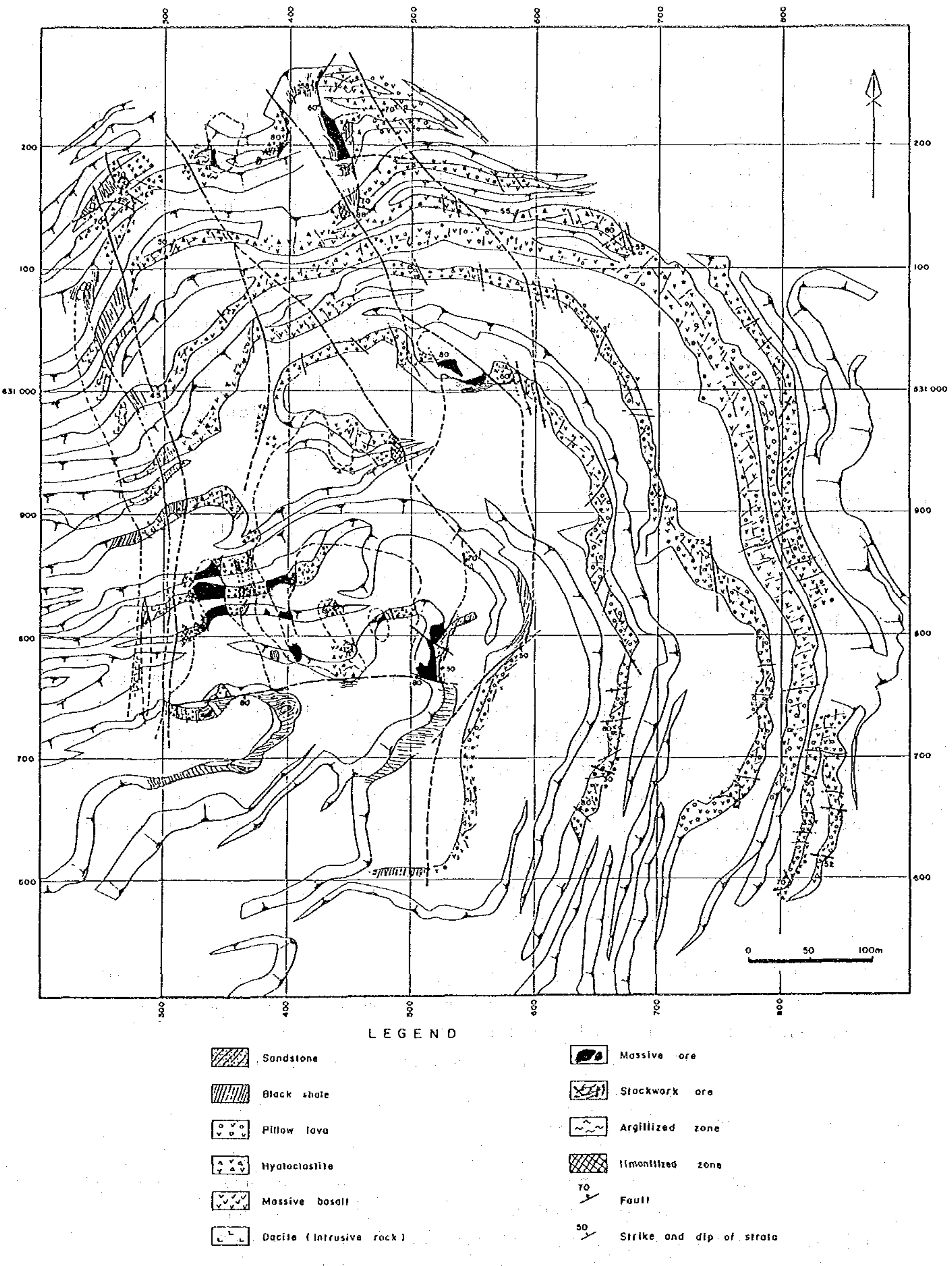


Figure 3-5 Sketch of Aşıköy Open Pit

The stratigraphic sequence of these bodies is, from the surface downward, black shale, massive ore, and hyaloclastite. The ore minerals are; large amount of pyrite, small amount of chalcopyrite, sphalerite, minor content of bornite, tetrahedrite, covelline, marcasite, and pyrrhotite. The gangue mineral is quartz. Assay result of massive ore of Drilling T-164 is Cu 6.92%, S 45.35%.

The smaller bodies less than 50 x 20m are massive and boulder ores occurring at the boundary of black shale and hyaloclastite. In some cases, 10-20cm boulder ores occur in the hyaloclastite. The hyaloclastite is in contact with pillow lava on the eastern side through a fault and the silicification and the amount of ores contained in the hyaloclastite decreases westward from the fault.

The hyaloclastite is silicified and thus bleached to a thickness of 1-2m immediately below the massive orebody. Further down, hematite is observed in the matrix of the hyaloclastite.

3-2 Bakibaba Deposit

The Bakibaba Deposit is located approximately 900m east of the Aşiköy Orebody. This is the original deposit of the Küre mine and has been worked sporadically since the Greek times. A large amount of mine waste is dumped near the deposit and it appears that a different deposit near Bakibaba was mined earlier. At present drilling is conducted from the surface. A horizontal section of the Bakibaba Deposit is shown in Figure 2-36 and an adit maps in Figures 2-37 and 2-38.

3-2-1 Geology and Geologic Structure

The geology of the vicinity of the Bakibaba Deposit consists of black shale, hyaloclastite, and pillow lava (partly massive basalt). Pillow lava, black shale-sandstone, and hyaloclastite occur elongated in the N-S direction. These rock units are bounded by faults with eastern dip.

3-2-2 Orebodies and Alteration

The ores occur at the boundary of black shale-sandstone and hyaloclastite and within hyaloclastite. They are massive ores are lenses elongated in the dip direction. The horizontal section of the orebodies are oval to circular with dimensions of 40 x 70m - 80 x 80m. The dip of the orebodies is 50°-60° SE and the extension in that direction has been confirmed up to

130m.

At the 920m gallery, the following geologic units are distributed from the west eastward; pillow lava, silicified hyaloclastite (pyrite disseminated), massive ore, black shale, hyaloclastite (partly pyrite network) and the massive ore is 10m wide and is elongated in the N-S direction. The alteration of the host rock in this gallery is silicification which is about 5m wide and extends in the E-W direction.

The massive ores of the Bakibaba Deposits is composed of a large amount of pyrite, small amounts of chalcopyrite and sphalerite, minor amounts of covelline and pyrrhotite, and the gangue minerals is quartz. The assay of the ore shows the grade to be Cu 4-15%, S over 40%, indicating locally high-grade copper zones.

Sulfide minerals have been oxidized on the surface near the orebodies and for 600 x 500m the surface red with limonite.

There are mine wastes 600m to the east of the orebodies and these contain minor amounts of chalcopyrite, bornite, covelline, pyrrhotite, magnetite and hematite with grades ranging from Cu 1 to 4%, Co 0.2 to 0.4%.

3-3 Kızılsu Deposit

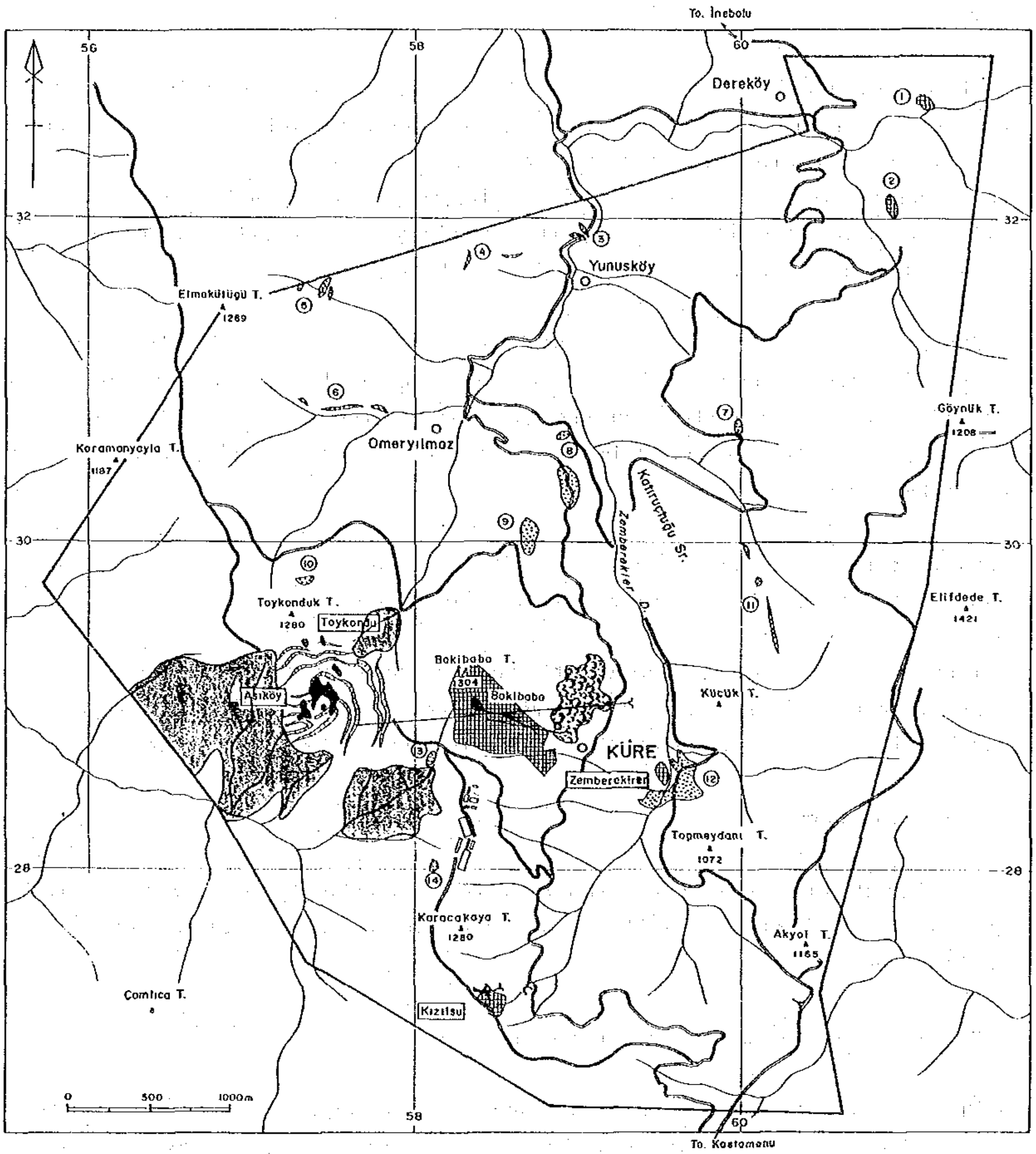
Kızılsu Deposit lies 1.7km south of the Bakibaba Deposit, and the high-grade part confirmed by drilling is being mined. Drilling was carried out until recently.

3-3-1 Geology and Geologic Structure

The geology of the vicinity of the Kızılsu Deposit consists of black shale, hyaloclastite, and massive basalt (partly pillow lava) from the southwest northeastward. These units are elongated in the NW-SE direction. The sediments and hyaloclastite are in fault contact.

3-3-2 Orebodies and Alteration

The orebodies are network and massive type in hyaloclastite. The horizontal extent is 300 x 150m. The results of the drilling indicates that most of the ore is of network type with massive ores occupying 80 x 40m in horizontal extent and about 15m thick. Both types of ores consists of a large amount of pyrite, small amount of chalcopyrite, minor amount of



L E G E N D

① Ersizlerdere	② İpsinler Köyü	③ North of Yunusköy	④ West of Yunusköy
⑤ East of Elmakütüğü	⑥ West of Ömeryılmaz	⑦ West of Göynük T.	⑧ East of Ömeryılmaz
⑨ North of Bakibaba	⑩ North of Toykondu	⑪ East of Bakibaba	⑫ Zemberekler
⑬ Southwest of Bakibaba	⑭ North of Karacakaya		

Massive ore Gossan Mineral showing Slag Dump

Figure 3-6 Mineral Showing Map of the Küre Mining Zone

sphalerite, bornite, covelline, tetrahedrite, and marcasite with quartz as the gangue mineral.

