THE REPUBLIC OF TURKEY
REPORT ON
THE MINERAL EXPLORATION
OF
KÜRE AREA

PHASE 2

FEBRUARY 1994

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

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PREFACE

The Government of Japan, in response to the request extended by the Government of the Republic of Turkey, agreed to conduct a metallic mineral exploration survey in the Küre Area, and commissioned its implementation to the Japan International Cooperation Agency.

The agency, taking the importance of the technical nature of the survey work into consideration, sought the cooperation of the Metal Mining Agency of Japan to accomplish the task.

The Government of the Republic of Turkey appointed the Etibank to execute the survey as a counterpart to the Japanese team. The survey was carried out from 1992 jointly by experts from both governments.

The Second Phase of the Cooperative Mineral Exploration consists of drilling and geophysical survey for base metal resources in the Küre Area.

We hope that this report will serve for the development of the project and contribute to the promotion of friendly relationship between the two countries.

We wish to express our sincere appreciation to the officials concerned of the Government of the Republic of Turkey for their close cooperation extended to the team.

February 1994

Kensuke Yanagiya

Kensuke YANAGIYA
President,
Japan International Cooperation Agency

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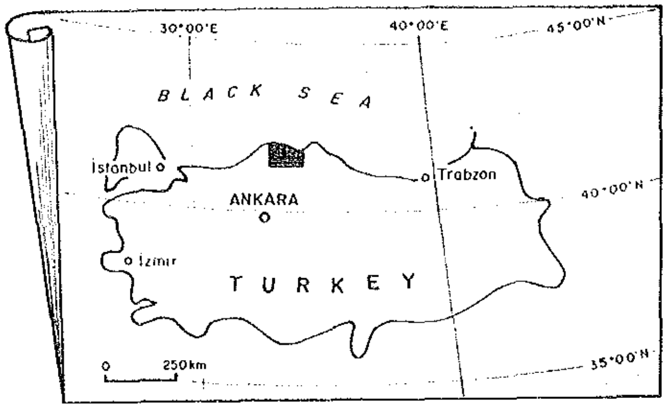


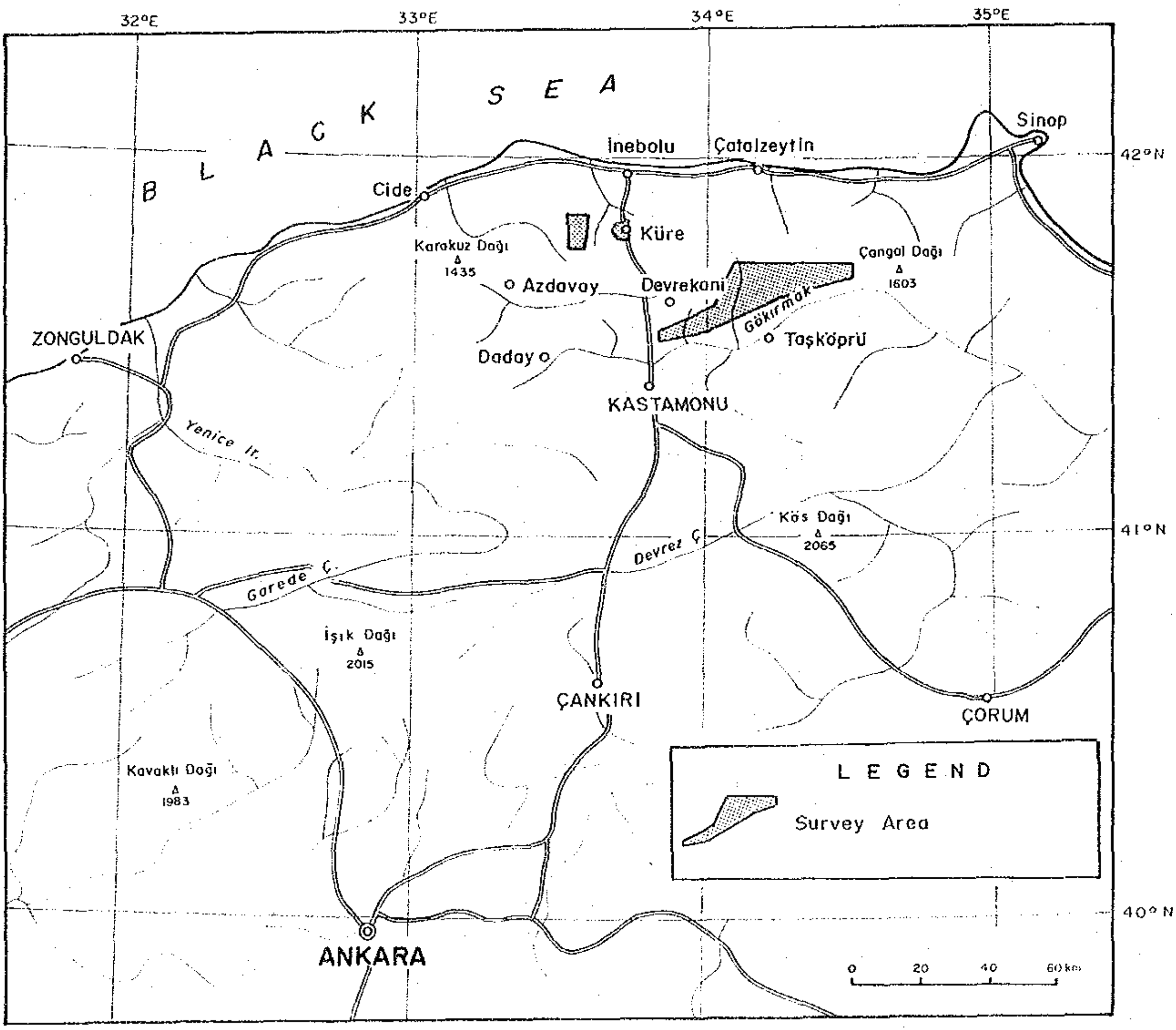


Fig. 1-1 Index Map of the Survey Area

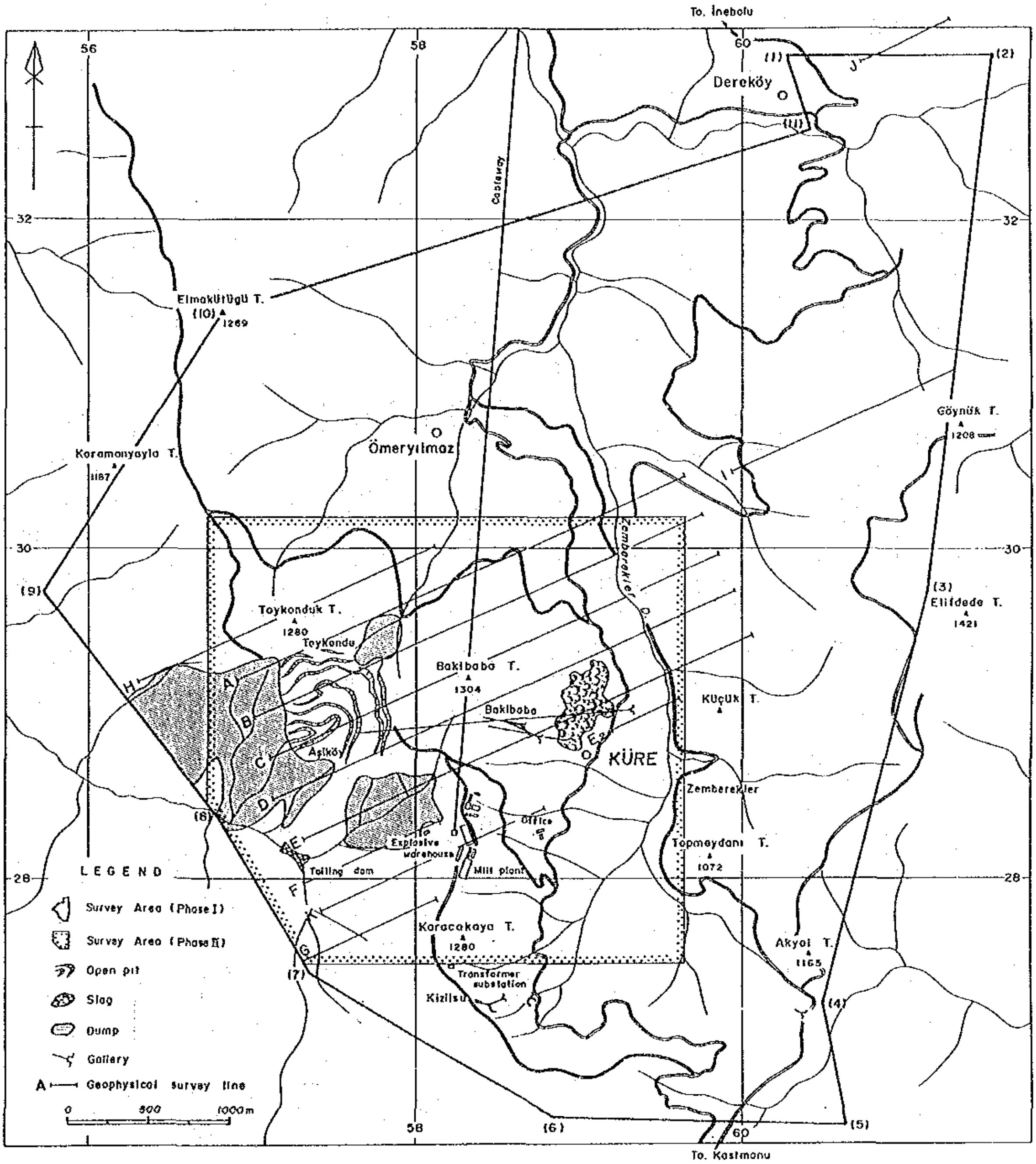


Fig. 1-2 Location Map of the Küre Zone

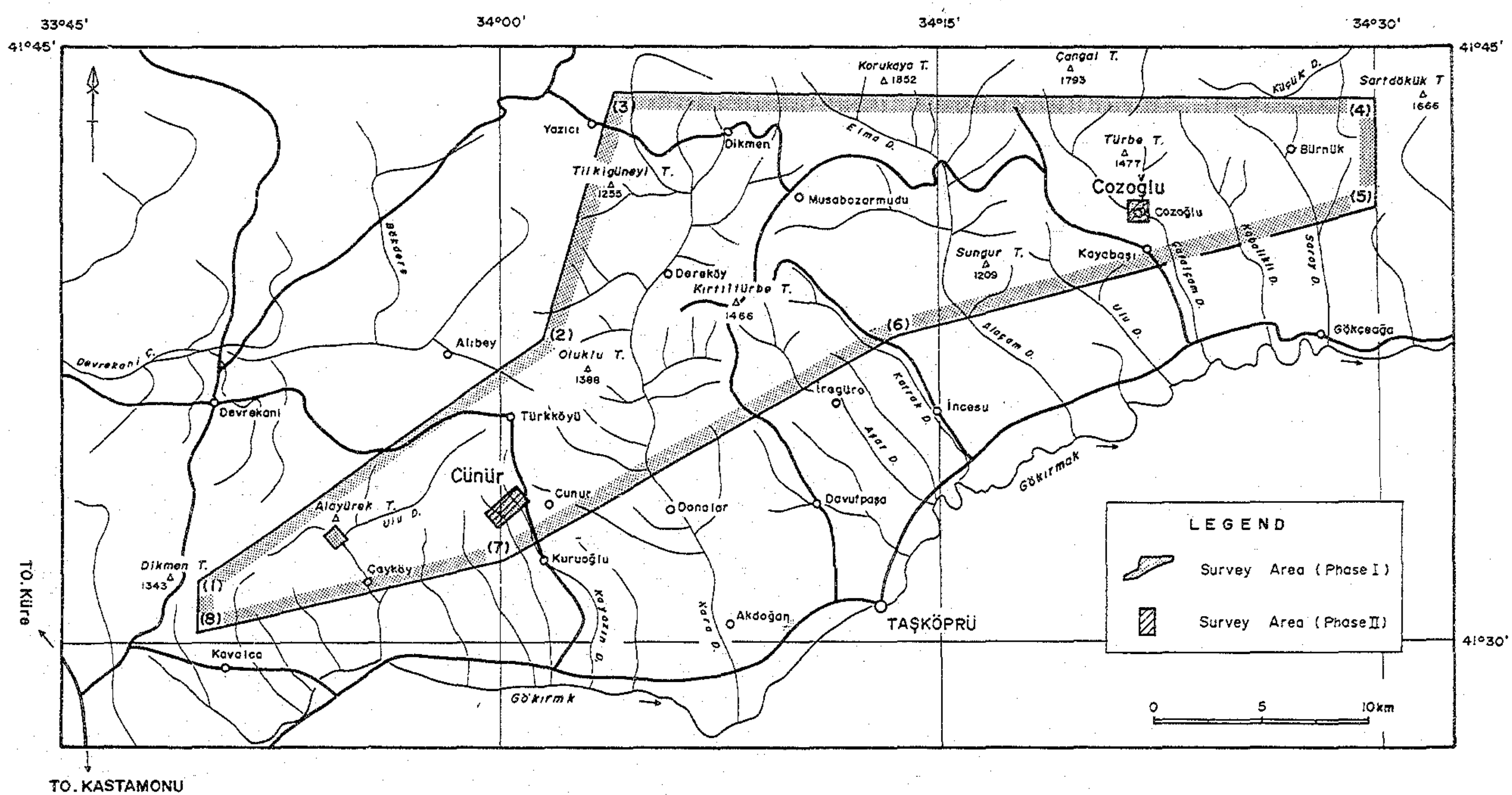


Fig. 1-3 Location Map of the Taşköprü Zone

SUMMARY

The work reported in this paper corresponds to the second phase of the three-phase cooperative mineral exploration programme in the Küre area. The principal objective of the project is to find new mineral deposits in the area through the exploration and examination of geology and mineralization.

In the second phase, drilling survey and geophysical exploration continued in the Küre area. The major purpose of this phase was to clarify the conditions of subsurface copper mineralization in the Küre zone, and to clarify the subsurface electric structure, and to evaluate the potential mineralization in the Taşköprü zone.

The work conducted during this phase comprised drilling survey and electric logging in the Küre zone and geophysical prospecting in the Taşköprü zone.
The amount of the survey is four vertical holes of diamond drilling totalling 1,003.55m, two holes of electric logging and time-domain IP with a total length of 21 km.

Küre Zone

The geology of the zone consists of pre-Jurassic ultramafic rocks, Jurassic basalt and sedimentary rocks of the Küre Formation, grayish white fossiliferous limestone of the Lower Cretaceous Karadana Formation, pale brown and white marl of the Upper Cretaceous Çağlayan Formation, talus deposits and also intrusive diorite and dacite.

The major part of the zone is occupied by the Jurassic Küre Formation. Basalt consists of pillow lava, hyaloclastite, and massive basalt. Sedimentary facies of the Küre Formation is composed of angularly fragmentated graywacke and tectonically sheared/argillized black shale. The matrix is made up of pelitic materials.
Basalt and brecciated sediments of the Küre Formation are interpreted as a constituent of mélange. The period of mélange formation is considered to be Middle Jurassic because the dacite intrusion into the mélange is inferred to be later Dogger.

The geologic structure of this zone is characterized by many faults. They are divided into two systems; N-S and E-W. The former system is crosscut by the latter. With the exception of diorite and dacite intrusive bodies and the Karadana Formation, the boundaries of all geologic units, including ultramafic bodies, have been displaced. The surface elongation of the intrusive bodies is harmonious with the strike of faults in the vicinity and with the boundary between sediments and basalt of the Küre Formation.
Basalt is interpreted to constitute the footwall of ore deposits. It extends in the N-S and NNW-SSE directions with imbricate structure.

The known ore deposits are the Cyprus-type deposits. It is

expected that deposits of the same type would be newly found in the zone.

Ore deposits together with footwall mineralized zone and hangingwall pelitic rocks are considered to be displaced by tectonic movements.

The results of drilling and electric logging show that pelitic rocks of the Küre Formation have extremely low resistivities. Cracks and fractures caused by tectonic movements in basalt are filled by underground water. This is considered to cause the low resistivity.

Drilling in this phase resulted in locating a mineralized zone at the northern extension of the Zemberekler mineralized zone. Results of the survey indicate that the known ore deposits and mineralized zones are aligned with N-S and NNW-SSE trends. The N-S and NNW-SSE extensions of the mineralized zones in basalt with low resistivity anomalies, is promising for future exploration. Extremely low resistivity zones with similar values as those in the known ore deposits are very promising for finding new ore deposits.

It is necessary to note in selecting future drilling sites that pelitic rocks show low resistivities, and it is difficult to distinguish ore deposits from pelitic rocks by resistivities.

It is recommended that drilling be carried out in the following localities for clarifying the conditions of subsurface copper mineralization during the third phase of the project.

(1) South-southeast of the Aşiköy ore deposit
(2) North-northwest of the Bakibaba ore deposit
(3) East of the Bakibaba ore deposit and north-northwest of the Zemberekler mineralized zone

Cünür Prospect in the Taşköprü Zone

The geology in the vicinity of the prospect consists of the Çangal meta-ophiolite, comprising pelitic schist, massive basalt, and green schist.

The mineralized zone is composed of eight lenses and bedded gossans in green schist. The gossans consist of quartz-limonite-pyrite network and limonite dissemination in the silicified and argillized parts of mafic rocks.

The results of time-domain IP survey show that resistivity of the zone below gossans are similar to those of the surrounding non-mineralized zone, and chargeabilities are lower than those of the surrounding silicified zones. Therefore, the size of mineralized zones expected to occur below gossans are estimated to be small.

Blind mineralized zones probably do not occur below the extensively silicified zone which occurs around gossans, because chargeability below the silicified zone is similar to those of surface outcrops.

High chargeability anomalies are identified at the southern margin of the zone. These anomalies are located adjoining to the silicified zone. The shape of chargeabilities, resistivities of these anomalies on cross sections and geology suggest that these anomalies indicate the existence of disseminated sulphide minerals.

No further work is recommended in the Cünür prospect.

Cozoğlu Prospect in the Taşköprü Zone

The geology around this zone is composed mainly of the Çangal meta-ophiolite, the Kizacik Formation, and the Alaçam Formation. The meta-ophiolite is composed of pelitic schist, massive metabasalt and green schist. The Kizacik Formation consists of grayish white limestone. The Alaçam Formation consists of quartz arenite and black mudstone.

In the central part of this zone there are two openings of old adits with a large amount of slags and waste dumps. They are in the Çangal meta-ophiolite.

The only mineralization observed at outcrops in this prospect is weak pyrite dissemination.

The results of geophysical survey of this phase show that high chargeability anomalies are distributed from the above zones which are covered by slags and waste dumps to the eastern part of this prospect. The shape of these anomalies on cross sections and the geological environment indicate that bedded cupriferous pyrite deposits probably occur within these zones.

The other high chargeability anomalies with values similar to the above anomalies are identified in the southern margin of the prospect, the Çangal meta-ophiolite area. It is considered that bedded cupriferous deposits may occur in these anomalous zones.

It is recommended that drilling exploration be carried out within the geophysical anomalies which are identified to the east of the slag dump for clarifying the conditions of subsurface copper mineralization.

CONTENTS

PART 2 KÜRE ZONE

PART 3 TAŞKÖPRÜ ZONE

PART 4 CONCLUSIONS AND RECOMMENDATIONS

Photographs

FIGURES

TABLES

PHOTOGRAPHS

PART 1 OVERVIEW

PART 1 OVERVIEW

CHAPTER 1 INTRODUCTION

1-1 Background and Objective of the Survey

The Turkey-Japan Cooperative Mineral Exploration has been carried out in four areas of the Republic of Turkey as an example, Çanakkale (1988-1990). As a result of these works, a large amount of information regarding metallic mineral resources was obtained.

The Government of Turkey planned to conduct mineral exploration in the Küre area, and requested the cooperation of the Japanese Government. In December 1991, the Japanese Government, complying with the request, sent a mission for project-finding, discussing the Scope of Work and to make a preliminary survey trip to the area. As a result of consultations with Etibank, the counterpart of the Metal Mining Agency of Japan, an agreement was reached for cooperative mineral exploration work in the Küre area on March 11, 1992.

The principal objective of the project is to find a new mineral deposit in the Küre area through the exploration and examination of geology and mineralization. Technology transfer to the counterpart organization is also an important objective of the project.

The first phase survey of this project was carried out in fiscal 1992. The purpose of the first phase was to clarify the geological environment and thereby understand the occurrence and conditions of ore deposits of the Küre area. The works carried out in the first phase were; compilation of available geological and geophysical information, geological survey of the whole area, and geophysical survey over the Küre zone.

In fiscal 1993, drilling survey and geophysical exploration continued on the Küre area. This year corresponded to the second phase of the cooperative mineral exploration programme in the Küre area. The major purpose of this phase was to clarify the conditions of subsurface copper mineralization in the Küre zone, to clarify the subsurface electric structure, and to evaluate the potentiality of mineralization in the Taşköprü zone.

1-2 Conclusions and Recommendations of the First Phase Survey

1-2-1 Conclusions

The geology of the Taşköprü zone consists mainly of the pre-Lias Çangal meta-ophiolite. The mineralized zone is accompanied by silicification and argillization in metabasalt and green schist.

