REPORT
ON
THE MINERAL EXPLORATION
IN
THE ESPiYE AREA,
THE REPUBLIC OF TURKEY

PHASE II

MARCH 1997

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

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PREFACE

The Government of Japan, in response to the request of the Government of Republic of Turkey, decided to conduct a mineral exploration composed of geophysical survey and drilling survey, in Espiye area, Republic of Turkey.

The Japanese Government entrusted the survey to the Japan International Cooperation Agency (JICA), and JICA in turn sought the cooperation of the Metal Mining Agency of Japan (MMAJ) to accomplish the survey, considering the importance of technical nature of the work. The survey will be carried out within a period of three years commencing from 1995. The JICA and MMAJ dispatched the survey mission for phase II survey consisting of 7 members to Turkey from July 21st, 1996 to November 9th, 1996.

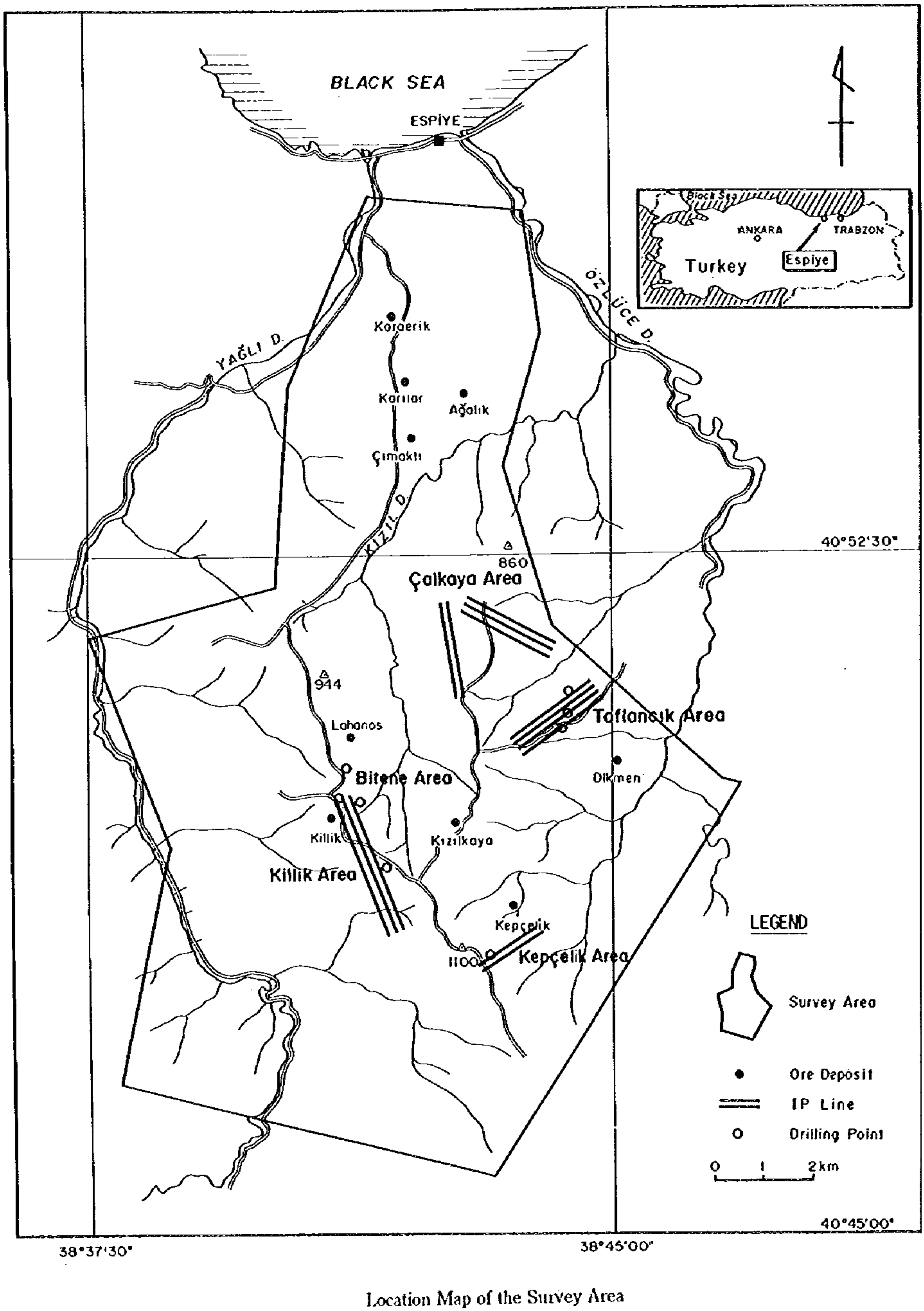
The field survey in Turkey was carried out successfully with cooperation of the Turkish Government authorities, and General Directorate of Mineral Research and Exploration. This report summarizes the result of the survey carried out in 1996 and also forms a part of the final consolidated report which will be submitted to the Government of Republic of Turkey after completion of the survey.

We wish to express our deep appreciation to the officials of the Government of Republic of Turkey and to the Embassy of Japan in Turkey concerned for their close cooperation extended to the survey mission.

March 1997

Kimio Fujita
President
Japan International Cooperation Agency

Syouzaburo Kiyotaki
President
Metal Mining Agency of Japan



Location Map of the Survey Area

Summary

This survey was carried out in order to study the geological frame work and discover new ore deposits of massive sulfide type in the Espiye area, the Republic of Turkey. The survey of this year (phase II) includes the geophysical exploration (IP method) and the drilling survey which were carried out for the following promising areas proposed in phase I survey. The extent of the survey was as follows. The total survey lines of 30km in the geophysical exploration IP method, eight boreholes of the drilling survey and total excavation length of 1,749m.

As far as Killik area is concerned, three survey lines of the geophysical exploration and one hole of the drilling survey (MJTE-1) were carried out. The drilling survey revealed a copper disseminaiton zone (25 cm wide, Cu grade of 4.88%) in footwall dacite. Through the geophysical exploration a strong IP anomaly zone in the southern part of the area was confirmed, and since this zone corresponds to the distribution area of the footwall, it was presumed that a dissemination - stockworked large scale low grade (Cu)ore deposit may exist.

As for Kepçelik area, two survey lines of the geophysical exploration and one hole of drilling survey (MJTE-2) were carried out. From the fact of weak mineralization in this area, it was presumed that the potential of an existence of massive sulfide ore body is low.

For Bitene area, three holes of drilling survey (MJTE-3,4 and 5) were carried out. A massive sub yellow ore (20cm wide, Cu grade of 12.58%, Au of 2.06ppm) in footwall dacite in MJTE-3 were confirmed. However, since a remarkable mineralization could not be observed in other boreholes, it was judged that the potential is low that an extension of Killik ore deposit or a large-scale satellite ore body around Lahanos ore deposit will exist.

With regard to Taflancık area, four survey lines of the geophysical exploration and three boreholes of the drilling survey (MJTE-6, 7 and 8) were carried out. The geophysical exploration revealed that a strong IP anomaly zone lie in the central part of the area. As the anomaly zone shows NNE-SSW trend, an existence of the same kind of mineralization such as in Lahanos Mine was expected. Drilling survey was conducted in a part of this anomaly zone. Though a massive ore body itself could not be discovered, intense mineralization was observed in the footwall in every three boreholes. High possibility of an existence of ore deposit was considered in the IP anomaly area because intense alteration zone with sericite, kaolinite also exists in some part and yellow ore fragments were observed.

Concerning Çalkaya area, though five survey lines of the geophysical exploration were carried out, not a new anomaly zone was found. However the hanging wall is too thin for IP survey, it is considered that the potential of this area is low at this stage.

Although, Karaerik - Çımaklı area was proposed as one of promising areas by phase I survey, obviously previous study around this area did not reached to the ore horizon. That is, the alteration and

mineralization occurred in a part of hanging wall. Therefore, there is space for the further prospecting.

Based on the above mentioned survey results, we propose that the geophysical survey and the drilling surveys to be carried out in the following area as the third year survey.

*Taflancık area

Survey method: Drilling survey

*Karaerik - Çımaklı area

Survey method: Geophysical and drilling survey

*Killik area

Survey method: Geophysical and drilling survey

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PART I General Remarks

Chapter 1 Introduction

1-1 Background and Purpose

This survey will be held for three years from 1995, and this year is the second year in this survey. The survey area was established around Espiye area in the Republic of Turkey where massive sulfide ore deposits can be highly expected to exist. It is urgently important to explore in this area and to evaluate, because real exploration works have not been carried out sufficiently.

Then the government of Turkey requested Japanese government to survey for mineral resources in the above mentioned area, under joint technological cooperation with Japan side. The government of Japan, in response to the request from the government of Turkey,decided to conduct the basic survey such as geophisical survey and drilling survey for new ore deposits, and to transfer the technology to Turkish side, as second year's program.

1-2 Conclusion and Proposal of the First Year

1-2-1 Conclusion of the First Year

The survey was composed of existing documents analysis, geological survey (including geochemical survey) and geophysical survey(gravity and IP methods). Conclusion from these surveys are described as follows,

1. Geology

Geology of the survey area are composed of Çatak, Kızılkaya and Çağlayan Formations, and intrusive rocks in ascending order which seem to be formed in late Cretaceous to Palaeocene. Çatak Formation is comprised of andesite lava and its pyroclastic rocks with small amount of pelitic rocks. Kızılkaya and Çağlayan Formations are mainly comprised of dacite lava and its pyroclastic rocks, and rock facies of these two Formations are very resemble to each other, but pelitic rocks are usually intervened between these two Formations. Hematite dacite and biotite dacite intruded into the above mentioned three Formations.

2. Geological Structure

Uplift zones in southern to western part where Çatak Formation deposited and subsidence zones in central to northern part where Kızılkaya and Çağlayan Formations deposited were confirmed.

Dacite of Kızılkaya Formation extruded in subsidence zones of central part controlled by north-east and north-western fractures in Çatak Formation. Centers of volcanic activities of Çağlayan Formations were shifted from south to north, and dacite of Çağlayan Formation extruded in northern part under control of north-northwest, north-east and east-western trending fractures.

3. Analysis of Gravity

On short wave gravity map, high gravity zones composed of andesitic rocks of Çatak Formation in southern part and low gravity zones composed of dacitic rocks of Kızılkaya Formation in central part were confirmed. In northern part, two gravity zones were confirmed, that is, one was low gravity zones composed of dacitic pyroclastic rocks of Çağlayan Formation, and the other was high gravity zones composed of dacite lava and intrusive rocks of Çağlayan Formation

North-eastern and north-western low gravity zones in central part was concluded to be subsidence zones controlled by geological structure of southern Çatak Formation. Massive sulfide ore deposits such as Lahanos and Killik ore deposits were revealed to develope around these low gravity zones where strongly regional and neutral acidity argillization could be observed.

4. Ore Deposits

In this survey area, two types of ore deposits were recognized, one is massive sulfide ore deposits and the other is disseminated to networked ore deposits. Massive sulfide ore deposits such as Lahanos and Killik ore deposits, were contained conformably in uppermost members of Kızılkaya Formation. Disseminated to networked ore deposits such as Karılar and Karaerik ore deposits were contained in Çağlayan Formation.

Ore minerals of massive sulfide ore deposits were composed of pyrite, chalcopyrite and sphalerite as main components, and galena, tetrahedrite, gold minerals and silver minerals as accessory components. In disseminated to networked ore deposits, pyrite was a main mineral, and chalcopyrite and sphalerite were accessory minerals. Scale and ore grade of massive sulfide ore deposits seemed to be much better than those of disseminated to networked ore deposits.

5. Alteration

Neutral to acidic alterations related with mineralization, were observed besides neutral to alkaline regional alteration. Strongly altered zone around Lahanos ore deposit showed white and acidic alteration products such as quartz, kaolinite, alunite and pyrite. Around other massive sulfide ore deposits such as Killik and Kızılkaya ore deposits, strongly altered zones composed of neutral acidity alteration products such as quartz, sericite and pyrite were formed showing white in color.

White~reddish brown strongly altered zones composed of neutral acidity alteration products such as quartz, sericite and hematite were formed around disseminated to networked ore deposits.

6. Geochemical Survey

Analytical data from rock and soil samples were analyzed statistically by principal components analysis that is one of multivariables analysis. Consequently second principal component from analysis of rock samples showed high positive correlation with Au, Ag, Cu, Pb, Zn, As, Sb, Fe and Mo, and contents of these elements were higher than those of worldwide backgroud values. Then 2nd component was thought to suggest the influence of mineralization. High scored areas of 2nd component developed around massive sulfide ore deposits such as Lahanos ore deposits and around disseminated to networked ore deposits such as Karaerik ore deposits, and they corresponded very well to mineralized zones around known ore deposits and known altered zones.

First principal component from analysis of soil samples had high positive correlation with Au, Ag, Cu, Pb, Zn, As, Sb, Mn, Mo and Ba, and 2nd component showed high positive correlation with Cu, Fe and Mn. High scored areas of 1st component developed around massive sulfide ore deposits such as Lahanos and Killik North ore deposits, then it was concluded to suggest the influence of mineralization from massive sulfide ore deposition. High scored areas of 2nd component developed around mineralized zones in Çağlayan Formation, therefore it was concluded to be anomalies derived from disseminated to networked ore deposition.

7. IP Anomaly

IP survey was performed in two areas, that is, one is area between Lahanos and Killik ore deposits and the other is area between Çalkaya and Taflancık. According to geological survey, Kızılkaya Formation containing massive sulfide ore deposits were covered by Çağlayan Formation in these two areas, and mineralization and alteration were observed in both Formations.

In these two areas, IP anomalous zones showing over 6mV/V chargeability and weak IP anomalous zones showing 4~6mV/V chargeability were recognized widely. These IP anomalous zones developed around boundary zones between Kızılkaya and Çağlayan Formations, and in Kızılkaya conformably, then they were interpreted to be influenced by massive sulfide ore deposition. On the contrary, low resistivity zones developed mainly around IP anomalous zones, but some of them were observed to have attained to surface. Then low resistivity zones reaching to surface were considered to be influenced by disseminated mineralization and argillization in Çağlayan Formation.

8. New Hopeful Areas for Exploration

New hopeful areas were selected as follows, after comparison of geology, geochemistry and geophysics with known ore deposits.

(1)Area between Lahanos and Killik Ore Deposits

In this area, Kızılkaya Formation containing massive sulfide ore deposits such as Lahanos and Killik ore deposits was covered by Çağlayan Formation. In Bitene area south of Lahanos ore deposits, ore showings composed of pyrite ore were observed. In Kızılkaya Formation of this area, acidic alteration zone composed of kaolinite were formed as well as case of Lahanos ore deposits, and high concentrated zones of Au, Ag, Cu, Pb, Zn, As and Sb were also observed. IP anomalous zones also developed widely, but their electrode intervals seemed not to be sufficient. In Çağlayan Formation, disseminated pyrite and neutral alteration zones could be observed.

(2)Area between Killik and Kepçelik Ore Deposits

Kızılkaya Formation containing massive sulfide ore deposits was covered by Çağlayan Formation in this area. Neutral alteration zones composed of sericite as well as Killik ore deposits were formed in Kızılkaya Formation. In Çağlayan Formation too, ore showings mainly composed of disseminated pyrite and neutral alteration zones composed of sericite were formed. Geochemical anomalous zones containing high amounts of Au, Ag, Cu, Pb, Zn, As and Sb developed in Kızılkaya Formation. Geochemical survey by soil samples and IP survey were not performed yet.

(3)Area between Çalkaya and Taflancık

Kızılkaya Formation was covered by Çağlayan Formation. Acidic to neutral alteration zones including kaolinite and sericite were formed in Kızılkaya Formation. Ore showings mainly composed of disseminated pyrite and neutral alteration zones composed of sericite were formed in some parts of Çağlayan Formation. High concentrated zones of Au, Ag, Cu, Pb, Zn, As and Sb were also formed in Kızılkaya Formation. IP anomalies were also detected, but their electrode intervals seemed not to be sufficient. Geochemical survey by soil samples was not carried out here.

(4)Area between Çımaklı and Karaerik Ore Deposits

Kızılkaya Formation was covered by Çağlayan Formation. Neutral alteration zones including sericite were formed in Kızılkaya Formation. Disseminated ore deposits mainly composed of pyrite such as Karılar ore deposits and neutral alteration zones including sericite were formed in Çağlayan Formation Geochemically anomalous zones with high contents of Au, Ag, Cu, Pb, Zn, As and Sb were confirmed in both Kızılkaya and Çağlayan Formations. Geochemical survey by soil samples and IP survey were not performed yet.

(5)Dikence Area

Kızılkaya Formation was not exposed in this area and was covered by Çağlayan Formation. In Çağlayan Formation, disseminated ore deposits mainly composed of pyrite and neutral alteration zones including sericite were formed. High concentrated zones of Au, Ag, Cu, Pb, Zn, As and Sb were confirmed in Çağlayan Formation. Geochemical survey and IP survey were not conducted yet.

1-2-2 Proposal to Second Year's Program

After discussing geology, ore showings and alteration, gravity distribution, geochemical and IP anomalies resulted from this year's survey, five new hopeful areas are selected as mentioned below and the following works were proposed for phase II program.

(1)Area between Lahanos and Killik ore deposits

(2)Area between Killik and Kepçelik ore deposits

(3)Area between Çalkaya and Taflancık

(4)Area between Çımaklı and Karaerik ore deposits

(5)Dikence area

(1)Area between Lahanos and Killik Ore Deposits

Drilling works are proposed in IP anomalous zones. Where electrode intervals were not sufficient in first year's IP survey and main target positions for drilling works were not decided, supplementary IP survey will be performed.

(2)Area between Killik and Kepçelik Ore Deposits

After geochemical survey by rock samples and survey for altered zones, parts of ore showings were detected. Then detailed geochemical survey by soil samples and IP survey will be necessary to delineate details of ore showings detected in first year's survey.

(3)Area between Çalkaya and Taflancık

Drilling works are proposed in the ore showings which were detected by first year's survey, that is, geochemical survey by rock samples, survey for altered zones and IP survey. Detailed geochemical survey by soil samples and geophysical survey are requested to plan another drilling works. IP survey and resistivity survey should be carried out simultaneously in geophysical survey, because Çağlayan Formation covers Kızılkaya Formation in this area with 200～300m thickness.

(4)Area between Çımaklı and Karaerik Ore Deposits

Detailed geochemical survey by soil samples and geophysical survey are proposed to clarify details of ore showings, because position of ore showings were detected roughly by first year's survey, that is, geochemical survey by rock samples and survey for altered zones.

(5)Dikence Area

Detailed geochemical survey by soil samples and geophysical survey are proposed to clarify details of ore showings, because position of ore showings were detected roughly by first year's survey, that is, geochemical survey by rock samples and survey for altered zones. IP and resistivity surveys should be performed simultaneously, because Kızılkaya Formation containing massive sulfide ore deposits is covered Çağlayan Formation with around 300m thickness.

1-3 Outline of Phase II Survey

1-3-1 Survey Area

The survey areas were established in the areas concluded to be hopeful by Phase I Survey. That is , Bitene Area to Killik Area (on the south of Lahanos Mine which operating presently), Kepçelik Area and Çalkaya Area to Taflanclk Area were selected.

1-3-2 Purpose of Survey

The purpose of geophysical survey (IP Method) was established to define drilling point after analyzing anomaly related mineralization along survey line in hopeful area and the purpose of drilling survey was to obtain the state of mineralization and to clarify the continuity of ore horizon in hopeful areas.

1-3-3 Method and Content of Survey

Geophysical survey (IP Method), drilling survey and laboratory tests were carried out, and the content of these surveys were summarized as shown in Table.1-1-1.

Table 1 - 1 - 1(1) List of Survey Amount

Area	Number of line	Length of line(km)
Killik	3	9
Kepçelik	2	3
Taflanclk	4	8
Çalkaya	5	10
Total	14	30

Table I - 1 - 1(2) List of Survey Amount

Area	Drilling No.	Depth(m)	incrination
Killik	MJTE-1	250	-90°
Kepçelik	MJTE-2	260	-90°
Bitene	MJTE-3 MJTE-4 MJTE-5	154 212 261	-90° -90° -90°
Taflancık	MJTE-6 MJTE-7 MJTE-8	212 200 200	-90° -90° -90°
Total	8 holes	1749	

Table I - 1 - 1(3) List of Survey Amount

Items	Amount
(1)Thin Section	15
(2)Polished Section	15
(3)X-ray diffraction	40
(4)Chemical Analysis Cu,Pb,Zn,Au,Ag,Fe,S	43
(5)K/Ar Dating	2
(6)Measurment of resistivity and chargeability	42

1-3-4 Survey Team

Members Participating in this survey are as follows.

Survey Team

Japanese Members			Turkish Members		
Shigehisa FUJIWARA	Leader	Dowa	Nevzat KARABALIK	Project Manager	MTA*
Saichi ISHII	Drilling	〃	Hüseyin YILMAZ	Camp Leader	〃
Kinichiro ITO	〃	〃	Mustafa KURÇELIK	Geologist	〃
Ryoichi SUDO	〃	〃	Ali FAIK ALTINBAŞ	〃	〃
Kuraei IWAKI	Geophysist	〃	Turgut ÇOLAK	〃	〃
Norikiyo SUGIURA	〃	〃	Hasan YEMEN	Geophysist	〃
Masatoshi MAEKAWA	〃	〃	Kadir DEMIR	〃	〃
			Hasan SOYLU	〃	〃
			Omer DUMAN	〃	〃
			Mustafa DEMIRHAN	〃	〃
			Hurşit ASLANOĞLU	Drilling	〃
			Ersin KARABULUT	〃	〃
			Avni AKDENIZ	〃	〃
			Etem OFLU	Measurement	〃
			Erdem ÖZBAYRAK	〃	〃

*:MTA(General Directorate of Mineral Research and Exploration)

Supervisor in Turkey

Toyo MIYAUCHI	MMAJ (Metal Mining Agency of Japan)
Katsuhisa OHONO	MMAJ
Mehmet BALCI	MTA
Yavuz ULUTÜRK	MTA
Murat ER	MTA

1-3-5 Terms of the survey

Field survey was carried out as follows.

Survey in Turkey : July 21, 1996 ～ November 9, 1996

Geophysical Survey : July 21, 1996 ～ September 23, 1996

Drilling Survey : July 21, 1996 ～ November 9, 1996

Chapter 2 Geography in the Survey Area

2-1 Location and Transportation

The Espiye area is an area of 150km^2 extending south from Espiye Town (population of about 10,000) located about 100km west of Trabzon City, a major city along the cost of the Black Sea, in the north-east area of the Republic of Turkey(see location map). It takes about one hour from Ankara, the capital, to Trabzon by air and less than two hours are required by car from Trabzon to Espiye through a paved road along the Black Sea.

This region belongs to Giresun Prefecture of which center is Giresun City located 30km west of Espiye Town in terms of administrative division.

The survey area is a hazelnut-producing area and is dotted with small villages. An unpaved road in bad condition leads to each village. However, they are often closed to traffic during the rainy season. It takes less than two hours by car with four-wheel drive from Espiye Town, a base town, to Kepçelik, the southern end of the second year survey area.

2-2 Topography and Drainage

Within this survey area belonging to the Black Sea coast part, a fold mountain range (Inoue, 1970) formed in the beginning of the Alpine orogenic cycle, called as the East Black Sea Mountain Range falls sharply into the vicinity of the coast, and there is little flat land. For this reason, the area is tens of meters to about 1,500 meters high above the sea level and its land form is steep and relatively rich in undulations.

The survey area is divided into two by a dividing ridge running from north to south in the center. That is, the eastern part belongs to the upper reaches of the river system of Kızıl Dere and Karadona Dere, a branches of Özluce Dere. The western part corresponds to the upper reaches of branch streams of the Yağli Dere system. These streams form a steep V-shaped valley.

2-3 Climate and Vegetation

This area which has the heaviest rainfall and snow in the Republic of Turkey belongs to a Black Sea type climate (MMAJ, 1970) because a warm and wet wind from the Black Sea blows against the Black Sea Mountains. For this reason, the vegetation grows thick. Rainfall is plentiful from September through March and the average rainfall for October in Trabzon reaches 300mm. In November rain turns to snow. The average temperature in August reaches the maximum, 24℃, and that in February falls to the minimum, 6℃.

Since this area is a hazelnut-producing area, even a steep mountainous slopes are covered with these trees in many places. Particularly, this tendency is significant in the northern part. Natural plants can be often seen in high elevation area of the southern part and shrubs such as rhododendrons grow thick with some evergreen oak trees and beech trees.

Chapter 3 General Geology

3-1 Outline of Geology

Turkey is geologically divided into three areas of Pontides in the north, Anatolides in the middle, and Torides in the south (Konmaz et al. 1992). The survey area is located in the north-east of the Pontides area. The basement in the Pontides area consists of metamorphic rocks and granitic rocks, and six stratigraphical units are distributed over it. They are Paleozoic, early Jurassic system - early Cretaceous system,late Cretaceous system - early Paleocene series, middle Paleocene - late Eocene series, Miocene series - Pliocene, and Pliocene series - Quaternary system in this order from the lowest layer.

Volcanic rocks belonging to the late Cretaceous system - early Paleocene are continuously distributed along the cost of the east Black Sea including this area and they are accompanied by massive sulfide type mine represented by Murgul, Çayeli, Lahanos,etc..

Güven et al (1992) classified the late Cretaceous system - early Paleocene into the Çatak Formation mainly composed of andesite - basaltic volcanics, Kızılkaya Formation mainly composed of dacitic volcanics, and Çağlayan Formation composed of andesite - basaltic lava, pyroclastics, and part of dacitic volcanics from the lowest layer. In addition, an intermittent distribution of granitic rocks which are thought to belong to the Tertiary period is observed in this zone.

From a structural point of view, the area along the coast of the Eastern Black Sea including this area is located in the north of the northern Anatoria Fault (WNW-ESE) which is a right-lateral transform fault and is classified as a Pontides orogenic zone as mentioned above.

It is thought that a deep fracture of an E-W - NE trending is related to the magmatism after Cretaceous period along the coast of the eastern Black Sea (Çagatay, 1993).

3-2 Mineralization and Mineralization zone

The eastern Black Sea area is a major metallogenic province in the Republic of Turkey (see Fig. I -3-1) and is accompanied by many ore deposits of copper, lead, zinc, iron sulfide, gypsum, etc. Among others, it is said that this area produces about 70% of the domestic yield of copper.

