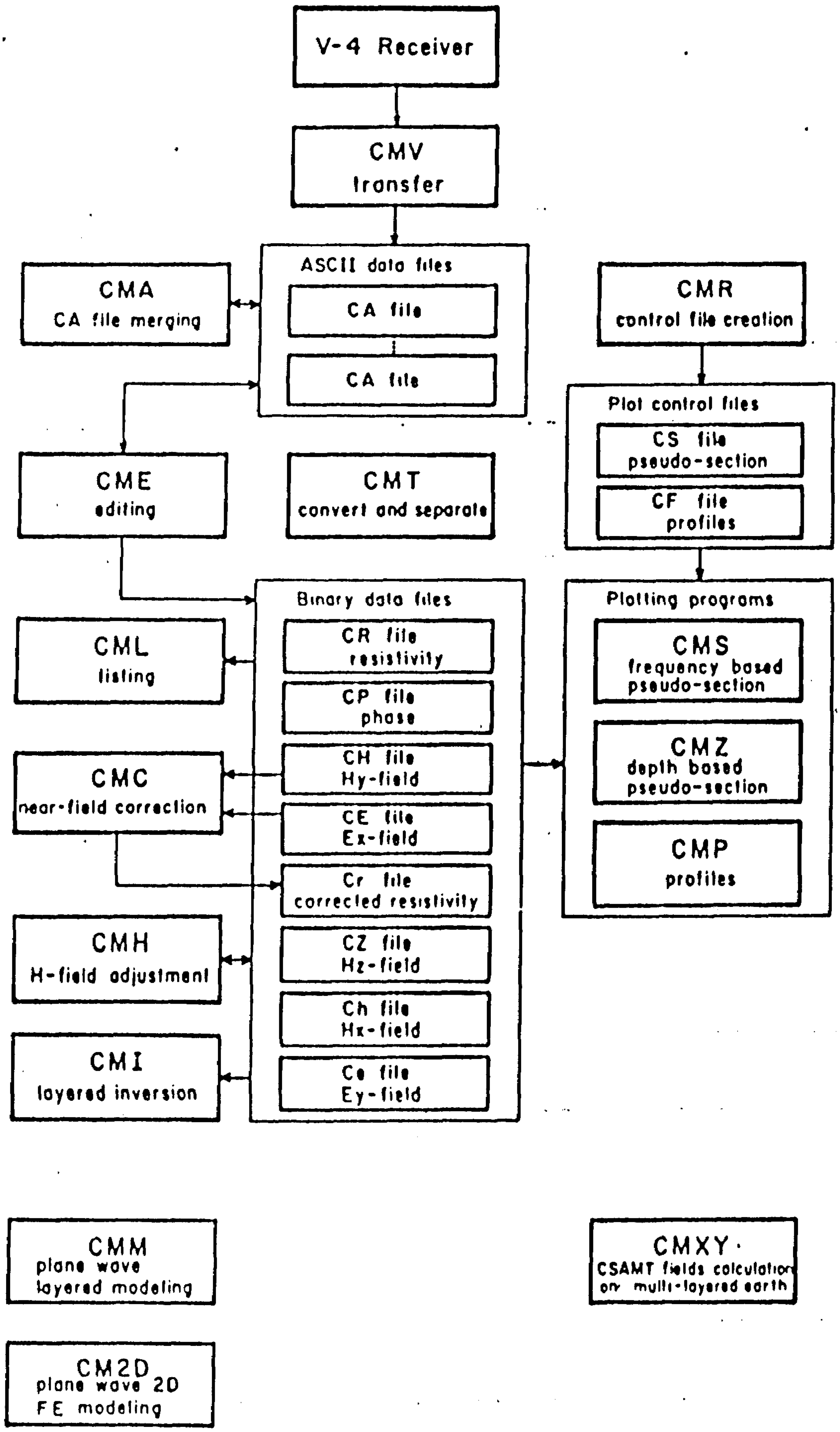


FIGURE 5.3
Phoenix software structure.

5.4 Computer Hardware

In-field processing used the Hewlett Packard HP9845 desk-top computer. The system is equipped with an 8 bit CPU, two cassette tape drives, RS-232C serial port and integral thermal printer.

6.0 DATA PRESENTATION

6.1 Frequency Pseudosections

The contoured apparent resistivity for near-field corrected data for each line surveyed is presented in a frequency pseudosection format (see Appendix A). Contour intervals are logarithmically distributed to compensate for the large dynamic range of the data. Zones of low resistivity (high conductivity) have been shaded at 5,000 ohm-meter intervals.

Other parameters, such as the phase difference, or E-field and H-field magnitude were also presented in the same format, to provide further information when required.

6.2 Frequency Profiles

Profiles of each sounding point were used when necessary by the author to provide more diagnostic information about an individual sounding point.

7.0 INTERPRETATION TECHNIQUES

7.1 First Order Correction

In order to use the interpretation methods and modelling techniques common to natural source surveys, CSAMT data must be corrected for the near-field effect.

The Cagniard equation given in Equation (1) is only valid when the transmitted electromagnetic field is far enough from the transmitting bipole such that it is a plane-wave or the far-field case. This distance is a function of the ground resistivity and the transmitter current in the bipole. If the actual distance between the transmitter and the receiver is much less than this far-field distance, the transmitted field is not plane-wave in character, and is considered in the near-field. In the near-field, the Cagniard equation overestimates the actual resistivity. Consequently "true" apparent resistivity values must be estimated using another technique:

$$\rho_a = K(r) * r\left(\frac{E}{H}\right) \quad (2)$$

(Yamashita, 1984)

Where r = the distance between the transmitter and receiver
K(r) = a constant function of r
E = E-field magnitude in mv/km
H = H-field magnitude in gammas

The area of gradual change between the near-field and the far-field distance is known as the "transition-field". Calculations of apparent resistivities in this case use a "transition-triangle method" (Yamashita, 1984). The combination of the calculations for the near-field, and the transition field is considered the first-order correction.

Considering the high resistivity contrast of rock units in the Abitibi though, apparent resistivities need only be compared *relatively*. Consequently data interpretated using the first order correction (or no correction at all in fact) is considered acceptable for resistivity mapping in this environment.

7.2 QUALITIVE INTERPRETATIONS

7.2.1 Frequency Pseudosections

The near-field corrected frequency pseudosections provide the starting point for the interpretation of results. By comparing the *relative* apparent resistivities down each line, possible contacts and vertical structure may be interpreted.

The reader must realize when viewing the sections that they do not represent a "slice of the earth", rather they are a convenient means by which to present the data. Each sounding point should be considered individually on the section.

Since the effective depth of investigation of CSAMT is a function of the earth resistivity and the characteristics of the conductor at depth, depth estimates for anomalies cannot be determined with any degree of certainty using qualitative analysis from the frequency sections.

When analyzing CSAMT data, the interpreter must also be aware of several "effects" which, if not considered or understood correctly, can lead to gross misinterpretations:

1) Static Shifts

Small, near-surface resistivity inhomogeneities often strongly affect the calculated apparent resistivity of CSAMT data, the same way that MT and AMT data is affected. When an electrode is placed within, or very near to such a feature, the apparent resistivity curve for that sounding point will be shifted along the resistivity axis. For conductive zones such as swamps, the curve will be shifted *down* the resistivity axis whereas for very resistive zones, such as outcrop, the curve will be shifted *up* the resistivity axis.

Static shifts may create interpretation problems when conductors of interest are below near-surface conductors for example. Resistivities from the near-surface anomaly will pull-down the resistivities above the deeper conductor such that the two anomalies may appear to merge as one long, deep conductor.

2) Undershoot

In both MT and CSAMT, the apparent resistivity increases as frequency decreases over structure of higher resistivity underlying lower resistivity. When the resistivity contrast is high, the apparent resistivity curve usually decreases *before* beginning to increase. This type of response is more commonly referred to as "undershoot". For data measured in the far-field, the decrease or undershoot is small. For CSAMT data measured in the near-field or the transition field, however, the undershoot is often very large and distinct, which can create problems with depth inversions.

Unfortunately, the undershoot response cannot be corrected using the first order correction. To correct for the effect, the biased data points can simply be removed from the resistivity curve and the curve replotted. However, in some cases it may be difficult to distinguish a true trough of apparent resistivity from an undershoot effect. A simple 1-D forward model may be useful to determine whether the trough is a true response or undershoot.

7.3 MODELLING

7.3.1 1-D Inversions

The depth for which the amplitude of the EM field decreases to *1/e* (37 percent) of its value at the surface is referred to as the skin depth. The strict definition of skin depth requires a homogeneous medium, however in practical application, such conditions do not exist therefore an apparent skin depth (*skin depth*$_a$) for an inhomogeneous medium may be defined as:

$$\text{skin depth}_a = \left(\frac{2\rho_a(f)}{2\pi f \mu_0}\right)^{1/2} \qquad (3)$$

Where apparent resistivity ($\rho_a(f)$) is the apparent resistivity measured at that frequency. The *skin depth*$_a$ is indicative of the depth of penetration of the EM wave, i.e. the lower the frequency of the transmitted signal, the deeper the depth of penetration.

PHOENIX GEOPHYSICS
2D FINITE ELEMENT
CSAMT MODELING

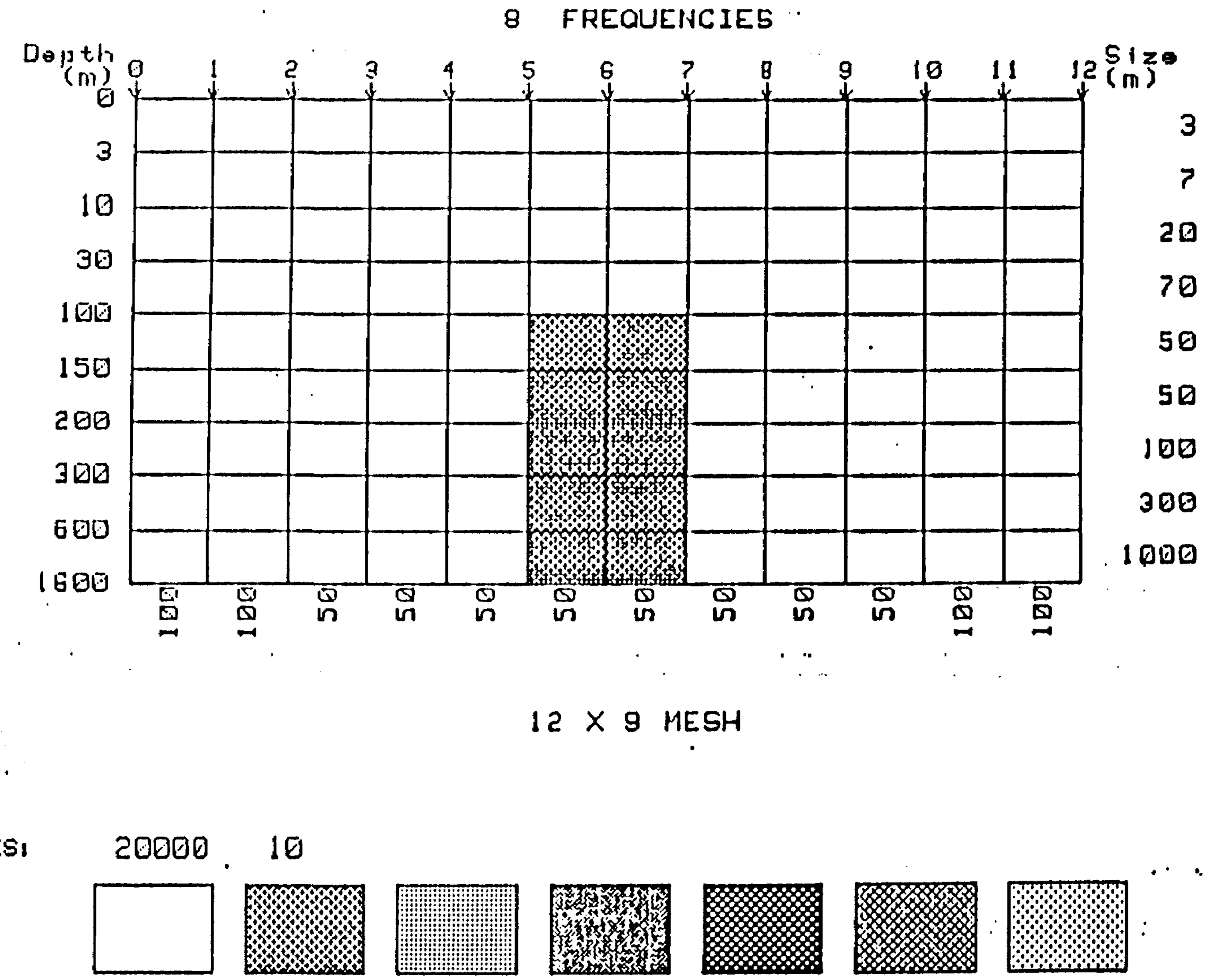


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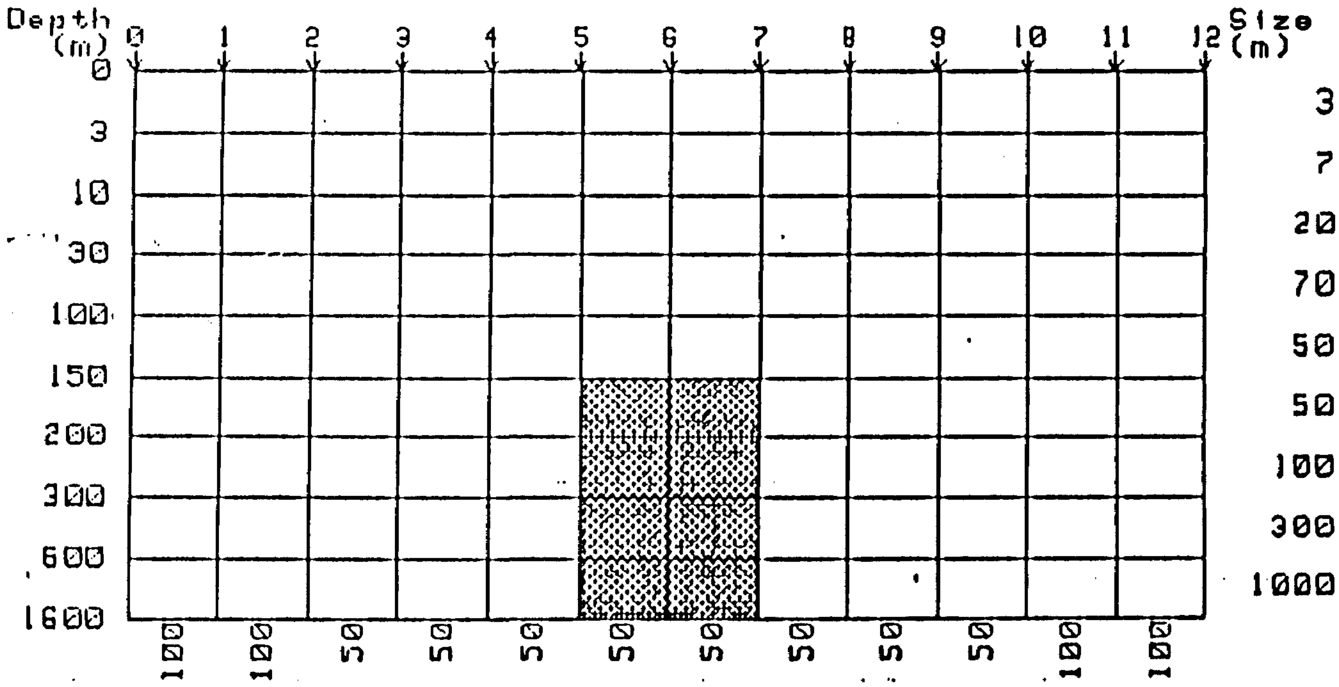
FIGURE 7.2
2-D forward model at 100 meters.

PHOENIX GEOPHYSICS, INC. 2-D CSAMT MODELING

	1	2	3	4	5	6	7	8	9	10	11	12	
4096	19K	18K	17K	14K	11K	9K	9K	11K	14K	17K	18K	19K	4096
2048	20K	19K	17K	14K	11K	8K	8K	11K	14K	17K	19K	20K	2048
1024	20K	19K	17K	14K	11K	8K	8K	11K	14K	17K	19K	20K	1024
512	20K	18K	17K	14K	10K	8K	8K	10K	14K	17K	18K	20K	512
256	19K	18K	17K	14K	10K	8K	8K	10K	14K	17K	18K	19K	256
128	19K	18K	17K	14K	10K	8K	8K	10K	14K	17K	18K	19K	128
64	19K	18K	16K	14K	10K	7K	7K	10K	14K	16K	18K	19K	64
32	19K	18K	16K	13K	10K	7K	7K	10K	13K	16K	18K	19K	32
16	19K	18K	16K	13K	10K	7K	7K	10K	13K	16K	18K	19K	16
8	19K	18K	16K	13K	10K	7K	7K	10K	13K	16K	18K	19K	8
4	19K	18K	16K	13K	10K	7K	7K	10K	13K	16K	18K	19K	4
2	19K	18K	16K	13K	10K	7K	7K	10K	13K	16K	18K	19K	2
1	19K	18K	16K	13K	10K	7K	7K	10K	13K	16K	18K	19K	1
.5	19K	18K	16K	13K	10K	7K	7K	10K	13K	16K	18K	19K	.5
.25	19K	18K	16K	13K	10K	7K	7K	10K	13K	16K	18K	19K	.25

PHOENIX GEOPHYSICS
2D FINITE ELEMENT
CSAMT MODELING

8 FREQUENCIES



12 X 9 MESH

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FIGURE 7.3
2-D forward model at 150 meters.

PHOENIX GEOPHYSICS, INC. — 2-D CSAMT MODELING

	1	2	3	4	5	6	7	8	9	10	11	12	
4096	19K	18K	17K	15K	14K	13K	13K	14K	15K	17K	18K	19K	4096
2048	19K	18K	17K	15K	13K	12K	12K	13K	15K	17K	18K	19K	2048
1024	19K	18K	17K	15K	13K	12K	12K	13K	15K	17K	18K	19K	1024
512	19K	18K	17K	15K	13K	12K	12K	13K	15K	17K	18K	19K	512
256	19K	18K	16K	15K	13K	12K	12K	13K	15K	16K	18K	19K	256
128	19K	18K	16K	14K	12K	12K	12K	12K	14K	16K	18K	19K	128
64	19K	17K	16K	14K	12K	11K	11K	12K	14K	16K	17K	19K	64
32	19K	17K	16K	14K	12K	11K	11K	12K	14K	16K	17K	19K	32
16	19K	17K	16K	14K	12K	11K	11K	12K	14K	16K	17K	19K	16
8	19K	17K	16K	14K	12K	11K	11K	12K	14K	16K	17K	19K	8
4	19K	17K	16K	14K	12K	11K	11K	12K	14K	16K	17K	19K	4
2	19K	17K	16K	14K	12K	11K	11K	12K	14K	16K	17K	19K	2
1	19K	17K	16K	14K	12K	11K	11K	12K	14K	16K	17K	19K	1
.5	19K	17K	16K	14K	12K	11K	11K	12K	14K	16K	17K	19K	.5
.25	19K	17K	16K	14K	12K	11K	11K	12K	14K	16K	17K	19K	.25

Considering the recorded apparent resistivity for each frequency, the apparent skin depth for a sounding point may be estimated by means of a simple inversion program. The program provides reasonable estimates only for layered, horizontally-homogeneous stratigraphy, and is therefore not also be exercised to avoid literal interpretation of depth structures, i.e. finite or isolated conductors (Bartel, 1987).

Static effects, as discussed above, may also lead to errors in inverted models. By the apparent skin depth calculation, the inverted resistivities will be shifted proportionally to the shift in the apparent resistivity curve, while the inverted depth will be shifted proportionally to the square root of the shift of the apparent resistivity curve. The interpreter must exercise care when applying inversions under these conditions to avoid misinterpretations.

7.3.2 2-D Forward Modelling

A two dimensional, finite element, forward modelling program was used when necessary to estimate the "best-fit" geology model for a particular frequency pseudosection.

The operator can specify a mesh size and up to seven (7) causative bodies each with an apparent resistivity value. The program was executed on an HP9000 computer by Phoenix Geophysics Ltd. at their facilities in Toronto.

8.0 RESULTS AND INTERPRETATION

The C14 project was undertaken to investigate an ultramafic breccia in Clifford Township, Ontario. Several drill holes have been completed, to evaluate the results of a ground magnetic and an IP and resistivity test survey. The CSAMT Test Survey was completed in an attempt to evaluate the usefulness of this relatively new technique in outlining the low resistivity zone that represents the increased porosity associated with the breccia.

Reconnaissance and detailed ground magnetic surveys clearly show a "kidney shaped" magnetic high. The magnetic high is centered at about 7+00N on line 2000E and line 2125N. This magnetic high correlates closely with the breccia pipe, as it was later outlined by the drill holes completed.

Dipole-dipole IP and resistivity measurements were completed on line 2000E and on line 2125E using X=50 meters; n=1,2,3,4,5. These pseudosections both indicate a region of very high resistivities (greater than 2000 ohm-meters) to the south of about 6+00N to 5+00N. On both sets of data, the dipole-dipole results indicate a relatively narrow zone of lower bedrock resistivities (less than 200 ohm-meters) just to the north of this resistivity contact.

This some of lower apparent resistivities is broader on the western line (line 2000E) than it is on line 2125E. To the north of this low resistivity feature, the basement rocks are indicated to have a more moderate resistivity value.

CSAMT measurements were completed on the C14 Grid, with an E-field dipole length of 50 meters. On line 2000E and line 2125E, the CSAMT apparent resistivity pseudosections show resistivity lows that correlate exactly with those detected by the X=50 meters, dipole-dipole measurements. The zone of low resistivities in the bedrock is broader on line 2000E than on line 2125E. The plan map, contoured presentation of the apparent resistivities measured at 64Hz, shows a region of low bedrock apparent resistivities that correlates closely with the magnetic high and the location of the breccia pipe.

The association of a magnetic high and an apparent resistivity low is unusual. Alteration in the bedrock will produce an apparent resistivity low, due to increased porosity. However, most alteration phenomena decrease, or totally destroy, the magnetite content of the rocks. This will result in the measurement of a magnetic low during a survey.

It would appear that magnetic and resistivity surveys would be useful in the search for breccia pipes. However, care must be exercised in the interpretation of these results in regions of deep glacial overburden. The magnetic anomalies may be reduced, due to the greater distance to the source. The apparent resistivity results will be drastically influenced by the presence of the thick, conductive, overburden layer.

The CSAMT pseudosections from line 2500E and line 125 exhibit the type of apparent resistivity pattern that can be encountered.

CERTIFICATION

I John M. Kovala certify:

1. That I reside at 7 Teck Hughes Property Kirkland Lake Ontario.

2. That I have completed the B.Sc. program in Geology at Laurentian University.

3. That I have been employed in the exploration Industry since 1983.

Signed

John M. Kovala
Project Geologist

Qual 2.10571

APPENDIX A

TECHICAL SPECIFICATIONS --- PHOENIX V4, T30, MG30

SIGNAL PROCESSING, DIGITAL

A-D Conversion — 16 bits, giving a resolution of 1 part in 65,000.

Sampling Rate — Controlled by microprocessor to a maximum of 12.5 kHz (16 kHz by early 1985).

TEST AND CALIBRATION

Calibration — A test signal output is provided to perform test and calibration functions. There is also a processor controlled internal test mode that allows automatic precise calibration of all filters. Calibration responses may be stored in the instrument and automatically removed from the measurements.

Test Signal — The externally available test signal can be either: a frequency domain signal of ± 5V, 200 ohm impedance, frequency 4 kHz - 1/128 Hz, or a time domain signal with a 50% duty cycle.

Display and Controls — The display is a 64 character dot matrix LCD and the computer results presented are the mean and standard deviation as well as the stack number.

All modes of operation and parameter control entries may be displayed and the display will prompt the operator to make the appropriate keypad entries.

The LCD will operate to a temperature of -10°C. For lower temperature operation an LCD heater is required (optional).

Memory — Non-volatile memory for data logging is provided. This is sufficient for storage of 36 SIP stations with a full complement of channels over the entire frequency range. Although this is sufficient for approximately three days operation, a further memory extension is optionally available.

I/O Ports — The memory may be transferred into a computer by an 8-bit parallel I/O port or by an optional serial RS-232 port.

Printer — A vest pocket-sized, 20 column, dot matrix printer operates through the 8 bit parallel I/O port. Power for the printer is supplied by the V-4; no additional batteries are required. The external printer configuration permits better environmental protection.

Analog Meters — A meter for each channel provides continuous monitoring of the signals. These meters are also used for battery monitoring.

GENERAL

Temperature — The storage temperature range is -50°C to +70°C. The operating temperature range is -40°C to +50°C. (-10°C to +50°C without LCD heater option).

Humidity — The instrument is moisture proof and may be operated during rain.

Altitude — -1600 m to 5000 m.

Vibration — Suitable for transport in light aircraft and bush vehicle.

Weight — 13 kg.

Case — The case is made of an Acrylic PVC alloy, which is vacuum formed, extremely tough, resilient, weather resistant and a good electrical insulator. It is equipped with a removable lid, carrying handle and packboard tie down loops.

Dimensions — 32 cm x 36 cm, 27 cm high.

Batteries — The standard instrument is equipped with three 6 volt rechargeable gel cells. The battery charger circuit (less transformer) is built-in.

Controlling Firmware

Programs — The standard version of the V-4 includes the control program for Spectral Induced Polarization operation (SIP).

Optional Programs available — Controlled Source Audio Magnetotelluric (CSAMT)
Time domain induced polarization
Others: Consult Phoenix for details.

Spectral I.P. [SIP] Operation

Frequencies — 2^{-10} Hz to 2^{12} HZ (1/1024 to 4096 Hz) in binary steps. An automatic frequency scan is initiated by selecting Fhigh and Flow to be different values. The scan can step by a factor of 4, 2, or $\sqrt{2}$.

Transmitter Links — For spectral IP, two highly isolated RF communication links are provided:

A: Transmitter drive link for transmitter switching control via a twisted pair cable.

B: Current Monitor link.
This link provides an accurate replica of the transmitter current to one of the eight channel inputs. This allows real-time deconvolution of the transmitter waveform from the other input channels. The required isolation transformer and demodulation circuits are built into the V-4.

Deconvolution — The physical quantity which we are attempting to determine is the resistivity transfer function. Since it is not possible to control kilowatts of power passing through unstable current electrodes to an accuracy of 1 part in 10000, it is necessary to monitor both current and voltage and then to deconvolve the current from the voltage to obtain the true spectral IP response. This deconvolution is carried out automatically in the V-4 at each frequency by dividing the voltage amplitude by the current amplitude and by subtracting the current phase from the voltage phase for all six voltage channels.

Operating Sequence — START sets the receiver and transmitter to 1 Hz and allows the System to cancel SP and adjust gain for each channel.

ENTER is pressed after each of the operating parameters is input through the keypad.

A averaging time
B number of channels
C current in amperes
D dipole identification
E electrode interval in meters
F frequency range (Fhigh, Flow)
The six parameters are held in memory. Only a few are usually changed from station to station along a line.

PRINT prints out the six operating parameters if it is desired to check their values.
RUN starts the automatic frequency scan. The unit first measures, calculates and prints the resistivity at 1 Hz. It then proceeds to Fhigh, makes the required measurements, displays and prints the results, proceeds to the next frequency and so on, down to Flow.
STORE is pressed if the scan is satisfactory and it is desired to store the results in memory.

Software — Phoenix supplies complete applications software for transferring spectral IP data to a computer; fitting the Cole-Cole model to spectral IP data; calculation of Cole-Cole parameters; removal of electromagnetic coupling; and plotting and contouring data pseudosections.

In addition, Phoenix supplies 2-dimensional modelling programs for both forward and inverse problems, to aid in interpretation.

All programs are written in BASIC.

CSAMT Operation

Frequencies — 2^{-2} to 2^{12} (0.25 Hz - 4096 Hz) in binary steps (or $\sqrt{2}$ steps).

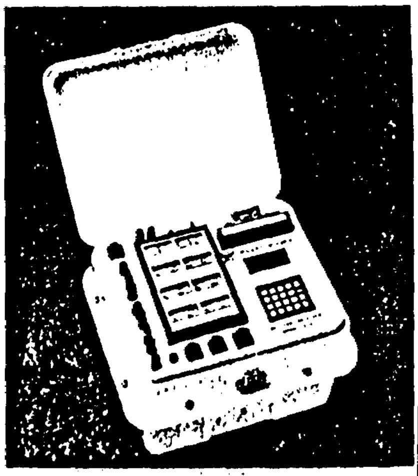
Productivity — Since the horizontal H field varies slowly, it is possible to measure only one H field for six electric dipoles. Thus production rates are six times greater than those of older, conventional, 2-channel instruments.

Real-time Calibration — The standard procedure is to store the transfer function of the instrument in memory and remove it from the signal in real time.

Software — In addition to the CSAMT control program, BASIC software utilities are available for plotting and contouring pseudosections of Cagniard apparent resistivity, and correcting for the near-field situation.

V-4

Eight Channel Universal Receiver



- **Versatility** — Instrument may be used for spectral IP, CSAMT, and conventional IP in either frequency or time domain.
- **Productivity** — Simultaneous measurement of eight input channels.
- **Microprocessor Control** — Microprocessor-controlled real-time filtering, signal stacking and averaging in time or frequency domain.
- **Reliability** — Data logging in solid state non-volatile memory.
- **Standard I/0** — Output ports for a vest pocket printer and computer or data link.
- **Automated Operation** — Automatic gain control and self-potential (SP) cancellation.

Features

EXTREMELY BROAD FREQUENCY RANGE

The V-4 was designed to cover the frequency range of most interest for electrical measurements. Its complete frequency range is six decades. With a top frequency of 4096 HZ it is a multifrequency EM unit as well as a spectral IP unit. High frequency measurements may be made very quickly, and provide useful, detailed data about the resistivity section. Pseudosection plots of the high frequency phase angles provide geometric as well as parametric EM information. The intermediate frequencies allow very accurate removal of electromagnetic coupling from IP data, and provide information on mineral type, which in certain situations can result in considerably more cost-effective exploration programs. Alternatively the high-frequency measurements may be made in CSAMT mode, providing rapid reconnaissance measurements of resistivity from 0.25-4096 Hz.

DESIGNED FOR BOTH RESEARCH AND PRODUCTION

The V-4 has been designed to be both an extremely powerful research instrument as well as the fastest production IP unit available. The conversion is accomplished simply by changing the limits of the frequency scan. Reconnaissance work might be carried out at a single frequency in which case the measurements are extremely fast and accurate. If an anomaly is encountered, the scan may be widened to provide additional data useful for the evaluation and removal of inductive coupling, and for purposes of mineral discrimination.

EIGHT CHANNEL CAPABILITY

The multichannel capability of the V-4 can decrease measurement time by a factor of six over conventional units.

REAL TIME DECONVOLUTION

Any variations in the transmitter waveform are closely monitored and accurately compensated for. This is equivalent to continuous calibration of the transmitter electrodes. All calculations are made in real time. No measurement time is wasted waiting for the processor, even at 4 kHz

MEAN/STANDARD DEVIATION

Both mean and standard deviation are continuously displayed and recorded. Thus a constant record is maintained of the precision of the measurement. If the desired accuracy is achieved early, time can be save by pressing NEXTF. The processor then prints the results and proceed with the next frequency.

VERSATILITY

The V-4 can be used for spectral IP, conventional IP in time or frequenc domain, and CSAMT, resulting in an extremely cost-effective instrumen package.

OPTIONS

- Dipole preamplifiers for spectral IP operation in high resistivity areas.
- RS-232 I/0 port.
- LCD heater for extended cold temperature operation.
- Memory extension.
- Operating firmware for CSAMT, time domain IP, and others to b announced.

Specifications, Hardware

INPUT

Channels	High input impedance differential amplifiers. Eight input channels may be measured simultaneously. Six channels are combined in one input connector. The other two inputs are equipped with isolated power supplies to power external devices such as coil preamplifiers.
Impedance	1000 Megohms.
Protection	The input is protected from excessive voltages by a 10,000 ohm fuse resistor.
Ranges	To ±10V maximum input signal.

SIGNAL PROCESSING, ANALOG

Gains	1 to 640, under microprocessor control.
Power Line Filtering	Triple notch filter for 1st, 3rd and 5th harmonic of 50 or 60 Hz. Notch depth 40 db minimum. Filter may be switched in or out.
Anti-Alias Filter	7 pole low pass filter with processor controlled corner frequencies.
Sp Cancellation	Under microprocessor control up to a range of ±2.5V.

PHOENIX

PHOENIX GEOPHYSICS LIMITED

Geophysical Consulting and Contracting, Instrument Manufacture, Sale and Lease.

[redacted]

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Markham, Ontario, Canada L3R 5M7
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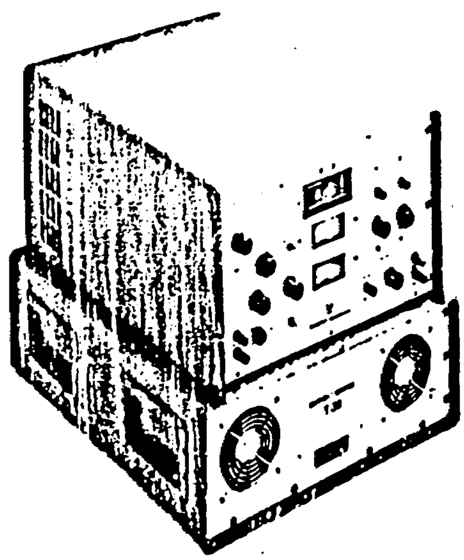
7100 WARDEN AVENUE, UNIT 7, MARKHAM, ONTARIO CANADA L3R 5M7

TELEPHONE(416) 477-8588
Telex: 06-986856
Cable: PHEXCO TORONTO

T-30

MULTIPURPOSE

CONTROLLED SOURCE



THE T-30 IS THE MOST ADVANCED CONTROLLED CURRENT SOURCE AVAILABLE FOR ELECTRICAL METHODS EXPLORATION. IT COMBINES MODERN GTO TECHNOLOGY WITH THIRTY YEARS OF TRANSMITTER DESIGN EXPERIENCE.

THE T-30 (30 KW) IS ONE OF TWO UNITS, IDENTICAL IN ALL SPECIFICATIONS EXCEPT FOR POWER AND WEIGHT. THE LIGHTWEIGHT VERSION OF THE T-30 IS DESIGNATED THE T-15. THE 15 kw T-15kw IS DESIGNED FOR END-USERS WHOSE APPLICATION PLACES A PREMIUM ON PORTABLILITY.

THESE TRANSMITTERS CAN BE USED FOR A VARIETY OF GEOPHYSICAL TECHNIQUES, INCLUDING CONVENTIONAL IP IN THE TIME OR FREQUENCY DOMAIN; TRUE WIDEBAND SPECTRAL IP; CSAMT (CONTROLLED SOURCE AUDIO MAGNETOTELLURICS); AND TDEM (TIME DOMAIN ELECTROMAGNETICS).

THE TRANSMITTER LOAD MAY BE EITHER A GROUNDED DIPOLE OR A LOOP, DEPENDING ON THE REQUIREMENTS OF THE APPLICATION. THE RAPID CONTROLLED TURN-OFF INTO INDUCTIVE LOADS IS SUITABLE FOR TDEM APPLICATIONS.

A VERY WIDE RANGE OF STANDARD BINARY-RELATED TIMING OPTIONS IS PROVIDED, AS WELL AS AN INPUT CONNECTION FOR AN ARBITRARY EXTERNAL TIMING DRIVE.

THESE UNITS ALSO FEATURE A VARIETY OF PROTECTIVE CIRCUITS, BUILT IN RECEIVER CALIBARION CIRCUITRY, CURRENT MONITOR OUTPUT FOR EXTERNAL DECONVOLUTION, CONSTANT SURRENT CONTROL, AND SEMI-INFINITE IMPEDANCE IN THE "OFF-TIME" WHEN USED FOR TIME-DOMAIN IP.

SUMMARY SPECIFICATIONS FOR THE TRANSMITTERS ARE GIVEN BELOW:

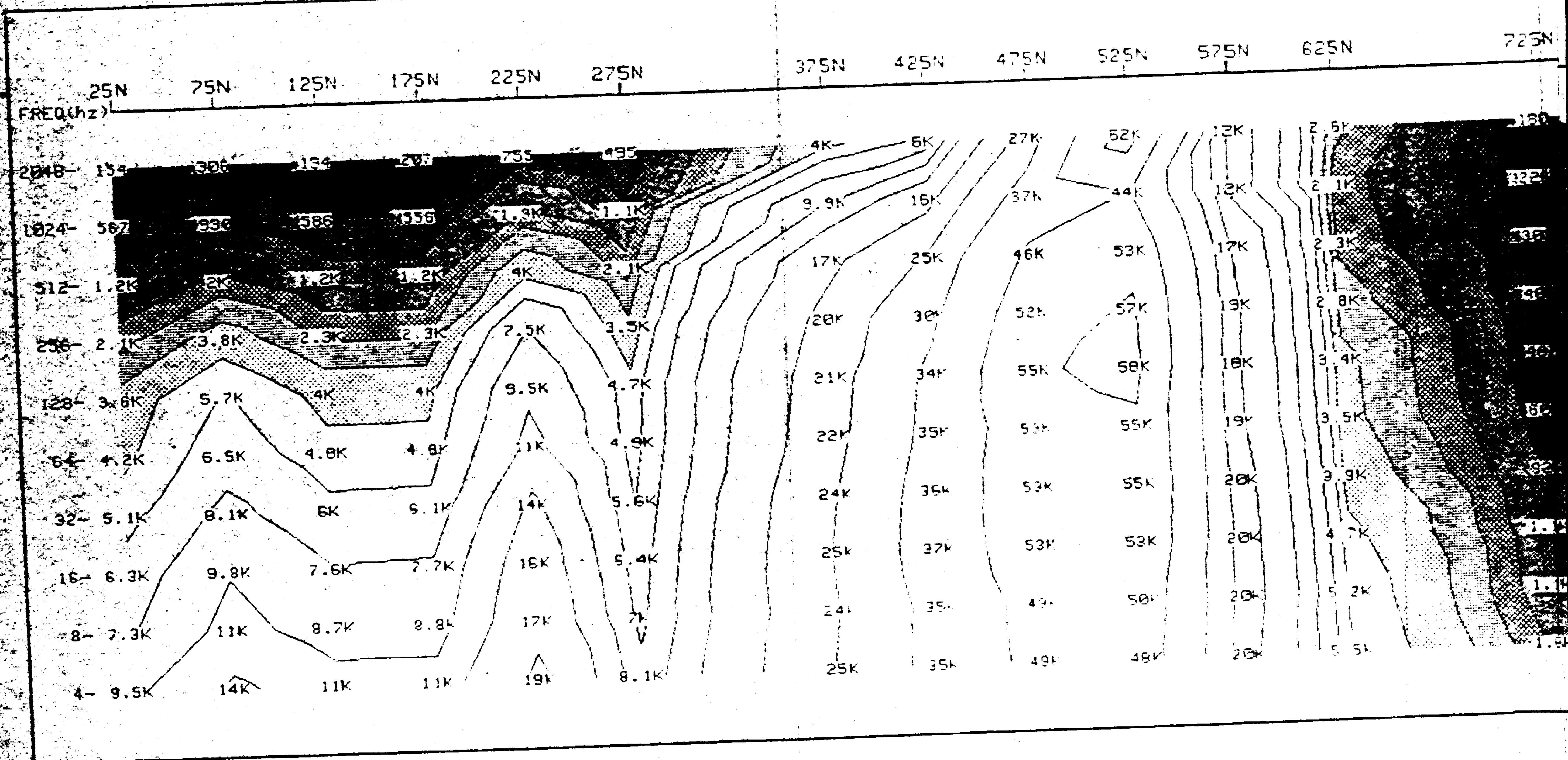
FREQUENCY	: DC - 10 kHZ.
MAX. VOLTAGE	: 800 VOLTS.
MAX. CURRENT	: 40 AMPERES.
WEIGHT	: T-15 75 KG.
	: T-30 120 KG.

THE STANDARD POWER SOURCE FOR BOTH UNITS IS THE MG-30 MOTOR GENERATOR. HOWEVER, AS ANY SUITABLE MG UNIT MAY BE USED, IT IS NOT NECESSARY TO PURCHASE THE MG UNIT FROM PHOENIX.

IN ADDITION TO THE MG-30, WHICH EMPHASIZES HIGH POWER/LOW WEIGHT, PHOENIX OFFERS A VARIETY OF MG OPTIONS. THE USER MAY REQUEST GASOLINE OR DIESEL ENGINES; 60 HZ. OR 400 HZ. ALTERNATORS; AND 110/208 V OR HIGHER VOLTAGE OUTPUT.

APPENDIX B

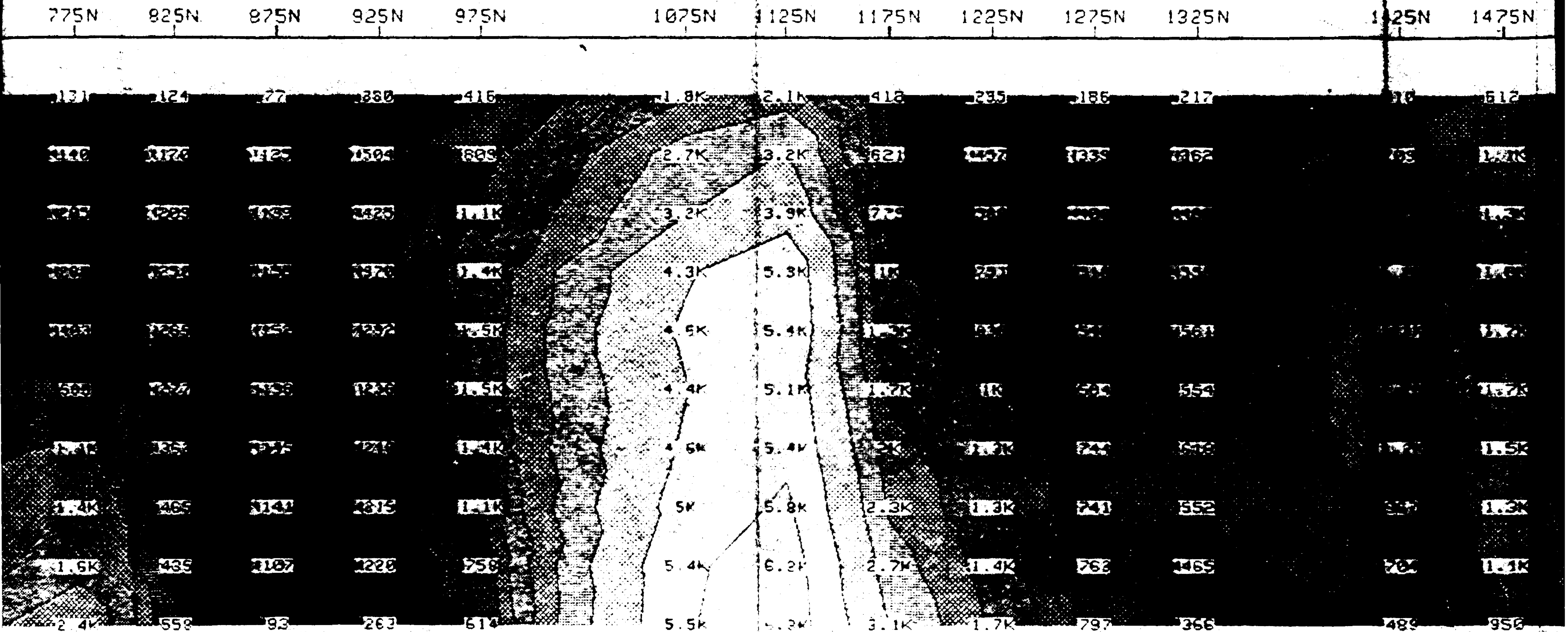
CSAMT FREQUENCY PSEUDOSECTIONS



FREQ(hz)
25N
75N
125N
175N
225N
275N
375N
425N
475N
525N
575N
625N
725N
2048
1024
512
256
128
64
32
16
8
4

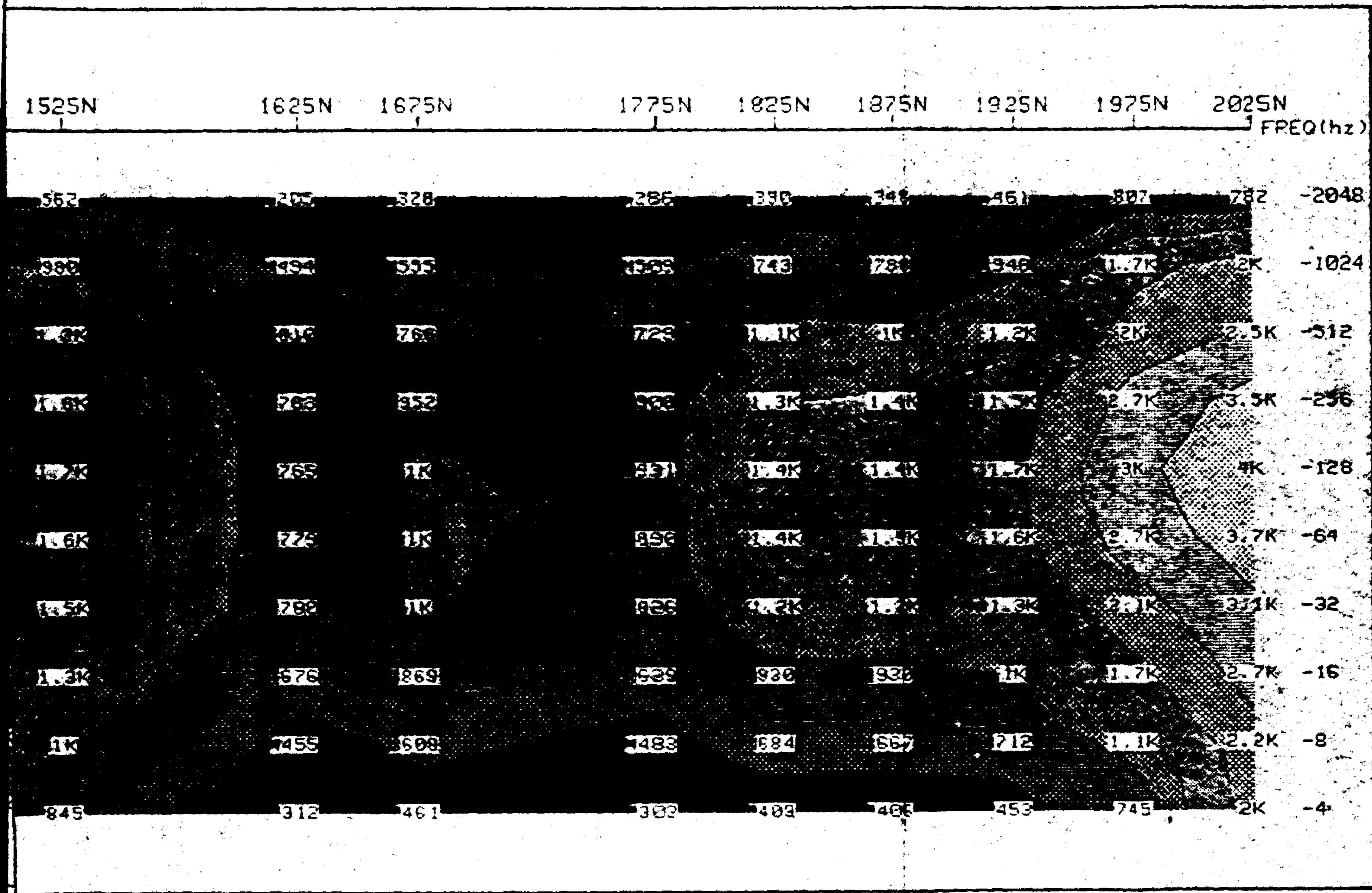
CSAMT APPARENT RESISTIVITY (CORRECTED)

LAC MINERALS LTD.   C14 LINE=0E   E-dipole=5000ft Tx-Rx=11.5km



Resistivity in ohm-m

Surveyed by QUANTECH CONSULTING INC.