The assay result of the massive ore is Cu 4%, S 40% and of gossan is Cu less than 1%, S 1-2%.

The upper part of the orebodies is gossan and the host rock is silicified and contains a large amount of quartz and some sericite.

3-4 Other Mineral Showings

(Mineral showings and alteration zones are shown in Fig. 3-6)

3-4-1 Ersizlerdere

This showing is located 4.7km northeast of Bakibaba. The ores are limonite veinlet network and quartz-limonite veins in the massive basalt and hyaloclastite. The horizontal extent of this showing is 100x40m. The analytical result of sample K009 is shown in Table 1-18 (10).

3-4-2 İpsinler

This is located 4km northeast of Bakibaba. Limonite dissemination in silicified massive basalt and sandstone is observed. The horizontal extent is 150x50m (Analysis, sample K018).

3-4-3 Northern Yunusköy

This is located 1.3km southwest of Dereköy Village. The showing consists of 0.4-0.5m thick silicified pyrite zone in dykes along the NW-SE trending fissure in the massive basalt.

3-4-4 Western Yunusköy

This is located 2.9km north of the Bakibaba. Limonite dissemination occurs in 2m thick lenses of silicified rock along the NNW-SSE faults in the black shale and along NNE-SSW faults bordering the black shale-sandstone and ultramafic rocks.

3-4-5 East of Elmakütüğü

This is located 2.9km north-northwest of Bakibaba. Pyrite dissemination occurs in the silicified parts of massive basalt and dacite.

3-4-6 Western Ömeryılmaz

This is located 2km north-northwest of Bakibaba. Limonite dissemination occurs in the silicified dykes along the E-W fault bordering the black shale and ultramafic rocks. The silicified dykes extend 500m intermittently.

3-4-7 Western Göynük

This is located 2.4km northeast of Bakibaba. Silicification-pyrite dissemination occurs in the massive basalt. This extends for 100x50m (Analysis; sample N029, N039).

3-4-8 Eastern Ömeryılmaz

There are two mineral showings in the hyaloclastite in contact with the black shale 300m east of Ömeryılmaz Village. The northern one is 2-3m thick silicification-pyrite network in dykes and the southern showing consists of silicification and limonite dissemination of 250-100m scale (Analysis; sample Y019).

3-4-9 North of Bakibaba

This is located 0.6km north-northeast of Bakibaba. Limonite dissemination occurs in parts of the silicified zone of the pillow lava, hyaloclastite, and massive basalt. The zone is 200x100m with quartz, sericite, and chlorite.

3-4-10 North of Toykondu

Gossan occurs at the fault contact of pillow lava and massive basalt. It is located 250m north of Toykondu.

3-4-11 East of Bakibaba

This is located 2km east of Bakibaba. Limonite dissemination occurs in the silicified dykes along the faults bordering the black shale and basalts and along the faults in the basalts. The altered minerals of the white altered rocks are quartz and minor amount of chlorite.

3-4-12 Zemberekler

This is located 1.2km southeast of Bakibaba. There are two showings in the pillow lava. One is the occurrence of gossan over 120 x 50m with mine wastes in the vicinity. The other is partly pyrite dissemination and veinlets in the silicified parts over 400 x 150m to the southeast of the former. The silicified rocks contain quartz with minor amount of pyrite and marcasite (Analysis; sample Y0012, Y024).

3-4-13 Southwest of Bakibaba

This is located 0.4km southwest of Bakibaba. Limonite dissemination occurs in the altered and bleached black shale.

3-4-14 North of Karacakaya

This is located 1km south-southwest of Bakibaba. Limonite dissemination occurs in the silicified parts of hyaloclastite. It covers an area of 50 x 50m.

CHAPTER 4 GEOPHYSICAL PROSPECTING

4-1 Outline of Geophysical Prospecting (CSAMT and IP Methods)

4-1-1 Objectives

To clarify the subsurface structure of the Küre Mining Zone by CSAMT electromagnetic method and also to understand the relation between the geologic structure and mineralization by IP electric method. Geophysical anomalies will be extracted at the same time in order to obtain guidance for future exploration.

4-1-2 Area of Survey

The geophysical survey was conducted in Küre Mining Zone in general which was the target for semi-detailed geological survey, it is shown in Figure 1-2.

4-1-3 Prospecting Methods

The method used is CSAMT and IP. CSAMT is generally a method used for investigating a specific area. During the present survey, array method for studying a linear profile and random point method for clarifying the resistivity structure of the whole Küre Mining Zone were applied. Ten profiles totaling 20,000m and 400 stations were measured with the array method and 113 stations were measured by random point method. With the IP method, three profiles totaling 4,000m were measured.

The lengths of traverse lines and the numbers of stations are as follows.

Array CSAMT Method

Line	Length (m)	Number of station	Distance of station (m)
A	3,000	60	50
B	3,000	60	50
C	3,000	60	50
D	3,000	60	50
E	3,000	60	50
F	900	18	50
G	900	18	50
H	2,000	40	50
I	600	12	50
J	600	12	50
Total	20,000	400	
Line interval : 250m			

Random Point CSAMT Method

Number of station	Distance of station
113 points	200 - 500m

IP Method

Line	Length (m)	Number of station	Distance of station (m)
DD	1,000	30	100
II	1,500	55	100
K	1,500	55	100
Total	4,000	140	

4-1-4 Selection of Traverse Lines

The analysis and interpretation of the reports of previous survey indicated that the regional structure of the Küre Mining Zone is not clear. In order to clarify the resistivity structure of the central part of the area and to pursue the relation between the Aşıköy and Bakibaba Deposits, five CSAMT lines at 250m intervals transecting the Aşıköy Orebody at N63°E direction were measured. From the results of this first measurements and the analysis of previous surveys, two lines for southeastern part of Aşıköy and one line for the vicinity of Toykondu were further added. Also 600m array CSAMT measurement was carried out for two anomalies in northeast Küre which were detected by random CSAMT.

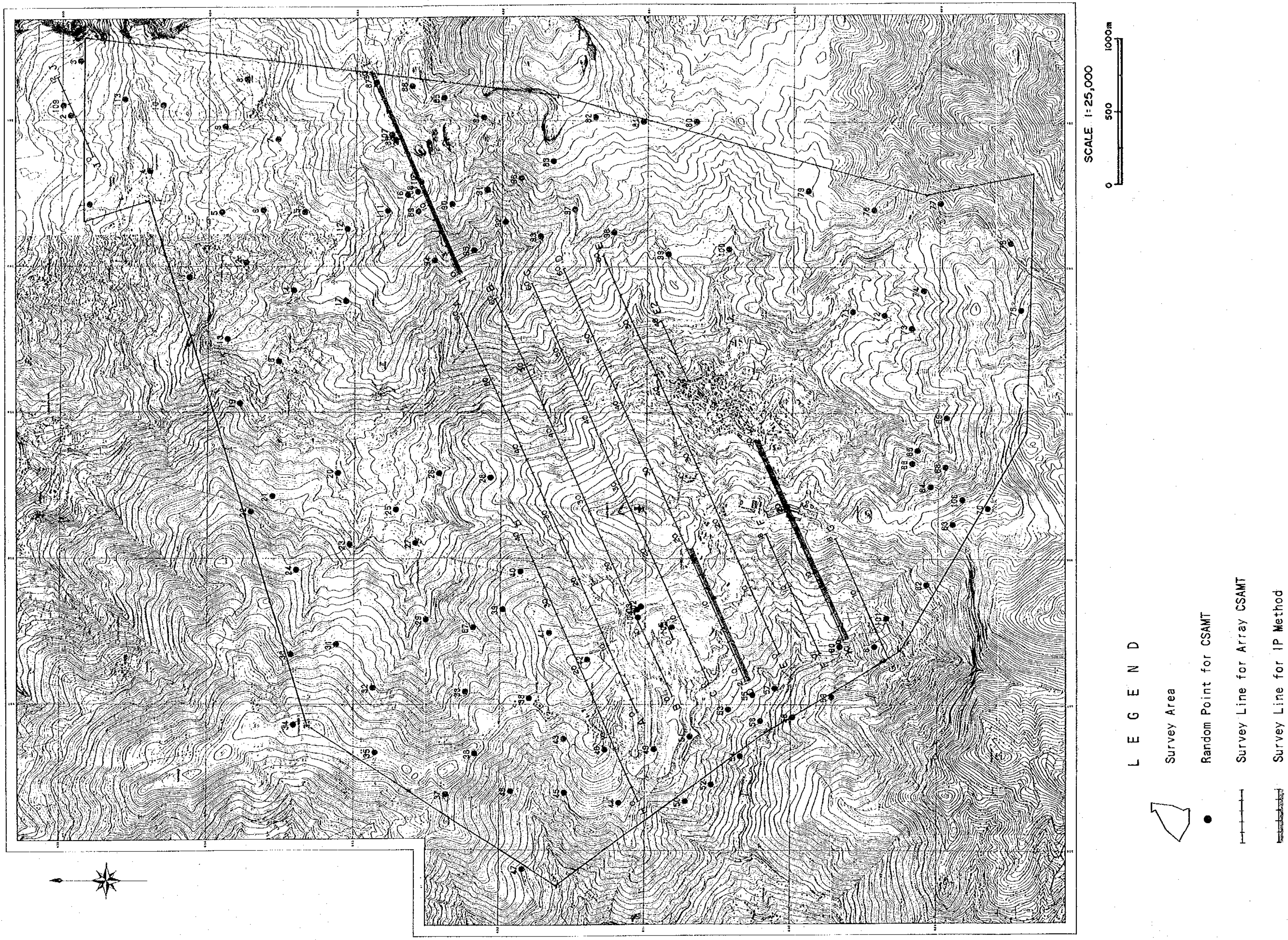


Figure 3- 7 Location Map of Survey Points and Lines

With IP method, two lines between the Aşıköy and Kızılsu Orebodies, and one in the northeastern part of Küre were measured in order to determine whether the anomalies detected by the array and random point CSAMT were caused by mineralization or not.

4-2 Methods Employed for Survey and Analysis

4-2-1 CSAMT Method

(1) Theoretical Background

One method of determining the resistivity distribution of the upper part of the earth's crust is the magnetotelluric method (MT method). This is a method of determining the subsurface resistivity structure by simultaneously measuring the telluric magnetism and telluric electric current.

The CSAMT (controlled source audiofrequency magnetotelluric) method is one kind of MT method. It uses frequency in the audio range and artificial source for the signal. This method is now used quite often for resistivity structure determination related to metallic deposits and geothermal resources. The advantages of using this method can be summarized as follows; the S/N ratio is good because the signal source is controlled, the measuring time is shorter because the measuring frequency is high, and transportation of the equipment in the field, particularly in rugged terrain, is easier because of the smaller and lighter equipment. The theory and method of measurement of CSAMT is the same as conventional MT method with the exception of using artificial source for signals.

Figure 3-8 illustrates the survey configuration. The apparent resistivity is calculated from the ratio of the electric field magnitude (Ex) and magnetic field magnitude (Hy) using the well known Cagniard equation (1) for MT.

$$Ra = \frac{1}{5f} \cdot \left| \frac{Ex}{Hy} \right|^2 \qquad \text{(ohm-m)} \qquad (1)$$

Where Ra : apparent resistivity in ohm-m.
f : frequency in Hz.
Ex : the E-field magnitude in mV/km.
Hy : the Hy-field magnitude perpendicular to the Ex-dipole in nT (gammas).

In general, Frequencies are used in the broad range between 10 to 10,000 Hz. The depth of apparent resistivity is shown by the skin depth, the skin depth is the effective depth of penetration of electromagnetic energy in a conductive medium when displacement currents can be neglected. The depth at which the amplitude of a plane wave has been attenuated to 1/e (or 37 percent):

$$\delta = 503\sqrt{\rho/f} \quad (m) \quad (2)$$

Where

Rho : the resistivity of the ground in ohm-m.

f : the frequency of the transmitted signal in Hz.