Various types of ore deposits are known in this metallogenic province. As a general tendency, an ore zonal arrangement is observed in order of porphyry Cu type, skarn deposit, network copper/iron sulfide deposit, massive - lenticular iron/copper/lead/zinc sulfide ore deposit, and manganese - hematite ore deposit from the mountain ridge toward the coast of the Black Sea. Among these, it is thought that a zone of the massive - lenticular iron/copper/lead/zinc sulfide ore deposits crosses the border into eastern Georgia.

Among these ore deposits, a massive sulfide ore deposit is particularly important. Murgul and Çayeli, a typical ore deposit, have the following features. Both ore deposits are formed in dacite lava of upper part of Kızılkaya Formation and the ore deposits are covered with relatively thick hematite dacite through a thin tuff of the hanging wall in Murgul. The ore deposit in Çayeli is covered with tuff and basaltic lava.

Ores in Murgul have the characteristic of stringer and dissemination. The aggregate of veinlets containing copper is the subject of the open cut mining. Zinc and gypsum exist only in the upper part of an ore body. An ore body in Çayeli is a steep lenticular ore body, and clastic ores rich in sphalerite, massive black ores, and yellow ores are found in this order from the top. Ores in the Lahanos ore deposit existing in the survey area resemble Çayeli ores, except that the distribution form of the Lahanos ore deposit is almost horizontal.

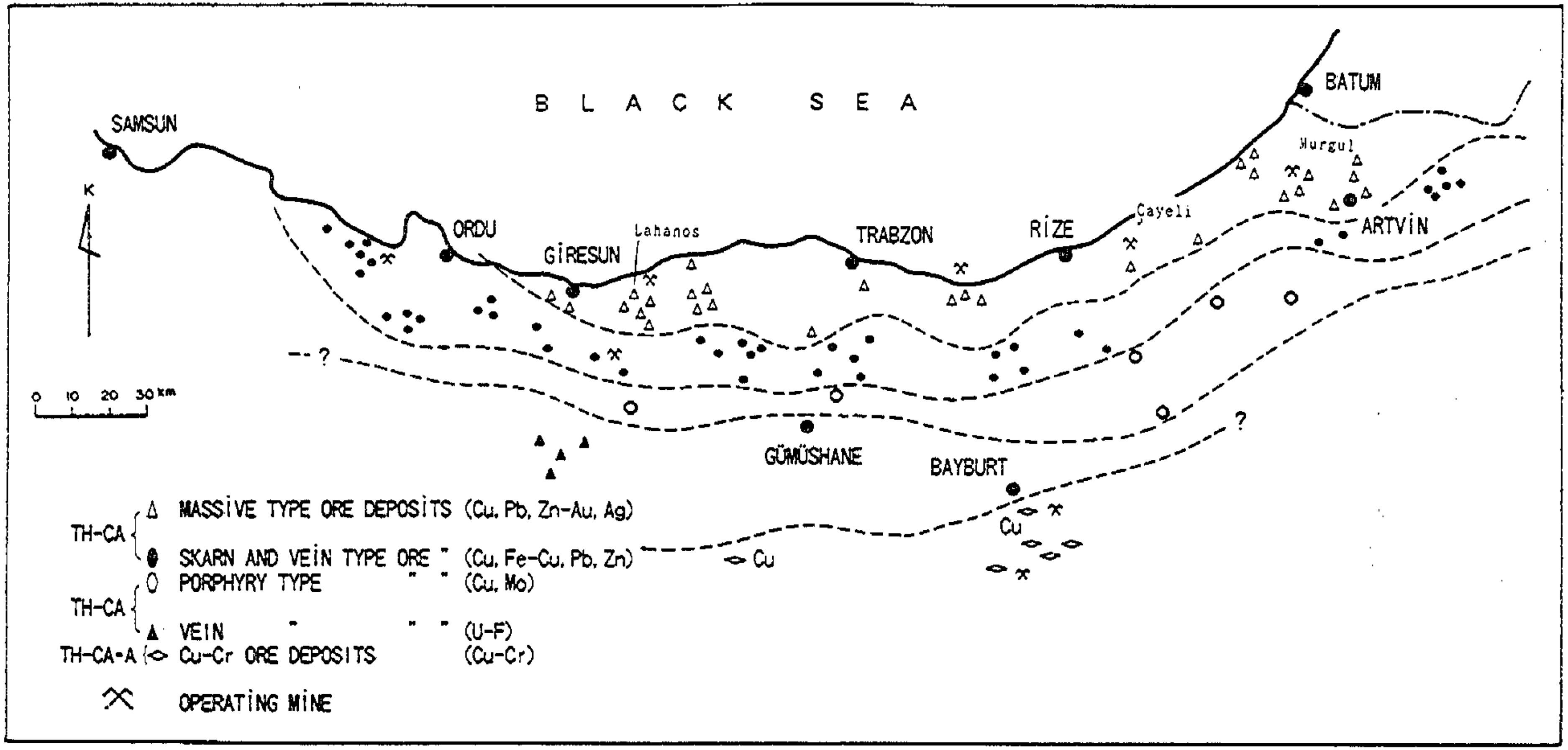


Fig. I -3-1 Metallogenic Province of East Black Sea Region

Chapter 4 General Discussion on Survey Results

4-1 Geological Structure, Characteristics of Mineralization, and Mineralization Restrictions

The geology in the survey area consists of the Çatak Formation mainly composed of andesitic volcanics, Kızılkaya Formation accompanies by pyroclastic rocks mainly composed of dacitic lava, Çağlayan Formation accompanied by a lot of intrusive rocks mainly composed of dacitic volcanics from the low layer. The schematic lithostratigraphy is shown in Figure I-4-I.

Also, the massive sulfide ore deposit along the coast of the Black Sea including this area is of the strata-bound type and resembles the kuroko-type ore deposit seen in Japan. Since the Lahanos ore deposit in operation in this area ,is hosted in top of the Kızılkaya Formation, an exploration area is limited to a distribution area of hanging wall such as the Çağlayan Formation .

As for the form of the ore body itself, the probability of a steeply dipping ore body such as that seen in the Çayeli Mine is low because the stratum gently undulate. In fact, it is said that an ore body is partly undulated in Lahanos but shows a gently inclined undulated form as a whole.

The ore body has a shape extending about 700 m in the NNE-SSW direction. A disseminated networked mineralization is predominant in the Kızılkaya ore deposit and it extend in a direction of NNE-SSW. This is reflected well on the landform and it is interpreted that a portion with a strong silicification remains as a mountain body in the same direction. The form and continuity of such an ore body are also observed clearly in the kuroko area in Japan. Therefore, it is necessary to pay attention to the alteration and mineralization zones indicating the NNE-SSW system in the survey area. However, as mentioned above, the distribution in the metallogenic province is NE-ENE system.

The drilling conducted 300 m south of the Lahanos Mine and the ground survey show a possibility that the mineralization accompanied by copper and zinc continued after a massive ore deposit was formed. In addition to this mineralization, the alteration with a strong argillization can be also observed, which is accompanied by sericite, carbonate minerals, and kaolinite. In particular, although kaolinite is not so popular in the kuroko-type ore deposit in Japan, it is thought that the existence of the kaolinite is not a little related to that of the massive ore deposit in this area because kaolinite is universally distributed around the Lahanos ore deposit, it is observed over and below the ore deposit in Çayeli Mine (former Madenköy Çagatay, 1993), etc..

4-2 Relationship between Geophysical (IP) Anomaly and Mineralization

Six holes of the drilling survey were carried out in the IP anomaly area. In the Taflancık area, distributions of two anomaly zone (northwest and southeast) in echelon form have been defined in Plane map of apparent chergeability (n=3-4). MJTE-6 is located near northwest anomaly zone, MJTE-8 is located in end of southeast anomaly zone and MJTE-7 is located near center of southeast anomaly zone. Among these boreholes, MJTE-6,MJTE-7 and MJTE-8 are points indicating a relatively strong anomaly of approx.

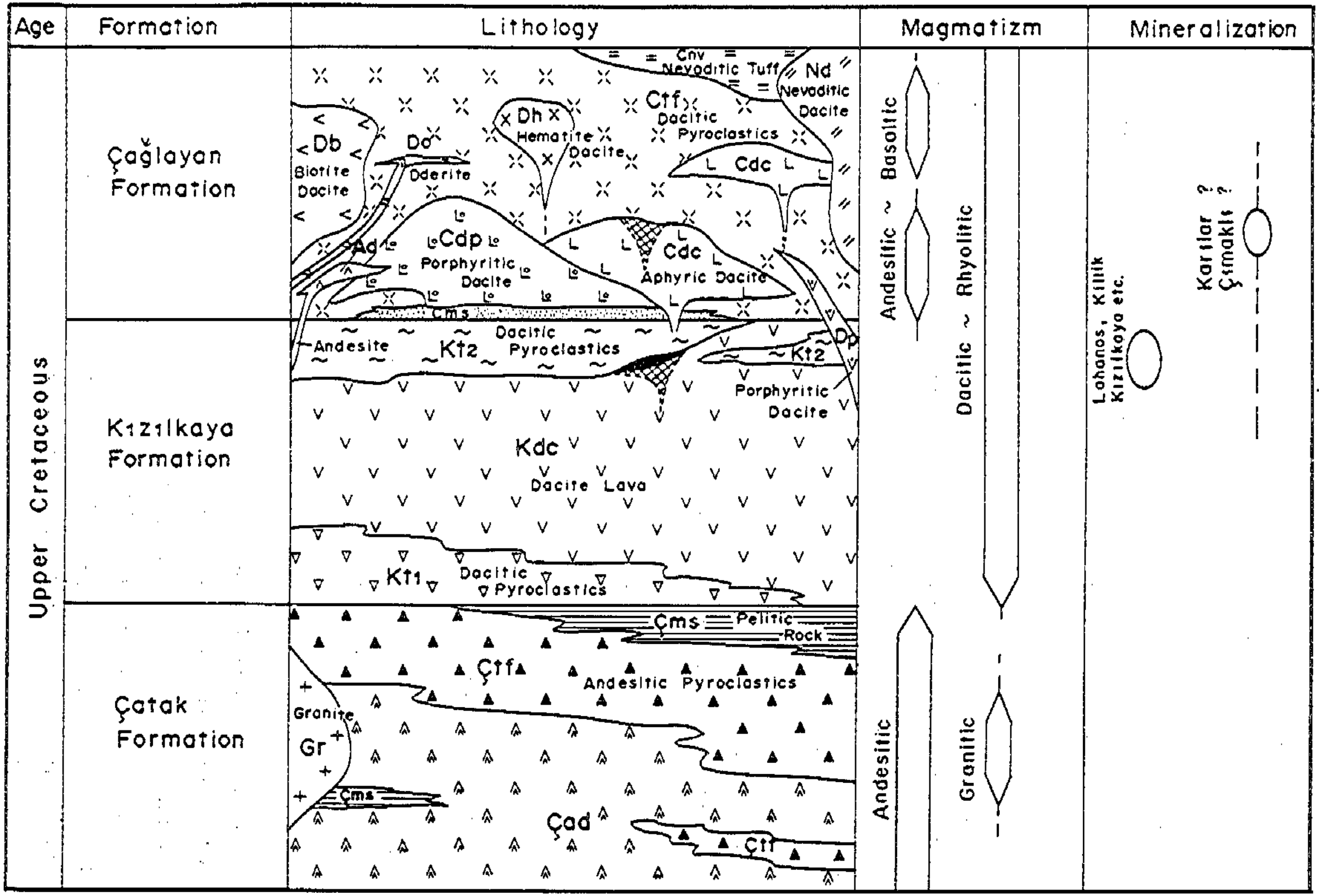


Fig. I -4-1 Schematic Lithostratigraphy

10mV/V or more. Footwall dacite accompanied by the mineralization appears at a depth of 114.8m at MJTE-6, 145.5m or more at MJTE-7, and 104.5m at MJTE-8 and reflects an IP anomaly well, but massive ore was not discovered

MJTE-5 and MJTE-2 are boreholes drilled in a weak IP anomaly area have an anomaly of about 8 to 10mV/V. It is possible that a stockworked pyritization indicates an anomaly at depths of 182 to 187m at MJTE-5 and the footwall dacite accompanied by mineralization of dissemination type indicates an anomaly at depths of 206 to 226m at MJTE-2.

Although MJTE-1 slightly deviates from the IP survey line, an anomaly was predicted at the depths judging from the IP cross section. The mineralization mainly containing pyrite was observed at a depth of 180m or less through the drilling and it is presumed that the anomaly reflects this mineralization. Therefore, an explorable depth by IP of this vicinity is less than 200m.

As mentioned above, the IP survey reflects the mineralization well and it is considered to be an effective means of exploration in this area.

4-3 Potentiality to Expectance of New Ore Deposit

The survey area occupies a part of the metallogenic province along the coast of the eastern Black Sea which is the major copper-producing area in the Republic of Turkey, and a lot of massive sulfide ore deposits including the Lahanos Mine, network ore deposits, and ore showings exist in this area.

The Lahanos ore deposit, the only operating massive sulfide mine in the area, is a strata-bound type ore deposit and it is clear that the ore deposit exists in the upper part of the Kızılkaya Formation mainly composed of dacitic volcanics. Also, the already known ore deposit is distributed in the ridge from the topographical point of view. This indicates that the distribution of the hanging wall is shallow, an ore deposit have been discovered and exploited where the mineralization and alteration and the ore showings are easily found, and areas covered thickly with a hanging wall remain unexploited.

Based on the viewpoint above, the drilling and IP surveys in the present phase, and the previous exploration data, we will describe a possibility of an existence of ore deposits by area.

Bitene area (MJTE-3, 4, and 5, northern end of IP lines A - C)

This is an area between the Lahanos ore deposit and the Killik ore deposit, and their satellite ore bodies and new ore bodies in the extension were expected.

We captured a massive ore with Cu of 12.58% at MJTE-3 and Au of 2.06ppm in the footwall. It seemed that there was room for exploration in an area between the Bitene and Killik ore deposits. However, the IP survey revealed that a strong anomaly was not seen in this neighborhood and the potential of an existence of a strata-bound massive sulfide ore deposit is low. It is highly possible that an andesitic intrusive rock body is distributed to the depths in the area between MJTE-5 and MJTE-3 and -4, and the probability of an existence of a large-scale massive ore body is low.

Killik area (MJTE-1, the middle of IP lines A - C to southern part)

This is an area between the Killik and Kızılkaya ore deposits. We discovered Cu of 4.88% in a dissemination zone of chalcopyrite in the footwall dacite through the drilling survey. The IP measurement clarified that an anomaly spreads around a marsh to the south of the drilling point. We cannot expect a strata-bound type ore deposit because that part is in the footwall dacitic lava. However, we can expect an existence of a low-grade and large-scale ore deposit such as the one in Murgul if the mineralization of copper observed at MJTE-1 exists.

Also, the IP survey and the topological features show that there is a limited possibility that a small-scale massive ore body may exist in the ridge between the drilling point and the Killik ore deposit.

Kepçelik area (MJTE-2, IP lines D - E)

This is an area around the south ridge of the old Kepçelik prospect. A prospect tunnel survey in two places and a drilling survey in two places have been so far conducted in Kepçelik area, and only an existence of lenticular kuroko-like (it has coarser and harder grains than those of kuroko in the Lahanos ore deposit) ores is known. Also, the potential of an existence of strata-bound sulfide ore deposits is low because the footwall dacite is as thin as 20 m at MJTE-2, the mineralization of a vein type of Cu and Zn is observed, etc..

Taflancık area (MJTE-6, 7, and 8, IP lines F, G, H, and I)

This is an unexploited area, but an anomaly was observed in the first phase of the IP survey and a new anomaly area was also discovered in the present phase of the IP survey. The plane distribution of an anomaly area revealed a spread of the NNE - SSW system which showed the same tendency as that of the distribution direction of the Lahanos ore body. But, we could not capture a massive ore body itself through the drilling survey in this IP anomaly area.

However, since there is an alteration zone accompanied by kaolinite, a development of stockwork accompanied mainly by pyrite as well as a little chalcopyrite was observed, yellow ore fragments etc., it was judged that the potential of an existence of massive ore deposits is high in this area.

It is advisable to carry out drilling survey in the next phase for in IP anomaly area where drilling has not been performed yet.

Çalkaya area (IP lines J - N)

The IP survey was executed in two different areas, but a new anomaly could not be discovered. It is because the Çağlayan Formation of the hanging wall may be thick. It was judged that the potential of an existence of an ore deposit is low.

Other areas

Among the areas proposed as a promising area based on the survey results of the first phase, the high-priority Karaerik ore deposit - the Çımaklı ore deposit in the northern part were excluded from the survey area of the present phase because a deep exploration is required and the schedule did not permit.

We visited the Karaerik, Kartlar, Çımaklı, and Ağalık ore deposits to collect a sample for the K/Ar age determination in the present phase and re-examined the previous data.

As a result, IP survey around the ore deposit and the drilling survey based on it have been carried out so far in this area. It turned out that most boreholes had an exploration depth of less than 150 m and did not reach the ore horizon. Also, a white colored argillic alteration accompanied by sericite and kaolinite took place, which is similar to that in Lahanos, and part of the Kartlar, Çımaklı, and Karaerik ore deposits are the mineralized and altered in hanging wall. Therefore, it is judged that there is room for exploration in the further depths.

Chapter 5 Conclusion and Proposal

5-1 Conclusion

We executed a geophysical survey (IP method, the total extension of the survey line is 30 km) and investigated eight boreholes (the total excavation length is 1749 m) in a promising area selected in the first phase and this phase of the survey. The following is a summary of the survey results in each area.

1. Bitene area (Three boreholes for drilling survey)

Three holes were drilled in the north-east to north north-east of the Killik ore deposit at MJTE-3 and 4. For the geological point of view, it was clarified that tuff of the Çağlayan Formation develop relatively thickly on a gentle slope over footwall dacite. The appearance depth of the footwall is 710 to 730m above sea level and it is higher than the altitude (about 650m) of the Lahanos ore deposit. The ore horizon gently inclines toward the north.

As for mineralization, a predominant stockwork zone was captured in the footwall dacite at MJTE-3 and a yellow ore part (Cu = 12.58%, Au = 2.06ppm) was observed at 20cm from the upper part.

MJTE-5 was drilled at a position 200 to 300m south of the end of the Lahanos ore deposit. It was clarified that relatively thick aphyric dacite of the Çağlayan Formation is observed from the surface and tuffs are not distributed. The footwall dacite appears at 650 m above sea level and this is almost equal to the depth of the ore horizon in the Lahanos ore deposit. A development of a slightly predominant networked powder pyrite is observed in the footwall dacite, but the ore grade is low. However, it turned out that there are veinlets of copper and zinc and the alteration accompanied mainly by sericite and kaolinite has occurred on the hanging wall Çağlayan Formation.

The Bitene area is located between the Lahanos ore deposit and the Killik ore deposit, and an existence of a new ore deposit was expected. But, the relatively predominant mineralization of footwall was only observed. Since there is little room for exploration because an intrusive rock body is distributed in the middle, it is though that the probability of an existence of a large-scale strata-bound massive sulfide ore deposit is low.

2. Killik area (Three IP survey lines, one borehole for drilling survey)

The geophysical survey (IP method) revealed that a strong anomaly zone exists in the southern part of the area, south from the south-east slope of the Yeniyolbaşı Mountain.

However, a strata-bound ore deposit cannot be expected because the anomaly part is in the distribution area of the footwall dacite, but the possibility still remains that a network - vein type large-scale low grade ore deposit (Murgul type) exists. A further survey will clarify the details.

The drilling survey (MJTE-1) was carried out at a point between the Killik ore deposit and the Kızılkaya ore deposit where the hanging wall is distributed and the above mentioned IP anomaly continues into the depths. From top to down, thick hematite dacite thin dacite lava of Çağlayan Formation and the footwall dacite of Kızılkaya Formation are observed but tuff of the Çağlayan Formation were not observed.

Both alteration and mineralization were found on and below the Çağlayan Formation and a 25 cm thick dissemination zone (Cu of 4.88%) of chalcopyrite was observed in the footwall dacite. Comparing a mineralization through the drilling with the IP results, the exploration depth of the IP method in this part is about 200m.

As mentioned above, there is a possibility of an existence of a Murgul-type ore deposit in this area. Considering the IP surveys (phase I and II survey), a small-scale strata-bound type ore body may exist directly below the ridge in the southern part of the Yeniyolbaşı Mountain.

3. Kepçelik area (Two IP survey lines, one borehole for drilling survey)

In the geophysical survey (IP method) we observed a weak anomaly in the depths in the southwestern part of the survey lines, and we conducted a drilling survey (MJTE-2) for this anomaly. The survey revealed a dissemination-type and vein-type weak mineralization and clarified that the Kızılkaya Formation dacite is very thin. It was judged that the probability of an existence of a large-scale ore deposit is low.

4. Taflancık area (Four IP survey lines, three boreholes for drilling survey)

This area was an unexploited area. With the help of the anomaly obtained from the results of the IP survey of the phase I, we carried out an IP survey in this year and successfully found an new anomaly area.

The plane distribution direction of the anomaly area indicates NNE - SSW and corresponds with the distribution direction of the Lahanos ore body. In the Taflancık area, distributions of two anomaly zone (northwest and southeast) in echelon form has been defined in plane map of apparent chergeability(n=3-4). MJTE-6 is located near northwest anomaly zone, MJTE-8 is located in end of southeast anomaly zone and MJTE-7 is located near center of southeast anomaly zone.

Geologically, this area is composed of hematite dacite, dacite lava of Çağlayan Formation, dacitic lava and tuff of Kızılkaya Formation and those units show a gentle north dip.

It presents the alteration mainly accompanied by sericite and kaolinite at MJTE-7 and chlorite shows a tendency to be predominant toward the north.

The mineralization of pyrite dissemination - network with a small amount of disseminated chalcopyrite are observed, which is the strongest in the footwall dacite at MJTE-7 and extends to the shallowest part at MJTE-8.

Microscopic investigation showed that the mineralization is accompanied by a trace of sphalerite and colloform and framboidal pyrite exists.

Since yellow ore fragments were obtained in MJTE-6, it was presumed that a supply source exists nearby. Although strong mineralization have been observed in MJTE-7 and MJTE-8, massive ore body could not discovered. The source area for yellow ore fragments is supposed to be in the northwest IP anomaly zone

Judging from the above-mentioned facts, the probability of an existence of a massive sulfide ore deposit is high in this area so that we hope for a drilling survey to the northwest IP anomaly zone in the future.

5. Çalkaya area (Five IP survey lines)

Only a continuous weak IP anomaly was partly observed from a weakly mineralized outcrop and a new anomaly area could not be obtained. It may be partly because the hanging wall is thick, but at the present time we cannot help judging that the probability of existence of ore deposit is low in this area.

6. Other areas

The Karaerik - Çımaklı area is one of selected promising areas in the first phase of the survey. It is clear that the previous surveys have not reached the massive ore horizon. Judging from the alteration accompanied mainly by sericite and kaolinite and the geochemical anomaly, the possibility of existence of ore deposit still remains in the further depths (200 to 350 m).

7. The age determination of sericite in the alteration zone clarified that the age of the alteration related to the Kızılkaya and Karaerik ore deposits is 77 Ma.

5-2 Proposal to the Third Year's Program

Based on the results obtained from the second phase of the survey, we suggest that the third phase of the survey be conducted in the following areas. We describe those areas in order of priority. Proposed areas are shown in Fig. I -5-1

1. Taflancık area

Since an ore deposit may exist in a new anomaly zone extending in the same direction as that of the Lahanos ore body that obtained by the geophysical survey IP method, the drilling survey should be conducted in the third phase of the survey.

2. Karaerik - Çımaklı areas

This is an area where ore showings exist on the surface and the potential of an existence of an ore deposit is high. Sufficient exploration has not been carried out so far. Therefore, it is advisable to apply the geophysical survey IP and CSAMT methods and to conduct a drilling survey in a promising area.

3. Killik area

A strata-bound type ore deposit is less expected in a strong anomaly zone which distributed from the southeastern slope of the Yeniyolbaşı Mountain to the south defined by the geophysical survey IP method, but the possibility of a large-scale network ~ vein type low grade ore deposit (Murgul type) still remains. It is recommended that an IP survey be conducted along E-W trending valley and ridge of the south end to define an extension of the mineralization and a drilling survey be carried out in a promising area.

Also, results of the IP survey revealed a possibility that an ore body may exist in the south ridge of the Yeniyolbaşı Mountain. In order to verify this, it is desirable that a drilling survey be conducted.