1525N
1625N
1675N
1775N
1825N
1875N
1925N
1975N
2025N
FREQ(hz)
-2048
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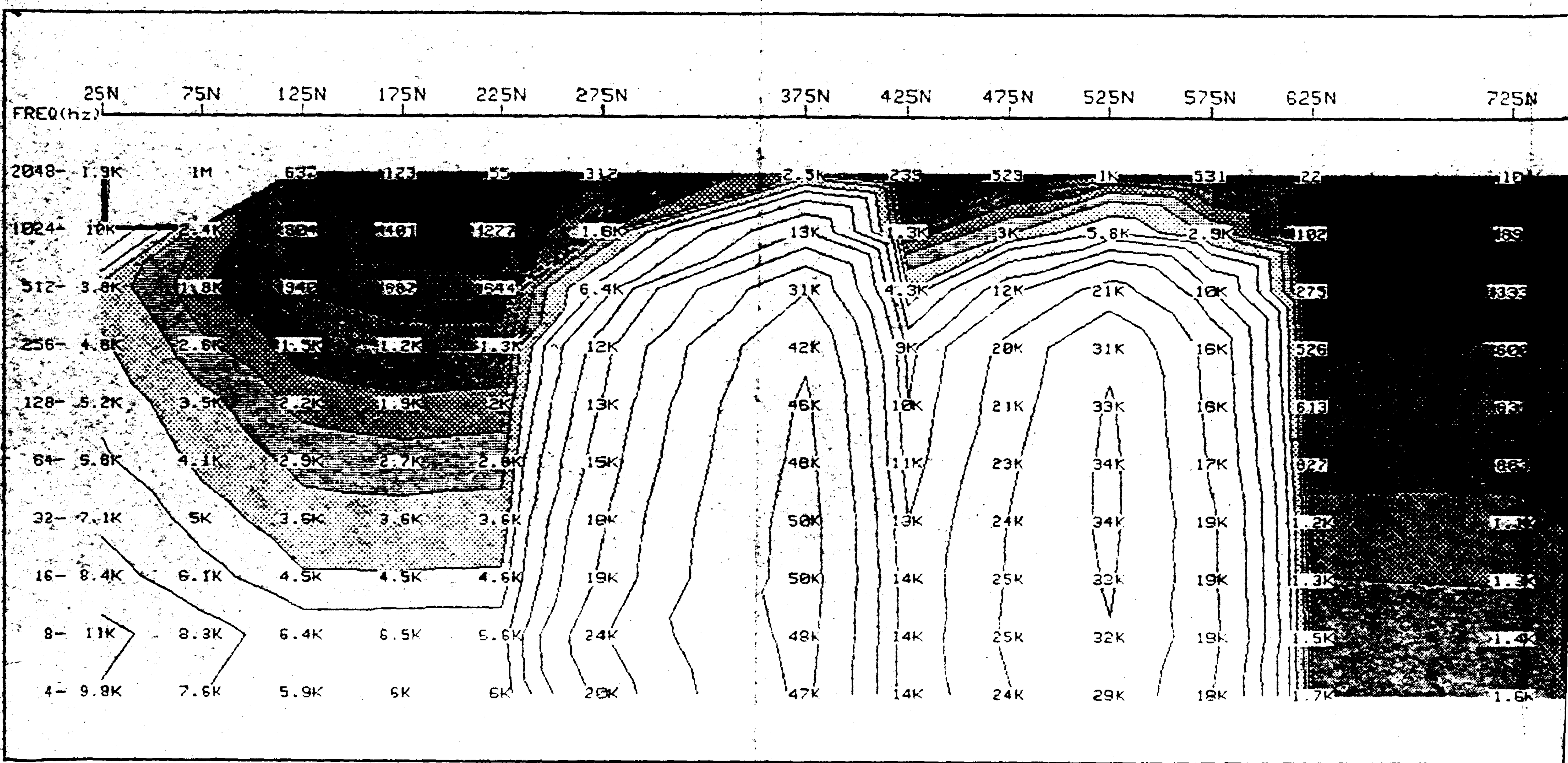
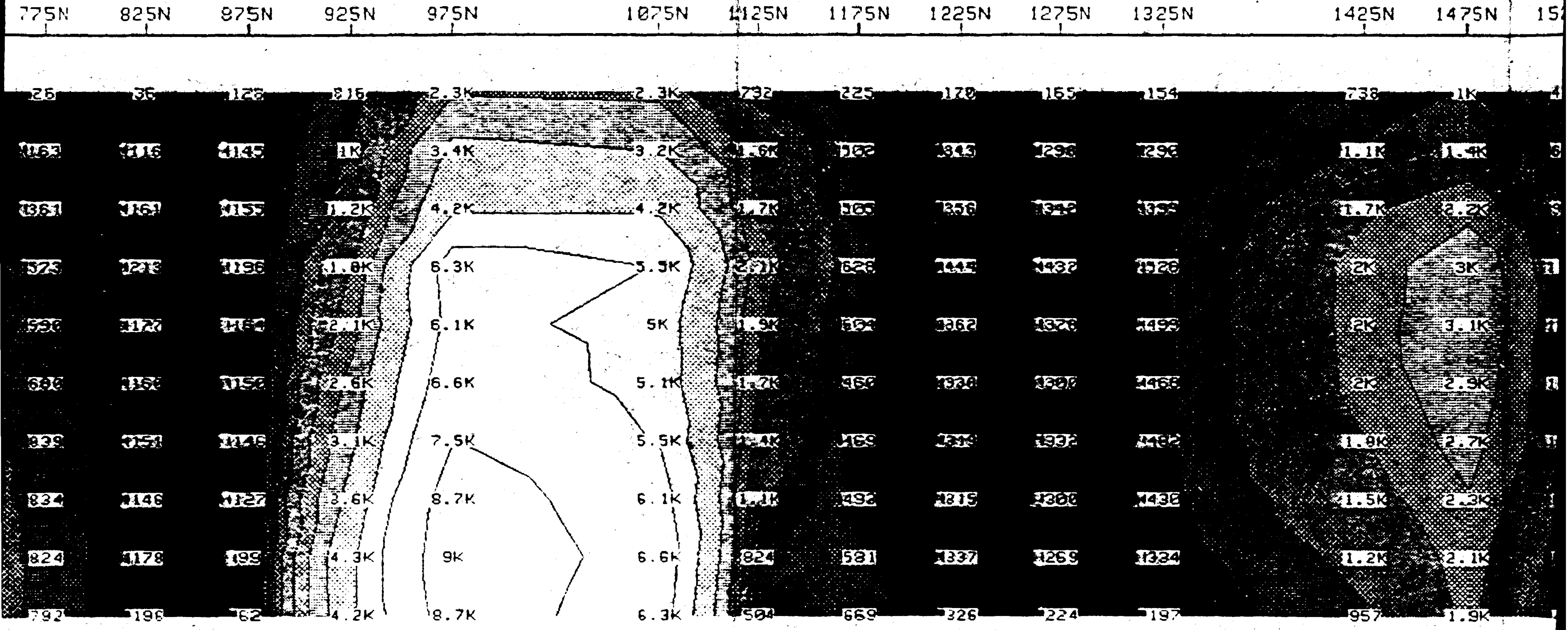
-512
-256
-128
-64
-32
-16
-8
-4



FREQ(hz)
25N
75N
125N
175N
225N
275N
375N
425N
475N
525N
575N
625N
725N
2048
1024
512
256
128
64
32
16
8
4
1M
6.4K
31K
13K
1.3K
3K
5.8K
2.9K
12K
21K
42K
20K
31K
16K
5.2K
3.5K
13K
46K
21K
33K
5.8K
4.1K
15K
48K
11K
23K
34K
17K
7.1K
5K
3.6K
18K
50K
13K
24K
34K
19K
8.4K
6.1K
4.5K
4.6K
19K
50K
14K
25K
19K
11K
8.3K
6.4K
6.5K
24K
48K
14K
25K
32K
9.8K
7.6K
5.9K
6K
47K
14K
24K
29K
1.7K

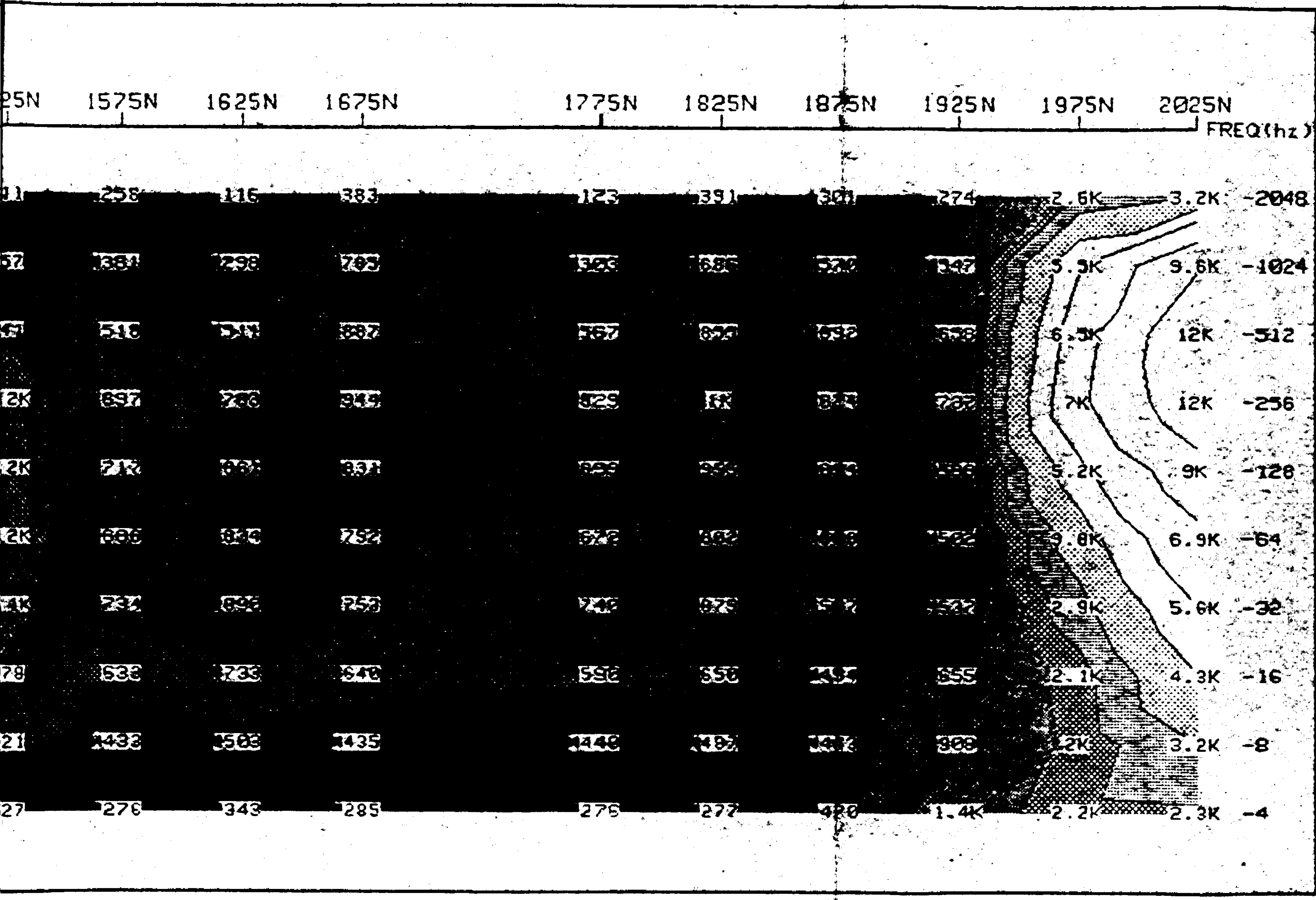
CSAMT APPARENT RESISTIVITY (CORRECTED)

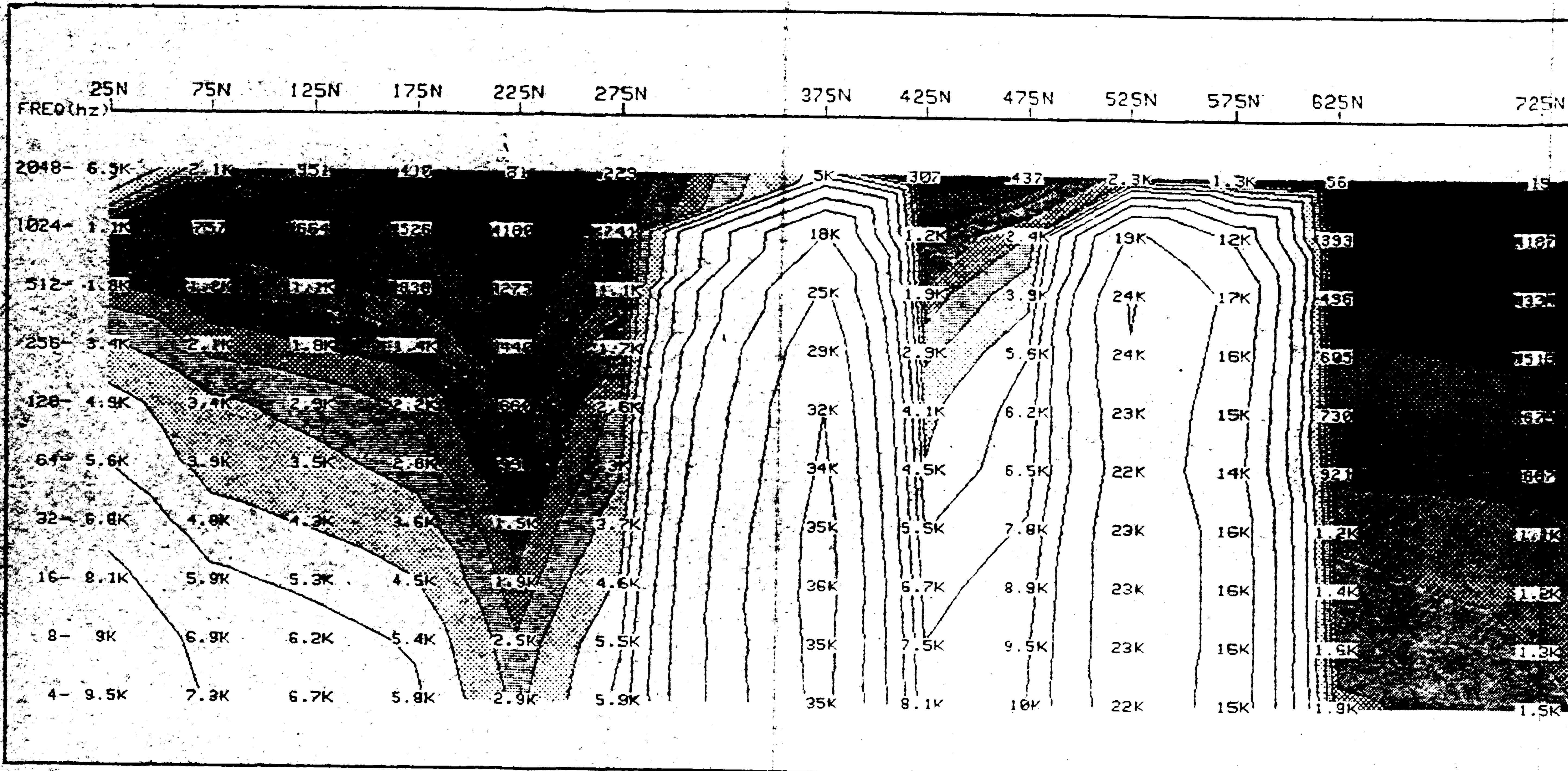
LAC MINERALS LTD.   C14 LINE=125E   E-dipole=5000ft Tx-Rx=11.375km



Resistivity in ohm-m

Surveyed by QUANTECH CONSULTING INC. NOV 1987

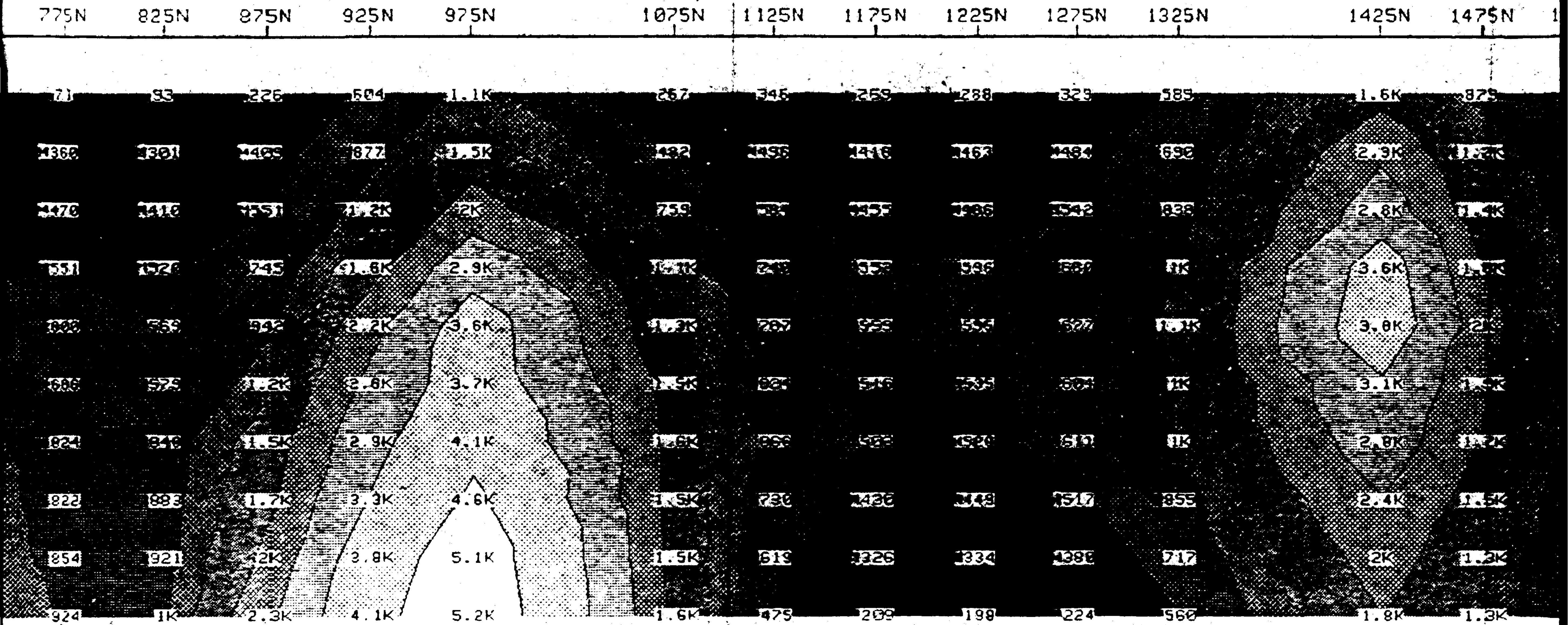

1575N
1625N
1675N
1775N
1825N
1875N
1925N
1975N
2025N
FREQ(hz)
-2048
-1024
-512
-256
-128
-64
-32
-16
-8
-4
2.6K
3.2K
5.5K
9.6K
6.5K
12K
7K
12K
5.2K
9K
6.9K
5.6K
2.9K
4.3K
2.1K
3.2K
2.2K
2.3K
1.4K



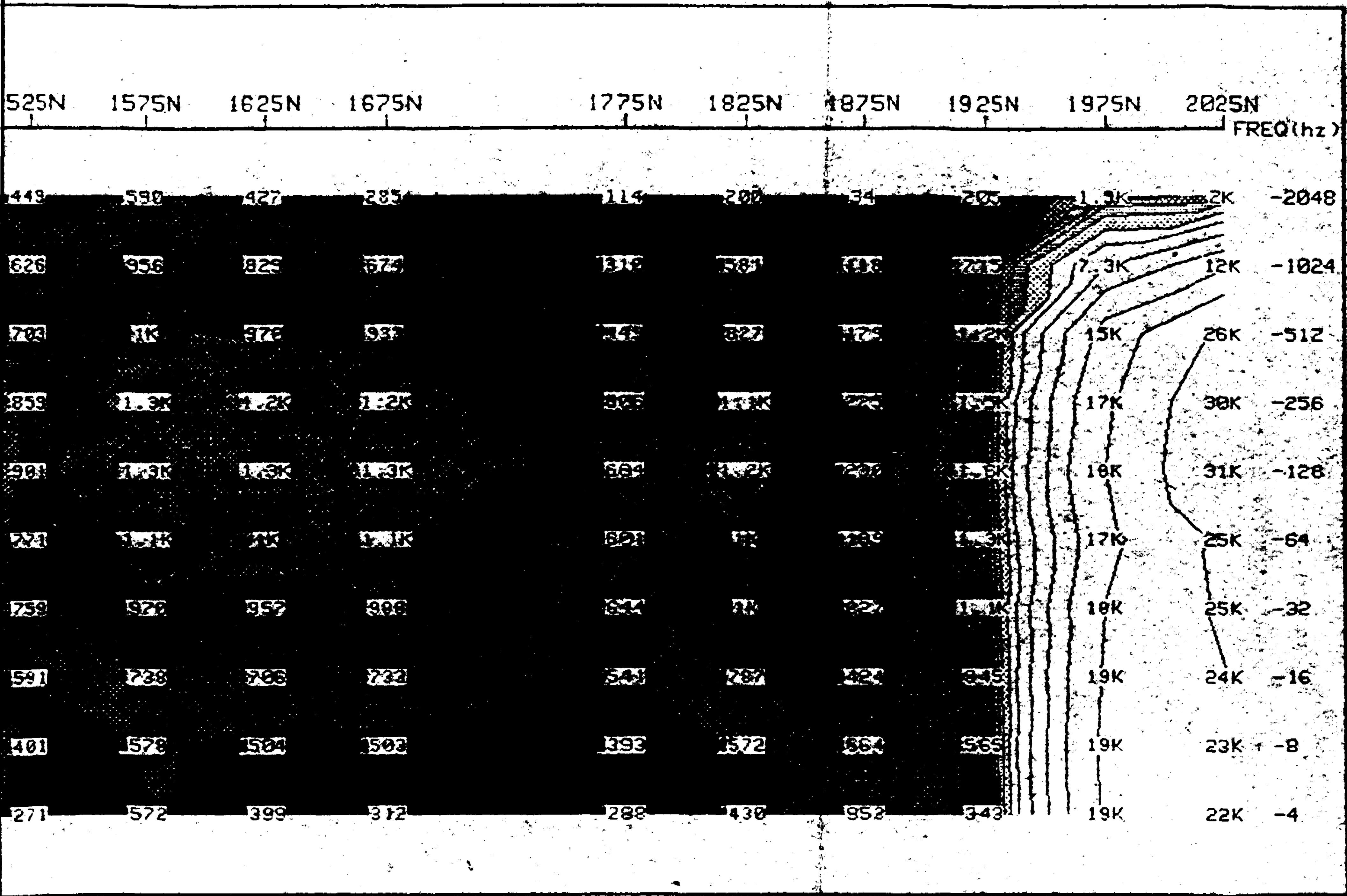
FREQ(hz)
25N
75N
125N
175N
225N
275N
375N
425N
475N
525N
575N
625N
725N
2048
1024
512
256
128
64
32
16
8
4
5K
307
437
2.3K
1.3K
56
18K
1.2K
2.4K
19K
12K
393
25K
1.9K
3.9K
24K
17K
496
29K
2.9K
5.5K
16K
695
32K
4.1K
6.2K
23K
15K
730
5.6K
3.9K
3.5K
2.8K
34K
4.5K
6.5K
22K
14K
6.8K
4.8K
4.3K
3.6K
1.5K
3.7K
35K
5.5K
7.8K
1.2K
8.1K
5.9K
5.3K
4.5K
1.9K
4.6K
36K
6.7K
8.9K
1.4K
9K
6.9K
6.2K
5.4K
2.5K
5.5K
7.5K
9.5K
1.6K
1.3K
9.5K
7.3K
6.7K
5.8K
2.9K
5.9K
8.1K
10K
1.9K
1.5K

CSAMT APPARENT RESISTIVITY (CORRECTED)

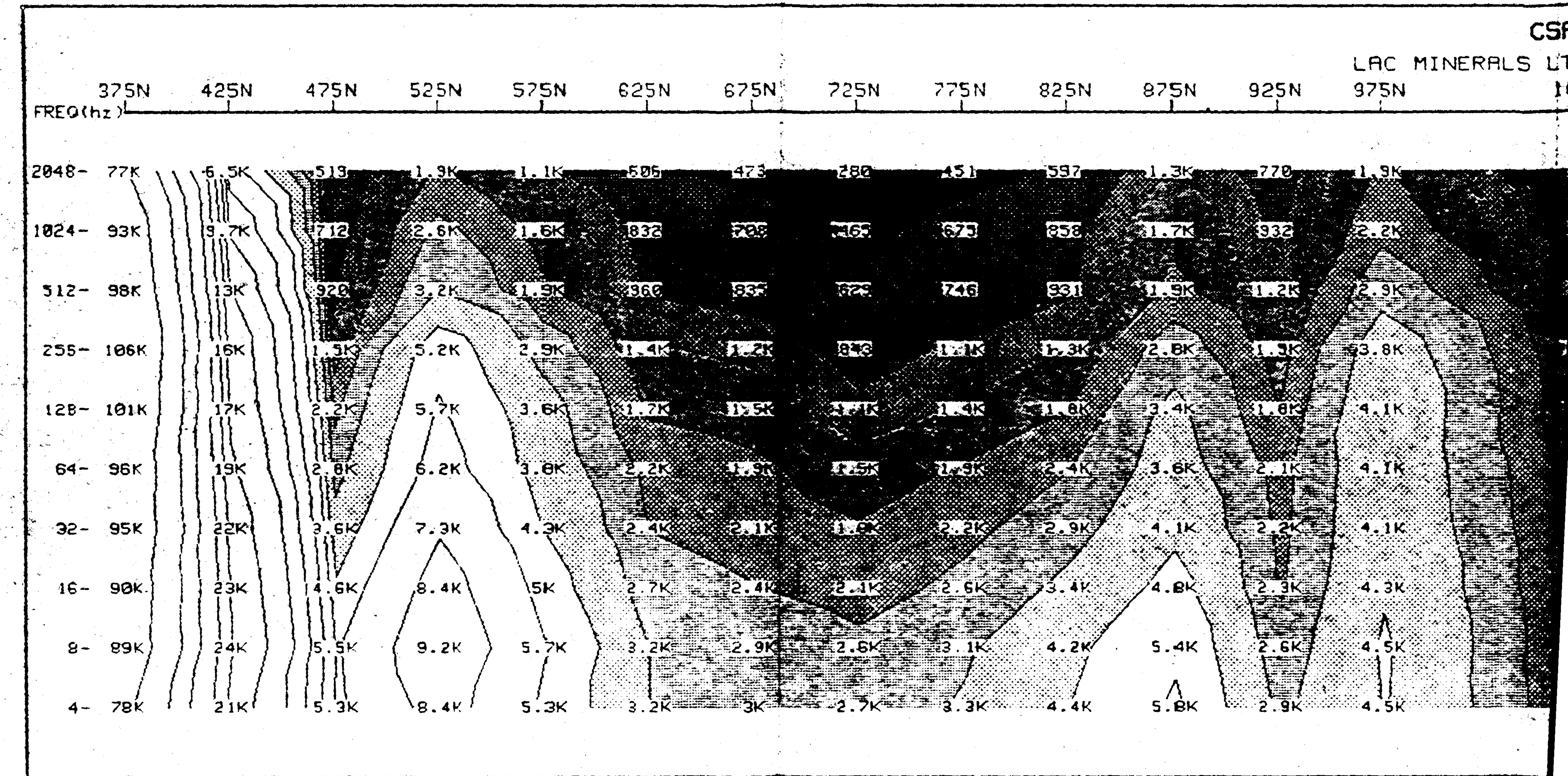
LAC MINERALS LTD. C14 LINE=250E E-dipole=5000ft Tx-Rx=11.25km



Resistivity in ohm-m
Surveyed by QUANTECH CONSULTING INC. NOV/1987



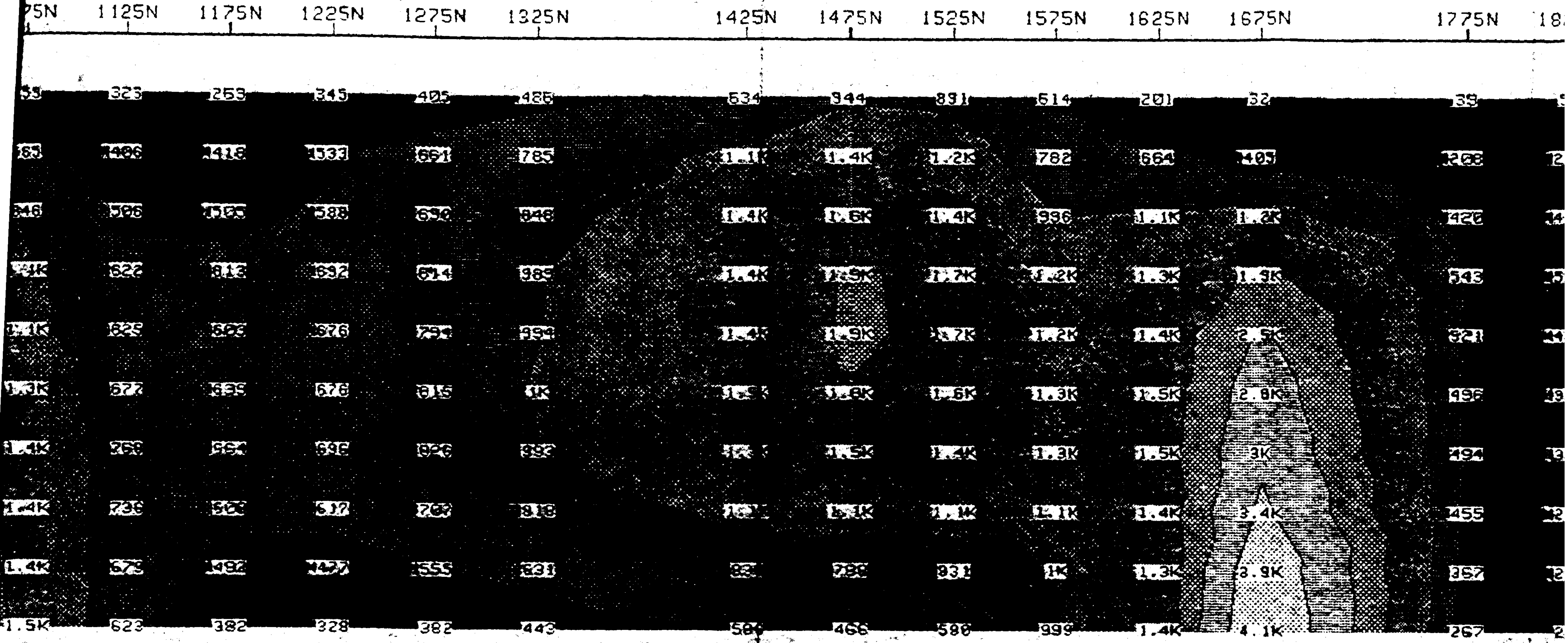
525N
1575N
1625N
1675N
1775N
1825N
1875N
1925N
1975N
2025N
FREQ(hz)
449
590
427
285
114
200
34
205
1.3K
2K
-2048
626
956
823
7.3K
12K
-1024
703
1K
15K
26K
-512
859
1.3K
1.2K
1.2K
17K
30K
-256
18K
31K
-128
17K
25K
-64
759
18K
25K
-32
591
19K
24K
-16
401
578
504
503
393
572
19K
23K
-8
271
572
399
288
430
952
343
19K
22K
-4



CSF
LAC MINERALS LT
375N 425N 475N 525N 575N 625N 675N 725N 775N 825N 875N 925N 975N
FREQ(hz)
2048- 1024- 512- 256- 128- 64- 32- 16- 8- 4-

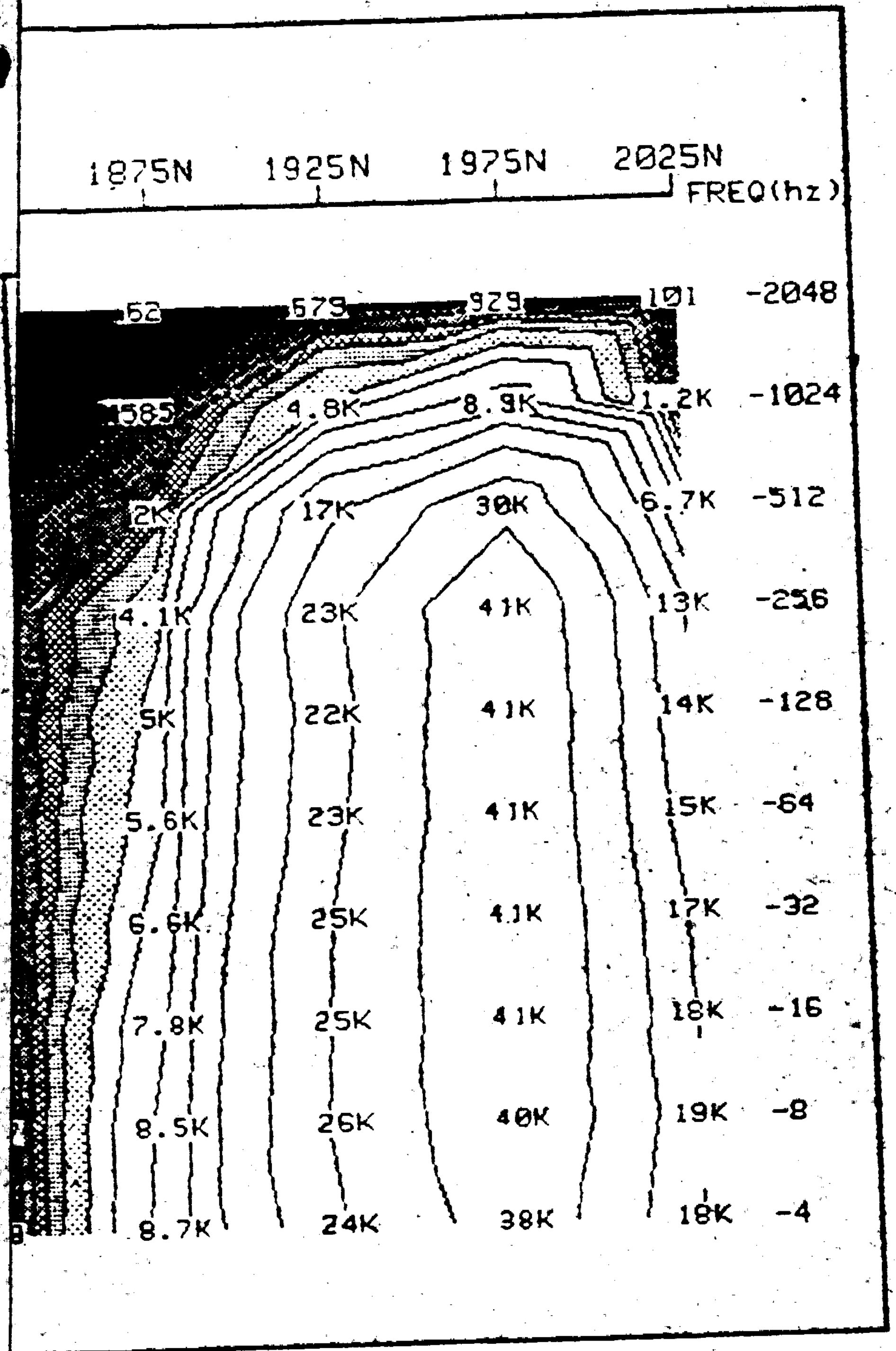
MT APPARENT RESISTIVITY (CORRECTED)

. C14 LINE=375E E-dipole=5000ft Tx-Rx=11.125km



Resistivity in ohm-m

Surveyed by QUANTECH CONSULTING INC. NOV/1987


1875N
1925N
1975N
2025N
FREQ(hz)
-2048
-1024
-512
-256
-128
-64
-32
-16
-8
-4
62
679
929
101
1585
4.8K
8.9K
1.2K
2K
17K
30K
6.7K
4.1K
23K
41K
13K
5K
22K
41K
14K
5.6K
23K
41K
15K
6.6K
25K
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17K
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18K
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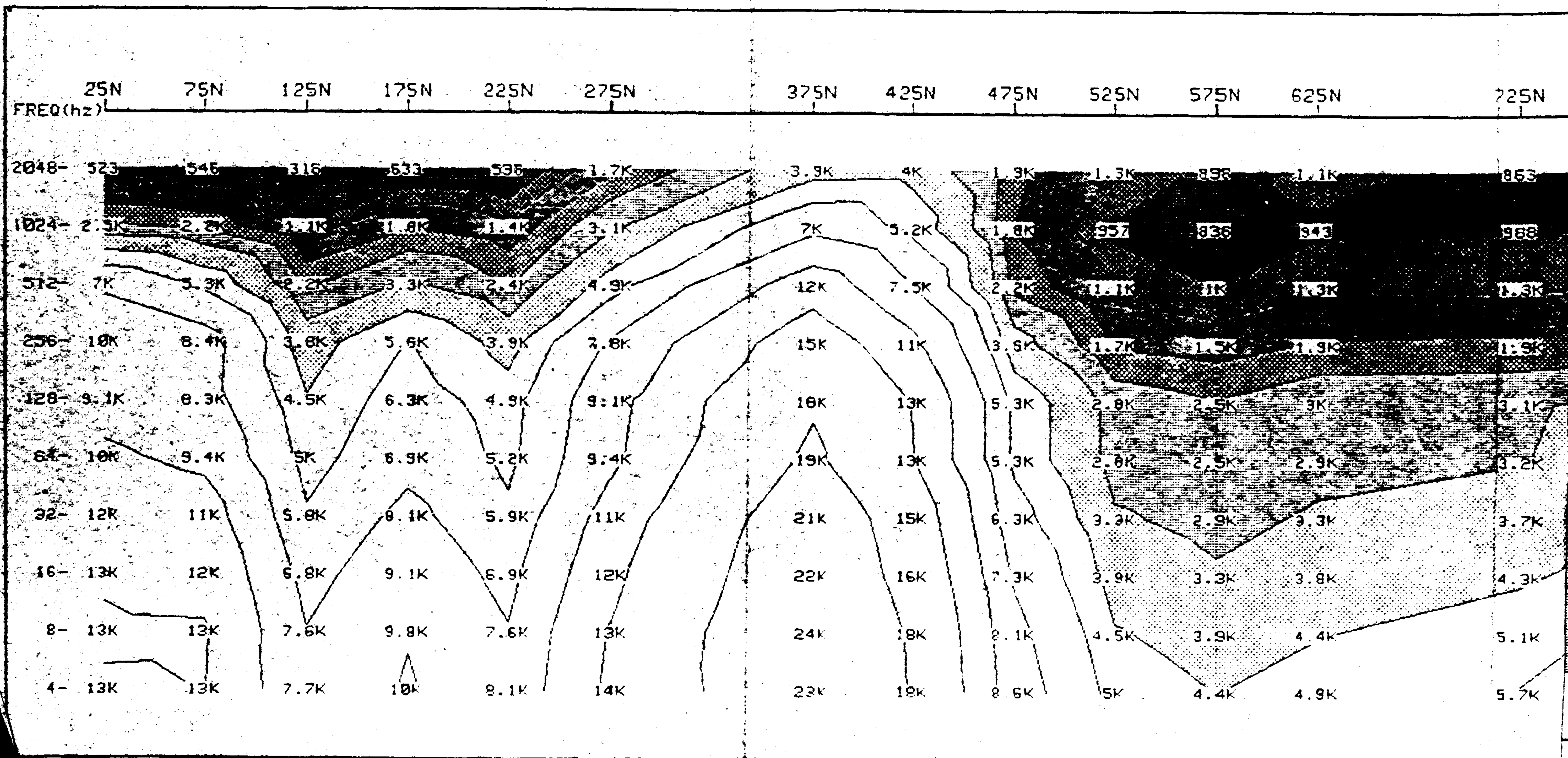
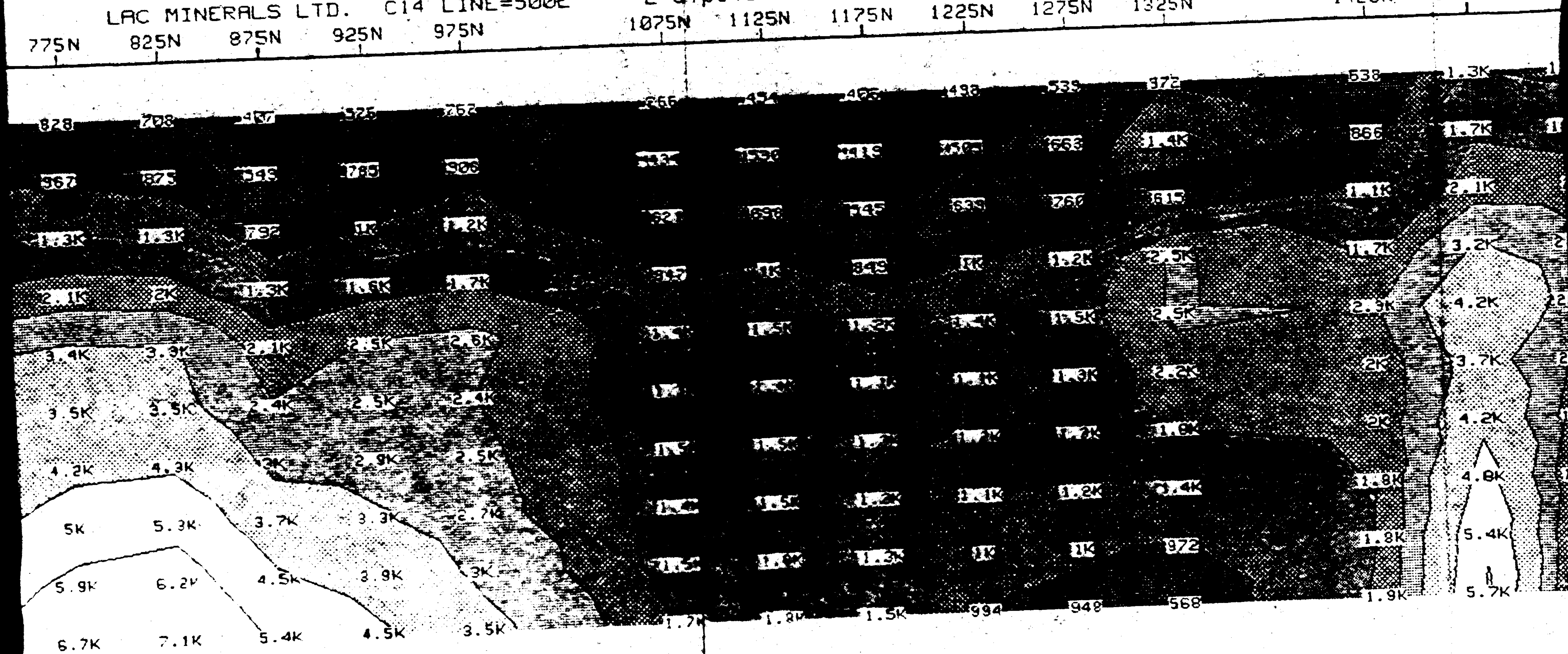
40K
19K
8.7K
24K
38K
18K