In the Küre and Dikmendağ zones, ore deposits and mineral showings occur in the Lias basalt. Although it is different in age, the mineralization in these zones and in the Taşköprü zone are closely related to ophiolite. The geologic environment indicates that the mineralization in the Taşköprü zone is a Besshi-type and those in the Küre and Dikmendağ a Cyprus-type.

The following localities were extracted as targets for the future exploration: Küre zone;south of the Aşıköy deposit, both north and south of the Bakibaba deposit, near the entrance to the Gallery 920ML, south of the İpsinler mineralized zone, and the Kızılsu deposit and Zemberekler mineralized zone. Taşköprü zone; Cozoğlu, Cünür and Alayürek.

Each locality is briefly described as follows.

(1) South of the Aşıköy Orebody

Clear CSAMT anomalies were obtained in this locality. The surface is covered by sandstone-shale alternation of the Küre Formation. It is located to the south of the Aşıköy deposit which is currently mined by open pit. It corresponds to the southern extension of the deposit. There are three N-S trending tectonic lines parallel with each other near the Küre mine. It is near the western line.

(2) In the Vicinity of the Entrance to the Gallery 920ML

CSAMT anomalies were obtained in this locality. The values are significant next to the south of the Aşıköy deposit. Pyrite dissemination was found in the 920ML gallery. No exploration work has been conducted. This locality corresponds to the northern extension of the Zemberekler mineralized zone. Basalt occurs on the surface.

(3) North and South of the Bakibaba Deposit

CSAMT anomalies were obtained with values next to the two localities mentioned above. Basalt and a minor amount of sandstone-shale alternation are observed on the surface. These anomalies are located to the north and south of the Bakibaba deposit with high copper grade. The existence of the N-S tectonic lines in the surrounding area appears to require further exploration work.

(4) South of the İpsinler Mineralized Zone

Very strong CSAMT anomalies occur in this locality. The surface is covered by limestone talus deposits of the Karadana Formation. The manifestation of mineralization is not observed on the surface. IP anomalies were not obtained. The strong CSAMT anomalies were interpreted to be occurred from either the subsurface water flow, or targets below 200 m in depth. Further geophysical investigation is warranted.

(5) Kızılsu Deposit and Zemberekler Mineralized Zone

Küre mine is located in a topographically steep area. There are high voltage electric power lines in the area. Therefore, geophysical work can be carried out only in limited parts. This locality is subject to the exploration by drilling.

(6) Cozoğlu Mineralized Zone

Two openings of old adits and waste dumps were found in an area of 350 x 350 m in metabasalt. In one of the old adits, there is a 10 cm thick quartz vein with copper oxide stains and gossan of 3 m wide, but the exposure is not good. Geophysical exploration is necessary to confirm the mode of occurrence of mineralization.

It may provide an information regarding the mineralization in the deeper zones.

(7) Cünür Mineralized Zone

This zone occurs in metabasalt and green schist. There are extensive gossan occurrences (500 x 60 m - 100 x 10 m) in eight localities in this zone. Pyrite veinlets were found in one of the gossans. Copper oxide smears on the host rock in another gossan. These gossans are surrounded by silicified zones. Further geochemical and geophysical exploration are warranted.

Geochemical and geophysical exploration in both the Cünür and Alayürek mineralized zones delineated strong mineral showings, low resistivity zones, and FE anomalies.

(8) Alayürek Mineralized Zone

This zone is developed in green schist and metabasalt. Pyrite dissemination occurs over an area of 600x50 m. Chalcopyrite was found in some parts of the mineralized zone. Samples of high-grade copper ore were collected during the previous survey. No such sample has been found in this phase. Although the metamorphism of the host rocks is not strong, further geochemical and geophysical exploration are desired.

On the basis of the above results, it is believed that green schist and metabasalt extend in the NNE-SSW direction with comparatively steep dip. Mineralized zones are expected to extend further downward. Although the surface manifestation of mineralization is relatively weak, the Besshi-type mineralization tends to become stronger in the deep. In order to confirm the subsurface conditions of mineralization in these zones, further geochemical and geophysical exploration are warranted.

(9) Basic Rock Area of the Dikmendağ Zone

The results of the first phase survey revealed that basaltic rocks were intercalated within sandstone-shale alternations. Pyrite mineralization was observed in some of the basalt. Although the surface manifestation of mineralization is weak, there is a possibility that this type of mineralization becomes stronger in deeper zones. Geophysical exploration is necessary to confirm that possibility.

(10) Ophiolite Area

The Küre Formation is widely distributed in the east and west of the Küre mine. This is called the Akgöl Formation in term of the regional geology of the Inebolu-Kastamonu area. It is composed of ophiolite and the alternation of sandstone and shale. It is treated as a single unit in the field. The content of minor element, however, is different from occurrence to occurrence. By means of the geochemical method, it is possible to distinguish mineralized unit from barren one. The distribution of mafic volcanic rocks was clarified by the past surveys. They occur in the east of Küre mine and in western part of Dikmendağ zone. Geological investigation in these areas is expected to yield useful results.

1-2-2 Recommendations for the Second Phase Survey

It was recommended that the following work should be carried out in the second phase of the project.

Zone	Promising Localities	Geochemical Survey	Geophysical Prospecting	Drilling Survey
Küre	Southern Part of Aşıköy Orebody			Reco
	Vicinity of Entrance to Gallery 920ML			Reco
	North and South of Bakibaba Deposit			Reco
	South of İpsinler Mineralized Zone.		Reco	
	Zemberekler and Kızılsu Deposits			Reco
Taşköprü	Cozoğlu Mineralized Zone		Reco	
	Cünür Mineralized Zone	Reco	Reco	
	Alayürek Mineralized Zone	Reco		
Dikmendağ	Distribution Area of Basic Rock	Reco ?	Reco	
Distribution Area of Ophiolite		Reco		

Reco:Recommendation

1-3 Outline of the Second Phase Survey

1-3-1 Coordinates of the Survey Areas

The localities surveyed during the period of this report is shown in Figures 1-2 and 1-3. The coordinates of the survey areas are as follows.

Drilling Survey Area

Survey Area		Latitude	Longitude		Latitude	Longitude
Küre Zone	1	41°49.00'	33°41.12'	2	41°49.00'	33°43.04'
	3	41°47.55'	33°43.09'	4	41°47.58'	33°41.40'
	5	41°47.99'	33°41.12'			

Geophysical Prospecting Areas

Survey Area		Latitude	Longitude		Latitude	Longitude
Cünür of Taşköprü	1	41°34.07'	33°59.56'	2	41°33.65'	34°00.08'
	3	41°32.97'	33°59.05'	4	41°33.39'	33°58.42'
Cozoğlu of Taşköprü	1	41°41.18'	34°21.56'	2	41°41.17'	34°22.28'
	3	41°40.49'	34°22.27'	4	41°40.49'	34°21.55'

1-3-2 Exploration Theme

The exploration of this phase corresponded to the second phase of the three-year cooperative mineral exploration programme in the Küre area.

The work conducted this phase was composed of drilling survey in the Küre zone and geophysical prospecting in the Taşköprü zone.

The major exploration theme of drilling survey in the Küre zone was to clarify the conditions of subsurface copper mineralization in the south of the Aşıköy ore deposit and in the north of Zemberekler mineralized zone.

The major exploration theme of geophysical prospecting in the Taşköprü zone was to clarify the geophysical properties (resistivity and chargeability) in the deeper parts and to assess the potential of blind deposits in the Cünür and Cozoğlu prospects.

1-3-3 Exploration Work

Drilling

A drilling programme was conducted at the south of the Aşıköy ore deposit and in the north of the Zemberekler mineralized zone in the Küre zone. The programme consisted of four vertical holes of diamond drilling totalling 1,003.55 m. The minimum size of the core was BQ. It targeted to the low resistivity anomalies defined by CSAMT survey last year. A series of drill logs of 1:200 scale was produced.

Geophysical Prospecting

Geophysical time-domain IP survey at the Cünür and Cozoğlu mineralized zones in the Taşköprü zone was conducted. The following specifications were applied for this survey.

a) Electrode configuration : Dipole
b) Electrode spacing : 100 m, Horizontal
c) Electrode separation coefficient : N=1-4

Amount of works done this phase is summarized in Table 1-1.

Table 1-1 Amount of Survey and Laboratory Studies

Survey	Localities	Type of Survey	Amount
Drilling	Küre	4 holes	1,003.55 m
Geophysical	Taşköprü	IP method	21 km 14 lines

Type of Study	Amount
Ore Grade Analysis (Au,Ag,Cu,Co,S)	22 pcs
Thin Section	28 pcs
Polished Section	9 pcs
X-Ray Diffraction	12 pcs
Rock Resistivity and Polarization	20 pcs

1-3-4 Members of the Second Phase Survey

(1) Survey Periods of Coordinators of MMAJ and Survey Team

From November 29 to December 9,1993 :Atsuhiko MINOWA
Nobuyuki OKAMOTO

Survey Team: Drilling Survey:August 28,1993- January 6,1994
Geophysical Survey:September 20- November 26,1993

(2) Members Participating in the Project

Turkish Side

Assistant General Manager	Ibrahim BOZAN
Mineral Exploration Department	
Director	Ergün GÜRCAN
Ass. Manager	Şevket ORHON
Manager	Ekrem UTKUÇAL
Manager	Ihsan DUR
Küre Mine	
General Manager	Kemal Aydın ÇELİK
Deputy Manager	Mahir TEZCAN
Deputy Manager	Mehmet ZENGİN
Chief Engineer	Muammer ŞAHIN
Survey Members of Etibank	
Coordinator	Ahmet ÜNSAL
Ass. Coordinator	Necmettin ÇELIK
Drilling Engineer	Sadık KELEŞOGLU
Ass. Manager	Cemalettin SOLAK
Chief Driller	Ahmet TÜNCER
Geophysicist	Tayfun AKKUŞ
Geophysicist	Orhan ERSÖZ

Japanese Side

Metal Mining Agency of Japan	
Coordinator	Atsuhiko MINOWA
Coordinator	Nobuyuki OKAMOTO
Survey Members of NED	
Team leader	Yoneharu MATANO
Drilling Engineer	Saichi ISHII
Drilling Engineer	Itsuki HATAZAWA
Drilling Engineer	Tadateru SUGIBUCHI
Drilling Engineer	Soji KANNARI
Drilling Engineer	Mitsuo NOMURA
Drilling Engineer	Koichi TAMURA
Geophysicist	Masao YOSHIZAWA
Geophysicist	Ikuo TAKAHASHI
Geophysicist	Norikiyo SUGIURA

CHAPTER 2 GEOGRAPHY

2-1 Location and Access

The Küre mining district is located in Küre County, Kastamonu Province, which is situated about 255 km from Ankara. Kastamonu is the capital of the province and is the largest city in the northern Anatolia. Küre mine is located approximately 60 km north of Kastamonu and about 300 km west of İstanbul, the largest city in Turkey. The population of Kastamonu city is approximately 50,000. Taşköprü is the second largest city of the Kastamonu Province, and its population is more than 20,000. The population of Küre town is around 4,000. Small villages are scattered within the area.

The distance along the road from Ankara to Küre is approximately 300 km through Çankırı and Kastamonu. It takes 5 hours by long-distance bus. The Küre mining district is the second most productive copper district in the Republic of Turkey.

Main roads are almost totally paved. There are automobile roads which connect the major highways and villages. These roads are usually unpaved. They become very bad roads in winter because they are not gravel roads. They become extremely muddy in the wet season. The highway between Ankara and İnebolu via Kastamonu is paved. It is about 240 km long from Ankara to Kastamonu. It can be covered by car in four hours. The base camp for drilling survey of the second phase survey was set in Küre mine. The base camp for geophysical prospecting was settled in Taşköprü and Küre mine. Three cars were chartered for transportation during the field work. It takes one and half hours from Küre mine to Taşköprü.

2-2 Topography and Drainage System

2-2-1 Topography

The Küre area is located in the northern part of the Anatolia plateau. It is bounded on the north by the Black Sea, on the west by Karakuz mountain (the highest peak is 1,435 m), on the east by Çangal mountain (the highest peak is 1,605 m), and on the south by the northern Anatolia Fault extending in the E-W direction. Within the area covered by the Landsat images, the highest peak is the Kös mountain (2,065 m) which is located near the southern border of the survey area.

As the survey area is situated in the central Pontids mountains, the terrain is mountainous with narrow valleys and moderate ridges. The elevation ranges from 650 m at the gorge of the Zemberekler river in the küre mining district, to 1,304m at Bakibaba mountain. There are many villages in the flat area lower than 600 m above sea. Vegetables and fruits are cultivated in such area. Whereas in the mountain area of more than 1,000 m above sea, the cultivation of wheat and cattle raising are very active.

2-2-2 Drainage System

Küre area is located in the upper reaches of Karacehennemboğazı river which flows into the Black Sea. The Taşköprü area is in the upper reaches of the Gökırmak drainage system which flows into the Black Sea through Taşköprü basin. Most of these rivers flow only in the spring thaw.

2-3 Climate and Vegetation

2-3-1 Climate

Due to the high altitude of the survey area, the weather condition is not stable, its temperature varies extremely. It is cold in eight months of the year. Snow falls very much in winter. It is delightfully warm and occasionally hot in summer. Heavy fog and sudden shower sometimes happen. The annual precipitation and annual average temperature in Küre mining area are estimated to be more than 600 mm and 10°C respectively, but it is located in the higher latitude than Kastamonu. The monthly average temperature and precipitation recorded by the Kastamonu Meteorological Station is as follows.

Table 1-2 Monthly Temperature of Kastamonu

Month(°C)	Jan	Feb	Mar	Apl	May	June	July	Aug	Sep	Oct	Nov	Dec	Annual
Max.	17.0	14.2	26.4	23.8	26.0	32.0	35.0	35.0	29.2	29.0	17.0	9.8	
Min.	-8.9	-6.8	-2.4	-2.1	5.2	10.0	11.1	10.5	0.5	4.3	-3.8	-10.0	
Average	-2.5	-0.7	4.7	9.1	12.9	16.9	19.6	19.8	14.8	10.8	4.1	-0.8	9.0

(Data range from 1989 to November 1993)

Table 1-3 Monthly Precipitation of Kastamonu

	Jan	Feb	Mar	Apl	May	June	July	Aug	Sep	Oct	Nov	Dec	Annual
Ave. (mm)	20	12	18	47	64	96	24	19	24	39	36	37	438

(Data range from 1989 to November 1993)

2-3-2 Vegetation

The large precipitation of the area results in the luxurious growth of vegetation. Nearly three-quarters of the area is covered with forest, which is locally quite dense, and the flat land in the area now covered by wheat fields has apparently been cultivated for farming. The remaining is used for grazing. Some trees large enough for timbers grow in the forest. Many of them, however, consist of small one not suitable for timbers. They are composed dominantly of deciduous trees. Whereas in some places, such as Toykondu, Bakibaba, and the southern highland area of Taşköprü and Dikmendağ, coniferous trees(pines and cedars) are common.

CHAPTER 3 GEOLOGY OF THE SURVEY AREA

3-1 General Geology of Kastamonu Region

The Kastamonu region, bounded by the Bolu metamorphic massif on the west, covers the Daday-Devrekani metamorphic massif in the central part and the Ilgaz metamorphic massif to the east. It includes granitoid intrusions.

The Bolu massif consists of a metamorphic assemblage of Precambrian period, formed under the middle-pressure amphibolite facies and overlain by Silurian-Devonian age non-metamorphic arkose conglomerate.

The Ilgaz massif consists of metamorphic rocks of Precambrian period, formed under the conditions from gloucophane schist to green schist facies.

Two tectono-stratigraphic assemblages have been identified in the Daday-Devrekani massif. From bottom to top, they are composed of the Daday-Devrekani meta-sedimentary group of Precambrian period and the Çangal meta-ophiolite of pre-Liassic epoch.

Four major formations which are underlain by the above mentioned massif are distributed in the region; Akgöl Formation, Bürnük Formation, İnalti Formation and Çağlayan Formation.

The Akgöl Formation is composed of black shale, siltstone, fine-grained sandstone, limestone, spilite, diabase, gabbro and serpentinite. It has a common feature of deep marine environment. Some part of this formation are metamorphosed due to the Early Dogger tectonics and by the Dogger intrusions.

The Bürnük Formation which deposited in intermontane alluvial environment has lithologies such as red colored conglomerate, sandstone, siltstone and sandy limestone of Later Dogger to Early Malm epoch.

The İnalti Formation consists of calcareous rocks and sandstone of shallow marine environment of Malm epoch. It is mostly unconformable with the overlying Cretaceous system.

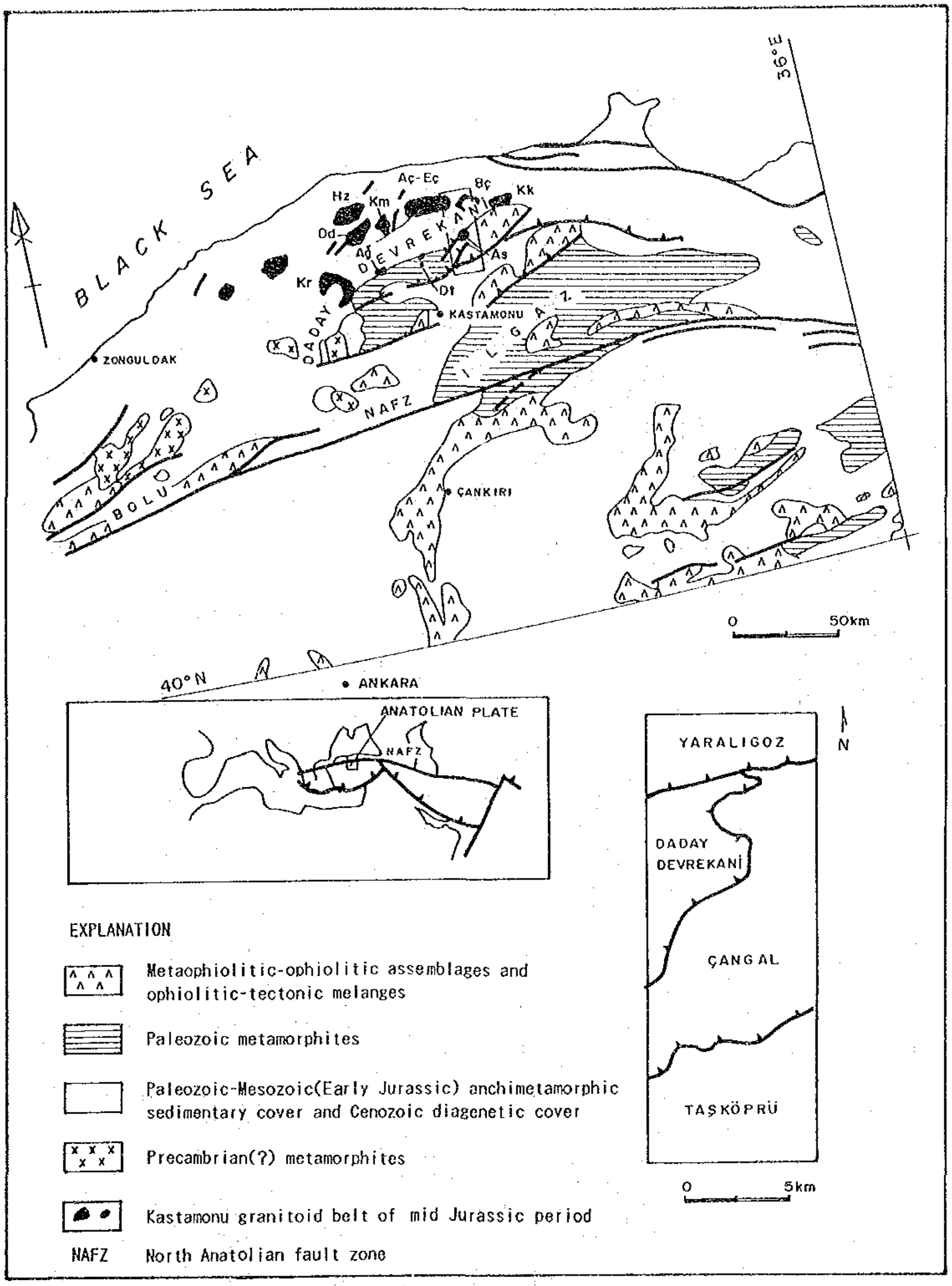
The Çağlayan Formation of Aptian-Cenomanian epoch consists of turbidity sandstone, conglomerate and carbonaceous shale.

3-2 Geology and Geologic Structure of the Survey area

(1) Küre Zone

The geology of the Küre zone consists of pre-Jurassic ultramafic rocks, Jurassic basalt, sedimentary rocks of the Küre Formation, grayish white fossiliferous limestone of the Lower Cretaceous Karadana Formation, pale brown and white marl of the Upper Cretaceous Çağlayan Formation, talus deposits, intrusive diorite and dacite. The major part of the zone is occupied by the Jurassic Küre Formation. The basalt is composed of pillow lava, hyaloclastite, and massive basalt. Sedimentary facies of the Küre Formation is composed of angularly fragmentated graywacke and tectonically sheared/argillized black shale. The matrix consists of pelitic materials.

Basalt and brecciated sediments of the Küre Formation are interpreted as a constituent of mélange.