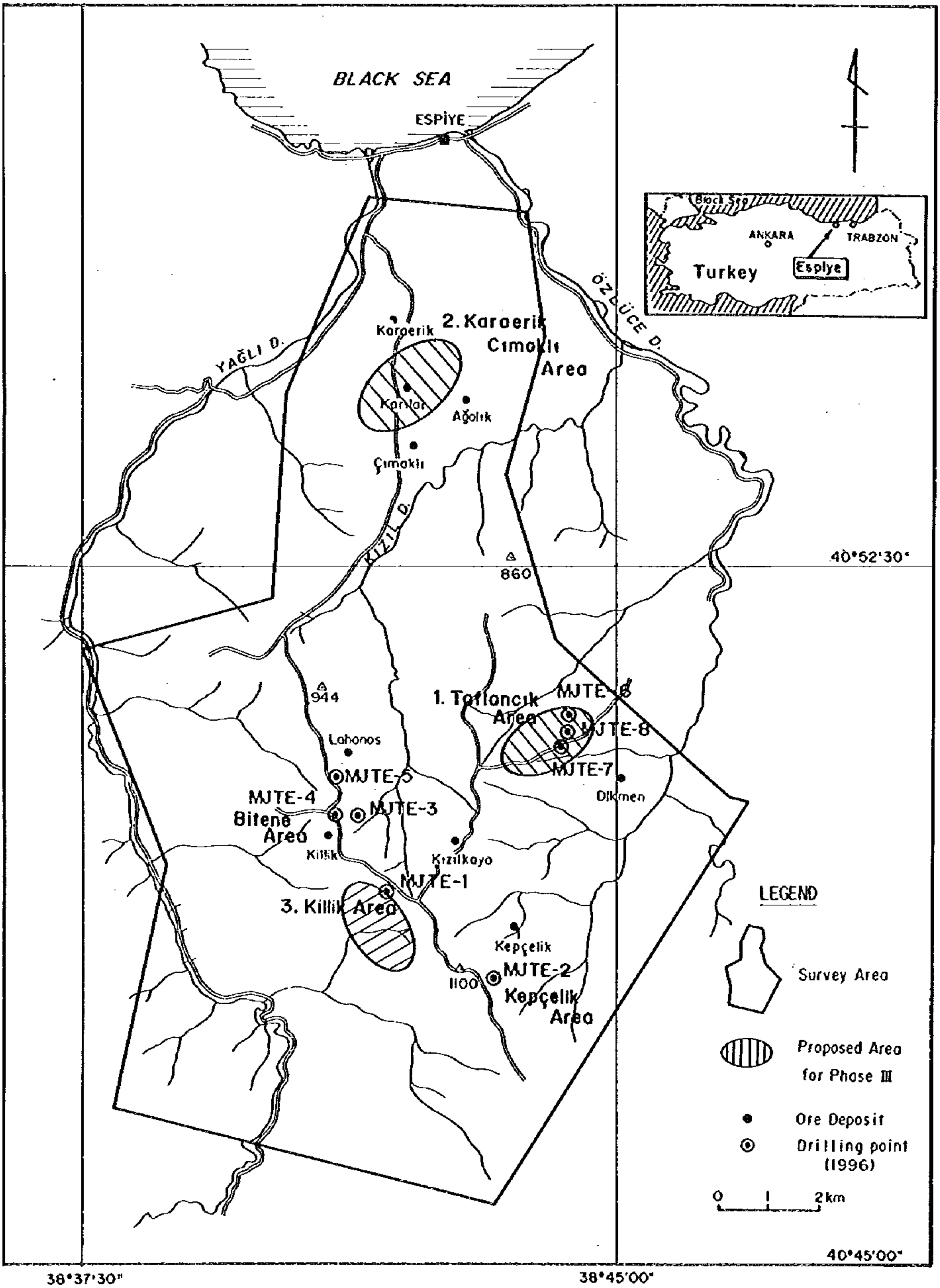


Fig. I -5-1 Location of the Proposed Areas

PART Ⅱ Details of the Survey

PART II Details of the Survey

Chapter 1 Geophysical Survey (IP Method)

1-1 Method of the survey

1-1-1 Content of the survey

The survey areas for electric survey (IP survey) were established in the areas concluded to be hopeful by phase I survey. Locations of the areas are shown as Fig. II -1-1. Specification of geophysical survey is shown in Table II -1-1.

Table II - 1 - 1 Specification of the Geophysical Survey

Method	Induced polarization method (IP method)
Detection method	Time domain method
Electrode arrangement	Dipole-Dipole
Separation of electrode arrangement	a=100m
Coefficient of electrodes separation	n=1-5
Number of survey line	14
Total length of survey line	30.0km
Tests of physical property of rocks and ores (laboratory test)	42 specimens for chargeability and resistivity

1-1-2 Operation of the Measurements

1. Determination of survey line and survey

Survey lines were planned to start from the well known peak. Open traverse method was adopted to locate exact survey points. Locations of each survey lines are shown too in Fig. II -1-2.

2. Electric prospecting (IP method)

1) The principle of IP method

As we send an electric current into the earth, various electric chemical phenomena occur in the medium that composes the ground. IP method measures the following two phenomena.

[Over Voltage Effect]

Sending an electric current makes superficially electric two multi-layer on the surface of sulphide and metal conductors. And an electric discharge occurs to opposite direction as switching off an electric current. This phenomenon is occurred by the complex effect of ion and electron conduction. The origination in this phenomenon is the mineral with an electron conductivity and is too the survey object of IP method.

[Normal Effect or Background]

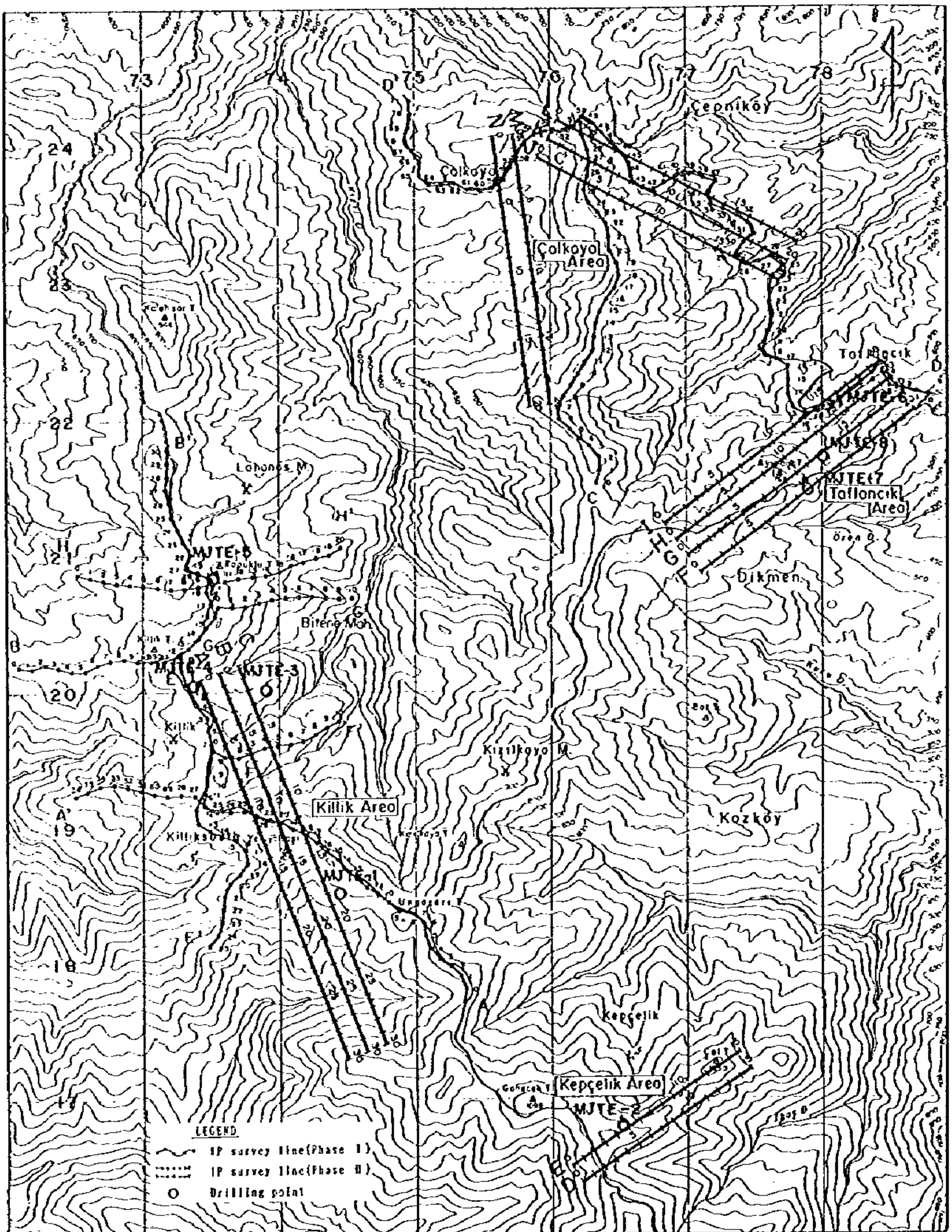


Fig. II－1－1 Location of the IP Survey Area

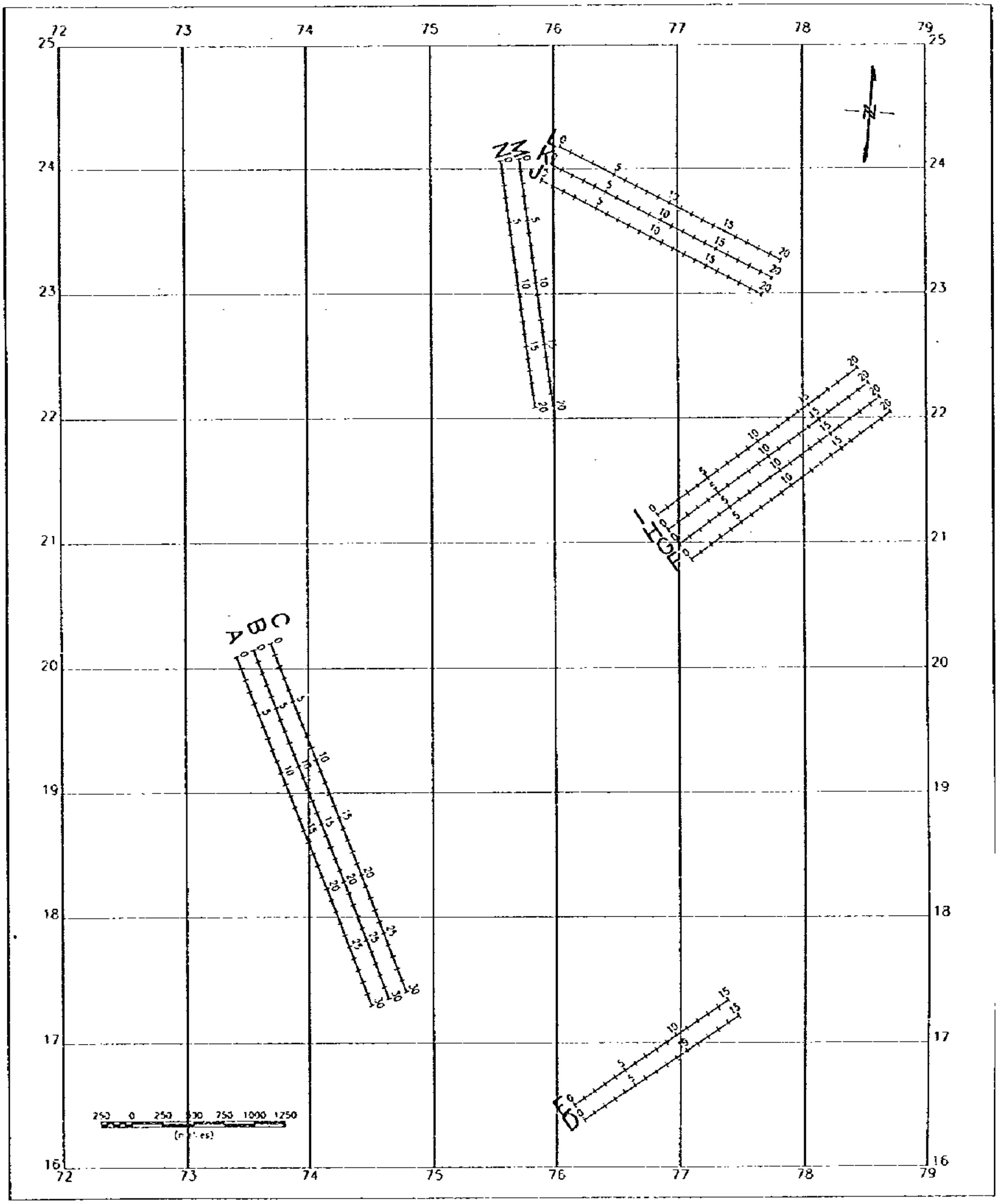


Fig. II - 1 - 2 Location of the IP Survey Lines

Polarization occurs by sending an electric current in ordinary rocks. The main origination of this phenomenon is membrane polarization caused by a small quantity of mixed clay minerals. The membrane polarization of montmorillonite is the most largest of all of the various clay minerals and kaolinite is small. The membrane polarization is maximum when there is 5% capacity ratio of clay minerals. However, a membrane polarization decreases when the capacity ratio is larger or smaller than 5%.

The maximum value of membrane polarization is about 5% capacity ratio in the montmorillonite stone quantity, if expressing it with FE value it is about 2%.

This value is extremely small compared to above-mentioned Over Voltage Effect in the sulphide minerals.

2) Measuring method of IP phenomenon

The outline illustration of measurement is shown in Fig. II -1-3.

The measurement had been carried out by the time-domain method. This method (abbreviation symbol T.D. method, transient IP method) sends an intermittent direct current (on/off 2.0sec) into the ground through a couple of current electrode C1,C2.
After that, we get two date from a couple of potential electrodes P1,P2. One is the primary potential difference (Vp) just before switching off an electric current, the other is the secondary potential difference (Vs) during T time (T time is from 60msec to 1590msec) after switching off an electric current.

In this survey, we had measured Vs during T time after switching off an electric current.

The concept of operation is shown in Fig. II -1-3. The concept of the method of measurement is shown in Fig. II -1-4 and the list of sampling time is shown Table in II -1-3.

IP effective measurement value by IP method is generally called with chargeability,expressed with Vs/Vp[mV/V].

The data of secondary potential difference in this survey has not received an influence of the effect of electromagnetic coupling. At this investigation, the chargeability adopted mid-point 935msec data.

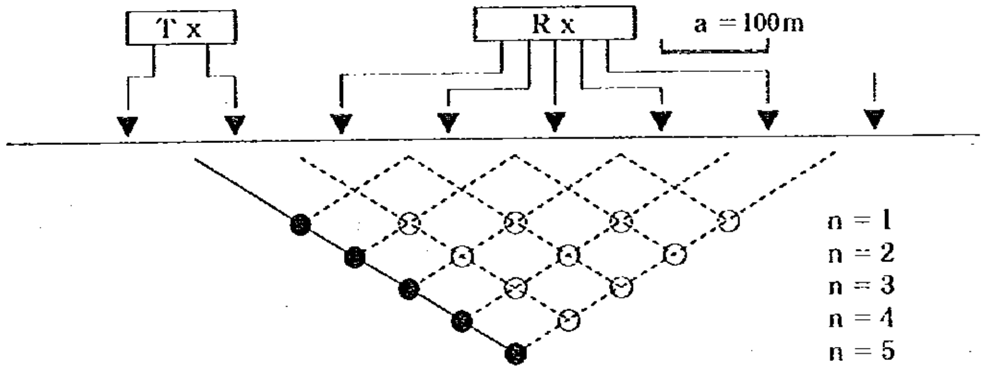


Fig. II - 1-3 Concept of Operation

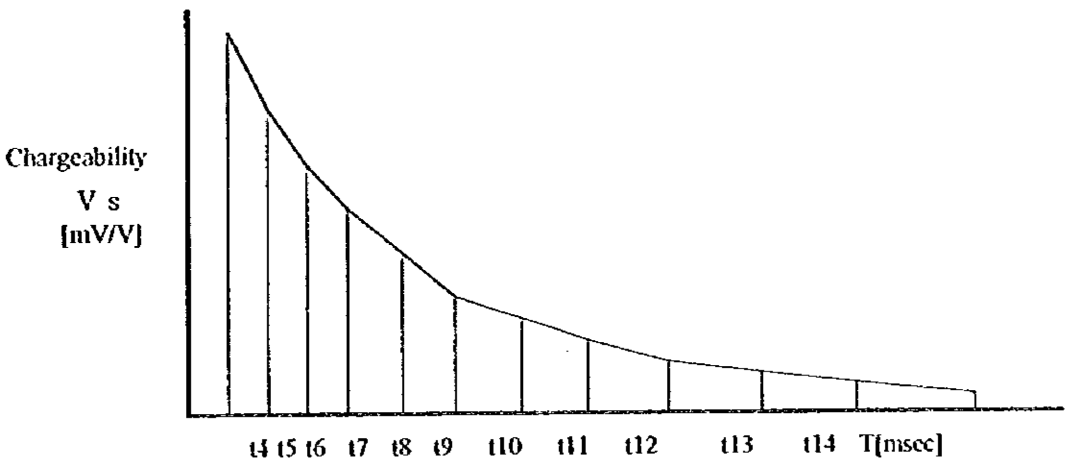


Fig. II - 1 - 4 Concept of the Method of Measurement

Table II - 1 - 2 List of Sampling Time

Slice #	t4	t5	t6	t7	t8	t9	t10	t11	t12	t13	t14
Mid-Point	60	90	130	190	270	380	520	705	935	1230	1590 msec
Width	20	40	40	80	80	140	140	230	230	360	360 msec

3. Measuring equipments and materials

The measuring equipments and materials are shown in Table II-1-3.

Table II - 1 - 3 List of Equipment and Materials

Field survey

Equipment	Maker	Type	Specification	Amount
*Transmitter	SCINTREX	TSQ-3	1500V,10A max output:3000W	1
*Engine Generator	INDUSTRIAL COMMERCIAL	10DE	220V 400Hz 8HP single cylinder 2cycle	1
*Receiver	SCINTREX	IPR-12	8channel,14window Input Range:50uV to 14V	1
Electrode		Current	stainless steel	1
		Potential	CuSO4	1
Cable	FUJIKURA		VSF1.25mm²cable	1
Measuring compass	USHIKATA		Pocket compass 100m Esron tape	4
* Communication device	KENWOOD	TH-45G	Output:600mAhW Battery:12V	12

* provided by MTA

Laboratory test

Transmitter	IRIS	IP-L	Output:1uA - 100mA Max 10V	1
Receiver	SCINTREX	IPR-12	8channel,14window Input Range:50uV - 14V	1
Electrode			Pt	1

1-1-3 Method of Analysis

Simulated Analysis from Pseudo Cross Sections

Simulation analyses of resistivity and pseudo cross section of IP were carried out using infinite elemental program of 2nd and half dimension by Coggon(1971) and Rijo(1977).After data and modification were input in dialogue style and calculations were repeated several tens times, result was obtained approximately almost same as the presumed model on pseudo cross sections.

1-2 Results of Survey

1-2-1 Results of Survey

Apparent resistivity and chargeability acquired in this survey are shown in Figs. II -1-5～18 as cross sections, Figs. II -16-19～22 show apparent resistivity in plans, and Figs. II -23～26 show chargeability in plans.

1)Cross Sections of Apparent Resistivity and Chargeability

A·B·C-survey line (Killik Area)

Dacitic lava of Kızılkaya Formation and dacitic lava and dacitic pyroclastics of Çağlayan Formation develop along those lines. Hematite dacite intrusive also can be seen around the top of this survey line center.

Relatively high resistivity more than 200Ω·m was usually observed on surface where hematite dacitic lies, but around No.19 of A-survey line and No.16 of B-survey line, relatively low resistivity ranging from 50Ω·m were measured. Clear relation between litofacies and resistivity couldn't be obtained.

Around No.9 where dacitic pyroclastics covers, resistivity ranging from 10～100Ω·m was obtained. Mainly, along the valley of No.25, chargeability was shown 30mV/V as maximum. Clear anomaly of chargeability was recognized. The value of Southern anomaly was higher than others. Dacitic lava of Kızılkaya Formation develop and we recognized vein like mineralization.

Around No.4 of C-survey line, weak IP anomaly like pantaloon shape was recognized and it seems to be derived from superficial ore showing. Dacitic pyroclastics of Çağlayan Formation develop along this line. Weak mineralization was recognized under 70m of MJTE-3.

D·E-survey line (Kepçelik Area)

Andesitic pyroclastics of Çatak Formation, dacitic lava of Kızılkaya Formation, and dacitic pyroclastics and pelitic rocks of Çağlayan Formation develop along this line, high resistivity ranging from 200～700Ω·m were measured on surface where dacitic pyroclastics lies.

Around No.0～1 and 10, weak IP anomaly (The maximum chargeability was 12mV/V.) was seen. Outcrop of weak mineralization was recognized around No.0～1.

F·G·H·I-survey line (Taflacık Area)

Dacitic lava of Çağlayan Formation and hematite dacite (intrusive rocks) develop widely on dacitic lava of Kızılkaya Formation.

Resistivity ranging from 10～300Ω·m was measured due to argillization and hard portion on surface where dacitic lava of Çağlayan Formation and hematite dacite distribute.

At depth of No.9～12, chargeability was shown 20mV/V as maximum. Clear IP anomaly was recognized.

Anomaly of chargeability distributed shallow on southward of F-survey line, and it became higher on northward of I-survey line.

J·K·L-survey line (Çalkaya Area)

Dacitic pyroclastics of Çağlayan Formation, and porphyritic dacitic lava develop along those lines.

Resistivity ranging from 3～1,000Ω・m was measured due to argillization and hard portion on surface. A clear anomaly of chargeability was not seen.

M·N-survey line (Çalkaya Area)

Along those lines, dacitic pyroclastics of Çağlayan Formation develop widely. Hematite dacite (intrusive rocks) develops in a small way at the end and center of those lines.

On surface, low resistivity less than around 40Ω・m was observed due to argillization.

On surface where hematite dacite lies, resistivity ranging from 20Ω・m were measured in argillized part. And resistivity ranging from 500Ω·m were observed in hard part.

Around No.5～6 of N-survey line, weak IP anomaly (the maximum chargeability was 10mV/V)was seen.

2)Plans of Apparent Resistivity and Chargeability

When dipole-dipole array of electrodes and high electrode separation index ranging from 4 or 5 are adopted in IP survey, pattern of IP anomaly originated from shallow places is characteristically inclined to be enlarged on deeper plans. In such a case, IP anomaly pattern does not correspond well to actual origin of anomaly. Therefore, description here is based on low electrode separation index ranging from 1 to 3.

(Killik Area)

Resistivity ranging from 100～500Ω・m prevailed mostly in the survey area.

In the area where resistivity less than 100Ω·m of No.3～12 , dacitic pyroclastics of Çağlayan Formation develop.

Low resistivity was observed to the depth. Resistivity more than 100Ω·m areas of No.1～7 correspond to intrusive rocks of hematite dacite that distribute NE-SW system.

Anomalous chargeability around No.25 seems to develop southwestward. Judging from electrode separation index separate from n=3 in line A, the anomaly indicate around n=1 to 2.

Weak chargeability anomaly around No.5 of C-survey line increased northeastward. since electrode separation index separate from n=1, it reflects sallow anomaly source.

(Kepçelik Area)

High resistivity more than 200Ω·m was measured.

Weak chargeability anomaly was recognized around No.2 at the end of this survey line, distribution pattern of anomaly was not clear.

On surface between No.0 and No.1 of D-survey line, weak mineralization was recognized.

(Taflanclk Area)

In the area where resistivity show more than 100Ω·m around No.14, as electrode separation index was higher, resistivity lowered. Therefore, low resistivity area distribute widely under the hematite dacite .

Anomaly zone of chargeability around No.12 of n=1 extends to NNE-SSW. Anomaly of chargeability become clear from n=2, the intensity increase to the south.

(Çalkaya Area)

Generally low resistivity and low chargeability were observed due to argillization on surface. Clear anomaly of chargeability was not seen.

The above-mentioned facts regarding resistivity and IP patterns are summarized as shown in Table II-1-4.

Table II－1-4 Results of IP Survey

Survey Line	Apparent Resistivity (Ω・m)	Chargeability (mV/V)	Characteristics of IP Distribution Pattern
A	14～729	-1.7～31.7	Around No.20～25 more than 10mV/V Clear IP anomaly like pantaloon shape
B	25～970	-4.4～30.4	Around No.20～30 more than 10mV/V Clear IP anomaly
C	24～704	-0.9～26.0	Around No.4 more than 10mV/V IP anomaly like pantaloon shape Around No.24～30 more than 10mV/V Clear IP anomaly
D	79～992	-1.7～12.8	Around No.0～1 and 10 Weak IP anomaly
E	135～1,419	-0.4～11.0	Around No.0～1 Weak IP anomaly At depth of No.4～8 Weak IP anomaly
F	24～289	1.0～19.9	Around No.5～12 more than 10mV/V Clear IP anomaly
G	19～338	0.3～16.9	Around No.11～13 more than 10mV/V Clear IP anomaly
H	18～288	0.4～16.1	At depth of No.10 more than 10mV/V Clear IP anomaly
I	12～927	-1.0～18.1	At depth of No.12,15 more than 10mV/V Clear IP anomaly
J	3～497	0.8～4.6	No anomaly
K	9～993	0.8～5.0	No anomaly
L	12～353	0.3～7.4	No anomaly
M	9～543	0.8～6.6	No anomaly
N	12～351	0.7～10.4	Around No.5～6 extremely weak IP anomaly like pantaloon shape

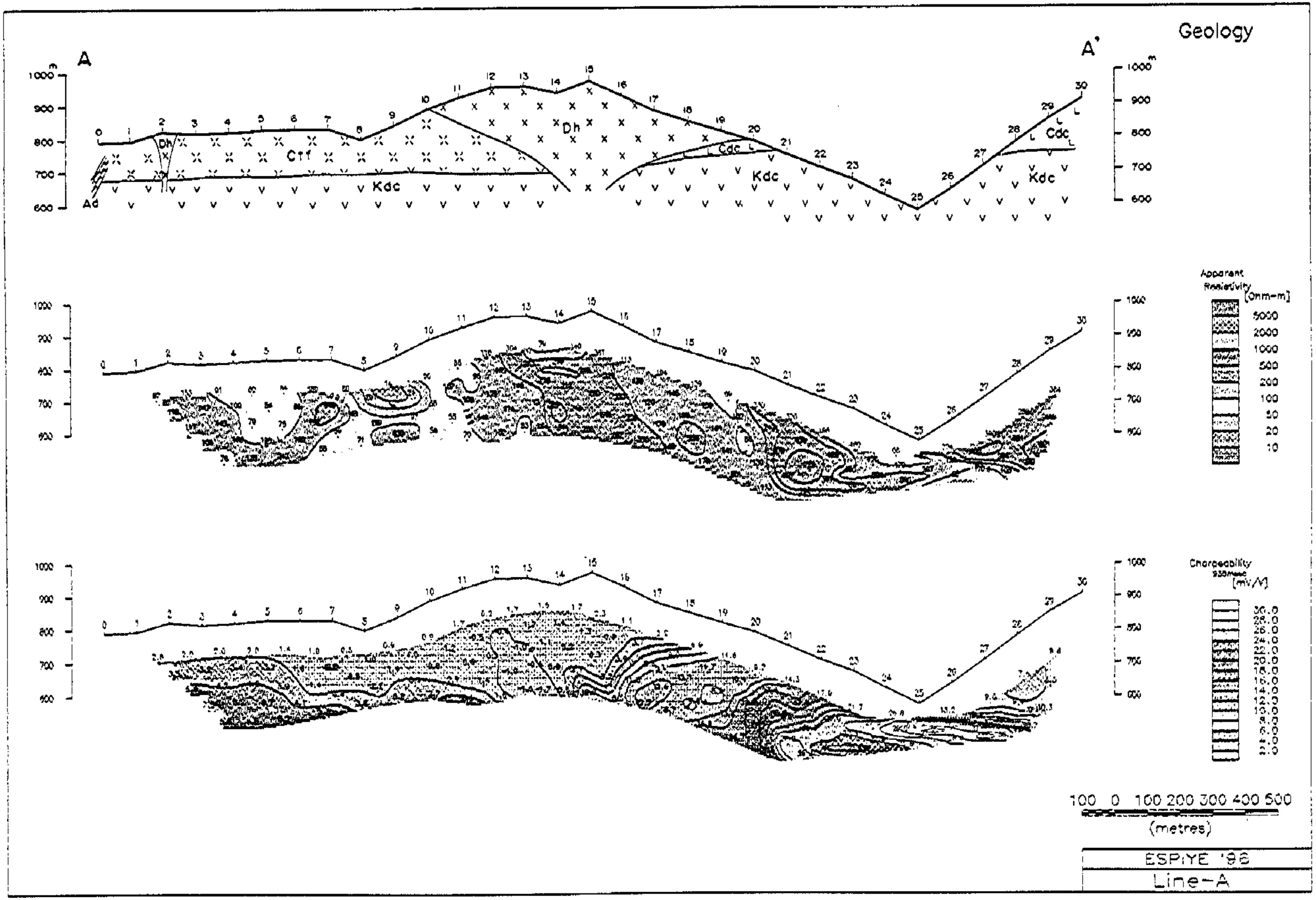


Fig. II - 1 - 5 Section of Apparent Resistivity and Chargeability (Line A)