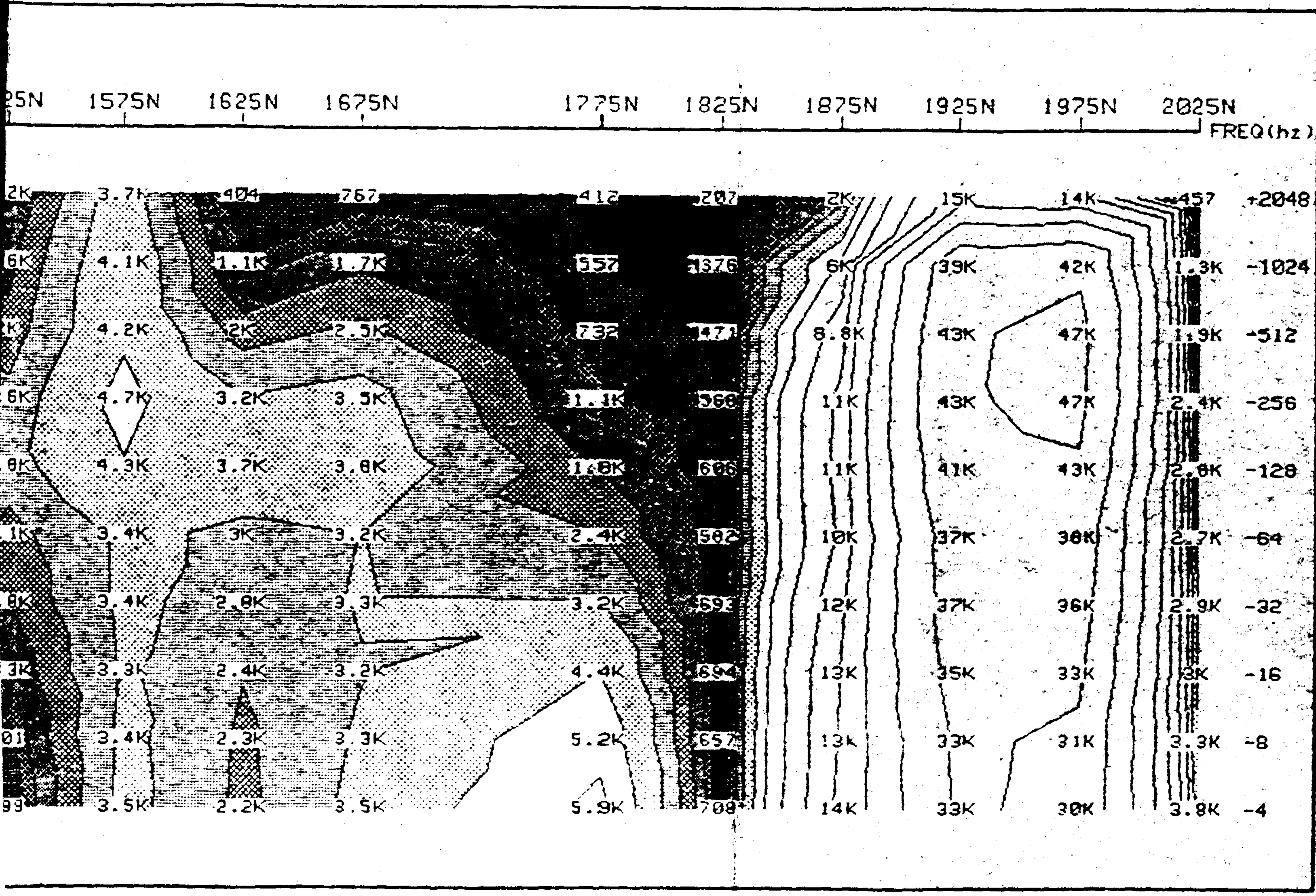
FREQ(hz)
25N 75N 125N 175N 225N 275N 375N 425N 475N 525N 575N 625N 725N
2048- 523 546 316 633 538 1.7K 3.9K 4K 1.9K 1.3K 898 1.1K 863
1024- 2.3K 2.2K 1.1K 1.8K 1.4K 3.1K 7K 5.2K 1.8K 957 836 943 968
512- 7K 5.3K 2.2K 3.3K 2.4K 4.9K 12K 7.5K 2.2K 1.1K 1K 1.3K 1.3K
256- 10K 8.4K 3.8K 5.6K 3.9K 7.8K 15K 11K 3.5K 1.7K 1.5K 1.9K 1.5K
128- 9.1K 8.3K 4.5K 6.3K 4.9K 9.1K 18K 13K 5.3K 2.8K 2.5K 3K 3.1K
64- 10K 9.4K 5K 6.9K 5.2K 9.4K 19K 13K 5.3K 2.8K 2.5K 2.9K 3.2K
32- 12K 11K 5.8K 8.1K 5.9K 11K 21K 15K 6.3K 3.3K 2.9K 3.3K 3.7K
16- 13K 12K 6.8K 9.1K 6.9K 12K 22K 16K 7.3K 3.9K 3.3K 3.8K 4.3K
8- 13K 13K 7.6K 9.8K 7.6K 13K 24K 18K 8.1K 4.5K 3.9K 4.4K 5.1K
4- 13K 13K 7.7K 10K 8.1K 14K 23K 18K 8.6K 5K 4.4K 4.9K 5.7K

CSAMT APPARENT RESISTIVITY (CORRECTED)

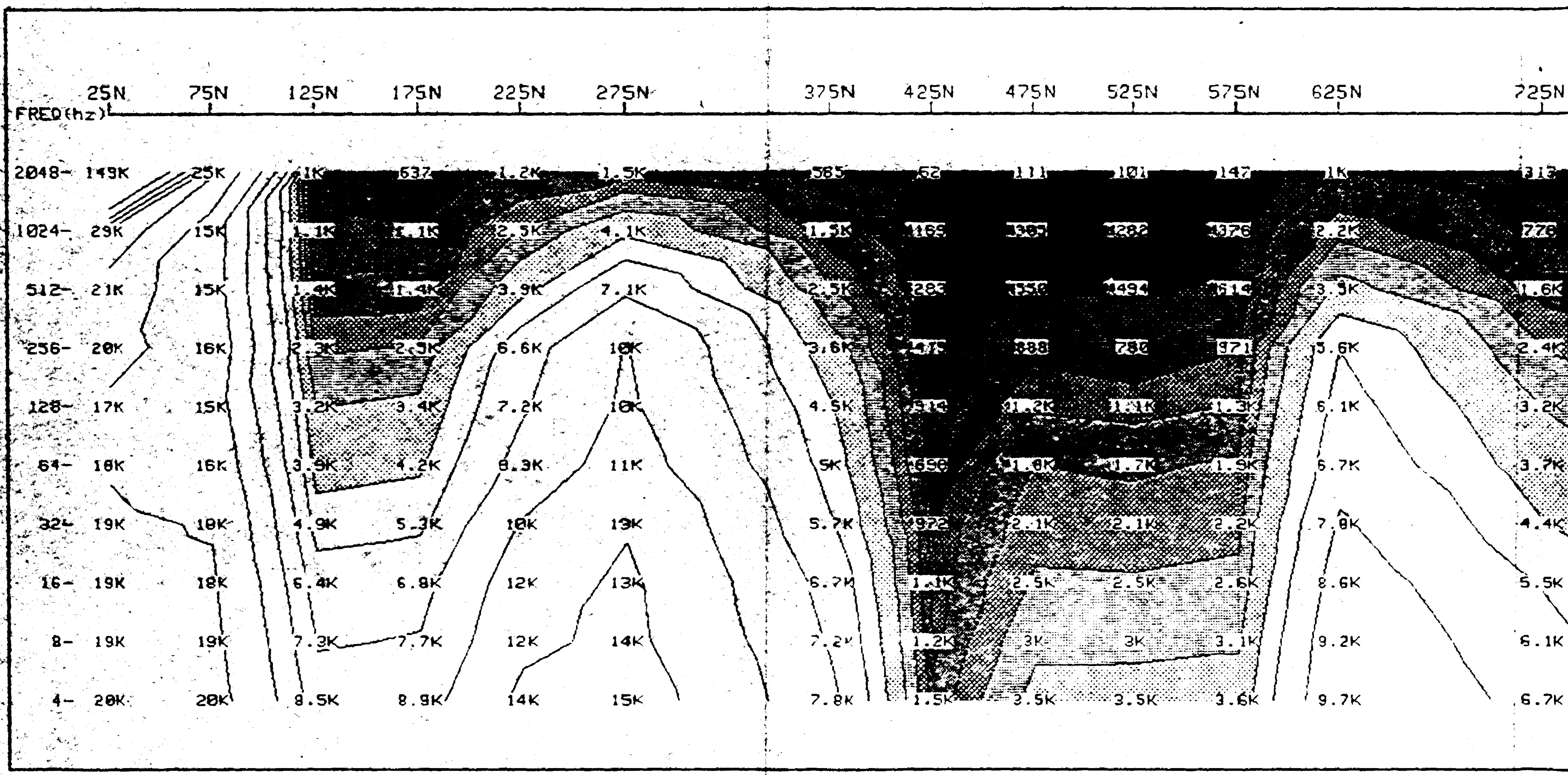
LAC MINERALS LTD. C14 LINE=500E E-dipole=5000ft Tx-Rx=11km



Resistivity in ohm-m
Surveyed by QUANTECH CONSULTING INC. NOV/1987

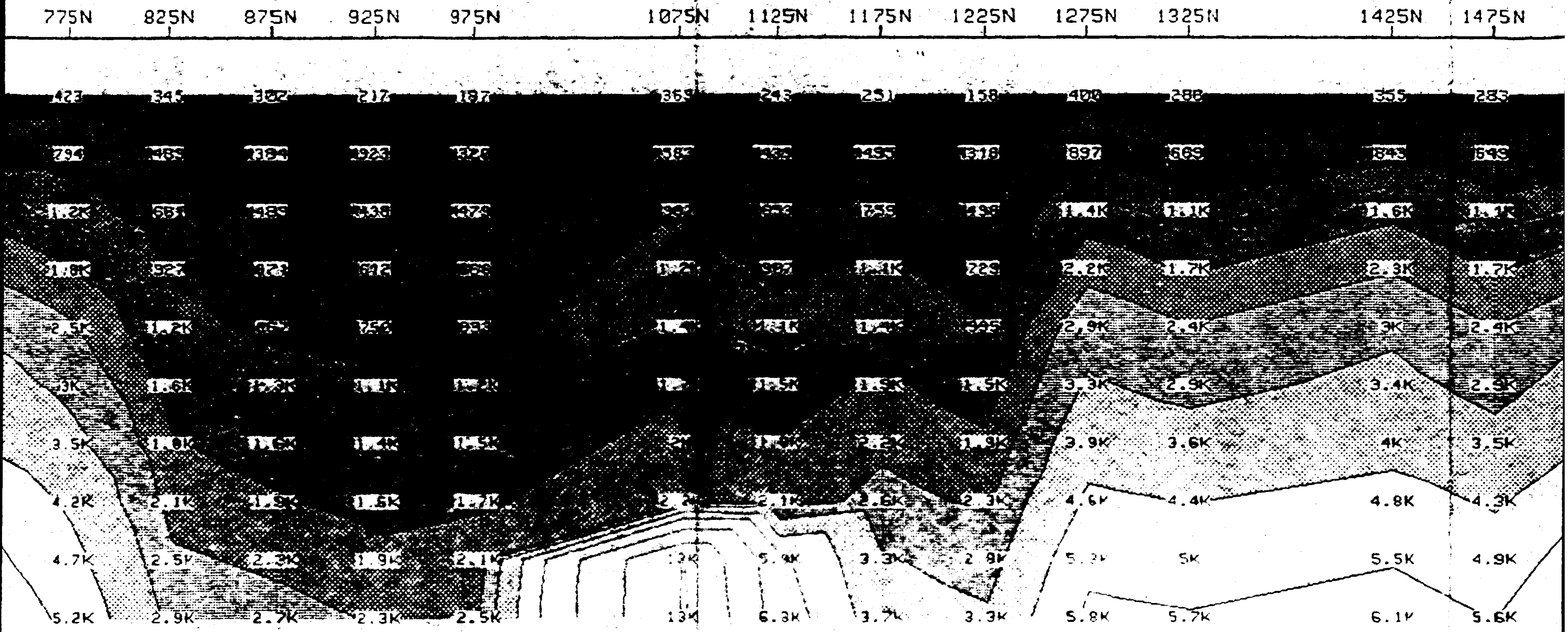


1575N
1625N
1675N
1775N
1825N
1875N
1925N
1975N
2025N
FREQ(hz)
+2048
-1024
-512
-256
-128
-64
-32
-16
-8
-4

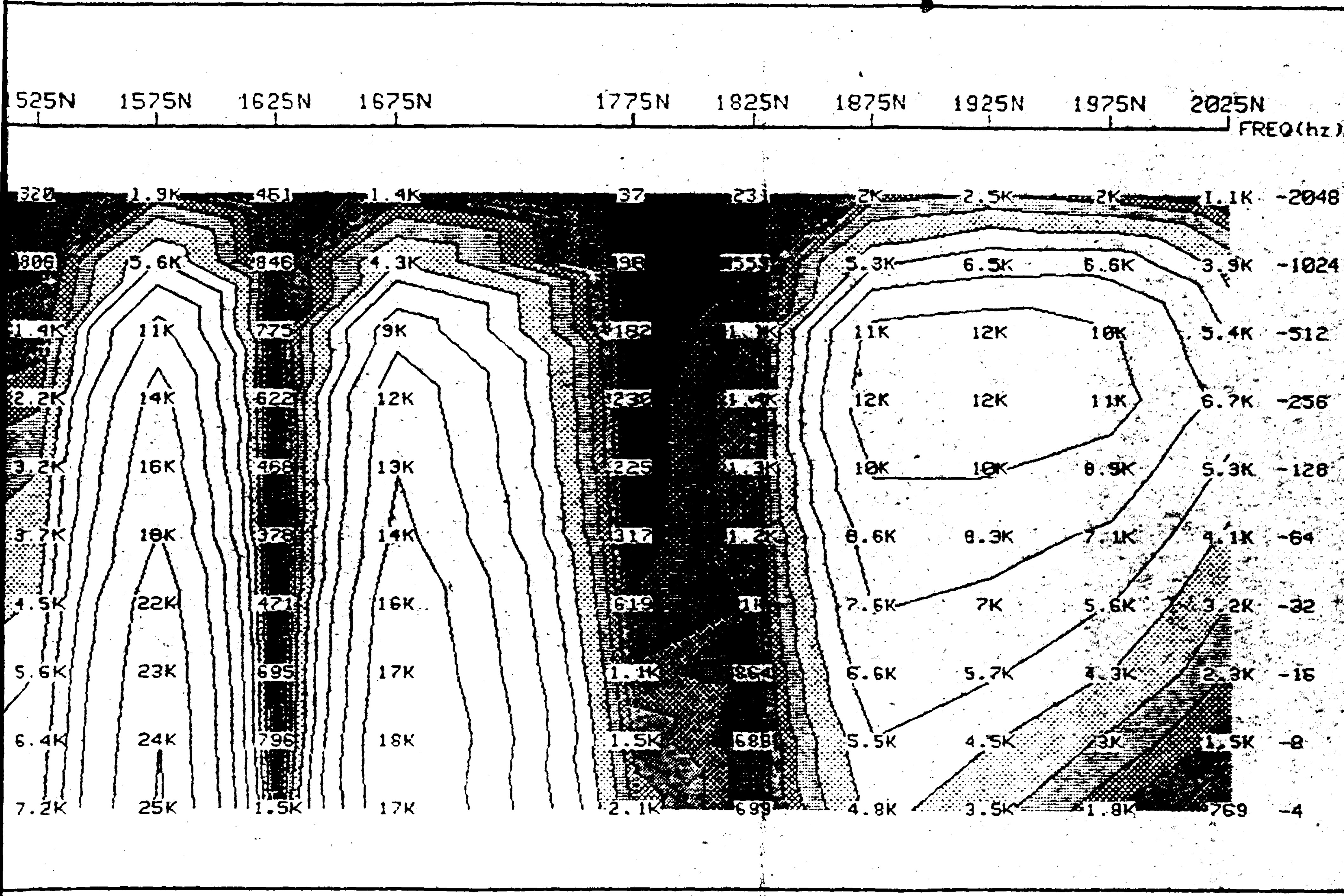

FREQ(hz)
25N 75N 125N 175N 225N 275N 375N 425N 475N 525N 575N 625N 725N
2048- 149K 25K 1K 637 1.2K 1.5K 585 62 111 101 147 1K 313
1024- 29K 15K 1.1K 1.1K 2.5K 4.1K 1.5K 169 385 282 376 2.2K 776
512- 21K 15K 1.4K 1.4K 3.9K 7.1K 2.5K 283 350 494 614 3.9K 1.6K
256- 20K 16K 2.3K 2.5K 6.6K 10K 3.6K 475 888 780 971 5.6K 2.4K
128- 17K 15K 3.2K 3.4K 7.2K 10K 4.5K 914 1.2K 1.1K 1.3K 6.1K 3.2K
64- 18K 16K 3.9K 4.2K 8.3K 11K 5K 650 1.8K 1.7K 1.9K 6.7K 3.7K
32- 19K 18K 4.9K 5.3K 10K 13K 5.7K 972 2.1K 2.1K 2.2K 7.8K 4.4K
16- 19K 18K 6.4K 6.8K 12K 13K 6.7K 1.1K 2.5K 2.5K 2.6K 8.6K 5.5K
8- 19K 19K 7.3K 7.7K 12K 14K 7.2K 1.2K 3K 3K 3.1K 9.2K 6.1K
4- 20K 20K 8.5K 8.9K 14K 15K 7.8K 1.5K 3.5K 3.5K 3.6K 9.7K 6.7K

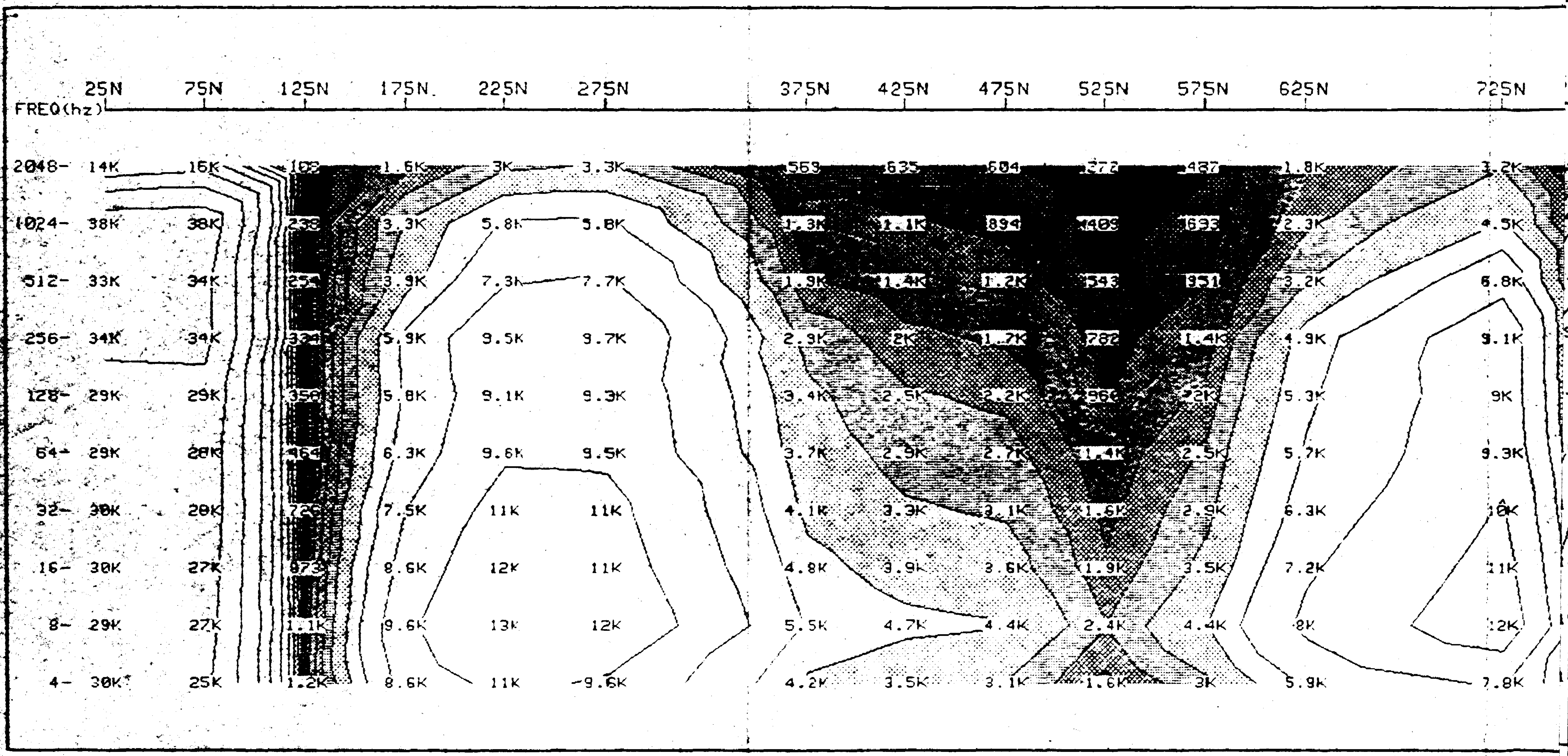
CSAMT APPARENT RESISTIVITY (CORRECTED)

LAC MINERALS LTD. C14 LINE=625E E-dipole=5000ft Tx-Rx=10.875km



Resistivity in ohm-m
Surveyed by QUANTECH CONSULTING INC. NOV 199?


525N 1575N 1625N 1675N 1775N 1825N 1875N 1925N 1975N 2025N
FREQ(hz)
320 1.9K 461 1.4K 37 23 2K 2.5K 2K 1.1K -2048
806 5.6K 846 4.3K 5.3K 6.5K 6.6K 3.9K -1024
1.4K 11K 775 9K 182 11K 12K 10K 5.4K -512
2.2K 14K 622 12K 12K 12K 11K 6.7K -256
3.2K 16K 468 13K 225 10K 10K 8.9K 5.3K -128
3.7K 18K 378 14K 317 1.2K 8.6K 8.3K 7.1K 4.1K -64
4.5K 22K 471 16K 619 1K 7.6K 7K 5.6K 3.2K -32
5.6K 23K 695 17K 1.1K 6.6K 5.7K 4.3K 2.3K -16
6.4K 24K 796 18K 1.5K 688 5.5K 4.5K 3K 1.5K -8
7.2K 25K 1.5K 17K 2.1K 699 4.8K 3.5K 1.8K 769 -4



FREQ(hz)
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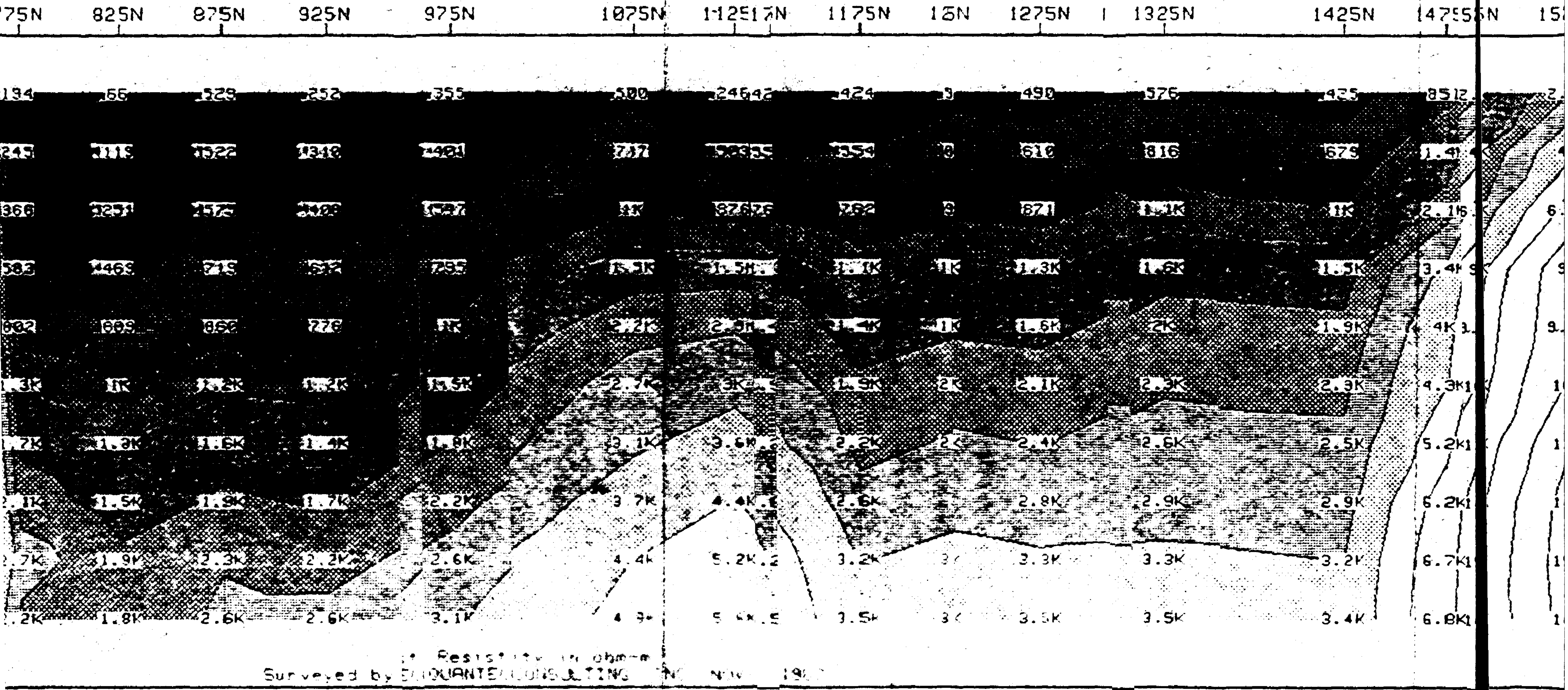
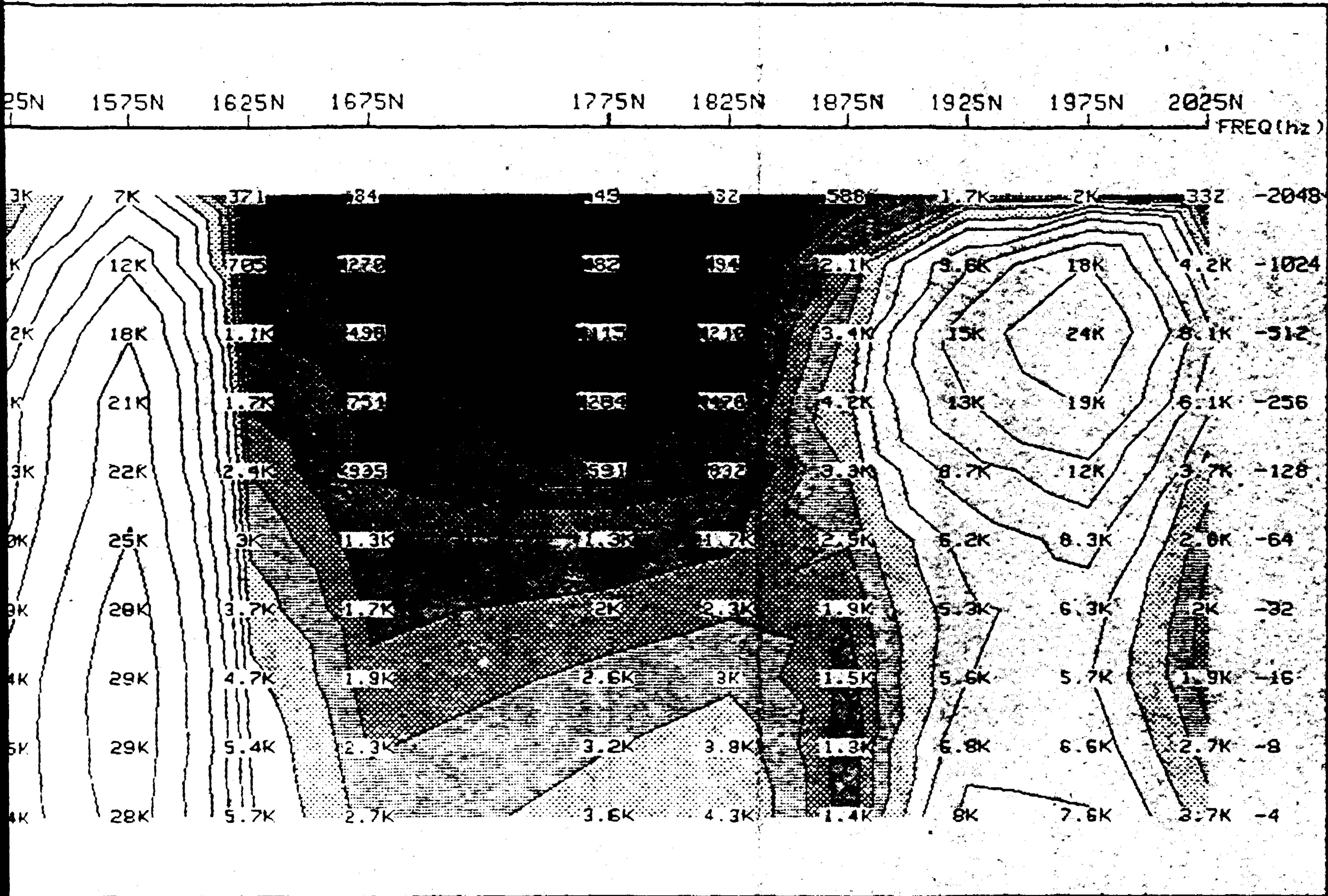
2048- 14K 16K 103 1.6K 3K 3.3K 563 635 604 272 487 1.8K 3.2K
1024- 38K 38K 238 3.3K 5.8K 5.8K 1.3K 1.1K 894 409 693 2.3K 4.5K
512- 33K 34K 254 3.9K 7.3K 7.7K 1.9K 1.4K 1.2K 543 951 3.2K 6.8K
256- 34K 34K 334 5.9K 9.5K 9.7K 2.9K 2K 1.7K 782 1.4K 4.9K 9.1K
128- 29K 29K 356 5.8K 9.1K 9.3K 3.4K 2.5K 2.2K 960 2K 5.3K 9K
64- 29K 28K 464 6.3K 9.6K 9.5K 3.7K 2.9K 2.7K 1.4K 2.5K 5.7K 9.3K
32- 30K 28K 726 7.5K 11K 11K 4.1K 3.3K 3.1K 1.6K 2.9K 6.3K 10K
16- 30K 27K 873 8.6K 12K 11K 4.8K 3.9K 3.6K 1.9K 3.5K 7.2K 11K
8- 29K 27K 1.1K 9.6K 13K 12K 5.5K 4.7K 4.4K 2.4K 4.4K 8K 12K
4- 30K 25K 1.2K 8.6K 11K 9.6K 4.2K 3.5K 3.1K 1.6K 3K 5.9K 7.8K

CSAMT APPARENT RESISTIVITY (CORRECTED)

LAC MINERALS LTD. C14 LINE=7E E-dipole=5(300ft Tx-Rx=.75km





1575N
1625N
1675N
1775N
1825N
1875N
1925N
1975N
2025N
FREQ(hz)
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-512
-256
-128
-64
-32
-16
-8
-4
7K
12K
18K
21K
22K
25K
28K
29K
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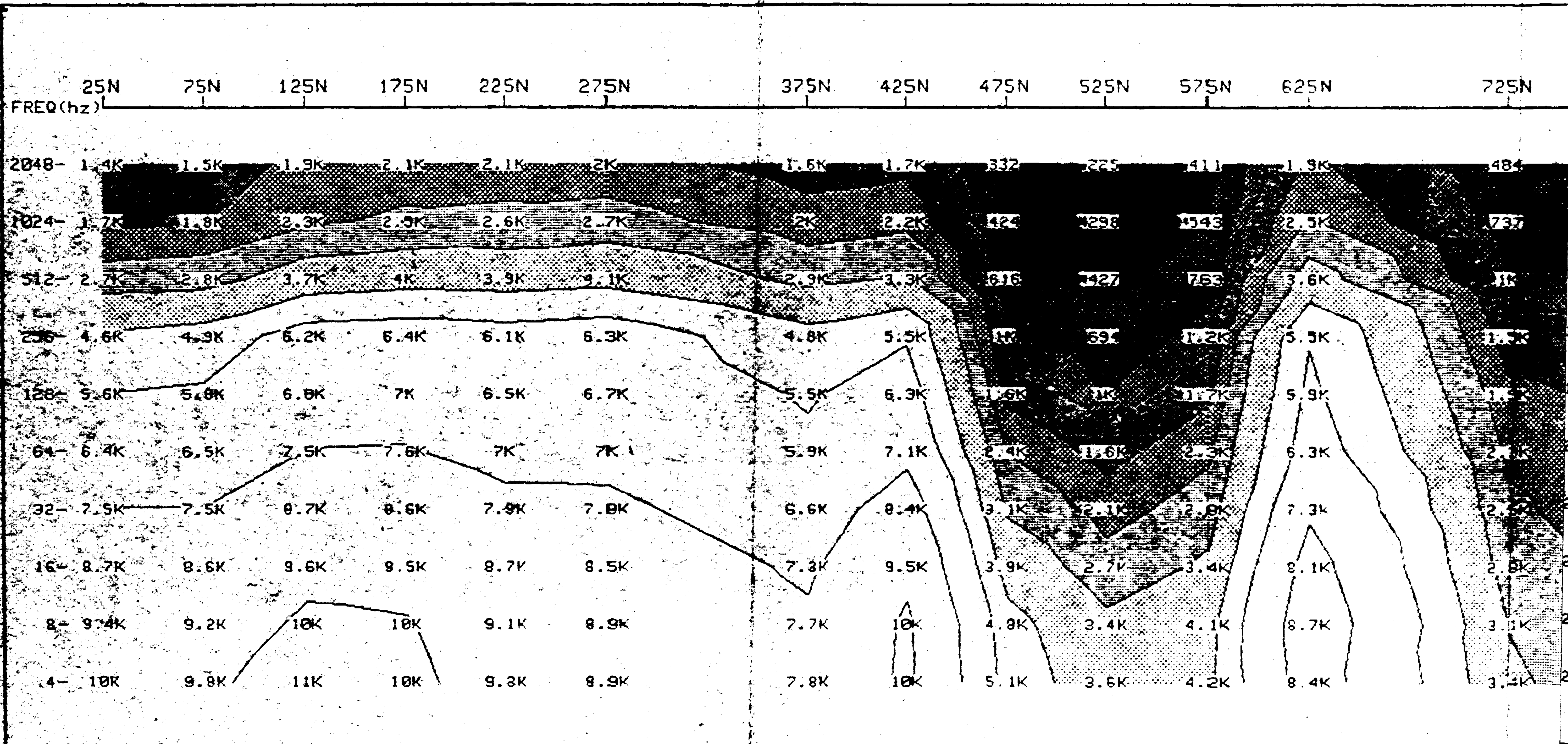
13K
12K
8.3K
6.3K
5.7K
6.6K
7.6K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FREQ(hz)
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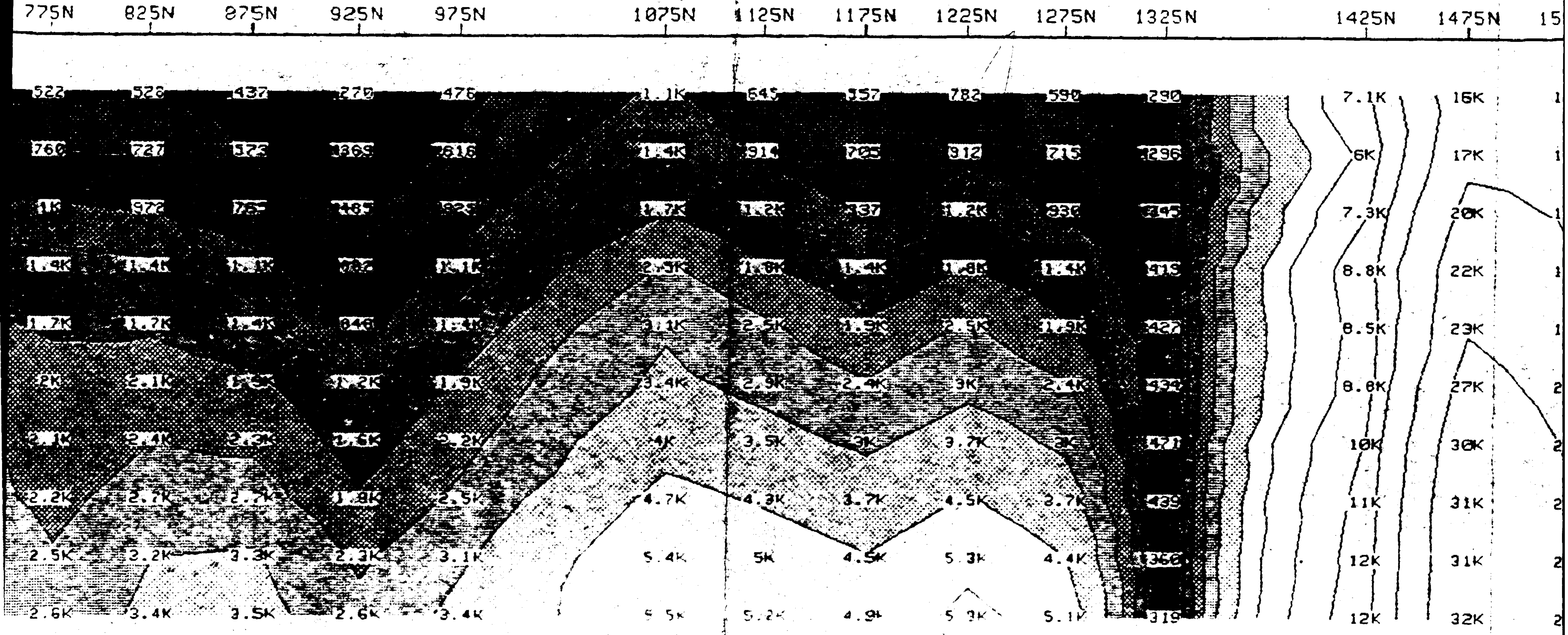
1024- 1.7K 1.8K 2.3K 2.5K 2.6K 2.7K 2K 2.2K 424 298 543 2.5K 737
512- 2.7K 2.8K 3.7K 4K 3.9K 4.1K 2.9K 3.3K 616 427 763 3.6K
256- 4.6K 4.9K 6.2K 6.4K 6.1K 6.3K 4.8K 5.5K 694 1.2K 5.5K 1.5K
128- 5.6K 5.8K 6.8K 7K 6.5K 6.7K 5.5K 6.3K 1.6K 1K 1.7K 5.9K
64- 6.4K 6.5K 7.5K 7.6K 7K 7K 5.9K 7.1K 2.4K 1.6K 2.3K 6.3K
32- 7.5K 7.5K 8.7K 8.6K 7.9K 7.8K 6.6K 8.4K 3.1K 2.1K 2.8K 7.3K
16- 8.7K 8.6K 9.6K 9.5K 8.7K 8.5K 7.3K 9.5K 3.9K 2.7K 3.4K 8.1K 2.8K
8- 9.4K 9.2K 10K 10K 9.1K 8.9K 7.7K 10K 4.8K 3.4K 4.1K 8.7K
4- 10K 9.8K 11K 10K 9.3K 8.9K 7.8K 10K 5.1K 3.6K 4.2K 8.4K 3.4K

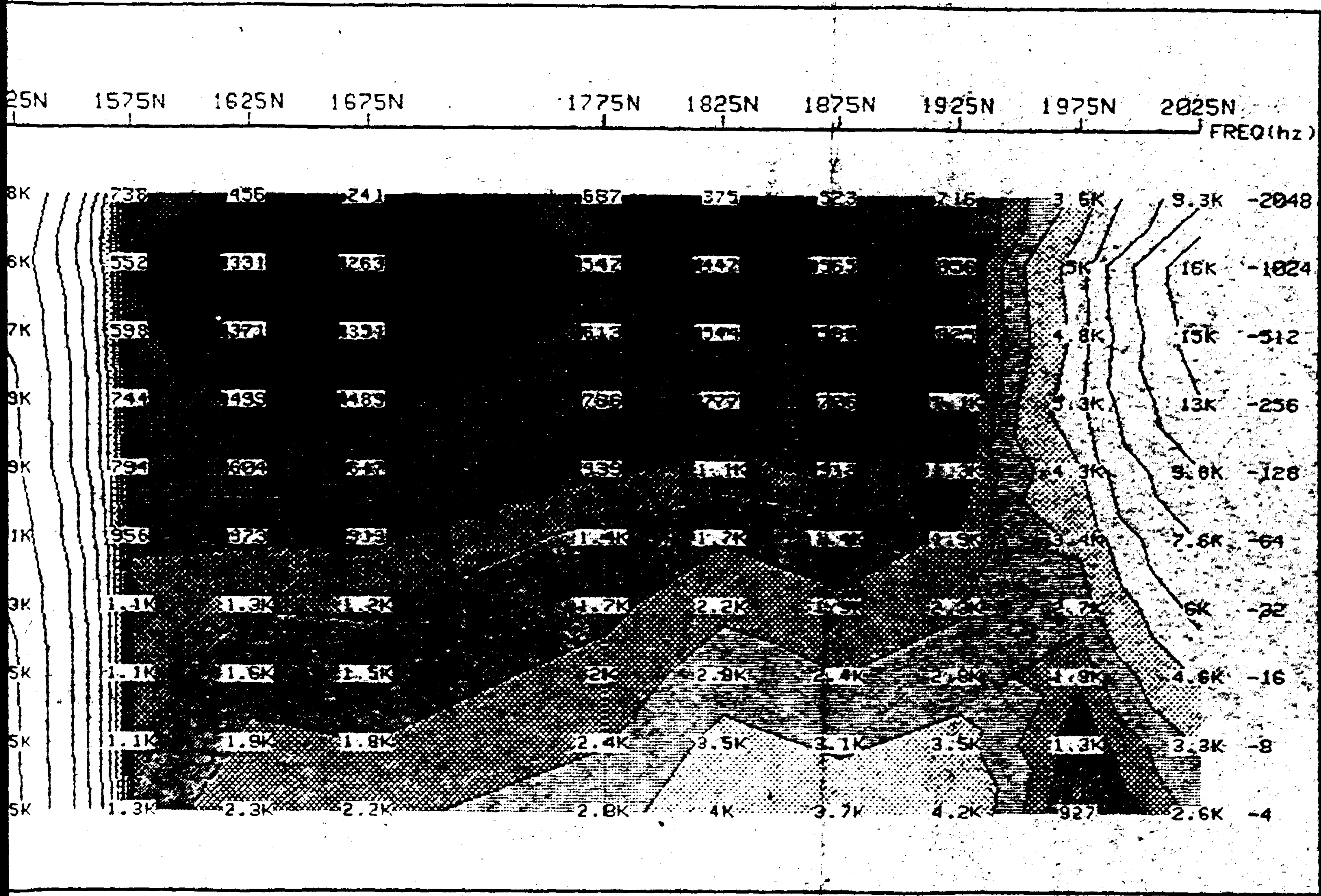
CSAMT APPARENT RESISTIVITY (CORRECTED)

LAC MINERALS LTD. C14 LINE=875E E-dipole=5000ft Tx-Rx=10.625km



Resistivity in ohm-m
Surveyed by QUANTECH CONSULTING INC. NOV/1987

875



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1575N
1625N
1675N
1775N
1825N
1875N
1925N
1975N
2025N
FREQ(hz)
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-1024
-512
-256
-128
-64
-32
-16
-8
-4
738
456
241
687
375
523
716
3.6K
9.3K
552
331
263
5K
16K
598
4.8K
15K
744
5.3K
13K
794
4.3K
9.8K
956
3.4K
7.6K
1.1K
1.3K
1.2K
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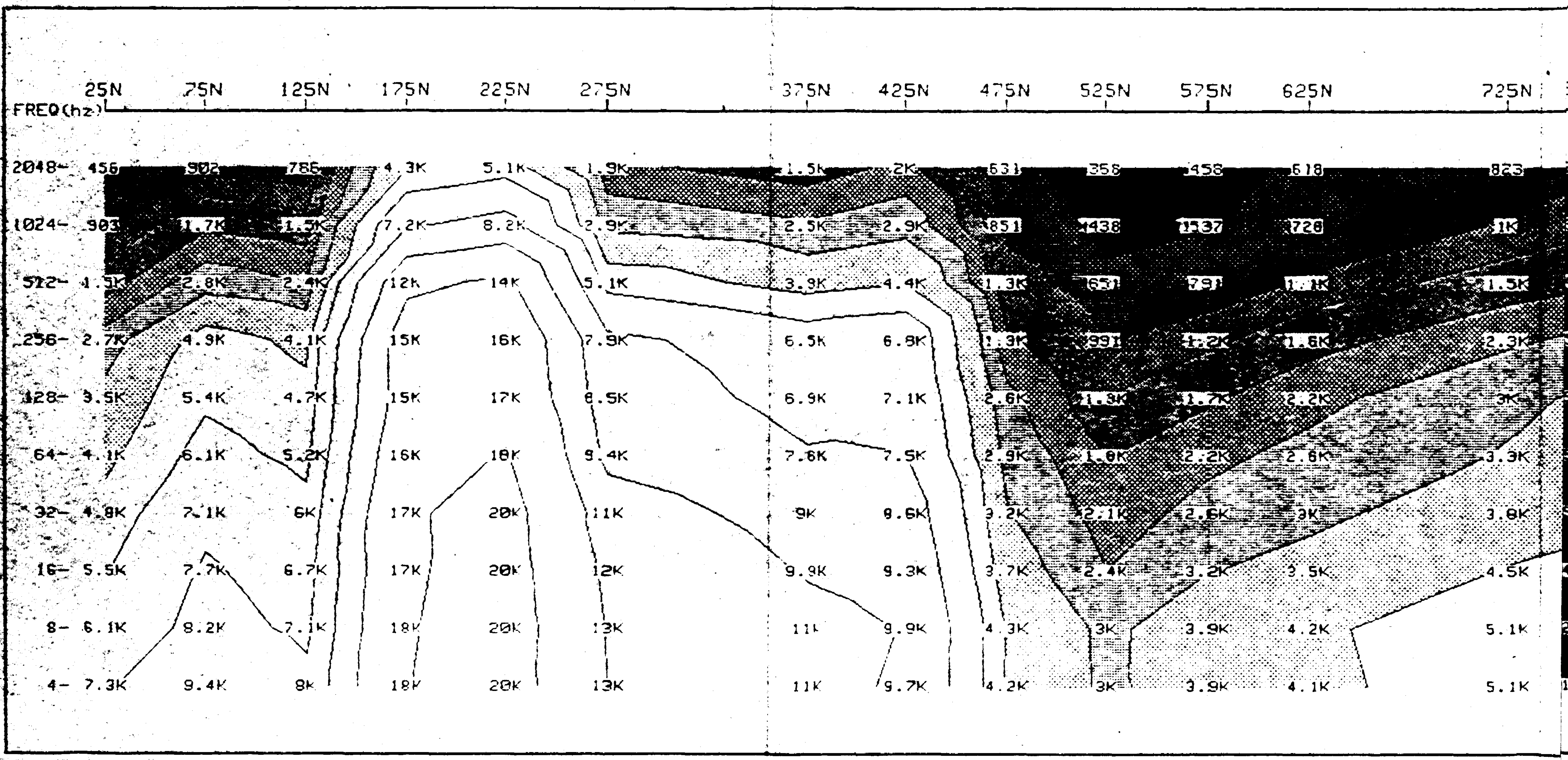
4.2K
927
2.6K