Structural-geologic map of Kastamonu granitoid belt and surrounding areas, modified after Yılmaz (1979) and Boztuğ et al.(1985). Rectangle outlines: mapped area, enlarged at lower right. Granitoid outcrops: Bç, Büyükçay; Aç-Eç, Ahiçay-Elmaliçay; Kk, Karacakaya; As, Asarcık; Dd, Dikmendağ; Hz, Hayzer; Ağ, Ağlı; Kr, Kürek; Km, Karaman; Dt, Deverkani town.

Fig. 1-4 Structural-Geologic Map of Kastamonu Granitoid Belt and Surrounding Areas

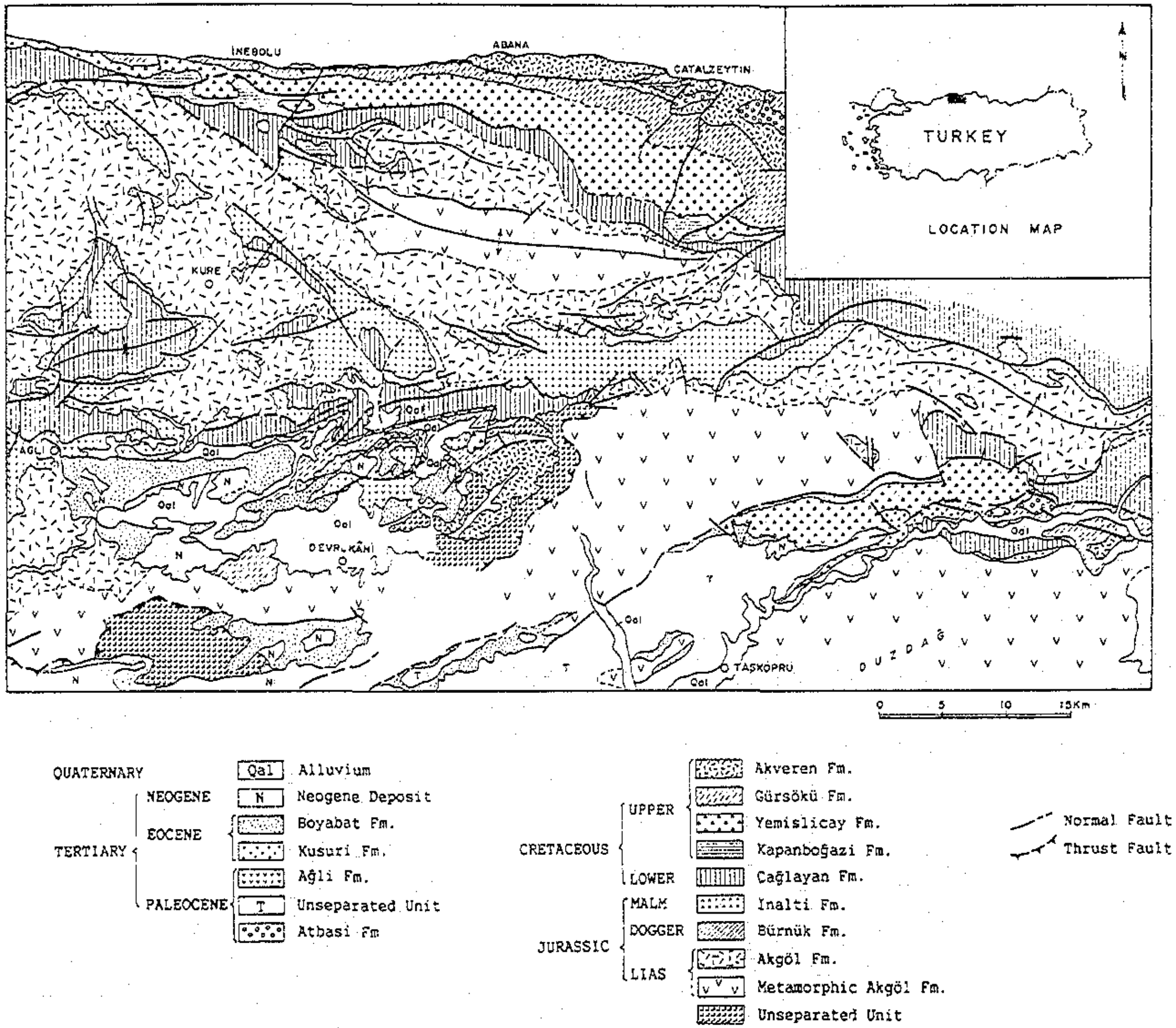


Fig. 1-5 Geologic Map of the Inebolu-Kastamonu Area

The geologic structure of this zone is characterized by many faults. They are divided into two systems; N-S and E-W. The former system is crosscut by the latter. With the exception of diorite and dacite intrusive bodies and the Karadana Formation, the boundaries of all geologic units, including ultramafic bodies, have been displaced. The surface elongation of the intrusive bodies is harmonious with the strike of faults in the vicinity and with the boundary between sediments and basalt of the Küre Formation.

(2) Taşköprü Zone

The basement of this zone is composed of biotite gneiss of the Devrekani metamorphic rocks. This rock occurs in the northwestern part of the zone.

The Çangal meta-ophiolite has the largest exposure in fault contact with underlying Devrekani metamorphic rocks. The meta-ophiolite is composed of serpentinite, meta-basalt, green schist and pelitic schist.

The Kayadibi Formation occurs in the eastern part of this zone, comprising black shale, siltstone, fine-grained sandstone, limestone and basalt.

The Muzrup Formation of Latest Dogger to Early Malm epoch is distributed in the southern margin of the zone, covering unconformably on the Kayadibi Formation. This formation consists of red conglomerate, sandstone, siltstone and psammitic limestone.

Being underlain unconformably by the Muzrup Formation, the Kizacık Formation occurs in the northern margin of the zone. It is composed of calcareous rock and calcareous sandstone.

The Alaçam Formation consists of turbiditic sandstone, conglomerate and calcareous shale. It is distributed in the southern margin of the zone, and is underlain unconformably by the lower formation.

The Çayköy Formation is exposed in the southern part of the zone, comprising of sandstone, andesite lava and andesitic pyroclastic rocks. This formation has an unconformable relationship with underlying Alaçam Formation.

Granite occurs in the northern and eastern parts of the zone. Dacite is exposed in the central part of the zone.

The geologic structure of the Çangal meta-ophiolite is difficult to interpret because of the metamorphism. It is, however, inferred that the beds are generally steeply dipping and extend in the east-west direction.

3-3 Mineralization

(1) Küre Zone

Aşıköy, Toykondu, Bakibaba, and Kızılsu are the known ore deposits in this zone. These deposits occur at the boundary between hyaloclastite and black shale of the Küre Formation. They also occur within hyaloclastite. The other large mineralized zone which is distributed on the surface occurs in Zemberekler. This mineralized zone is composed of three types of mineral showings; gossans, pyrite dissemination and pyrite veinlets in silicified basalt.

The Aşıköy deposit is the largest one in this zone. It is composed of many ore bodies which have the largest dimension of 380m east to west, 200m north to south, and 15 to 30m thick.

Ores are classified into massive ore, brecciated ore comprising fragments of massive ore filled in a matrix of chalcopyrite and pyrite, brecciated ore comprising subrounded to subangular massive ore fragments of 10 to 30cm in diameter in black shale, network ore and disseminated ore.

Ore minerals are composed of a large amount of pyrite with a small amount of chalcopyrite, sphalerite and marcasite, and a minor amount of covelline, tetrahedrite and pyrrhotite.
Gangue minerals are mainly composed of quartz with a small amount of rutile, leucoxene, clay and carbonate minerals.
The ore grade of Aşıköy in drill cores range from 1 to 9 % Cu and from 40 to 48 % S.

Hyaloclastite on the footwall side of massive ore is sometimes silicified for a thickness of 1-3 m containing a large amount of quartz and minor sericite. The host rock of network zone is generally green, but it is bleached and silicified where the network is dense and sulfide minerals are strongly disseminated.

The geologic environment, mode of occurrence, and mineral composition of these orebodies show a common feature which is characteristic to the Cyprus-type ore deposits. The ore potential of this type may be high in the Küre zone.

(2) Taşköprü zone

Three types of sulfide mineralization are observed in this zone; bedded, lens-shaped and dissemination. The mineralization with a large amount of pyrite, a small amount of chalcopyrite and a minor amount of sphalerite occurs in the zone which is occupied mainly by metabasalt and green schist. The mineralization is accompanied by silicification and argillization.

There is also a zone where a large amount of slags and abandoned adits occur, but no mineralization has been discovered at the surface outcrops and within waste dumps.

Bedded cupriferous pyrite deposits are possibly expected in this zone.

Chapter 4 DISCUSSIONS OF THE RESULTS OF THE SECOND PHASE SURVEY

4-1 Geology, Geologic Structure and Mineralization

(1) Küre Zone

The geology of the zone studied in this phase consists of pre-Jurassic ultramafic rocks, the Jurassic Küre Formation, and diorite and dacite which are intruded into the Küre Formation.

The known ore deposits occur in the Küre Formation.

The Küre Formation is composed of basalt, and brecciated formations comprising fragments of pelitic and flysh rocks, and being cemented by pelitic materials.

Basalt is divided into pillow lava, hyaloclastite, and massive basalt. The chemical composition of the basalt is characterized by mid-ocean ridge basalt. Secondary minerals such as chlorite, epidote, prehnite and actinolite are generally observed in basalt under the microscope.

The known ore deposits in this zone tend to occur at the boundary between hyaloclastite and black shale of the Küre Formation also within hyaloclastite. Ore is divided into massive, brecciated, disseminated and network ones. Massive and brecciated ores occur at the boundary between hyaloclastite and black shale. Disseminated and network ores occur within hyaloclastite.

The major part of massive ore is composed of sulphide minerals. The brecciated ore is composed of quartz, clay minerals and sulphide minerals.

The major ore minerals are pyrite and chalcopyrite with a minor amount of bornite, pyrrhotite, magnetite, sphalerite, galena, marcasite, electrum, bravoite and carrollite.

Massive and brecciated ores sometimes contain minute pyrite of colloform and gel-form together with coarse pyrite. In many cases, such pyrite shows cataclastic feature. Chalcopyrite fills among the pyrite grains.

Alteration zone below massive ores is composed of chlorite, epidote, carbonate minerals, and locally quartz and sericite. Wall rocks of network zone generally show green color. They are silicified, and contain numerous veinlet and dissemination.

Basalt is submarine effusive rock. It is considered that the basalt erupted on the deep ocean floor, because tuffs formed by steam explosion do not occur in this zone. There are massive ores comprising a large amount of pyrite, a small amount of chalcopyrite and sphalerite, and a minor amount of marcasite and pyrrhotite.

Considering to these evidences, the known ore deposits in this zone are interpreted to be a Cyprus-type.

On the basis of these considerations, the process of ore deposit formation and emplacement is inferred as follows.

Hydrothermal systems accompanied by basalt eruption were formed on the mid-ocean ridge. Massive ores were formed from minute pyrite of colloform and gel-form together with coarse pyrite, and chalcopyrite filled among the pyrite grains.

After the formation of ore deposits, ores were covered by deep ocean pelitic sediments. The ores with basalt and pelitic sediments were sheared and mixed with flysh sediments which deposited around the subduction zone by obduction. Thus a mélange was formed.

The period of mélange formation is interpreted to be Middle Jurassic, prior to the intrusion of dacite.

The Küre Formation which is interpreted as a mélange, is characterized by the arrangement of basalt and sedimentary rocks which extend in the direction of N-S to NNW-SSE. This direction is harmonious with the major faults. It agrees with the distribution of pillow lava and hyaloclastite around the Aşıköy and Bakibaba ore deposits. It also agrees with the surface elongation of intrusive rocks.

Tectonically dislocated ore deposits are distributed in the same direction as the distributions of Aşıköy - Toykondu and Bakibaba - Kızılsu ore deposits.

Basalt shows an imbricate structure. The boundary between basalt and sedimentary rocks are proposed as interesting zones for future exploration. The N-S to NNW-SSE extension of the known ore deposits are considered to be promising zones for exploration.

(2) Cünür Prospect in the Taşköprü Zone

Eight lenses and bedded gossans occur in green schist in the Cünür prospect. The gossans extend in the NE-SW direction which is harmonious to the bedding plane. The maximum lateral extension is 400x50 m. The mineralization is quartz-limonite-pyrite network and limonite dissemination in the silicified and argillized parts of mafic rocks. Azurite and chrysocolla occur in parts of the gossans in the central part of the prospect. An assay result of the samples is Cu 4.3 % and Zn 1.4 %. Pyrite veinlets occur in gossans in the northeastern part of the prospect with an assay result of Au 1.9 g/t, Ag 115 g/t and S 40 %. These zones are considered to be promising for copper and zinc ores. Bedded cupriferous pyrite deposits are expected below the surface, because gossans are harmoniously distributed with pelitic rocks.

(3) Cozoğlu Prospect in the Taşköprü Zone

There are two openings of old adits on the surface. A large amount of mine wastes is found in the vicinity of openings. They are all within the Çangal meta-ophiolite.

One of the two old adits has a cross cut at 7 m from the entrance and pyrite dissemination is observed in parts of green schist with some oxidized copper minerals. Assays of these samples indicate Cu 0.7-0.9 % and S 1.8 % .

Another opening is supposed to be a collapsed incline or a shaft. Near the opening, there is a quartz vein of 30cm thick in green schist with malachite flecks filled in cracks. The quartz vein shows Cu 2.5 %, Zn 0.7 %. It contains zinc oxide minerals. There are, however, many segregation quartz veins in green schist near the mineralized zone, and it is inferred that there is no relationship between the quartz vein near the adit opening and the copper oxide. A part of green schist in the vicinity is altered into gray clay.

Pyrite dissemination along the schistosity of green schist occurs in this prospect.

There are slags within 400x150 m range. Samples from two of these slags show Cu 1.0-4.8 %. Chalcopyrite and bornite are observed microscopically in such samples.

It is difficult to determine the type of mineralization from the surface showings. Bedded cupriferous pyrite deposit is a possible type of deposit. The reasons are; lack of strong alteration of green schist on the surface, the occurrence of copper and zinc oxide minerals, and the existence of a large amount of slag.

4-2 Geophysical Prospecting and Mineralization

During the preceding year, low resistivity anomalies were confirmed by CSAMT and IP survey. These anomalies are considered to be related to ore deposits of Aşıköy, Bakibaba and kızılsu. Of particular interest is the many small anomalies detected southeast of Aşıköy orebody as these occur as several linearly oriented groups of anomalies and they apparently are continuous to the Kızılsu deposit to the southeast. Also small but continuous anomalies were detected to the north and south of Bakibaba Deposit. Weak anomalies were detected near the mineral showings to the northeast of Bakibaba and these are considered to continue to the Zemberekler mineralized zone.

Also during the last year, the following three localities were selected to be being promising for future prospecting from study of the results of the above survey as well as those obtained by ETiBANK previously and the conditions of the mineral showings and the known deposits. These areas are; (1) south of Aşıköy deposit, (2) near the entrance of 920mL adit, (3) North and south of Bakibaba deposit.

During the present year (Fiscal 1993), a total of 1,003.55m in four holes were drilled at these localities. They are; (1) two holes, MJTK-1 and MJTK-7, at a location south of Aşıköy, (2) one hole, MJTK-4, near the entrance to 920mL adit, (3) one hole, MJTK-6, at the anomalies between the Bakibaba and Aşıköy deposits.

The conditions of these drill holes are as follows.

MJTK-1: This hole was drilled at the low resistivity of <50ohm-m detected at Station Nos. 8 and 9 of the CSAMT Line D. Two-dimensional analysis indicated the existence of anomalies near 50ohm-m at 100-200m depth and 50-100ohm-m anomalies at 200-500m depth.

The geology is; graywacke and breccia with intercalations of 2-7m thick black shale to 165m depth, black shale between

165-350m, breccia (chert, black shale, graywacke pebbles) below 350m. It is believed that the low resistivity is formed by the relatively large amount of black shale below 150m. Also the fact that the clay matrix of the breccia between 250-320m also contributed to the low resistivity.

MJTK-4: This hole was drilled at the weak resistivity anomaly of 50-100ohm-m detected at Station Nos. 37 and 38 of CSAMT Line D.

The geology is; black shale and breccia, of which the matrix is black shale, with intercalations of 1m thick graywacke to 81m depth, massive basalt and hyaloclastite with thin veinlet of pyrite below 175m.

The results of electric logging indicated that the range of resistivity between 70 - 100ohm-m at 175m depth and increasing resistivity zone below 175m. The high resistivity value over 800ohm-m is detected at the bottom of this hole.

It is believed that the low resistivity is formed by the relatively large amount of black shale above 175m.

MJTK-6: This hole was drilled at the low resistivity between 75-100ohm-m detected at Station Nos. 15 and 16 of the CSAMT Line D.

The geology is; Talus deposits between the surface to 18.6m, basalt except black shale between 117.5m - 123.7m and the four clay intercalations of 1m thick

The electric logging detected that the resistivity value between 100-120ohm-m at 105m depth and high resistivity zone over 700ohm-m below 105m

It is believed that the low resistivity is formed by basalt weathered above 53.4m depth.

MJTK-7: This hole was drilled at the low resistivity of 13ohm-m detected at the station No.14-15 of Line F by one-dimensional analysis.

The geology is; almost breccia (chert and black shale pebbles) except graywacke between 7.1-12.4m and between 24.6-32.3m and black shale at 21.3-24.6m, 62.5-84.1m and 115.0-121.5m width.

It is clear from the results of the drilling that the low CSAMT resistivity of the four holes are all caused by black shale. Although veinlets of pyrite were confirmed below 175m and Cu 2.63% at 176.9m-178.9m of MJTk-4, massive orebodies have not been located.

4-3 Potential of Resources

(1) Küre Zone

The Küre Formation which contains the known ore deposits, is considered as a mélange. Basalt and breccia formation are distributed with imbricate structure. All directions of lateral extension of basalt, the distribution of known ore deposits and strike of major faults, are N-S to NNW-SSE.

Basalt shows submarine effusive facies. Tuffs which imply steam explosion do not occur in this zone. It is interpreted that the basalt erupted in deep ocean. Ore deposits are composed of massive, brecciated, network ores with a large amount of pyrite, a small amount of chalcopyrite and sphalerite, and a minor amount of marcasite and pyrrhotite. No hydrothermal alteration zone occurs in the footwall basalt below massive ores.

From the above facts, the known ore deposits in this zone are interpreted to be a Cyprus-type.

New ore deposits which are expected to occur in this zone, could be a Cyprus-type copper deposit. Ore reserves is estimate to range from one to ten million tons, grading 2 to 3 percent copper, with reference to the known ore deposits.

The dislocation of mèlange constituents, including ore bodies, must be surveyed before exploration works.

Many faults are observed within basalt. Basalt has certain extents which can be shown on the geologic map. Network and dissemination of sulphide minerals are usually accompanied by the known ore deposits.

These facts indicate that ore bodies were dislocated along with footwall mineralized zone and basalt.

As pelitic rocks of hanging wall have bedding planes parallel to the boundary between basalt and pelitic rocks, some parts of pelitic rocks were also dislocated together with footwall basalt.

As mentioned above, ore deposits occur very close to a mineralized zone in footwall basalt. The existence of mineralized zone in basalt suggests some possibility of massive ore around such zone.

Drilling in this phase results in finding veinlets and dissemination of sulphide minerals in pillow lava at the northern extension of the Zemberekler mineralized zone. The known massive ore deposits occur in hyaloclastite. The mineralized zone in the drill hole MJTK-4 occurs in pillow lava. As hyaloclastite is considered to occur at the flank of and above pillow lava, new massive ore deposits are possibly expected to occur around this hyaloclastite.

The results of drilling and electric logging show that pelitic rocks of the Küre Formation have extremely low resistivities. Basalt whose cracks and fractures caused by tectonic movements are filled by underground water, may show rather low resistivity.

Extremely low resistivity zones except from the known ore deposits, were found in 100 to 200 m in depth between the Station 9 and 13 of the Line B, and in 100 to 200 m in depth between the Station 9 and 11 of the Line E during the CSAMT survey.

The zones which are located in the N-S and NNW-SSE extensions from the known mineralized zones, and have low resistivity, are situated in the following localities; 150 to 300 m in depth between the Station 23 and 27 of the Line C , in the NNW extension from Bakibaba ore deposit, 200 to 300 m in depth between the Station 37 and 39 of Line E , in the NNW extension from the Zemberekler mineralized zone, and in the SSE extension from MJTK-4.

(2) Cünür Prospect in the Taşköprü Zone

The mineralized zone consists of eight lenses and bedded gossans in green schist. The gossans are composed of quartz-limonite-pyrite network and limonite dissemination in the silicified and argillized parts of mafic rocks. The areas extending from gossans are occupied by silicified basic rocks.

The results of time-domain IP survey show that the resistivities of the zone extended below gossans are similar to those of the surrounding non-mineralized zone, and the chargeabilities are lower than those of the surrounding silicified zones. The size of mineralized zones expected to occur below gossans is estimated to be small.

Blind mineralized zones can not be expected below the extensively silicified zone which occurs around gossans because the chargeabilities of the zones below silicified zones are similar to those of surface outcrops.