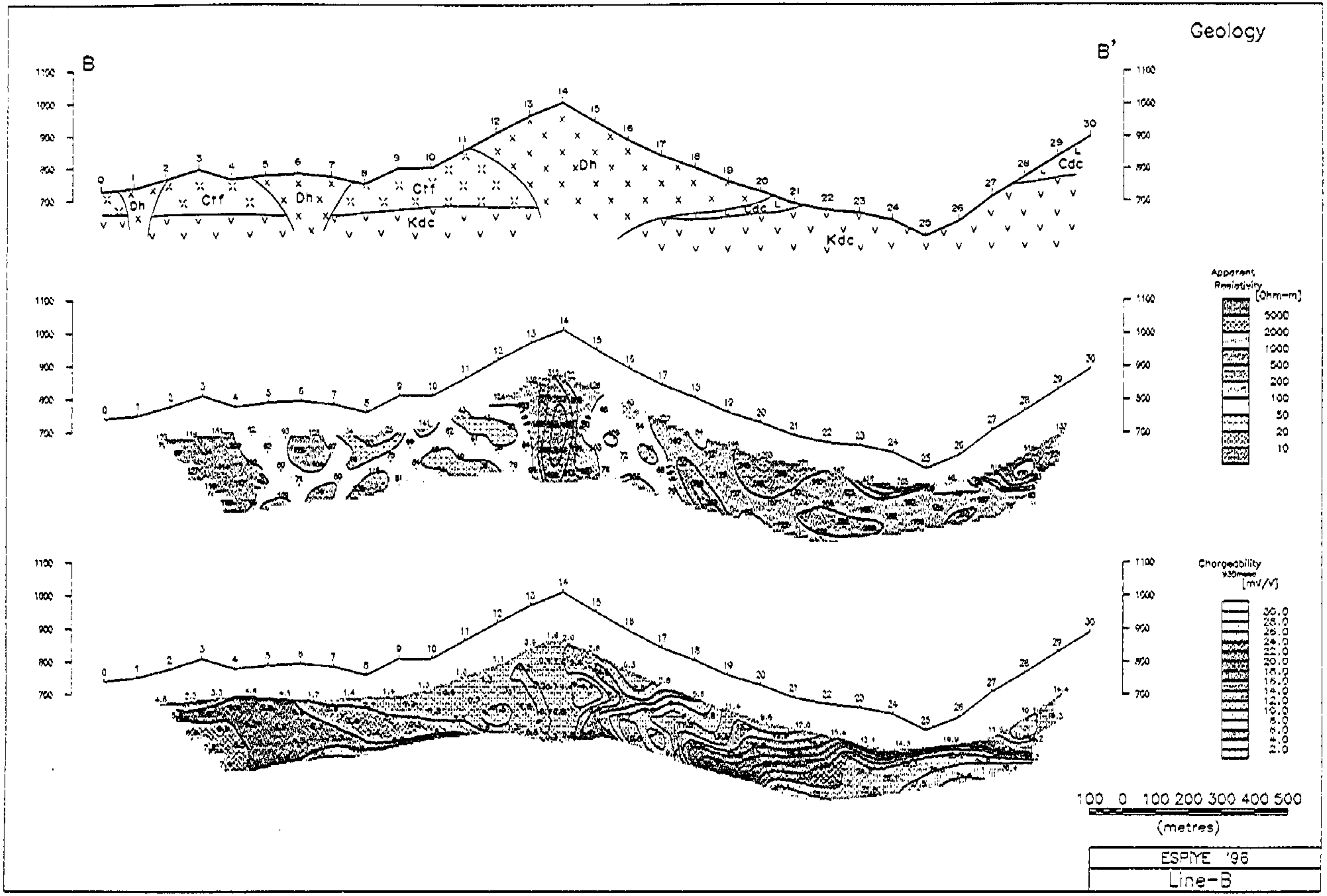


Fig. II - 1 - 6 Section of Apparent Resistivity and Chargeability (Line B)

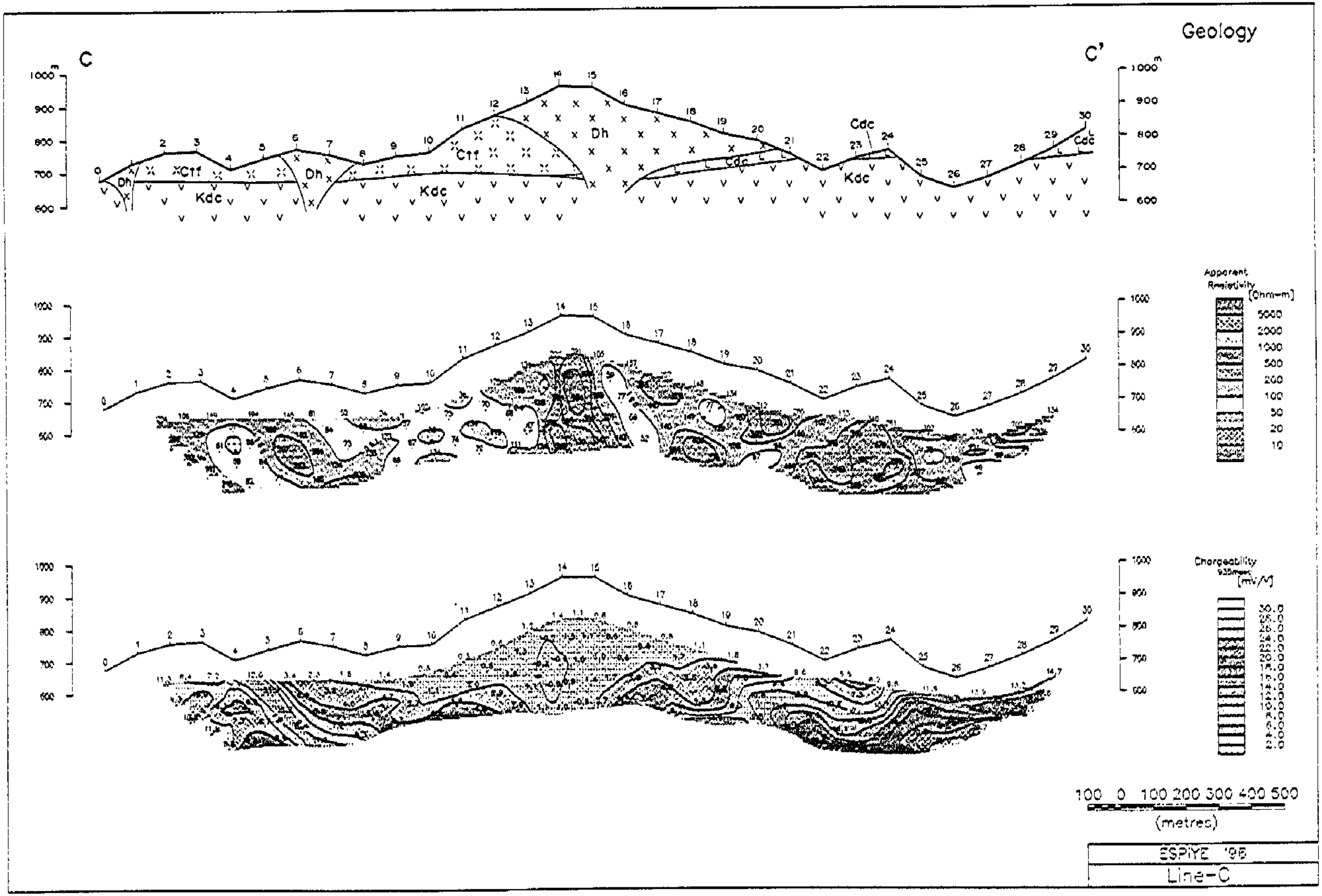


Fig. II-1-7 Section of Apparent Resistivity and Chargeability (Line C)

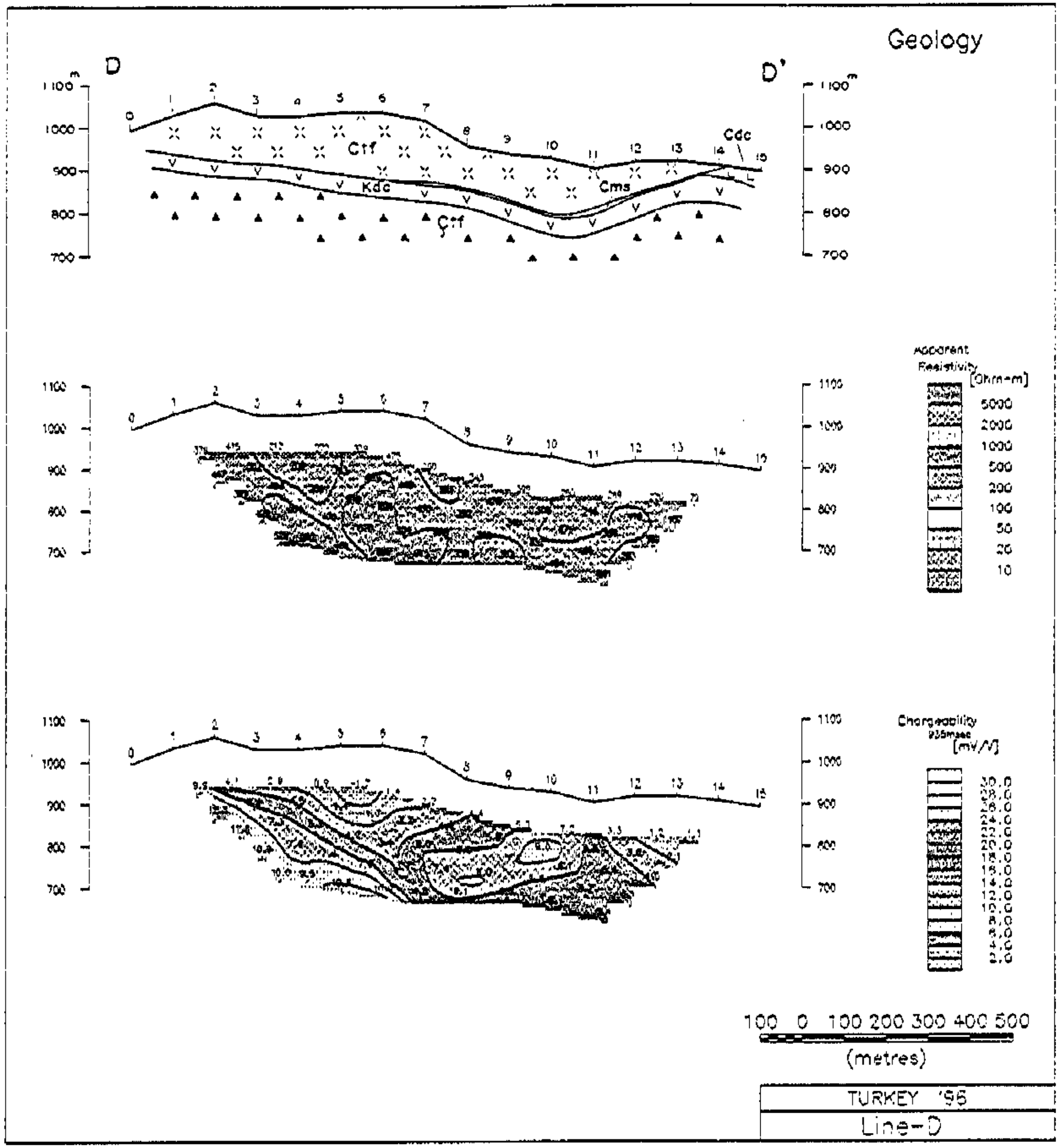


Fig. II - 1 - 8 Section of Apparent Resistivity and Chargeability (Line D)

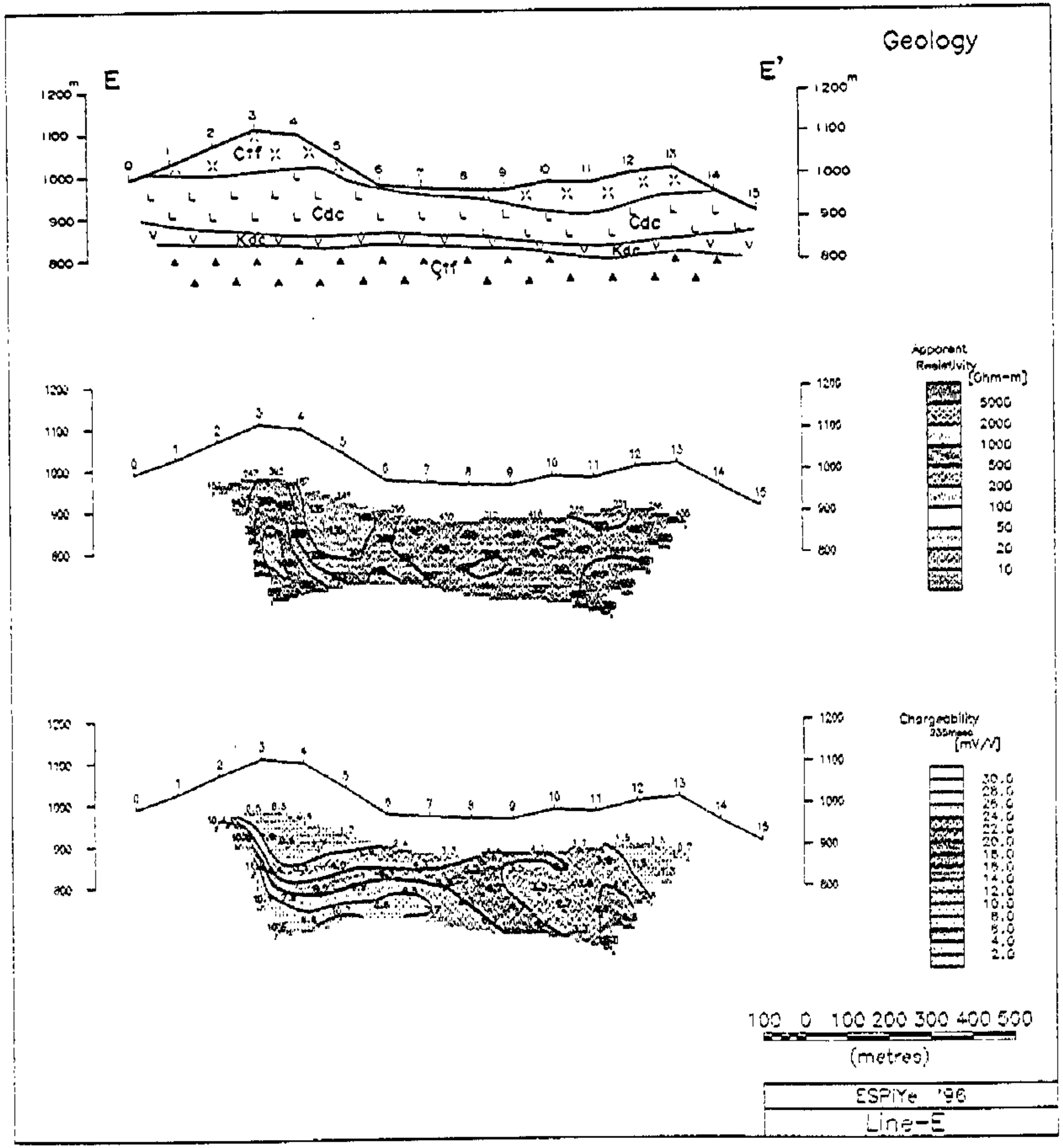


Fig. II - 1 - 9 Section of Apparent Resistivity and Chargeability (Line E)

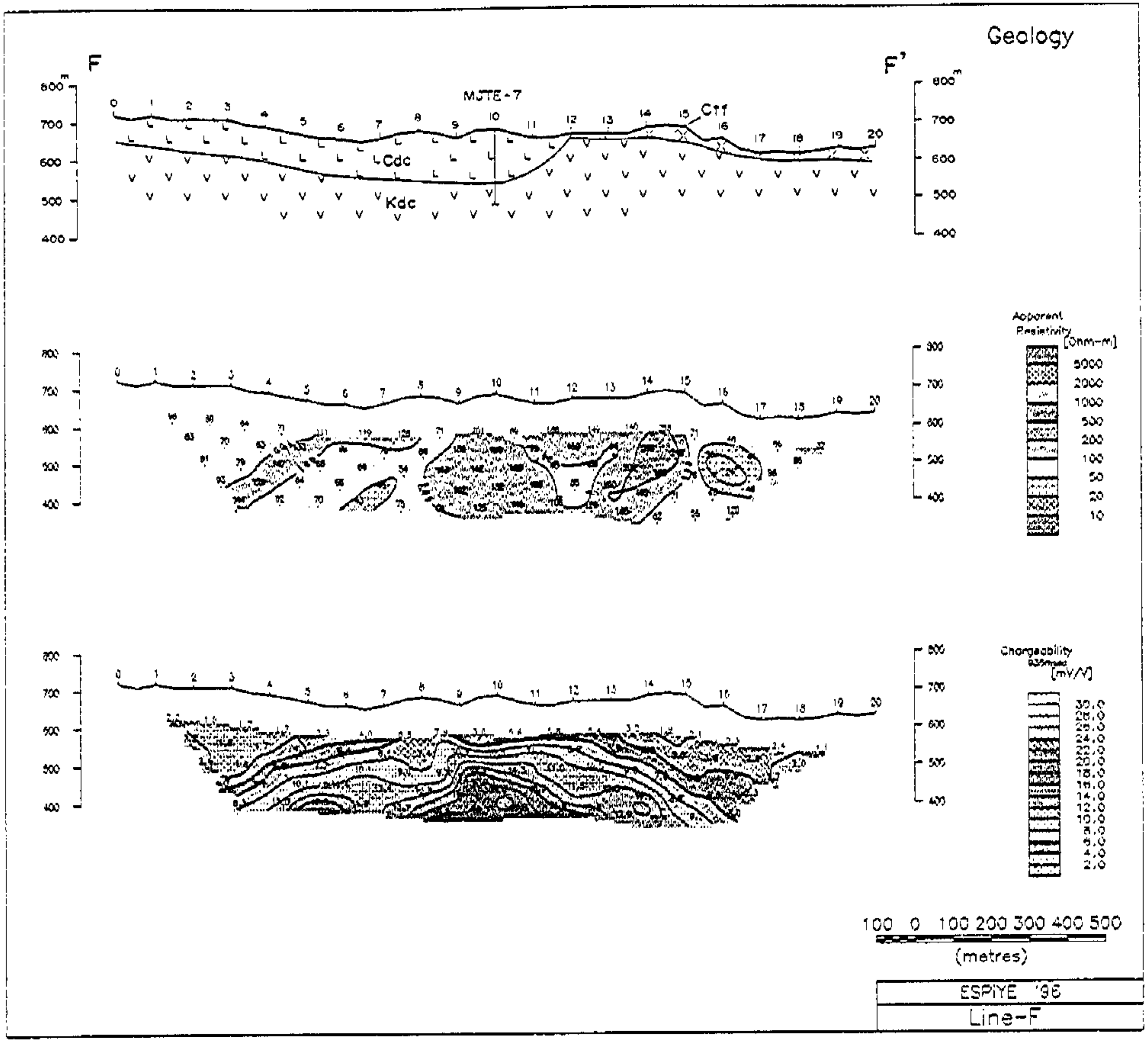


Fig. II-1-10 Section of Apparent Resistivity and Chargeability (Line F)

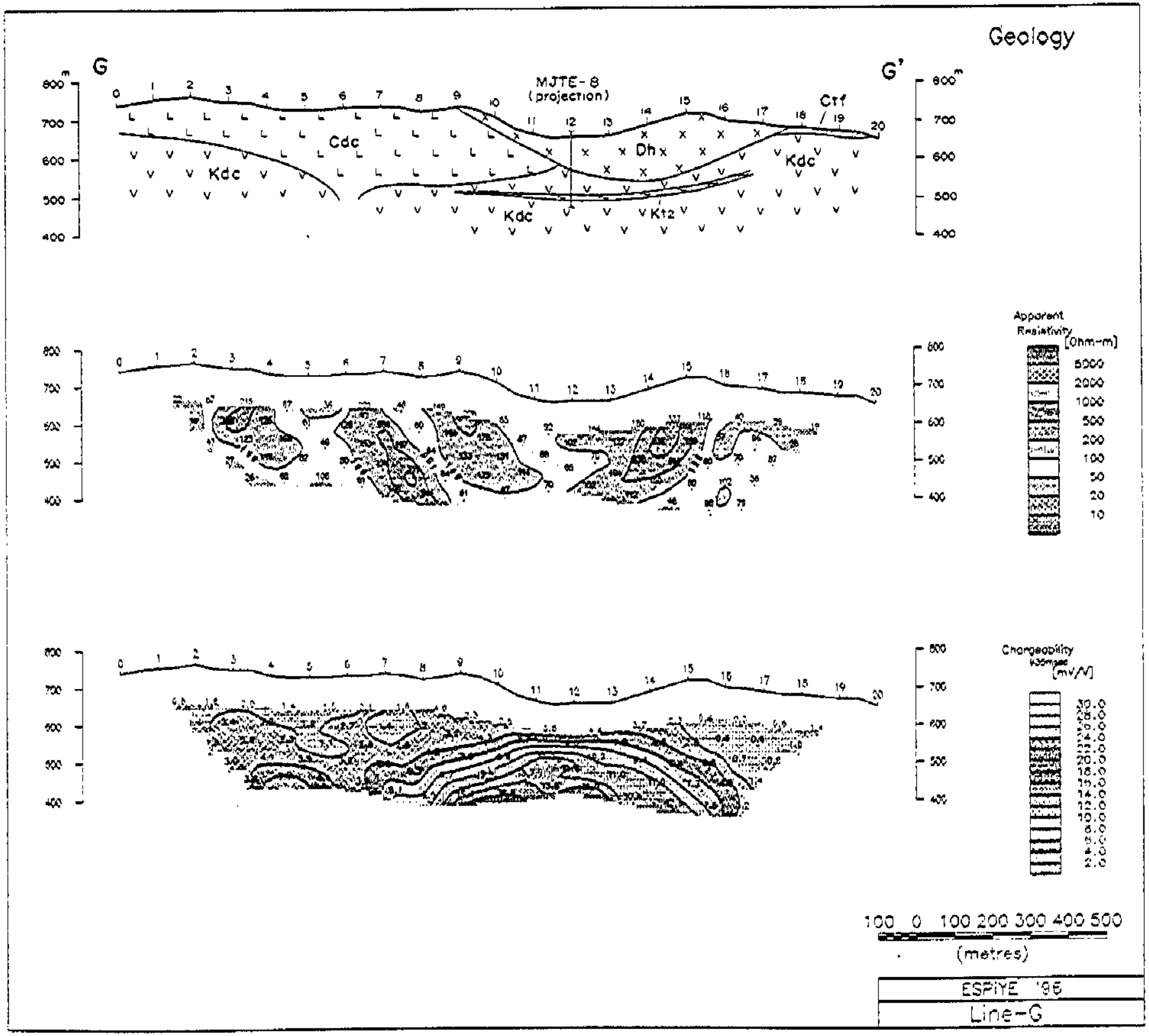


Fig. II - 1 - 11 Section of Apparent Resistivity and Chargeability (Line G)

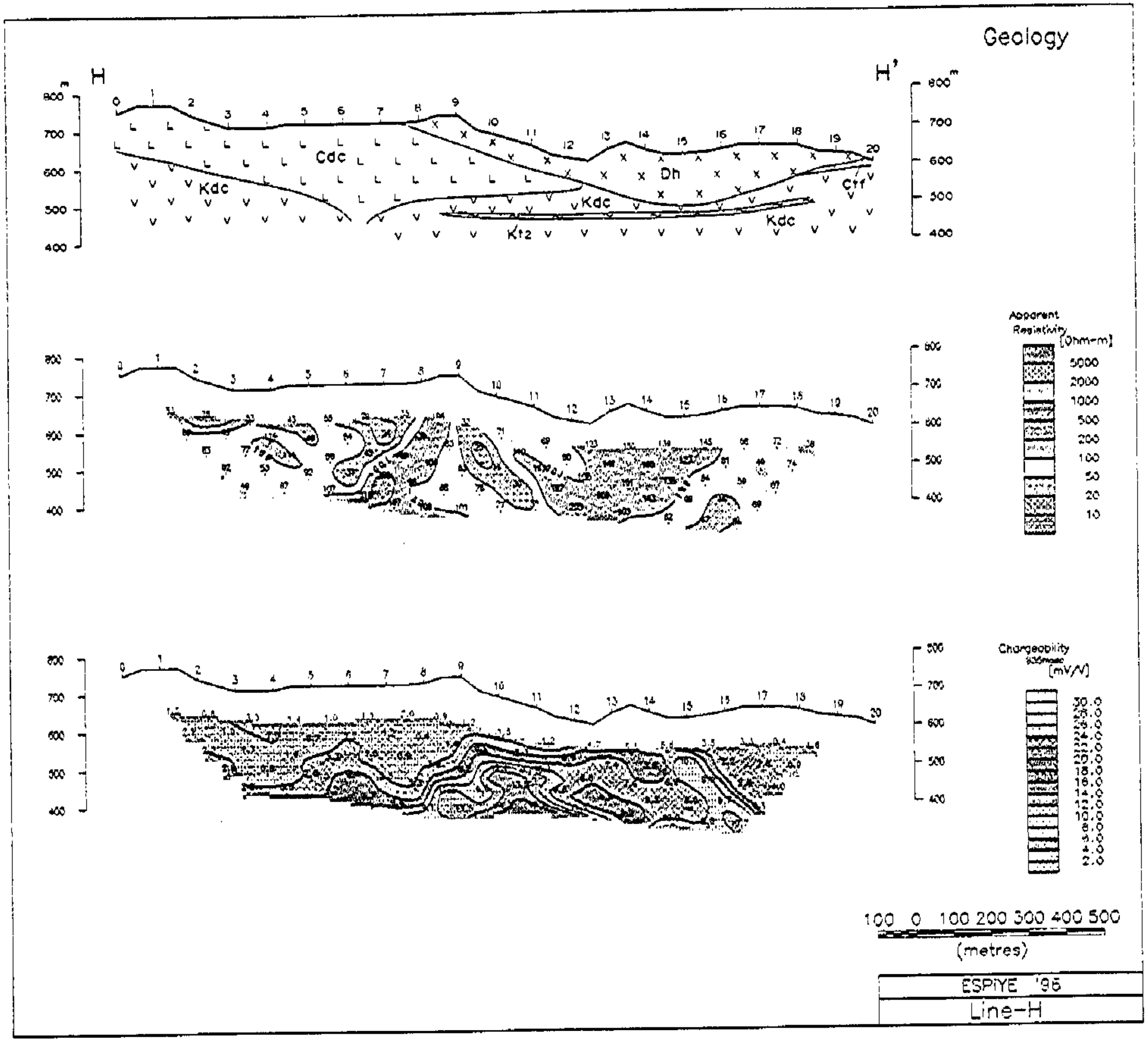


Fig. II - 1 - 12 Section of Apparent Resistivity and Chargeability (Line H)

