The ordering of the units in the study area from older to younger is as follows;

Devrekani Metamorphics: Meta sedimentary assemblage composed of gneiss, metaquartzite, schist and meta-carbonate. (Paleozoic/Pre-Cambrian)
Elekdağ Metamorphics: Composed of metaultrabasics, metagabbro, metadiabase, metaspilite, metaporphyrite, meta-sediments and metamorphosed sediments. (Pre-Liassic/Liassic)

Akgöl Formation: Sandstone-shale (Liassic).
Çangal Granitoides: With a calc-alkaline content (Dogger).
Bürnük Formation: Basal conglomerate (Malm).
İnaltı Formation: Limestone (Malm-Lower Cretaceous).
Çağlayan Formation: Composed of olistholithcal shale, sandstone, carbonates, shale-sandstone (Lower Cretaceous).
Gökçeağaç Formation: Composed of microtic limestone, siltstone, agglomerate, tuff, lava, sandstone, conglomerate, shale and reefal limestone (Upper Cretaceous-Lower Palaeocene).
Taşköprü-Boyabat Basin Sediments: Composed of limestone, marl, clay sandstone and conglomerate (Tertiary).

Devrekani Metamorphics metamorphosed in amphibolite facies and Elekdağ Meta-ophiolite metamorphosed in green schist facies have tectonic contact in the region. The thrusting is NE-SW directed. Furthermore, both of the two units are cut by Dogger granitoides of epizonal character.

Elekdağ Meta-ophiolite should belong to an old oceanic crust that vanished in Lower Mesozoic (Paleo-Tethys).(Yılmaz, 1984)

There is no volcanic activity in Late Jurassic-Early Cretaceous. Sedimentary units are widely distributed.

Within the Late Cretaceous-Palaeocene period, Kastamonu-Boyabat Basin started to open and together with the sediments, volcanic activities gave agglomerate, tuff and lava to the basin.

Generally, the region was sometimes under the effect of tensional regime and abundant and continuous compressional forces starting from Early Jurassic. Kastamonu-Boyabat Basin seems to be a rift basin.
Most of the tectonic dis-continuities have E-W and NE-SW directions.

Analysis of Pyritic Ore Samples

Sam.No.	Location	Cu %	Co %	Pb %	Ni %	Zn %	Exp.
1	Cozoğlu M.	0.76	0.04	0.007	0.002	0.2	Slag
2	Cozoglu M.	1.19	None	0.003	0.003	0.75	Slag
3	Yaybeydere M.	24.18	0.04	0.04	0.02	0.3	Slag
4	Yaybeydere M.	2.24	0.007	0.015	0.01	0.15	
5	Fındıklıdere M.	2.47	None	0.002	0.004	0.1	
6	Fındıklıdere M.	0.02	0.015	None	0.003	0.04	
7	Fındıklıdere M.	0.02	0.007	1.12	0.01	0.56	
8	Sey Yayla	0.015	0.01	0.007	None	0.04	
9	Çebiş M.	0.04	None	0.2	0.002	0.42	
10	Boyalı M.	0.15	None	0.002	0.002	0.3	
11	Beyköy-Asardere	0.26	0.01	None	None	0.03	
12	Cünür M.-Tahtalık pn.	0.03	None	None	None	None	
13	Karadere,Burçaklar dere	0.19	0.01	0.004	0.002	0.04	
14	North of Delı İmam M.	0.015	0.01	0.002	0.002	None	
15	Sincanlı dere	0.015	None	0.003	0.002	0.07	

Invisible elements' detection limit percentages;
DL. %:Co 0.004, Ni 0.002, Pb 0.002, Zn 0.03