High chargeability anomalies are identified at the southern margin of the zone. These anomalies are located adjoining to the silicified zone. The shape on cross sections, chargeabilities and resistivities of these anomalies indicate that these anomalies are characterized by the dissemination of sulphide minerals. The above characteristics and the mineralizations observed on the surface suggest that these anomalies may indicate the existence of disseminated sulphide minerals.

(3) Cozoğlu Prospect in the Taşköprü Zone

The mineralized zone observed in outcrops in this prospect is only a weak dissemination of pyrite. The reasons why new ore deposits may be expected to occur in this prospect, are the existences of a large amount of slag and waste dump, and two openings of old adits.

The results of geophysical prospecting in this phase show that high chargeability anomalies are distributed from the above zones which are covered by slags and waste dumps to the eastern part of this prospect. The shape of these anomalies on cross sections may indicate that bedded cupriferous pyrite deposits probably occur within these zones.

The other high chargeability anomalies having similar values to the above mentioned anomalies are identified in the southern margin of the zone, where is covered by the Çangal meta-ophiolite.

The southern extension of these anomalies is not clear because survey stations are limited, but it is considered that bedded cupriferous deposits may occur in these anomalous zones.

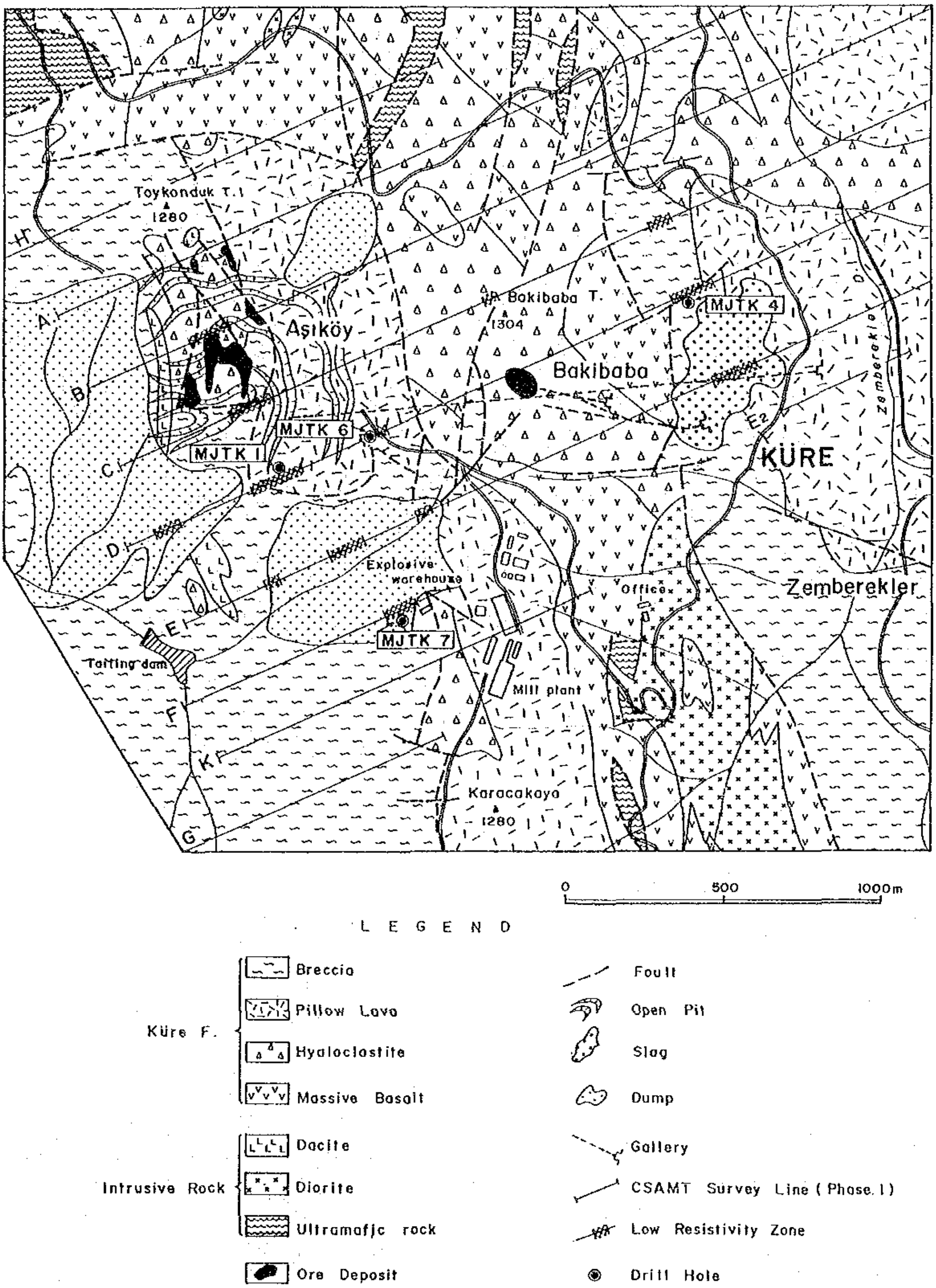


Fig. 1-6 Integrated Interpretation Map of the Survey Results in Küre Zone

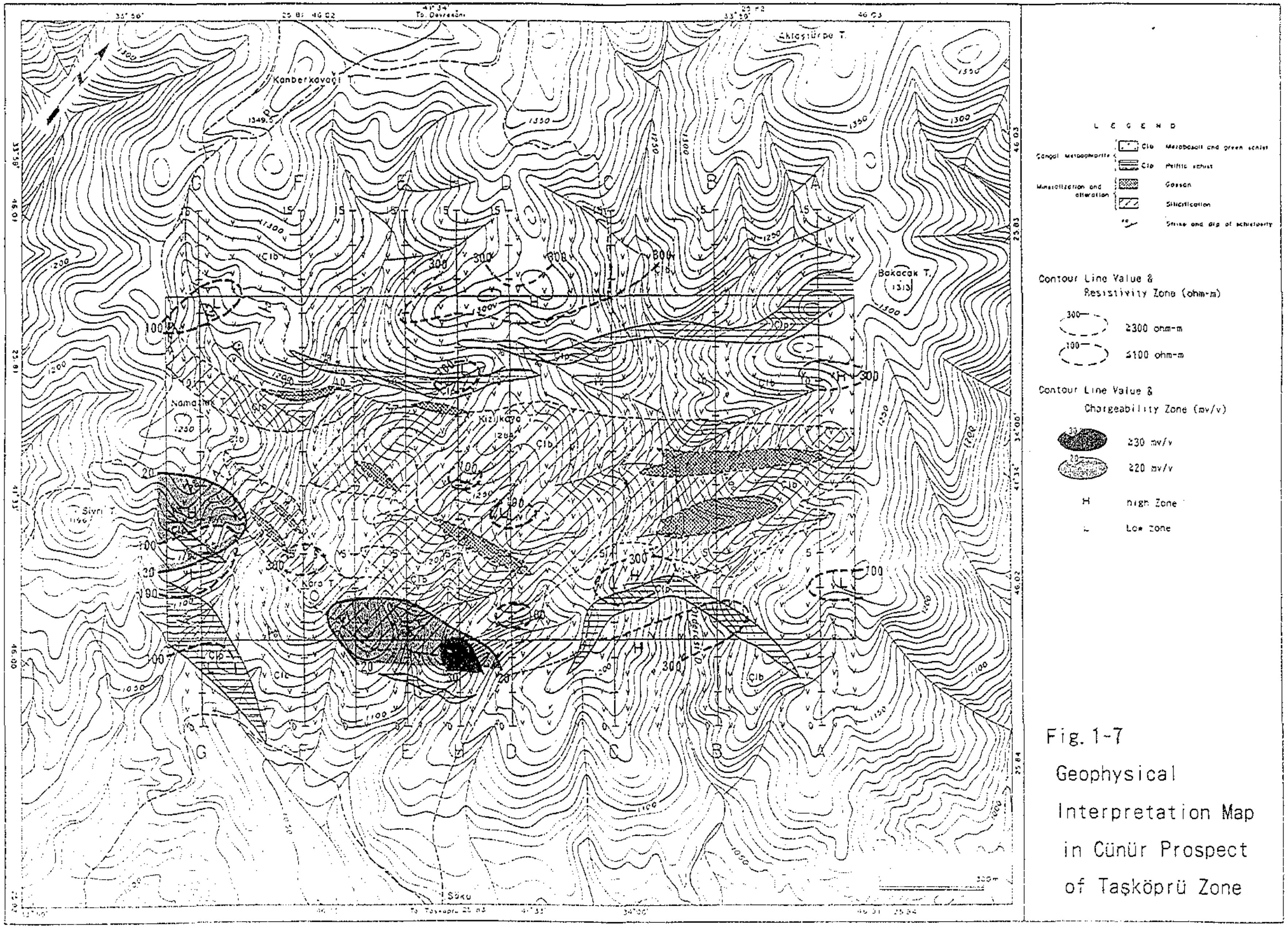


Fig. 1-7
Geophysical
Interpretation Map
in Cünür Prospect
of Taşköprü Zone

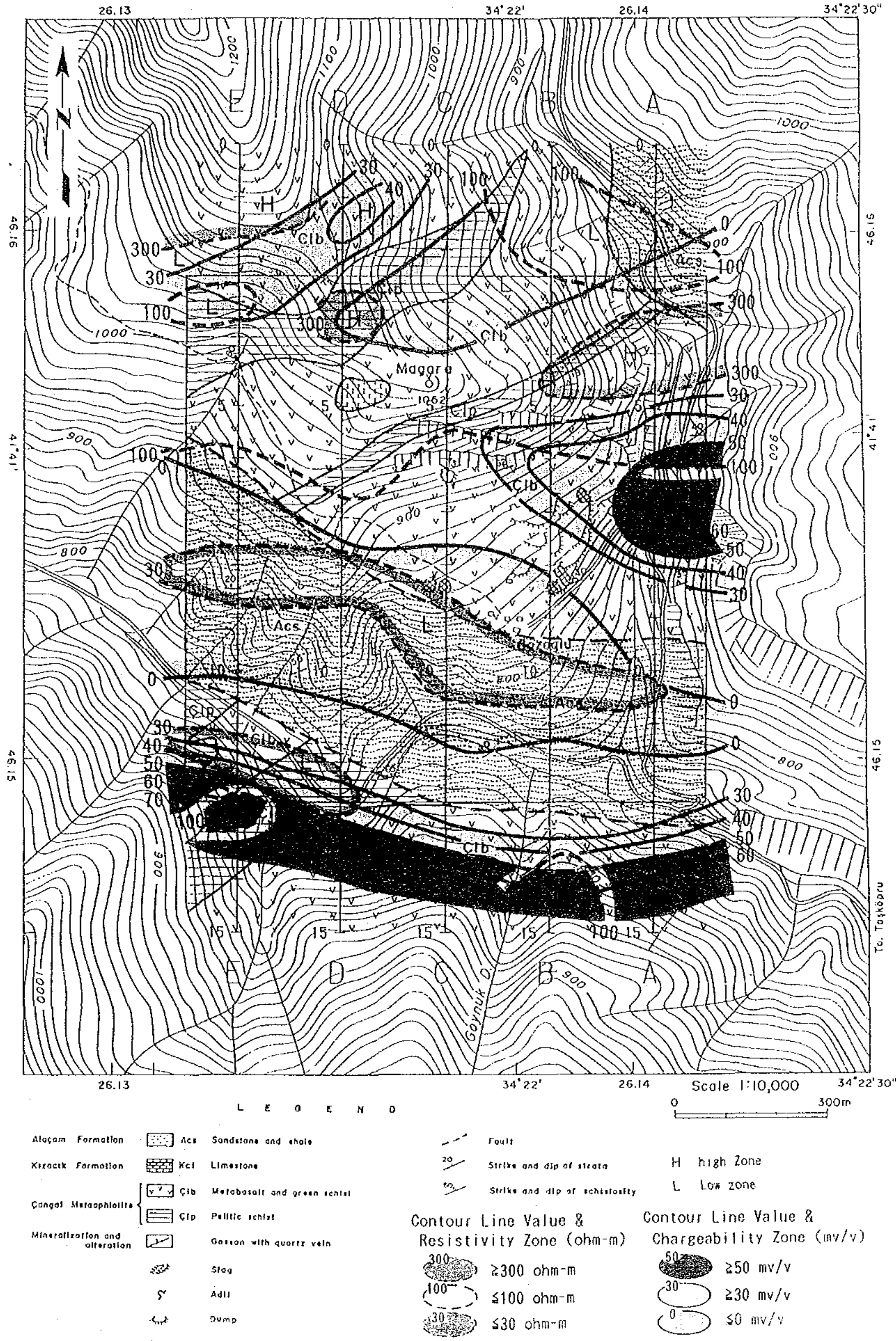
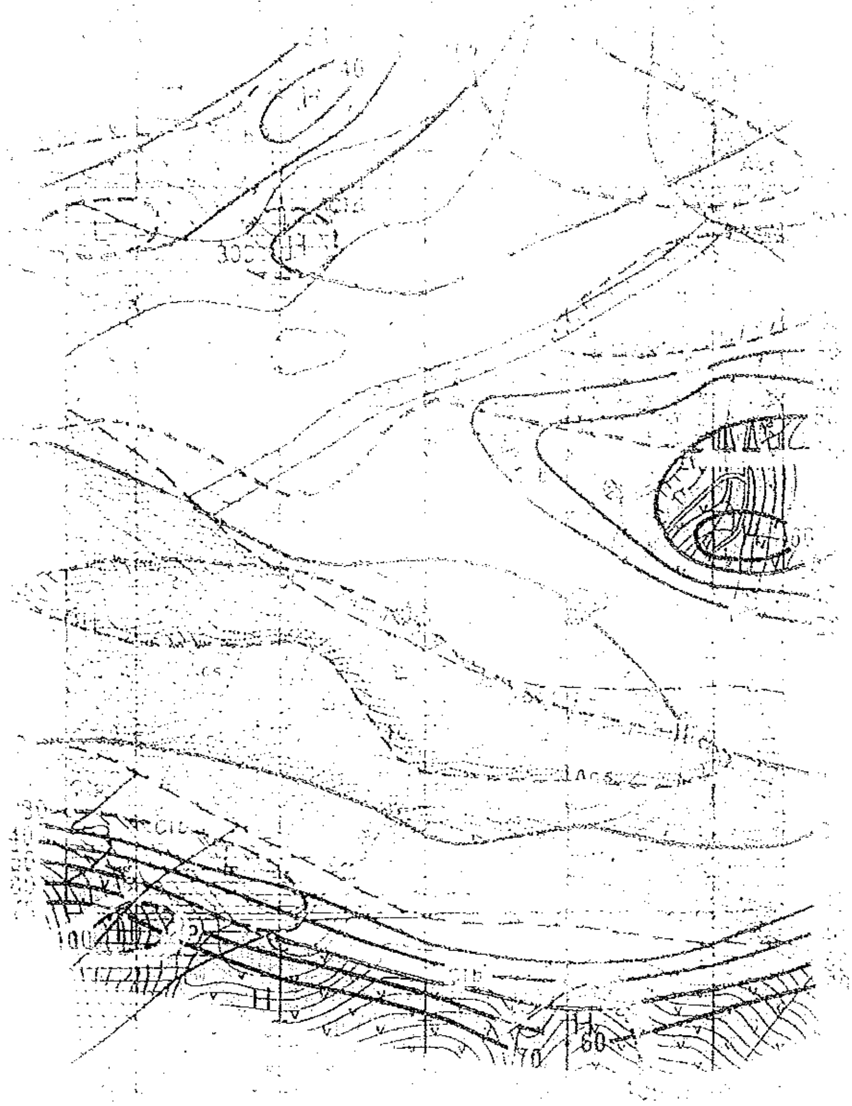


Fig. 1-8 Geophysical Interpretation Map in Cozoğlu Prospect of Taşköprü Zone



CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS

5-1 Conclusions

Küre Zone

(1) The geology of the zone consists of pre-Jurassic ultramafic rocks, Jurassic basalt, sedimentary rocks of the Küre Formation, grayish white fossiliferous limestone of the Lower Cretaceous Karadana Formation, pale brown and white marl of the Upper Cretaceous Çağlayan Formation, talus deposits and intrusive diorite and dacite.

(2) The major part of the zone is occupied by the Jurassic Küre Formation. The basalt is composed of pillow lava, hyaloclastite, and massive basalt. Sedimentary facies of the Küre Formation is composed of angularly fragmentated graywacke and tectonically sheared/argillized black shale. The matrix consists of pelitic materials.

Basalt and brecciated sediments of the Küre Formation are interpreted as a constituent of mèlange. The period of mèlange formation is inferred to be Middle Jurassic, since intrusion into the mèlange is inferred to be Later Dogger epoch.

(3) The geologic structure of this zone is characterized by many faults. They are divided into two systems; N-S and E-W. The former system is crosscut by the latter. With the exception of the diorite and dacite intrusive bodies and the Karadana Formation, the boundaries of all geologic units, including ultramafic bodies, have been dislocated. The surface elongation of the intrusive bodies is harmonious with the strike of the faults in the vicinity and with the boundary between sediments and basalt of the Küre Formation.

Basalt is interpreted to be footwall rocks of ore deposits. It is distributed extending to N-S and NNW-SSE direction with imbricate structure.

(4) The known ore deposits are the Cyprus-type deposits. The new ore deposits of the same type are expected to occur in the zone. They occur at the boundary between hyaloclastite and black shale of the Küre Formation and also within hyaloclastite. They consist of massive ore, brecciated ore, network ore and disseminated ore.

(5) Ore deposits together with footwall mineralized zone and hanging-wall pelitic rock are considered to be dislocated by the tectonic movements.

(6) The results of drilling and electric logging show that pelitic rocks of the Küre Formation have extremely low resistivities. Basalt whose cracks and fractures caused by tectonic movements are filled by underground water, may show rather low resistivity.

(7) Drilling in this phase results in finding a mineralized zone at the northern extension of Zemberekler mineralized zone. The results of the survey indicate that the known ore deposits and mineralized zones are distributed in the N-S and NNW-SSE directions. The zones which are located in the N-S and NNW-SSE extensions from the mineralized zones in basalt with low resistivity anomalies, are promising for future exploration. Extremely low resistivity zones same as those in the known ore deposits are full of promise for finding of new ore deposits.

It is necessary to mind for deciding of drilling location that pelitic rocks show low resistivities, and it is difficult to distinguish ore deposits from pelitic rocks by resistivities.

Cünür Prospect in the Taşköprü Zone

(1) The geology around the prospect is the Çangal meta-ophiolite consisting of pelitic schist, massive basalt, and green schist.

(2) The mineralized zone is composed of eight lenses and bedded gossans in green schist. The gossans consist of quartz-limonite-pyrite network and limonite dissemination in the silicified and argillized parts of mafic rocks.

(3) The results of time-domain IP survey show that resistivities of the zone extended below gossans are similar to those of the surrounding non-mineralized zone, and chargeabilities are lower than those of the surrounding silicified zones. The size of mineralized zones expected to occur below gossans is estimated to be small.

(4) Blind mineralized zones may not be expected below the extensively silicified zone which occurs around gossans, because chargeabilities of the zones below silicified zone are similar to those of surface outcrops.

(5) High chargeability anomalies are identified at the southern margin of the zone. These anomalies are located adjoining to the silicified zone. The shape on cross sections, chargeabilities, resistivities of these anomalies and geology suggest that these anomalies may indicate the existence of disseminated sulphide minerals.

Cozoğlu Prospect in the Taşköprü Zone

(1) The geology around this prospect is composed mainly of the Çangal meta-ophiolite, the Kızacık Formation, and the Alaçam Formation. The meta-ophiolite consists of pelitic schist, massive metabasalt and green schist. The Kızacık Formation consists of grayish white limestone and the Alaçam Formation of quartz arenite and black mudstone.

(2) There are two openings of old adits, a large amount of slag and waste dumps on the surface. They are distributed in the Çangal meta-ophiolite.

(3) The mineralized zone observed in outcrops in this prospect is only a weak dissemination of pyrite.

(4) The results of geophysical survey in this phase show that high chargeability anomalies are distributed from the above zones which are covered by slags and waste dumps to the eastern part of this prospect. The shape of these anomalies on cross sections and the geology may indicate that bedded cupriferous pyrite deposits probably occur within these zones.

(5) The other high chargeability anomalies having similar values to the above mentioned anomalies are identified in the southern margin of the prospect, where is covered by the Çangal meta-ophiolite. It is considered that bedded cupriferous deposits may occur in these anomalous zones.

5-2 Recommendations for the Third Phase Survey

Küre Zone

It is recommended that drilling exploration should be carried out in the following localities for the purpose of clarifying the conditions of subsurface copper mineralization in the third phase of the project.

(1) South-southeast of the Aşıköy ore deposit
(2) North-northwest of the Bakibaba ore deposit
(3) East of the Bakibaba ore deposit and north-northwest of the Zemberekler mineralized zone

Cünür Prospect in the Taşköprü Zone

No further work is recommended in the Cünür prospect.

Cozoğlu Prospect in the Taşköprü Zone

It is recommended that drilling works should be carried out in the geophysical anomalies which are identified in the east of the localities where are occupied by slags for the purpose of clarifying the conditions of subsurface copper mineralization.