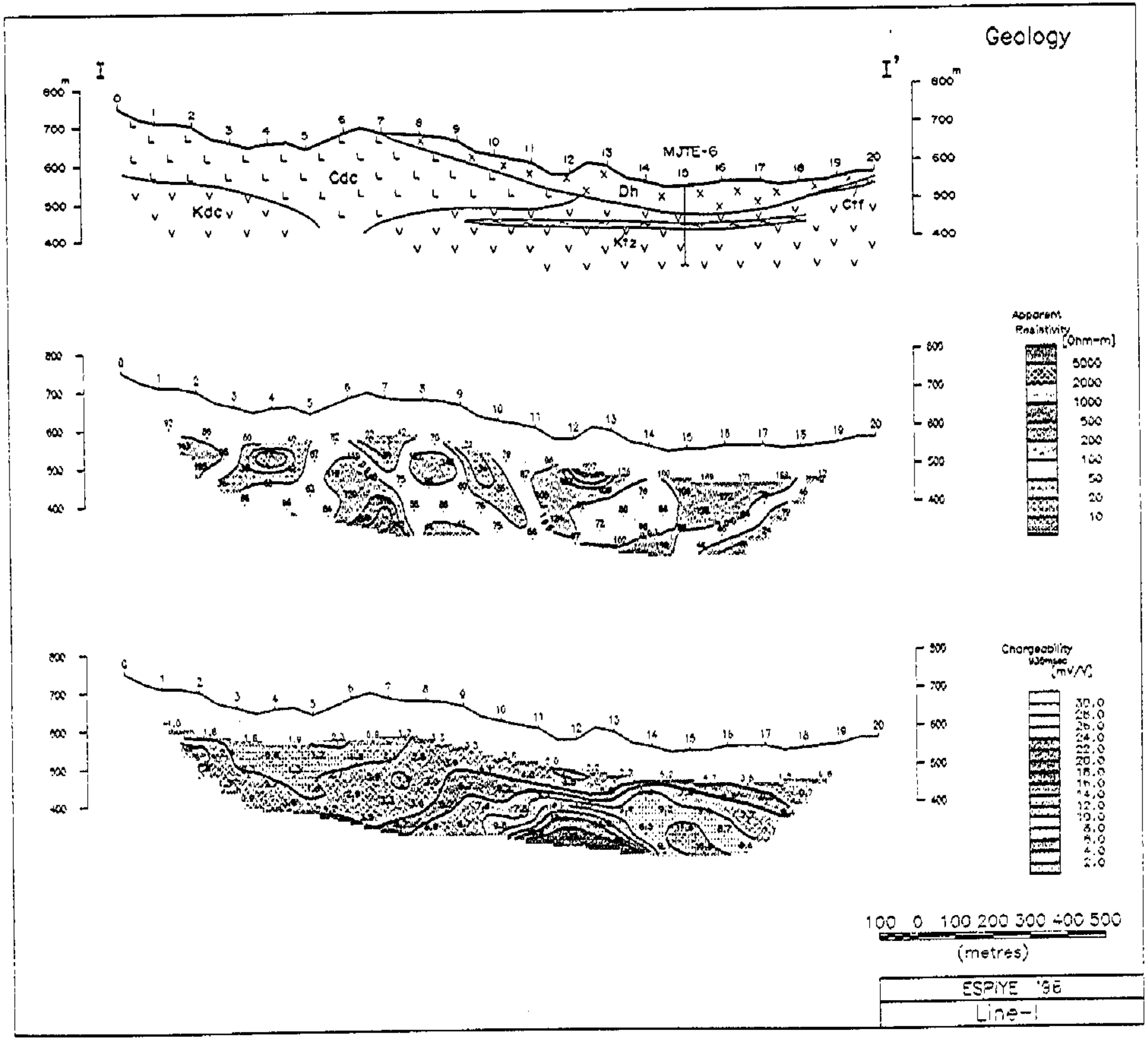


Fig. II - 1 - 13 Section of Apparent Resistivity and Chargeability (Line I)

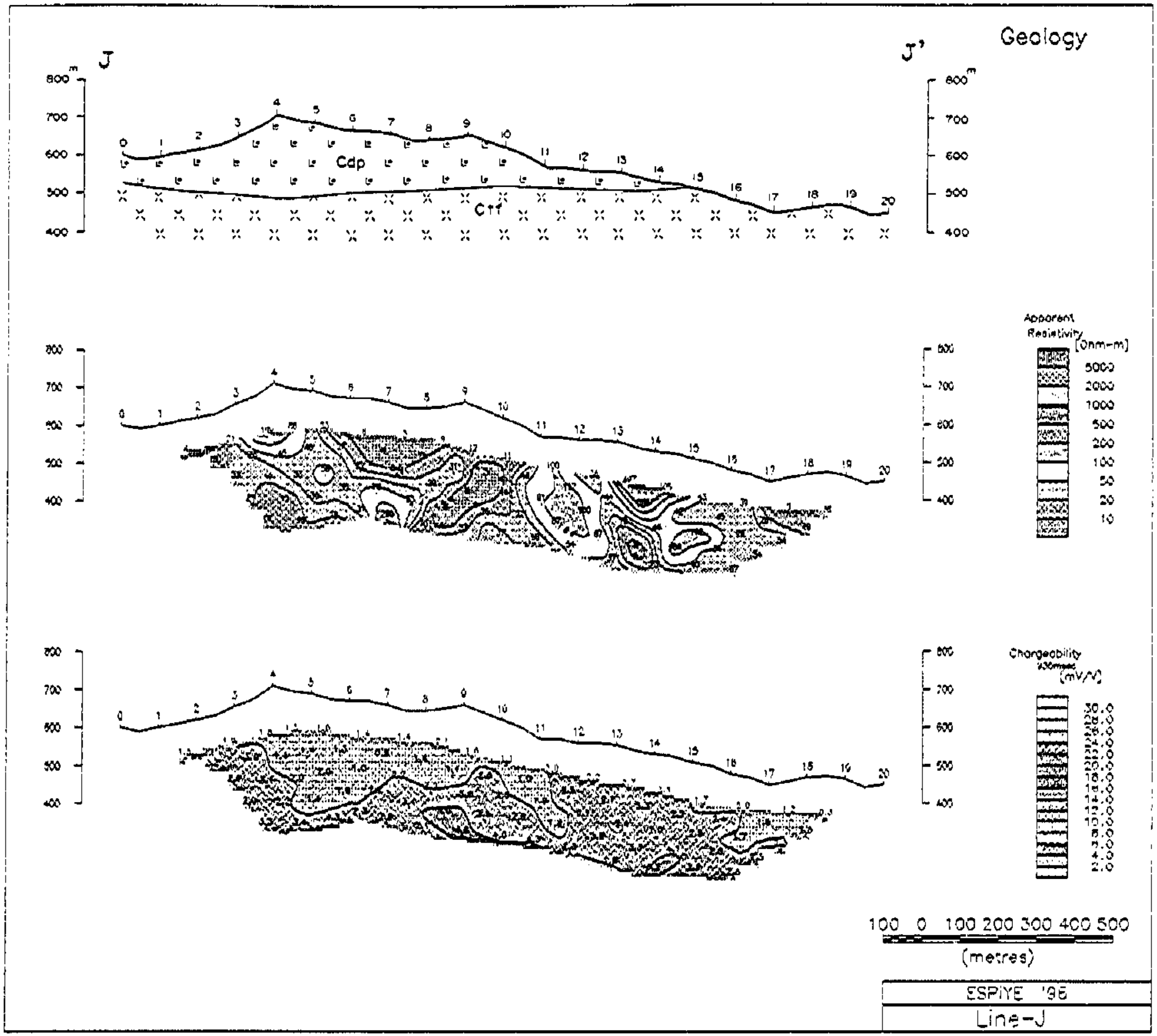


Fig. II - 1 - 14 Section of Apparent Resistivity and Chargeability (Line J)

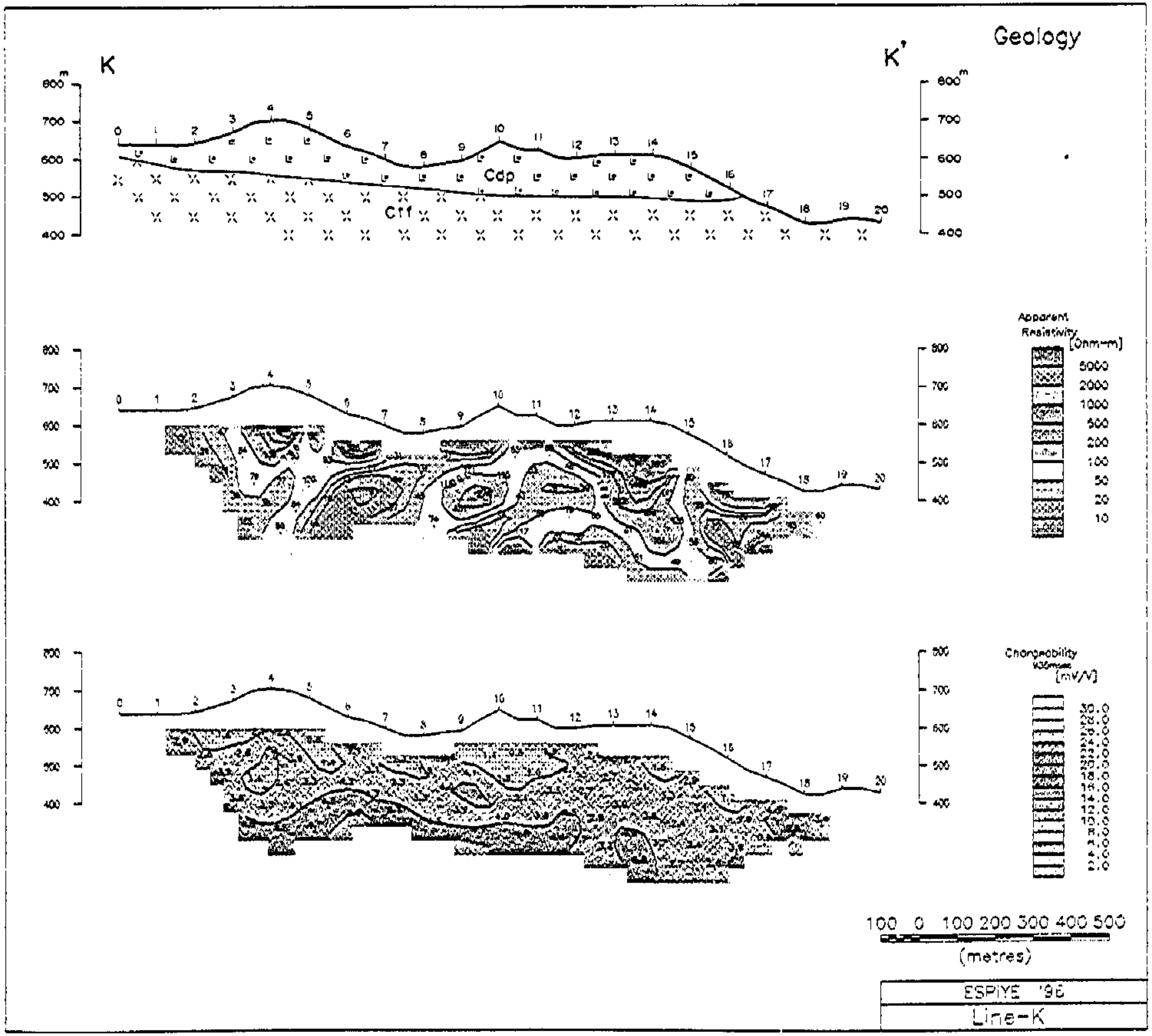


Fig. II - 1 - 15 Section of Apparent Resistivity and Chargeability (Line K)

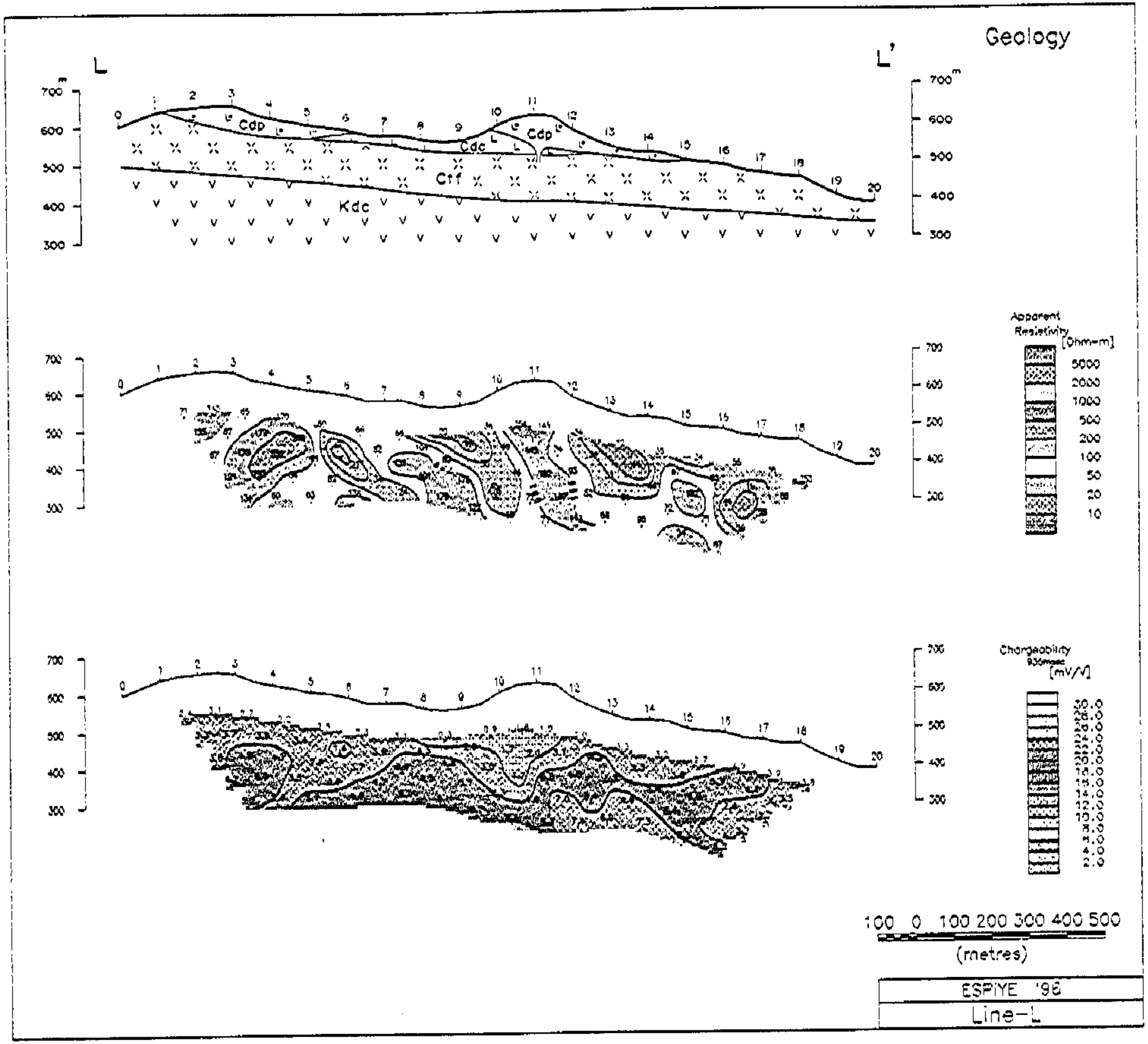


Fig. II - 1 - 16 Section of Apparent Resistivity and Chargeability (Line L)

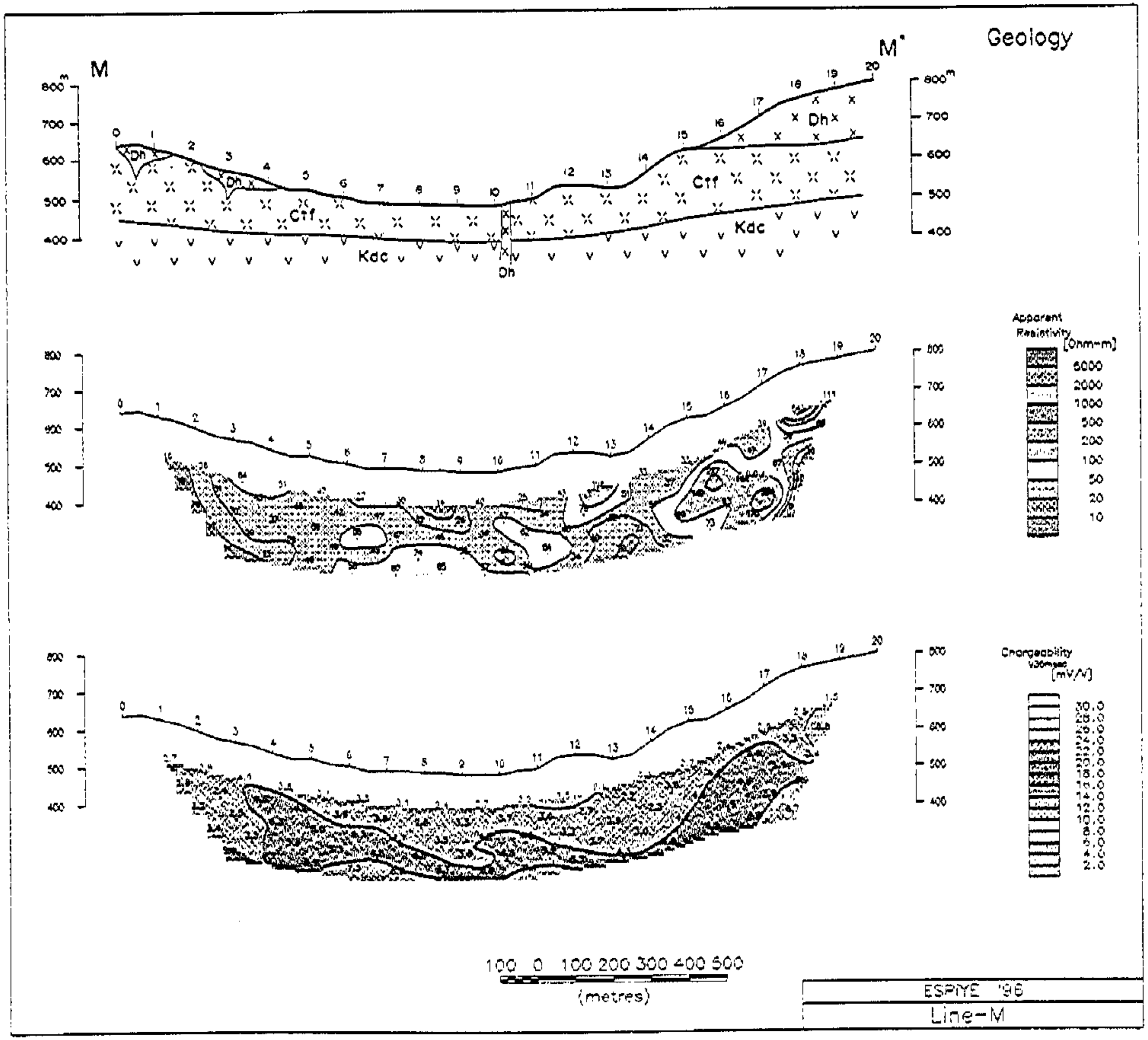


Fig. II - 1 - 17 Section of Apparent Resistivity and Chargeability (Line M)

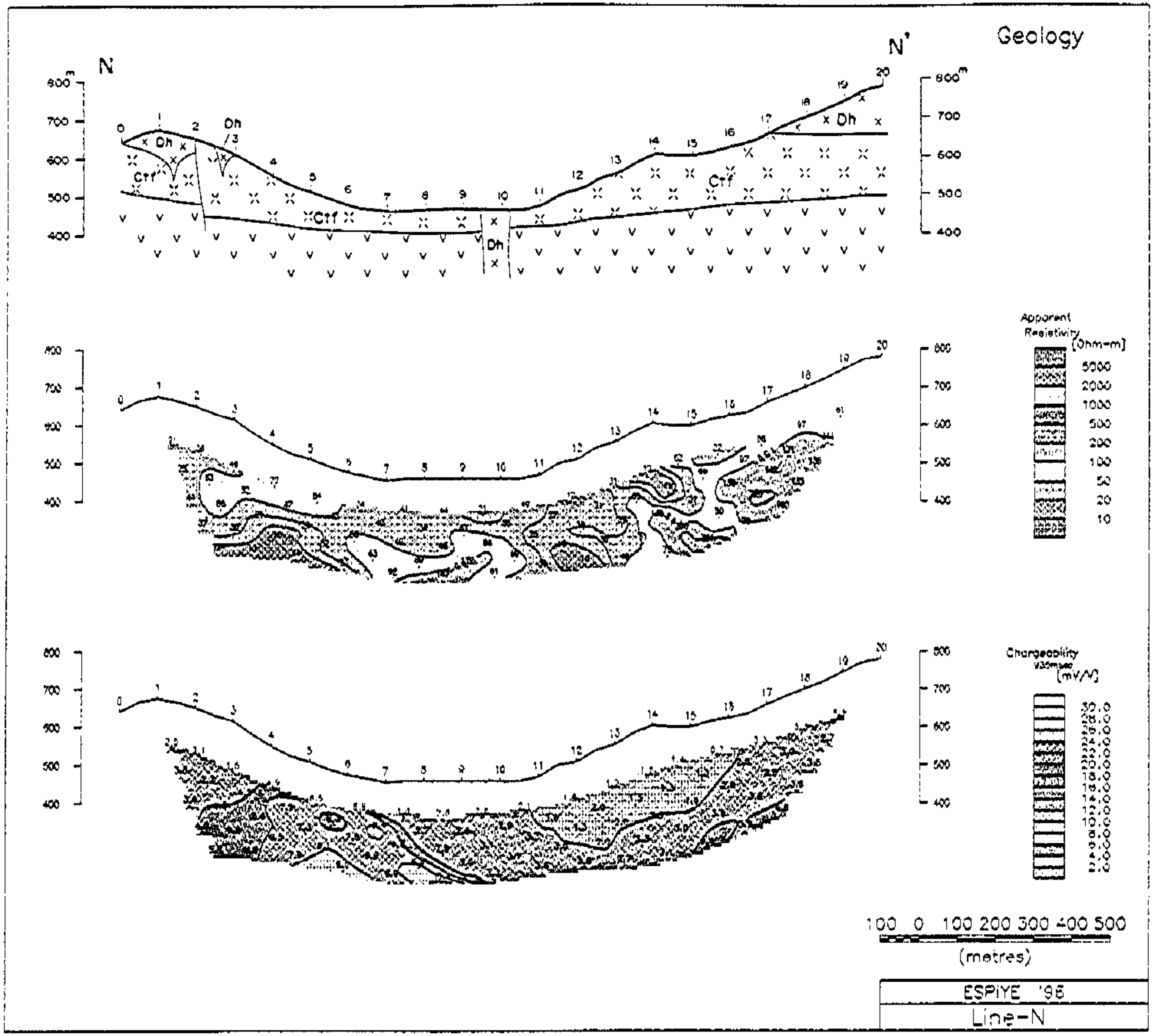


Fig. II - 1 - 18 Section of Apparent Resistivity and Chargeability (Line N)