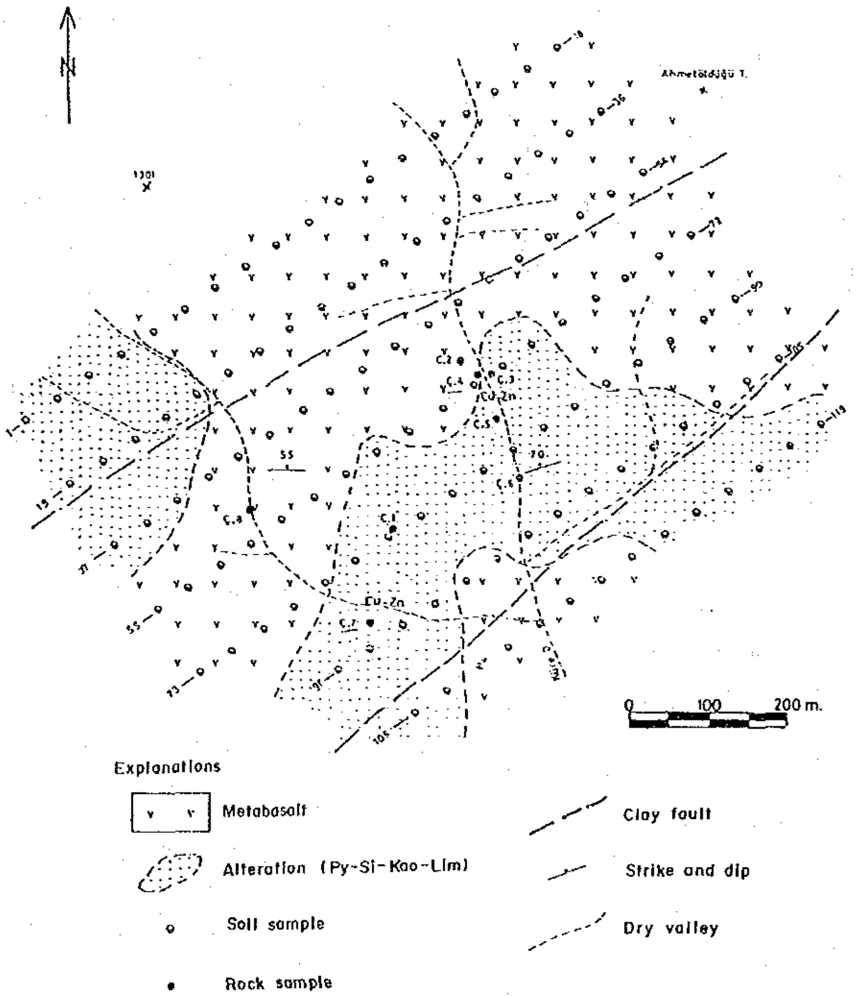


Figure 2-18 Geologic Map of the Cünür Mineral Occurrence

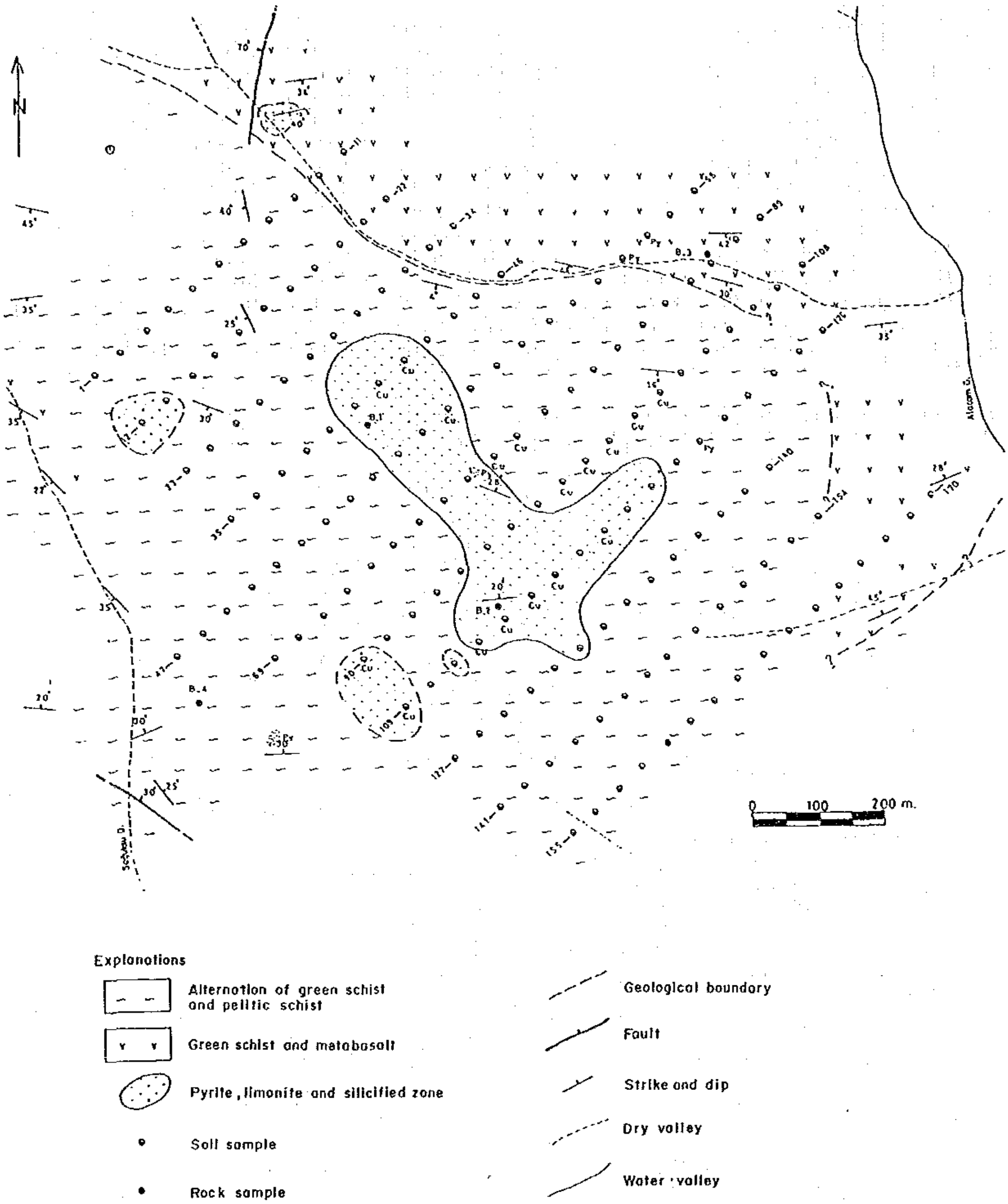


Figure 2-19 Geologic Map of the Boyalı Mineral Occurrence

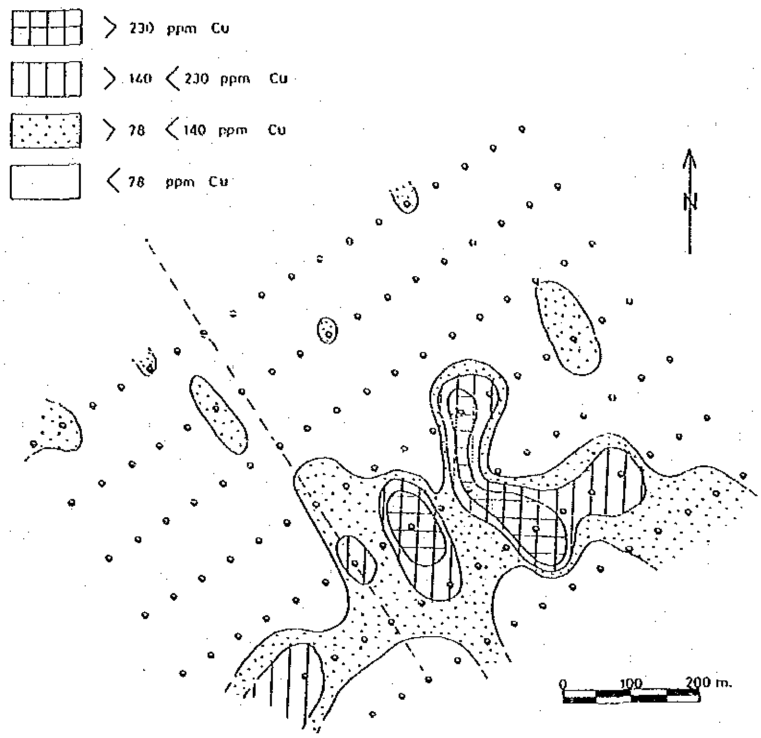


Figure 2-20 Geochemical Anomaly Map of Cünür

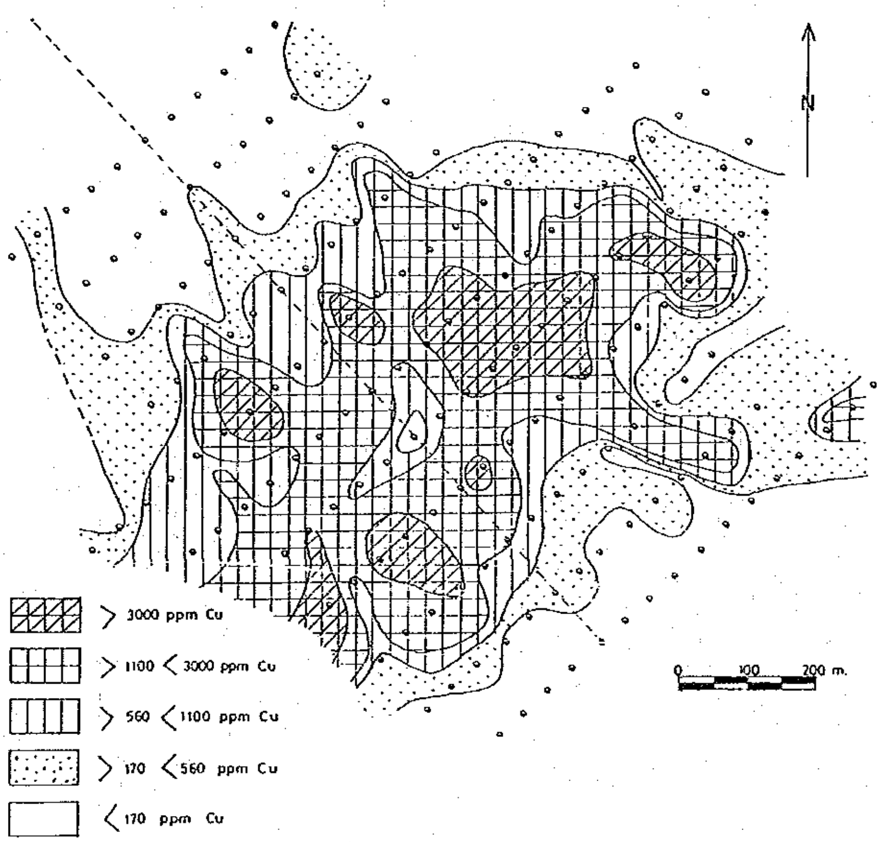


Figure 2-21 Geochemical Anomaly Map of Boyalı

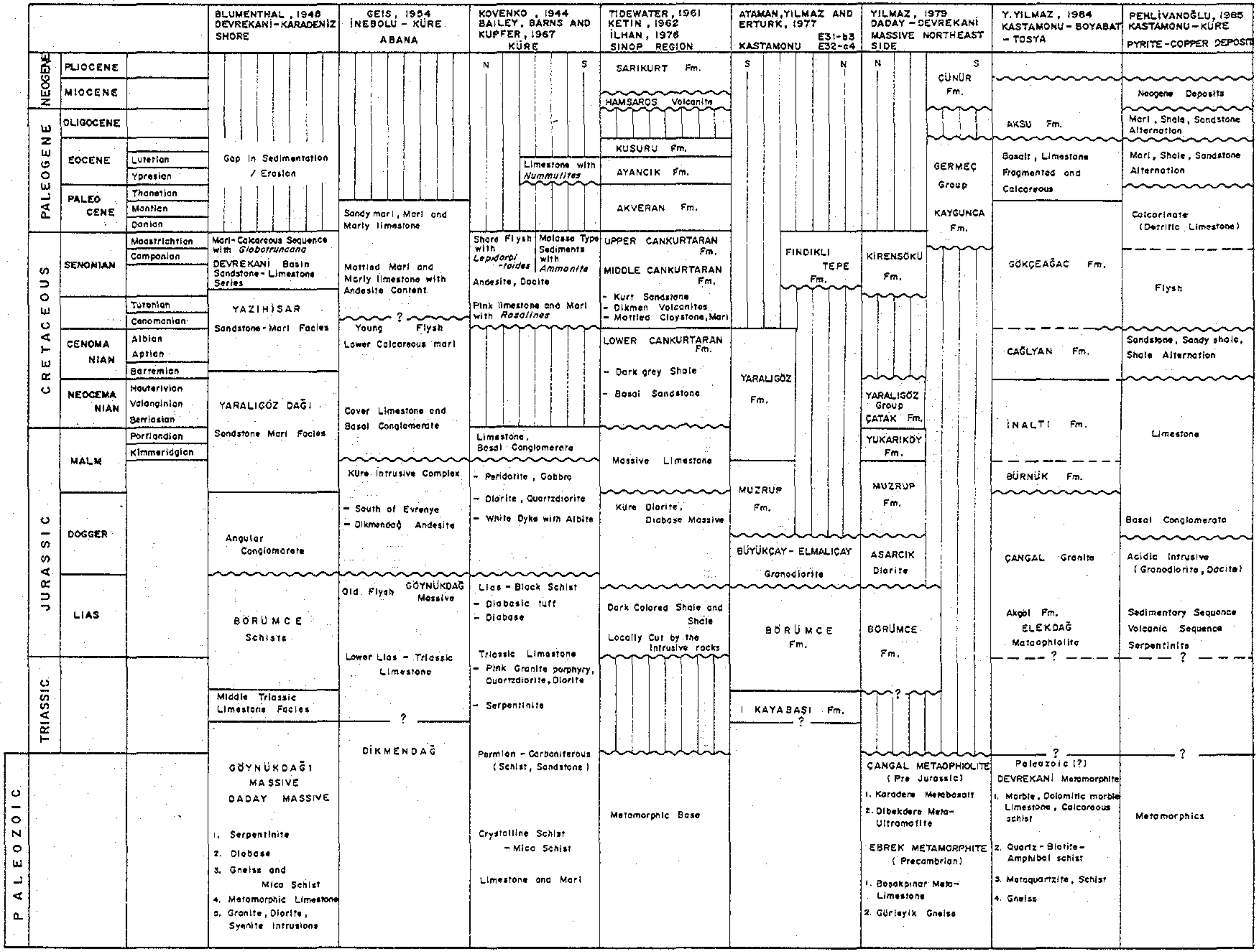