PART 2 KÜRE ZONE

PART 2 KÜRE ZONE

CHAPTER 1 OUTLINE OF KÜRE ZONE

1-1 Outline of the Zone

The Küre zone is located in the central northern part of the Küre area. The land consists of well-vegetated mountains extending in the east to west direction. It is bounded to the north by the Black Sea and to the south by the Anatolia plateau.

The office of the Küre mine is located at 1,100 m above sea level. The relief around the mine is steep.

The Küre mine is only one operating mine in the area and exploiting a large amount of ore from the Aşıköy ore deposit by open pit mining, and a small amount of ore from the Bakibaba ore deposit by underground mining.

Because 948 ML of the Aşıköy orebody is the base boundary of open pit operation, the ores from 948ML to 756ML have to be operated by the economical and modern underground mining methods. The main transportation level was built at 920ML and an inclined shaft to this level is currently preparing from the south of the Aşıköy orebody.

Geological and geophysical surveys were conducted in the first phase. The extensional localities of the Aşıköy and Bakibaba ore deposits and Zemberekler mineralized zone were extracted as the next exploration targets.

Drilling survey comprising four holes totalling 1003.55 m and electric logging for two holes were carried out elucidating the nature of low resistivity zones obtained by CSAMT survey last year.

1-2 Geology and Mineralization

The geology of the zone consists of pre-Jurassic ultramafic rocks, Jurassic basalt, sedimentary rocks of the Küre Formation, fossiliferous limestone of the Lower Cretaceous Karadana Formation, marl of the Upper Cretaceous Çağlayan Formation, intrusive diorite and dacite.

Basalt of the Küre Formation that occupies the major part of the zone is composed of pillow lava, hyaloclastite and massive basalt.

Sedimentary facies of the Küre Formation is composed of angularly fragmentated graywacke and sheared/argillized black shale.

The geologic structure of this zone is characterized by many faults. They are divided into two systems; N-S and E-W. With the exception of diorite and dacite intrusive bodies, the boundary of all geologic units, including ultramafic bodies, have been displaced. The surface elongation of intrusive bodies is harmonious with the strike of faults in the vicinity and with the boundary between sediments and basalt of the Küre Formation.

Aşıköy, Toykondu, Bakibaba and Kızılsu are the known ore deposits in this zone. These deposits occur at the boundary between hyaloclastite and black shale of the Küre Formation also within the hyaloclastite. They consist of massive, brecciated, network and disseminated ores. They contain a large amount of pyrite with a small amount of chalcopyrite and a minor of sphalerite. The geologic environment, mode of occurrence, and mineral composition of these orebodies show a common feature which is characteristic to the Cyprus-type ore deposits.

CHAPTER 2 RE-ANALYSIS OF THE FIRST-PHASE GEOPHYSICAL SURVEY

2-1 Outline of the First Phase Geophysics and Re-analysis

CSAMT and IP methods were applied over an area surrounding Aşıköy deposit during the first phase of the this project. In CSAMT, 400 stations in array were arranged in 10 profile lines and 113 stations in random . A total of 4000m in three lines were measured by IP in order to determine the cause of the low resistivity detected by CSAMT.

The low resistivity anomalies most probably related to Aşıköy, Bakibaba and Kızılsu ore deposits were confirmed for the major CSAMT anomalies. Many small anomalies were detected to the southeast of the Aşıköy deposit. Of particular interest is the many small anomalies detected southeast of Aşıköy orebody as these occur as several linearly oriented groups of anomalies and they apparently are continuous to the Kizilsu deposit to the southeast. Also small but continuous anomalies were detected to the north and south of Bakibaba deposit. Weak anomalies were detected near the mineral showings to the northeast of Bakibaba and these are considered to continue to the Zemberekler mineralized zone.

Also during the last year, the following three localities were selected to be being promising for future prospecting from study of the results of the above survey as well as those obtained by ETiBANK previously and the conditions of the mineral showings and the known deposits. These areas are; (1) south of Aşıköy deposit, (2) near the entrance of 920mL adit, (3) north and south of Bakibaba deposit.

Two-dimensional inversion analysis was carried out for CSAMT array Lines A-E near the Aşıköy Deposit. This was done in order to increase the accuracy of analysis and to determine the depth of the anomaly sources. The results are shown in Figure 2-1.

2-2 Two-dimensional Inversion Analysis and Mineralization

The correlation between the geology and the result of two-

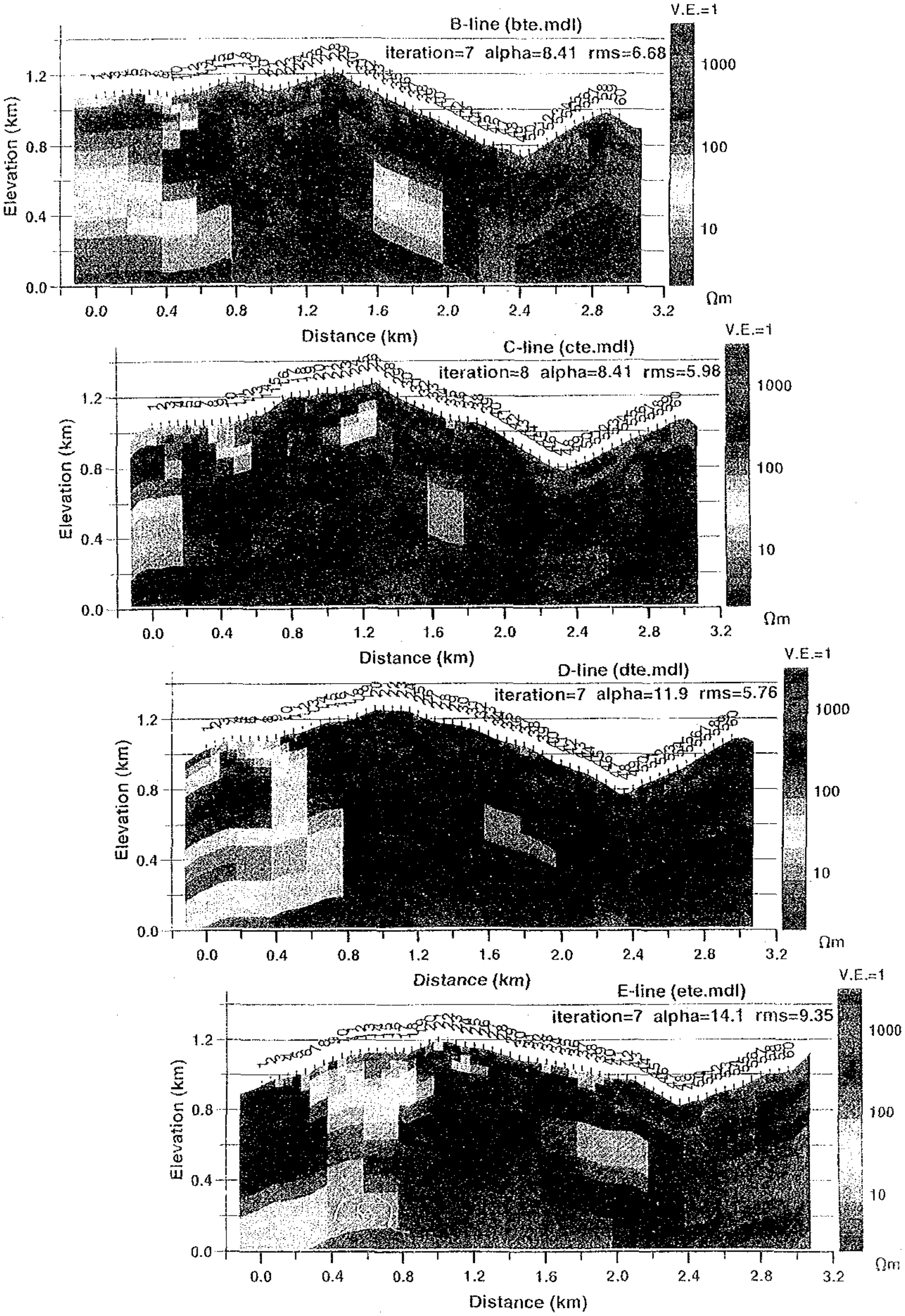


Fig. 2-1 Two-dimensional interpretation of CSAMT Method in the Küre area

dimensional inversion analysis was made to the depth of 400m as the reliability of the analysis is the highest to this depth. Line C which lies within the Aşıköy pit where many holes have been drilled in the past was studied as an example.

In two-dimensional inversion analysis, 50m line-length and 50m depth is calculated as one block down to 200m below the surface and 100m line-length and 100m depth as one block below 200m.

For the comparison with the geological data drilled and the cell mentioned above, the section (upper) in figure 2-2 shows the geology on the line C, and the section (middle) shows the data both sides 50m width in NW and SE direction from the line C were averaged by drilling data, the section (bottom) in same figure shows the cell in <100 ohm-m calculated by two-dimensional inversion analysis. By the comparison with the two sections in middle and bottom, massive ore bodies are generally shown by the low resistivity cell, but in detail, the sediments are also detected by the low resistivity cell. In other case, the massive ore bodies are rarely indicated by high resistivity cell. There is only one cell in <10 ohm-m shown by massive ore body.

It is seen from the above that the possibility of the occurrence of massive orebodies is high for the blocks with resistivity lower than 10ohm-m, and that the possibility of massive orebodies and sedimentary rocks are high for those with resistivity below 100ohm-m.

CHAPTER 3 DRILLING SURVEY

3-1 Outline of Drilling

Geological and geophysical surveys were conducted in the first phase. The extensional localities of the Aşıköy and Bakibaba ore deposits and the Zemberekler mineralized zone were extracted as targets for future exploration. Drilling survey of four holes totalling 1003.55 m were done this phase to clarify the conditions of subsurface copper mineralization in the south of the Aşıköy ore deposit and in the north of the Zemberekler mineralized zone.

Details of each hole are summarized in Table 2-1.

The drilling locations, schematic geologic column of the zone and geologic cross sections along the drill holes are shown in Figures 2-3, 2-4 and 2-5 respectively.

A series of drill logs of 1:200 scale was prepared, and the whole drill cores were photographed in color. Twenty-eight thin sections for petrography and nine polished sections for ore microscopy were produced. Twelve rock samples were examined for X-ray powder analysis. Twenty-two ore assay samples were obtained.

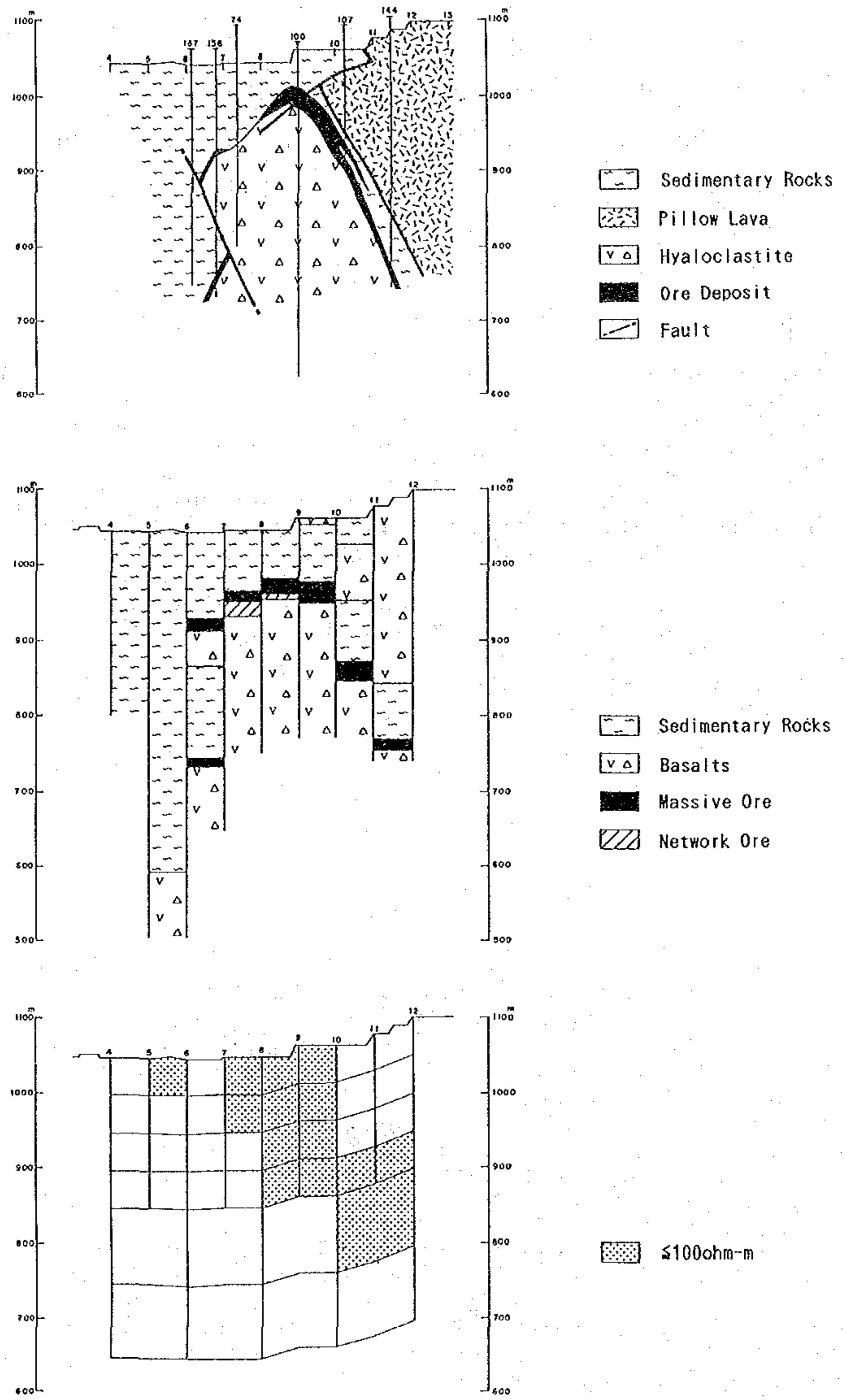


Fig. 2-2 The Relation Map between the Aşıköy Deposit
and CSAMT Anomalies of Two-Dimensional Interpretation

Table 2-1 Coordinates of Drill Holes and Hole Length

Hole No.	Locality	Coordinates		Elevation	Incli-nation	Drilled Length
MJTK-1	South of Aşıköy	30,536N	57,633E	1,095m	-90°	401.00m
MJTK-4	East of Bakibaba	31,082N	58,912E	1,060m	-90°	200.30m
MJTK-6	East of Aşıköy	30,658N	57,944E	1,181m	-90°	150.80m
MJTK-7	Southeast of Aşıköy	30,088N	58,028E	1,128m	-90°	251.45m

3-2 *Geology and Mineralization*

3-2-1 Geology

The geology of the zone consists of pre-Jurassic ultramafic rocks, basalt and sedimentary rocks of the Jurassic Küre Formation, intrusive diorite and dacite.

Basalt of the Küre Formation that occupies the major part of the zone is composed of pillow lava, hyaloclastite and massive basalt.

Sedimentary facies of the Küre Formation is composed of angularly fragmentated graywacke and sheared/argillized black shale.

The geologic structure of this zone is characterized by many faults. They are divided into two systems; N-S and E-W. With the exception of the diorite and dacite intrusive bodies, the boundary of all geologic units, including the ultramafic bodies, have been displaced. The surface elongation of the intrusive bodies is harmonious with the strike of faults in the vicinity and with the boundary between sediments and basalt of the Küre Formation.

3-2-2 Mineralization

Aşıköy, Toykondu, Bakibaba and Kızılsu are the known ore deposits in this zone. These deposits occur at the boundary between hyaloclastite and black shale of the Küre Formation. They also occur within the hyaloclastite. They consist of massive, brecciated, network and disseminated ores. They contain a large amount of pyrite with a small amount of chalcopyrite and a minor amount of sphalerite. The geologic environment, mode of occurrence, and mineral composition of these orebodies show a common feature which is characteristic to the Cyprus-type ore deposits.