FREQ(hz)
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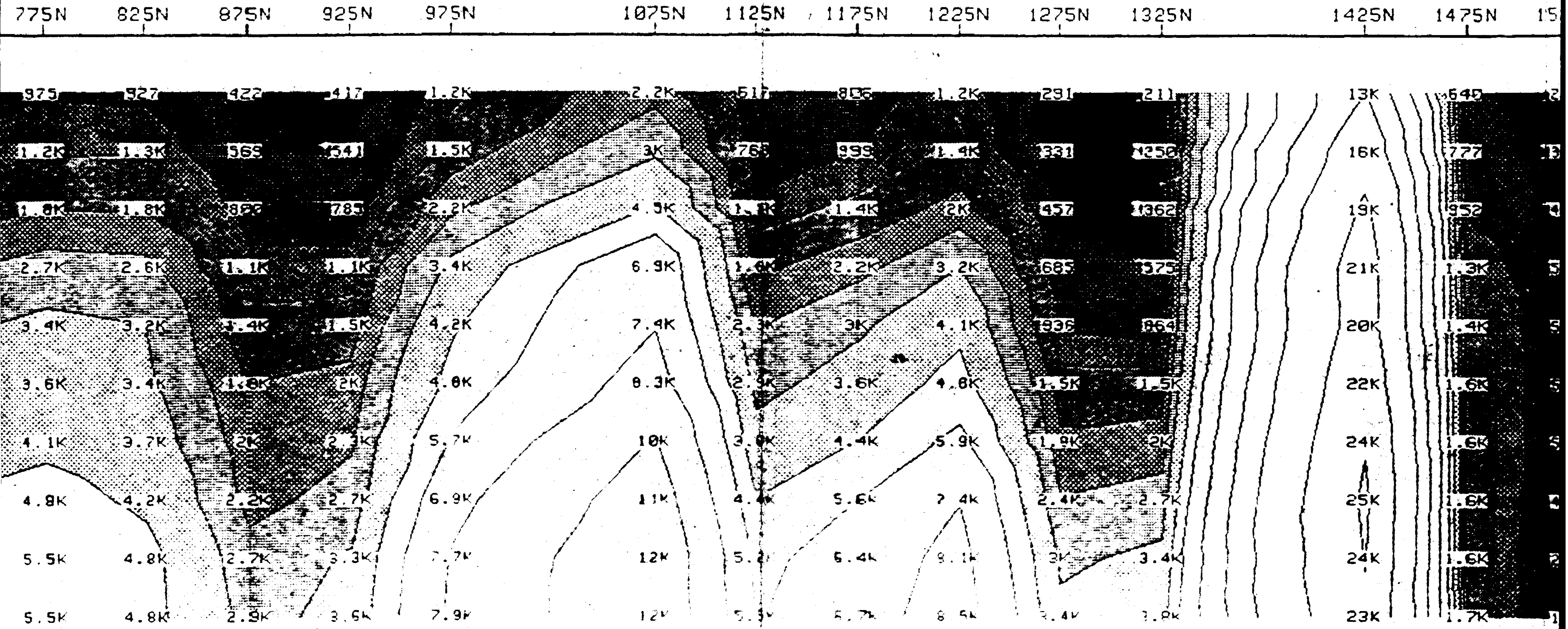
125N
175N
225N
275N
375N
425N
475N
525N
575N
625N
725N
2048- 456 902 786 4.3K 5.1K 1.9K 1.5K 2K 631 358 458 618 823
1024- 303 1.7K 1.5K 7.2K 8.2K 2.9K 2.5K 2.9K 851 438 537 728 1K
512- 1.5K 2.8K 2.4K 12K 14K 5.1K 3.9K 4.4K 1.3K 631 791 1.1K 1.5K
256- 2.7K 4.9K 4.1K 15K 16K 7.9K 6.5K 6.8K 1.3K 991 1.2K 1.6K 2.3K
128- 3.5K 5.4K 4.7K 15K 17K 8.5K 6.9K 7.1K 2.6K 1.3K 1.7K 2.2K 3K
64- 4.1K 6.1K 5.2K 16K 18K 9.4K 7.6K 7.5K 2.9K 1.8K 2.2K 2.6K 3.3K
32- 4.8K 7.1K 6K 17K 20K 11K 9K 8.6K 3.2K 2.1K 2.6K 3K 3.8K
16- 5.5K 7.7K 6.7K 17K 20K 12K 9.9K 9.3K 3.7K 2.4K 3.2K 3.5K 4.5K
8- 6.1K 8.2K 7.1K 18K 20K 13K 11K 9.9K 4.3K 3K 3.9K 4.2K 5.1K
4- 7.3K 9.4K 8K 18K 20K 13K 11K 9.7K 4.2K 3K 3.9K 4.1K 5.1K

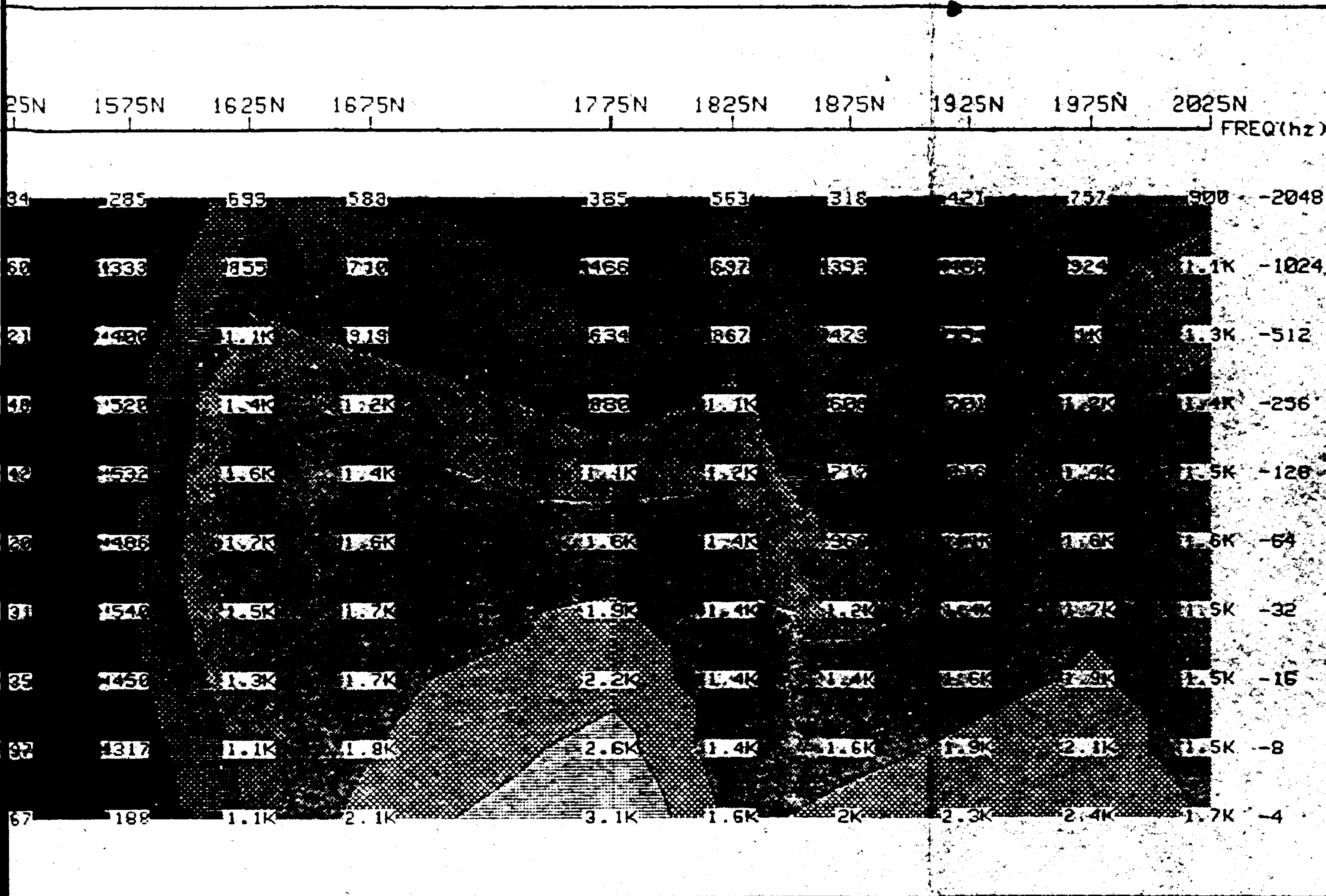
CSAMT APPARENT RESISTIVITY (CORRECTED)

LAC MINERALS LTD. C14 LINE=1000E E-dipole=5000ft Tx-Rx=10.5km



Resistivity in ohm-m

Surveyed by QUANTECH CONSULTING INC. [illegible]



25N
1575N
1625N
1675N
1775N
1825N
1875N
1925N
1975N
2025N
FREQ(hz)
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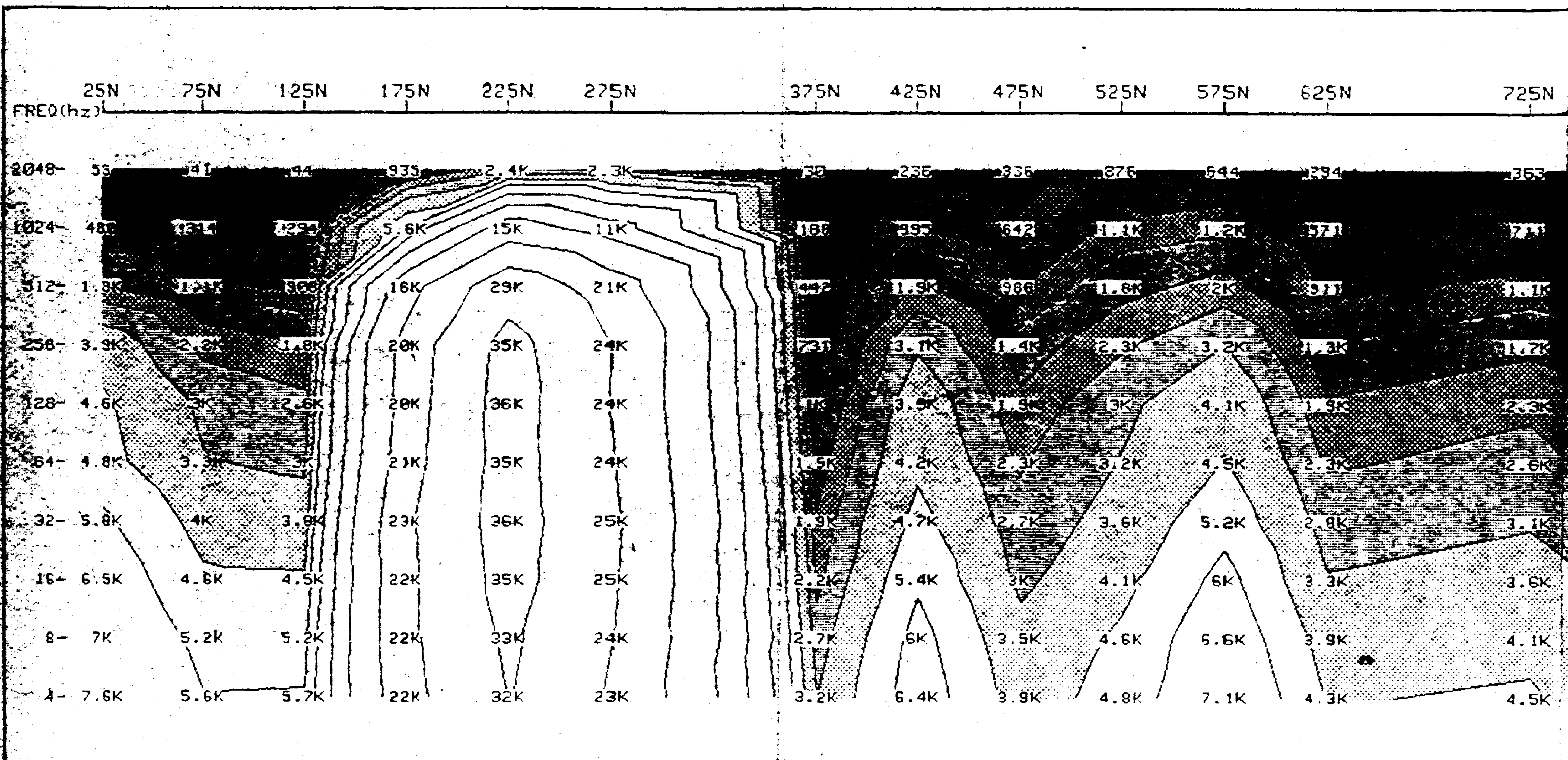
-32
-16
-8
-4



25N
75N
125N
175N
225N
275N
375N
425N
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575N
625N
725N
FREQ(hz)
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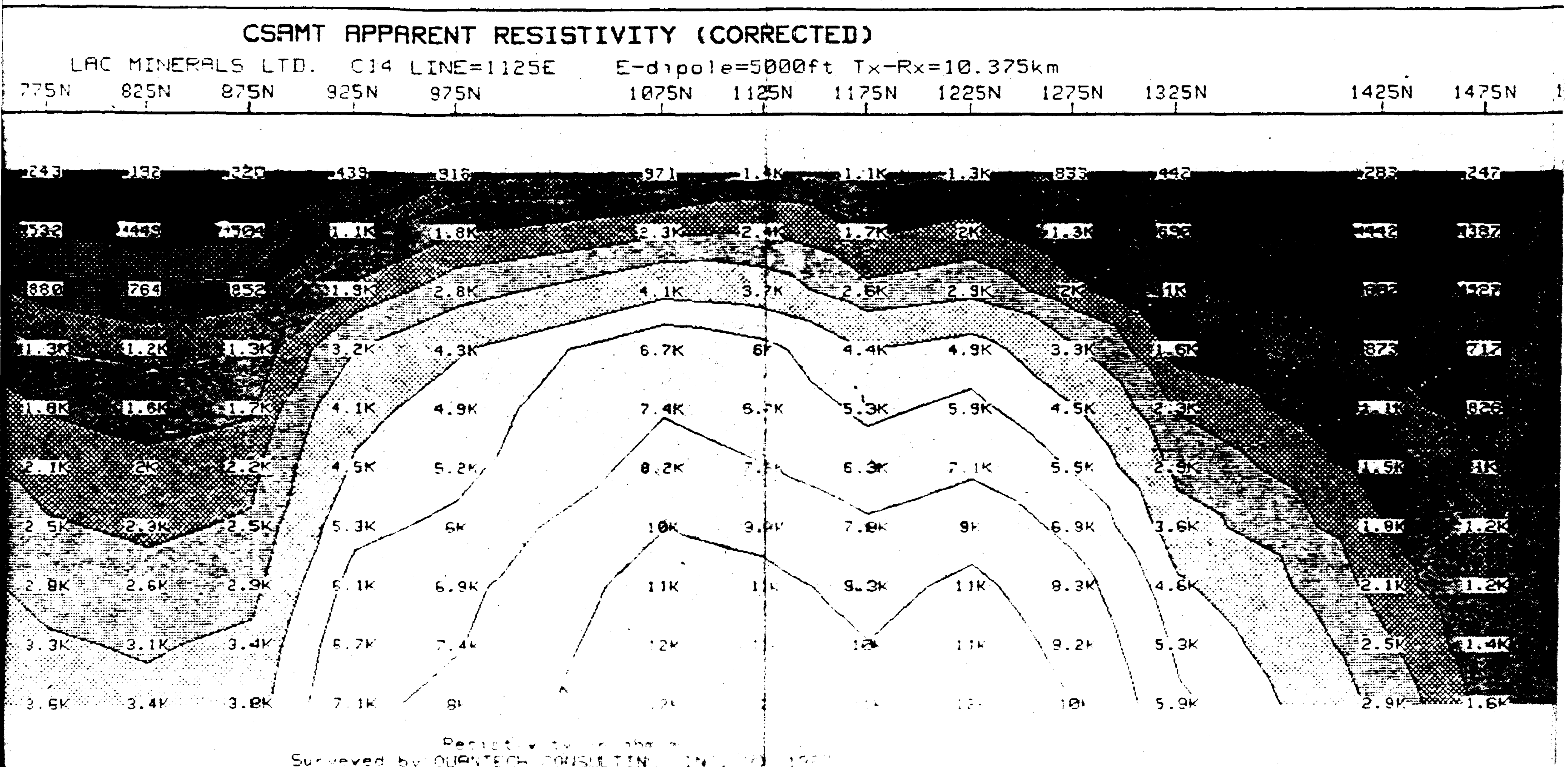
1024
512
256
128
64
32
16
8
4


CSAMT APPARENT RESISTIVITY (CORRECTED)
LAC MINERALS LTD. C14 LINE=1125E E-dipole=5000ft Tx-Rx=10.375km
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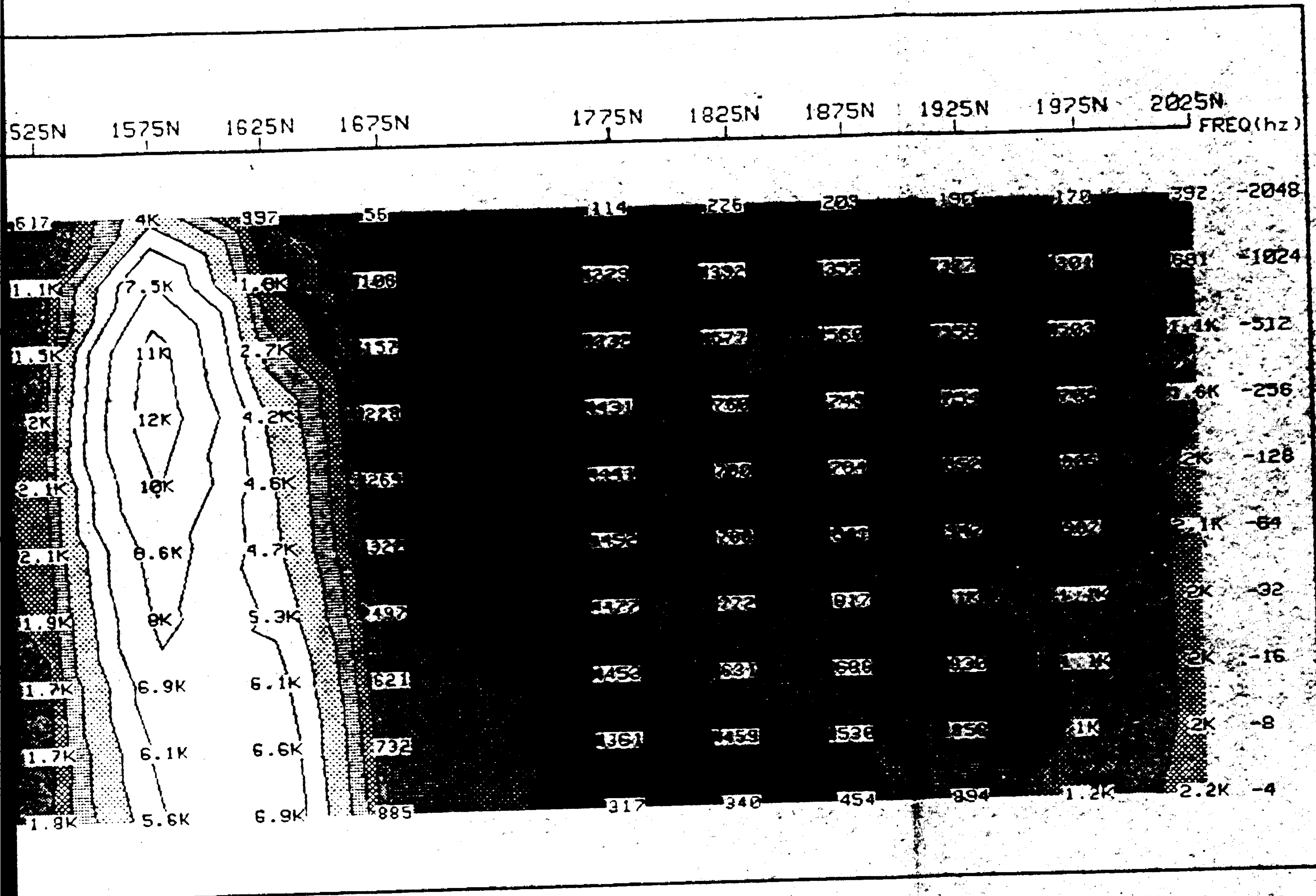
Surveyed by QUANTECH CONSULTING



525N
1575N
1625N
1675N
1775N
1825N
1875N
1925N
1975N
2025N
FREQ(hz)
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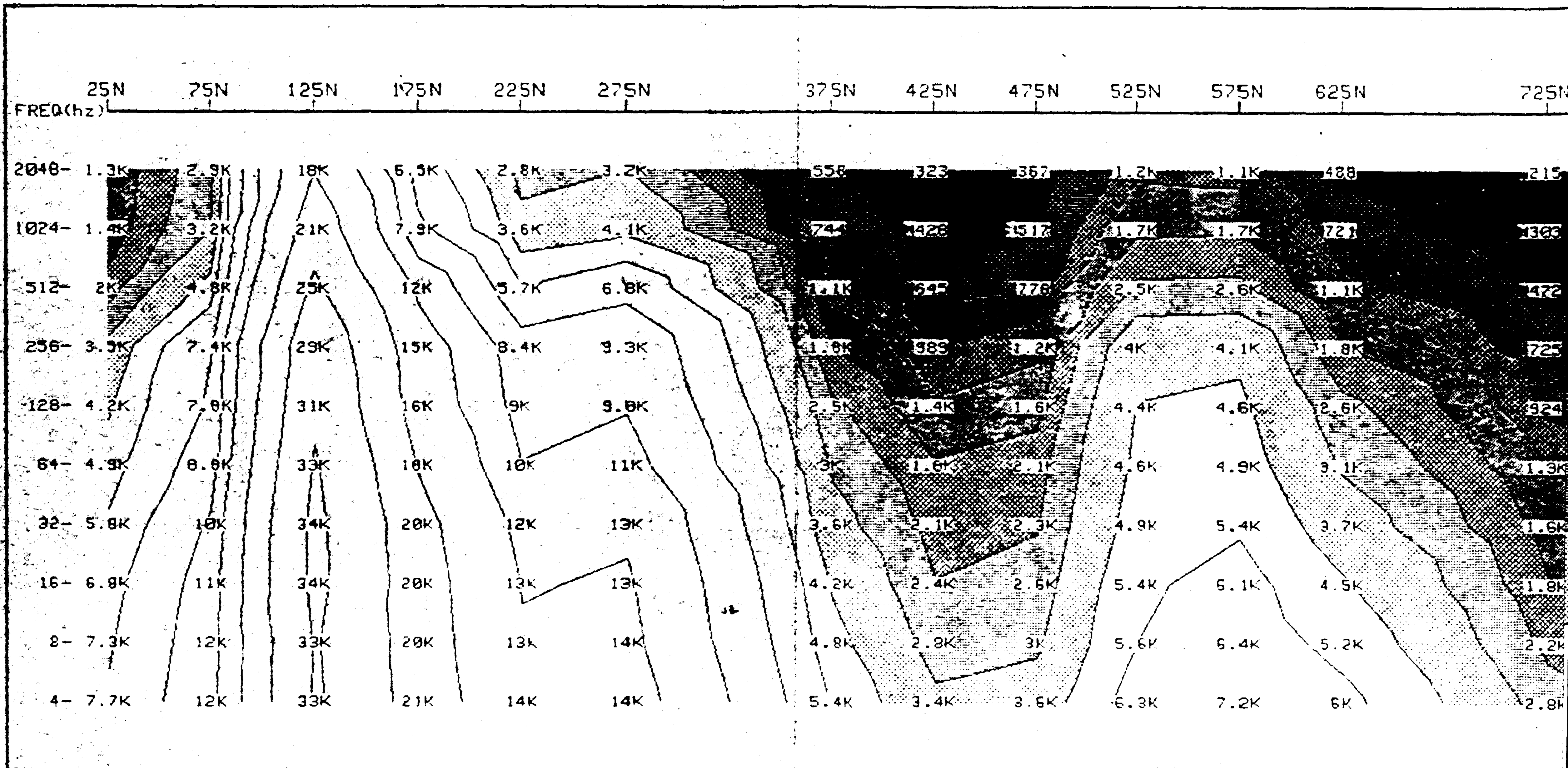
-16
-8
-4



25N
75N
125N
175N
225N
275N
375N
425N
475N
525N
575N
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725N
FREQ(hz)
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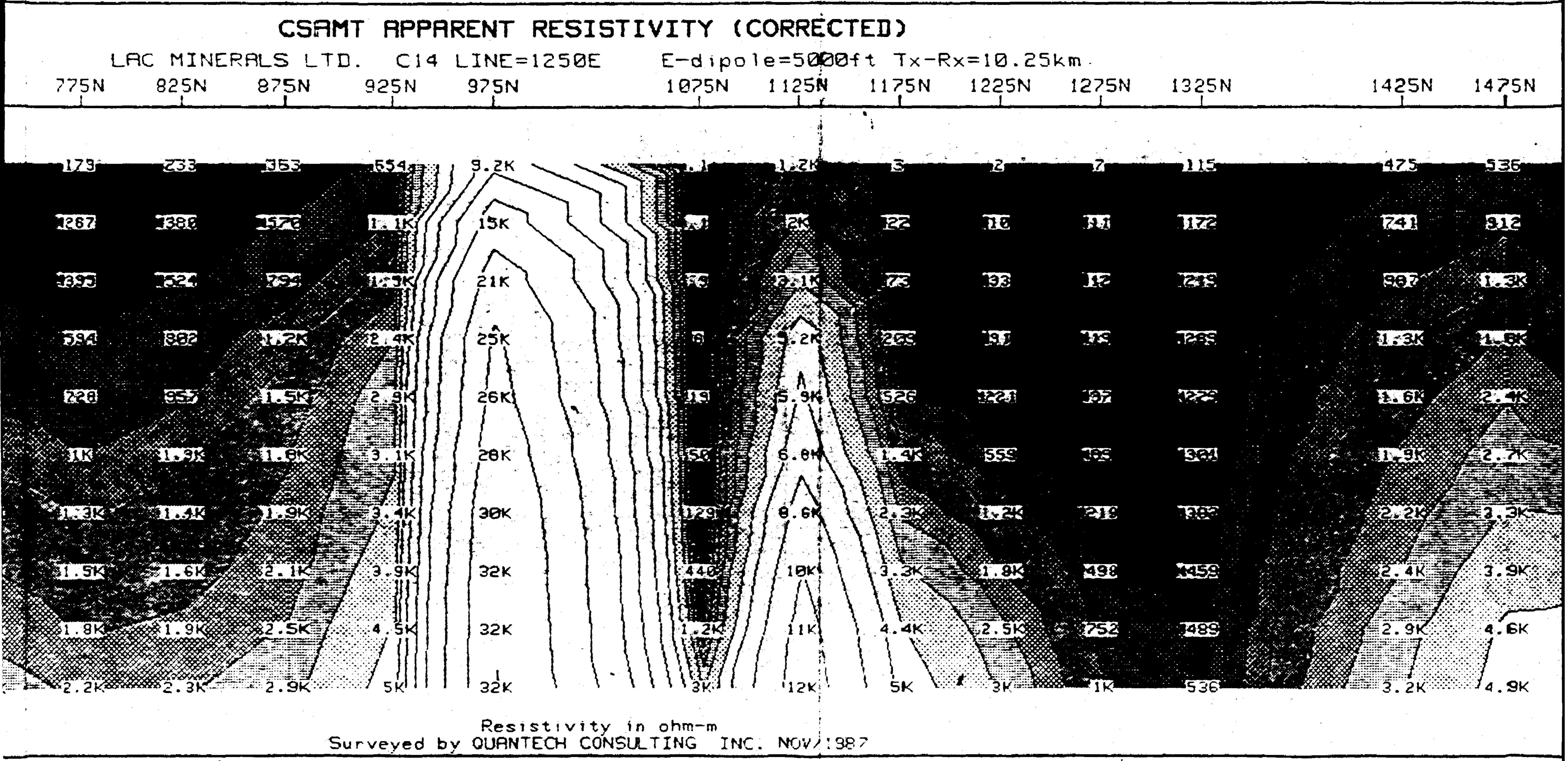
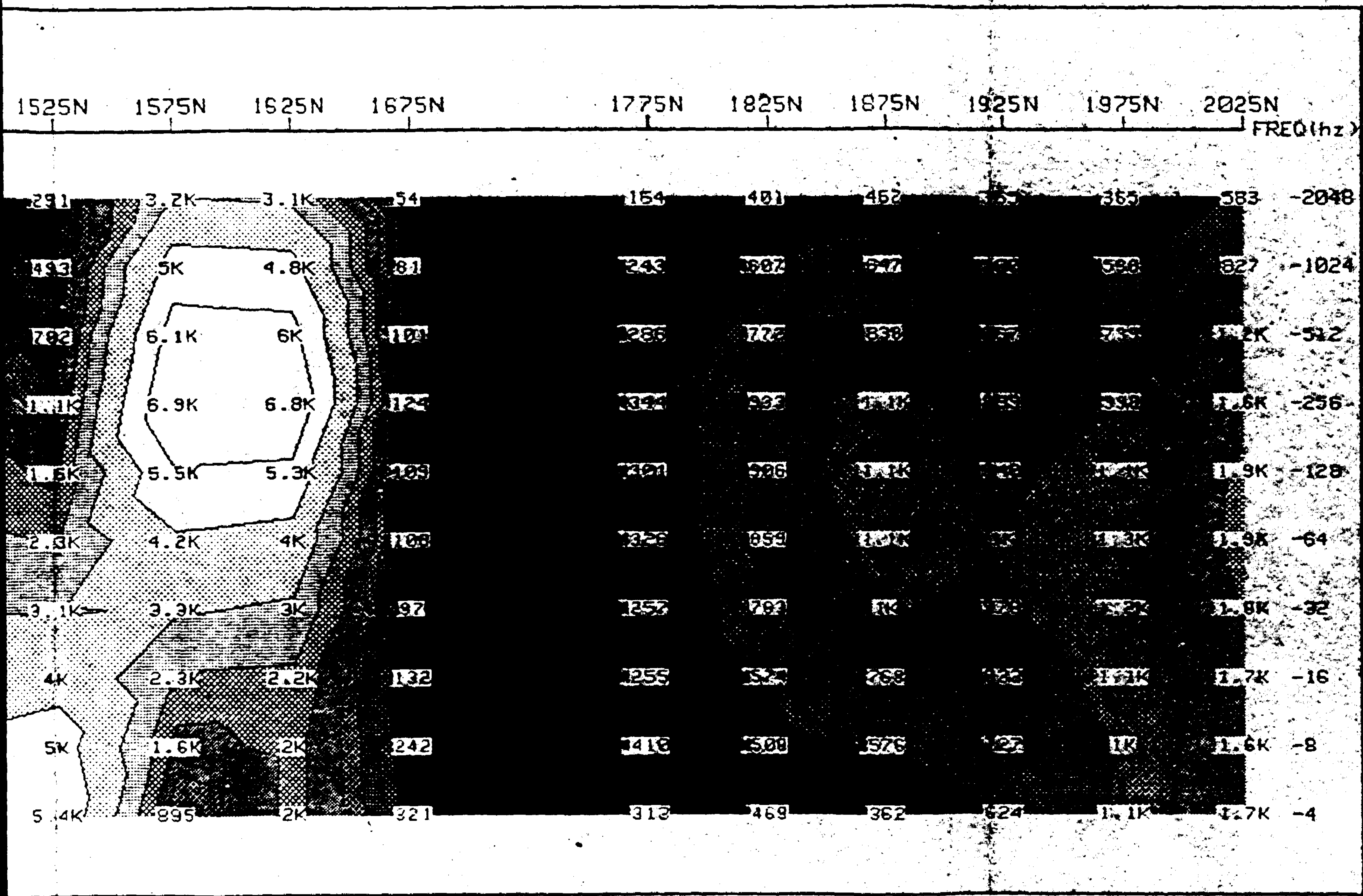
32-
16-
8-
4-


CSAMT APPARENT RESISTIVITY (CORRECTED)
LAC MINERALS LTD. C14 LINE=1250E E-dipole=5000ft Tx-Rx=10.25km
775N 825N 875N 925N 975N 1075N 1125N 1175N 1225N 1275N 1325N 1425N 1475N
Resistivity in ohm-m
Surveyed by QUANTECH CONSULTING INC. NOV/1987

12 50



1525N
1575N
1625N
1675N
1775N
1825N
1875N
1925N
1975N
2025N
FREQ(hz)
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-1024
-512
-256
-128
-64
-32
-16
-8
-4
3.2K
3.1K
5K
4.8K
6.1K
6K
6.9K
6.8K
5.5K
5.3K
4.2K
4K
3.3K
3K
4K
2.3K
2.2K
5K
1.6K
2K
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827
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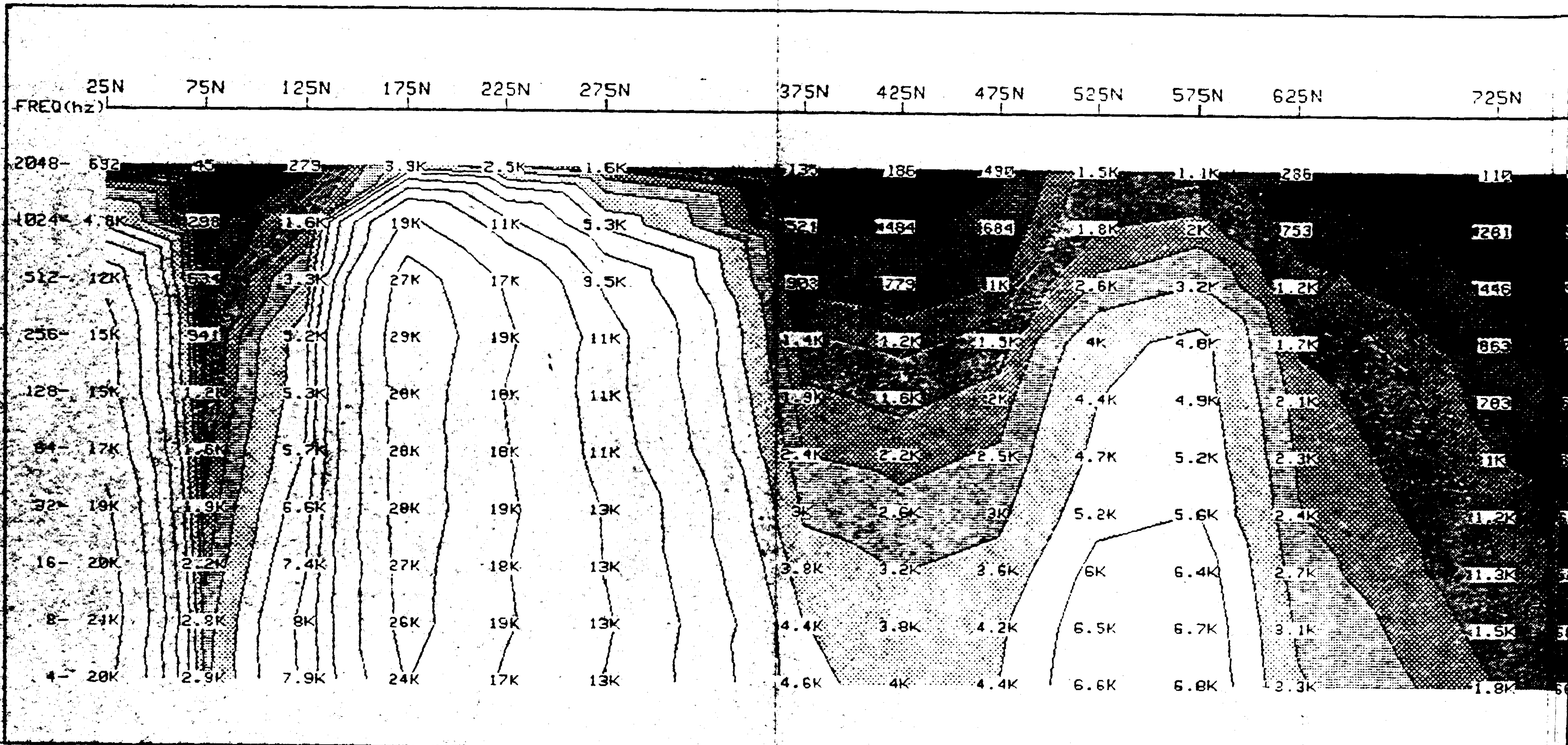
242

FREQ(hz)
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75N
125N
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225N
275N
375N
425N
475N
525N
575N
625N
725N
2048-
1024-
512-
256-
128-
64-
32-
16-
8-
4-
692 45 279 3.9K 2.5K 1.6K 135 186 490 1.5K 1.1K 286 110
4.8K 298 1.6K 19K 11K 5.3K 521 484 684 1.8K 2K 753 281
12K 3.3K 27K 17K 9.5K 908 779 1K 2.6K 3.2K 1.2K 446
15K 941 5.2K 29K 19K 11K 1.4K 1.2K 1.5K 4K 4.8K 1.7K 863
15K 1.2K 5.3K 28K 18K 11K 1.9K 1.6K 2K 4.4K 4.9K 2.1K 703
17K 1.6K 5.7K 28K 18K 11K 2.4K 2.2K 2.5K 4.7K 5.2K 2.3K 1K
19K 1.9K 6.6K 28K 19K 13K 3K 2.6K 3K 5.2K 5.6K 2.4K 1.2K
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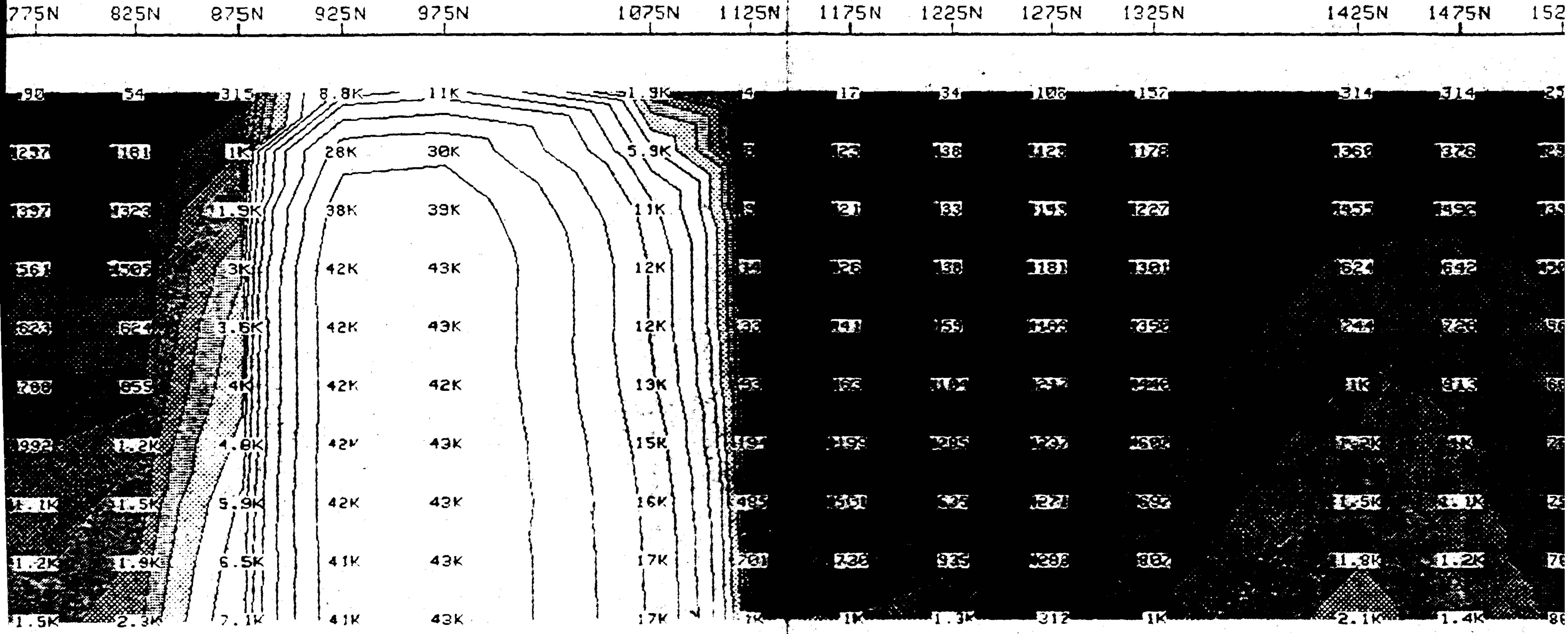
21K 2.8K 8K 26K 19K 13K 4.4K 3.8K 4.2K 6.5K 6.7K 3.1K 1.5K
20K 2.9K 7.9K 24K 17K 13K 4.6K 4K 4.4K 6.6K 6.8K 3.3K 1.8K

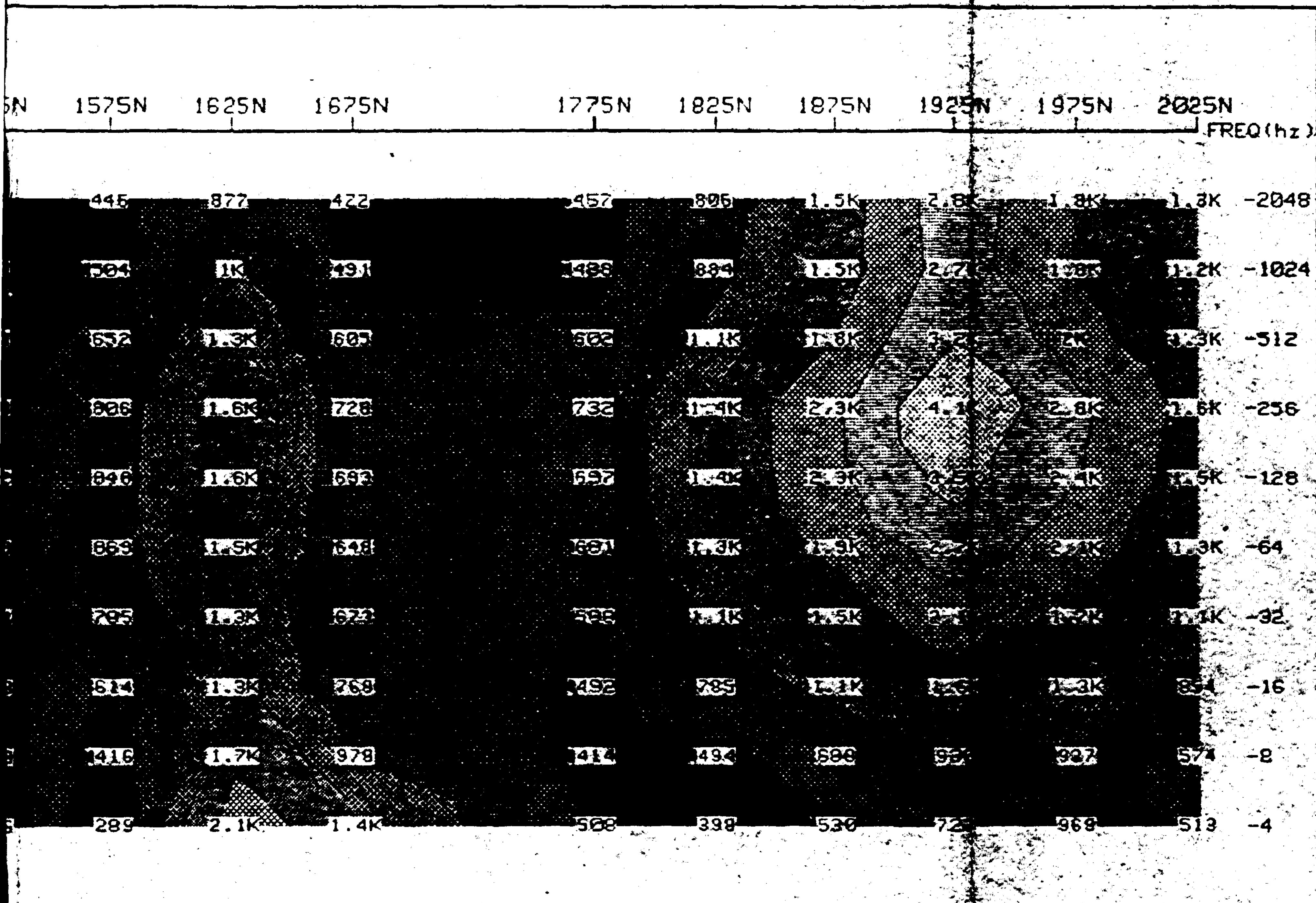
CSAMT APPARENT RESISTIVITY (CORRECTED)