For Example, if the resistivity of the ground is assumed to be 100 ohm-m, the penetration is determined from the standard MT depth equation

$$D= \delta / \sqrt{2} = 356\sqrt{\rho/f} \quad \text{(meters)}.$$

Hence typical ground resistivity and effective penetration can vary as follows:

Ground resistivity (ohm-m)	Penetration range between 2048 Hz	and 4 Hz
1	8 m	178 m
10	25	563
100	79	1780
1000	249	5629

At a distance from the transmitter dipole the transmitted electromagnetic field becomes a "plane wave" and this area is called "far-field". The Cagniard equation is valid in the "far-field" situation for the calculation of the apparent resistivity. The far-field distance, Df, is given approximately by the following equation:

$$Df > 3 \times \text{skin depth} = 1509 \cdot \sqrt{\rho/f}$$

If the distance between the transmitter and the receiver is significantly less than Df, the transmitted magnetic field is not "plane-wave" in character; it is referred to as the "near -field".

On the other hand, if the measuring station is far from the transmitter dipole, receiving signal becomes weak and S/N ratio becomes small.

Hence field operation is carried out under the following conditions:

1) The station is far 3 δ (4km) from the transmitting dipole (f:4Hz, ρ :30 ohm-m 3 delta=4100m)
2) The station is located less than 8 km from the transmitting dipole for the

purpose of obtaining sufficient signal strength.

3) The survey area is less than 30 degree from the perpendicularline to the transmitter dipole

(2) Field Operation and Equipment.

The standard configuration is six Ex dipoles and one Hy magnetic field measurements for each of the 10 frequencies, The Ex fields are measured with a dipole using non-polarizable porous pots. The survey traverse line, for the series of equally spaced Ex dipoles, is parallel to the transmitter dipole. A horizontal magnetic sensor coil is placed on the ground, approximately at the center of the series of Ex field. It must be placed several meters away from the Ex dipole line and the receiver console, to avoid interference.

The measurements are performed at each of ten frequencies with a binary step: 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048 Hz, and are three time operations to make sure the repeatability of data.

The equipment manufactured by Zonge in USA is shown in Table 3-1 and Figure 3-8 for field configuration.

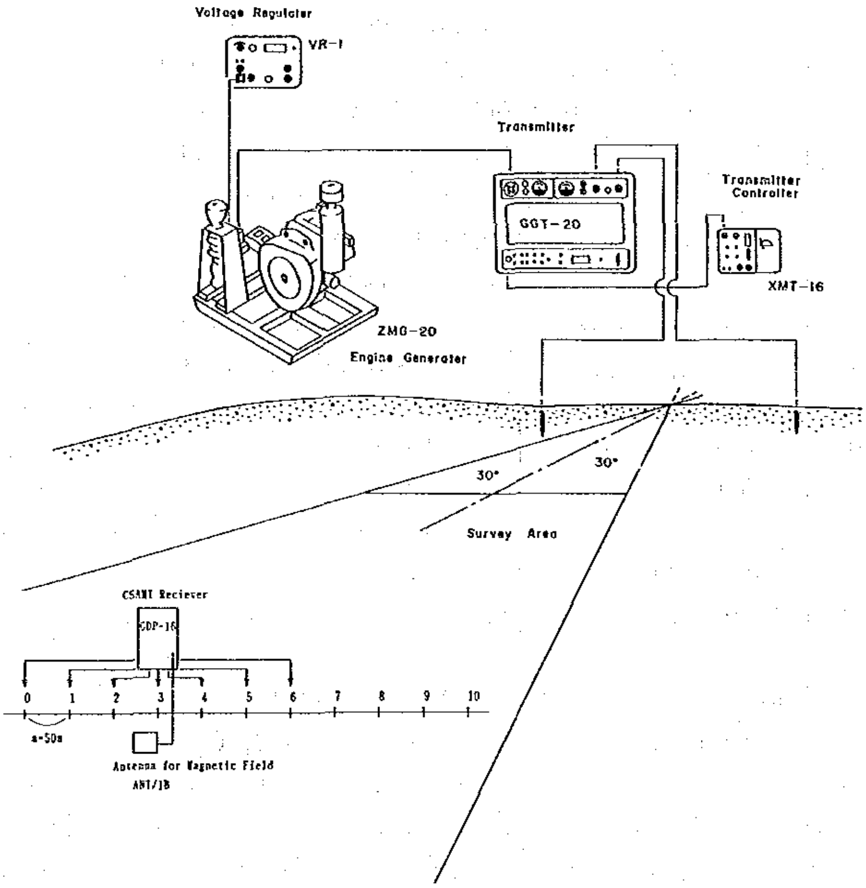


Figure 3-8 Survey Configuration of CSAMT Method

Table 3-1 Equipments for CSAMT Method

Item	Model	Specification	Quant.
Transmitting System	Chiba Electric Transmitter CH-120A	Output Voltage :400,600,800,1000V Output Current :0.1-20A Wave Form :Rectangular wave Frequency :DC-8,192 Hz Weight :40 Kg	1 pc
	Zonge GGT-20 Transmitter	Output Voltage :400,600,800,1000V Output Current :0.4-40A Wave Form :Rectangular Frequency :DC-8,192Hz Weight :120 Kg	1 pc
	Zonge XMT-16 Transmitter Controller	Frequency :DC-8,192Hz Weight :5.8Kg Power Requirement:12 Volt Battery	1 pc
	Zonge ZMG-20 Engine Generator	Maximum Power :20 kw Frequency :400 Hz Output Voltage :115V Power :62Hp	1 pc
Receiving System	Zonge GDP-16/8 Data Processor	Input Channel :8 ch. Sensitivity :0.03 μV Weight :23Kg Power Requirement:DC 12 Volt	1 pc
	Toshiba Computer J-3100GT	16 bits	1 pc
	Zonge ANT/1B Antenna	1 Coil Weight :6.2Kg	1 pc
Electrode	Current Potential	Fe Plate 24cmx36cm Non-polarizable $CuSO_4$	15 Sheets Porous Pot
Walkie Talkie	Yaesu	Output :5.0 watt 900 MHz	4 pcs

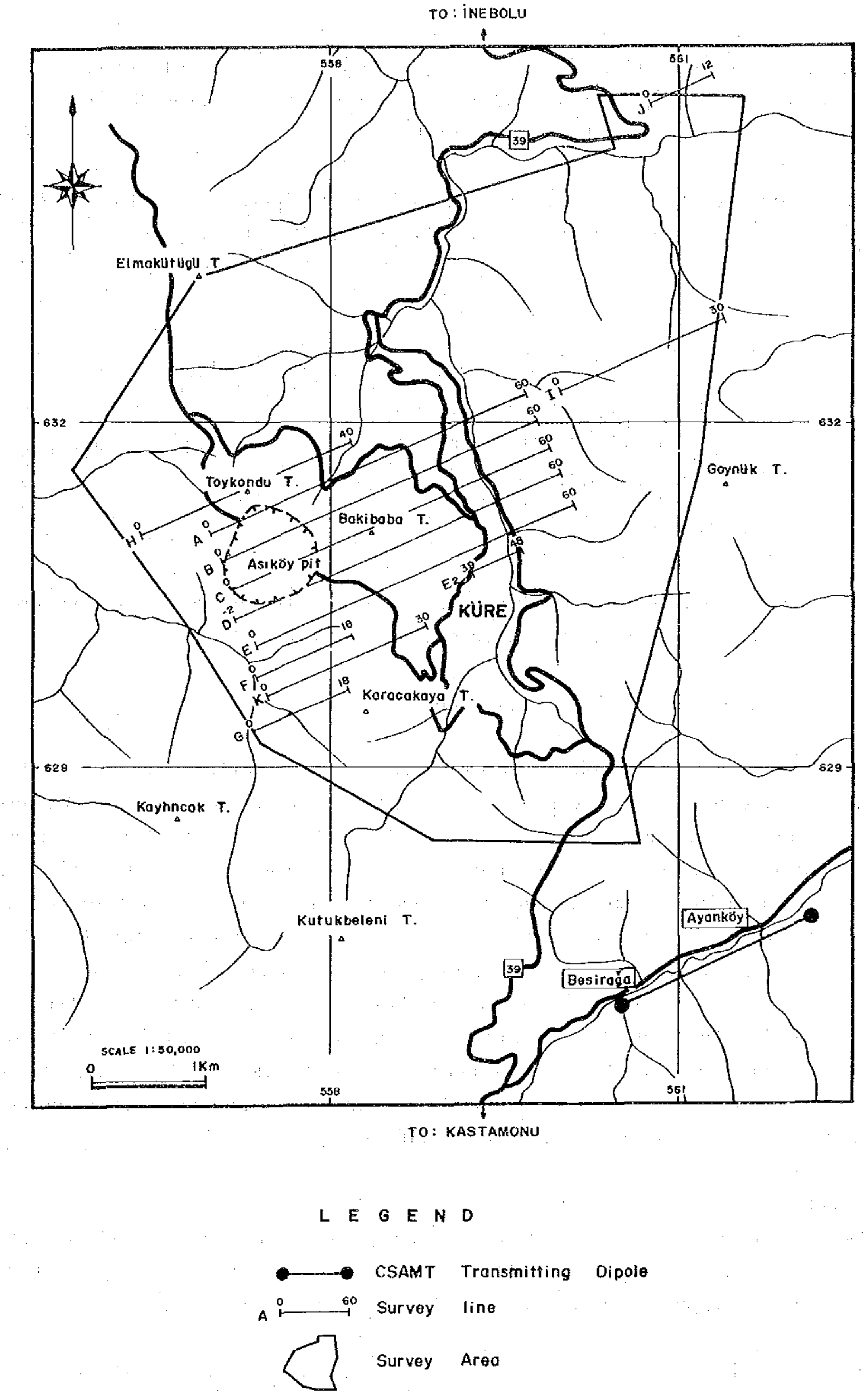


Figure 3-9 Location Map of Transmitting Dipole

The transmitter (powered by a suitable motor generator) sends current into the grounded dipole (distance of two electrodes is about 1900m), shown in Figure 3-9, located 4 km NNE from the Küre Mine.

The transmitting dipole is at a distance of about 1.9 km in the N63°E direction. The coordinates and conditions are as follows:

Location	Elevation (m)	Orientation	Distance of dipole	Current (Amp)
NE electrode:Lat. 41°46'54"N :Long.33°44'52"E	900	N63E	1,900m	3.5-11
SW electrode:Lat. 41°46'30"N :Long.33°43'39"E	950			

The field conditions of random stations were the same as array system on the survey line with the exception of measurement of one Ex field.

(3) Data Processing and Interpretation

The magnitudes of Ex and Hy are measured at the stations, the resistivities and the parameters(the phase differences in Ex-Hy and the standard deviation) are calculated, stored in the RAM of the receiver unit and transferred into the field personal computer at the end of each day. The data were immediately processed at the camp. The field presentation of the results is in the form of a contoured apparent resistivity pseudosection plot and a plane map. The skin depth equation suggests that the data of lower frequencies inform us of deeper characteristics, the CSAMT data can be plotted with frequency as the sounding parameter (vertical axis) and receiver position as the lateral parameter(horizontal axis). This type of plot is called a sounding pseudosection, and the plane maps of each frequency are plotted with the apparent resistivity.

One-Dimensional Inversion Analysis

The CSAMT curve, plotted with ten frequencies as X-axis and apparent resistivity as Y-axis, is interpreted for one-dimensional multi-layer structure by computer as shown in the Figure 3-10.

1) The initial models are made by qualitative analysis of the observed CSAMT curve using the Bostick Inversion.