Low resistivity zones extending from the Aşıköy orebodies

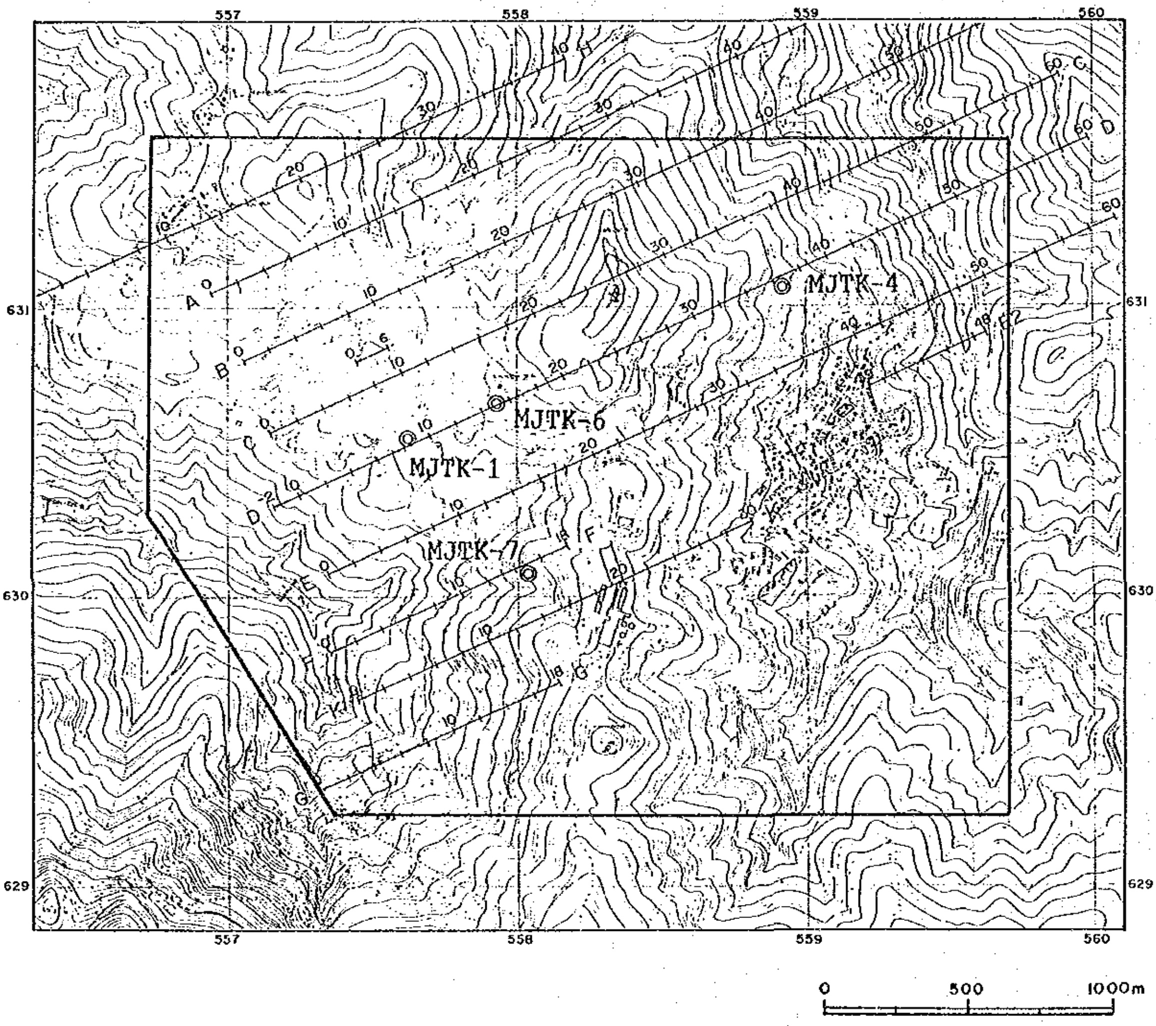


Fig. 2-3 Location Map of Drill Holes

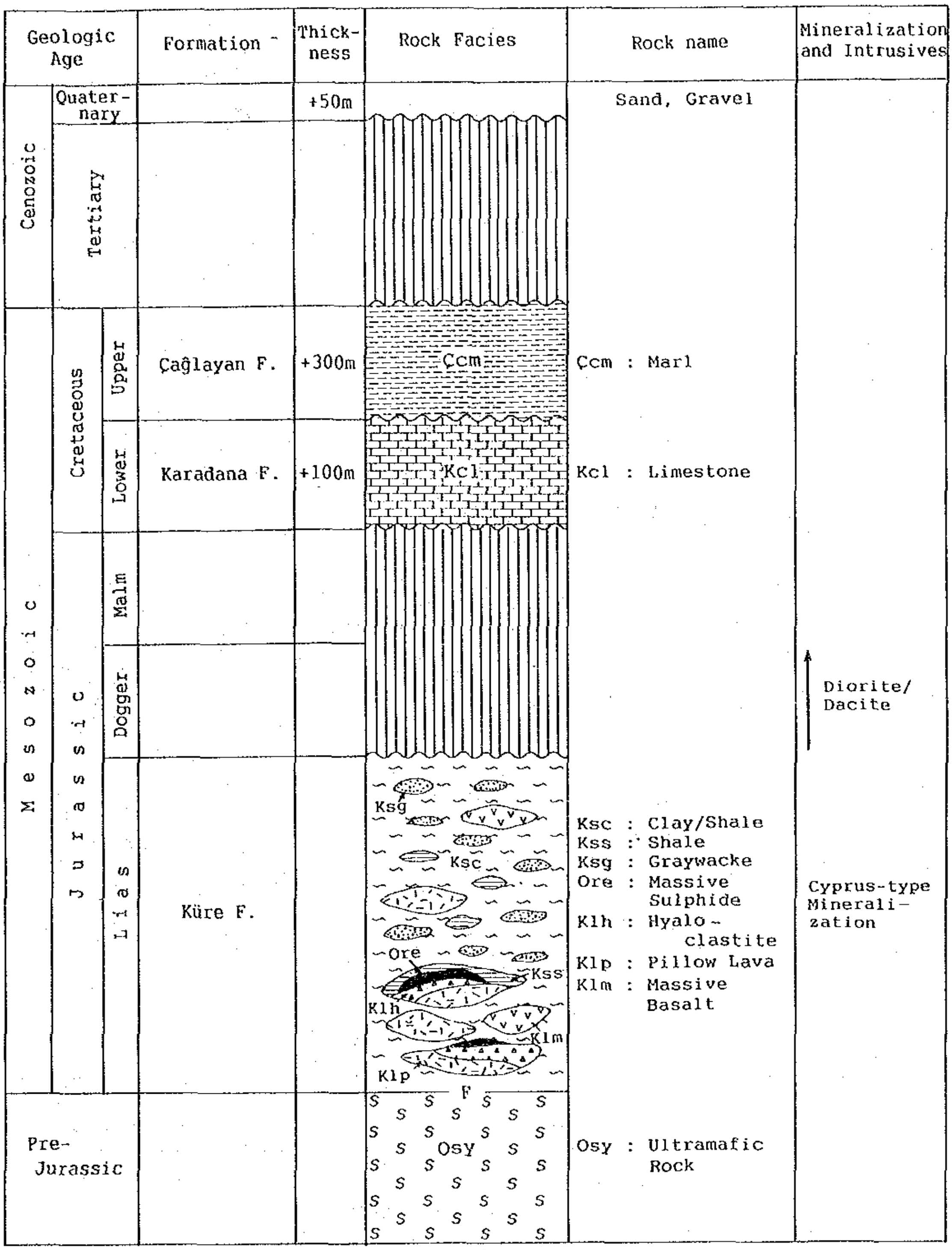


Fig. 2-4 Schematic Geologic Column of Küre Zone

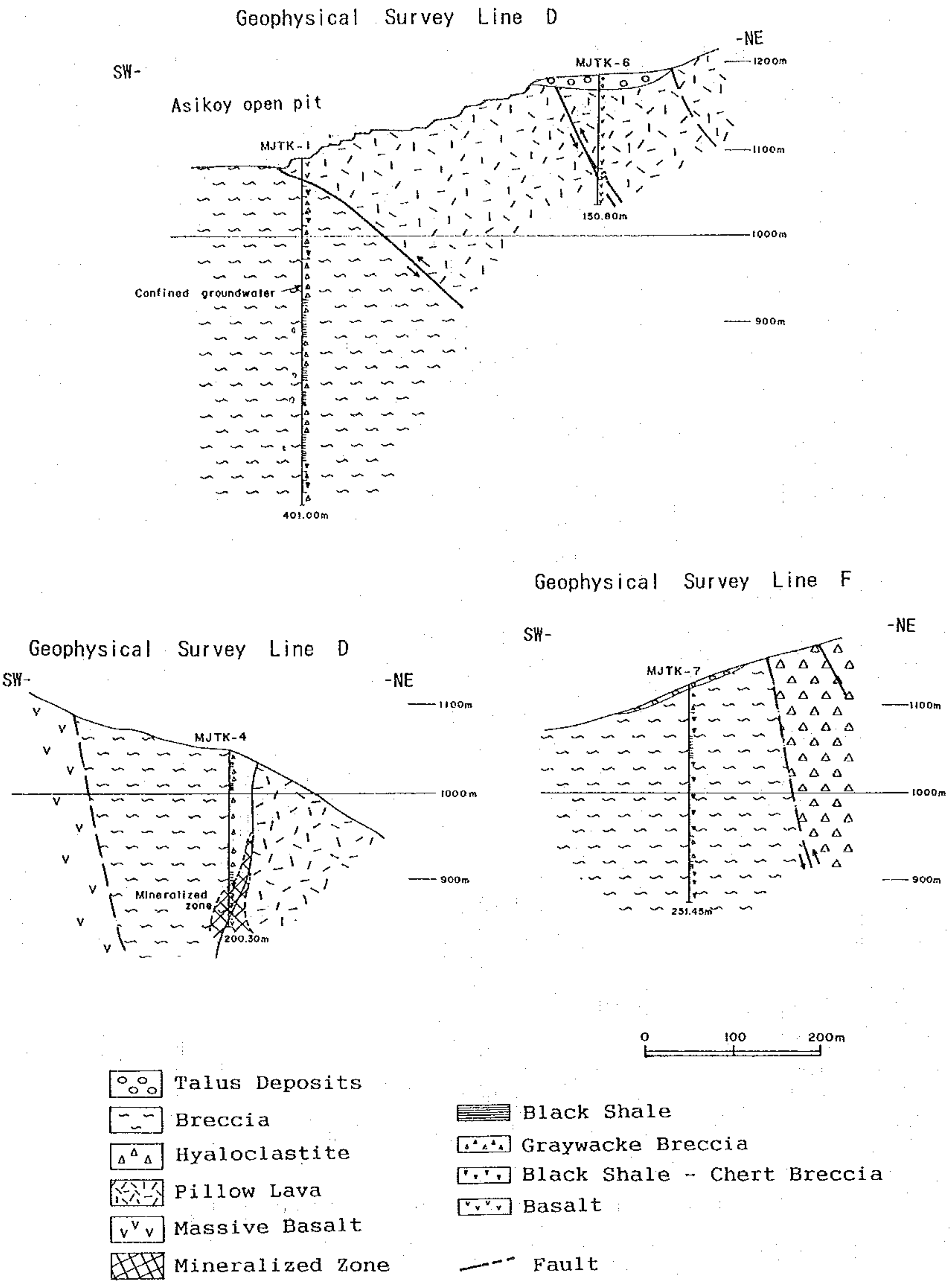


Fig. 2-5 Geologic Cross Section along the Drill Holes

southeastward were obtained by CSAMT survey in the first phase. The other low resistivity zones with an elongation of NW-SE to the Zemberekler mineralized zone at the east of the Bakibaba ore deposit and the other similar zones at the north and south of the Bakibaba orebody were detected.

3-3 Drilling Method, Equipment and Progress

3-3-1 Drilling Method and Equipment

(1) Method

For surface parts, drilling was done by conventional drilling method using HW casing shoe (114 mm in diameter) or NW casing shoe (89 mm in diameter) with inserting HW or NW casing pipes.

For the bedrock zone, wireline method was adopted with NQ and BQ standard-sized diamond bits (76 mm and 56 mm in diameter respectively) and its core tubes.

Bentonite mud was usually mixed in the circulating drill water. The drilling water was lost in the hole many times because of fractures being developed. For preventing water loss, TELSTOP (squeezed refuse of cottonseed) and oil bentonite (mixture of light oil and bentonite) were injected. The density of mud water was kept in high to prevent the big collapse of wall.

(2) Equipment

The drilling machines were L-44 of Longyear and D-750 of Atlas Copco. Specifications of drilling machine and equipment are shown in Table 2-2. Diamond bits and expendable items used during the drilling are listed in Tables 2-3 and 2-4 respectively.

(3) Working System

Drilling operation was carried out by three shifts per day (8 hours per shift), while the appurtenant works, such as road construction, rig construction, mobilization and demobilization, were done by one shift per day. A shift crew consists of one drilling engineer and three workers normally. Additional six workers were involved in case of the appurtenant work. A base camp for drilling operation was set in Küre mine. The commute between the base camp and drilling site was by car.

(4) Road Construction

A road of 250 m in length for transportation to MJTK-4 was constructed using a bulldozer. A road of 100 m to MJTK-7 was also built.

(5) Transportation

Most of machines and equipments which were used in the second phase, were provided by Etibank at Küre mine. All diamond bits were transported from Japan by airplane. A part of mud materials was shipped from Yokohama to Istanbul. After landed, they were transported to Küre mine by trucks.

Table 2-2 Specifications of Drilling Machine and Equipment

Drilling Machine Model "L-44"	1 set
Specifications:	
Capacity	975m(BW), 1,035m(BQ)
Dimension L × W × H	2,743mm × 1,448mm × 2,057mm
Hoisting capacity	7,659kg
Spindle speed	Forward 210, 436, 800, 1,350rpm
Engine model "Deutz F5L-912"	81hp / 2,200rpm
Drilling Machine Model "D-750"	1 set
Specifications:	
Capacity	425m(BQ)
Dimension L × W × H	2,355mm × 900mm × 1,750mm
Hoisting capacity	3,000kg
Spindle speed	Forward 245, 430, 740, 1,335rpm
Engine model "Deutz F3L-912"	36.5hp / 1,800rpm
Drilling Pump Model "DG-130"	4 set
Specifications:	
Piston diameter	68.5mm
Stroke	75mm
Capacity	discharge capacity 130 liter/min
Dimension L × W × H	1,600mm × 650mm × 640mm
Engine	16hp / 2,000rpm
Generator	1 set
Specifications:	
Capacity	2.7kw 50hz 220v
Derrick for L-44	
Specifications:	
Height	17m
Max load capacity	20,000kg
Derrick for D-750	
Specifications:	
Height	7.5m
Max load capacity	6,000kg
Drilling tools	
Drilling rod NQ-WL 3.0m	150 pcs
BQ-WL 3.0m	250 pcs
Casing pipe HW 1.0m	5 pcs
HW 3.0m	10 pcs
NW 3.0m	30 pcs
BW 3.0m	90 pcs

Table 2-3 Drilling Meterage and Diamond Bit Consumption

Item	Size	Bit No.	Drilling Meterage				Total
			MJTK-1	MJTK-4	MJTK-6	MJTK-7	
	NQ	436119	19.20				19.20
		436120	12.30				12.30
		13829		29.10			29.10
		13830		17.40			17.40
		13831	16.15				16.15
		13832	20.35				20.35
		13833	8.40				8.40
		13834	23.85				23.85
		13835			15.00		15.00
		13836			36.90		36.90
		13837				22.40	22.40
		13838				34.40	34.40
		13839				29.00	29.00
		186742	33.95				33.95
		191429	32.00				32.00
		191525	17.75				17.75
		Total	183.95	46.50	51.90	85.80	368.15
		Drilling Length/Bit 23.00m					
Diamond Bit	BQ	13841		32.30			32.30
		13842		33.40			33.40
		13843		31.30			31.30
		13844		26.60			26.60
		13845		25.70			25.70
		13846			28.10		28.10
		13847			34.30		34.30
		13848			33.60		33.60
		13849	28.00				28.00
		13850	24.60				24.60
		13851	29.15				29.15
		13852	39.25				39.25
		13853	29.00				29.00
		13854	27.55				27.55
		13855				32.80	32.80
		13856				29.90	29.90
		13857	31.10				31.10
		13858	24.45				24.45
		13859	18.10				18.10
		13860				30.85	30.85
		13861				28.75	28.75
		13862				21.15	21.15
		13863				16.50	16.50
		Total	251.20	149.30	96.00	159.95	656.45
		Drilling Length/Bit 28.54m					
	HW	12604	3.10				3.10
		12605	9.00				9.00
		12606	8.50				8.50
		12607	9.00				9.00
		12608			4.60		4.60
		12609				4.75	4.75
		Total	29.60		4.60	4.75	38.95
		Drilling Length/Bit 6.49m					
	NW	13864	12.00				12.00
		13865	9.00				9.00
Casing Shoe		13866		4.50			4.50
		13867	5.90				5.90
		13868	12.00				12.00
		13869	12.00				12.00
		13870	6.40				6.40
		13871			19.80		19.80
		13872				12.00	12.00
		13873				12.00	12.00
		13874				11.85	11.85
		Total	57.30	4.50	19.80	35.85	117.45
		Drilling Length/Bit 10.68m					

Table 2-4 Consumption of Expendable Items

Description	Specifi-cations	Unit	Quantity				
			MJTK-1	MJTK-4	MJTK-6	MJTK-7	Total
Light oil		liter	7,400	1,800	1,600	3,200	14,000
Hydraulic oil		liter	64	42	86	88	280
Engine oil		liter	96	140	102	192	530
Gear oil		liter	25	10	42	35	112
Gasoline		liter	510	2,400	190	320	3,420
Greas		kg	35	16	18	20	89
Bentonite		kg	13,300	5,500	7,500	5,500	31,800
C.M.C.		kg	144	40	50	56	290
Tel-stop		kg				45	45
Seaclay		kg	60			110	170
Libonite		kg	226	30	70	118	444
Mud oil		liter	54			54	108
Cement		kg	1,120	400	400	600	2,520
Diamond bit	NQ-WL	pc	8	2	2	3	15
Diamond bit	BQ-WL	pc	9	5	3	6	23
Diamond shoe	HW	pc	4		1	1	6
Diamond shoe	NW	pc	6	1	1	3	11
Diamond shoe	BW	pc	2	1	1	1	5
Diamond reamer	NQ-WL	pc	1	1	1	1	4
Diamond reamer	BQ-WL	pc	4	1	1	1	7
Core barrel Ass'y	NQ-WL	set	1	1			2
Core barrel Ass'y	BQ-WL	set	1	1			2
Inner tube Ass'y	NQ-WL	set	1	1			2
Inner tube Ass'y	BQ-WL	set	1	1			2
Outer tube	NQ-WL	pc	1	1			2
Outer tube	BQ-WL	pc	1	1			2
Inner tube	NQ-WL	pc	2	1	1	1	5
Inner tube	BQ-WL	pc	2	1	1	1	5
Locking coupling	NQ-WL	pc	2	2	2	2	8
Locking coupling	BQ-WL	pc	2	2	2	2	8
Adapter coupling	NQ-WL	pc	2	2	2	2	8
Adapter coupling	BQ-WL	pc	2	2	2	2	8
Core lifter case	NQ-WL	pc	5	2	2	3	12
Core lifter case	BQ-WL	pc	9	5	4	6	24
Core lifter	NQ-WL	pc	5	2	2	3	12
Core lifter	BQ-WL	pc	9	5	4	6	24
Stop ring	NQ-WL	pc	5	2	2	3	12
Stop ring	BQ-WL	pc	9	5	4	6	24
Thrust ball bearing	NQ-WL	pc	2	1	1	1	5
Thrust ball bearing	BQ-WL	pc	2	1	1	1	5
Hanger bearing	NQ-WL	pc	2	1	1	1	5
Chack piece	NQ-WL	pc	1	1			2
Chack piece	BQ-WL	pc	1	1			2
Cylinder liner		pc	18	6	6	6	36
Piston rubber		pc	105	12	21	12	150
Hoisting wire rope	14mm-100m	roll	2	1			3
Wireline rope	6mm-500m	roll	2	1		1	4
Waste		kg	50	10	10	15	85
Core box	NQ-WL	box	22	6	8	13	49
Core box	BQ-WL	box	35	24	14	24	97

(6) Drilling Water

Water for drilling was taken directly from water supply pipes in Küre mine or transported by a tank lorry.

(7) Withdrawal

After the completion of drilling programme, the machine, equipment and drilling cores were stored in a drilling warehouse in the Küre mine.

3-3-2 Progress of Drilling

The progress of each drill hole is described below. Summary of working time, records of drilling operation, records of drilling performance and charts of drilling progress are shown in Tables 2-5 to 2-13 and Figures 2-6 to 2-9 respectively.

(1) MJTK-1

Drilling machine L-44 of Longyear was employed in this hole.

For surface basalt in open pit, drilling was done by HW diamond casing shoe using conventional drilling method. HW and NW casing pipes were inserted to 3.1 m deep. From 3.1 m to 34.6 m, drilling was carried out by the wireline method with NQ diamond bit, using bentonite mud water. Drilling work could not be kept on continuously because of intermittent water loss between surface and 24.0 m, and the collapse of wall at clay zone developing from 31 to 33m in depth.

To prevent water loss, cementing of the hole was practiced. Drilling by NQ wireline was done until 43 m. Big collapse of wall from 34 m to the bottom happened in this depth. Even though NW casing pipes were extended to the depth, collapsed material has not been taken out. The continuation of this hole was given up.

After taking out of casing pipes and dismantling the machine, the drill site moved 12 meters to the northwest from the original drill location.

Before starting again, mud materials, casing pipes and water tank were prepared.

For surface basalt in open pit, drilling was done by HW diamond casing shoe using the conventional drilling method. HW and NW casing pipes were inserted to 5.75 m. From 5.75 m to 149.8 m, drilling was carried out by the wireline method with NQ diamond bit, using bentonite mud water. Up to 39.4 m in depth water loss and collapse of wall were intermittently occurred. Against for these troubles, HW and NW casing pipes were extended to 26.5 m and 39.4 m respectively.

Inserting of BW casing pipes to the bottom of hole was planned because argillized black shale around 131 m in depth collapsed several times. BW casing pipes could not be inserted below 129 m.

After cleaning out of hole by the NQ wireline method, it took five days to insert NQ drilling rods to 149.8 m as substitutes for BW casing pipes having bigger outer diameter.

Table 2-5 Summary of Working Time

Hole No.	Bit Size	Drilling		Shift		Men Working		Working Time							
		Drilling Length	Core Length	Drilling	Total	Engineer	Worker	Drilling	Other Works	Recovering	Total	Assemblage	Dismantlement	Transportation	Grand Total
		m	m	shift	shift	men	men	hours	hours	hours	hours	hours	hours	hours	hours
MJTK-1	HW	5.75	3.30	2	2	2	6	6	10		16	64	16	24	120
	NQ	144.05	119.35	60	68	68	204	269	212	63	544				544
	BQ	251.20	221.20	95	112	112	336	483	346	75	904				904
	Total	401.00	343.85	157	182	182	546	758	568	138	1,464	64	16	24	1,568
MJTK-4	NW	4.50	2.00	2	2	2	6	7	9		16	32	16		64
	NQ	46.50	29.60	17	20	20	60	74	43	35	152				152
	BQ	149.30	149.20	40	40	40	120	217	93	10	320				320
	Total	200.30	180.80	59	62	62	186	298	145	45	488	32	16		536
MJTK-6	HW	3.60	3.00	1	2	2	6	6	2	8	16	32	24		72
	NQ	51.90	37.40	21	21	21	63	89	76	3	168				168
	BQ	95.30	90.00	28	31	31	93	136	96	16	248				248
	Total	150.80	130.40	50	54	54	162	231	174	27	432	32	24		488
MJTK-7	NW	5.70	2.70	4	4	4	12	11	14	7	32	90	16	24	162
	NQ	85.80	65.95	47	54	54	162	175	173	42	390				390
	BQ	159.95	154.00	55	57	57	171	301	124	31	456				456
	Total	251.45	222.65	106	115	115	345	487	311	80	878	90	16	24	1,008

Table 2-6-1 Record of Drilling Operation (MJTK-1, First)