LAC MINARALS LTD. C14 LINE=1375E E-dipole=5000ft Tx-Rx=10.125km



Resistivity in ohm-m

Surveyed by QUANTECH CONSULTING INC. NOV/1987


1575N
1625N
1675N
1775N
1825N
1875N
1925N
1975N
2025N
FREQ(hz)
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-512
-256
-128
-64
-32
-16
-8
-4
446
877
422
457
806
1.5K
1.8K
1.3K
1K
1.5K
1.2K
1.3K
1.6K
728
732
2.3K
2.8K
1.6K
1.6K
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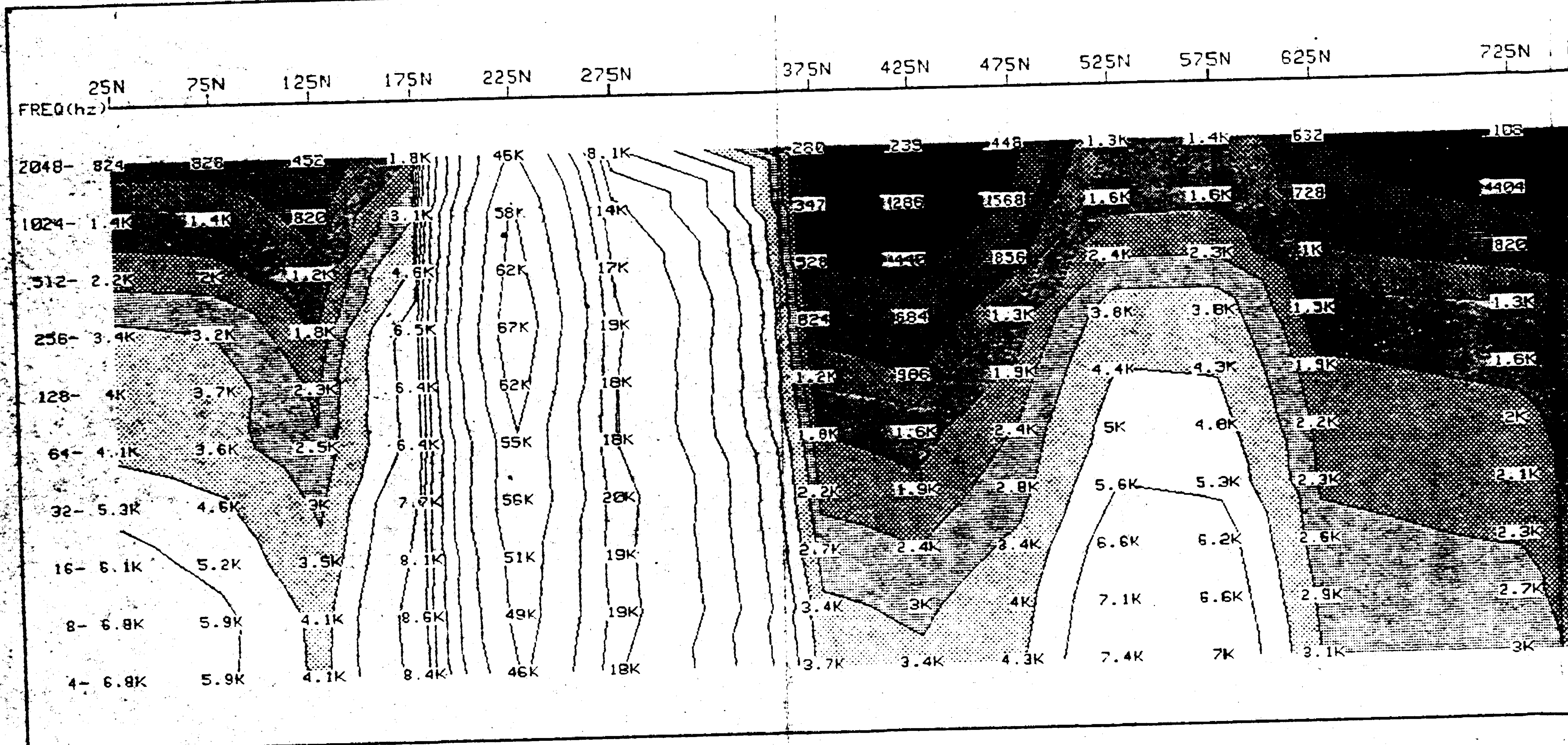
513



FREQ(hz)
25N
75N
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425N
475N
525N
575N
625N
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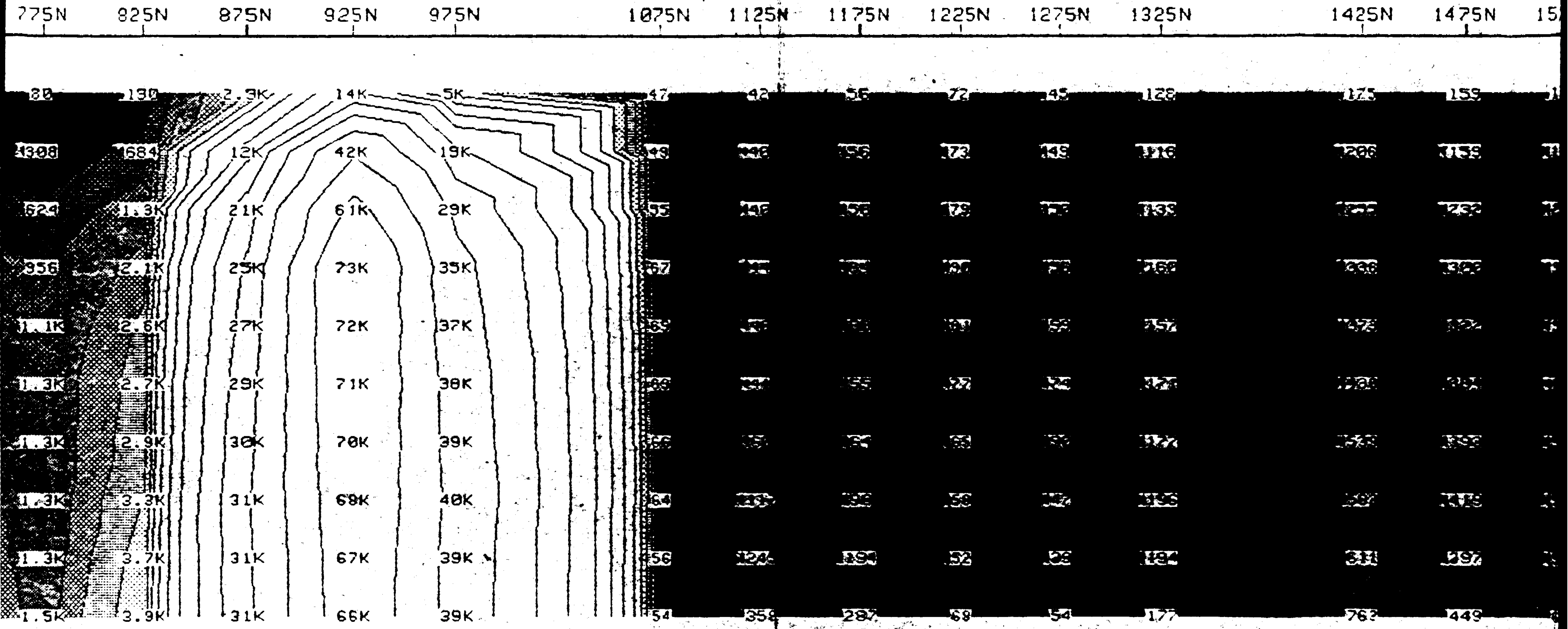
1024-
512-
256-
128-
64-
32-
16-
8-
4-

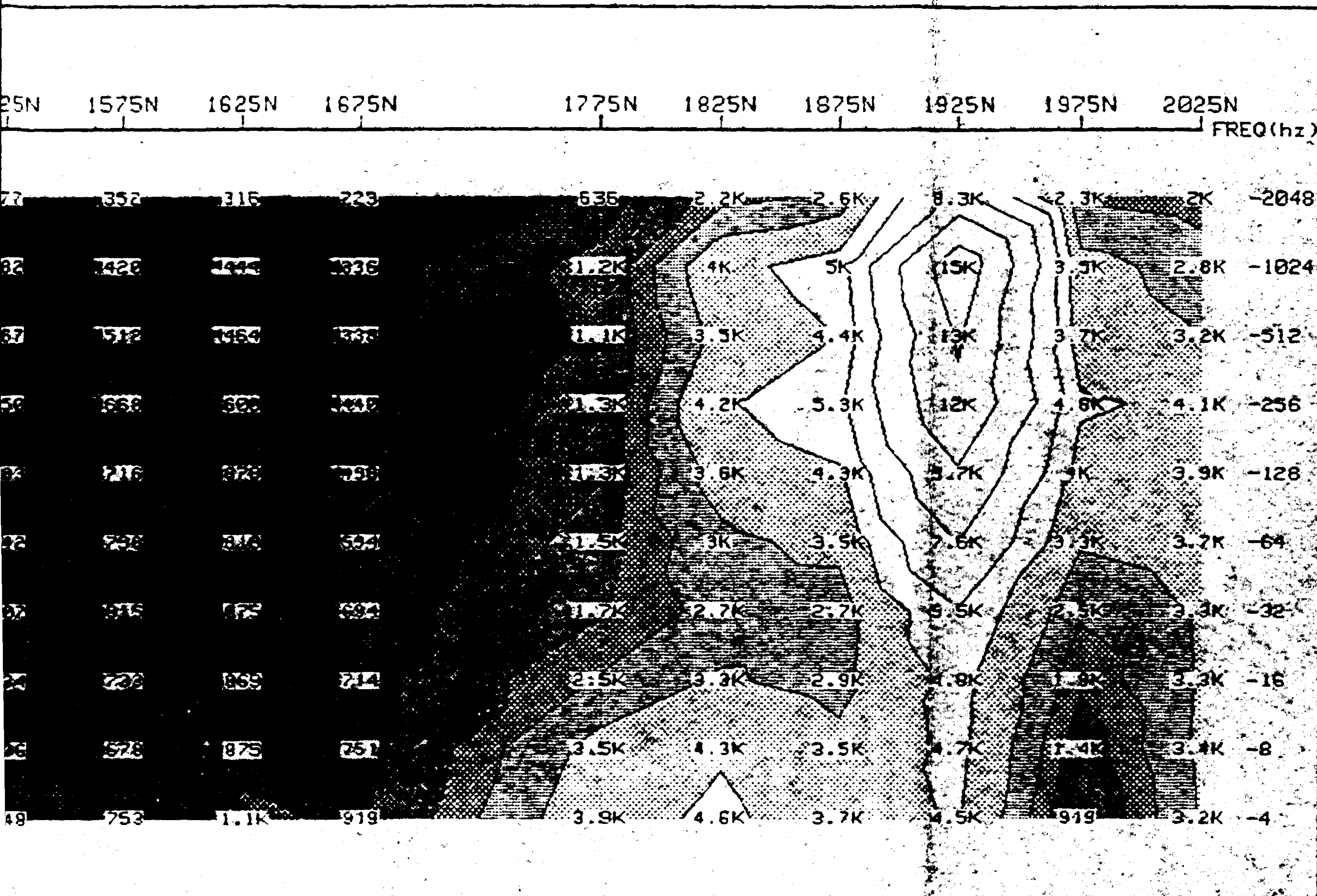
CSAMT APPARENT RESISTIVITY (CORRECTED)

LAC MINERALS LTD. C14 LINE=1500E E-dipole=5000ft Tx-Rx=10km



Resistivity in ohm-m

Surveyed by QUANTECH CONSULTING INC. NOV 1987



1575N
1625N
1675N
1775N
1825N
1875N
1925N
1975N
2025N
FREQ(hz)
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-1024
-512
-256
-128
-64
-32
-16
-8
-4
352
316
223
636
2.2K
2.6K
2.3K
2K
1.2K
4K
5K
15K
2.8K
1.1K
3.5K
4.4K
13K
3.7K
3.2K
4.2K
5.3K
12K
4.1K
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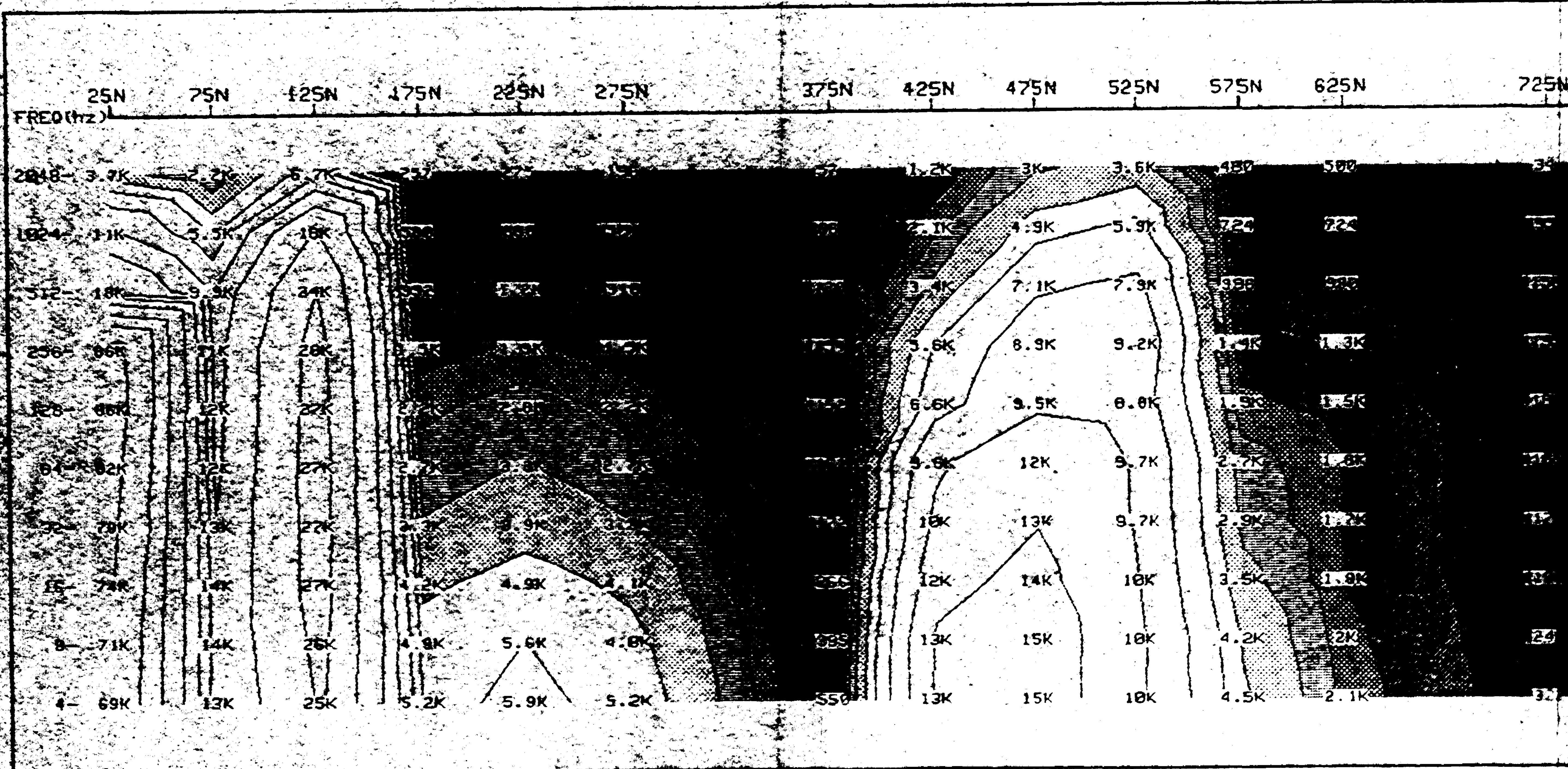
919
3.2K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425N
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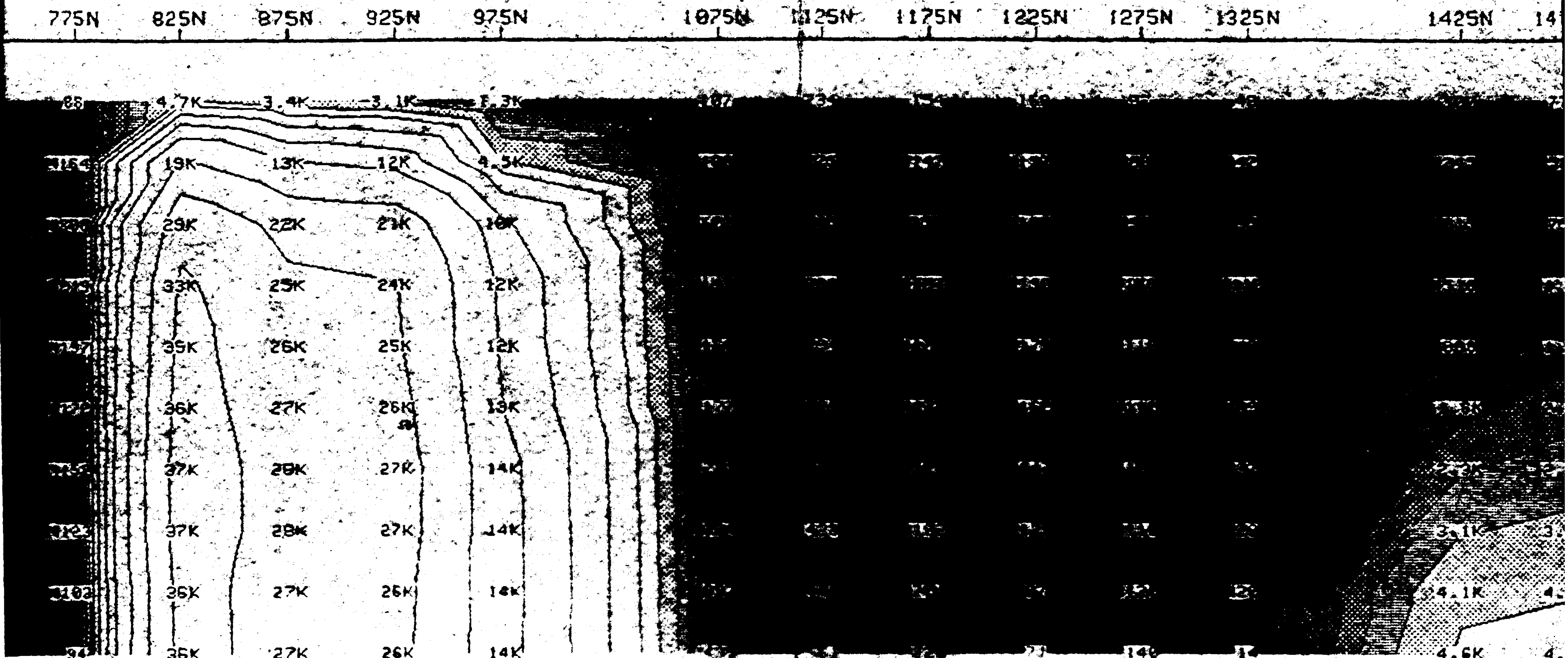
525N
575N
625N
725N
FREQ(hz)
2048
1024
512
256
128
64
32
16
8
4

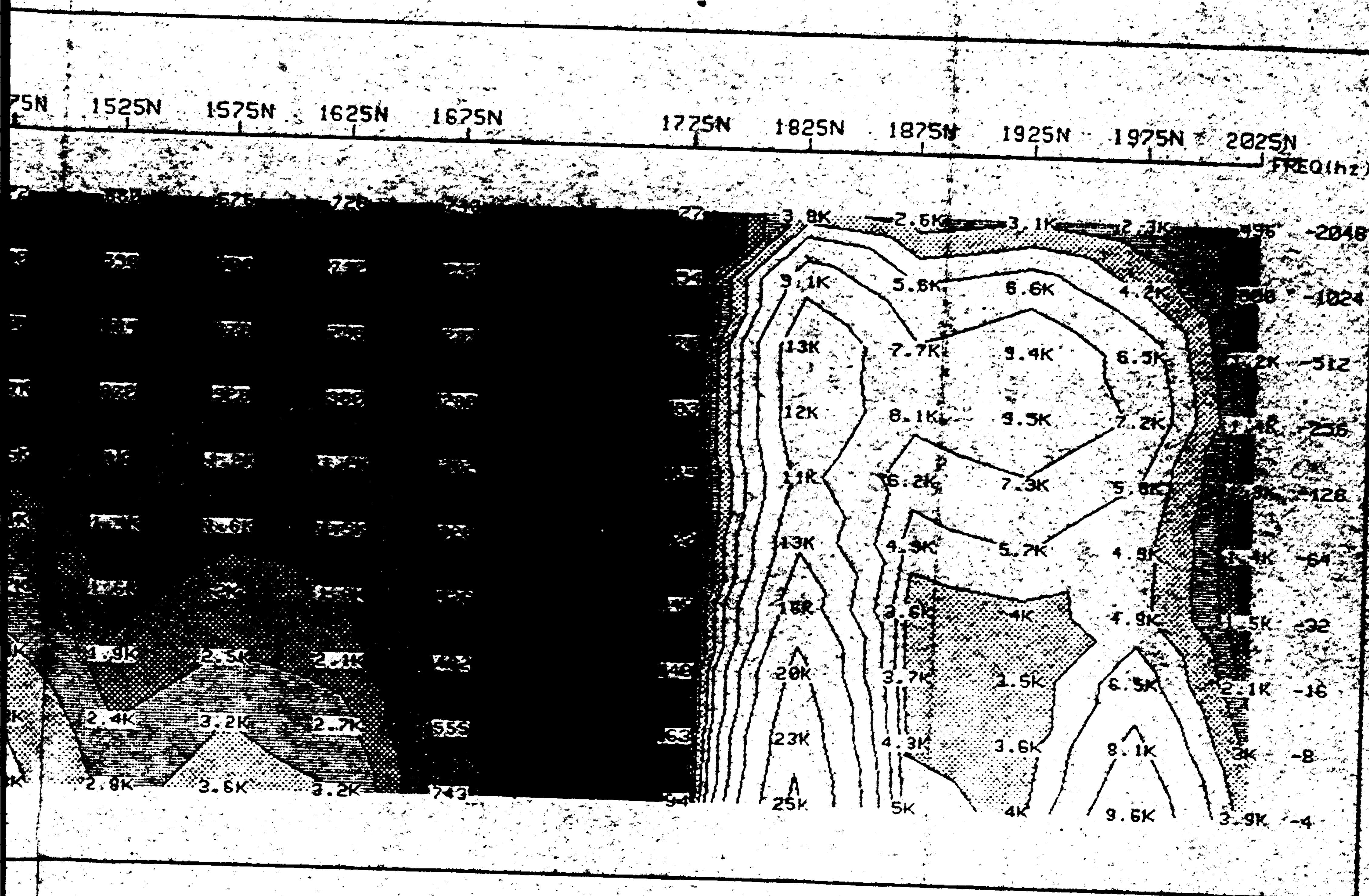
CSAMT APPARENT RESISTIVITY (CORRECTED)

LAC MINERALS LTD. C14 LINE=1625E E-dipole=5000ft Tx-Rx=9.875km



Resistivity in ohm-m

Surveyed by QUANTECH CONSULTING INC NOV 1987


1525N
1575N
1625N
1675N
1775N
1825N
1875N
1925N
1975N
2025N
FREQ(hz)
-2048
-1024
-512
-256
-128
-64
-32
-16
-8
-4
3.8K
2.6K
3.1K
2.3K
5.6K
6.6K
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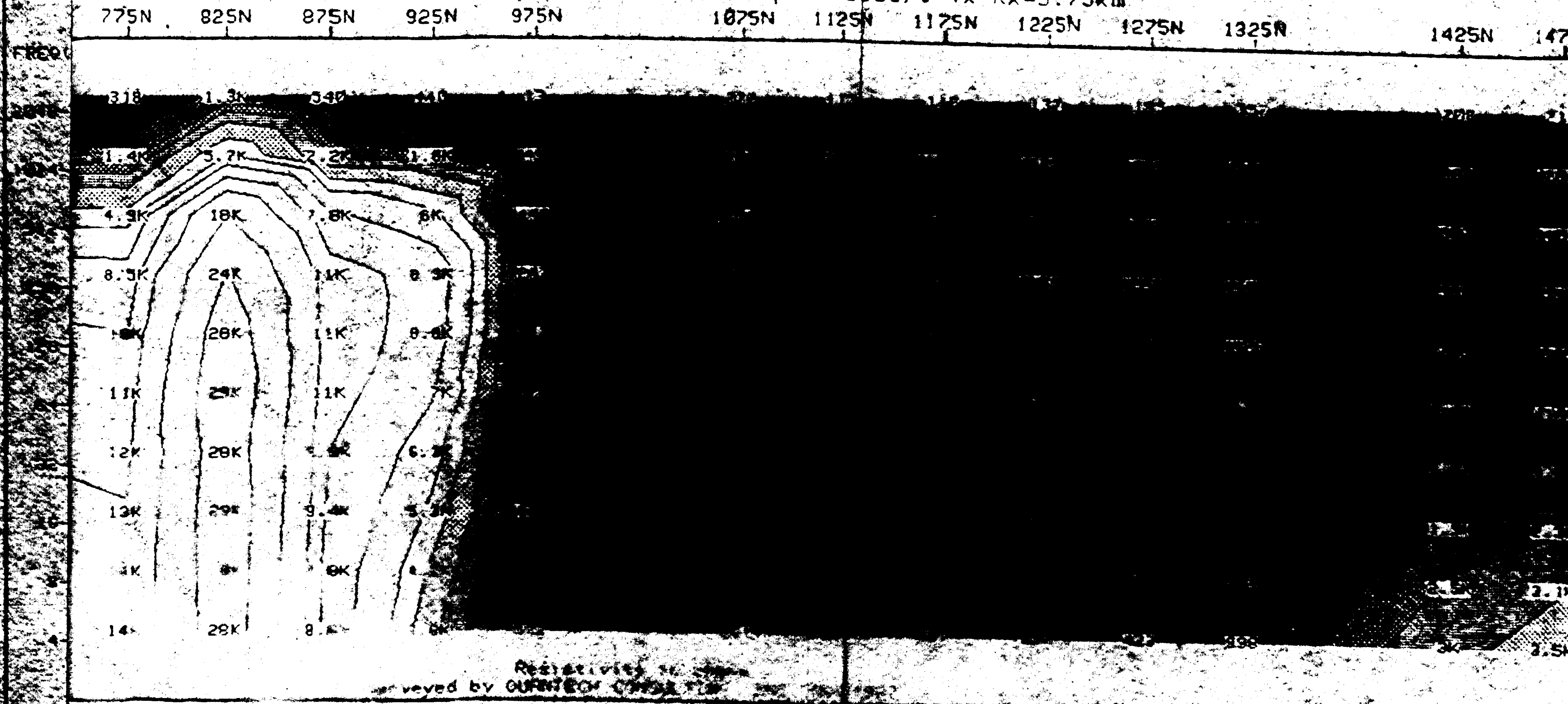
13K
7.7K
9.4K
6.5K
12K
8.1K
9.5K
7.2K
7.3K
5.7K
4.5K
4.9K
20K
3.7K
1.5K
6.5K
2.1K
23K
4.3K
3.6K
8.1K
25K
5K
4K
9.6K
3.9K
1.9K
2.5K
2.4K
3.2K
2.7K
2.9K
3.6K

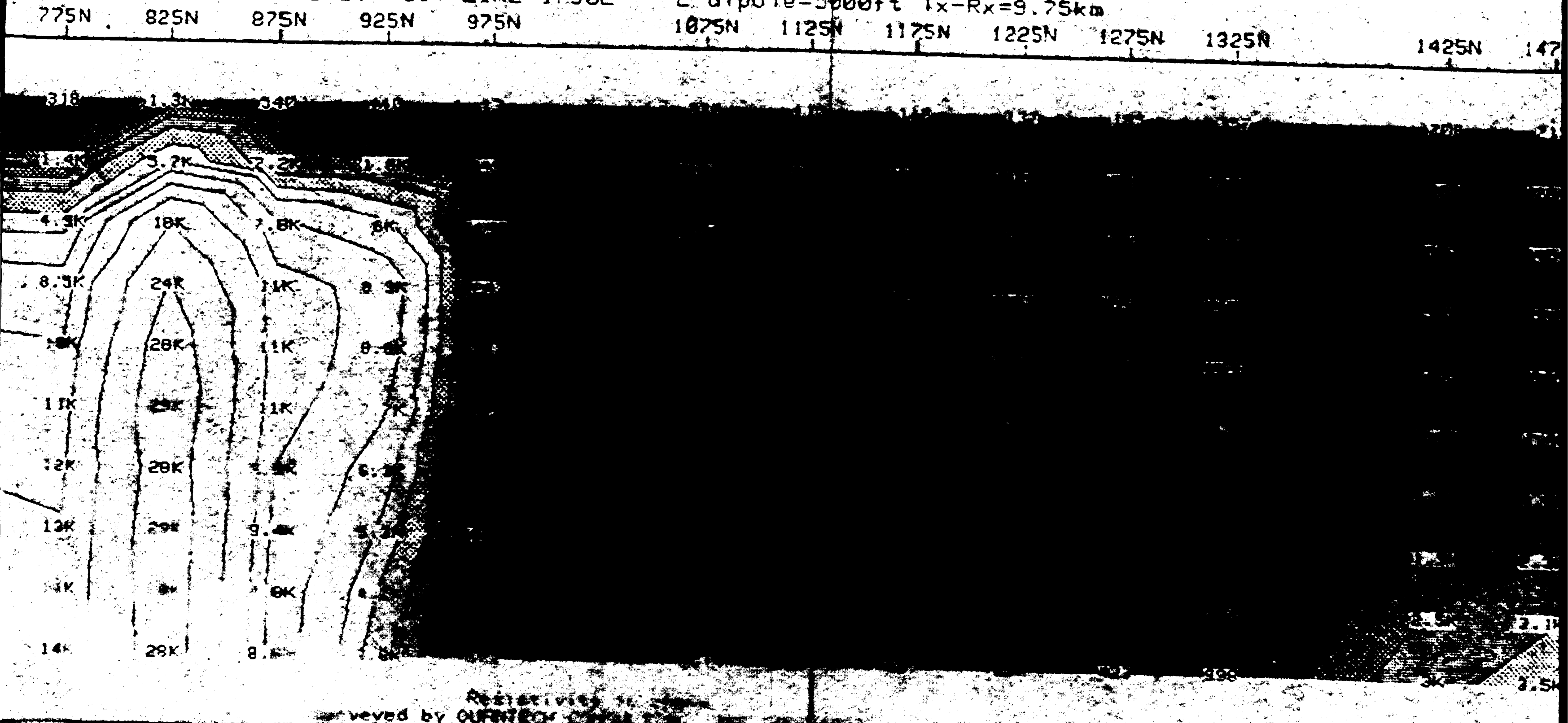
CSAMT APPARENT RESISTIVITY (CORRECTED)

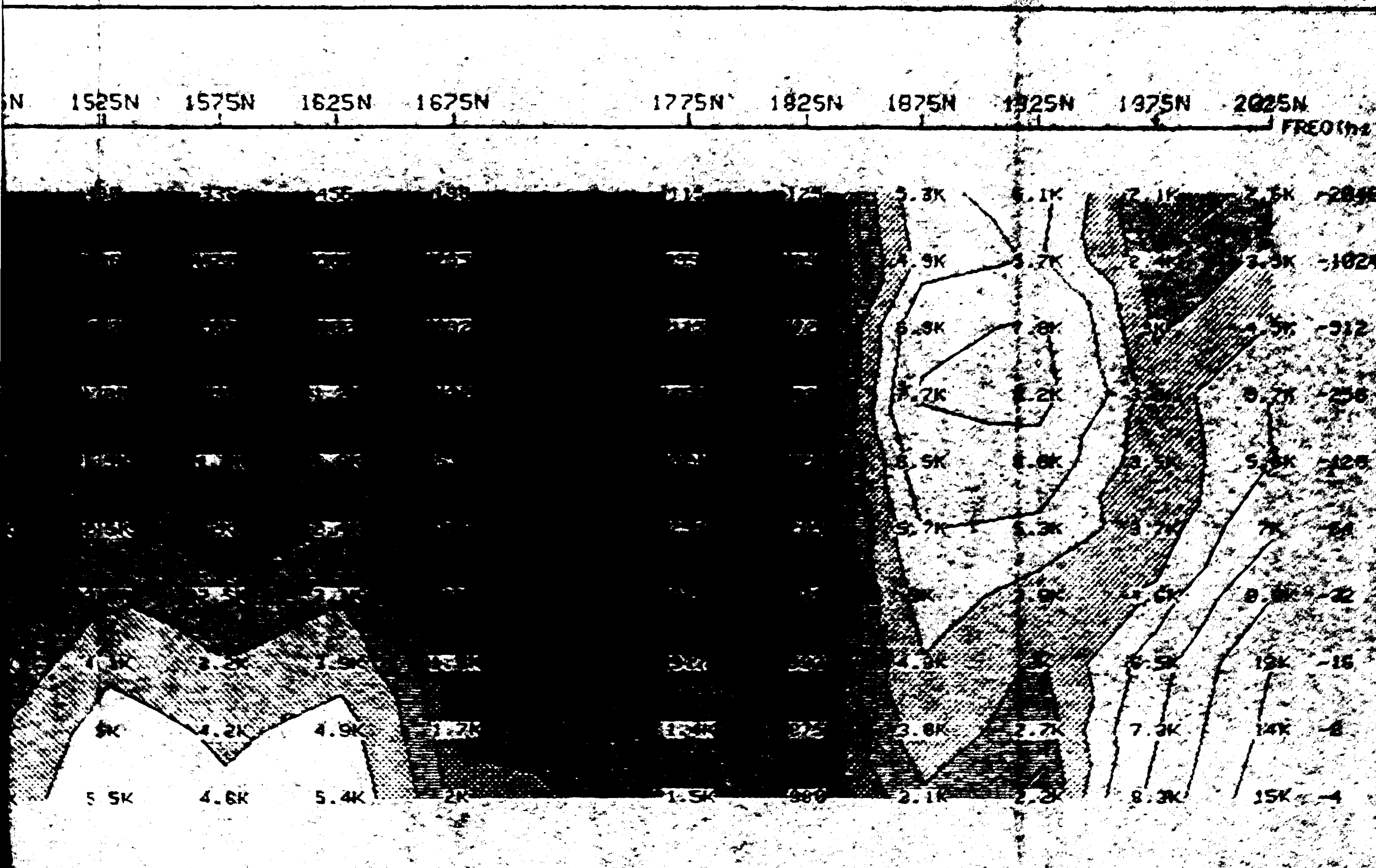
LAC MINERALS LTD. C14 LINE=1750E E-dipole=5000ft Tx-Rx=9.75km



CSAMT APPARENT RESISTIVITY (CORRECTED)

LAC MINERALS LTD. C14 LINE=1750E E-dipole=5000ft Tx-Rx=9.75km



1525N
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1675N
1775N
1825N
1875N
2025N
FREQ(hz)
5.3K
4.5K
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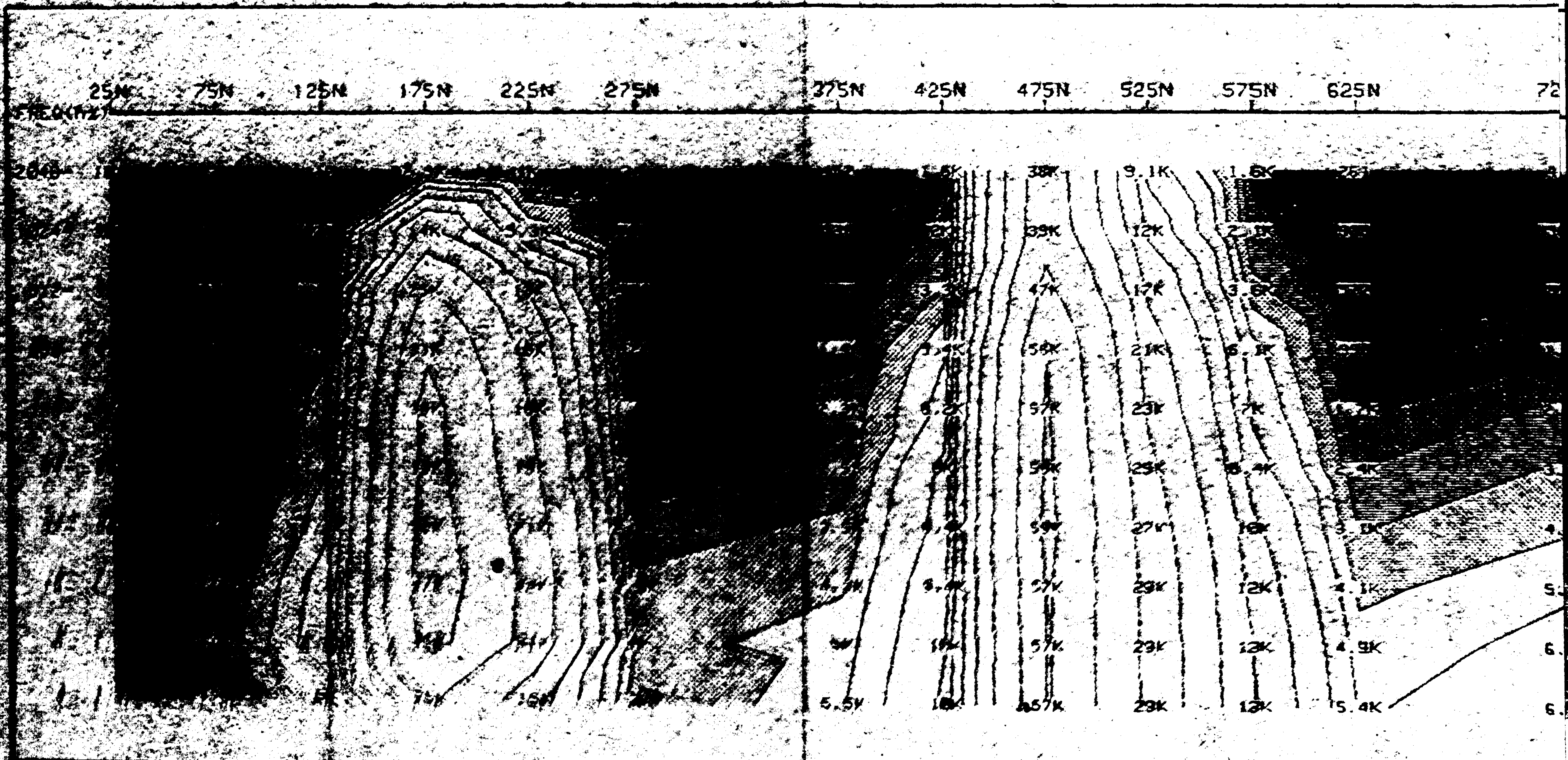
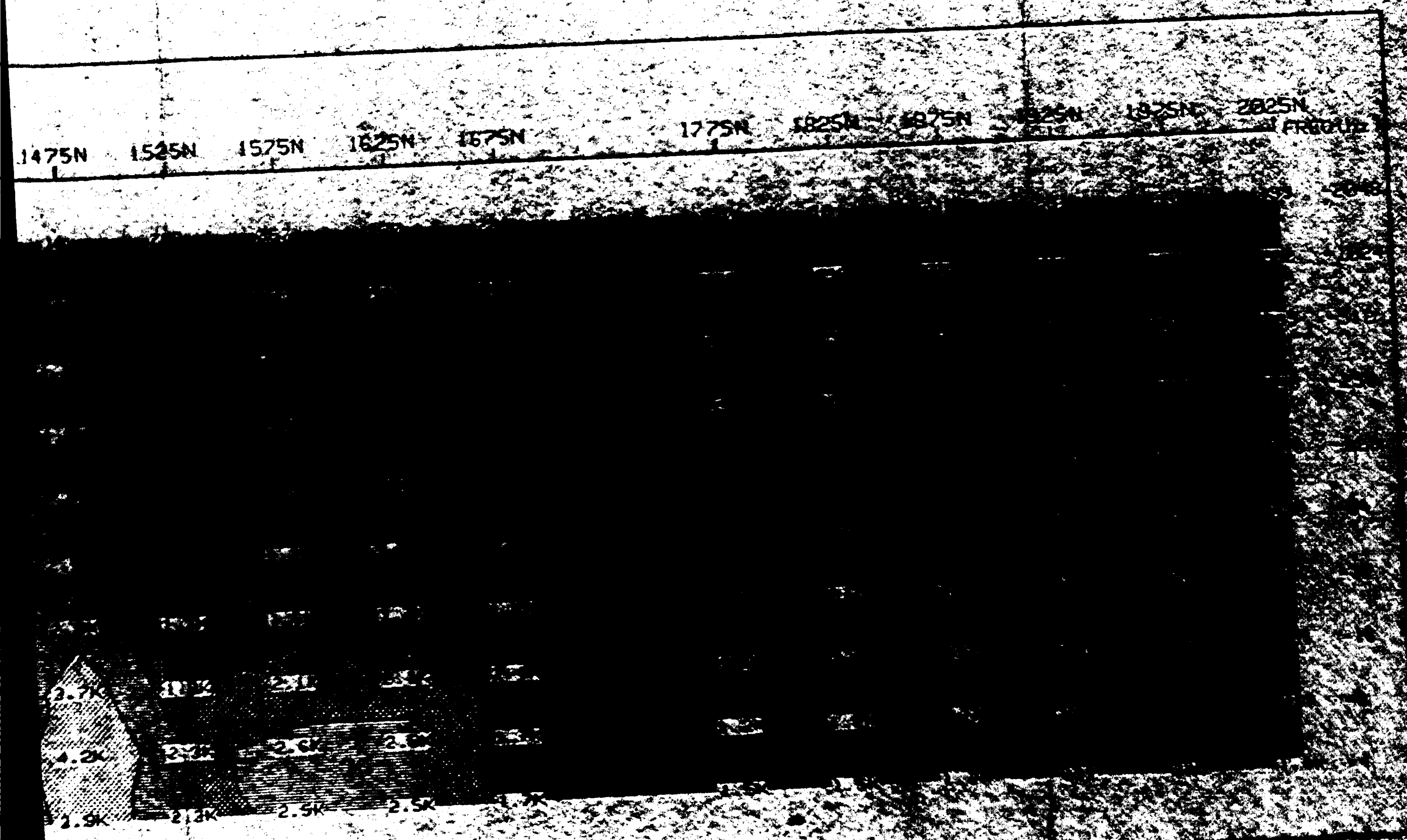
4.3K
3.8K
2.1K
6.1K
2.7K
2.2K
7.3K
8.3K
15K
14K
7K
5.5K
4.6K
5.4K
4.2K
4.9K
1.5K
2K

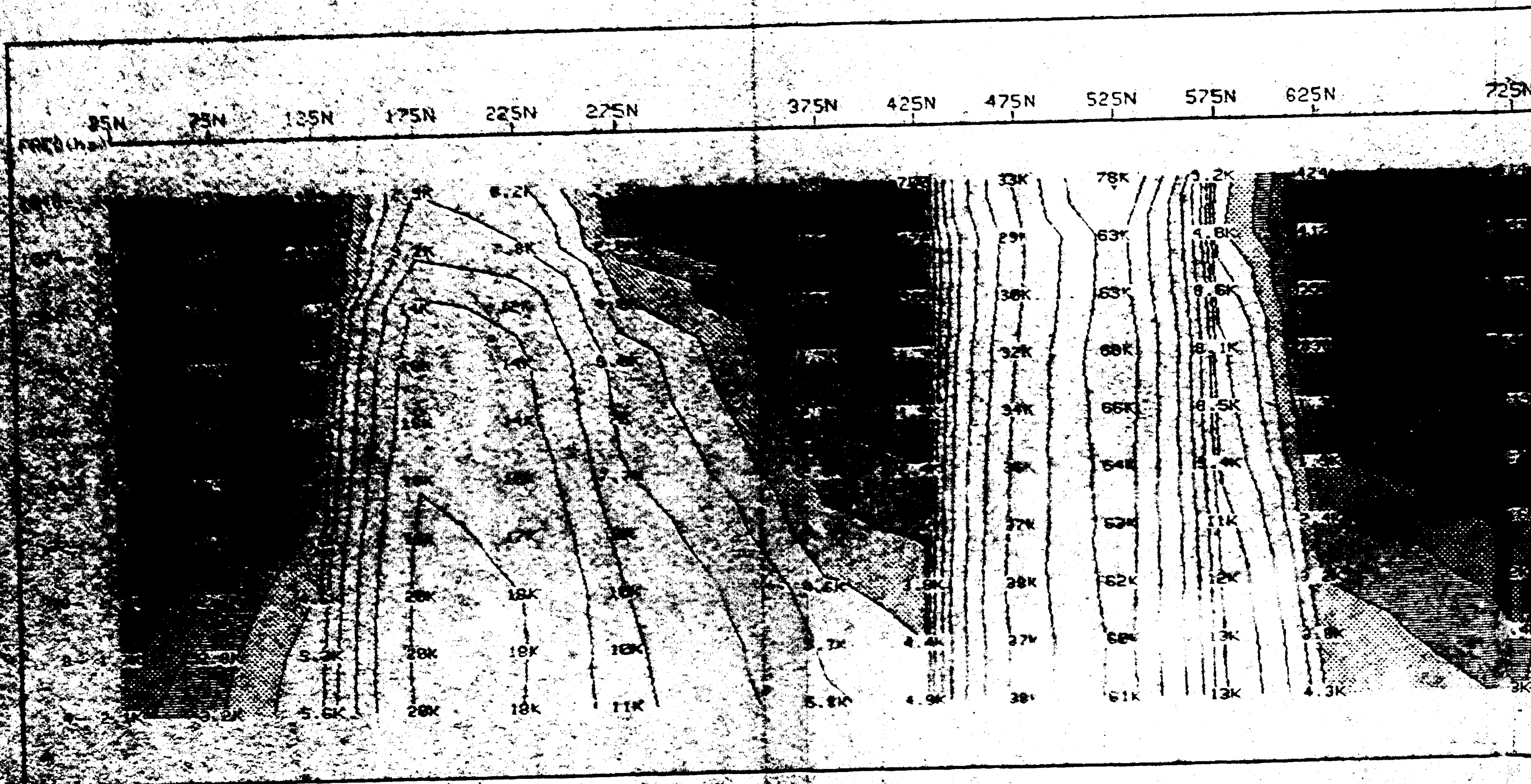

25N
75N
125N
175N
225N
275N
375N
425N
475N
525N
575N
625N
FREQ(HZ)
1.6K
38K
9.1K
1.6K
39K
12K
47K
17K
54K
21K
57K
23K
25K
27K
5.5K
57K
23K
12K
4.9K
18K
13K
5.4K