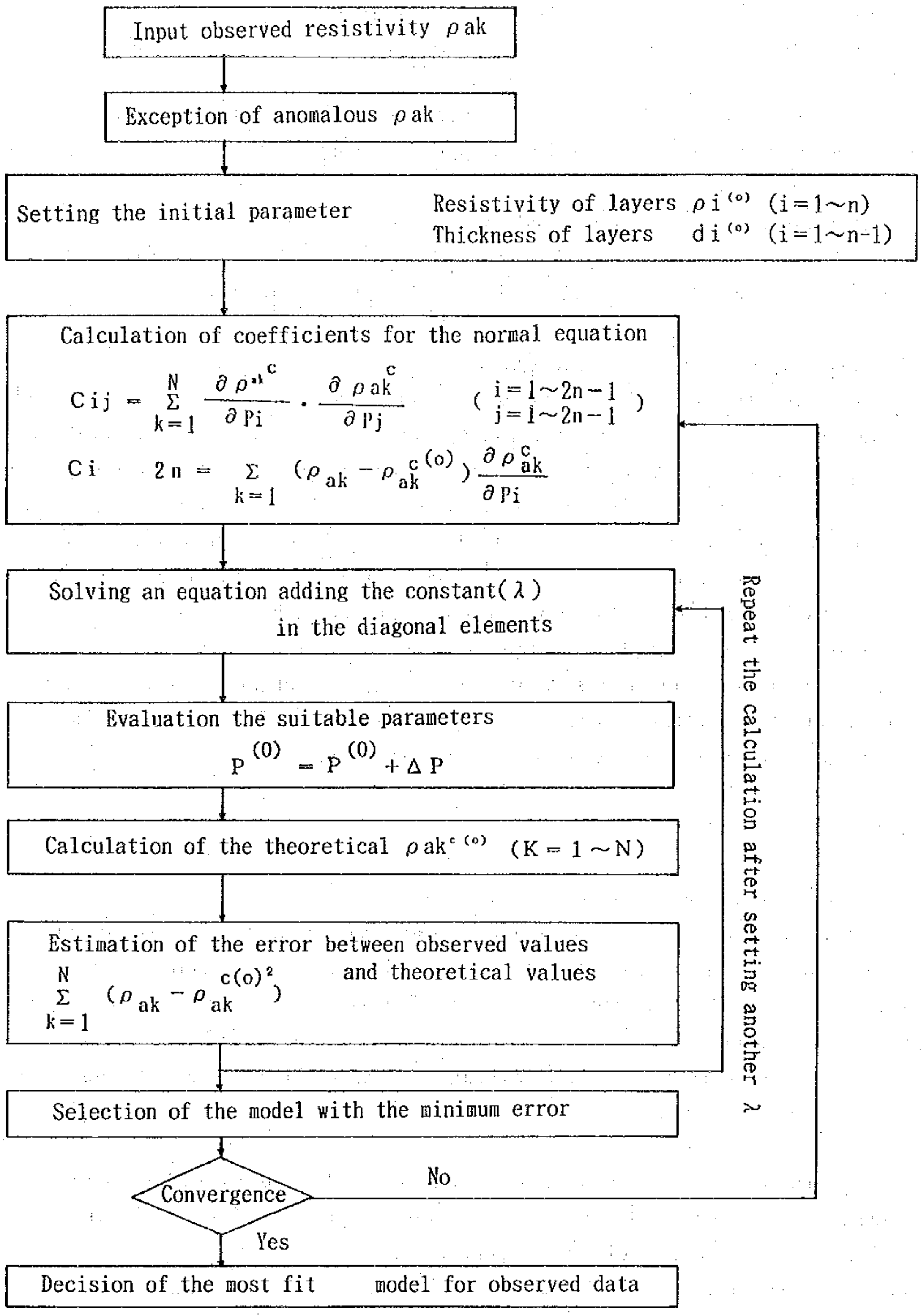


Figure 3-10 Flow Chart of 1-D. Automatic Interpretation for CSAMT Data

2) The parameters, namely resistivities and thickness of layers, are corrected by the non-liner minimum square method.

3) The theoretical CSAMT curve of the model is compared with the observed CSAMT curve.

4) The procedures 2) and 3) are repeated, the deviation between observed value and the theoretical value of model are minimized.

These data which are analyzed, the resistivities and thickness of layers, are plotted on the cross section of resistivity and plane map on each levels of 100m, 200m, 300, 500m below the ground surface.

Two-Dimensional Inversion Analysis

There are two methods of two-dimensional analysis, one is called forward method, the suitable model made from the result of one-dimensional analysis is calculated. The other is called inversion method, the fitness model is obtained directly from observed values. In this report, two-dimension inversion analysis is applied for the CSAMT anomaly zones. The program was prepared by Ogawa and Uchida (1988, GSJ). This program calculates the coefficients of partial differential equation for the parameters of response function when the model is calculated by forward method. The second step is that new parameters are set by the inversion analysis applied numerical solution of singular value. The most fit model of minimum deviation with observed values is selected from these parameters.

4-2-2 IP Method

(1) Theoretical Background

The metallic minerals and rocks generate the polarization phenomena (induced polarization) due to these electric and chemical properties. There are two IP phenomena, one is called electrode polarization, generated at the surface of metallic minerals and these sulfides, The other is generated by membrane or overvoltage effects. The theory of the IP survey depends on the former.

In this survey the frequency domain method used by 0.3 HZ and 3 Hz was applied. The results are illustrated by the pseudosection of frequency effect (FE) and apparent resistivity.
FE and apparent resistivity are defined the following equations.

1) FE (Frequency Effect in percent)

The FE value is calculated by resistivity (R) at 0.3 Hz and 3.0 Hz as follows:

$$F\ E = \frac{R(0.3\ Hz) - R(3.0\ Hz)}{R(3.0\ Hz)} \times 100 \quad (\%)$$

2) Resistivity

The value of resistivity is calculated by the following equation :

AR = pai**Ñan(n+1)(n+2)ÑV/I (ohm-m)

where a : electrode separation in meters
n : electrode separation coefficient
V : voltage received in volts
I : transmitted current in amperes

In the present survey, the apparent resistivity at 3 Hz was calculated, and terrain correction was made with the computer

(2) Field Operation and Equipment

The field configuration of IP survey is illustrated in Figure 3-11.

The distance between receiver dipole and transmitting dipole is changed in measuring.

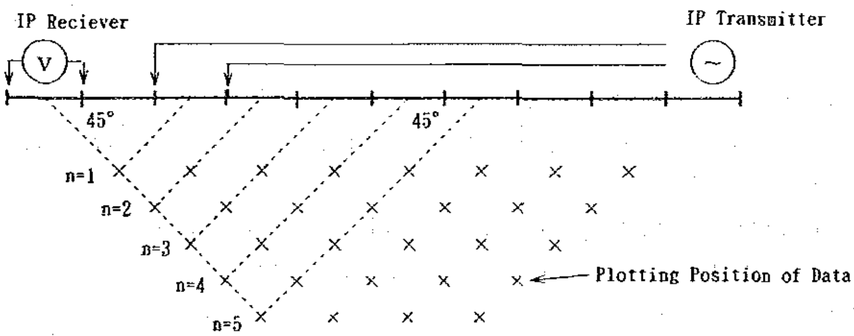


Figure 3-11 Survey Configuration of IP Method

The conditions of field work are as follows.

The electrode configuration : dipole - dipole
The distance of electrode : horizontal 100 m
The coefficient of electrode : n= 1 - 5
Frequency : 0.3 Hz and 3.0 Hz

The equipment used for IP survey is shown in Table 3-2.

Table 3-2 Equipments of IP Method

Item	Model	Specification
Transmitter	Chiba Electric Lab. Model 8104T	Output Voltage :200 V-800 V Output Current :0.2-2.5 Amp Wave Form :Square Wave Frequency :0.1Hz-3 Hz
Engine Generator	McCulloch MK-2	Output :2 kw Frequency :400 Hz Output Voltage :115 V
Receiver	Chiba Electric Lab. Model 8104R	Sensitivity :10 V Frequency Range:0.1-3 Hz Power Requirement 006Px4 pcs
Electrode	Current Potential	Stainless ø0.6cm, Length 60 cm Non polarizable $CuSO_4$ Porous Pot

(3) The Data Processing and Interpretation

Apparent resistivity data and FE are illustrated on the pseudosection and plane map.

The terrain effect appear on the pseudosections of apparent resistivity. Correction calculated by computer is performed on the measured values of apparent resistivity.

These pseudosections show analytically the characteristics of apparent resistivity and FE.

Two dimensional model simulations are applied for IP data.

4-3 Results of Geophysical Prospecting

4-3-1 CSAMT Method

A total of 513 stations, 400 array stations and 113 random points were measured by CSAMT method. The apparent resistivity is shown in five maps for each frequency, also an apparent resistivity profile was prepared for each array traverse line. Also one-dimensional analysis of the CSAMT-curve was carried out and the results are a resistivity structure map each for four depth levels and a structural profile for each traverse. For the array anomalies, inversion analysis was made in order to obtain two-dimensional structures which fit the measured values. Logarithmical iso-interval contours of 1, 3, 10, 100, 300,........ were used for both the apparent resistivity and the analyzed resistivity because the range of values was very wide.

The following is the results obtained by this survey. The maps and sections of the work are attached in the appendix.

Apparent Resistivity Maps

The measured resistivity values were plotted on one map for each of the five frequencies, namely 1,024Hz, 256Hz, 64Hz, 16Hz, and 4Hz. The vicinity of Aşıköy Orebody, where CSAMT array survey was carried out, was plotted on a 1:10,000 scale map (Figure 3-12). An apparent resistivity map (1:25,000 scale) was prepared for the whole Küre Mining Zone using random point data as well as the array data (Figure 3-13). The interpretation of these maps is reported below.

(1) The resistivity of the whole Küre Mining Zone is dominantly 100-300ohm-m. Low resistivity of less than 100ohm-m is widely distributed in the vicinity of survey boundary line of the 1,024Hz and 256Hz maps. This zone correspond to the black shale and sandstone areas shown as Kss in the maps.

(2) High resistivity exceeding 1000ohm-m is detected mostly in the central part of the area, and it widens in the lower frequency zones. It is, thus, inferred that the igneous rocks are more widely distributed in the deeper subsurface zones.

(3) Notably low resistivity (under 30ohm-m) over high to low frequency range was detected at five localities, namely Aşıköy, Bakibaba, Kızılsu, north of Ersizler, and southwest of İpsinler. Of these the former three are those considered to be related to known orebodies and mineral showings.

(4) It is seen in the 64Hz and 16Hz maps, that the low resistivity zone widens in the vicinity of the exploration area, particularly in the northeast and southwest.

(5) Medium to low resistivity zone is widely distributed in the vicinity of the Aşıköy Orebody where array CSAMT was carried out. Significant low resistivity anomaly occurs directly over the Aşıköy and many smaller low

anomalies have been detected to the southeast. These anomalies tend to continue in the N-S and NNW-SSE directions. Small low anomalies occur sporadically to the east, south, and southeast of Bakibaba.

Apparent Resistivity Sections

Apparent resistivity sections with apparent resistivities on the vertical axis, these of high frequencies were plotted at the shallow part of subsurface, and measured distance on the horizontal axis were prepared for each array CSAMT line (Figure 3-14).

The characteristic features of the resistivity distribution of the profiles are as follows.

Line A: Medium-high resistivity is dominant. Many pipe-shaped high resistivity anomalies are detected from the vicinity of Route 39 at the eastern part of the section to the eastern side and from Mt. Toykondu to the central part of the line. These anomalies show abrupt changes with neighboring stations and indicate discontinuity of resistivity distribution. Low anomalies were detected only at the southwestern edge of the line.

Line B: High anomalies occur between the open pit of Aşıköy to Mt. Bakibabá and the eastern side of Route 39. Notable low anomaly zone (under 30ohm-m) is detected at the Aşiköy Orebody. Also low was found at two stations to the west.

Line C: High anomalies occur at the eastern part of Mt. Bakibaba summit and to the east of Route 39. This tendency is similar to Lines A and B. Independent low anomalies occur at Aşıköy Orebody, immediately under Mt. Bakibaba, and Station No. 38.

Line D: High anomalies occur in the central part of the Line (low frequency range) and near Route 39 (all frequency range). Low anomalies occur on the western side of Aşıköy Orebody in the high frequency range. Independent low anomalies are detected at Station No.37 (intermediate frequency, 64-128Hz). The Bakibaba Deposit is located at the central part of the Line, but the shallow subsurface zones have been mined out and the existing ores are in the deeper parts, the resistivity is around 50ohm-m.

Line E: High anomalies in this Line occur scattered in the lower frequency range compared to the lines described earlier. On the other hand, low anomalies occur at Station Nos. 3 to 17 to the south of Aşıköy Orebody, and at Station Nos. 20, 33, 37 to 39 in the central part of the Line. Readings at Station Nos. 39 to 48 are affected by high voltage transmission line and artificial smoothing has been applied and the data are not very reliable.