	Drilling Length			Total		Shift		Working Man	
	Shift 1 (m)	Shift 2 (m)	Shift 3 (m)	Drilling (m)	Core Length (m)	Drilling (shift)	Total (shift)	Enginner (man)	Worker (man)
Sep/ 7	Preparation						1	3	15
Sep/ 8	Assemblage						1	3	15
Sep/ 9	ditto						1	3	15
Sep/10	ditto						1	3	15
Sep/11	ditto						1	3	15
Sep/12	1.20	1.90		3.10	0.00	2	2	3	9
Sep/13	1.20	2.30	Reaming	3.50	3.50	3	3	3	9
Sep/14	2.40	Reaming	4.40	6.80	5.90	3	3	3	9
Sep/15	3.40	2.40	Reaming	5.80	5.80	3	3	3	9
Sep/16	Reaming	1.60	2.70	4.30	2.60	3	3	3	9
Sep/17	Reaming	Reaming	1.20	1.20	0.40	3	3	3	9
Sep/18	0.90	Reaming	Reaming	0.90	0.60	3	3	3	9
Sep/19	Pow sus	Pump	Pump			3	3	3	9
Sep/20	Pump	2.20	1.90	4.10	1.50	3	3	3	9
Sep/21	1.50	Reaming	0.20	1.70	1.20	3	3	3	9
Sep/22	1.70	Cleanout	Cleanout	1.70	0.60	3	3	3	9
Sep/23	Reaming	Reaming	Water			3	3	3	9
Sep/24	1.10	0.40	Pow sus	1.50	0.50	3	3	3	9
Sep/25	Cement	Cement	Cement			3	3	3	9
Sep/26	Cement	Cement	Cement			3	3	3	9
Sep/27	Drillout	Drillout	Drillout			3	3	3	9
Sep/28	Drillout	0.10	2.60	2.70	0.90	3	3	3	9
Sep/29	3.40	1.80	0.50	5.70	3.70	3	3	3	9
Sep/30	Reaming	Cleanout	Cleanout			3	3	3	9
Oct/ 1	Pump	Cleanout	Cleanout			3	3	3	9
Oct/ 2	Extract						1	3	9
Oct/ 3	Transfer						1	3	9
Oct/ 4	ditto						1	3	9
Oct/ 5	ditto						1	3	9
Oct/ 6	ditto						1	3	9
Oct/ 7	ditto						1	3	9
Oct/ 8	5.10	0.25	1.45	6.80	3.70	3	3	3	9
Oct/ 9	2.30		3.20	5.50	4.30	3	3	3	9
Oct/10	0.50	1.90	0.25	2.65	2.65	3	3	3	9
Oct/11	0.50	1.75	Water	2.25	1.95	3	3	3	9
Oct/12	0.80	0.20	1.10	2.10	1.90	3	3	3	9
Oct/13	2.60	Reaming	1.40	4.00	3.80	3	3	3	9
Oct/14	2.30	Reaming	1.00	3.30	2.50	3	3	3	9
Oct/15	1.60	0.20	Reaming	1.80	0.60	3	3	3	9
Oct/16	Reaming	0.60	1.70	2.30	2.10	3	3	3	9
Oct/17	2.00	2.20	2.60	6.80	6.80	3	3	3	9
Oct/18	2.15	Reaming	0.65	2.80	2.80	3	3	3	9
Oct/19	2.40	2.70	3.80	8.90	8.40	3	3	3	9
Oct/20	2.60	3.40	3.15	9.15	6.45	3	3	3	9
Oct/21	2.65	3.40	2.90	8.95	8.35	3	3	3	9
Oct/22	3.85	2.85	2.10	8.80	8.80	3	3	3	9
Oct/23	2.00	3.55	2.20	7.75	7.75	3	3	3	9
Oct/24	6.65	3.95	2.45	13.05	11.90	3	3	3	9
Oct/25	2.85	5.35	3.40	11.60	8.60	3	3	3	9
Oct/26	3.95	3.05	2.3	9.30	6.05	3	3	3	9
Oct/27	5.65	4.8	3.75	14.20	11.65	3	3	3	9
Oct/28	5.00	4.20	2.40	11.60	9.10	3	3	3	9
Oct/29	1.05	2.25	0.50	3.80	1.70	3	3	3	9
Oct/30	Cleanout	Cleanout	2.00	2.00	0.80	3	3	3	9
Oct/31	0.40	CP ins	CP ins	0.40	0.00	3	3	3	9

Pump : Pump repairing
Pow sus : Electric power suspension
Water : Water supply suspension

Cement : Cementing of hole
Extract : Extraction of casing pipes
CP ins : Casing pipes inserting

Table 2-6-2 Record of Drilling Operation (MJTK-1, Final)

	Drilling Length			Total		Shift		Working Man	
	Shift 1 (m)	Shift 2 (m)	Shift 3 (m)	Drilling (m)	Core Length (m)	Drilling (shift)	Total (shift)	Enginner (man)	Worker (man)
Nov/ 1	CP ins	CP ins	CP ins			3	3	3	9
Nov/ 2	CP ins	CP ins	Cleanout			3	3	3	9
Nov/ 3	Cleanout	Cleanout	Cleanout			3	3	3	9
Nov/ 4	CP ins	CP ins	0.55	0.55	0.20	3	3	3	9
Nov/ 5	2.25	0.30	2.05	4.60	3.55	3	3	3	9
Nov/ 6	2.65	2.30	1.95	6.90	5.50	3	3	3	9
Nov/ 7	4.80	2.70	2.15	9.65	8.60	3	3	3	9
Nov/ 8	1.85	3.15	1.30	6.30	5.45	3	3	3	9
Nov/ 9	0.75	1.00	1.10	2.85	2.05	3	3	3	9
Nov/10	2.10	2.80		4.90	2.35	3	3	3	9
Nov/11	0.55	2.30	2.20	5.05	3.45	3	3	3	9
Nov/12	2.15	2.75	3.45	8.35	7.15	3	3	3	9
Nov/13	3.45	3.65	3.30	10.40	9.80	3	3	3	9
Nov/14	3.85	3.70	0.95	8.50	8.50	3	3	3	9
Nov/15	3.15	3.60	2.00	8.75	8.75	3	3	3	9
Nov/16	3.45	1.50	1.55	6.50	6.50	3	3	3	9
Nov/17	3.40	2.60	2.65	8.65	7.50	3	3	3	9
Nov/18	1.70	1.45	2.00	5.15	4.35	3	3	3	9
Nov/19	3.35	3.85	2.75	9.95	8.50	3	3	3	9
Nov/20	3.90	3.80	3.40	11.10	8.85	3	3	3	9
Nov/21	2.85	1.45	4.15	8.45	2.80	3	3	3	9
Nov/22	3.60	1.30	1.35	6.25	1.50	3	3	3	9
Nov/23	1.55	1.90	2.10	5.55	5.55	3	3	3	9
Nov/24	1.85	3.75	4.15	9.75	9.75	3	3	3	9
Nov/25	1.85	2.45	2.35	6.65	6.55	3	3	3	9
Nov/26	3.15	4.35	3.90	11.40	11.40	3	3	3	9
Nov/27	4.85	3.10	1.75	9.70	8.70	3	3	3	9
Nov/28	1.65	2.05	3.00	6.70	6.70	3	3	3	9
Nov/29	4.00	1.40	Cleanout	5.40	4.50	3	3	3	9
Nov/30	Cleanout	Cleanout	2.35	2.35	2.35	3	3	3	9
Dec/ 1	2.60	4.55	4.00	11.15	11.15	3	3	3	9
Dec/ 2	1.80	2.15	3.20	7.15	7.15	3	3	3	9
Dec/ 3	0.45	2.80	6.10	9.35	9.35	3	3	3	9
Dec/ 4	4.70	4.15	0.90	9.75	9.75	3	3	3	9
Dec/ 5	2.95	2.40	4.15	9.50	9.50	3	3	3	9
Dec/ 6	3.05	3.20	2.95	9.20	8.70	3	3	3	9
Dec/ 7	3.00	1.75	Extract	4.75	4.75	2	3	3	9
Dec/ 8	Dismantlement						1	3	9
Dec/ 9	ditto						1	3	9
Dec/10	Transportation						1	3	9
Dec/11	ditto						1	3	9
Dec/12	ditto						1	3	9
Total				401.00	343.85	241	258	291	903

CP ins : Casing pipes inserting   Extract : Extraction of casing pipes

Table 2-7 Record of Drilling Operation (MJTK-4)

	Drilling Length			Total		Shift		Working Man	
	Shift 1 (m)	Shift 2 (m)	Shift 3 (m)	Drilling (m)	Core Length (m)	Drilling (shift)	Total (shift)	Enginner (man)	Worker (man)
Sep/18	Assemblage						1	3	15
Sep/19	ditto						1	3	15
Sep/20	ditto						1	3	15
Sep/21	ditto						1	3	15
Sep/22	2.00	2.50	2.50	7.00	3.00	3	3	3	9
Sep/23	2.40	4.60	4.50	11.50	4.10	3	3	3	9
Sep/24	Pump	2.90	2.00	4.90	3.70	2	3	3	9
Sep/25	3.60	3.60	3.00	10.20	8.10	3	3	3	9
Sep/26	0.80	0.40	Pump	1.20	1.10	2	3	3	9
Sep/27	Pump	4.20	4.10	8.30	5.80	2	3	3	9
Sep/28	2.00	2.60	1.10	5.70	3.60	3	3	3	9
Sep/29	2.20	0.60	2.90	5.70	5.60	3	3	3	9
Sep/30	4.60	4.60	2.70	11.90	11.90	3	3	3	9
Oct/ 1	4.30	4.90	3.50	12.70	12.70	3	3	3	9
Oct/ 2	4.20	3.40	4.40	12.00	12.00	3	3	3	9
Oct/ 3	4.90	4.40	3.20	12.50	12.50	3	3	3	9
Oct/ 4	4.50	6.60	2.00	13.10	13.10	3	3	3	9
Oct/ 5	3.20	4.50	4.00	11.70	11.70	3	3	3	9
Oct/ 6	3.50	3.80	3.40	10.70	10.70	3	3	3	9
Oct/ 7	3.50	3.20	2.20	8.90	8.90	3	3	3	9
Oct/ 8	3.90	4.40	4.40	12.70	12.70	3	3	3	9
Oct/ 9	3.70	3.50	3.50	10.70	10.70	3	3	3	9
Oct/10	3.20	3.60	4.60	11.40	11.40	3	3	3	9
Oct/11	3.00	4.00	3.30	10.30	10.30	3	3	3	9
Oct/12	4.50	2.70	Cleanout	7.20	7.20	2	3	3	9
Oct/13	PVC ins	Extract					1	3	9
Oct/14	Dismantlement						1	3	9
Oct/15	Transportation						1	3	9
Total				200.30	180.80	59	70	84	276

Pump : Pump repairnig
PVC ins : Polyvinyl chloride pipe inserting
Extract : Extraction of casing pipes

Table 2-8 Record of Drilling Operation (MJTK-6)

	Drilling Length			Total		Shift		Working Man	
	Shift 1 (m)	Shift 2 (m)	Shift 3 (m)	Drilling (m)	Core Length (m)	Drilling (shift)	Total (shift)	Enginner (man)	Worker (man)
Oct/14	Leveling						1	3	9
Oct/15	Transportation						1	3	9
Oct/16	Assemblage						1	3	9
Oct/17	ditto						1	3	9
Oct/18	Pump	3.60	3.10	6.70	4.50	2	3	3	9
Oct/19	2.80	3.00	1.70	7.50	1.60	3	3	3	9
Oct/20	2.20	2.20	1.40	5.80	2.70	3	3	3	9
Oct/21	1.60	2.30	0.70	4.60	2.30	3	3	3	9
Oct/22	1.00	2.50	4.40	7.90	7.50	2	3	3	9
Oct/23	3.70	3.30	4.70	11.70	11.40	2	3	3	9
Oct/24	3.30	3.00	2.20	8.50	7.60	3	3	3	9
Oct/25	2.10	0.70	4.30	7.10	7.10	3	3	3	9
Oct/26	3.20	4.20	2.90	10.30	10.10	3	3	3	9
Oct/27	1.60	Reaming	Mach rep	1.60	0.90	2	3	3	9
Oct/28	Reaming	Cleanout	4.10	4.10	4.10	3	3	3	9
Oct/29	3.60	3.50	5.40	12.50	12.30	3	3	3	9
Oct/30	4.70	4.50	4.40	13.60	13.60	3	3	3	9
Oct/31	5.30	5.00	5.00	15.30	15.30	3	3	3	9
Nov/ 1	2.50	3.20	0.50	6.20	2.90	3	3	3	9
Nov/ 2	0.30	2.00	4.60	6.90	6.00	3	3	3	9
Nov/ 3	3.20	3.20	4.40	10.80	10.80	3	3	3	9
Nov/ 4	4.00	3.60	2.10	9.70	9.70	3	3	3	9
Nov/ 5	PVC ins	Extract					2	3	9
Nov/ 6	Dismantlement						1	3	9
Nov/ 7									
Nov/ 8	Transportation						1	1	3
Total				150.80	130.40	50	62	73	219

Pump : Pump repairnig
PVC ins : Polyvinyl chloride pipe inserting
Mach rep: Drilling machine repairing
Extract : Extraction of casing pipes

Table 2-9 Record of Drilling Operation (MJTK-7)

	Drilling Length			Total		Shift		Working Man	
	Shift 1 (m)	Shift 2 (m)	Shift 3 (m)	Drilling (m)	Core Length (m)	Drilling (shift)	Total (shift)	Enginner (man)	Worker (man)
Nov/ 7	Leveling						1	3	9
Nov/ 8	Transportation						1	2	6
Nov/ 9	Assemblage						1	3	9
Nov/10	ditto						1	3	9
Nov/11	ditto	Assembl	2.70	2.70	1.40	1	3	3	9
Nov/12	0.55	0.85	0.70	2.10	0.60	3	3	3	9
Nov/13	1.20	2.60	0.20	4.00	2.70	3	3	3	9
Nov/14	0.70	0.80	1.70	3.20	1.90	3	3	3	9
Nov/15	0.40	2.30	2.40	5.10	2.60	3	3	3	9
Nov/16	Reaming	1.40	1.60	3.00	1.30	3	3	3	9
Nov/17	Assembl	1.20	2.60	3.80	2.40	2	3	3	9
Nov/18	0.70	Assembl	1.20	1.90	1.60	2	3	3	9
Nov/19	Assembl	1.20	1.10	2.30	2.15	2	3	3	9
Nov/20	Assembl	0.80	0.90	1.70	1.60	2	3	3	9
Nov/21	0.50	0.90	2.00	3.40	2.80	3	3	3	9
Nov/22	0.70	0.60	3.30	4.60	1.10	3	3	3	9
Nov/23	Pump	1.00	2.00	3.00	2.30	2	3	3	9
Nov/24	1.10	3.80	1.90	6.80	6.00	3	3	3	9
Nov/25	2.60	3.80	0.85	7.25	7.25	3	3	3	9
Nov/26	1.75	3.00	2.90	7.65	4.65	3	3	3	9
Nov/27	Cleanout	3.40	3.20	6.60	6.30	3	3	3	9
Nov/28	2.30	2.50	3.20	8.00	6.80	3	3	3	9
Nov/29	2.90	3.40	4.00	10.30	9.40	3	3	3	9
Nov/30	1.80	1.50	0.80	4.10	4.10	3	3	3	9
Dec/ 1	2.20	2.80	2.90	7.90	7.90	3	3	3	9
Dec/ 2	2.60	2.70	3.30	8.60	7.50	3	3	3	9
Dec/ 3	1.80	3.10	Mach rep	4.90	4.40	2	3	3	9
Dec/ 4	2.10	3.20	3.30	8.60	8.60	3	3	3	9
Dec/ 5	2.80	Cleanout	2.60	5.40	5.00	3	3	3	9
Dec/ 6	1.80	3.00	3.10	7.90	7.40	3	3	3	9
Dec/ 7	1.90	3.00	3.70	8.60	8.60	3	3	3	9
Dec/ 8	2.90	3.40	4.50	10.80	10.50	3	3	3	9
Dec/ 9	3.40	2.20	2.80	8.40	8.40	3	3	3	9
Dec/10	2.20	3.80	4.20	10.20	10.00	3	3	3	9
Dec/11	1.30	2.90	2.15	6.35	6.35	3	3	3	9
Dec/12	2.75	2.40	3.50	8.65	8.45	3	3	3	9
Dec/13	3.20	4.00	3.55	10.75	10.35	3	3	3	18
Dec/14	2.40	3.00	2.40	7.80	7.00	3	3	3	18
Dec/15	2.25	2.60	2.60	7.45	7.05	3	3	3	18
Dec/16	2.60	2.50	2.50	7.60	7.60	3	3	3	18
Dec/17	3.90	2.85	3.55	10.30	10.30	3	3	3	18
Dec/18	3.25	3.60	3.55	10.40	9.35	3	3	3	18
Dec/19	2.70	4.75	1.90	9.35	8.95	3	3	3	18
Dec/20	Extract						1	3	18
Dec/21	Dismantlement						1	3	18
Dec/22	Dismantlement						1	3	18
Dec/23	Transportation						1	3	18
Dec/24	Transportation						1	3	18
Dec/25	Transportation						1	3	18
Total				251.45	222.65	109	126	143	537

Assembl : Assemblage
Extract : Extraction of casing pipes

Mach rep: Drilling machine repairing

Table 2-10 Record of Drilling Performance (MJTK-1)

	Survey Period				Total man day	
	Period	Days	Work day	Off day	Engineer	Worker
Operation			days	days	men	men
Preparation	07.09.1993 - 11.09.1993	5	5	0	15	75
Drilling	12.09.1993 - 07.12.1993	87	Drilling 81	0	243	729
			Recovering 6	0	18	54
Removing	08.12.1993 - 12.12.1993	5	5	0	15	45
Total	07.09.1993 - 12.12.1993	97	97	0	291	903

Drilling length			
Length planned	400.00m	Overburden	
Increase or Decrease in length		Core length	343.85m
Length drilled	401.00m	Core recovery	% 85.7

Core recovery of 100m hole		
Depth of hole (m)	Core recovery (%)	Core recovery cumulated (%)
0.00 - 100.00	86.0	86.0
100.00 - 200.00	76.7	81.6
200.00 - 300.00	83.0	82.0
300.00 - 401.00	97.5	85.7

Working hours	h	%	%
Drilling	845	42.6	40.4
Other working	766	38.6	36.7
Recovering	373	18.8	17.9
Total	1,984	100.0	95.0
Assemblage	64		3.1
Dismantlement	40		1.9
Water transportation			
Road construction and transportation			
Grand total	2,088		100.0

Efficiency of drilling	
Total m/work period(m/day)	401.00m/81days (4.95 m/day)
Total m/work shift (m/shift)	401.00m/157 shifts (2.55 m/shift)

Drilling length/bit(each sized bit)			
Bit size	HW	NQ	BQ
Drilled length	5.75m	144.05m	251.20m
Core length	3.30m	119.35m	221.20m

Casing pipe inserted			
Size	Meterage (m)	Meterage drilling length × 100 (%)	Recovery (%)
H W	26.5	6.6	100.0
N W	39.4	9.8	100.0
B W	149.8	37.4	100.0

Table 2-11 Record of Drilling Performance (MJTK-4)

	Survey Period				Total man day	
	Period	Days	Work day	Off day	Engineer	Worker
Operation			days	days	men	men
Preparation	18. 09. 1993 - 21. 09. 1993	4	4	0	12	45
Drilling	22. 09. 1993 - 12. 10. 1993	21	Drilling 21	0	63	189
			Recovering 0	0	0	0
Removing	13. 10. 1993 - 15. 10. 1993	3	3	0	7	21
Total	18. 09. 1993 - 15. 10. 1993	28	28	0	82	255

Drilling length			
Length planned	150. 00m	Overburden	
Increase or Decrease in length	50. 00	Core length	180. 80m
Length drilled	200. 30m	Core recovery	% 90. 3

Core recovery of 100m hole		
Depth of hole (m)	Core recovery (%)	Core recovery cumulated (%)
0. 00 - 100. 00	81. 2	81. 2
100. 00 - 200. 30	100. 0	90. 3

Working hours	h	%	%
Drilling	298	58. 2	53. 2
Other working	169	33. 0	30. 2
Recovering	45	8. 8	8. 0
Total	512	100. 0	91. 4
Assemblage	32		5. 7
Dismantlement	16		2. 9
Water transportation			
Road construction and transportation			
Grand total	560		100. 0

Efficiency of drilling	
Total m/work period(m/day)	200. 30m/21days (9. 54 m/day)
Total m/work shift (m/shift)	200. 30m/ 59 shifts (3. 39 m/shift)

Drilling length/bit(each sized bit)			
Bit size	NW	NQ	BQ
Drilled length	4. 50m	46. 50m	149. 30m
Core length	2. 00m	29. 60m	149. 20m

Casing pipe inserted			
Size	Meterage (m)	Meterage drilling length x 100 (%)	Recovery (%)
H W			100. 0
N W	4. 5	2. 2	100. 0
B W	51. 0	25. 5	100. 0

Table 2-12 Record of Drilling Performance (MJTK-6)

		Survey Period				Total man day	
		Period	Days	Work day	Off day	Engineer	Worker
Operation				days	days	men	men
	Preparation	14.10.1993 - 17.10.1993	4	4	0	8	24
	Drilling	18.10.1993 - 04.11.1993	18	Drilling 18	0	54	162
				Recovering 0	0	0	0
	Removing	05.11.1993 - 08.11.1993	4	3	1	7	21
	Total	14.10.1993 - 08.11.1993	26	25	1	69	207

Drilling length				
Length planned	150.00m	Overburden	18.60m	
Increase or Decrease in length		Core length	130.40m	
Length drilled	150.80m	Core recovery	% 86.5	

Core recovery of 100m hole		
Depth of hole (m)	Core recovery (%)	Core recovery cumulated (%)
0.00 - 100.00	84.1	84.1
100.00 - 150.80	91.4	86.5

Working hours	h	%	%
Drilling	231	51.6	45.8
Other working	190	42.4	37.7
Recovering	27	6.0	5.4
Total	448	100.0	88.9
Assemblage	32		6.3
Dismantlement	24		4.8
Water transportation			
Road construction and transportation			
Grand total	504		100.0

Efficiency of drilling			
Total m/work period(m/day)	150.80m/18days (8.38 m/day)		
Total m/work shift (m/shift)	150.80m/ 50 shifts (3.02 m/shift)		
Drilling length/bit(each sized bit)			
Bit size	HW	NQ	BQ
Drilled length	3.65m	51.90m	95.30m
Core length	3.00m	37.40m	90.00m

Casing pipe inserted			
Size	Meterage (m)	Meterage / drilling length × 100 (%)	Recovery (%)
H W	4.6	3.0	100.0
N W	24.4	16.2	100.0
B W	67.1	44.5	100.0

Table 2-13 Record of Drilling Performance (MJTK-7)

	Survey Period				Total man day	
	Period	Days	Work day	Off day	Engineer	Worker
Operation			days	days	men	men
Preparation	07.11.1993 - 10.11.1993	4	4	0	11	33
Drilling	11.11.1993 - 19.12.1993	39	Drilling 39	0	117	405
			Recovering 0	0	0	0
Removing	20.12.1993 - 25.12.1993	6	6	0	18	108
Total	07.11.1993 - 25.12.1993	49	49	0	149	555