CSAMT APPARENT RESISTIVITY (CORRECTED)

LAC MINERALS LTD. C14 LINE=1875E [illegible]

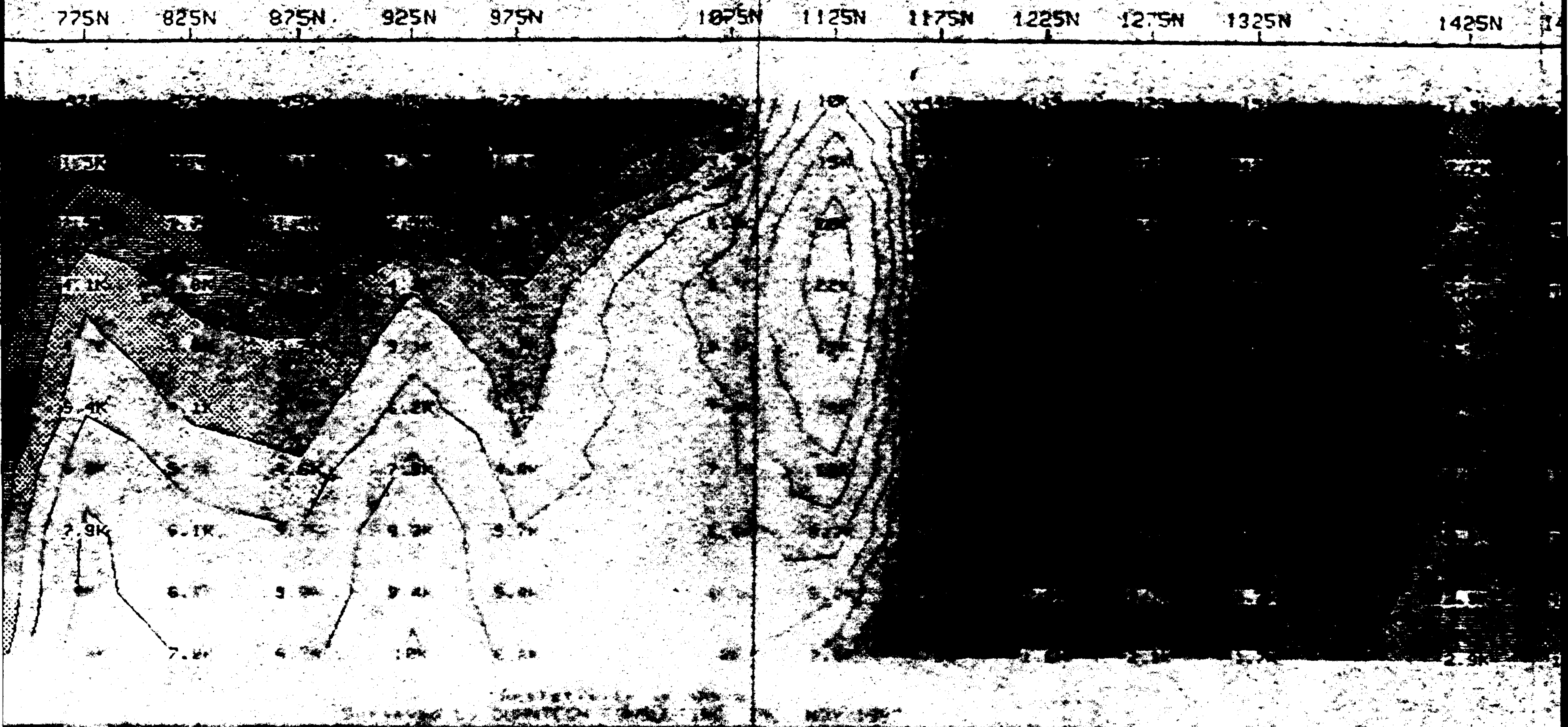
Resistivity in ohm-m
Surveyed by QUANTECH CONSULTING INC. NOV/1987

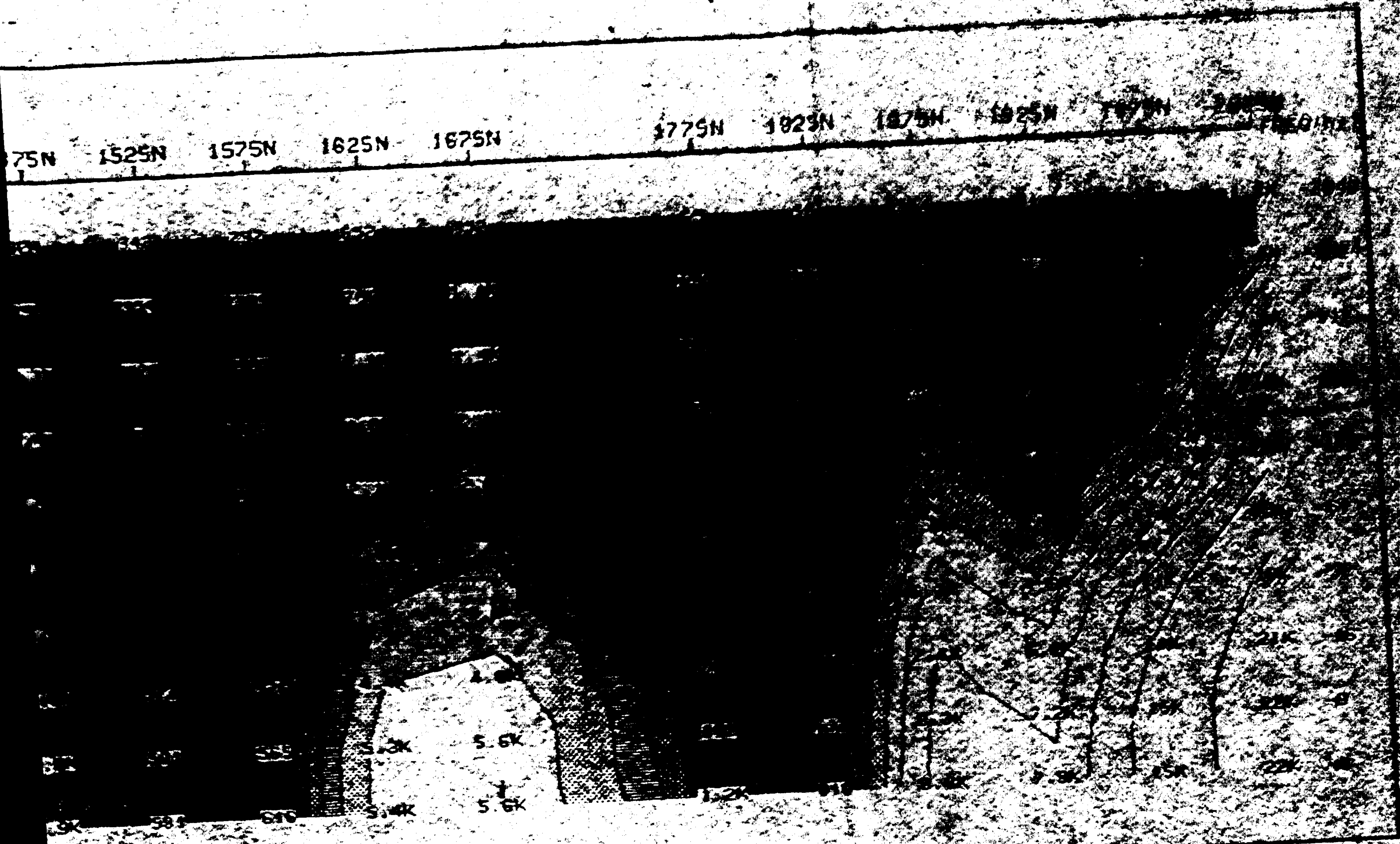

1475N
1525N
1575N
1625N
1675N
1775N
2025N
2.7K
4.2K
2.9K
2.5K
2.5K

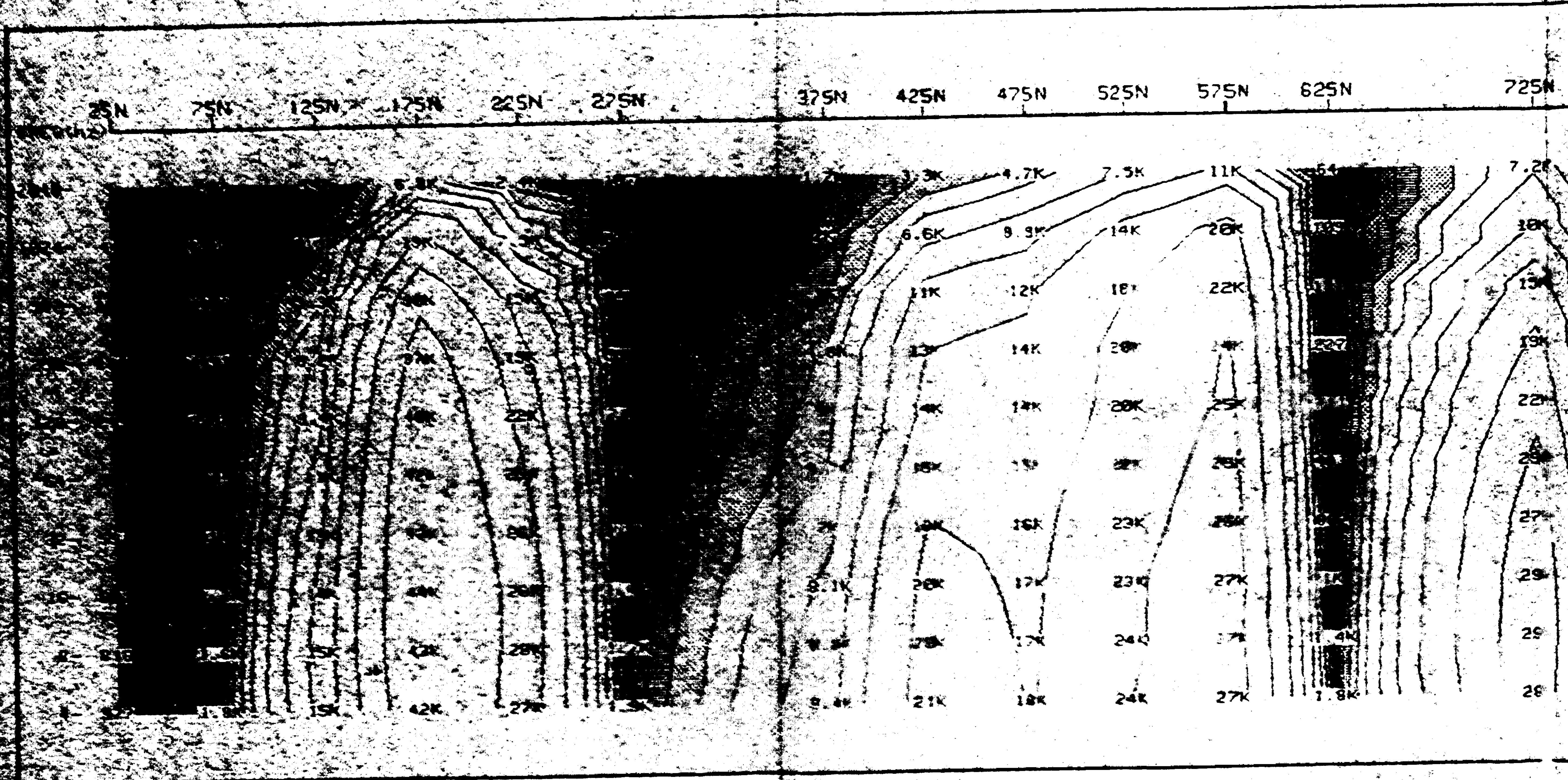

175N
225N
275N
375N
425N
475N
525N
575N
625N
725N

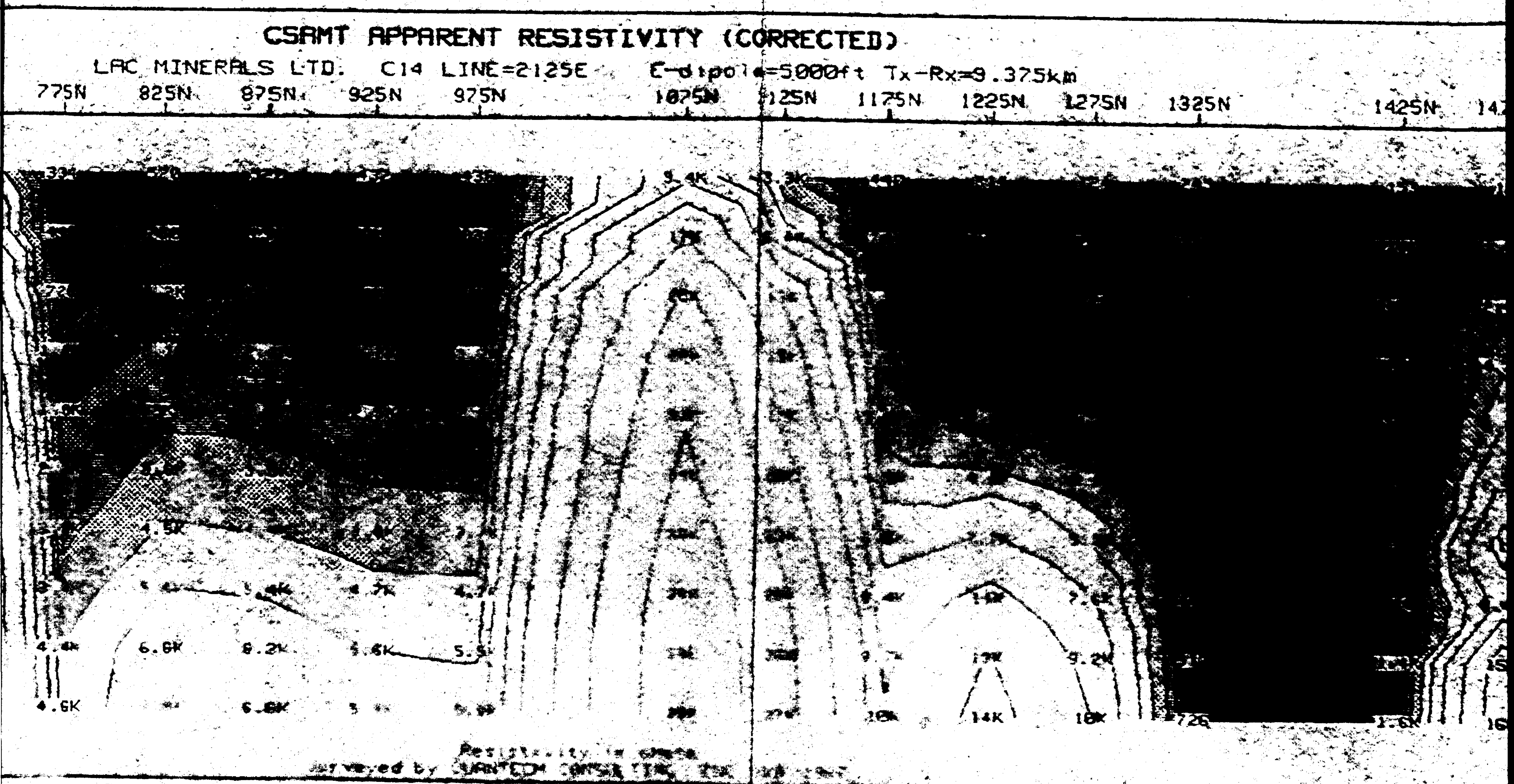
CSAMT APPARENT RESISTIVITY (CORRECTED)

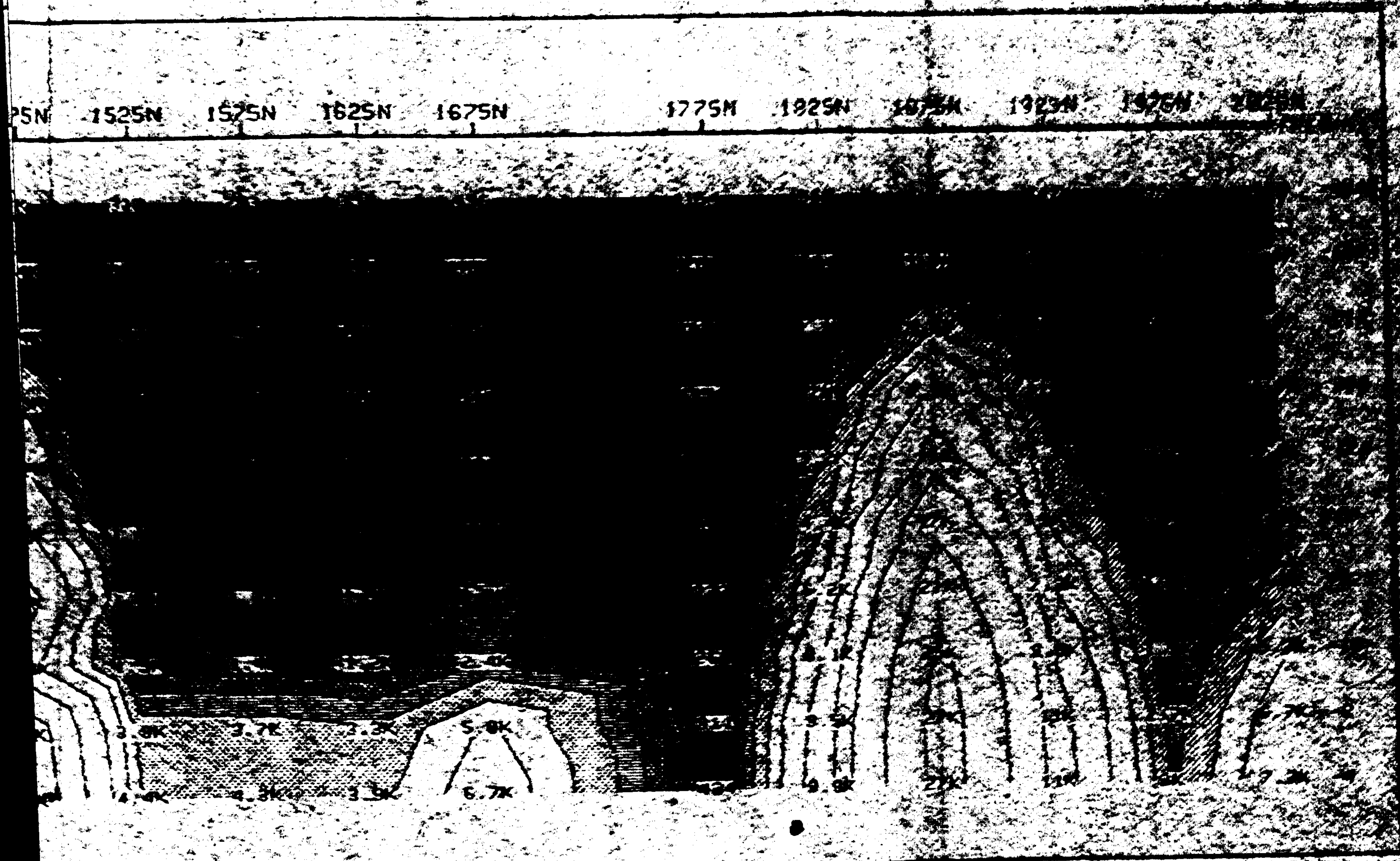
LAC MINERALS LTD. CI4 LINE=2000E E-dipole=5000ft Tx-Rx=9.5km



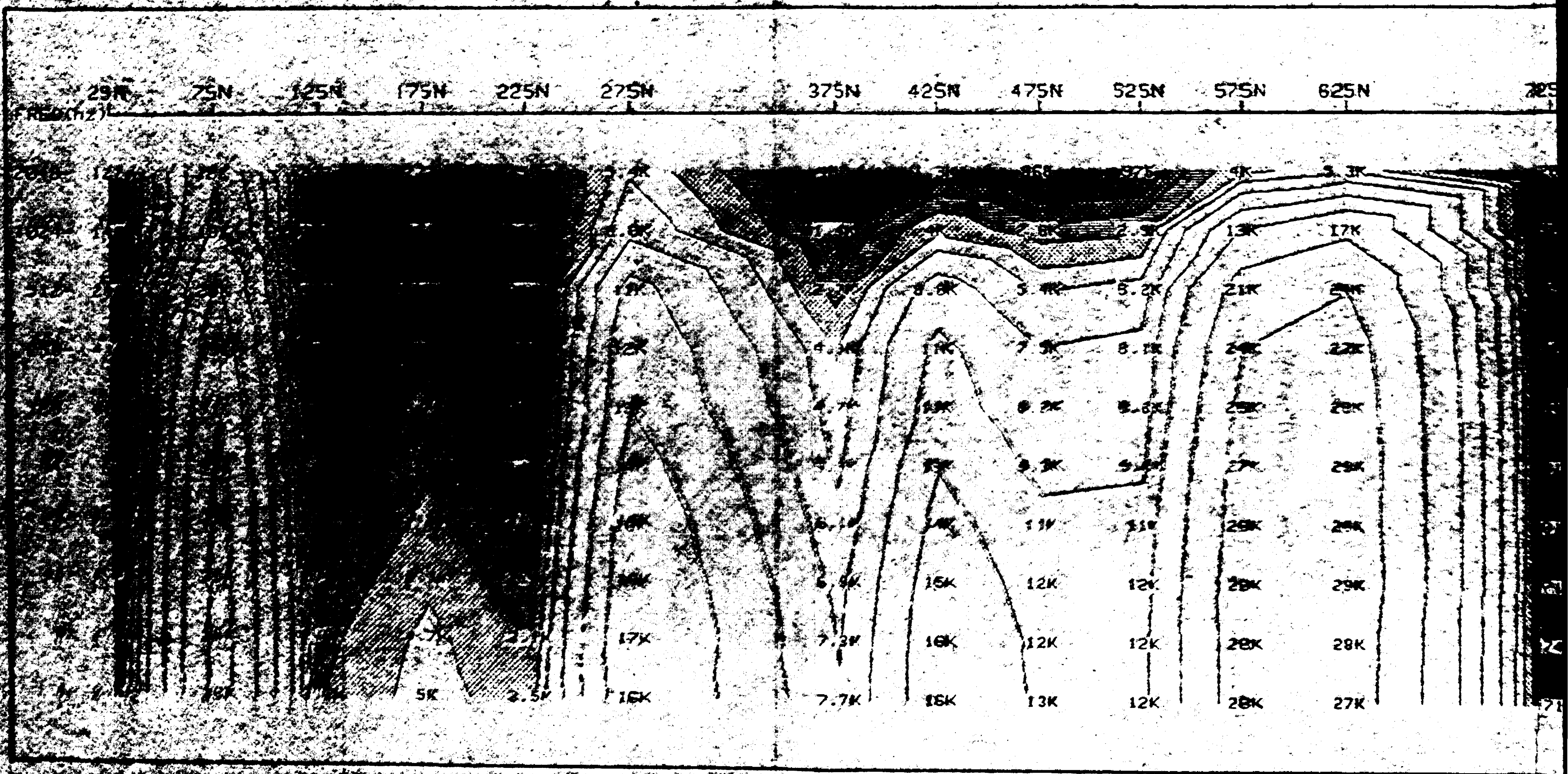

1525N
1575N
1625N
1675N
1775N
5.6K
5.6K


25N
75N
125N
175N
225N
275N
375N
425N
475N
525N
575N
625N
725N


CSAMT APPARENT RESISTIVITY (CORRECTED)
LAC MINERALS LTD. C14 LINE=2125E E-dipole=5000ft Tx-Rx=9.375km
775N
825N
875N
925N
975N
1075N
1125N
1175N
1225N
1275N
1325N
1425N
4.5K
4.4K
6.6K
9.2K
5.6K
5.5K
4.6K
6.8K
14K
18K
1.6K
Resistivity in ohm-m



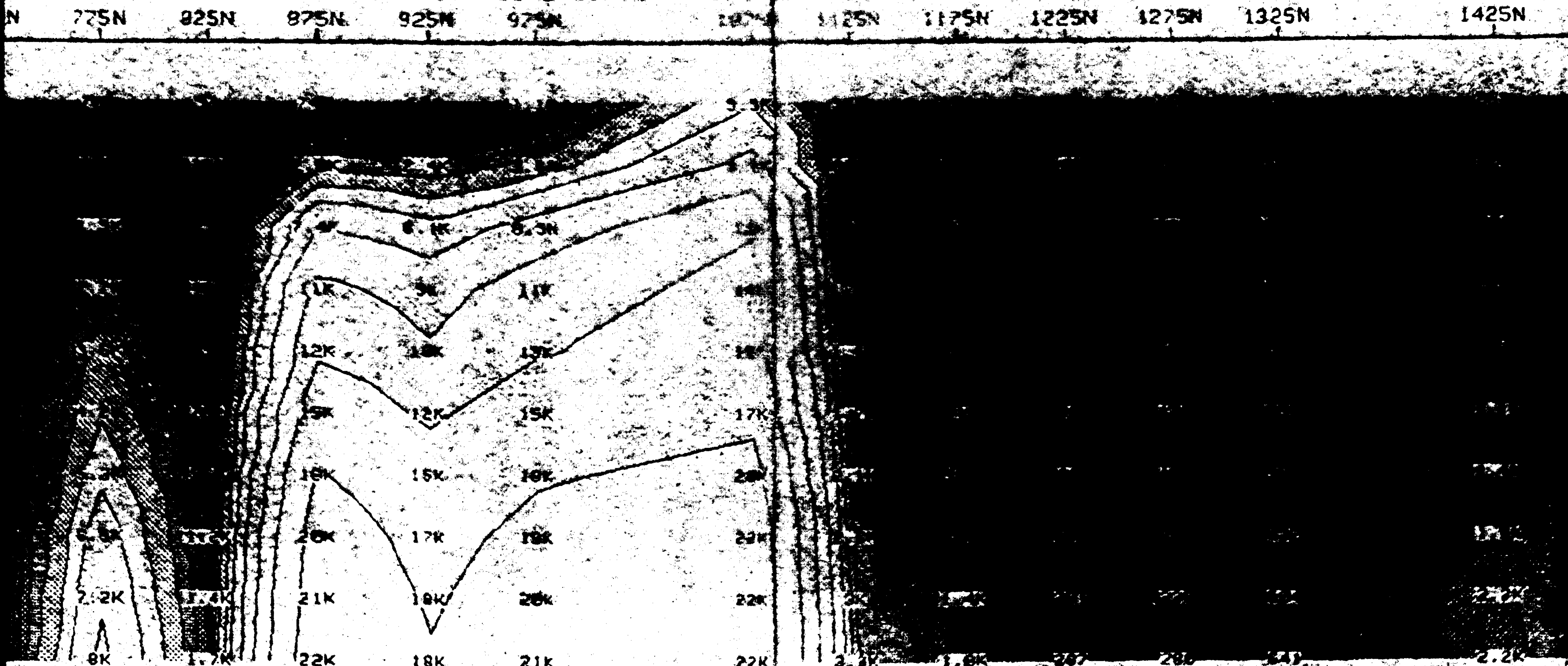
1525N
1575N
1625N
1675N
1775N
1825N
6.7K



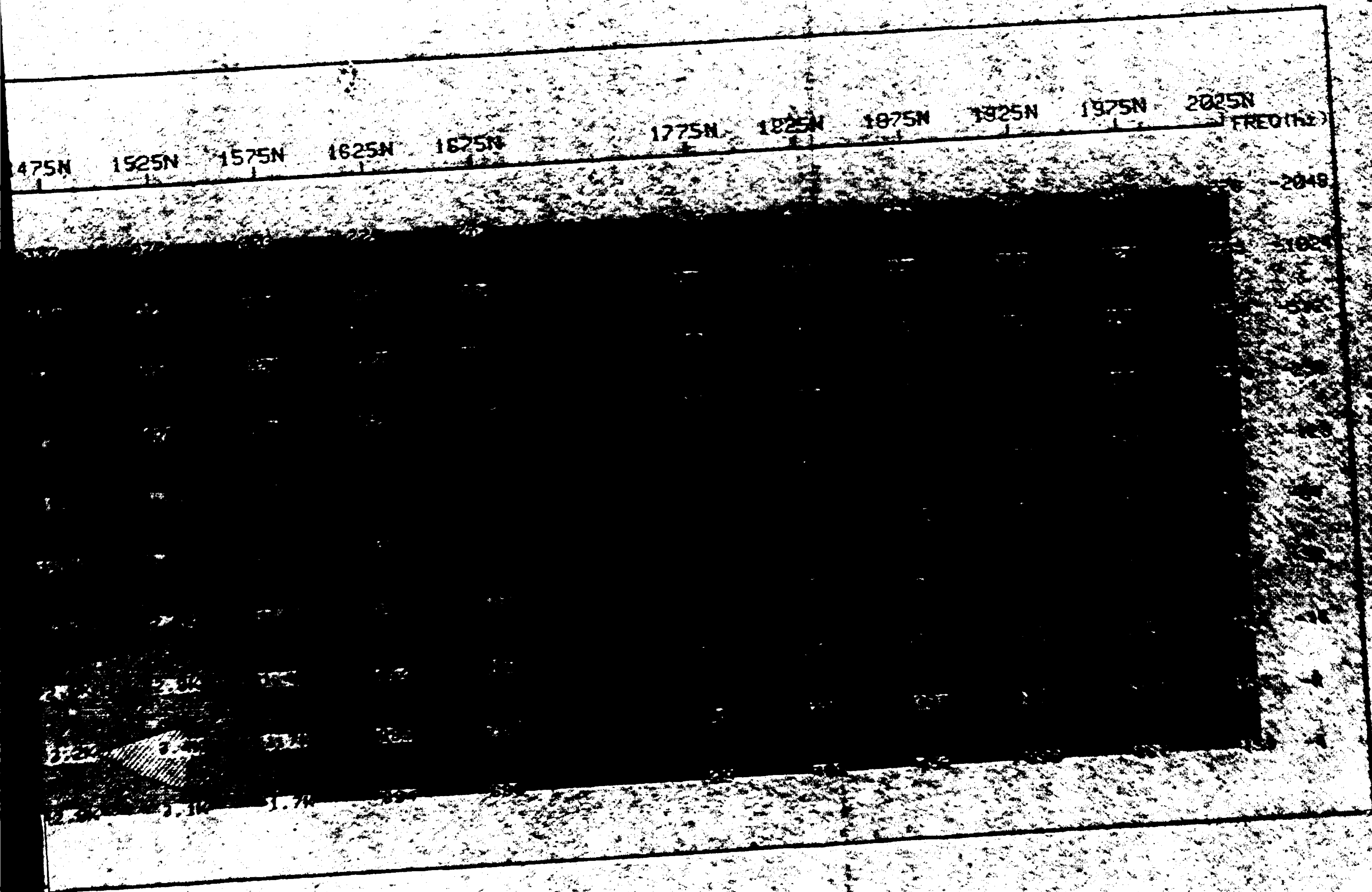
29N
75N
125N
175N
225N
275N
375N
425N
475N
525N
575N
625N
FREQ(hz)
13K
17K
21K
12K
12K
12K
29K
17K
7.3K
16K
12K
12K
28K
28K
5K
16K
7.7K
16K
13K
12K
28K
27K

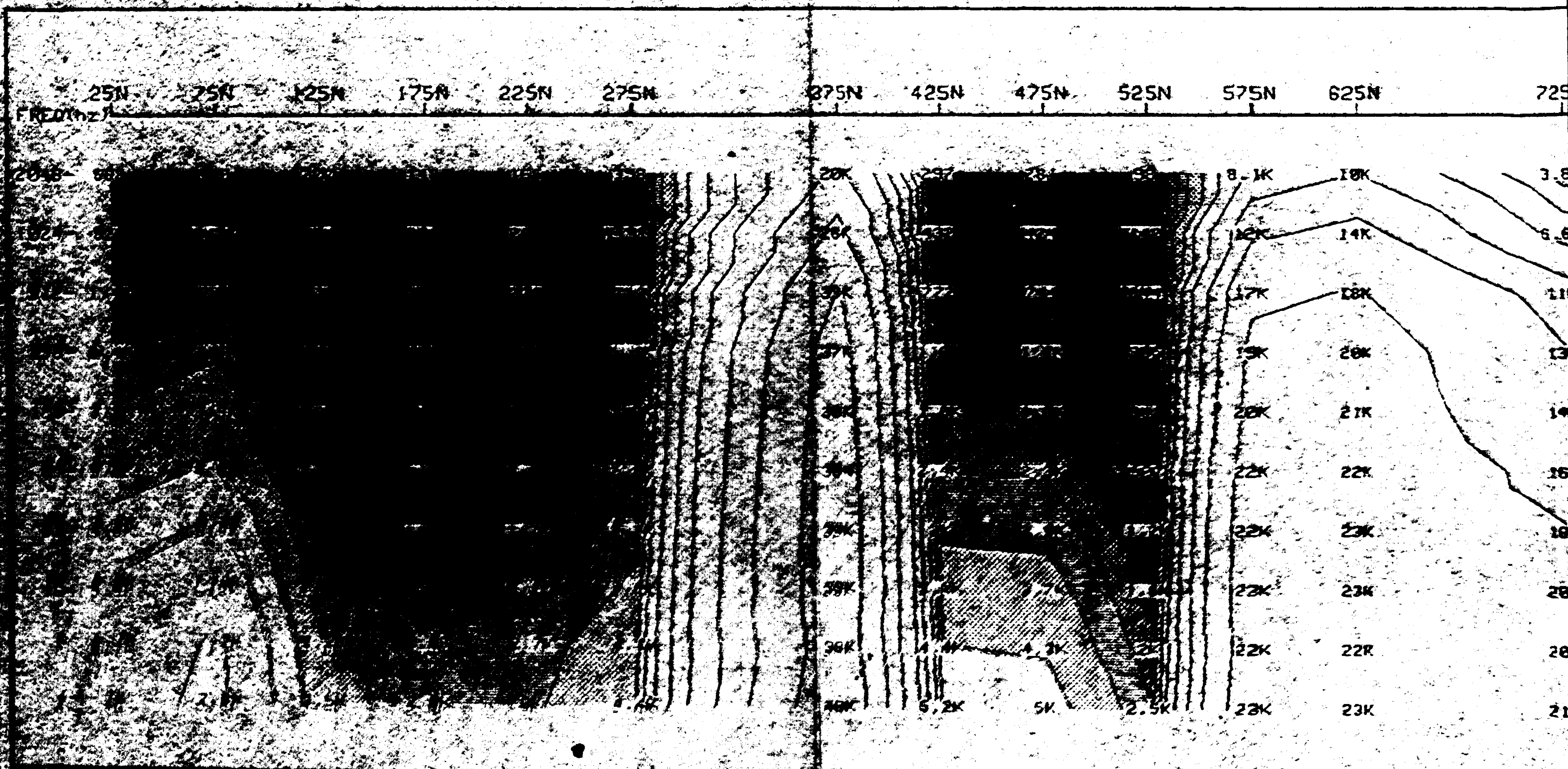
CSAMT APPARENT RESISTIVITY (CORRECTED)

LAC MINERALS LTD. C14 LINE=2375



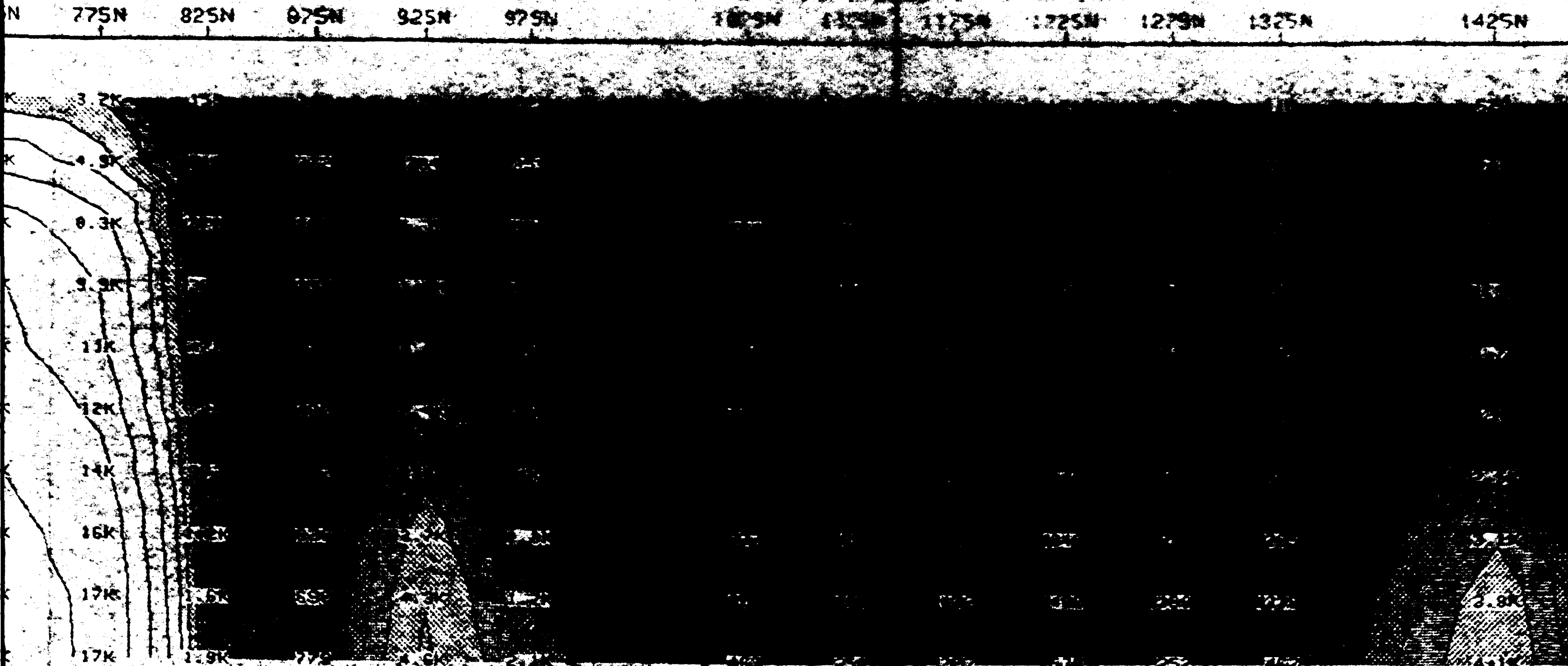
Resistivity in ohm-m
Surveyed by QUANTECH CONSULTING INC. NOV/1987


1525N
1575N
1625N
1675N
1775N
1825N
1875N
1925N
1975N
2025N
FREQ(Hz)
2048


FREQ(hz)
25N
75N
125N
175N
225N
275N
375N
425N
475N
525N
575N
625N
5K
2.5K
23K

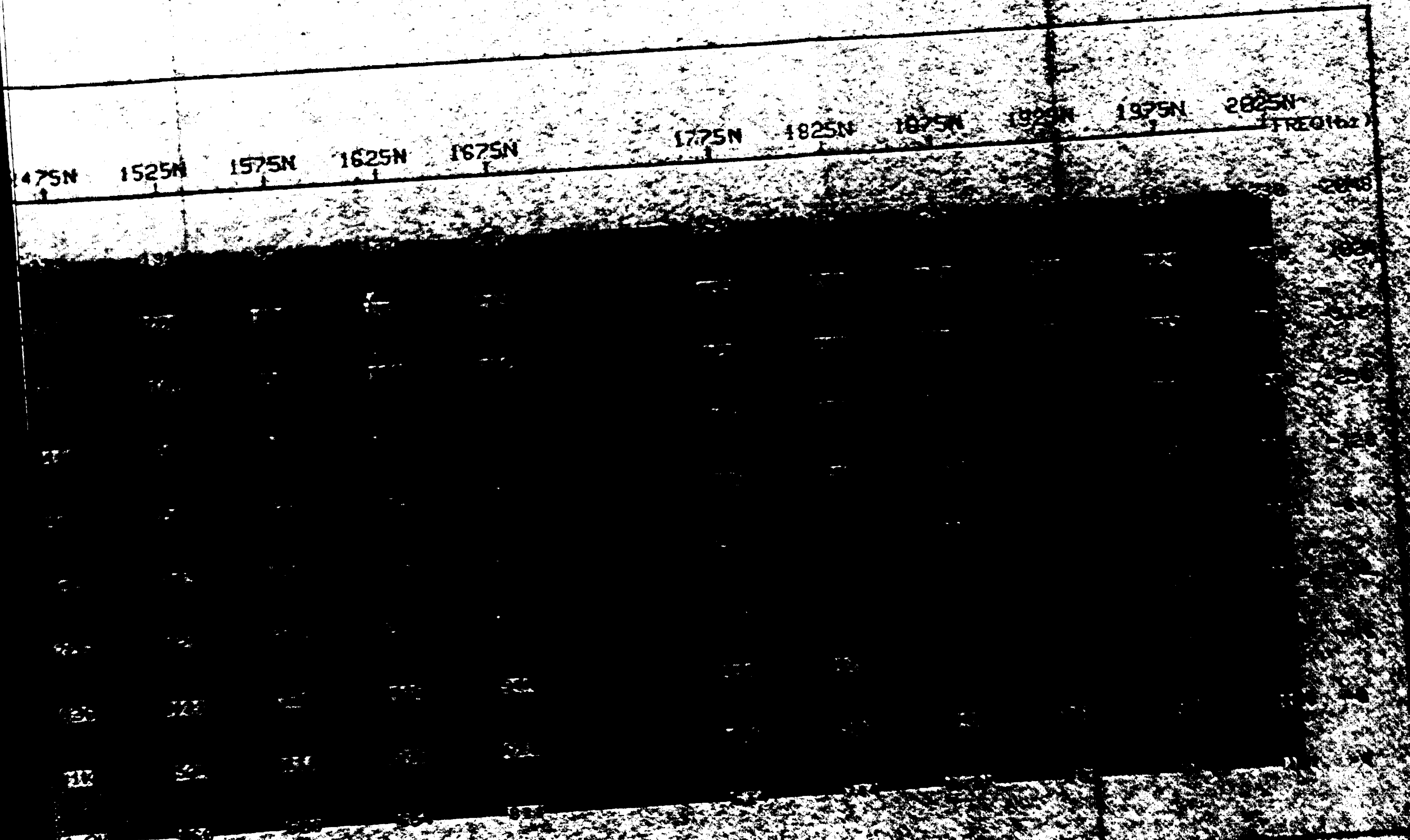
CSAMT APPARENT RESISTIVITY

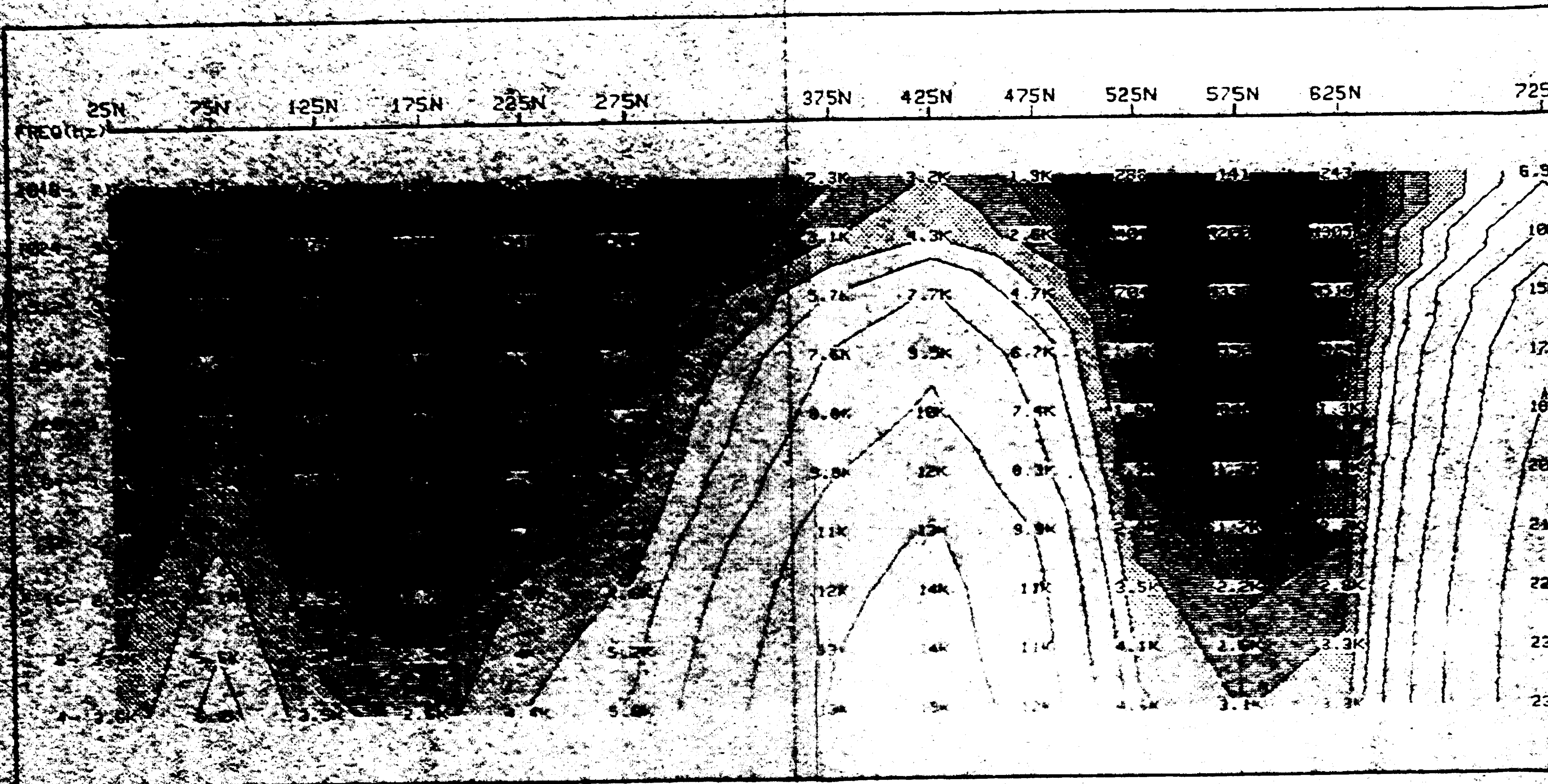
LAC MINERALS LTD. C14 LINE=2500E



Resistivity in ohm-m

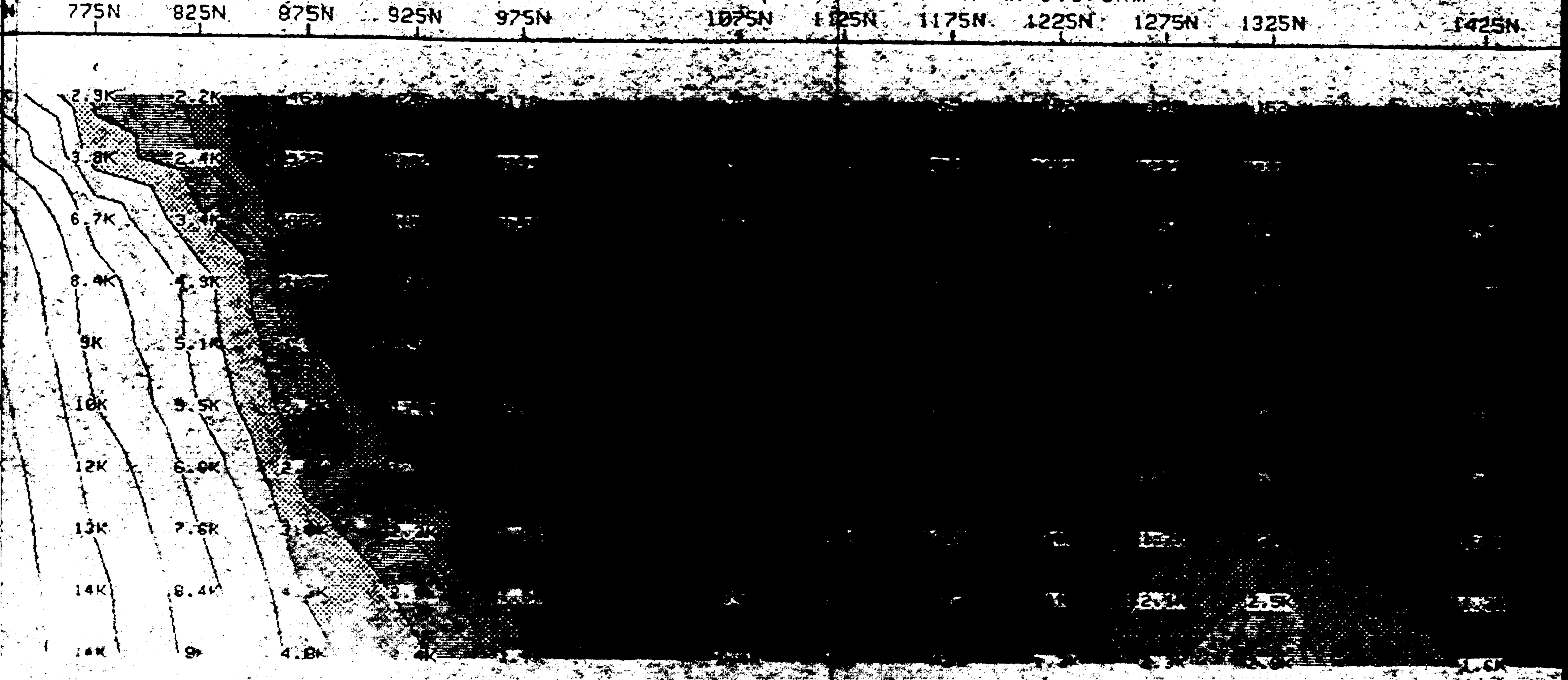
Surveyed by QUANTECH CONSULTING INC. NOV/1987


1525N
1575N
1625N
1675N
1775N
1825N
1975N
2025N
FREQ(hz)


25N
75N
125N
175N
225N
275N
375N
425N
475N
525N
575N
625N
FREQ(Hz)

CSAMT APPARENT RESISTIVITY (CORRECTED)

LAC MINERALS LTD. C14 LINE=2625E E-dipole=5000ft Tx-Rx=8.875km



Resistivity ...
Surveyed by QUANTECH ...