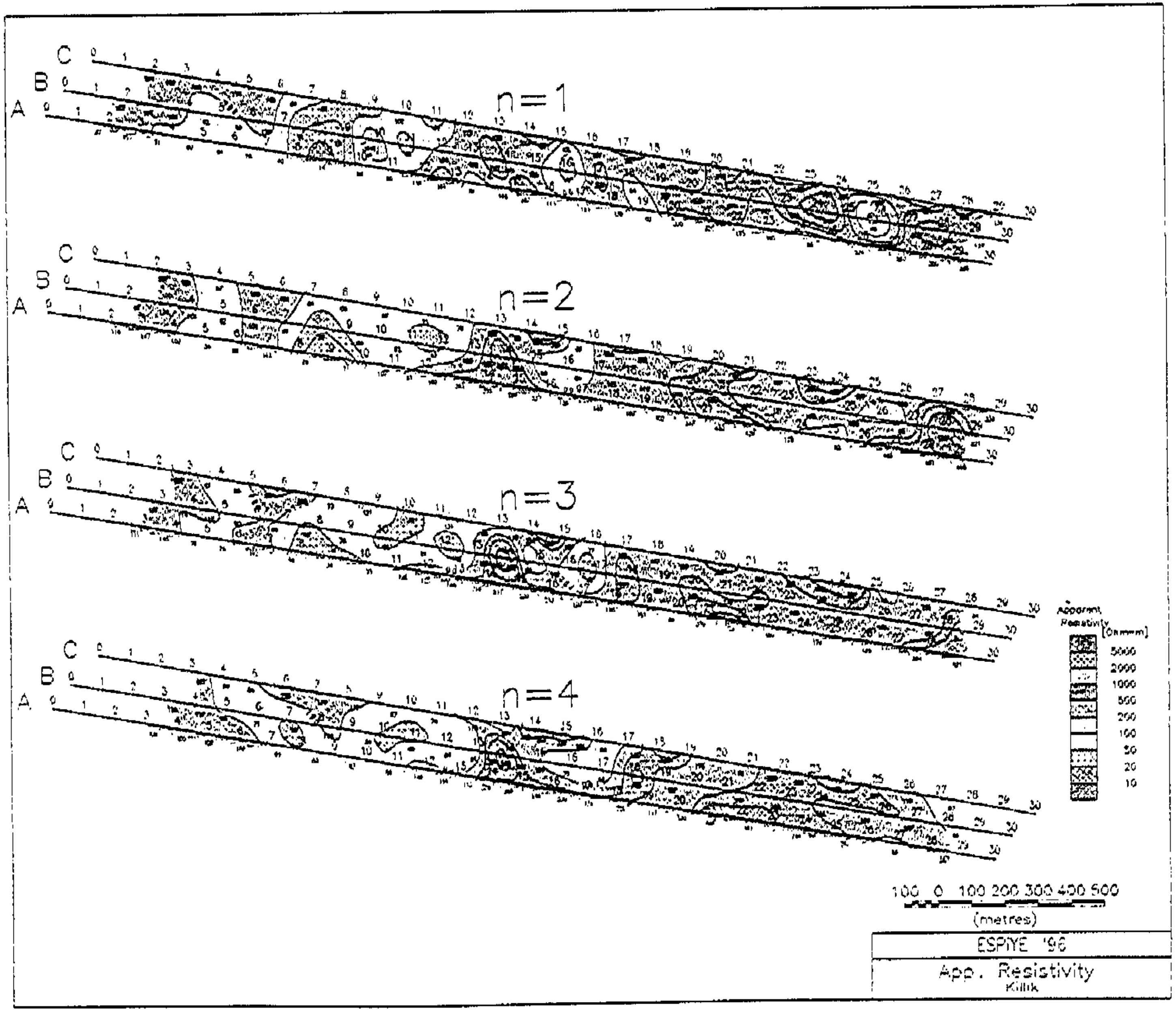


Fig. II - 1 - 19 Plane Map of Apparent Resistivity (Killik Area)

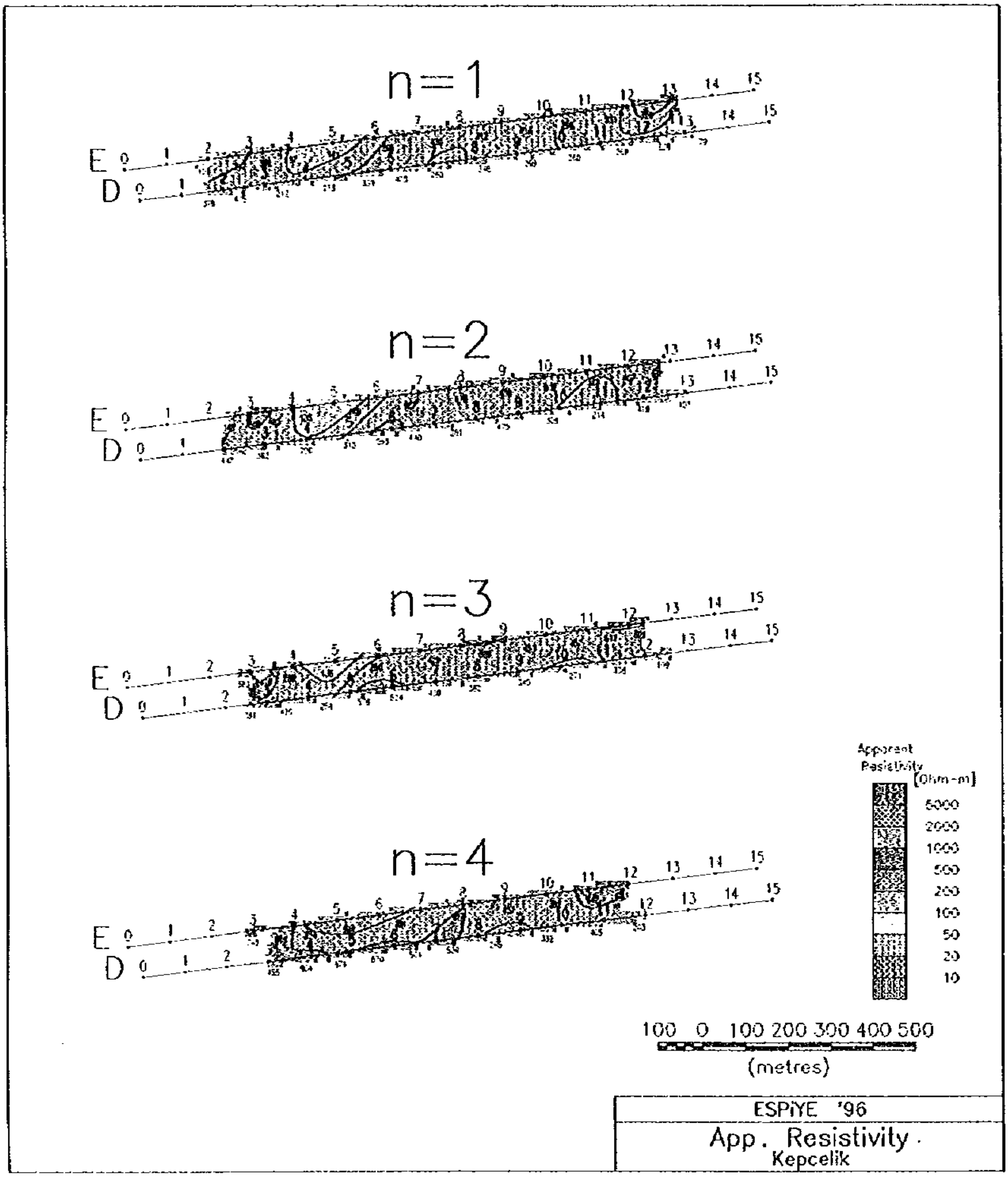


Fig. II－1－20 Plane Map of Apparent Resistivity (Kep ç elik Area)

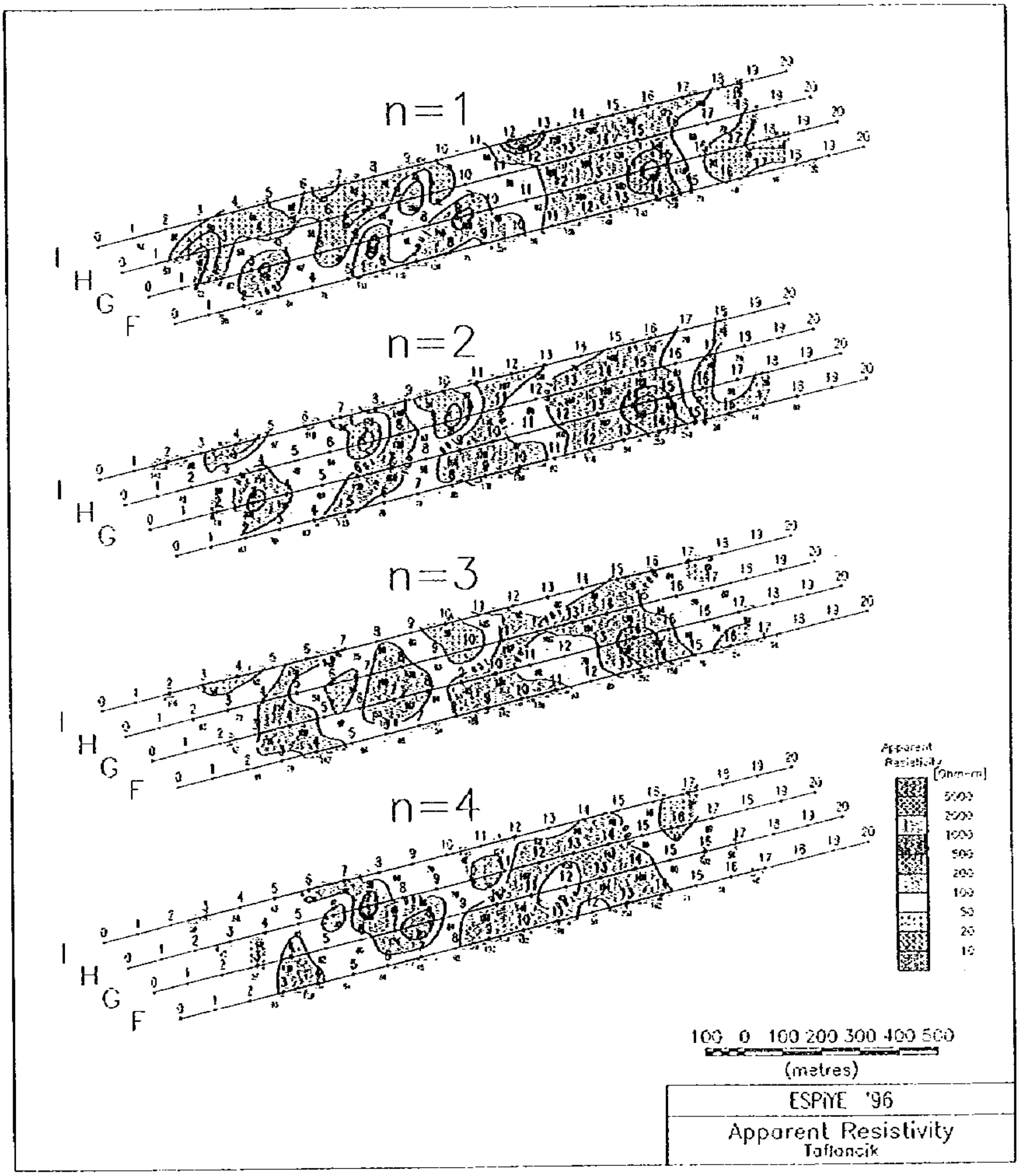


Fig. II - 1 - 21 Plane Map of Apparent Resistivity (Taflancık Area)

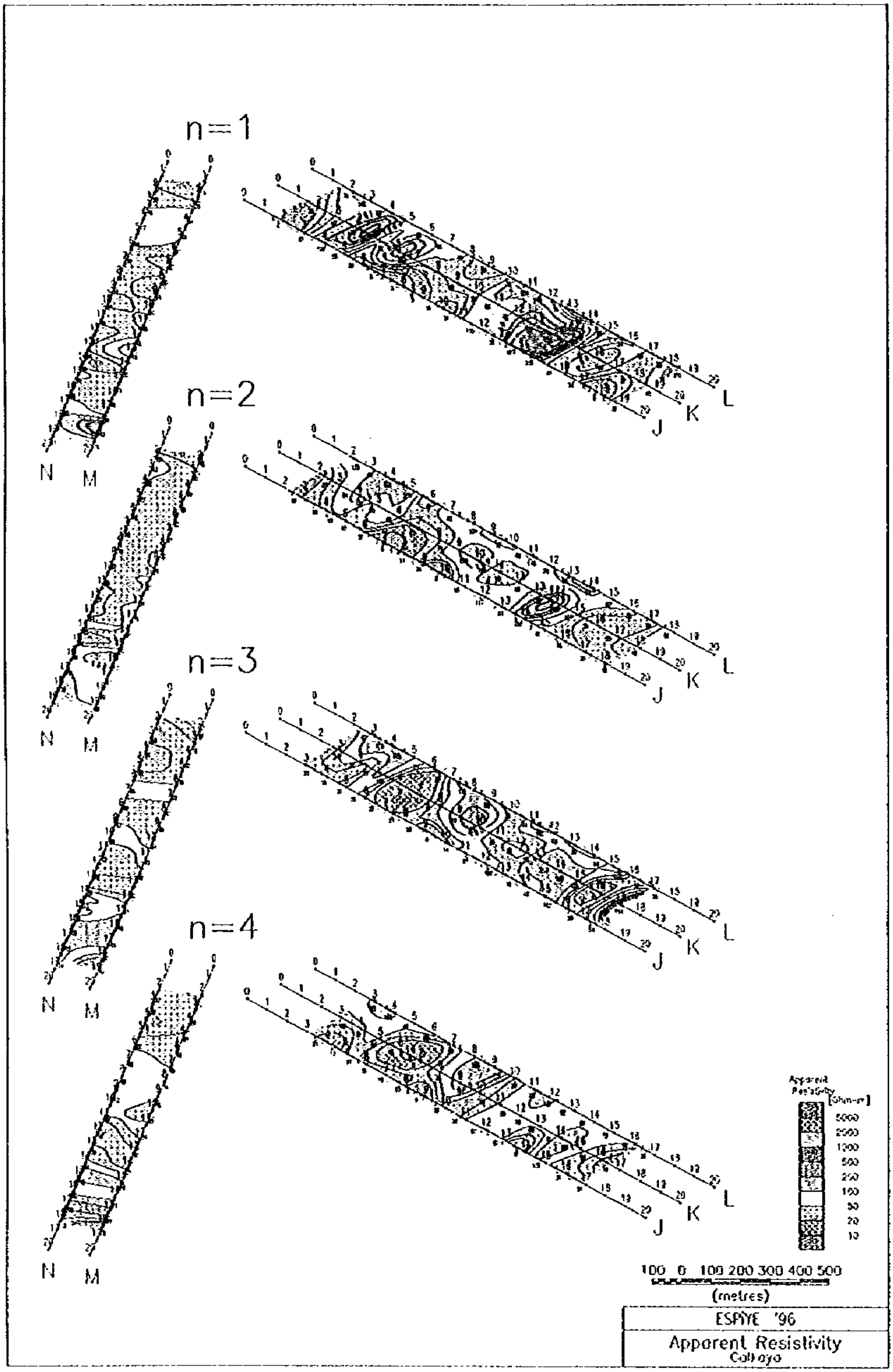


Fig. II - 1 - 22 Plane Map of Apparent Resistivity (Çalkaya Area)

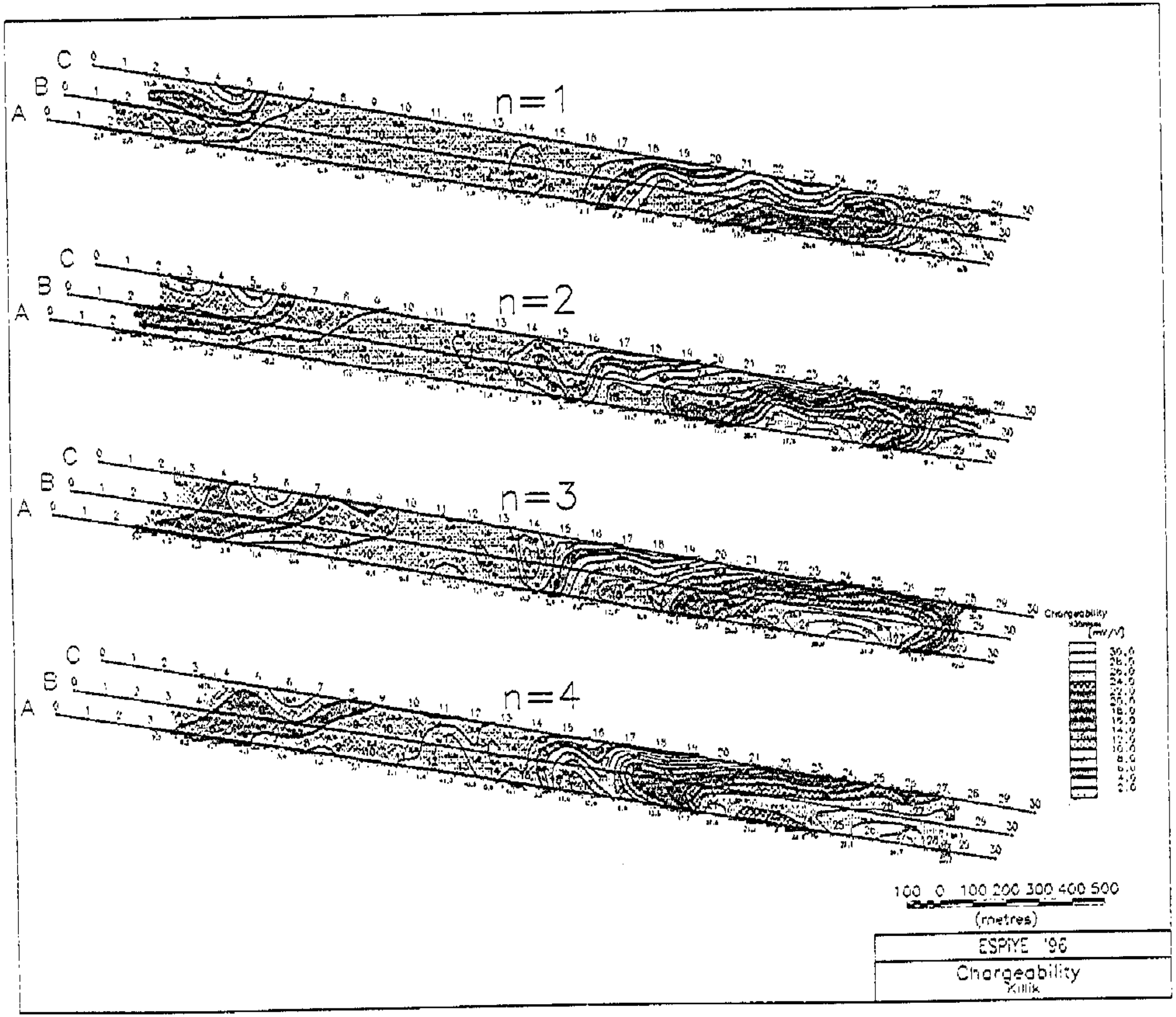


Fig. II-1-23 Plane Map of Apparent Chargeability (Killik Area)

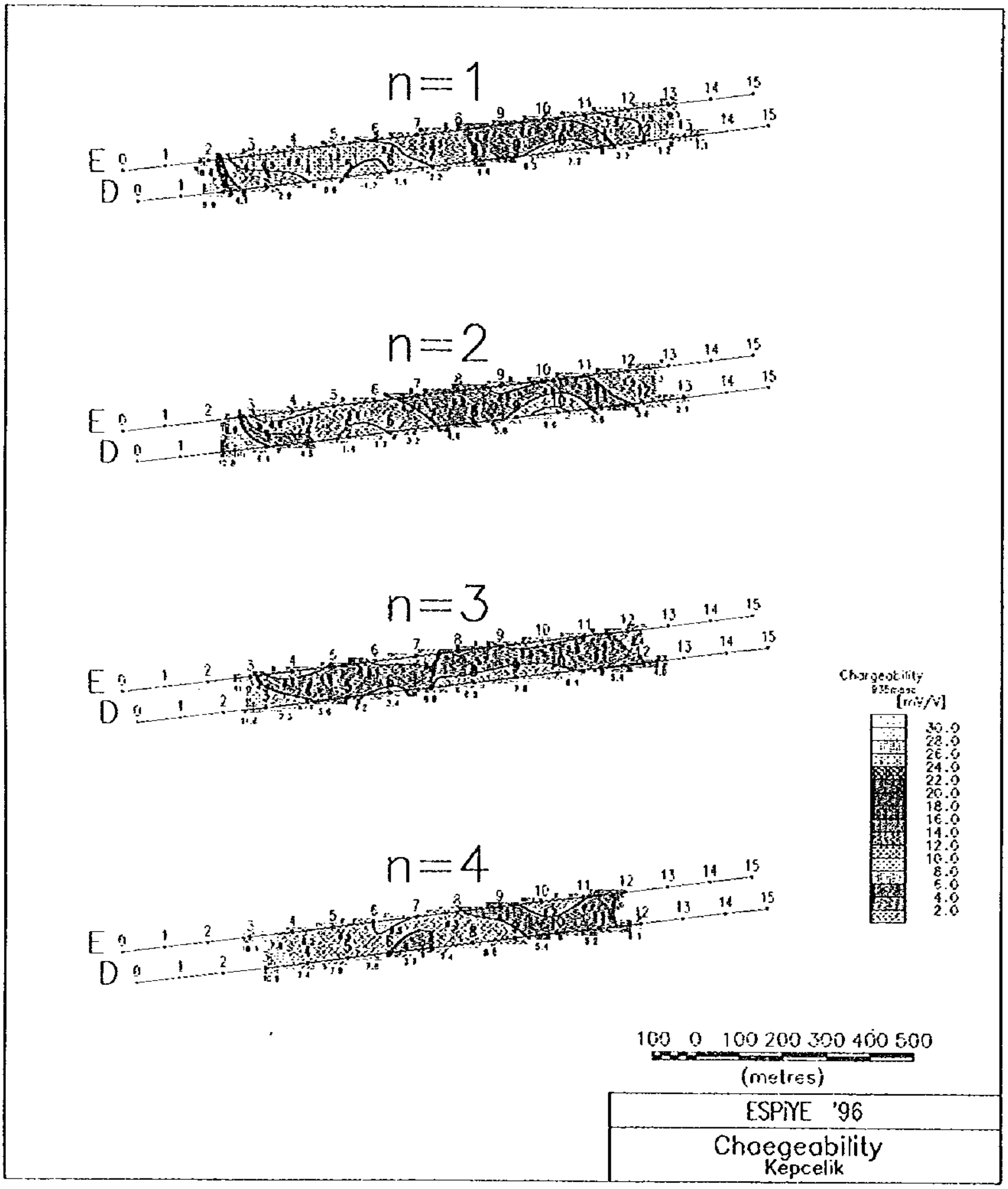


Fig. II - 1 - 24 Plane Map of Apparent Chargeability (Kep ç elik Area)

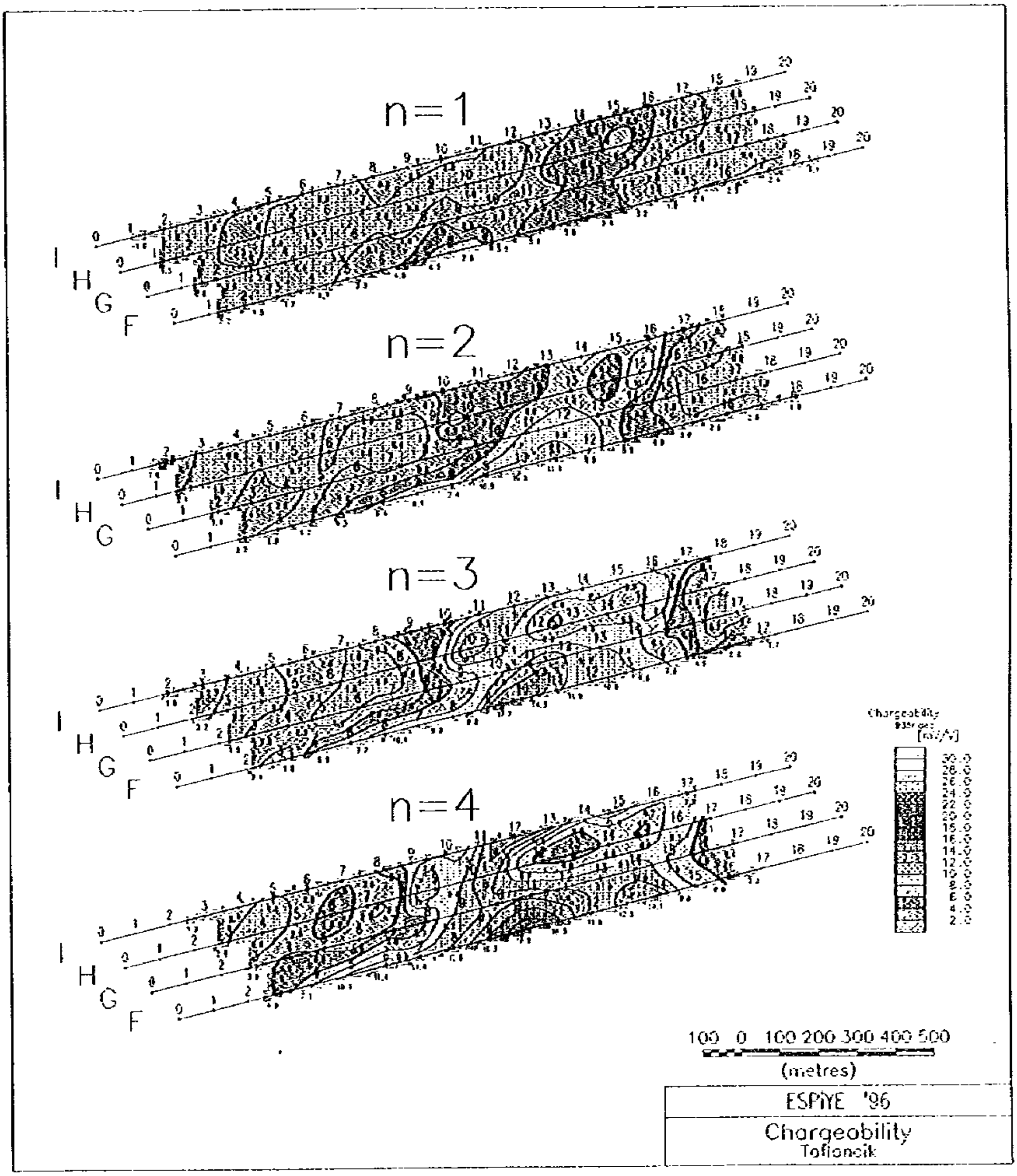


Fig. II－1－25 Plane Map of Apparent Chargeability (Taflanc ı k Area)

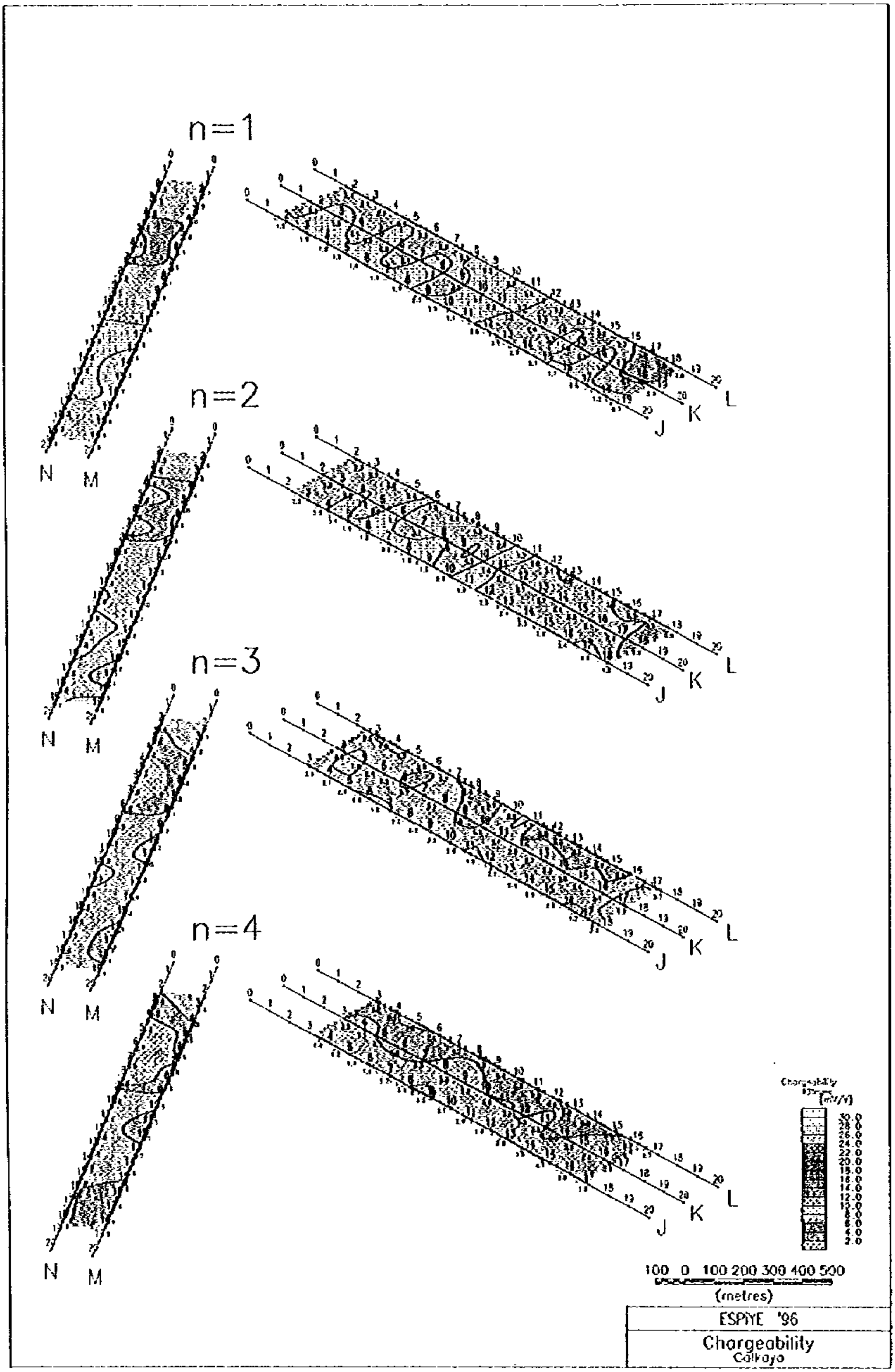


Fig. II - 1 - 26 Plane Map of Apparent Chargeability (Çalkaya Area)

1-2-2 Physical Properties of Rocks and Ores

1. Measuring Method for Physical Properties

In order to have the basic data regarding electrical specialities of drilling core in the survey area, typical 42 samples collected in the area were measured their resistivity and chargeability by time-domain method.