Line E 2: This is a supplementary line set 150m south of Line E. Pillow lava is distributed throughout the line and high anomalies are dominant. Low anomalies are detected at the western end.

Line F: Black shale and sandstone are distributed throughout the line and the resistivity values are dominantly intermediate between 100-300ohm-m. Low anomalies are detected at Station Nos. 1 and 12 to 16 and noted.

Line G: This line is located 400m south of Line F and the geology is black shale and sandstone. Intermediate resistivity values are dominant as in Line F. There is an ore dressing plant to the east of this line, and the data of the eastern half of this line is disturbed by the noise.

Line H: This line is located 250m north of Line A and the main objective is the exploration of the northern extension of Toykondu Orebody. The western half of this line consist of black shale and sandstone with intermediate to low resistivity. Low anomalies have been detected at three localities. Basaltic rocks occur in the eastern half of the line and high anomalies exceeding 1000ohm-m are dominant with serpentine at the eastern end with intermediate resistivity of 500ohm-m.

Line I: This line was set in order to check the anomalies detected by random point CSAMT. Notable low anomalies are detected in the sedimentary rocks (Kss) to the east of Station No.9. Massive basalt occurs in the western side of Station No.9 and high anomalies are detected.

Line J: Distribution of sedimentary rocks (Kss) is inferred below the surface talus deposits. Low resistivity under 100ohm-m is detected and low anomalies occur at Station Nos. 4 to 6.

The resistivity distribution of this area is generally discontinuous laterally indicating fault structure. This is particularly noted by CSAMT array measurement in Lines A to D. The geologic structure of this area is strongly affected by crustal movement with many faults and the dip of the strata is generally steep, over 65°. Therefore it is understandable that, with the station interval of 50m, the CSAMT curve of the neighboring stations changes abruptly as seen in the measured results. There is a NNW-SSE - NW-SE trend of the distribution of high anomalies which is considered to reflect the trend of the geologic structure.

Resistivity Structure Maps

The results of one-dimensional multi-layer analysis of each station are plotted on maps for subsurface depths of 100m, 200m, 300m, 500m in Figure 3-17. The relevant features of the maps are described below.

100m: The resistivity value of the Küre Mining Zone as a whole is dominantly intermediate. The high zones occur at north of Mt. Bakibaba and northeastern part of Küre, and they correspond to the occurrences of basaltic rocks. The low anomalies are detected at Aşıköy Orebody, Bakibaba Orebody, and south of Ipsinler.

200m: The general trend of resistivity structure of this depth is similar to that of 100m depth. The distribution of low anomalies in the west, northwest and northeast tends to increase. The low anomalies to the east of Bakibaba Orebody are becoming significant.

300m: The general trend is similar to the above two sheets. The low anomalies in the west and northeastern part of the area is increasingly stronger, at below 10ohm-m.

500m: The low anomaly distribution decreases at this depth. The distribution of high anomalies of 1000ohm-m expands in the NNW-SSE direction, and new high anomalies are detected in the southern part of the area, vicinity of Kızılsu Deposit, and northeastern part of the area.

Resistivity Structure Sections

One-dimensional multi-layers analysis was carried out using the measured apparent resistivity for each station. The resistivity values (ohm-m) of each layer and depth of layer boundaries (in meters below surface) are shown for each traverse line and in Figure 3-18. The following features are seen from the sections.

Line A: It is shown by the analysis that high resistivity is concentrated from the shallow subsurface to the deeper zones of localities to the north of Mt. Bakibaba and to the east of Route 39. Notable low anomalies are shown at Stations 41 and 42 (northeastern Bakibaba low anomalies) and at the western end of the line. The former is accompanied by low zone of under 50ohm-m within Stations 35 to 45. Stations 6 to 11 corresponds to the northern extension of the Aşıköy Orebody and low zone of about 50ohm-m is extracted with eastward dip.

Line B: The high resistivity zone in the central and eastern parts of the line has features similar to Line A. The lowest resistivity anomalies, in the order of several ohm-m, measured during the course of this project occur in the shallow zones of the western part of the line. This is within the Aşıköy Orebody. Low anomalies of 30-50ohm-m are identified below the Aşıköy Orebody in the medium to deeper zones. These anomalies probably represent the mineralized zones in the vicinity of the orebody. There are weak anomalies of 50ohm-m in the medium depth zone of Stations 40 to 43 which is considered to be the southern extension of the weak anomalies to the northeast of Bakibaba.

Line C: Shallow low anomalies detected at Stations 7 to 11 are the important low anomalies in this line. These represent the Aşıköy Orebody. The weak anomaly zone in the western part of the orebody is deeper and thicker than in Line B. Low anomalies are identified on the western slope of Mt. Bakibaba and weak ones at Stations 34 to 38. Both of these occur in the relatively shallow zone in the central part of the line. The former is a low resistivity zone of 2.1ohm-m between 120-180m depth and it is noted as it lies at the northern extension of the Bakibaba Deposit. The latter is located in the northern part of the a slag dump, and this is an anomaly without manifestations on the surface, it will be called the eastern Bakibaba weak anomalies.

The trend of the high anomalies is similar to the above lines, namely wide high anomaly zones in the central and eastern parts of the line.

Line D: Shallow low anomalies in the western part of the line is noted as it is located south of Aşıköy Orebody. There is a 6 to 14ohm-m low resistivity zone at 50-100m depth between Stations 5 and 7. This probably represents a satellite orebody. Bakibaba Deposit occurs in the deeper parts of Stations 24 to 26 near the center of the line, but the resistivity is 30 odd ohm-m and not an important low zone. This is considered to be caused by the relatively small size of the orebody and the fact that mining has progressed and the remaining ore reserves are small. Medium scale low anomalies are detected between Stations 35 and 39 and are considered to be a part of the eastern Bakibaba anomalies.

High anomalies are concentrated in the eastern part of the line, but the 1000ohm-m high resistivity near Bakibaba tends to decrease in this line.

Line E: A low resistivity zone of less than 50ohm-m was identified at 100-400m depth in the western third of the line. A low resistivity zone 80-

120m below Stations 5-10 is notable. A very low resistivity zone of 1.1ohm-m is identified 40-55m below Stations 20-21. Another low zone of 30ohm-m is identified below Stations 35 to 39 in the east central part of the line. This is considered to be a part of the weak eastern Bakibaba anomalies continuing from Line C.

High resistivity is distributed along the whole line in 100-400m depth.

Line E2: A low resistivity zone of 1.4-25ohm-m is identified in the western edge of the line. This anomaly is located at the southern end of the eastern Bakibaba anomalies. Other than the above, high resistivity exceeding 1000ohm-m is distributed along this line.

Line F: Shale and sandstone are distributed all along the line and the results of the analysis shows medium-low resistivity zone of under 200ohm-m in the upper strata. Low anomalies of under 50ohm-m are identified at Stations 0-2, 6-7, 11-12, and 14-15 within the above generally low zone. Of these, at Stations 0-2, low zone of under 10ohm-m exist in the shallow (50m depth) and deeper (over 200m depth) zones. There is a dam for mine wastes near the western end of the line and thus this low could be the effect of the water permeated from the dam.

Line G: Shale and sandstone are distributed along this line as in the case of Line F. Medium to low resistivity of under 200ohm-m is dominant here and high resistivity is identified only in the deeper parts of the eastern side of the line. It is thus inferred that shale and sandstone thicker in the vicinity of this line. There are no significant anomalies in this line.

Line H: This line is located 250m north of Line A with the objective of investigating the structure and mineralization of the northern extension of Aşıköy-Toykondu Deposits. A low resistivity zone of under 50ohm-m is identified at depth of 200m or more west of the century of the line. Low anomalies were not detected on the northern slope of Mt. Toykondu (Stations 19-22) which is at the northern extension of the Toykondu Orebody.

Line I: This line was set in order to investigate the anomalies identified by random point CSAMT. A thick low resistivity formation, under 10ohm-m, was identified to occur in the eastern side of Station 9. The depth of the formation is 100-300m and becomes shallower to the west. On the other hand, high resistivity of over 1000ohm-m is widely distributed in the western side of the line.

Line J: This line was also established for investigation the random point anomalies. The resistivity over this line is under 50ohm-m and is not lower than that of Line I, but the thickness of the low zone is about 500m. It is inferred that Kss sedimentary formation is distributed in the deeper parts.

The results of the analysis explained above are shown in Figure 3-24. This figure mainly shows the low resistivity zones under 30ohm-m for each depth level and the high zones exceeding 1000ohm-m for all levels. Also the lines of resistivity discontinuity inferred from the apparent resistivity sections and resistivity structure sections are shown in broken lines.

Results of Two-Dimensional Analysis

Two-dimensional analysis was carried out only for anomalies identified by CSAMT array method. The results in the western part and from the central to the eastern part are shown as the three dimensional view by profile panels in Figure 3-19.

Lines B-E: The low resistivity zones at intermediate to deeper depths identified by one-dimensional analysis of all lines either disappeared or changed to intermediate resistivity. The resistivity of the deeper parts increased. On the other hand, the resistivity distribution of the shallow zones do not change significantly and the distribution trend is similar to the results of the one-dimensional analysis. It was found that the shallow low resistivity anomalies in the western parts of all B, C, D, and E Lines (Aşıköy Orebody and to the southeast) are continuous and that the possibility of the extension of the orebody or the existence of satellite orebodies is high. A high resistivity zone thrusting from the deeper parts to the century of the area is extending in the SE-NW direction which is harmonious with the distribution of basalt.

Lines I and J:The results regarding these two lines are similar to those of the one-dimensional analysis. The thickness of the shallow low anomaly zone is decreasing somewhat and the deep low anomaly zones either disappeared or changed to intermediate resistivity with the increase of resistivity.

CSAMT Results

The interpretation of the results of CSAMT array and random point surveys one- and two-dimensional analysis thereof are described below.

(1) As a whole, the resistivity of the Küre Mining Zone is dominantly of intermediate values, 100-300ohm-m. This intermediate resistivity is dis-

tributed quite widely in the vicinity of the area. The high resistivity zones of more than 1000ohm-m are concentrated in the central part of the area and extend in the NW-SE direction. The distribution of these high anomaly zones tend to expand toward the deeper parts and resistivity exceeding 300ohm-m extends throughout the area at 500m depth or more.

(2) Regarding low resistivity anomalies, those related to Aşıköy, Bakibaba, and Kızılsu Deposits are significant. A group of small anomalies to the southeast of Aşıköy Orebody was detected by the present work. Also small but strong low resistivity anomalies are confirmed to the north and south of the Bakibaba Deposit.

(3) Regarding weak anomalies, there is a northeastern Bakibaba weak anomalies which are considered to be related to the mineral showings at northeast of Bakibaba Orebody. Slag from old Bakibaba Mine is dumped widely to the south of these anomalies. Although not recorded as a mineral prospect because of the slag, significant east Bakibaba anomalies extending in the NNW-SSE direction have been identified below the slag heap. This anomaly zone continues for four traverse lines, from Line C to E 2, and is in en echelon position with the northeastern Bakibaba weak anomalies in the north, and the Zemberekler Stream Mineralized Zone is in the southern extension of this anomaly zone.

(4) Mineral prospect are known at Ersizler and Ipsinler in the northeastern part of Küre Zone. Random CSAMT points were established at these localities for investigation of the prospecting. Some lowering of resistivity was observed, but not to the extent of calling it anomaly. Thus these localities are considered to be not promising.

(5) Although Kızılsu and Zemberekler Stream mineral showings are considered to have high mineral potential, CSAMT random points could not be established because of the noise from the high tension transmission cables.

(6) Significant low resistivity anomalies were identified at 400m north of Ersizler Prospect and 1km south of İpsinler Prospect by CSAMT random point measurements. Array CSAMT measurements were carried out in addition to the original plan, and notable low anomalies were analyzed at both localities. Both anomalies were detected in the talus deposits with tall limestone cliffs in the back. And IP exploration was carried out in order to check whether the anomalies were caused by mineralization or by factors other than mineralization such as groundwater.