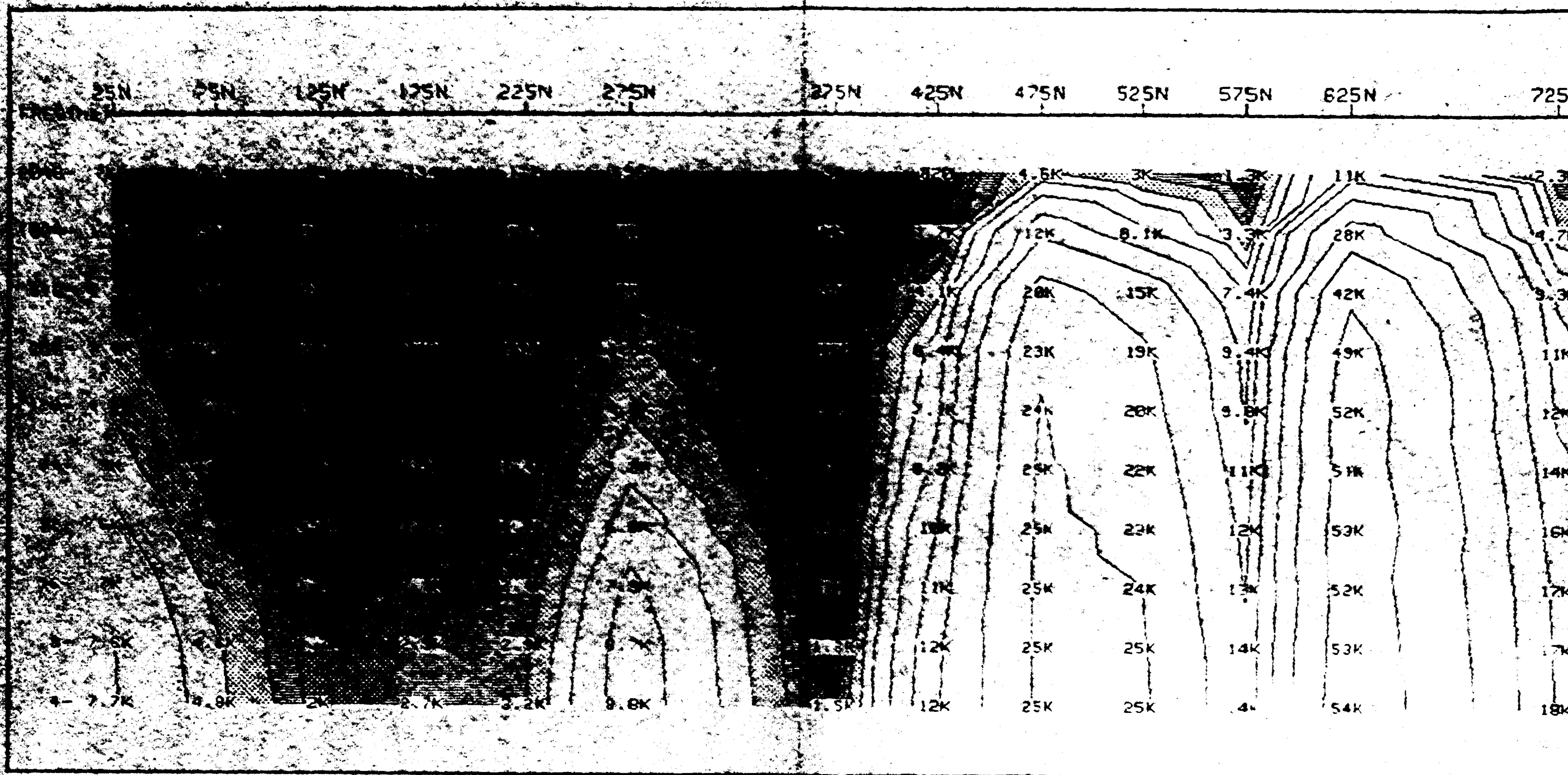
1475N	1525N	1575N	1625N	1675N	1775N	1825N	1875N	1925N	1975N	2025N	FREQ(hz)

[redacted]

2048

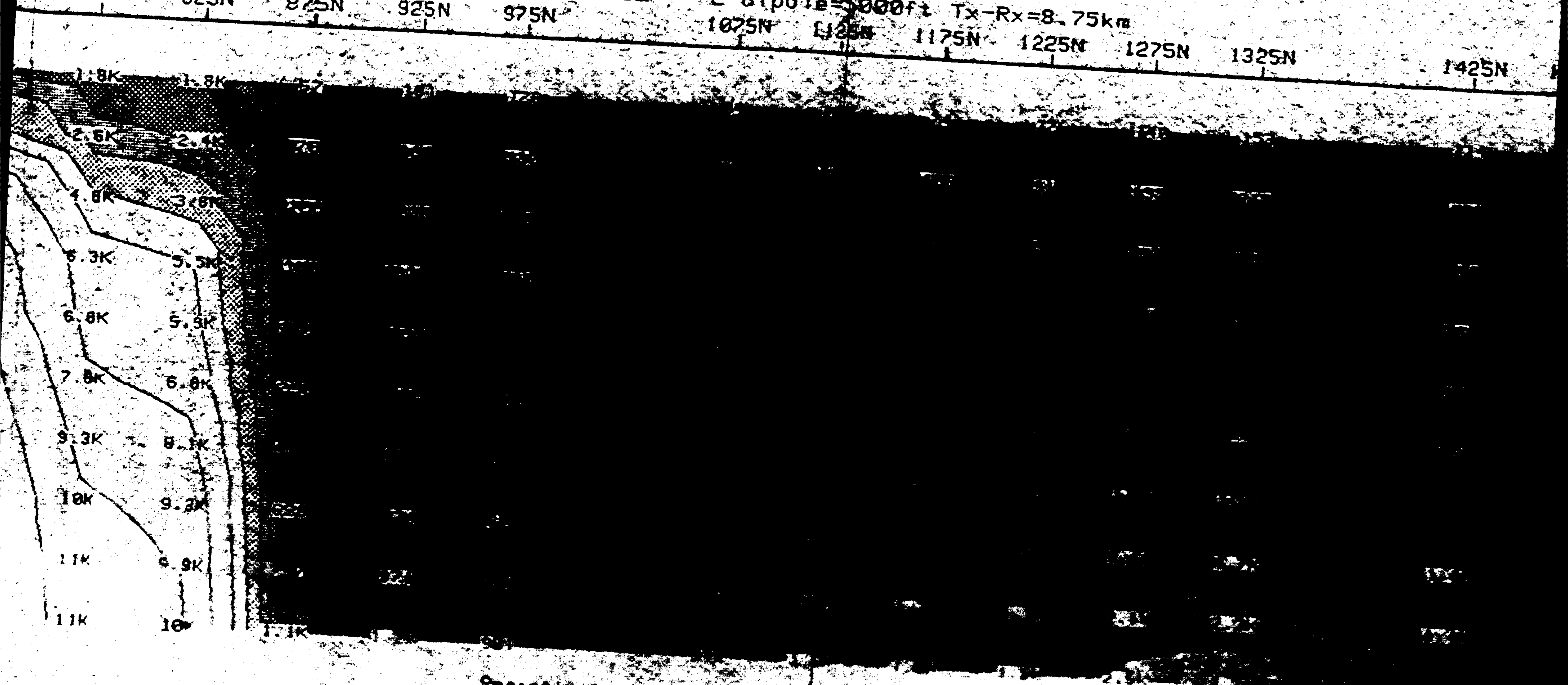
1024

512


25N
75N
125N
175N
225N
275N
375N
425N
475N
525N
575N
625N
725N
4.6K
3K
1.3K
11K
2.3K
12K
8.1K
3.3K
28K
4.7K
28K
15K
7.4K
42K
9.3K
23K
19K
9.4K
49K
11K
24K
28K
9.8K
52K
12K
25K
22K
11K
51K
14K
25K
23K
12K
53K
16K
11K
25K
24K
13K
52K
17K
12K
25K
25K
14K
53K
12K
25K
25K
54K
18K
7.7K
9.8K

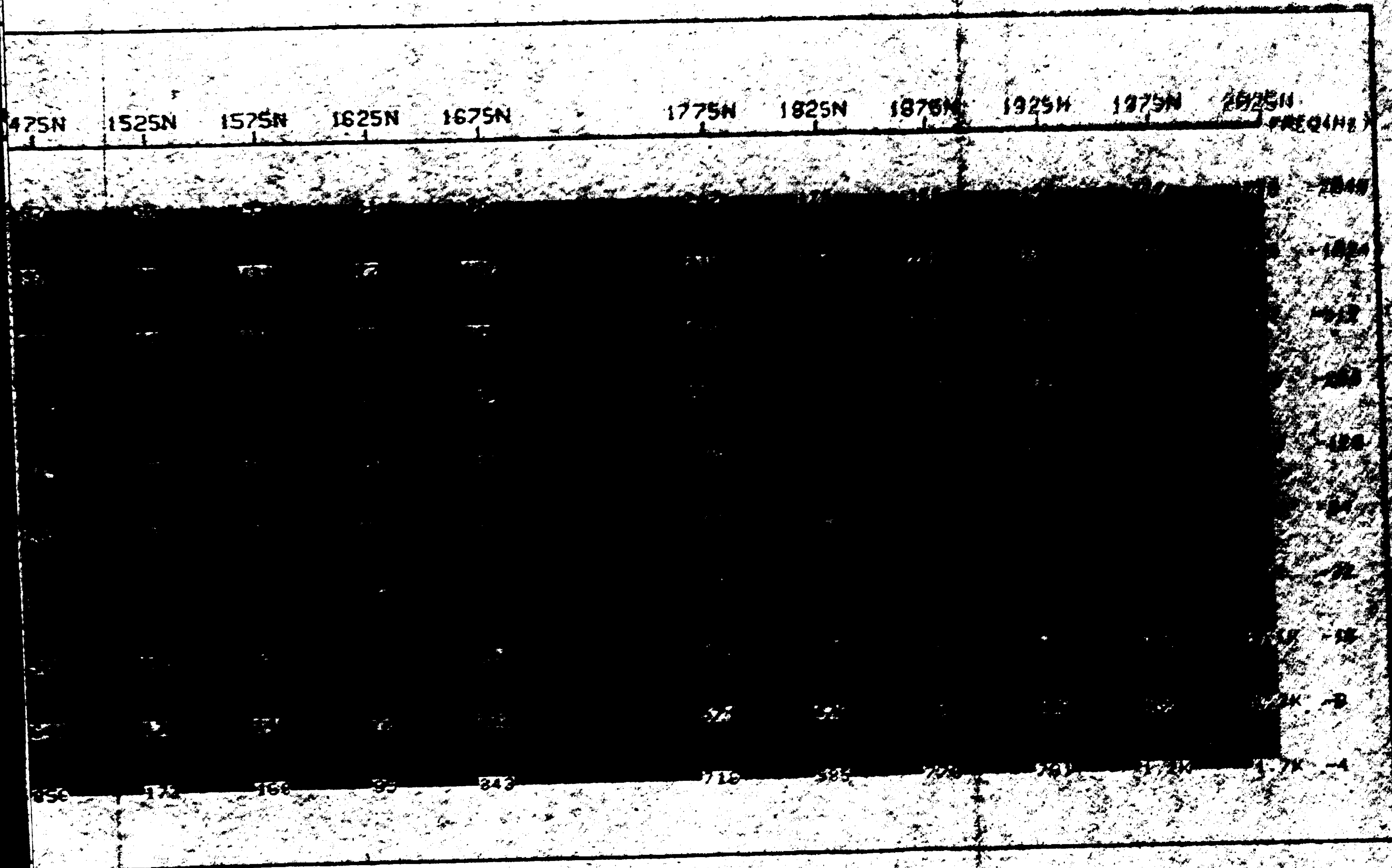
CSAMT APPARENT RESISTIVITY (CORRECTED)

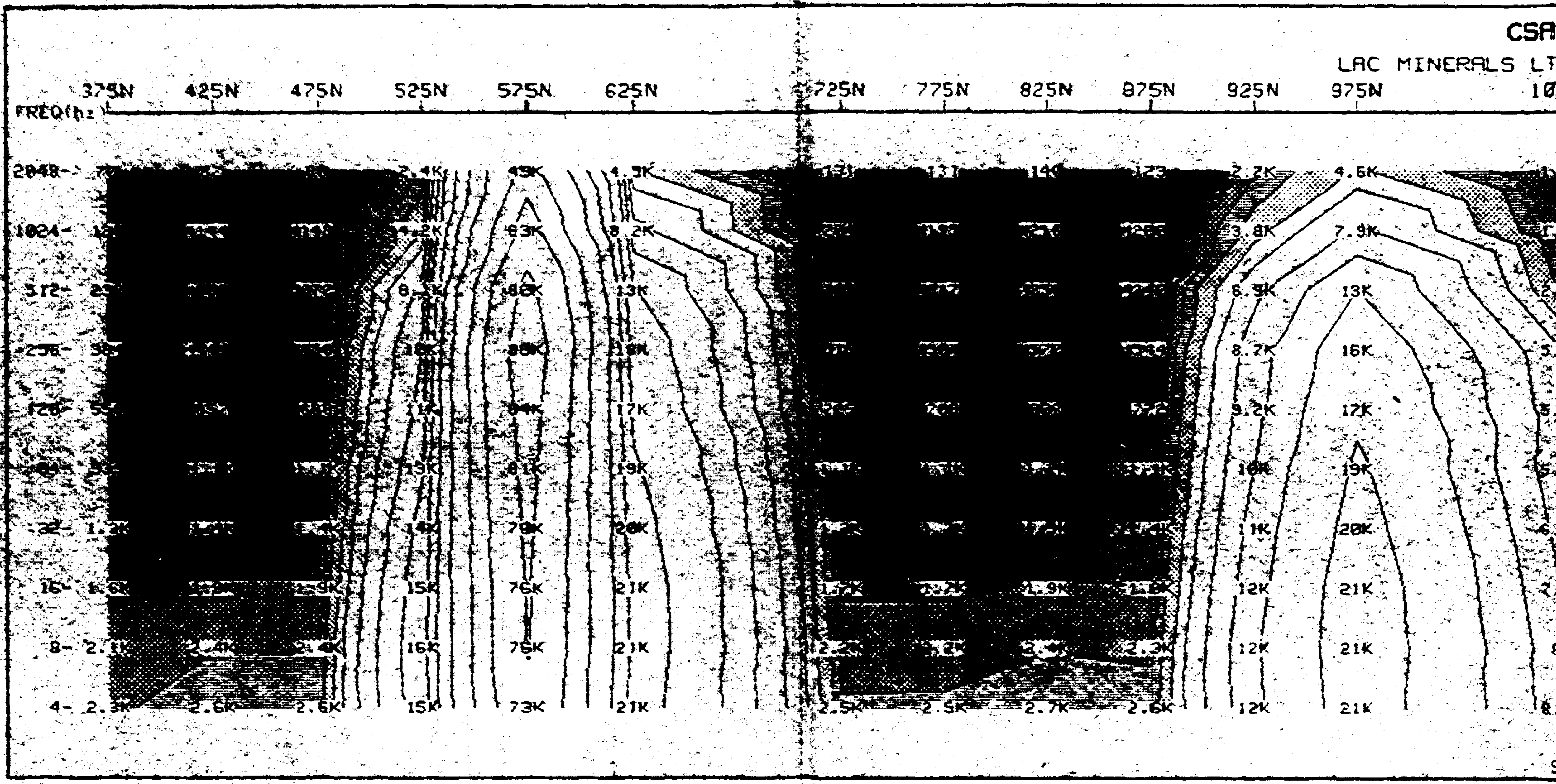
LAC MINERALS LTD. C14 LINE=2750E E-dipole=5000ft Tx-Rx=8.75km



Resistivity in ohm-m

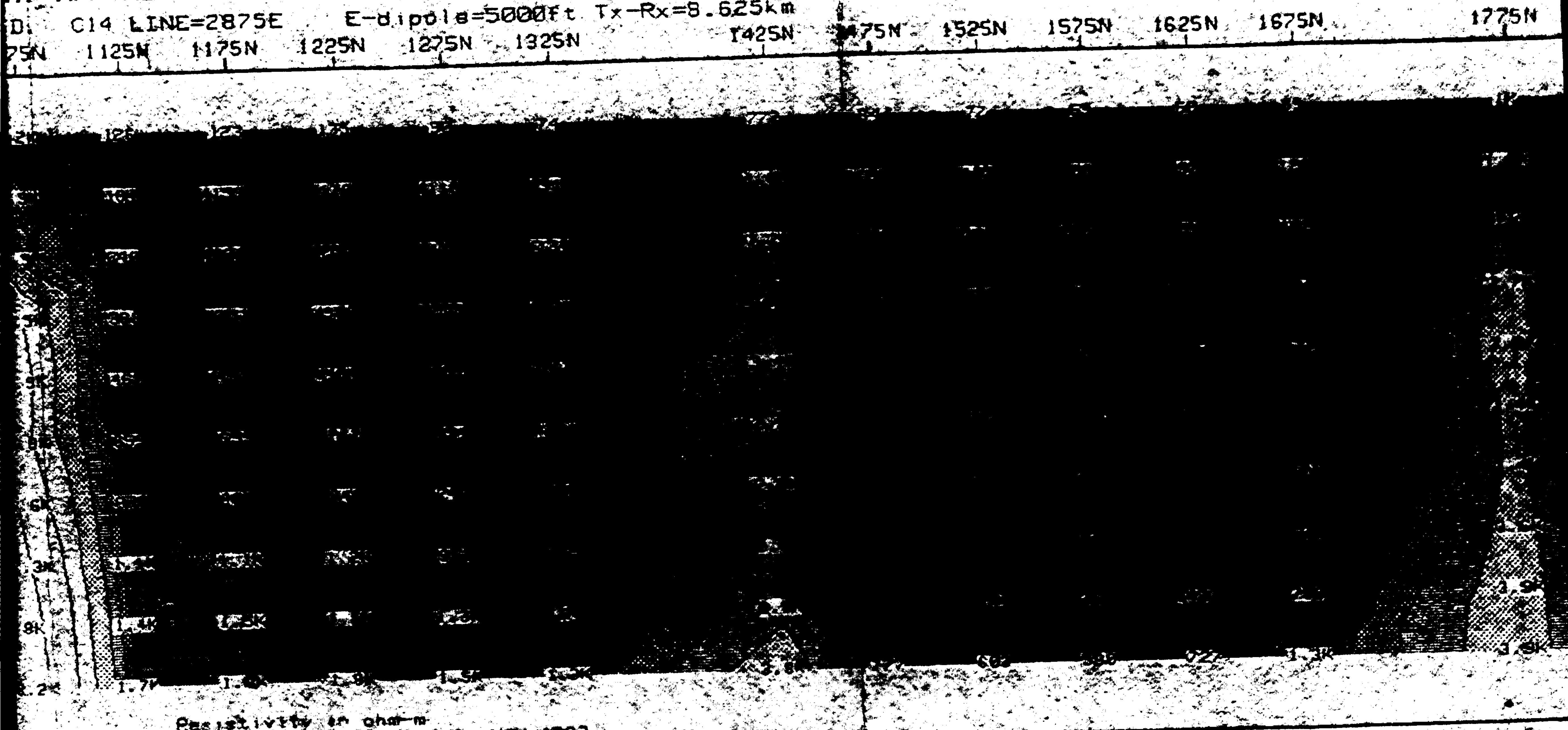
Surveyed by ZONTECH CONSULTING INC. NOV 1987.


1525N
1575N
1625N
1675N
1775N
1825N



CSA
LAC MINERALS LT
375N
425N
475N
525N
575N
625N
725N
775N
825N
875N
925N
975N
FREQ(hz)
2048
1024
512
256
128
64
32
16
8
4
2.4K
49K
4.3K
2.2K
4.6K
63K
8.2K
3.8K
7.9K
8.3K
80K
13K
6.9K
13K
16K
88K
19K
8.7K
16K
21K
84K
17K
9.2K
17K
15K
81K
19K
10K
19K
14K
79K
20K
11K
20K
1.2K
1.6K
2.9K
15K
76K
21K
1.7K
1.9K
1.6K
12K
21K
2.1K
2.4K
2.4K
16K
76K
21K
2.2K
3.4K
2.3K
12K
21K
2.3K
2.6K
2.6K
15K
73K
21K
2.5K
2.5K
2.7K
2.6K
12K
21K

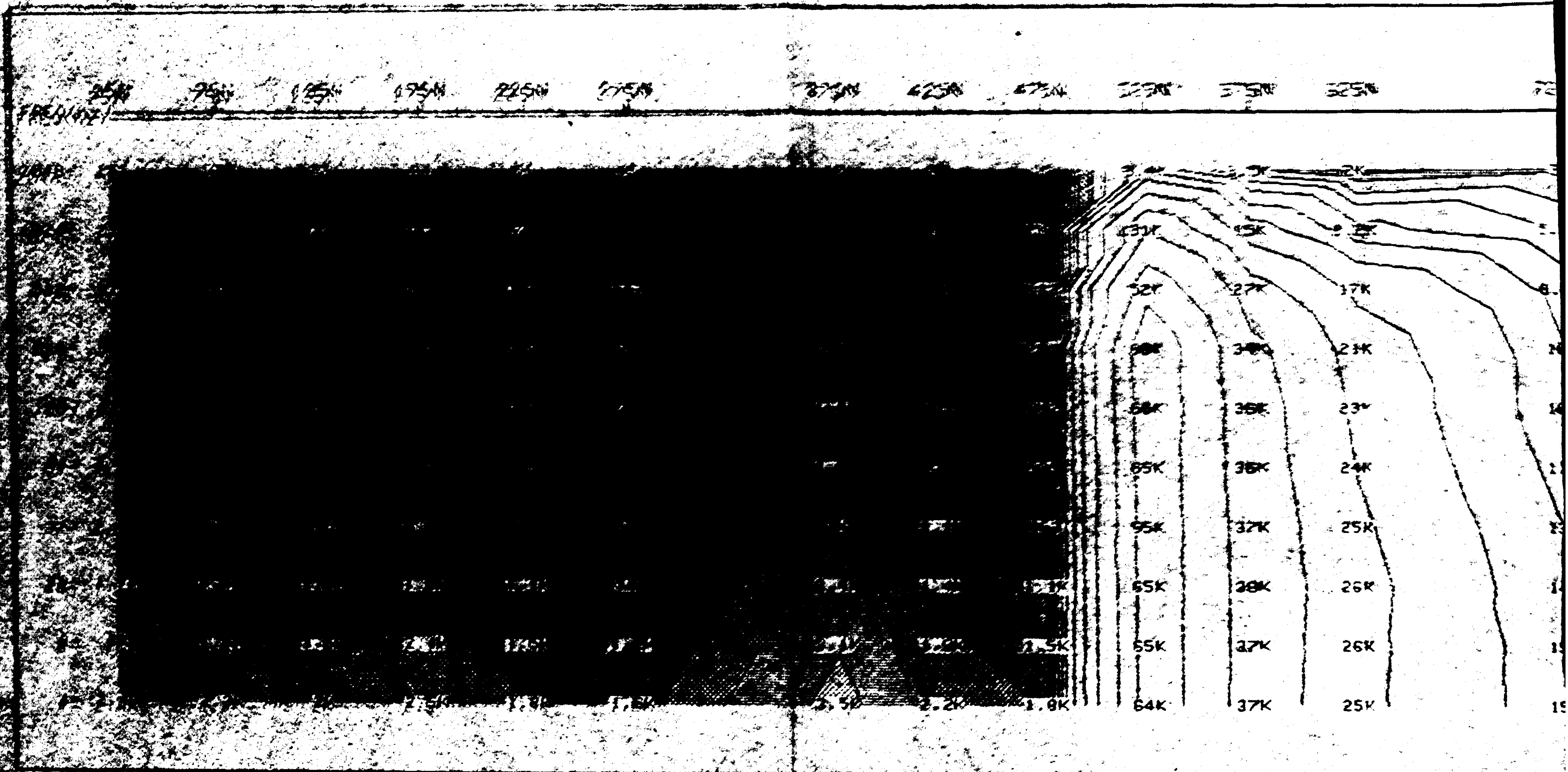
MT APPARENT RESISTIVITY (CORRECTED)



Surveyed by QUANTECH CONSULTING INC. NOV/1987

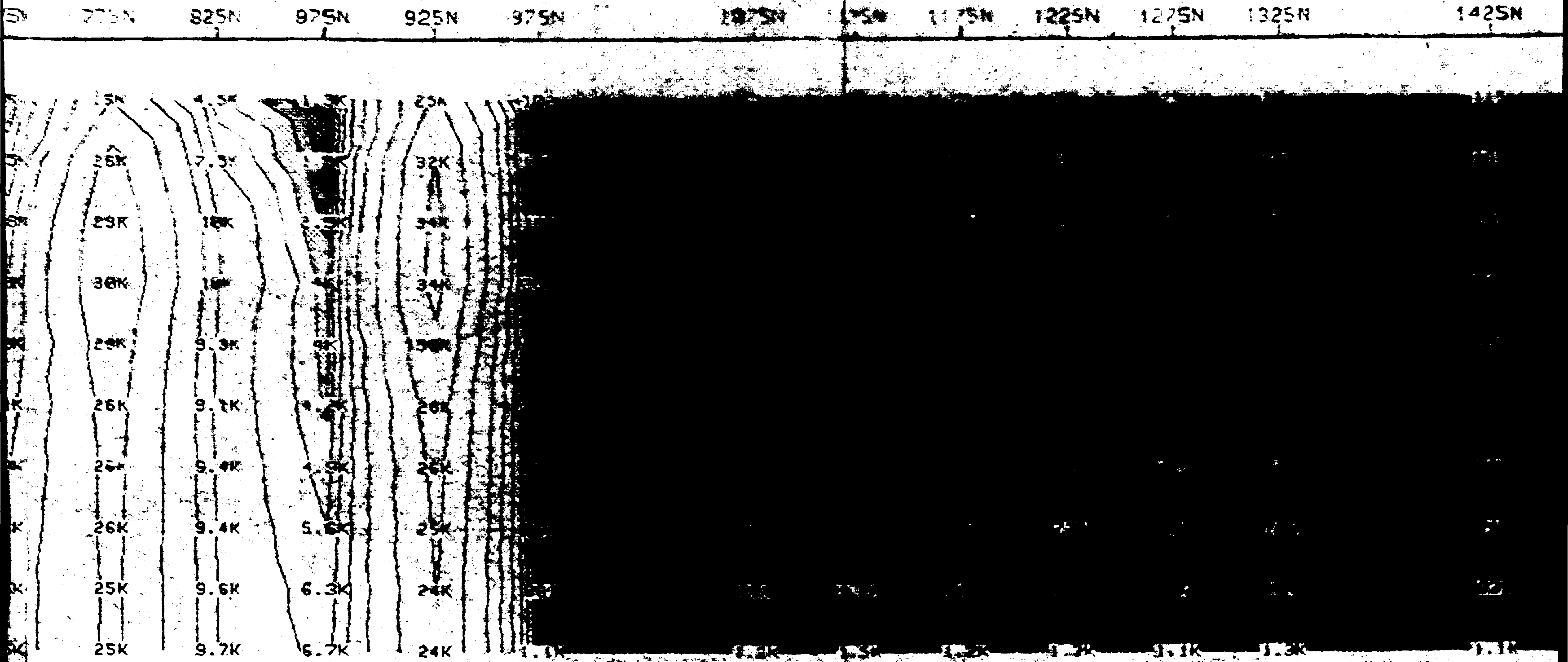
2825

1825N	1875N	1925N	1975N	2025N	FREQ(HZ)
[redacted]					-2048
					-1024
					[illegible]
					[illegible]
					[illegible]
					[illegible]
					-32
					[illegible]
					-8
					-4


FREQ(HZ)
[redacted]
45K
52K
27K
17K
65K
36K
24K
95K
37K
25K
55K
26K
55K
27K
26K
64K
37K
25K

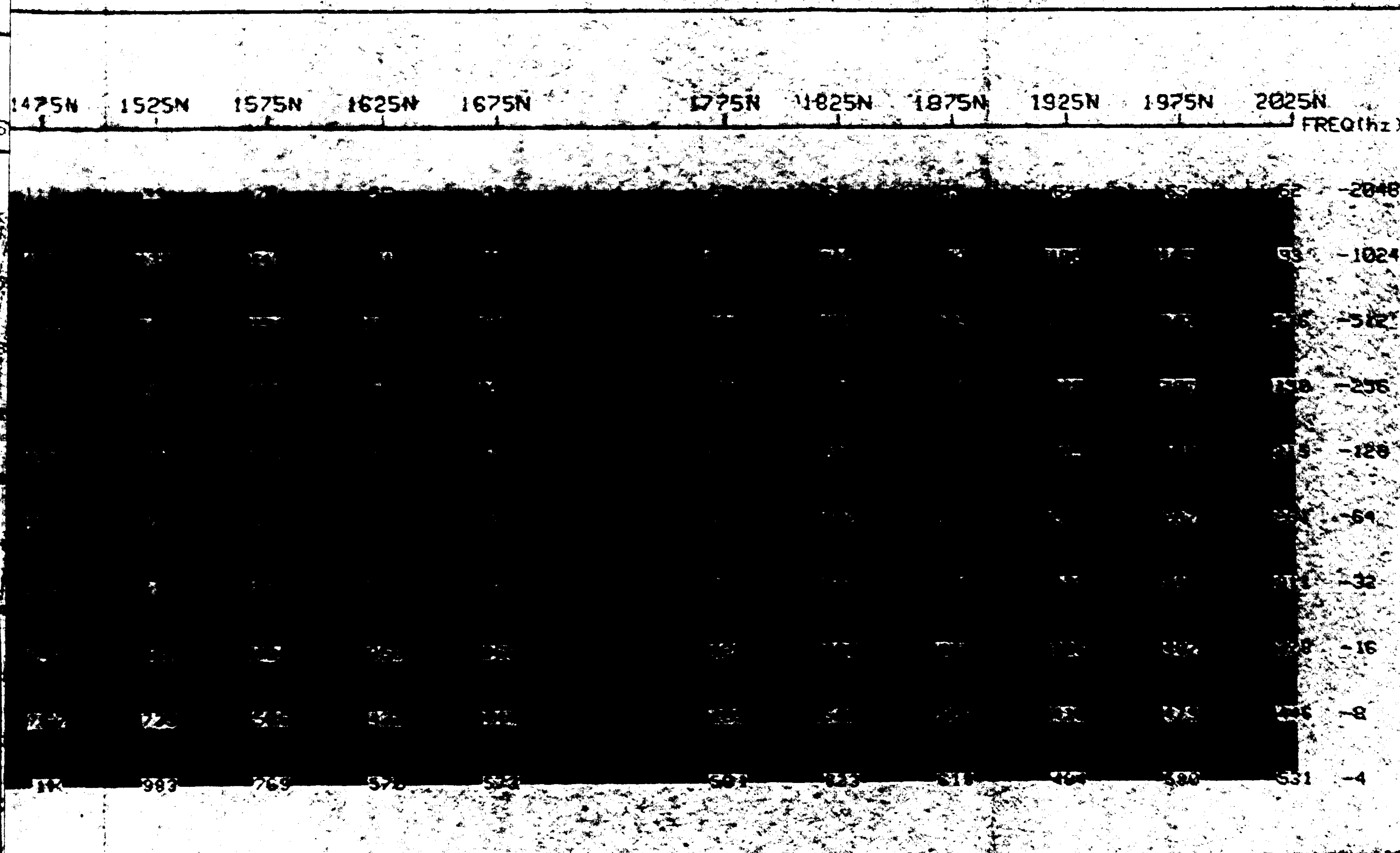
CSAMT APPARENT RESISTIVITY (CORRECTED)

LAC MINERALS LTD. C14 LINE=3000E

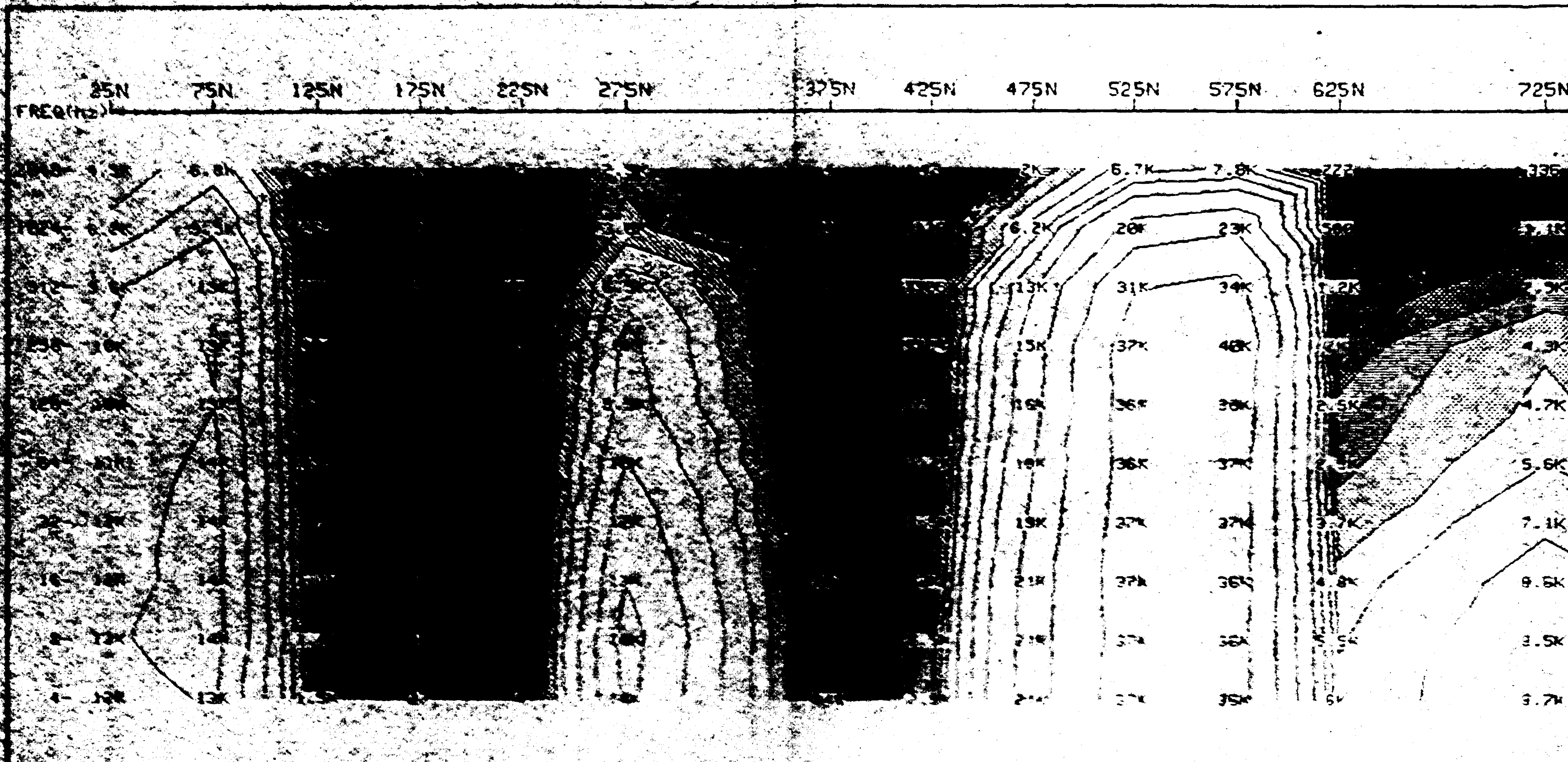


Resistivity in ohm-m

Surveyed by QUANTECH CONSULTING INC. NOV/1987

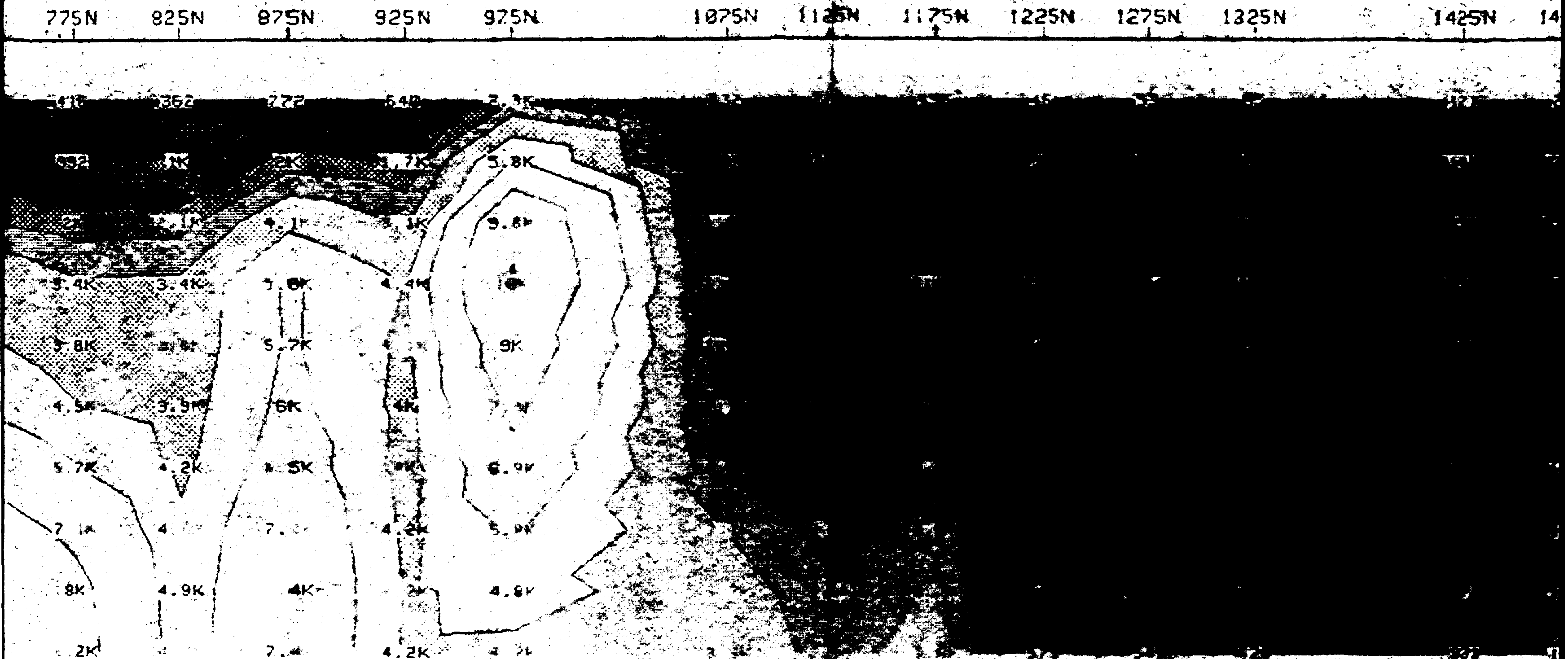


1475N
1525N
1575N
1625N
1675N
1775N
1825N
1875N
1925N
1975N
2025N
FREQ(hz)
-2048
-1024
-256
-16
-8
-4
983
531

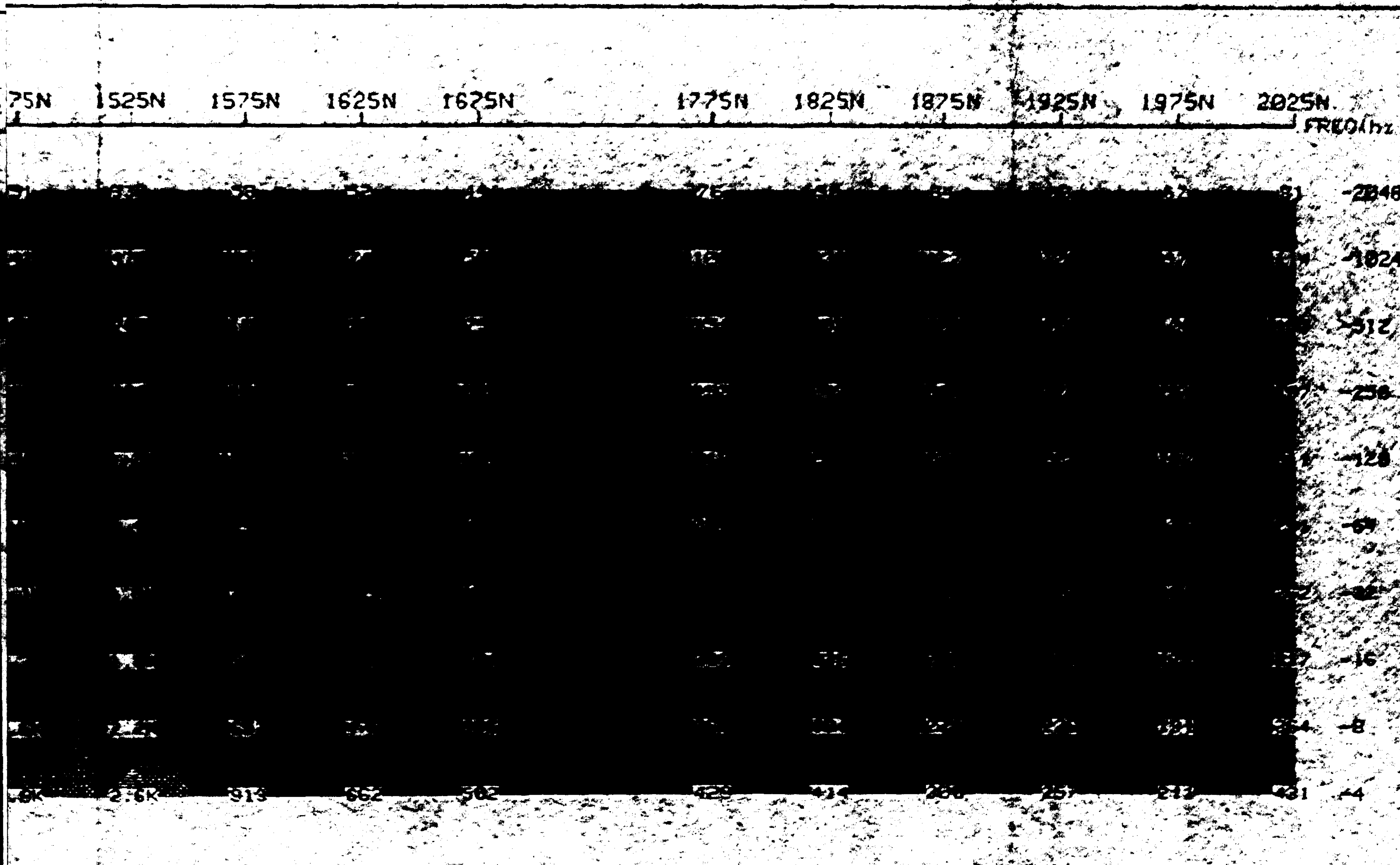

FREQ(Hz)
25N
75N
125N
175N
225N
275N
375N
425N
475N
525N
575N
625N
725N
6.7K
7.8K
6.2K
20K
23K
13K
31K
34K
15K
37K
40K
2.5K
4.7K
5.6K
3.7K
7.1K
4.8K
8.5K
3.5K
3.7K