Samples were soaked in water (100Ω·m) for a day after cubing.

2. Employed Equipment

List of employed equipment for this purpose is shown as Table II-1-3.

3. Results of Measurement

Results of measurement are listed as shown in Table II-1-5.

Relation between apparent resistivity and chargeability in each samples is drawn as shown in Fig. II-1-27. And apparent resistivity and chargeability of the exprolation well are drawn as shown in Fig. II-1-28.

Samples are taken from relatively hard portion to avoid destruction.

Resistivity values of each samples showed high. Resistivity varies from 43Ω·m to 1,260Ω·m .

Resistivity of samples shows variable value reflecting alteration grade.

Chargeability varies from 0.55mV/V to 115.04mV/V.

Chargeability of samples which can be observed pyrite clearly by the naked eye varies more than 10mV/V.

Dacitic lava of Kızılkaya Formation and dacitic lava of Çağlayan Formation which were recognized relatively strong mineralization showed high chargeability ranging from 100mV/V partly.

Chargeability of mineralized sample tends to show higher value reflecting the high chargeability and resistivity of matrix corresponding to equal sulfides. Therefore, divide chargeability by resistivity, and we get criterion of degree of mineralization. That is , chargeability (M12 mV/V) divided by resistivity (Ω·m) gives more than 0.2, it shows clear mineralization.

Intensely mineralized samples of drilling core shows 0.63 at 109.8m depth of MJTE-3 (dacitic lava of Kızılkaya Formation).

Including samples of the first year, we work out less than 0.1 as for not mineralization rocks, 1~10 as for siliceous ore, more than 20 as for black ore, and more than100 as for yellow ore respectively.

1-2-3 Results of Analysis

Referring the result of measured physical properties of collected rocks and ores, simulating analysis were performed on A, D, F, H and I survey lines that indicated principal IP anomalies. Each results are

Table II - 1-5 Results of Physical Property Tests

No.	Bor. No.	DEPTH (m)	Rock Type	RHO (Ω·m)	M4 60msec	M5 90msec	M6 130msec	M7 190msec	M8 270msec	M9 380msec	M10 520msec	M11 705msec	M12 935msec	M13 1230msec	M14 1590msec		M12/RHO
1	MJTE-1	59.10	Dh	82.10	27.64	25.62	23.81	21.91	19.72	17.58	15.33	13.02	10.78	8.75	6.85		0.13
2		89.50	Dh	425.40	32.07	27.86	24.36	21.06	18.69	15.31	12.86	10.69	8.74	7.06	5.62		0.02
3		170.60	Dh	158.70	22.93	19.92	17.74	15.73	14.01	12.26	10.53	8.91	7.33	5.87	4.58		0.05
4		160.00	Cdc	1260.60	24.33	19.71	16.22	13.14	10.61	8.56	6.90	5.57	4.43	3.60	2.83		0.00
5		226.70	Kdc	195.83	268.07	241.41	220.66	194.81	169.99	145.25	124.41	104.30	86.55	70.95	57.66	Py net	0.44
6		250.00	Kdc	278.10	27.39	22.37	18.60	15.43	12.81	10.59	8.69	7.09	5.64	4.43	3.41		0.02
7	MJTE-2	15.90	Ctf	185.70	14.89	12.96	11.29	9.80	8.43	7.13	5.96	4.91	3.97	3.08	2.26		0.02
8		63.00	Cdc	236.41	27.72	23.58	20.36	17.33	14.71	12.35	10.28	8.26	6.57	5.03	3.74		0.03
9		114.50	Cdc	216.41	17.27	14.20	11.83	9.90	8.15	6.71	5.39	4.12	3.15	2.26	1.59		0.01
10		200.00	Cdc	378.00	12.59	10.69	9.18	7.73	6.47	5.32	4.30	3.34	2.56	1.83	1.47		0.01
11		220.00	Kdc	165.30	19.65	16.32	13.35	10.85	8.74	6.94	5.41	4.19	3.20	2.39	1.79		0.02
12		249.00	Ctf	695.30	11.41	9.39	7.70	6.14	4.78	3.68	2.80	2.10	1.54	1.14	0.81		0.00
13	MJTE-3	32.83	Ctf	208.00	18.57	15.04	12.31	9.87	7.96	6.31	5.01	3.99	3.01	2.32	1.75		0.01
14		60.53	Ad	122.30	8.63	6.53	5.07	3.85	2.94	2.13	1.61	1.12	0.80	0.56	0.50		0.01
15		76.54	Ctf	635.50	328.51	301.61	274.55	245.11	216.27	187.95	161.69	137.11	115.01	95.45	78.51	Py diss	0.19
16		109.83	Kdc	126.50	261.63	233.65	207.59	181.55	157.18	134.59	114.21	95.74	79.74	65.61	53.71	Py net	0.63
17		119.83	Kdc	100.00	135.57	116.56	99.91	84.23	70.45	58.32	48.14	39.14	31.65	25.32	20.13	Py diss	0.32
18	MJTE-4	71.10	Ctf	125.70	4.12	5.13	3.20	1.85	1.94	1.28	1.33	0.91	0.71	0.56	0.57		0.01
19		126.00	Ctf	161.60	5.33	3.73	2.58	1.50	1.49	1.33	1.00	0.89	0.73	0.67	0.53		0.00
20		142.50	Kdc	365.50	2.52	1.95	1.80	1.60	1.59	1.55	1.49	1.33	1.17	0.97	0.75		0.00
21		178.00	Kdc	76.92	18.11	15.10	12.73	10.70	8.69	6.85	5.39	3.92	2.83	2.03	1.46		0.04
22		200.70	Kdc	77.59	22.00	19.80	17.51	14.81	12.16	9.64	7.43	5.57	4.07	2.91	2.03		0.05
23	MJTE-5	115.70	Cdc	115.70	4.24	1.56	1.31	1.22	0.91	0.83	0.73	0.60	0.55	0.45	0.30		0.00
24		134.60	Kdc	72.60	23.03	18.56	15.68	13.19	11.38	9.71	8.37	7.12	6.15	5.28	4.71		0.09
25		161.50	Dh	103.60	15.03	12.47	10.45	9.04	7.26	6.00	4.83	3.85	3.10	2.33	1.76		0.03
26		182.92	Kdc	64.70	57.37	49.44	43.38	37.69	32.67	27.94	24.01	20.43	17.41	14.76	12.37	Py net	0.27
27		221.60	Kdc	43.30	24.75	21.61	19.11	16.63	14.33	12.37	10.57	8.90	7.45	6.03	4.94		0.17
28	MJTE-6	52.50	Dh	309.60	12.27	9.85	7.83	6.33	5.17	4.33	3.61	2.93	2.41	1.95	1.63		0.01
29		80.70	Kdc	176.90	12.82	10.77	9.24	7.82	6.54	5.44	4.52	3.68	3.03	2.36	1.91		0.03
30		99.20	Kt2	258.80	75.03	62.03	50.92	40.75	32.16	25.12	19.53	15.07	11.63	8.98	6.91	Py diss	0.04
31		127.50	Kdc	142.10	267.31	237.12	207.87	177.70	149.91	124.61	102.74	83.61	67.76	54.45	43.63	Py diss	0.48
32		194.80	Kdc	387.60	32.90	27.65	23.23	19.24	15.69	12.61	10.11	8.00	6.30	4.85	3.77		0.02
33	MJTE-7	50.70	Cdc	80.90	22.74	21.09	19.37	17.31	15.09	12.73	10.59	8.45	6.50	4.83	3.53		0.08
34		100.00	Cdc	253.40	16.94	14.24	11.93	9.88	8.11	6.62	5.31	4.24	3.41	2.69	2.06		0.01
35		148.40	Kdc	279.00	54.38	45.41	38.19	31.63	26.19	21.45	17.59	14.19	11.35	8.95	6.99	Py diss	0.04
36		162.00	Kdc	132.10	283.83	256.03	228.83	200.23	172.97	147.21	124.15	103.55	85.85	70.60	57.93	Py net	0.65
37		177.50	Kdc	412.10	37.96	32.79	27.94	23.54	19.63	16.19	13.21	10.71	8.62	6.81	5.40		0.03
38	MJTE-8	59.50	Dh	317.70	3.14	2.62	1.43	1.04	1.03	0.87	0.73	0.61	0.52	0.49	0.24		0.00
39		101.70	Dh	114.40	2.91	3.52	3.47	3.39	3.24	2.92	2.71	2.45	2.16	1.83	1.58		0.02
40		115.50	Kdc	111.90	37.52	34.62	31.52	28.07	24.53	21.42	18.37	15.55	13.05	10.81	8.84	Py net	0.12
41		178.00	Kt2	121.70	42.20	36.91	32.57	28.59	25.15	21.79	18.69	15.72	13.13	10.70	8.59	Py diss	0.11
42		200.00	Kdc	522.60	27.45	22.45	18.67	15.47	12.79	10.51	8.60	6.91	5.63	4.52	3.59		0.02
43	Lahanos		Ore	17.00	382.26	347.63	318.05	289.83	265.85	235.93	207.55	179.65	156.92	132.39	109.42		9.23
				8.63	459.50	422.55	391.30	357.15	322.84	286.55	254.45	223.03	192.21	164.55	139.63		22.35
				9.43	555.23	525.72	494.22	458.13	421.71	383.03	341.12	303.21	269.53	231.64	199.56		28.67
44	B-line No. 28		Kdc	914.80	111.79	100.65	90.13	79.37	69.09	59.48	50.81	42.97	36.05	29.97	24.73		0.01
				356.63	214.18	192.43	171.39	149.56	128.54	108.99	91.41	75.59	61.93	50.18	40.34		0.17
				459.90	151.71	136.03	121.11	105.93	91.65	78.29	66.07	55.21	45.78	37.33	30.31		0.10

Intrusive rock
Dh-Hematite Dacite
Dp:Porphyritic Dacite
Ad-Andesite

Caglayan Formation
Ctf:Dacitic Pyroclastics
Cdc:Porphyritic dacite Lava

Kizilkaya Formation
Kdc:Dacite Lava
Kt2:Dacitic Pyroclastics

Catak Formation
Ctf:Dacitic Pyroclastics

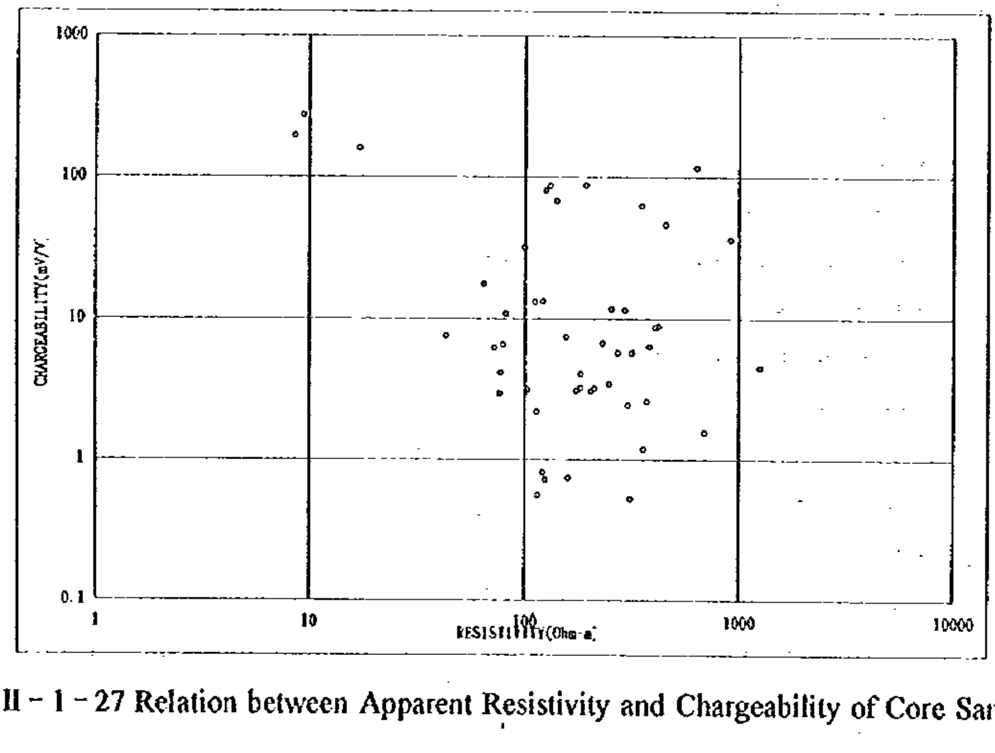


Fig. II - 1 - 27 Relation between Apparent Resistivity and Chargeability of Core Samples

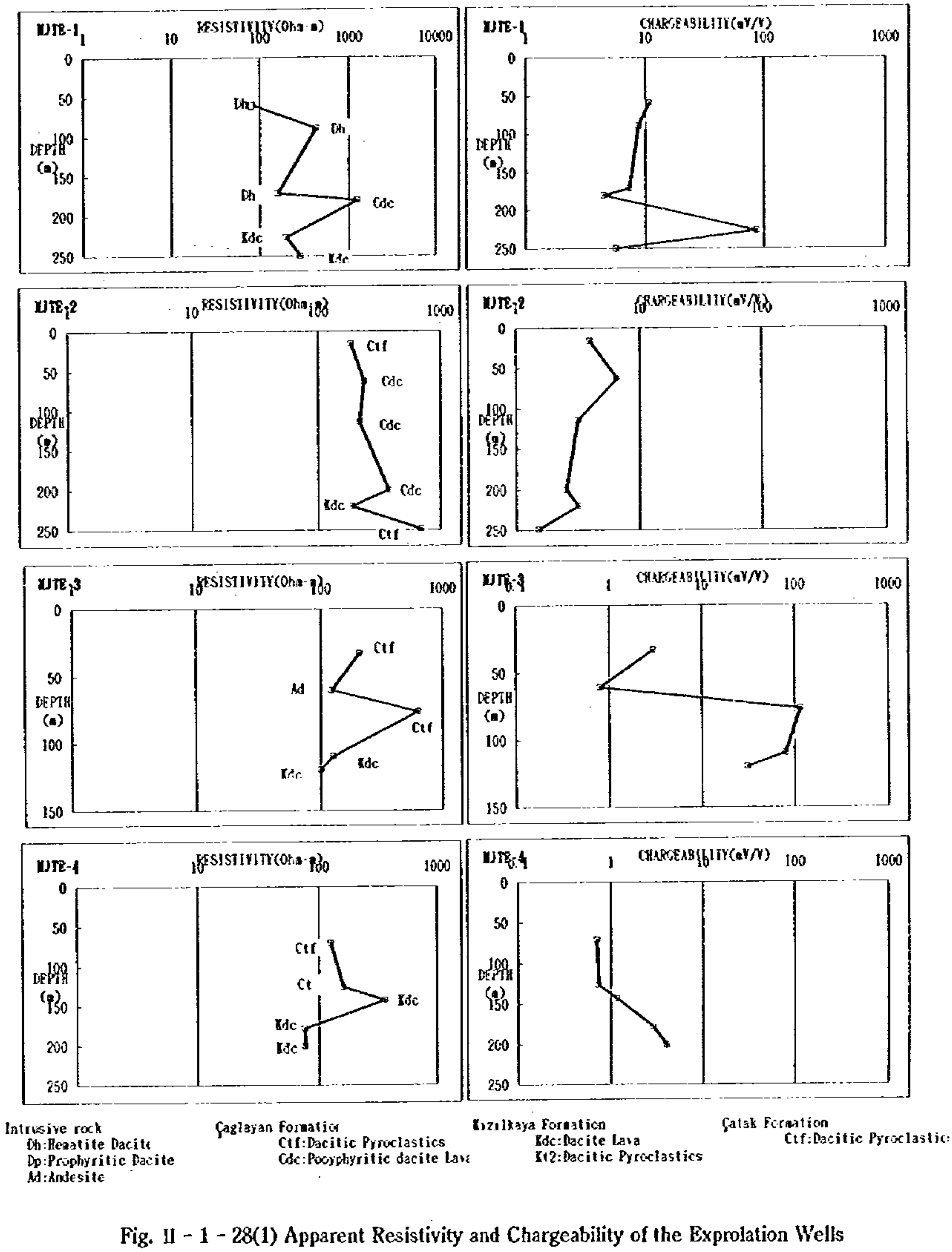
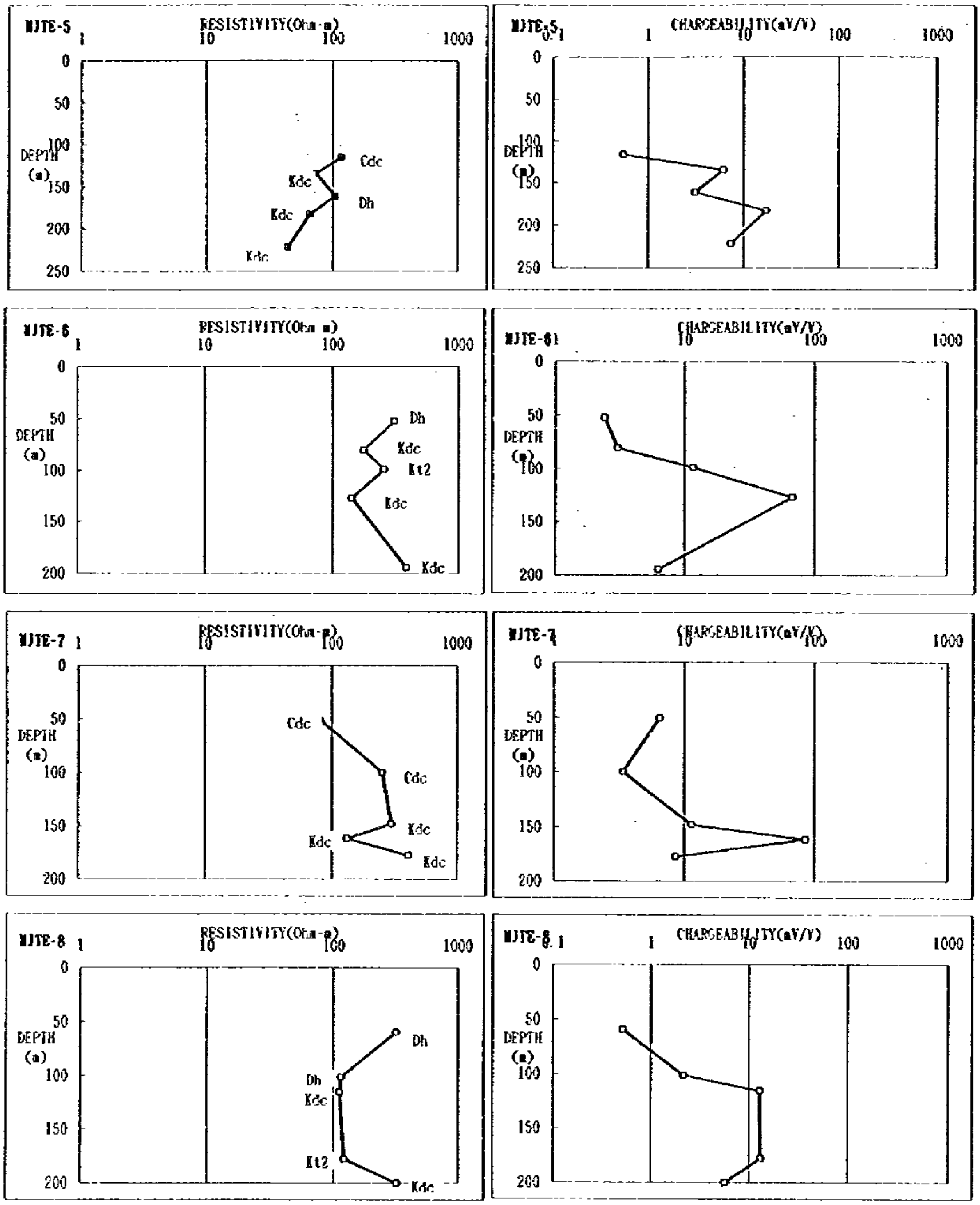


Fig. II - 1 - 28(1) Apparent Resistivity and Chargeability of the Exprolation Wells



Intrusive rock
Dh:Hematite Dacite
Dp:Prophyritic Dacite
Ad:Andesite

Caglayan Formation
Ctf:Dacitic Pyroclastics
Cdc:Porphyritic dacite Lava

Kizilkaya Formation
Kdc:Dacite Lava
Kt2:Dacitic Pyroclastics

Catak Formation
Ctf:Dacitic Pyroclas

Fig. II - 1 - 28(2) Apparent Resistivity and Chargeability of the Exprolation Wells drawn as shown in Fig. II -1-29～33.

A-survey line

IP anomaly around No.20～25 was analyzed.

The IP anomaly was simulated to have derived from area around 100m below that showed around 100～750Ω·m as resistivity and around 40～100mV/V as chargeability. We a ssumed that origin of extremely strong IP anomaly was around 100m below No.25 zone.

Origin of IP anomaly was estimated to have 100Ω·m and 100mV/V as resistivity and chargeability respectively. Chargeability (M12) divided by resistivity (Ω·m) to get degree of mineralization, we get 1.0. And it seems likely to siliceous ore.

Around here, more weak mineralized area was expected to develop widely. IP anomaly of resistivity and chargeability by 2 dimensional analysis included the influence of topography because results of measurement around No.25 affected seriously by topography.

D-survey line

Weak IP anomaly around No.0～5 was analyzed.

The IP anomaly was simulated to have derived from area around 100m below No.3 zone that showed around 300Ω·m as resistivity and around 90mV/V as chargeability. Chargeability (M12) divided by resistivity (Ω·m) gives 0.3. It showed extremely weak mineralization.

Origin of IP anomaly was computed by only value of IP anomaly at the end of this survey line. Therefore, the state of IP distribution was not clear.

IP anomaly of E-survey line was similar to D-survey line in shape, and so we a ssumed that they are alike in distribution.

F-survey line

IP anomaly around No.5～14 was analyzed.

The IP anomaly was simulated to have derived from area around 100m below No.8～14 zone that showed around 40Ω·m as resistivity and around 40mV/V as chargeability.

The value of physical properties of drilling core around IP anomaly showed 200Ω·m due to taking hard portion for the analysis. Therefore, the real resistivity of underground may be lower than the measured value by sample due to argillization and fracture.

Chargeability (M12) divided by resistivity (Ω·m) gives 1.0. This value shows siliceous ore level, and indicate relatively in a good state of mineralization.

H-survey line

IP anomaly around No.9～11 was analyzed.

The IP anomaly was simulated to have derived from area around 150m below No.4～11 zone that showed around 60Ω·m as resistivity and around 50mV/V as chargeability.

Chargeability(M12) divided by resistivity(Ω·m) gives 0.83. This value shows extremely weak mineralization.

I-survey line

IP anomaly around No.9～16 was analyzed.

The IP anomaly was simulated to have derived from area around 150m below No.10～14 zone that showed around 3Ω·m as resistivity and around 40mV/V as chargeability.

Chargeability (M12) divided by resistivity (Ω·m) gives 13.3. This value shows mineralization was in a good state.

Results of analysis are summarized as shown in Table II-1-6.