(7) The low resistivity anomalies at, the western end of Lines A and B, east-southeast of Yunusköy in the north, and east of Mt. Karamanyayla T., are distributed widely over two or three stations. The former two anomalies occur in shale and sandstone, and the latter in serpentine and there are no mineral showings in the vicinity. These anomalies are not considered to be important.

(8) It is known that the distribution of the high anomalies agree well with that of basaltic rocks. The high anomalies are distributed with NW-SE to NNW-SSE trend and the line of resistivity discontinuity also trend in the same direction.

4-3-2 IP Method

IP electrical prospecting is a method by which the orebodies are directly detected and confirmed. During the present survey, three lines, namely DD, II, and K were established in order to check the anomalies detected by CSAMT. The results of the measurements (Figure 3-20) and of two-dimensional model simulation are described for each line in the following sections.

Line DD: This line was set in order to investigate the shallow anomalies detected by CSAMT array in the western part of Line D.

The apparent resistivity is low, 50ohm-m, in the shallow subsurface parts of Stations 2 to 6. This is generally harmonious with the CSAMT results.

Regarding FE values, the background value for the whole line ranges from 0.5 to 1%. FE values increase slightly to the west of Station 6, but is within the normal range. The electrode separation index of the deeper parts is n=5 and negative anomalies of -0.1 to -0.9% are detected.

Two-Dimensional Model Simulation

The resistivity and FE values of each cell for the initial model were set by referring to the results of the CSAMT analysis. However, large discrepancies occurred between the measured and apparent resistivity patterns and values. Thus trial and error was repeated until values and contour patterns close to the measured results were obtained.

The final model with values close to the measured results is shown in Figure 3-21. The apparent resistivity is harmonious as a whole with observed data, but in detail, there are discrepancies with the measured values. Regarding FE, negative values were not obtained for the deeper parts with electrode separation index of n=5, but generally it is harmonious.

Line II: This line was measured in order to investigate the CSAMT anomalies detected by random points in the southern part of İpsinler. The anomalies were detected in the talus deposits with a tall limestone wall behind them. The IP method was applied with the purpose of investigating whether the anomalies were due to mineralization or groundwater.

The resistivity decreases abruptly in the shale and sandstone area to the east of Station 9. This agrees well with the results of CSAMT measurements. Regarding FE, background values of 0.5-1.0% were detected throughout the line. The value increases to about 2% in the pillow lava area to the west of Station 9. The results indicated that the possibility of sulfide occurrence in the CSAMT low resistivity zones is very low.

Line K: This line was set between Lines F and G of the CSAMT array measurement. The low resistivity anomaly group to the southeast of Aşıköy Orebody could not be detected by Line G because of the noise from the ore dressing plant. Thus this line was measured in order to investigate the southeastward continuation of the anomalies detected by Line F. IP values are also affected by the mill and steel-framed structures and the data near these structures cannot be used.

To the west of Station 16 is the shale and sandstone area whose FE values lie within the background of 0.5-0.8% and no anomalies are found. FE values exceeding 5% have been detected in the basalt of the eastern part of the line, but as the resistivity is not low here, these probably reflect weak mineralization of noise.

Results of IP Measurements

FE anomalies of significance have not been detected by IP in the three traverse lines. The low resistivity detected by CSAMT in Line II is believed to be caused by groundwater as mentioned in previous paragraphs. Regarding the inability to detect the shallow subsurface anomalies by Line DD, it is not feasible to detect anomalies at depth of 50m or so by electrode interval of a=100m. Shorter interval of 25 to 50m would be more suitable for work of this type.

4-3-3 Laboratory Tests

Forty three representative rocks in the area were sampled for measurement of physical characteristics such as resistivity and FE values by the same equipment used in the field. Sampling localities are plotted in Figure 3-22. The samples were roughly shaped at Etibank and reshaped into cubes or rectangles upon return to Japan and then measured. The results are laid out for each rock in Figure 3-23. The apparent resistivity and FE values are listed in Table 3-3.

The following features are noted for the rocks in this area.

(1) Resistivity is generally high in diorite and basalt in the range of 300-4,000ohm-m. On the other hand that of the sedimentary rocks , namely black shale and sandstone are low at 300- 600ohm-m. The value of each rock is scattered in a relatively wide range and they sometimes overlap. The resistivity of shale and sandstone tends to be higher than other rocks.

(2) The rock with the highest resistivity is limestone at 28,200ohm-m followed by serpentine, hyaloclastite, pillow lava, massive basalt, diorite, sandstone, and black shale. The lowest measured average is 302ohm-m of black shale.

(3) The FE values are more consistent compared to resistivity. They are within normal range.

(4) The rock with the highest FE value is serpentine at 12.2% followed by black shale, hyaloclastite, sandstone, diorite, massive basalt, pillow lava, and limestone. The lowest average is 0.4% of limestone.

(5) Serpentine has high resistivity and FE vales, the averages being 20,000ohm-m and 8% respectively. Limestone of this area has high resistivity and low FE within the general range.

(6) The ores of the Aşıköy, Bakibaba, and Kızılsu Deposits have high FE of around 40% and very low resistivity of 7.5ohm-m. Both of these physical properties are significantly different from the host rocks.

The FE of gossan and slag are both unexpectedly low, 4.25 and 17.9% respectively. The resistivity is high for gossan at 964ohm-m similar to the values of diorite and basalt, but that of slag is low at 220ohm-m within the normal range of sedimentary rocks.

Table 3-3 Results of Physical Property of Rock Samples

Rock	No.	FE(%)	ρ (ohm-m)	Remarks
Gossan	15 16	3.8 4.6	981.0 947.0	Kızılsu Bakibaba
Average value		4.2	964.0	
Slag	41	17.9	220.0	
Massive sulfide ore	33 39 40	56.0 30.4 3.4	9.8 5.4 7.2	Aşıköy ore Bakibaba ore Bakibaba ore
Average value		39.9	7.5	
Serpentinite	21 26 35	8.9 *20.5 6.8	28,267.0 12,237.0 *404.0	
Average value		7.9	20,252.0	
Diorite	17 18 23 24 31	2.6 1.0 1.0 1.4 1.6	352.0 3,602.0 609.0 688.0 1,198.0	Magnetite rich Calcite network Magnetite rich
Average value		1.5	1,289.8	
Pillow lava	1 2 3 5 22 25 30 42	0.8 0.2 1.4 0.7 1.6 0.6 0.7 0.6	3,829.0 1,187.0 2,893.0 1,022.0 922.0 2,248.0 456.0 2,335.0	Lenticular,vein,fissure Pyrite dissemination
Average value		0.8	1,861.5	
Hyaloclastite	4 28 29 32 34 37 38	4.0 0.6 4.0 5.2 1.9 0.9 5.5	2,190.0 1,158.0 3,280.0 8,972.0 *26,001.0 2,410.0 494.0	Pyrite dissemination
Average value		3.2	3,084.0	
Massive basalt	6 14 19 20	0.4 0.7 2.3 1.5	1,874.0 2,568.0 734.0 1,484.0	
Average value		1.2	1,665.0	
Black shale	9 13 43	2.4 2.0 7.7	262.0 572.0 72.0	Fissible and pyrite
Average value		4.0	302.0	
Sandstone	7 8 27 36	0.7 2.3 2.6 1.0	1,282.0 9,216.0 69.0 ,439.0	
Average value		1.7	596.7	
Limestone	10 11 12	0.4 0.1 0.6	17,988.0 40,041.0 26,650.0	
Average value		0.4	28,226.3	

* Excepted sample to calculate average value

The following conclusions are drawn regarding geophysical prospecting of this area.

If sulfide ores exist over certain size, it is highly probable that it can be identified by FE values. There are, naturally, cases when such orebodies cannot be detected because of its small size and large depth of emplacement.

Regarding resistivity, it is difficult to distinguish orebodies, because some of the black shale and sandstone samples have resistivity similar to sulfides. On the other hand, it is difficult to identify rocks by resistivity values, but it would most probably be possible to distinguish igneous rock and sedimentary rocks.

It should be pointed out that the number of samples collected was relatively small and it was not possible to process the measured data statistically. Arithmetic averages were obtained after eliminating samples showing singular values. Also the samples were collected only from outcrops and my not be representative of the whole rock bodies.

4-4 Summary of the Geophysical Prospecting and Discussions

The relation between the resistivity structure and the ore deposits, mineralized zones of the area was investigated by CSAMT method with 400 stations of array measurements and 113 random points. Then 4000m of IP lines were measured for promising anomalies detected by the CSAMT method. The following is the findings of the investigation as well as matters to be considered carefully.

4-4-1 CSAMT Prospecting

The following features can be pointed out regarding the characteristics of the resistivity structure and the anomalies after careful consideration of the plan maps and sections of the apparent resistivity and of the resistivity structure.

(1) In the Küre Mining Zone as a whole, intermediate resistivity of 100-300ohm-m is predominant. This tendency has spread into the neighboring areas. High resistivity of over 1,000ohm-m mainly occurs in the central part of the area with NW-SE trend. This high resistivity extends downward to the deeper zones and at 500m depth, resistivity exceeding 300ohm-m occurs throughout the area.

(2) The low resistivity anomalies related to Aşıköy, Bakibaba, and Kızılsu mineralization are notable. Particularly at the southeast of Aşıköy Ore-body, it was found by the present survey that groups of small anomalies extend toward the Kızılsu Deposit. Also small but significant low anomalies are confirmed in the northern and southern parts of the Bakibaba Deposit.

(3) Regarding weak anomalies, there are the northeastern Bakibaba weak anomalies which are related to the mineral showings in the northeastern part of Bakibaba. There are the eastern Bakibaba anomalies to the south of the above. On the surface, slag from the old Bakibaba Mine is dumped widely. Thus, although it has not been recorded as mineral showings, the present investigation shows that there is a mineralized zone extending in the NNW-SSE direction under the slag heap.

Regionally, this anomaly group is continuous for four traverse lines from Line C to E2. It occurs as en echelon with the northeastern Bakibaba weak anomalies in the north and the southern extension continues to the Zemberekler Stream Mineralized Zone.

(4) Ersizler and İpsinler Mineral showings are known in the northeastern Küre Mining Zone. CSAMT random points were measured in these localities for determining the existence of anomalies and slight decrease of resistivity was found, but not to the extent of being anomalies. Thus the potential of these two showings is considered to be low.

(5) Although the mineral potential of the Kızılsu Deposit and the Zemberekler Stream Prospect are considered to be high, noise from high tension transmission cables was strong and measurements could not be carried out.

(6) Notable low resistivity anomalies were confirmed about 1km south from the Ipsinler Mineral Showings and about 400m north of Ersizler Showings by CSAMT random point measurements. Array measurements were carried out on these anomalies and strong low anomaly zones were analyzed. These two localities, however, are in talus deposits with tall limestone cliff behind them. Therefore, there were some misgivings as to the cause of the anomalies, mineralization or groundwater and other factors not related to mineralization IP method was applied in order to ascertain the origin of the anomalies.

(7) The anomalies at, the western end of Lines A and B, east-southeast of Yunusköy, and east of Mt. Karamanyayla, appear to have wide distribution. The first two occur in shale and sandstone (Kss) and the latter in serpen-

tine. There are no mineral showings in the area and these are not considered to be promising.

(8) It was clarified by this investigation that the distribution of high resistivity corresponds to the occurrence of basaltic rocks. The high resistivity extends in the NW-SE to NNW-SSE direction and the discontinuity line of the resistivity also extend in the same direction. This direction is harmonious with the trend of the geologic structure of the area.

(9) The two low resistivity zones located at the middle-deeper parts under the southeastern part of Aşıköy and the eastern part of Bakibaba Deposit, disappeared after interpretation by two-dimensional analysis. The reason for the disappearance is the difference of methods between one-dimensional and two-dimensional analysis.

The one-dimensional structure is prepared by analyzing each station by the minimum error between the theoretical values of the horizontal multilayer structure model and the observed values. The other hand, the two-dimensional structure is prepared by analyzing the whole area (or several stations) calculated by the minimum error between theoretical and observed values. The areal extent for calculation and size of cells are carefully considered so that small size anomalies of one or two stations would not be neglected.