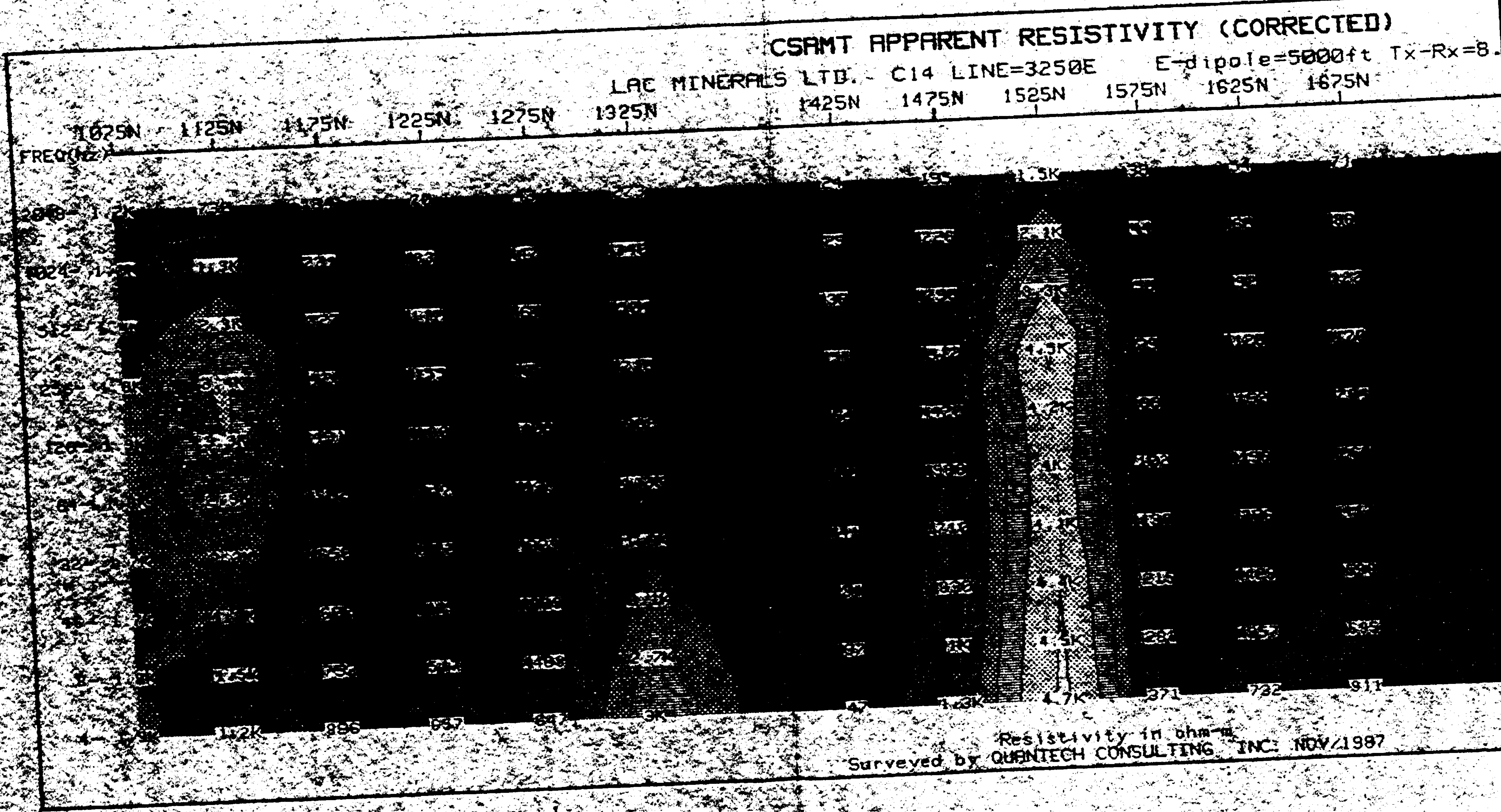
CSAMT APPARENT RESISTIVITY (CORRECTED)

LAC MINERALS LTD.   C14 LINE=3125E   E-dipole=5000ft Tx-Rx=8.375km



Resistivity in ohm-m
Surveyed by QUANTECH CONSULTING INC.

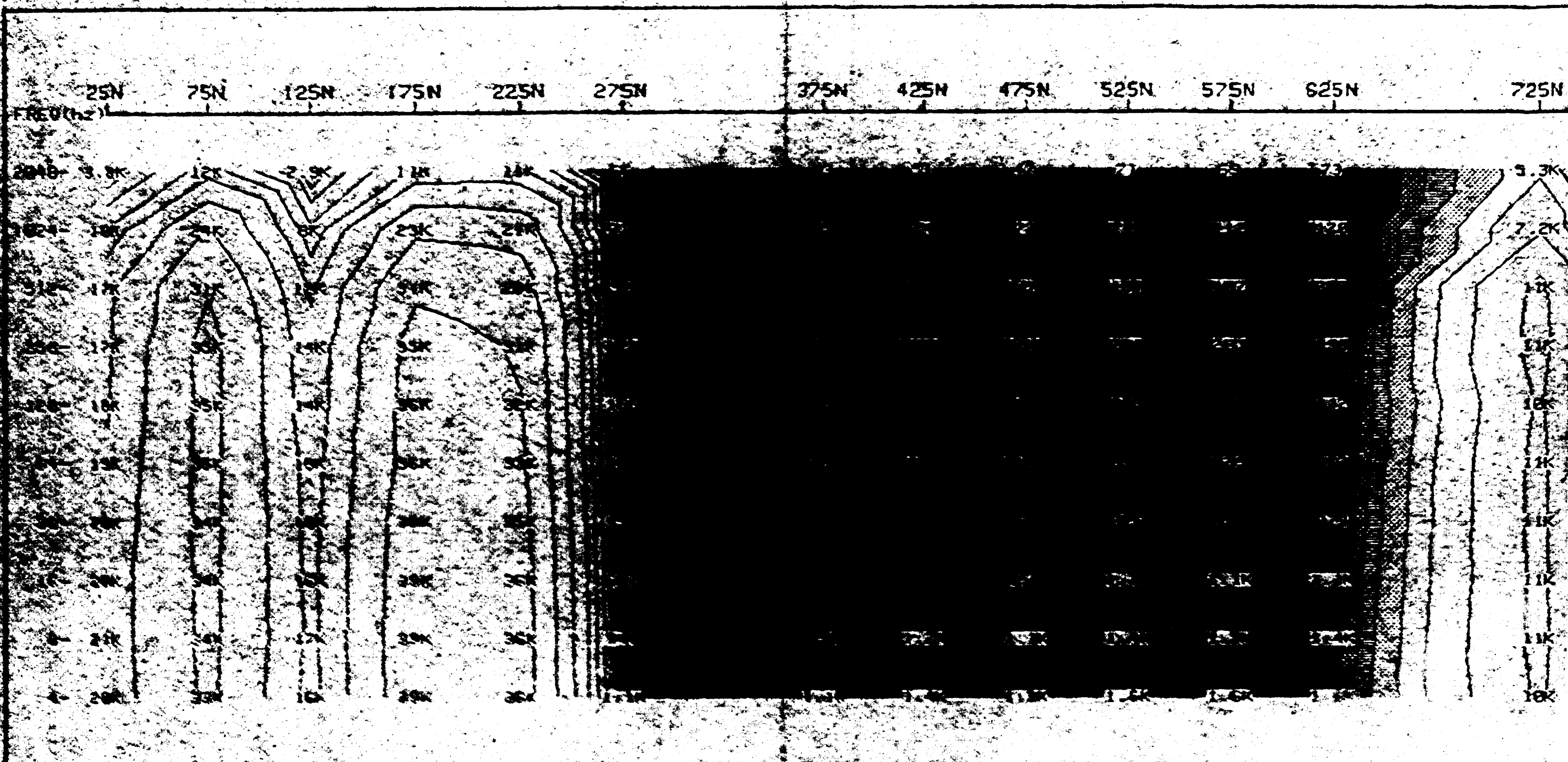

75N
1525N
1575N
1625N
1675N
1775N
1825N
1875N
1925N
1975N
2025N
FREQ(hz)
-2048
-1024
-512
-256
-128
-64
-32
-16
-8
-4
2.6K
913
662
502


CSAMT APPARENT RESISTIVITY (CORRECTED)
LAC MINERALS LTD. C14 LINE=3250E E-dipole=5000ft Tx-Rx=8.
1075N 1125N 1175N 1225N 1275N 1325N 1425N 1475N 1525N 1575N 1625N 1675N
FREQ(Hz)
Resistivity in ohm-m
Surveyed by QUANTECH CONSULTING INC. NOV/1987

3250

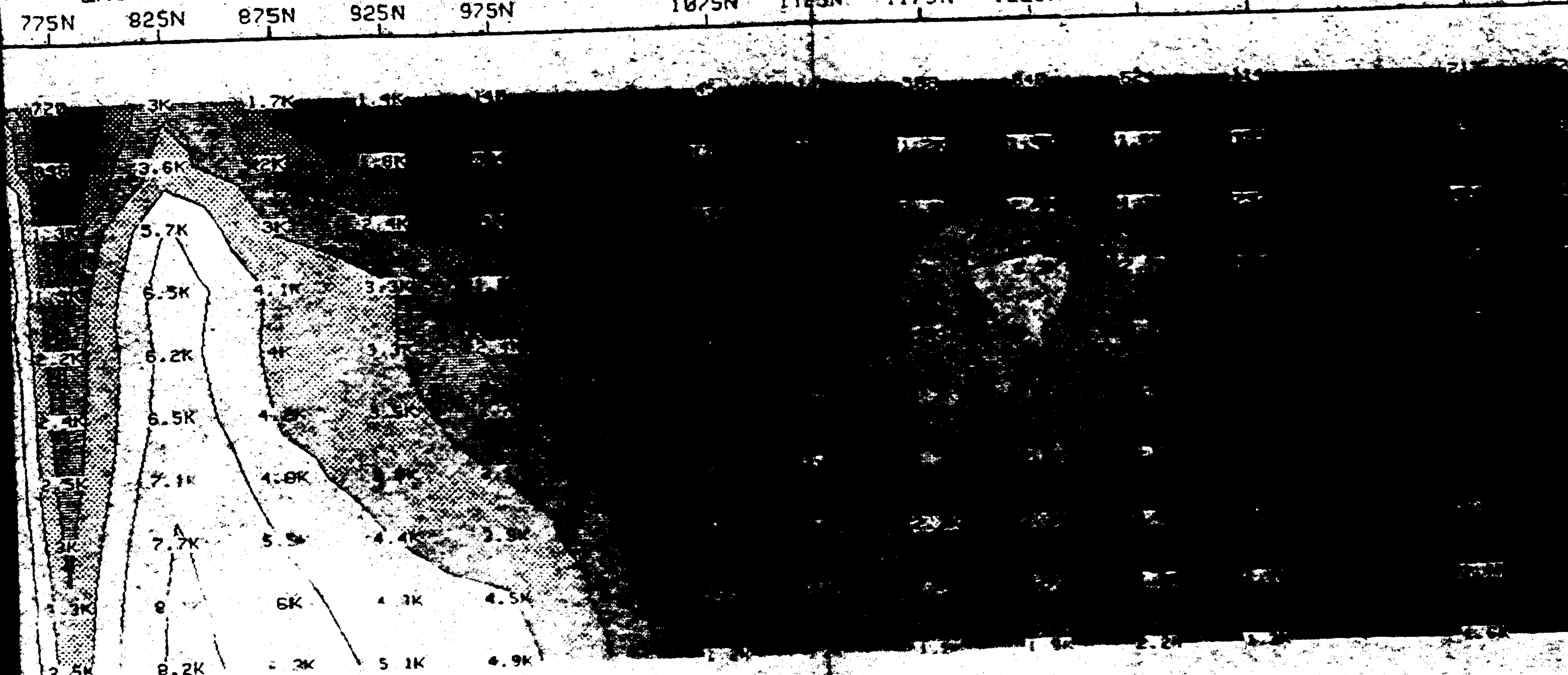
25km

FREQ(hz)	1775N	1825N	1875N	1925N	1975N	2025N
-2048	81	102	102	100	94	119
-1024	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	154
-512	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	240
-256	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	264
-128	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	265
-64	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
-32	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
-16	575?	[illegible]	273	145	125	198
-8	788	335	280	122	99	169
-4	981	816	334	183	78	161

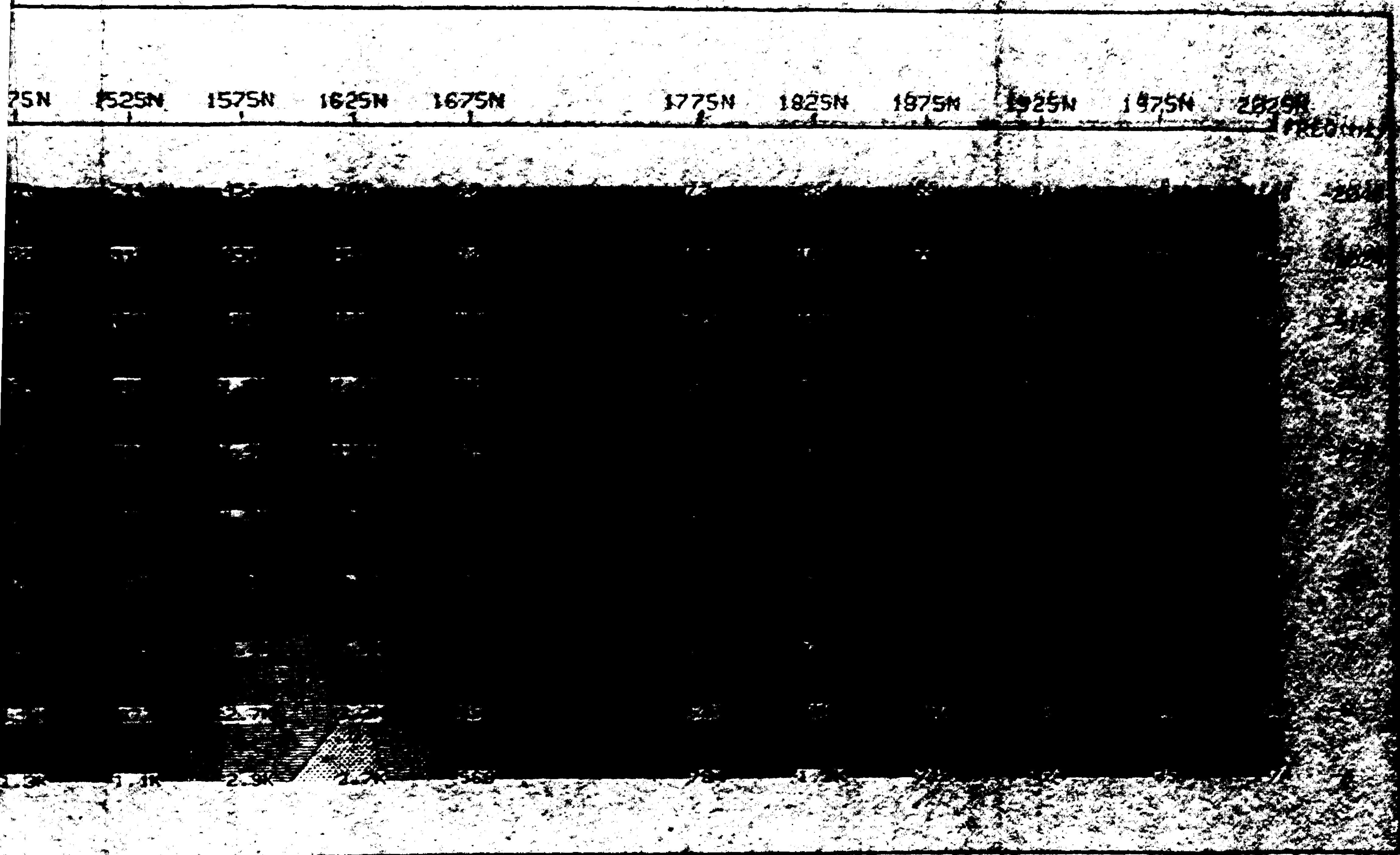

25N
75N
125N
175N
225N
275N
375N
425N
475N
525N
575N
625N
725N
FREQ(hz)

CSAMT APPARENT RESISTIVITY (CORRECTED)

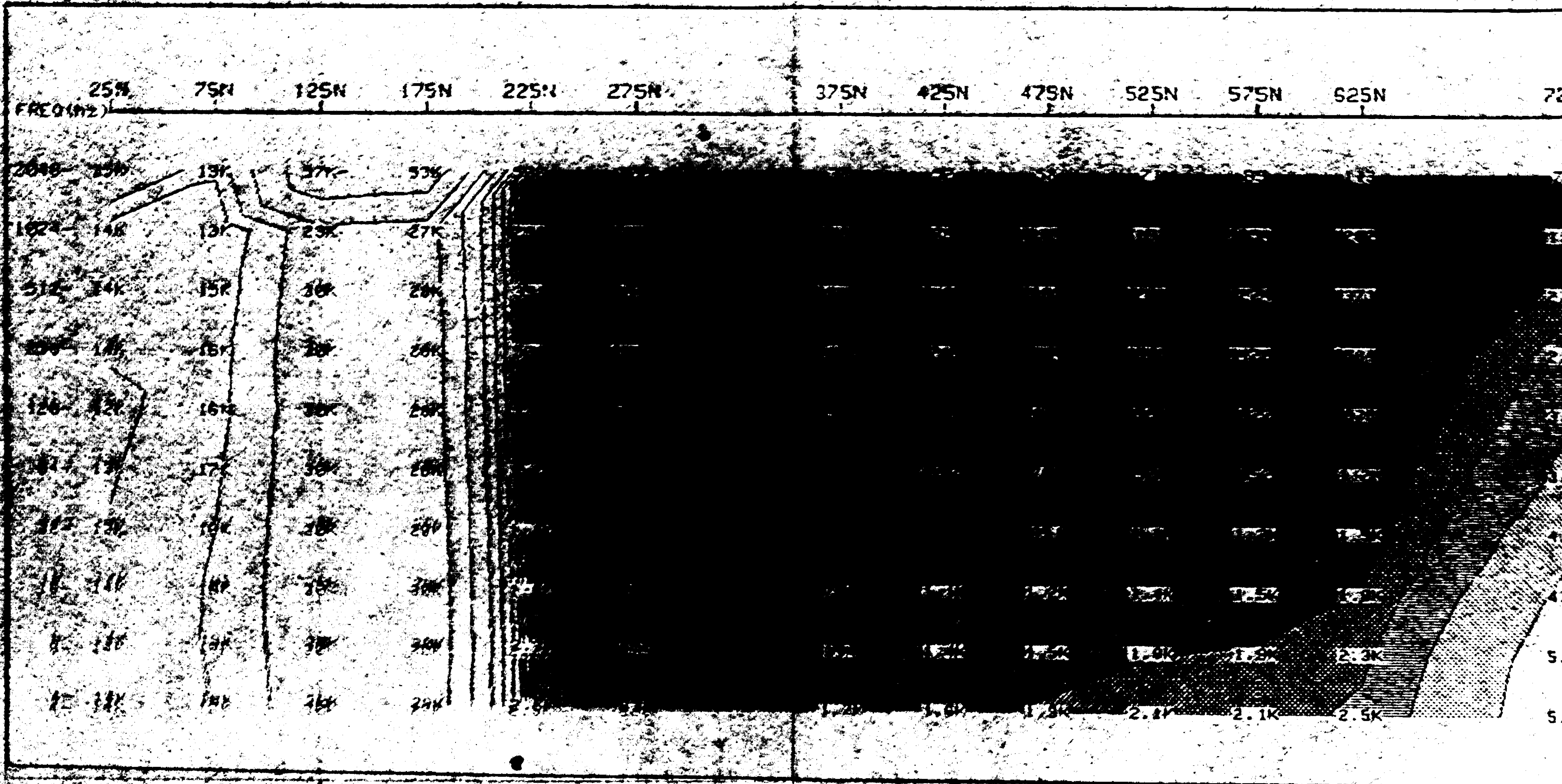
LAC MINERALS LTD. C14 LINE=3375E   E-dipole=?000ft Tx-Rx=8.125km



Resistivity in ohm-m
Surveyed by Q[illegible]NTECH CONSULTING INC.

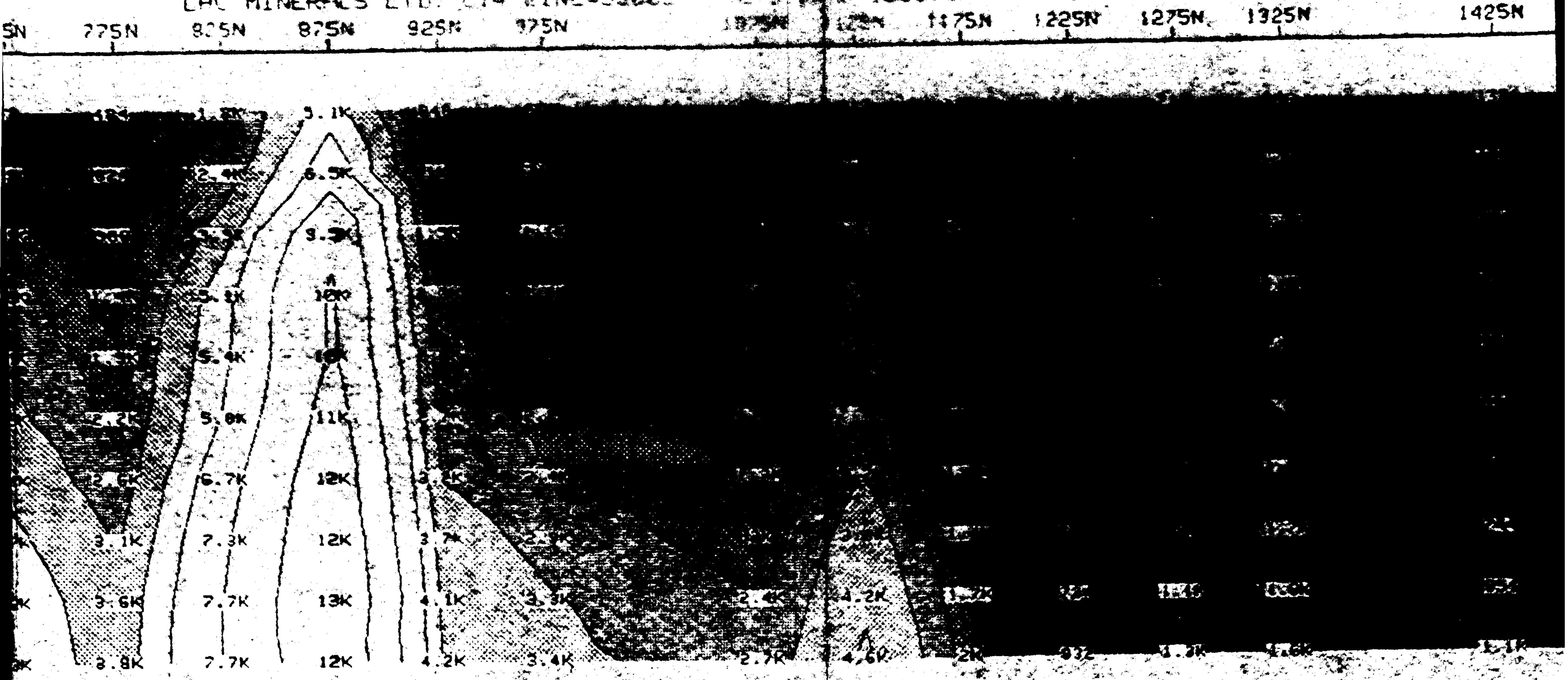


1575N
1625N
1675N
1775N
1825N
1875N

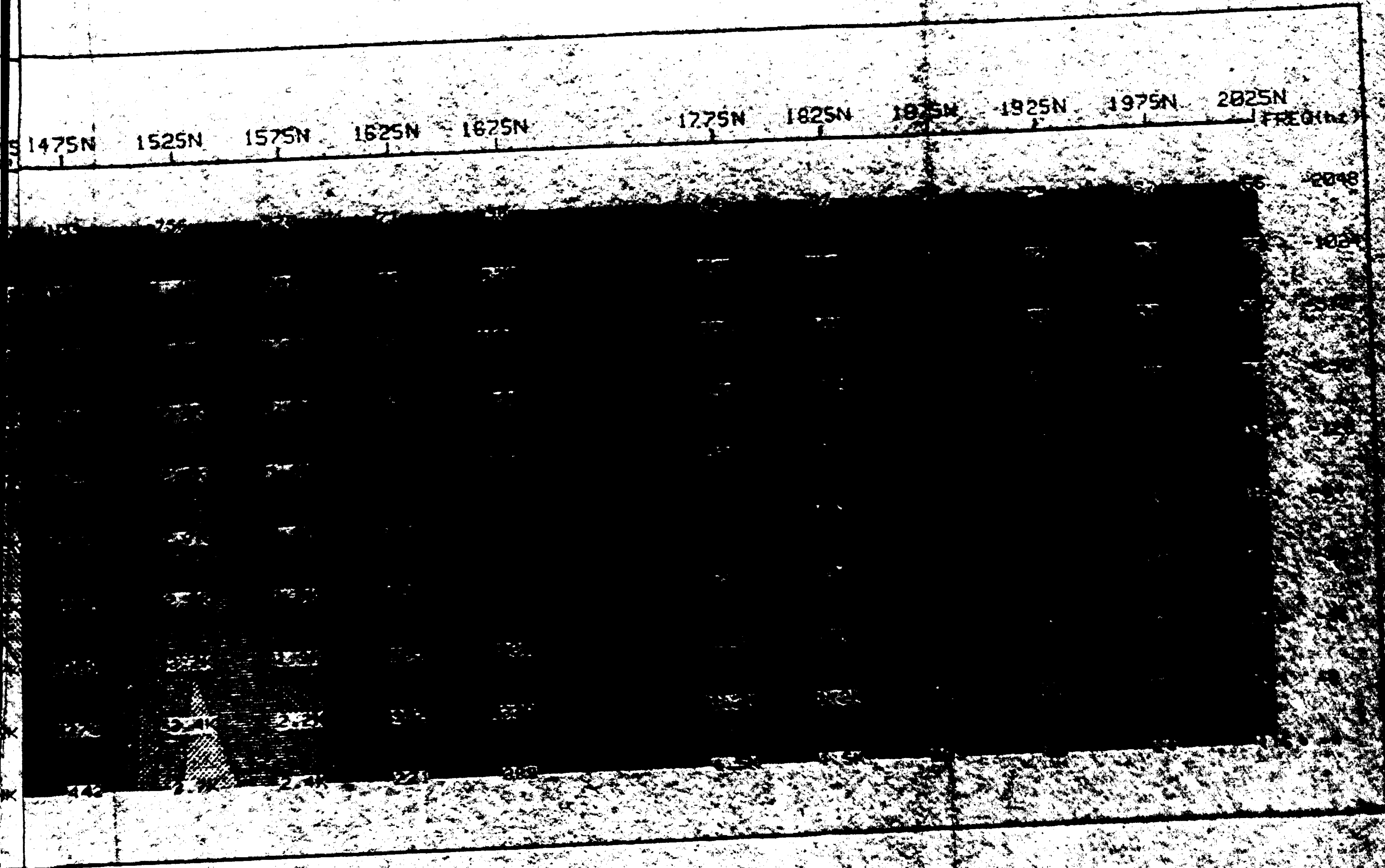

FREQ(HZ)
25N
75N
125N
175N
225N
275N
375N
425N
475N
525N
575N
625N
2048
1024
512
2.3K
2.5K
2.1K

CSAMT APPARENT RESISTIVITY (CORRECTED)

LAC MINERALS LTD. C14 LINE=3500E



Resistivity in ohm-m
Surveyed by QUANTECH CONSULTING INC. NOV/1987


1475N
1525N
1575N
1625N
1675N
1775N
1825N
1925N
1975N
2025N
FREQ(hz)
2048
1024

Ministry of Northern Development and Mines
Ontario

32D05SW0002 2.12955 CLIFFORD

900

Report of Work

Mining Act

(Geophysical, Geological and Geochemical Surveys)

Mining Lands Section, Mineral Development and Lands Branch:

Type of Survey(s)	Mining Division	Township or Area
CSAMT	Larder Lake	Clifford

Recorded Holder(s)	Prospector's Licence No.
LAC Minerals Ltd. 2.12955	T-664

Address	Telephone No.
6 Al Wende Ave., P.O. Box 670, KIRKLAND LAKE, Ont. P2N 3K1	(705)-567-5656

Survey Company: Quantech Consulting

Name and Address of Author (of Geo-Technical Report)	Date of Survey (from & to)
John Kovala, P.O. Box 334, KIRKLAND LAKE, Ontario P2N 3J1	01 (Day) 11 (Mo.) 87 (Yr.) – 30 (Day) 11 (Mo.) 87 (Yr.)

Credits Requested per Each Claim in Columns at right

Special Provisions	Geophysical	Days per Claim
For first survey: Enter 40 days. (This includes line cutting)	· Electromagnetic	20
	· Magnetometer	
For each additional survey: using the same grid:	· Other	
Enter 20 days (for each)	Geological	
	Geochemical	
Man Days	Geophysical	Days per Claim
Complete reverse side and enter total(s) here	· Electromagnetic	
	· Magnetometer	
	· Other	
	Geological	
	Geochemical	
Airborne Credits		Days per Claim
Note: Special provisions credits do not apply to Airborne Surveys.	Electromagnetic	
	Magnetometer	
	Other	

Total miles flown over claim(s).

Date	Recorded Holder or Agent (Signature)
Oct [illegible] 89	[signature]

Mining Claims Traversed (List in numerical sequence)

Mining Claim Prefix	Mining Claim Number	Mining Claim Prefix	Mining Claim Number	Mining Claim Prefix	Mining Claim Number
L	803325 ½	L	918236	L	1014640 ¼
	803326		918237 ½		1014648
	803327		918238		1014649
	803328		1014621		1014650
	803329		1014622 ½		1014651
	803330		1014623		1014652
	803331		1014624		1014653
	803333		1014625		1014654
	803334		1014626		1014655
	803335		1014627		
	803336 ½		1014635		
	803337		1014636 ¼		
	803338		1014637		
	803339		1014638 ¼		
	803340		1014639 ¼		
	803341				
	803342				

Total number of mining claims covered by this report of work: 41

Certification Verifying Report of Work

I hereby certify that I have a personal and intimate knowledge of the facts set forth in this Report of Work, having performed the work or witnessed same during and/or after its completion and annexed report is true.

Name and Address of Person Certifying: John Kovala, P.O. Box 334 KIRKLAND LAKE, Ontario P2N 3J1

Telephone No.	Date	Certified By (Signature)
(705)-567-5495	October 5, 1989	[signature]

For Office Use Only

Total Days Cr. Recorded	Date Recorded	Mining Recorder
	Date Approved as Recorded	Provincial Manager, Mining Lands

Received Stamp: LARDER LAKE MINING DIV. RECEIVED OCT 12 1989 AM PM 7,8,9,10,11,12,1,2,3,4,5,6 4:07 PM

1362 (89/06)

Ontario

Ministry of
Northern Development
and Mines

Ministère du
Développement du Nord
et des Mines

Mining Lands Section
880 Bay Street, 3rd Floor
Toronto, Ontario
M5S 1Z8

Telephone: (416) 965-4888

Your File: W8908-336
Our File: 2.12955

April 10, 1990

Mining Recorder
Ministry of Northern Development and Mines
4 Government Road East
Kirkland Lake, Ontario
P2N 1A2

Dear Sir:

Re: Notice of Intent dated February 23, 1990 for Geophysical (Electromagnetic) Survey submitted on Mining Claims: L 803326 et al in Clifford Township.

The assessment work credits, as listed with the above-mentioned Notice Intent have been approved as of the above date.

Please inform the recorded holder of these mining claims and so indicate on your records.

Yours sincerely,

W.R. Cowan
Provincial Manager, Mining Lands
Mines & Minerals Division

LS:pt
Enclosure

cc: Mr. G.H. Ferguson
Mining and Lands Commissioner
Toronto, Ontario

LAC Minerals Limited
Kirkland Lake, Ontario

John Kovala
Kirkland Lake, Ontario

Resident Geologist
Kirkland Lake, Ontario

Ministry of Northern Development and Mines

Ontario

Technical Assessment Work Credits

File
2.12955

Date	Mining Recorder's Report of Work No.
Feb 23/90	W8908.336

Recorded Holder: Lac Minerals Limited

Township or Area: Clifford

Type of survey and number of Assessment days credit per claim	Mining Claims Assessed
Geophysical	L 803326 to 331 incl.
Electromagnetic 20 days	803333 to 335 incl.
Magnetometer ____ days	803337 to 342 incl.
Radiometric ____ days	918236
Induced polarization ____ days	918238
Other ____ days	1014621
Section 77 (19) See "Mining Claims Assessed" column	1014623 to 627 incl.
Geological ____ days	1014635 to 637 incl
Geochemical ____ days	1014639
Man days ☐ Airborne ☐	1014648 to 655 incl.
Special provision ☒ Ground ☒	
☐ Credits have been reduced because of partial coverage of claims.	
☐ Credits have been reduced because of corrections to work dates and figures of applicant.	

Special credits under section 77 (16) for the following mining claims

15 days Elctromagnetics L 1014638, 1014640

10 days Electromagnetics L 803325, 803336, 918237, 1014622

No credits have been allowed for the following mining claims

☐ not sufficiently covered by the survey ☐ insufficient technical data filed

Note: Credits were reduced because L 2250 E was not Surveyed and L3250 E was not surveyed from BLO to 1075N.

The Mining Recorder may reduce the above credits if necessary in order that the total number of approved assessment days recorded on each claim does not exceed the maximum allowed as follows: Geophysical - 80; Geologocal - 40; Geochemical - 40; Section 77(19) - 60.

828 (85/12)

Ministry of Northern Development and Mines
Ontario

DOCUMENT No. W8908•336

2.12955

Mining Act

Report of Work
(Geophysical, Geological and Geochemical Surveys)

Instructions
- Please type or print.
- Refer to Section 77, the Mining Act for assessment work requirements and maximum credits allowed per survey type.
- If number of mining claims traversed exceeds space on this form, attach a list.
- Technical Reports and maps in duplicate should be submitted to Mining Lands Section, Mineral Development and Lands Branch.

Type of Survey(s)	Mining Division	Township or Area
CSAMT	Larder Lake	Clifford

Recorded Holder(s)	Prospector's Licence No.
LAC Minerals Ltd.	T-664

Address	Telephone No.
6 Al Wende Ave., P.O. Box 670, KIRKLAND LAKE, Ont. P2N 3K1	(705)-567-5656

Survey Company: Quantech Consulting

Name and Address of Author (of Geo-Technical Report)	Date of Survey (from & to)
John Kovala, P.O. Box 334, KIRKLAND LAKE, Ontario P2N 3J1	01 11 87 (Day Mo. Yr.) – 30 11 87 (Day Mo. Yr.)

Credits Requested per Each Claim in Columns at right

Special Provisions		Days per Claim
For first survey: Enter 40 days. (This includes line cutting)	Geophysical	
	- Electromagnetic	20
For each additional survey: using the same grid:	- Magnetometer	
	- Other	
Enter 20 days (for each)	Geological	
	Geochemical	
Man Days	Geophysical	Days per Claim
Complete reverse side and enter total(s) here	- Electromagnetic	
	- Magnetometer	
	- Other	
	Geological	
	Geochemical	
Airborne Credits		Days per Claim
Note: Special provisions credits do not apply to Airborne Surveys.	Electromagnetic	
	Magnetometer	
	Other	

Total miles flown over claim(s).

Date	Recorded Holder or Agent (Signature)
Oct 5 89	[signature]

Mining Claims Traversed (List in numerical sequence)

Mining Claim Prefix	Number	Mining Claim Prefix	Number	Mining Claim Prefix	Number
L	803325	L	918236	L	1014640
	803326		918237		1014648
	803327		918238		1014649
	803328		1014621		1014650
	803329		1014622		1014651
	803330		1014623		1014652
	803331		1014624		1014653
	803333		1014625		1014654
	803334		1014626		1014655
	803335		1014627		
	803336		1014635		
	803337		1014636		
	803338		1014637		
	803339		1014638		
	803340		1014639		
	803341				
	803342				

RECEIVED
NOV 06 1989
MINING LANDS SECTION

Total number of mining claims covered by this report of work. **41**

Certification Verifying Report of Work

I hereby certify that I have a personal and intimate knowledge of the facts set forth in this Report of Work, having performed the work or witnessed same during and/or after its completion and annexed report is true.

Name and Address of Person Certifying
John Kovala, P.O. Box 334 KIRKLAND LAKE, Ontario
P2N 3J1

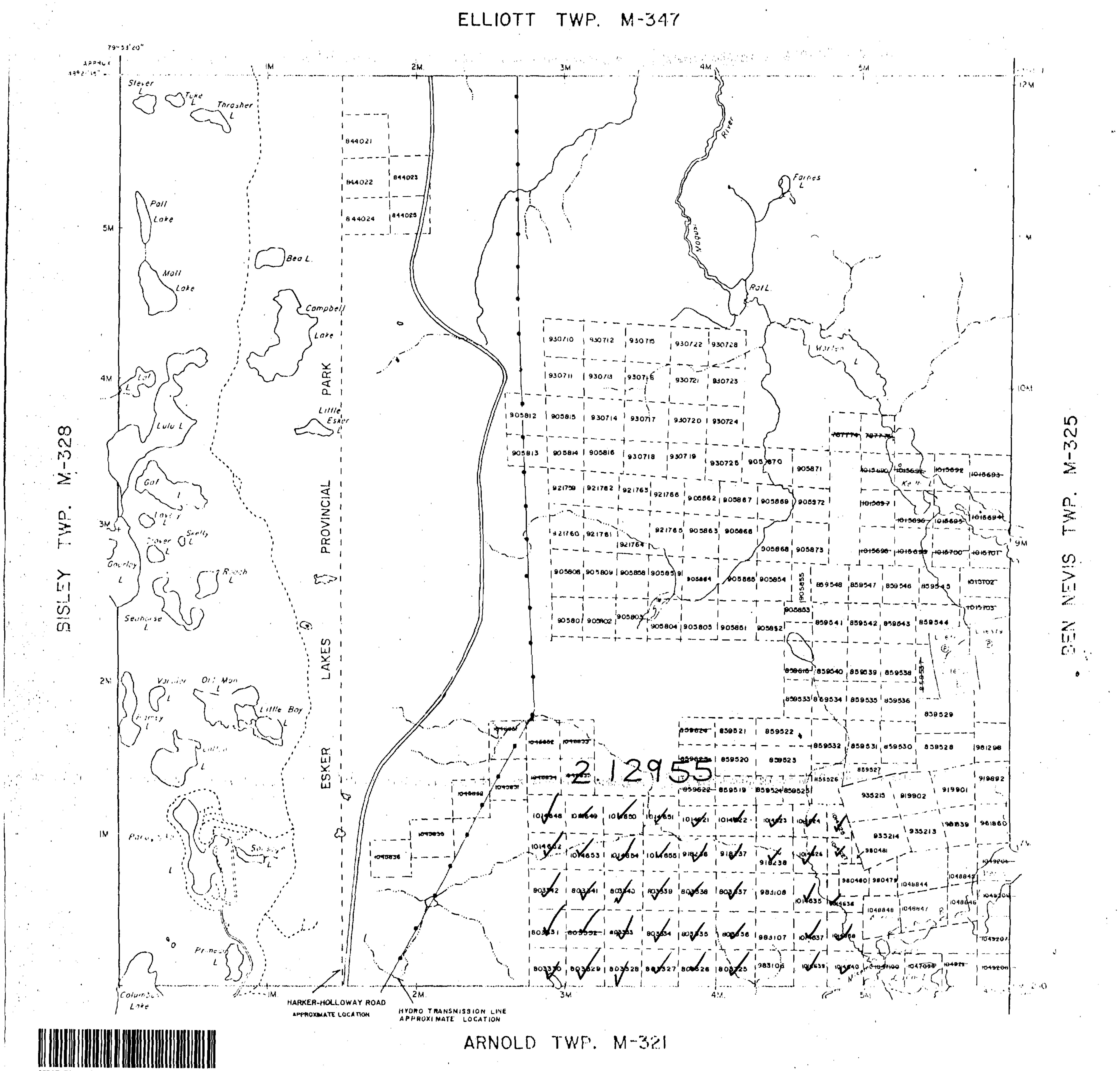
Telephone No.	Date	Certified By (Signature)
(705)-567-5495	October 5, 1989	[signature]

For Office Use Only

Total Days Cr. Recorded	Date Recorded	Mining Recorder
820	Oct 12/89	J. Bettrup [signature]
	Date Approved as Recorded	Provincial Manager, Mining Lands
	See revised	work statement

Received Stamp
LARDER LAKE MINING DIV.
RECEIVED
OCT 12 1989
AM 7 8 9 10 11 12 1 2 3 4 5 6 PM
4:07

1362 (89/06)



NOTES

400' surface rights reservation along the shores of all lakes and rivers.

TOWNSHIP SUBJECT TO FORESTRY OPERATIONS

NOTICE OF FORESTRY ACTIVITY

THIS TOWNSHIP / AREA FALLS WITHIN THE ABITIBI MANAGEMENT UNIT AND MAY BE SUBJECT TO FORESTRY OPERATIONS. THE MNR UNIT FORESTER FOR THIS AREA CAN BE CONTACTED AT: P.O. BOX 129 SWASTIKA, ONT. P0K 1T0 705-642-3222

LEGEND

PATENTED LAND
PATENTED FOR SURFACE RIGHTS ONLY
LEASE
LICENSE OF OCCUPATION
CROWN LAND SALES
LOCATED LAND
CANCELLED
MINING RIGHTS ONLY
SURFACE RIGHTS ONLY
HIGHWAY & ROUTE NO.
ROADS
TRAILS
RAILWAYS
POWER LINES

DATE OF ISSUE
LARDER LAKE MINING RECORDER'S OFFICE

TOWNSHIP OF

CLIFFORD

DISTRICT OF TIMISKAMING

LARDER LAKE MINING DIVISION

SCALE: 1 INCH = 40 CHAINS

PLAN NO. M-338

MINISTRY OF NORTHERN DEVELOPMENT AND MINES

32D05SW0002 2.12955 CLIFFORD

200

DATE RECEIVED MARCH 2 1989

2.12955

Lac Minerals Ltd.

Grid C14

Clifford Twp. Ont.

Grid and Claim Plan

Nov 1989

210

Scale 1:5000

Metric Grid