Table II-1-6 Summarized Table of IP Survey

Survey Line	Estimated Resistivity & Chargeability of Origin of IP Anomaly	Estimated Distribution Pattern of Origin of IP anomaly
A Killik area	150~750Ω・m & 40mV/V 100Ω・m & 100mV/V	・It developes at deeper part than 100m. Distribute widely. Extremely weak mineralization was assumed. ・At deeper place than 100m of No.25 siliceous ore was assumed.
D Kepçelik area	300Ω・m & 90mV/V	It developes at deeper part than 150m. Extremely weak mineralization was assumed. The state of distribution was not clear.
F Taflancık area	40Ω・m & 40mV/V	It developes at deeper part than 100m. Siliceous ore was assumed.
H Taflancık area	60Ω・m & 50mV/V	It developes at deeper part than 150m. Extremely weak mineralization was assumed. Widely distribute flatly.
I Taflancık area	3Ω・m & 40mV/V	It developes at deeper part than 150m. Mineralization was assumed relatively in a good state.

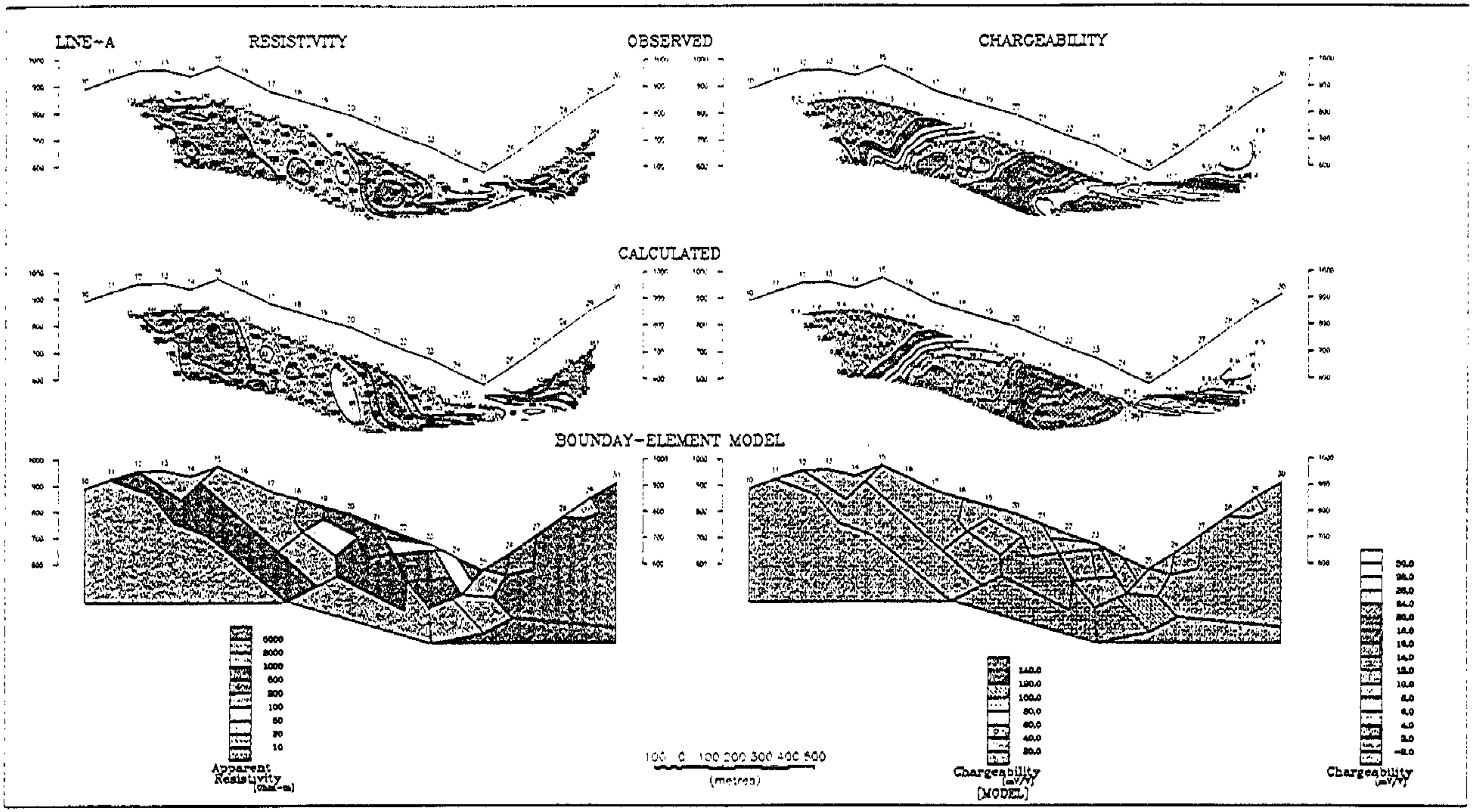


Fig. II - 1 - 29 Section of Simulated Result (Line A)

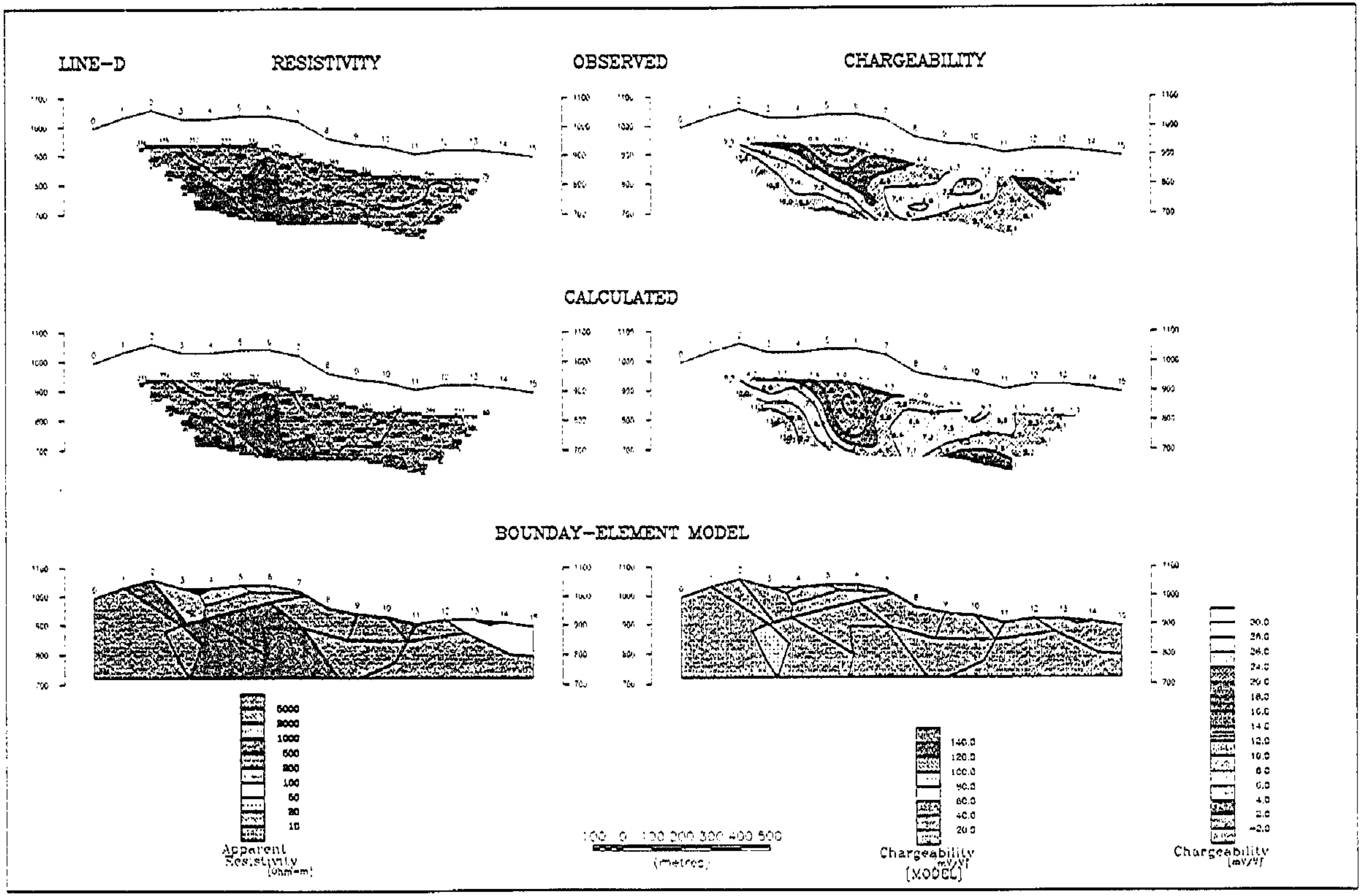


Fig. II - 1 - 30 Section of Simulated Result (Line D)

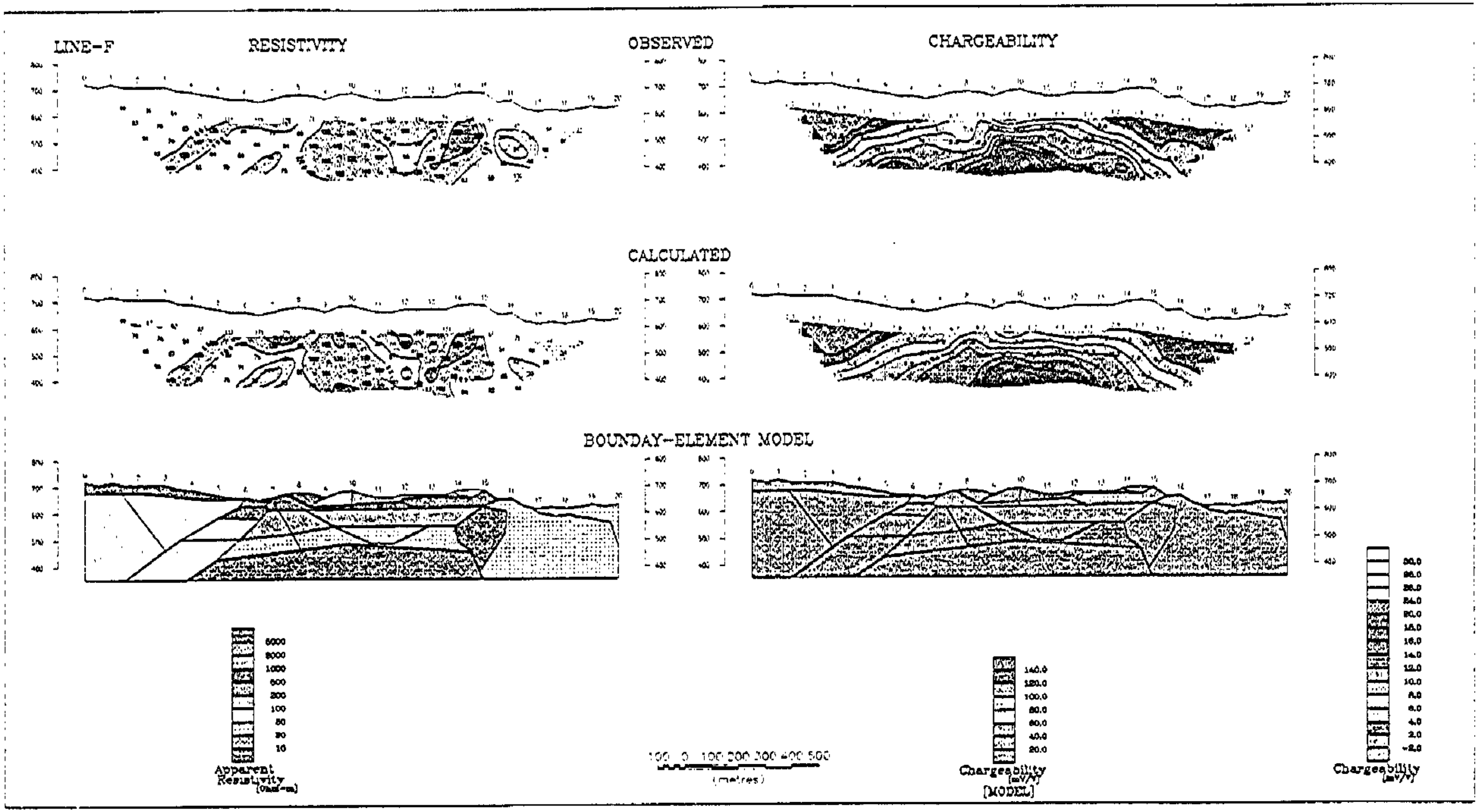


Fig. II-1-31 Section of Simulated Result (Line F)

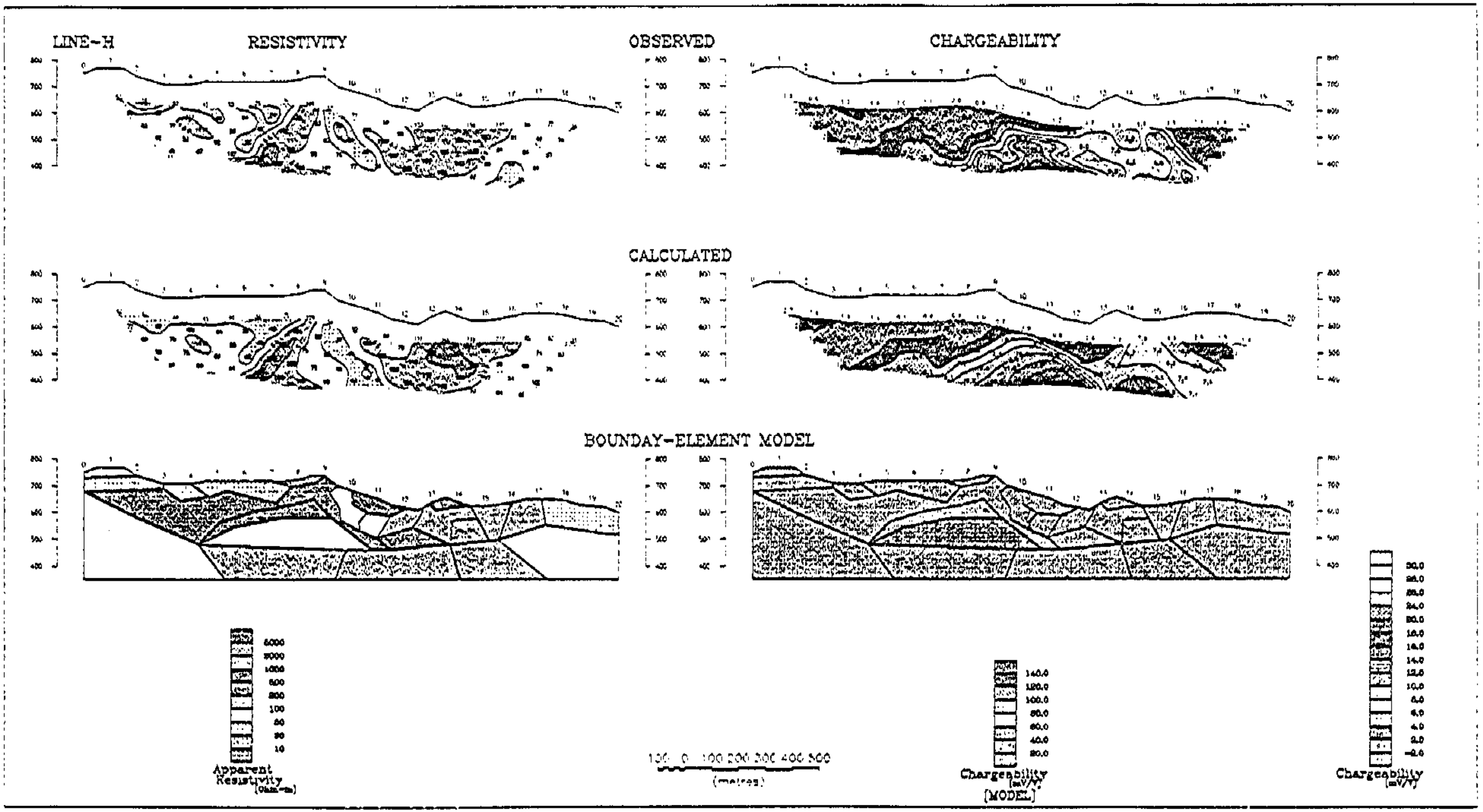


Fig. II-1-32 Section of Simulated Result (Line H)

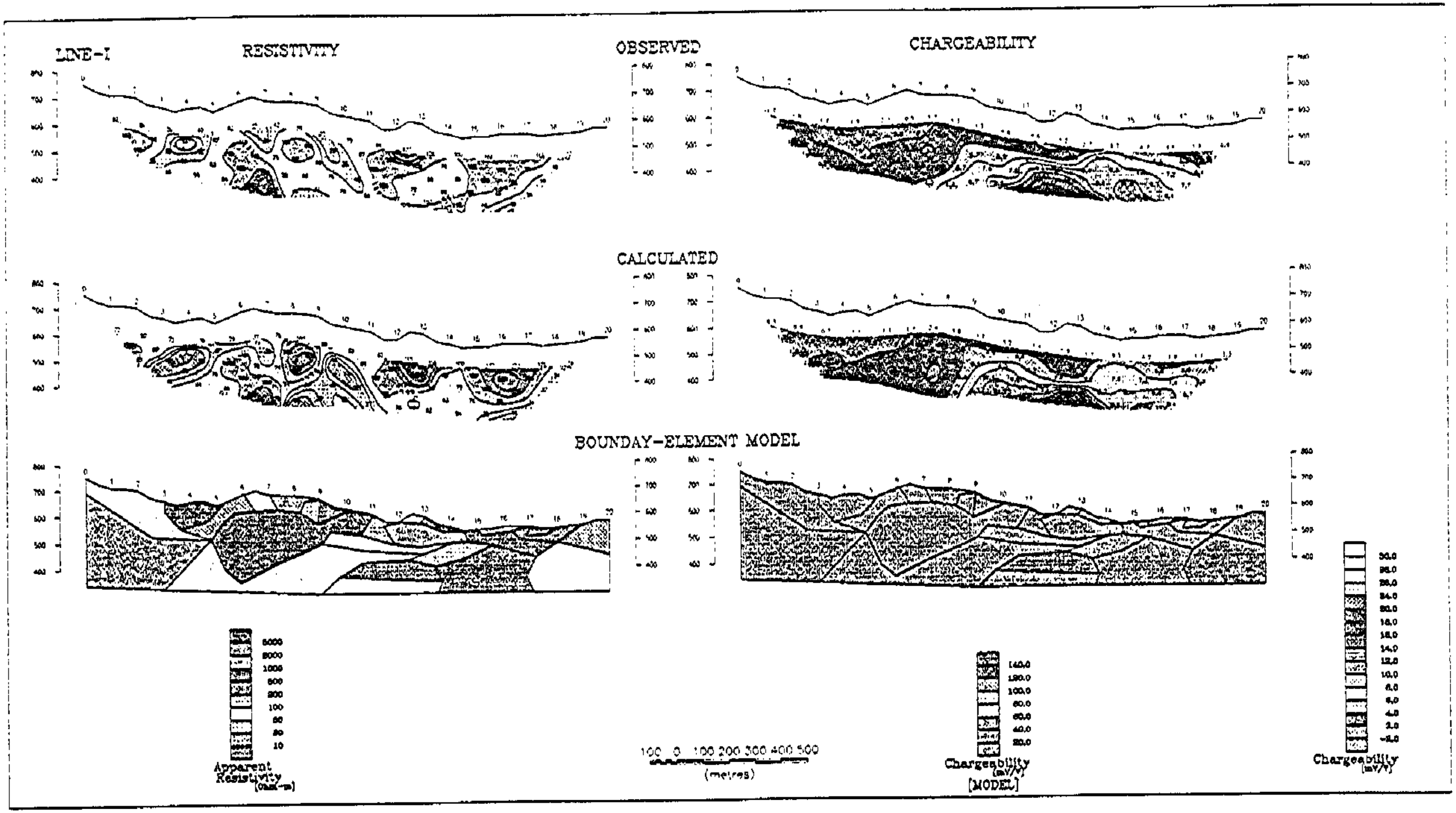


Fig. II - 1 - 33 Section of Simulated Result (Line I)

1-3 Consideration

The survey results are shown in the summarized map in Figure II-1-34.

The present survey clarified a distribution of the IP anomaly zone in Taflancık area extracted in the previous year. Also, a new IP anomaly zone was observed in Killik area.

The results were obtained that a high resistivity zone of 300 Ω.m or more among resistivity of n = 1 representing nearby surface obtained from the survey results corresponds well to intrusive rocks. However, the resistivity, on the whole, changes according to a degree of mineralization and argillization in a resistivity zone of approx. 200 Ω.m or less due to intrusive rocks, a difference in lithology of the Kızılkaya and Çağlayan Formation.

A low resistivity zone of approx. 40 Ω.m or less corresponds well to argillic alteration on surface.

1. Killik Area

A clear chargeability anomaly distributed in a wide area which was the greatest around No. 25 on each survey line was observed in Killik area.

The anomalous chargeability maximum 30 mV/V was in a distribution area of dacite lava in the Kızılkaya Formation.

According to the simulation analysis, the strongest anomaly source is considered to be a siliceous ore with a resistivity of 100 Ω.m and a chargeability of 100 mV/V at a depth of 100 m or more at No. 25. It is thought that a weak mineralized area is widely distributed on its periphery.

Considering this IP anomaly distribution and the IP effect affected by a steep landform, it is thought that a strong IP anomaly source has not been grasped yet in the present survey.

2. KepÇelik Area

A similar weak anomaly was observed on the end of each survey line in KepÇelik area.

According to the simulation analysis results, it is presumed that a resistivity is 300Ω.m and a chargeability is 90 mV/V at a depth of about 100m or more at No.3 as an anomaly source. Since this is an anomaly source calculated from an IP anomaly value at the end of the survey line, the distribution condition and other data are not clear. It is possible that this reflects a very weak mineralization.

3. Taflancık Area

An IP anomaly was observed on each survey line in Taflancık area. Farther we go north, stronger the tendency is that the IP anomaly distribution extends in the NNE-SSW direction in the depth.

According to the simulation analysis, it is presumed that there are anomaly sources with a resistivity of 40 Ω.m and a chargeability of 40 mV/V at a depth of about 100m or more of Nos. 8 to 14 on survey line F, with a resistivity of 60 Ω.m and a chargeability of 50 mV/V at a depth of 150 m or more of Nos. 4

to 11 on survey line H, and with a resistivity of 3 Ω.m and a chargeability of 40 mV/V at a depth of 150 m or more of Nos.10 to 14 on survey line I, respectively.

The weak mineralization was expected on all the survey lines and it is considered to be relatively favorable on the survey line I.

4. Çalkaya area

An anomaly in chargeability peculiar to each lines was not observed in Çalkaya area.

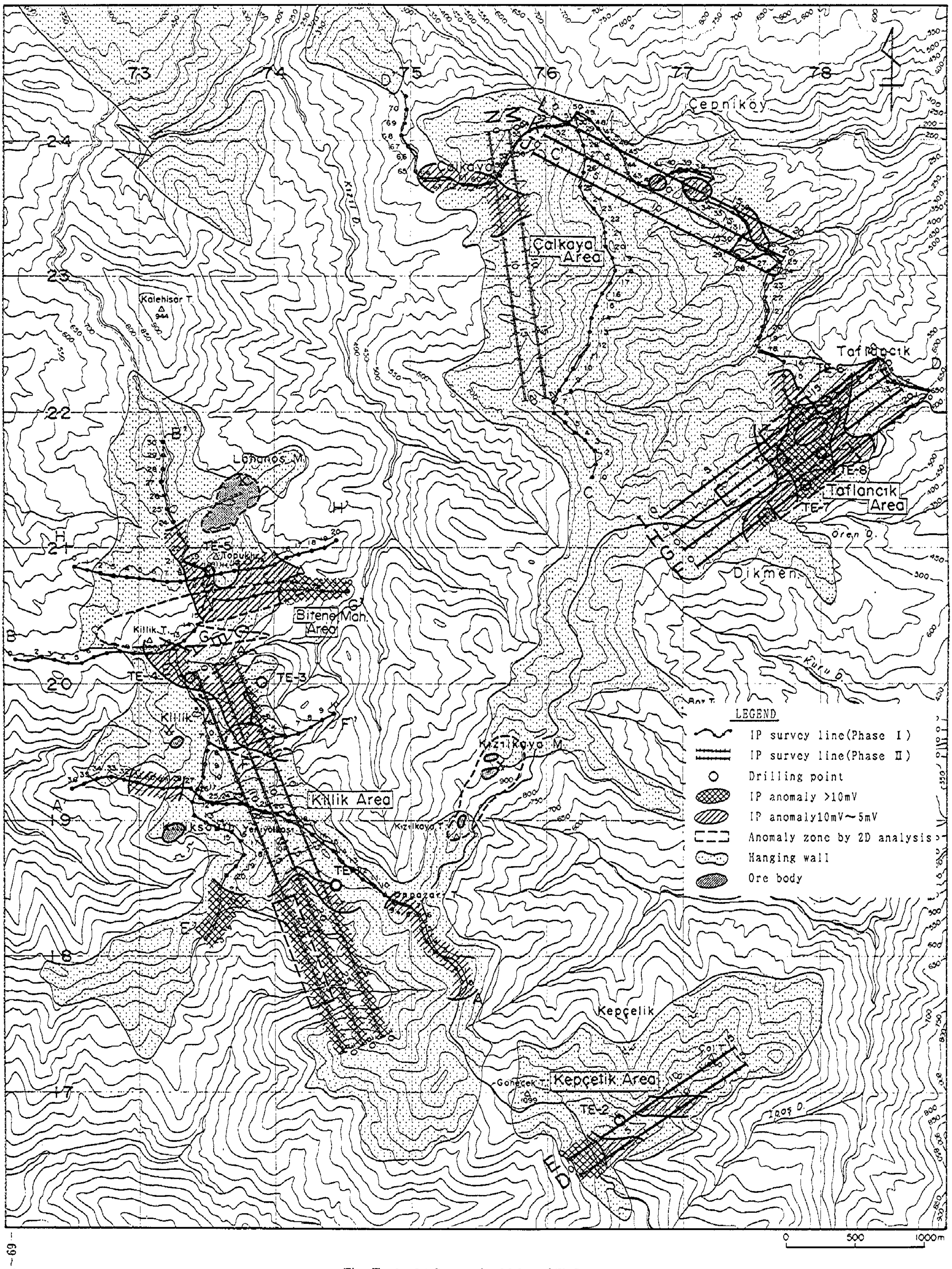


Fig. II-1-34 Summarized Map of IP Survey