The application of one-dimensional analysis is difficult or impossible in areas with steep dip, and thus the results of two-dimensional analysis is much more reliable than the one-dimensional method.

The above two low anomaly zones are important because these zones are continuous and related to ore deposits or mineral showings. More detailed two-dimensional reanalysis should be considered for the future exploration.

From the above, the major achievements of the CSAMT survey can be summarized as follows. Significant low resistivity zone was confirmed from the Aşıköy Orebody southeastward. Low resistivity anomaly zone was confirmed from the east of Bakibaba Deposit extending in the NW-SE direction to Zemberekler Stream Prospect. Small but strong low resistivity anomalies were confirmed to the north and south of Bakibaba. These anomalies are related to known deposits and mineral prospects and thus are very important for future mineral exploration in the area. The source of the two notable anomalies at south of Ipsinler and north of Ersizler Prospect could not be determined by CSAMT alone because of the complete lack of surface manifestations.

On the other hand, the distribution of high anomalies agrees with the occurrence of basaltic rocks and serpentine and the laboratory tests indicate the cause of the high resistivity to be these mafic bodies.

4-4-2 IP Prospecting

FE anomalies of any significance was not detected by CSAMT measurements in three traverse lines. The low anomalies detected by CSAMT in Line II are considered to be caused by groundwater because they occur in talus deposit and there is a tall limestone cliff in the back. The reason for the inability to detect the shallow, 50m, anomalies of Line DD is considered to be the long electrode interval of a= 100m, IP with 25-50m electrode interval would be more appropriate for such shallow depth.

4-4-3 Laboratory Tests

The following characteristics regarding the physical properties (resistivity and FE) of rocks were clarified.

(1) The general tendency regarding resistivity is; igneous rocks - diorite and basaltic rocks - have high 300-4,000ohm-m resistivity while sedimentary rocks - shale and sandstone - have low 70-1,300ohm-m values. These values vary considerably and those of the igneous and sedimentary rocks overlap. The values of shale and sandstone tend to be higher than those of other areas.

(2) The rock with the highest resistivity is limestone followed by serpentine, hyaloclastite, pillow lava, massive basalt, diorite, sandstone, and black shale.

(3) The FE values do not fluctuate as much as resistivity. They are within the normal range of natural rocks. Serpentine has the highest value of 12.1% followed by black shale, hyaloclastite, sandstone, diorite, massive basalt, pillow lava, and limestone. The lowest value is 0.4%, limestone.

(4) Serpentine of this area has high resistivity and high FE while limestone has high resistivity and low FE within the known range.

(5) Ores of Aşıköy, Bakibaba, and Kızılsu Orebodies have FE around 40% and extremely low resistivity of 7.5ohm-m. Thus they are distinguishable from the host rock by these physical properties. The FE of gossan and slag was unexpectedly low at 4.2% and 17.9%. The resistivity of gossan is high

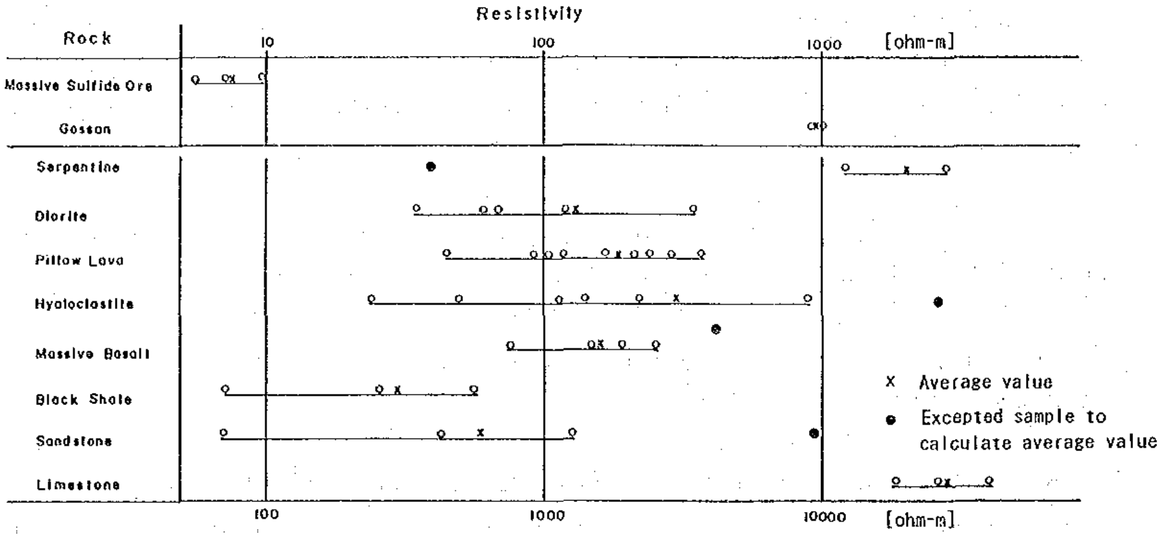
similar to diorite and basalt, but that of the slag is low at 220ohm-m, within the range of sedimentary rocks.

If sulfide ores exist over certain size, it is highly probable that it can be identified by FE values. There are, naturally, cases when such orebodies cannot be detected because of its small size and large depth of emplacement.

Regarding resistivity, it is difficult to distinguish orebodies, because some of the black shale and sandstone samples have resistivity similar to sulfides. On the other hand, it is difficult to identify rocks by resistivity values, but it would most probably be possible to distinguish igneous rock and sedimentary rocks.

The emphasis of the present survey was in the area adjoining the operating Küre Mine and urban areas. Therefore, noises from ore dressing mill, power transmission cables, ropeways, and other mine facilities were large impediment for geophysical measurements. The result was insufficient measurement points and lines in some of the high potential zones such as Kızılsu Deposit, and Ersizler Stream Prospect. Also the eastern side of the Route 39 where CSAMT array line was established, the noise from three power transmission cables was strong and antenna for measuring the magnetic field could not be set at the center of the array as in normal practice. Also in some cases the strong filtering was necessary in order to eliminate the disturbances in the resistivity curve. Thus the accuracy of the analysis of the above zones are not as high as for other parts of the area.

Many low resistivity anomalies were detected at 50-100m depth southeast of the Aşıköy Orebody. Considering the fact that the orebody (40-80m wide) confirmed by drilling near the Toykondu Orebody could not be detected from the surface, it is necessary to expand the frequency into high regions for acquiring information of shallow subsurface zones. The present technology enables the use of frequencies up to 8,000Hz and thus it would be possible to explore zones up to 20-30m depth.



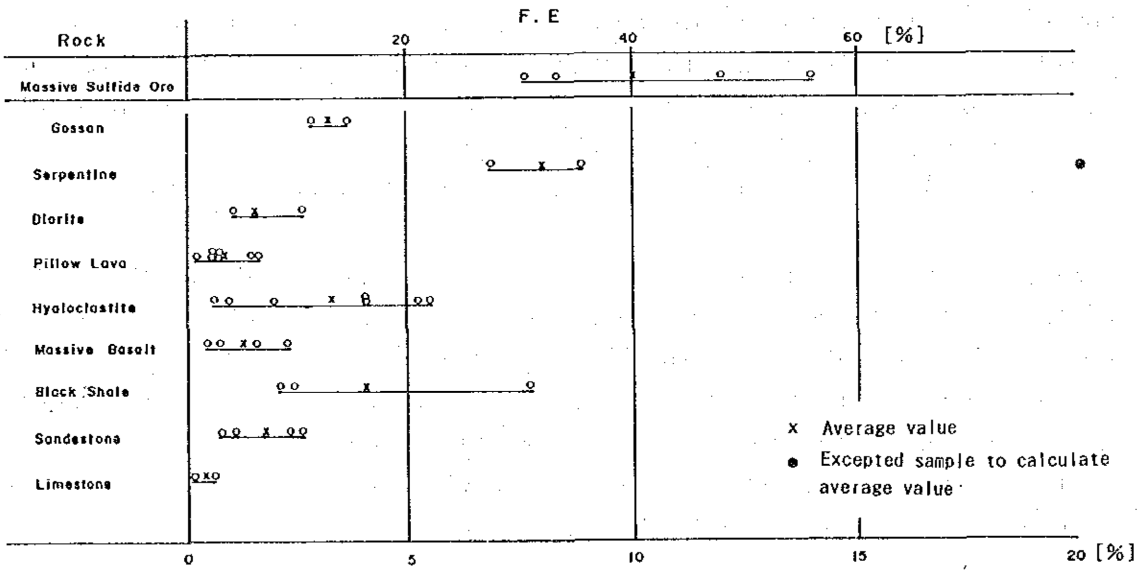


Figure 3-23 Distribution for Resistivity and FE of Rock Samples

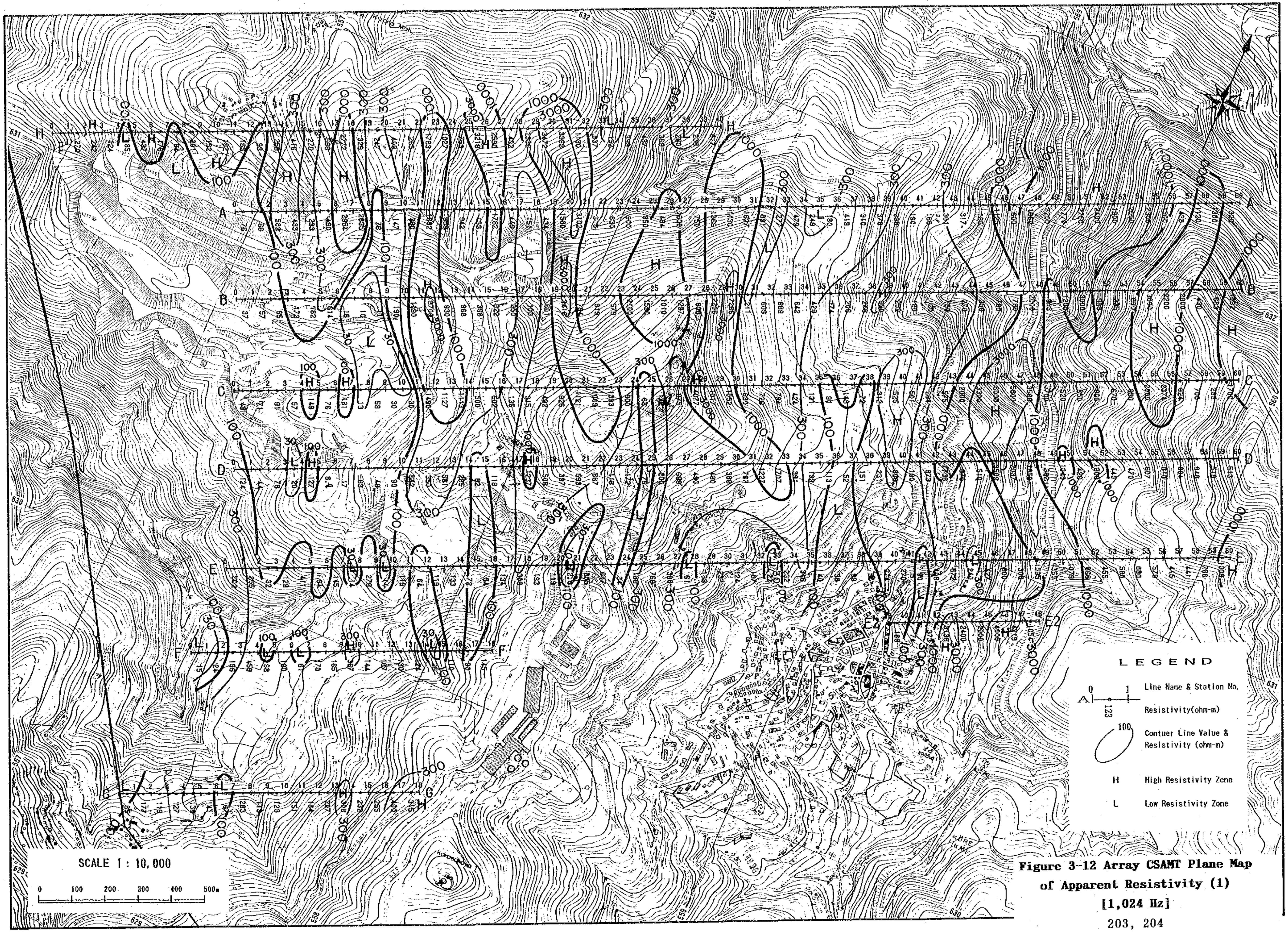


Figure 3-12 Array CSAMT Plane Map of Apparent Resistivity (1)
[1,024 Hz]