Drilling length			
Length planned	250.00m	Overburden	7.10m
Increase or Decrease in length		Core length	222.65m
Length drilled	251.45m	Core recovery	% 88.5

Core recovery of 100m hole		
Depth of hole (m)	Core recovery (%)	Core recovery cumulated (%)
0.00 - 100.00	77.3	77.3
100.00 - 200.00	96.4	86.8
200.00 - 251.45	95.0	88.5

Working hours	h	%	%
Drilling	487	55.0	47.9
Other working	319	36.0	31.4
Recovering	80	9.0	7.9
Total	886	100.0	87.2
Assemblage	90		8.9
Dismantlement	40		3.9
Water transportation			
Road construction and transportation			
Grand total	1,016		100.0

Efficiency of drilling	
Total m/work period(m/day)	251.45m/39days (6.45 m/day)
Total m/work shift (m/shift)	251.45m/106 shifts (2.37 m/shift)

Drilling length/bit(each sized bit)			
Bit size	NW	NQ	BQ
Drilled length	5.70m	85.80m	159.95m
Core length	2.70m	65.95m	154.00m

Casing pipe inserted			
Size	Meterage (m)	Meterage drilling x 100 length (%)	Recovery (%)
H W	4.75	1.9	100.0
N W	40.60	16.1	100.0
B W	91.50	36.4	66.7

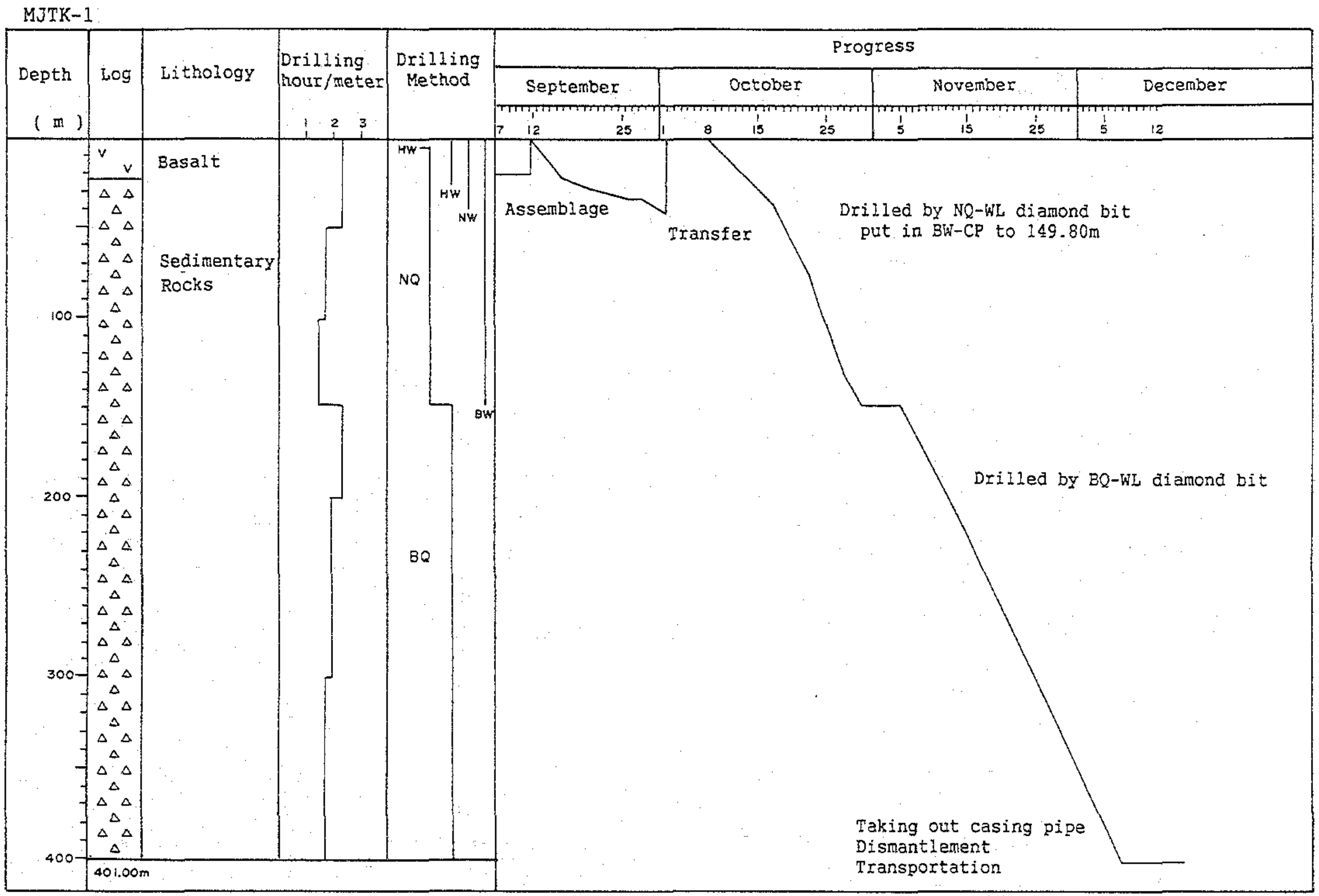


Fig. 2-6 Chart of Drilling Progress (MJTK-1)

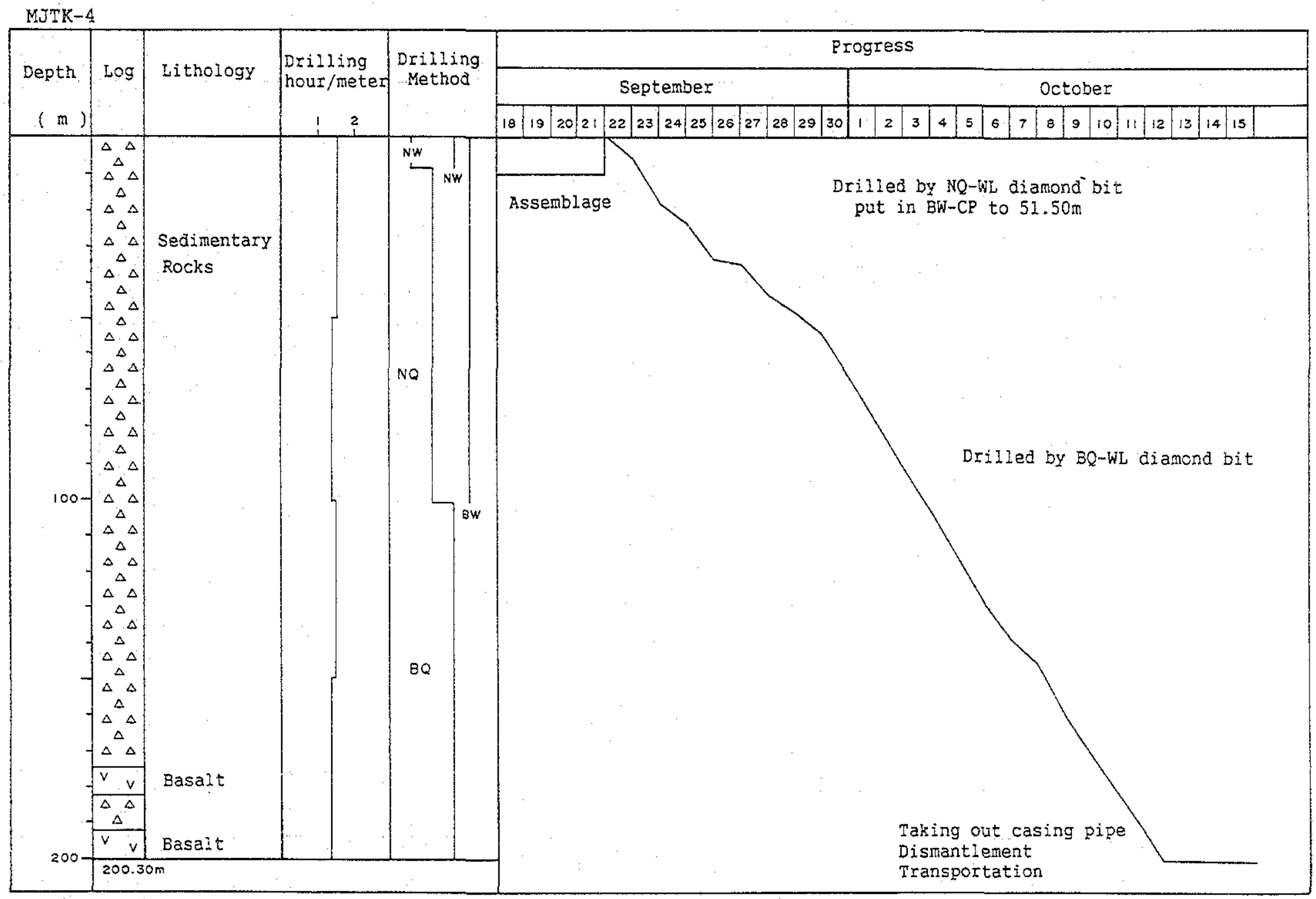


Fig. 2-7 Chart of Drilling Progress (MJTK-4)

MJTK-6

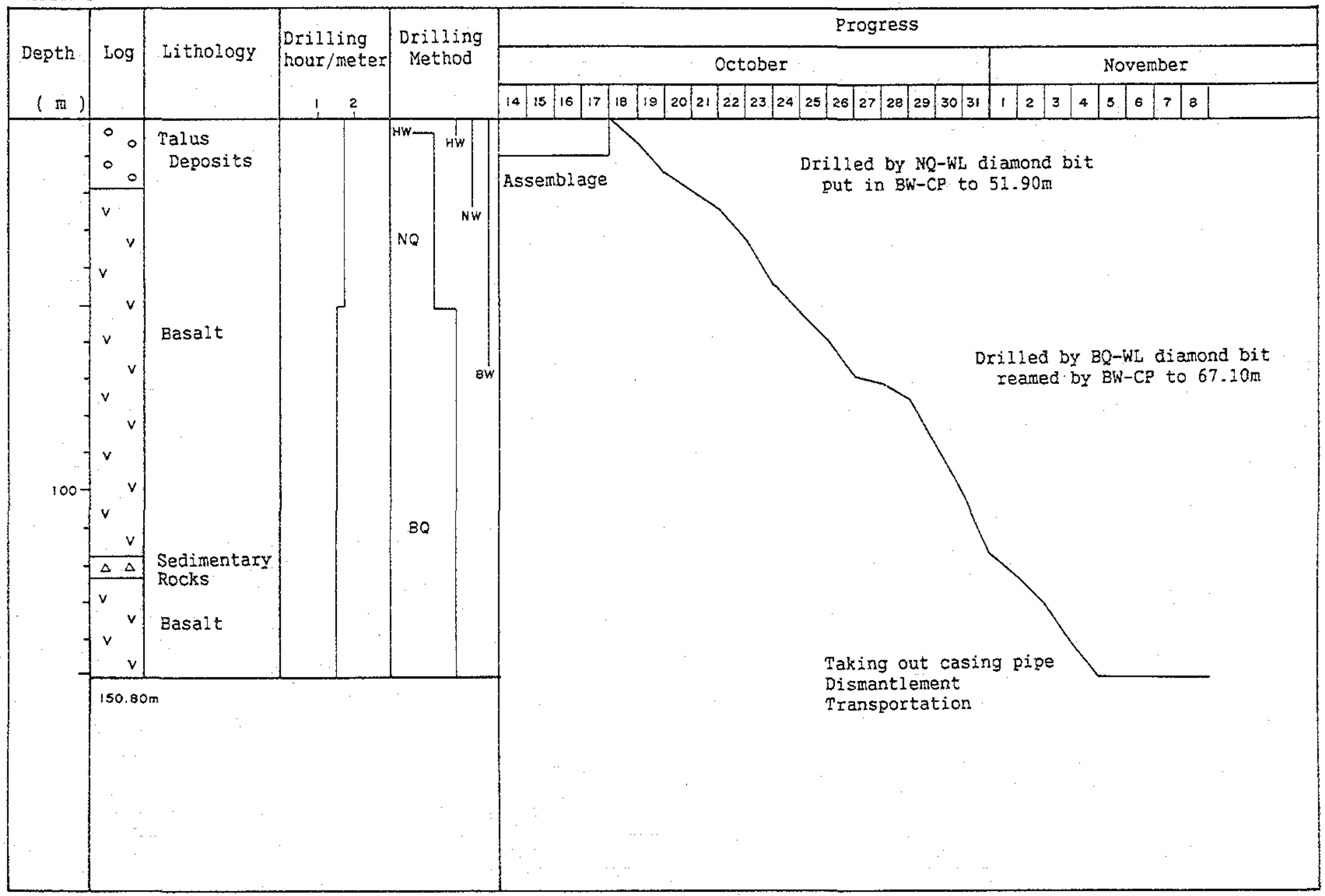


Fig. 2-8 Chart of Drilling Progress (MJTK-6)

MJTK-7

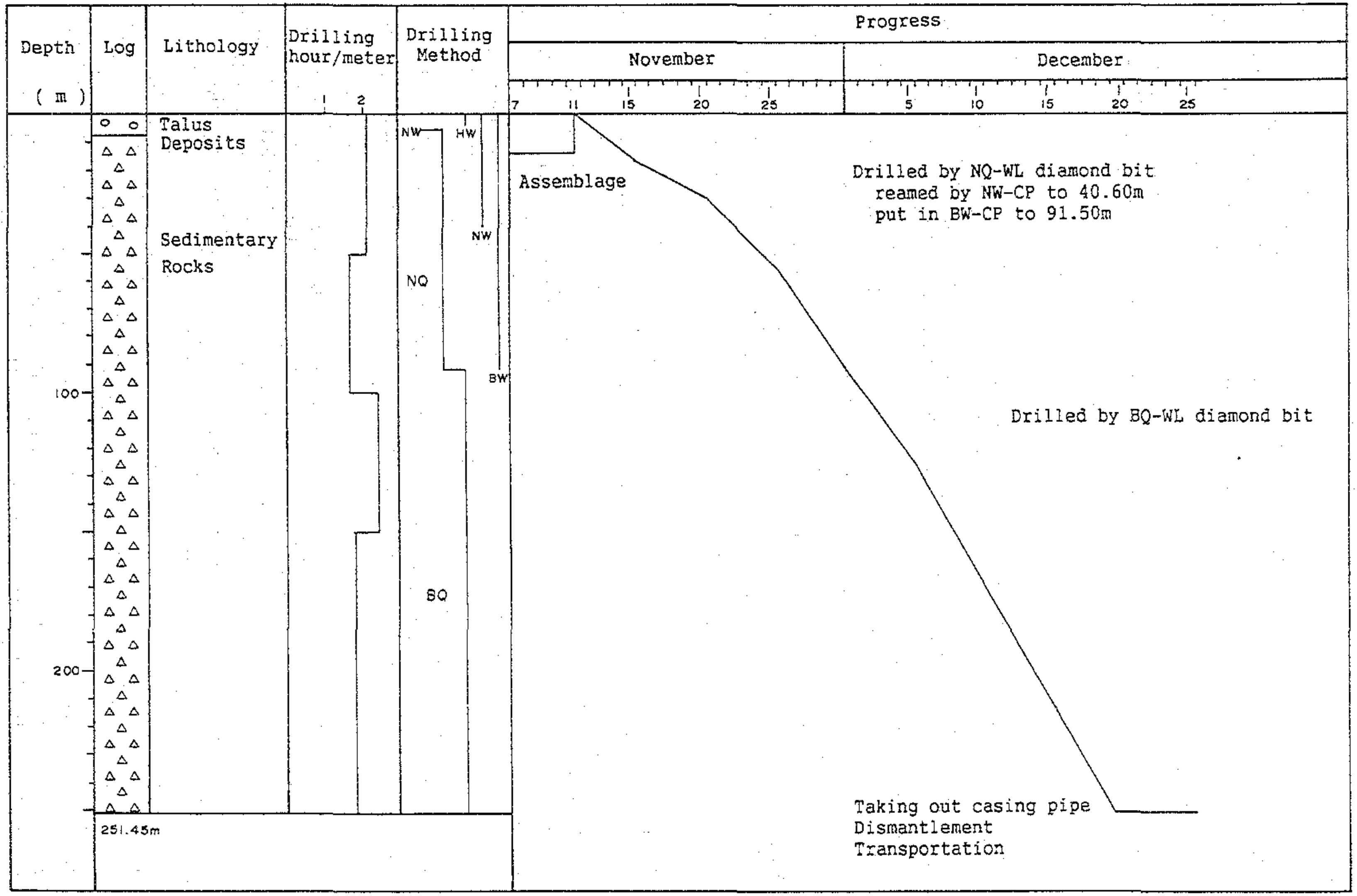


Fig. 2-9 Chart of Drilling Progress (MJTK-7)

Below 149.8 m to the bottom of hole, drilling was continued by the BQ wireline method using bentonite mud water.

Troubles in drilling pumps were happened many times due to high pressure of supply water caused by successive argillaceous rocks. The maintenance of pump was time-consuming as the pressure of water supply pump often exceeded 60 kg/cm^2 around 350 m in depth.

Density of mud water was attentively controlled to prevent the collapse of wall, because ground water flowed out below 150 m in depth, .

(2) MJTK-4

Drilling machine D-750 of Atlas Copco was employed in this hole.

For surface weathered rock, drilling was done by the conventional drilling method using NW diamond casing shoe. NW casing pipes were inserted to 4.5 m deep. From 4.5 m to 51.0 m, drilling was carried out by the wireline method with NQ diamond bits, using bentonite mud water.

After BW casing pipes were inserted to 51.0 m, drilling was operated by the BQ wire line method to the depth of 200.3 m.

Drilled length of this hole exceeded the original programme of 150 m in length to 200.30 m because a large number of pyrite lens was detected in black shale below 110 m in depth.

(3) MJTK-6

Drilling machine D-750 of Atlas Copco was employed in this hole.

For soil and talus deposits, drilling was done by the conventional drilling method using NW diamond casing shoe. After the hole was reamed by HW casing shoe, HW casing pipes were inserted to 3.6 m deep. From 3.6 m to 54.9 m, drilling was carried out by the wireline method with NQ diamond bits, using bentonite mud water.

HW and NW casing pipes were extended to 4.6 m and 24.4 m respectively because circulating water was lost completely down to 24 m.

After BW casing pipes were inserted to 54.9 m, drilling was operated by the BQ wire line method to the depth of 150.8 m.

BW casing pipes were extended to 67.1 m for preventing complete water loss between 54.9 m and 67 m in depth. Drilling was sometimes operated by using oil bentonite and sawdust in depths below 67 m where water was lost.

(4) MJTK-7

Drilling machine D-750 of Atlas Copco was employed in this hole.

For soil and talus deposits, drilling was done by the conventional drilling method using NW diamond casing shoe to 5.7 m. After the hole was reamed by HW casing shoe, HW casing pipes were inserted to 4.75 m deep and also NW casing pipes to 5.7 m. From 5.7 m to 91.5 m, drilling was carried out by the wireline method with NQ diamond bits, using bentonite mud water.

NW casing pipes were extended to 40.6 m because complete water loss continued from 24 m to 29 m in depth.

After BW casing pipes were inserted to 91.5 m, drilling was operated by the BQ wire line method to the depth of 251.45 m. After drilling finished, 10 BW casing pipes have not been recovered out of 30 pipes inserted.

3-4 Geology and Mineralization of Drill Holes

3-4-1 Geology

The geology of the area where drilling exploration was carried out this phase is composed of basalt and sedimentary rocks of the Küre Formation.

Basalt consists of pillow lava. Massive basalt and hyaloclastite are observed in drill holes. They are judged as constitutes of massive basalt because the former is interpreted as pillow lobe with tensional cracks, the latter is hyaloclastite between pillow lobes and they are correlated with surface outcrops of massive basalt. Basalt mostly has ophitic texture. Some parts of basalt show porphyritic or microspherulitic texture. Altered minerals are quartz, sericite, chlorite, calcite and pyrite.

Sedimentary rocks consist of breccia. Fragments of graywacke, siltstone, black shale, cherty shale and chert are observed. Pyrite fragments are rarely observed.

Breccia of graywacke is composed of massive and graded ones. The former is dominant between them. Fragments of graywacke are composed of quartz, feldspar, mafic minerals, opaque minerals, shale, chert and basic igneous rocks. Maximum size of fragments is 0.3 to 0.7 mm in diameter. Most of quartz grains show wavy extinction. Cracks of graywacke and chert are filled by muddy materials.

Siltstone is graded.

Fragments of cherty shale and chert are lens-shaped and have folded pinch and well structures.

The shape of breccia excluding cherty shale and chert is angular to sub-angular. The size of breccia ranges from several centimeters up to several meters.

Matrix of breccia is composed of pelitic rocks. Black shale surrounding breccia is sheared and argillized. It has a scaly cleavage. It is easily dissolved in water because it is clayey.

Under the microscope, schistose structure, micro-fault and micro-folding were observed in black shale which looked massive by naked eye. Black shale is composed of quartz, illite, chlorite and bituminous material.

3-4-2 Drill Hole Description

MJTK-1

The drill hole MJTK-1 is located at the Station 8.5 of the Line D of CSAMT survey. It targeted to the low resistivity