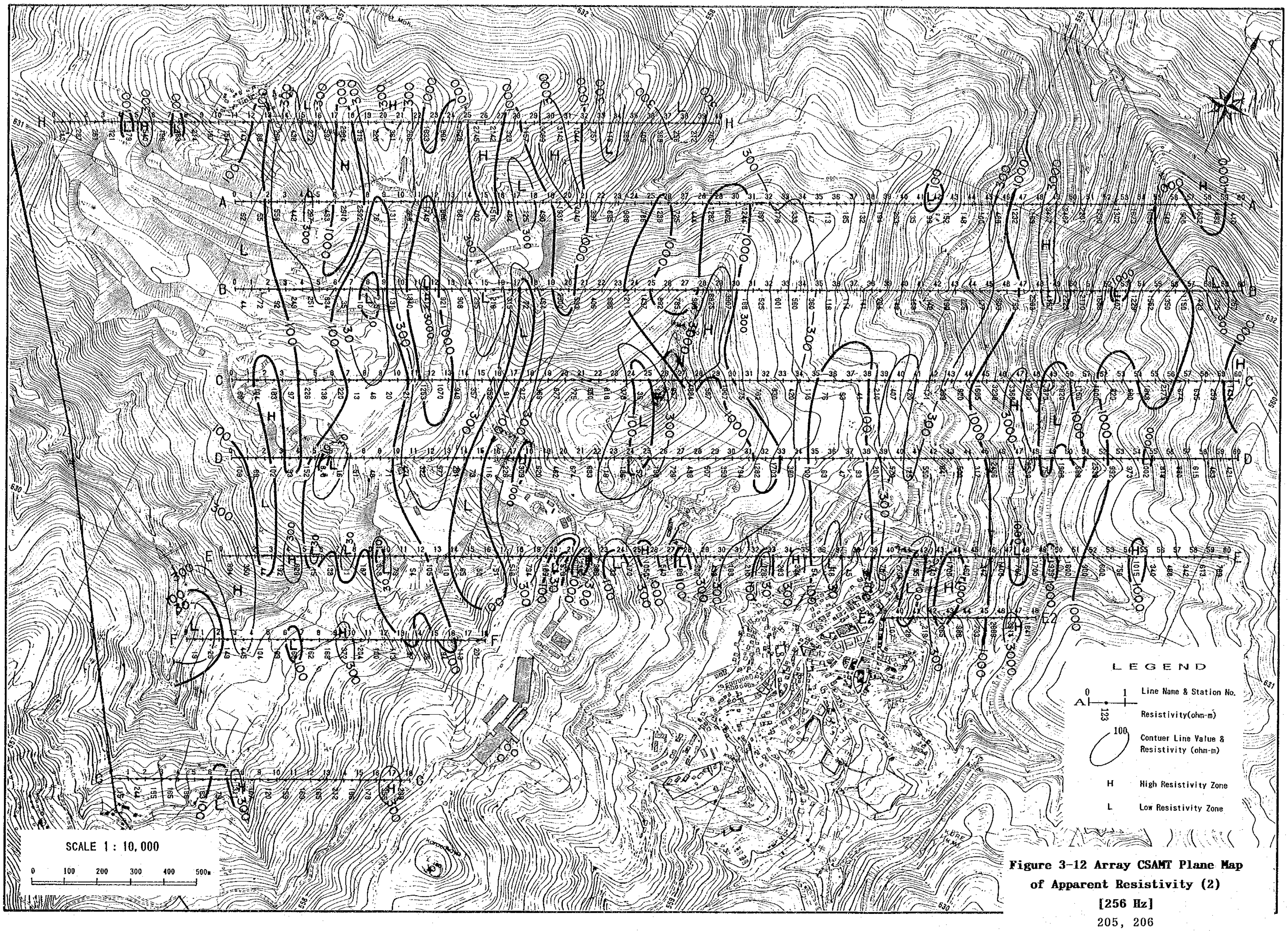


Figure 3-12 Array CSAMT Plane Map of Apparent Resistivity (2) [256 Hz]

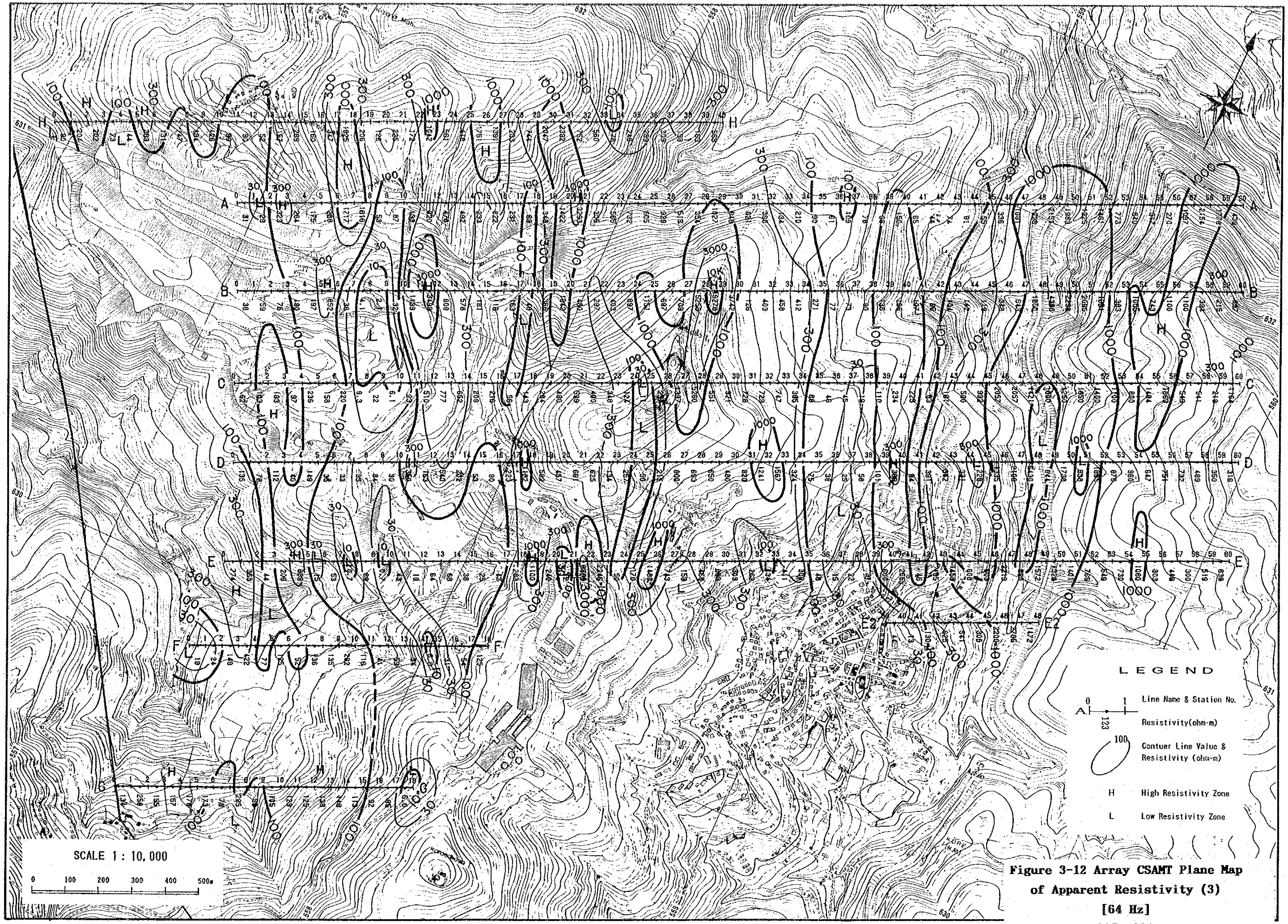


Figure 3-12 Array CSAMT Plane Map of Apparent Resistivity (3) [64 Hz]

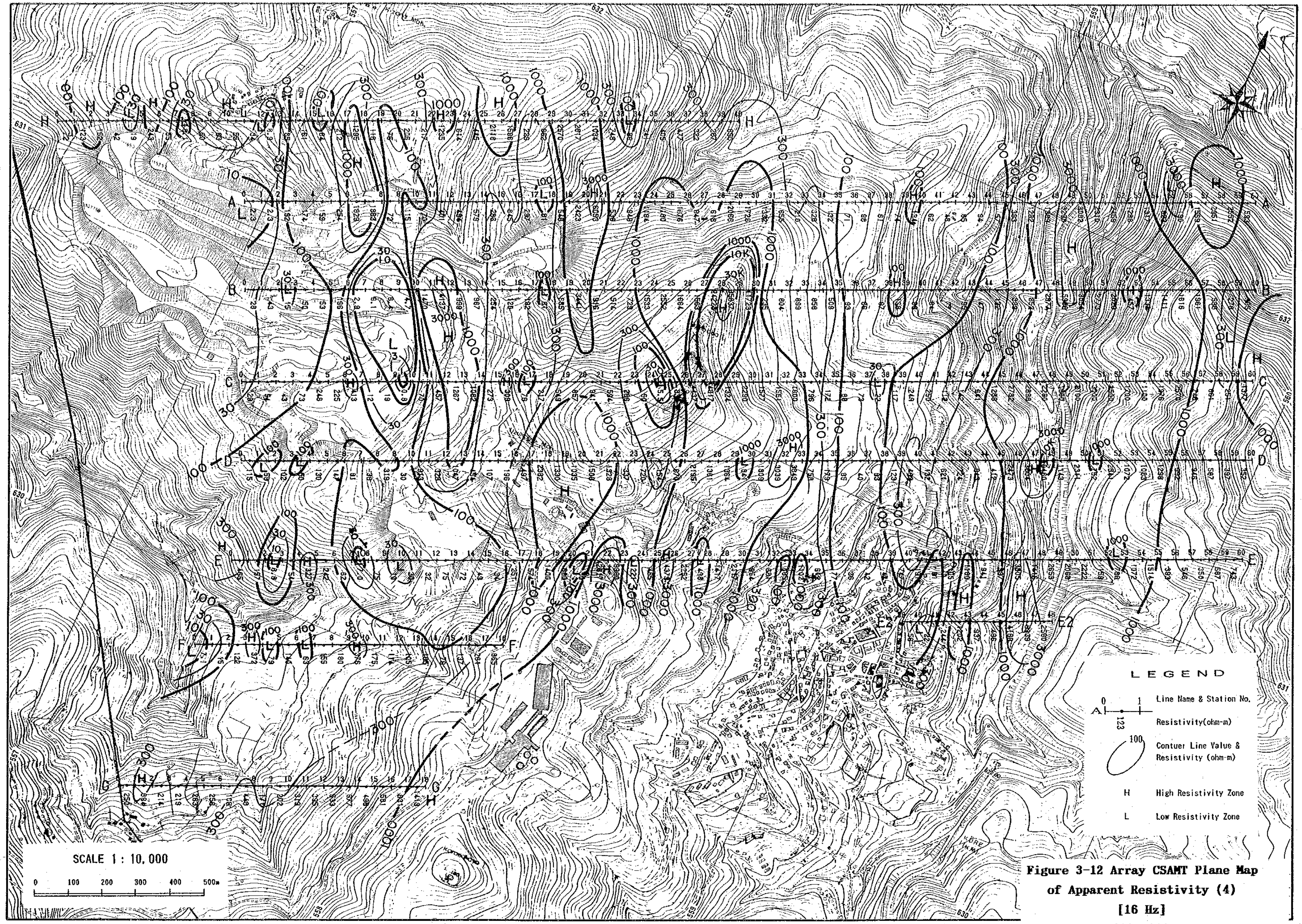


Figure 3-12 Array CSAMT Plane Map of Apparent Resistivity (4)
[16 Hz]