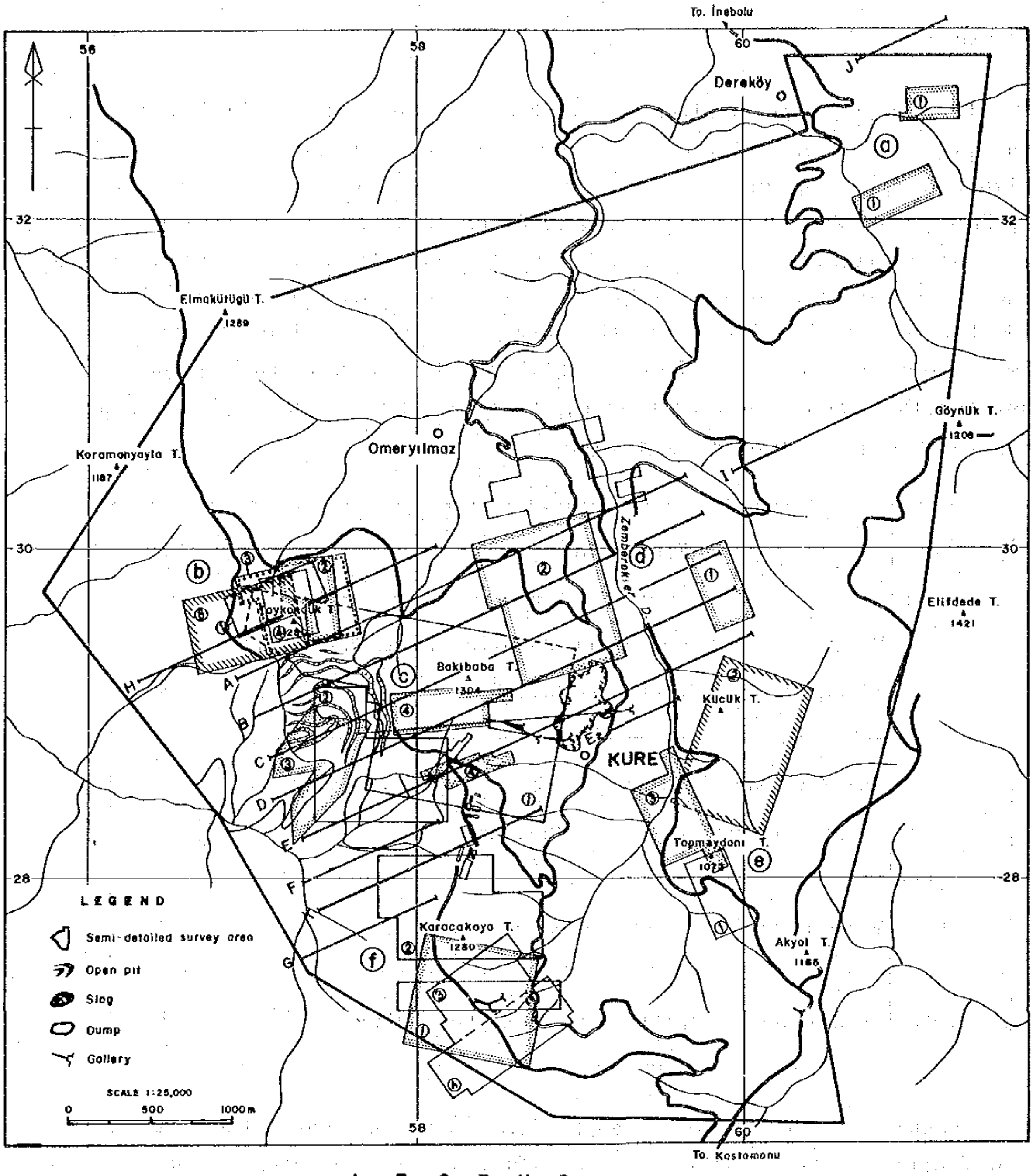
Figure 2-22 Correlation Map of Stratigraphy

2-3 Geophysical prospecting

Sixteen reports pertaining to geophysical work of the area were made available. Fifteen of them are regarding work in the Küre Mining Zone (Figure 2-23). One concerns IP work of the Sey Yayla Mineralized Zone in Taşköprü Zone. These were all prepared after 1964 and the methods used are; self potential (SP), electromagnetic (EM), resistivity by Wenner array and gradient array, and induced polarization (IP) methods. In all of the above reports, the equipment used for the survey is not described. But as most of the exploration was carried out by Etibank, the geophysical equipment was most probably those owned by the organization. The following list shows the geophysical equipment used by Etibank.

Method	Equipment	Qty
IP	Mcpher 67 Ip Transmitter Receiver Parts No.HP.Tx and STD Rx Freq.:0.3/2.5 Hz	3
EM	Scintrex SE-77 Multi Frequency EM Transmitter and Receiver Freq.:220/660 Hz	1
SP	Etibank SP Receiver (Home-made)	3
Mag.	GeoMetrics G816/826A Proton Magnetometer	1

The results of the previous geophysical work are compiled and summarized below. Many of the maps are lacking and some of the topographic maps are old and thus compilation was necessary during the course of this work. It should be noted that terrain correction has not been made for the apparent resistivity values, and also that the combination of the frequencies for FE values is 0.3/2.5Hz in these reports.



L E G E N D

Ⓐ Ersizler/İpsinler
① 1989, IP Method

Ⓑ Toykondu
① 1969, IP Method
② 1973, SP Method
③ 1978, IP Method
④ 1979, Gradient Resistivity Method
⑤ 1988, IP Method

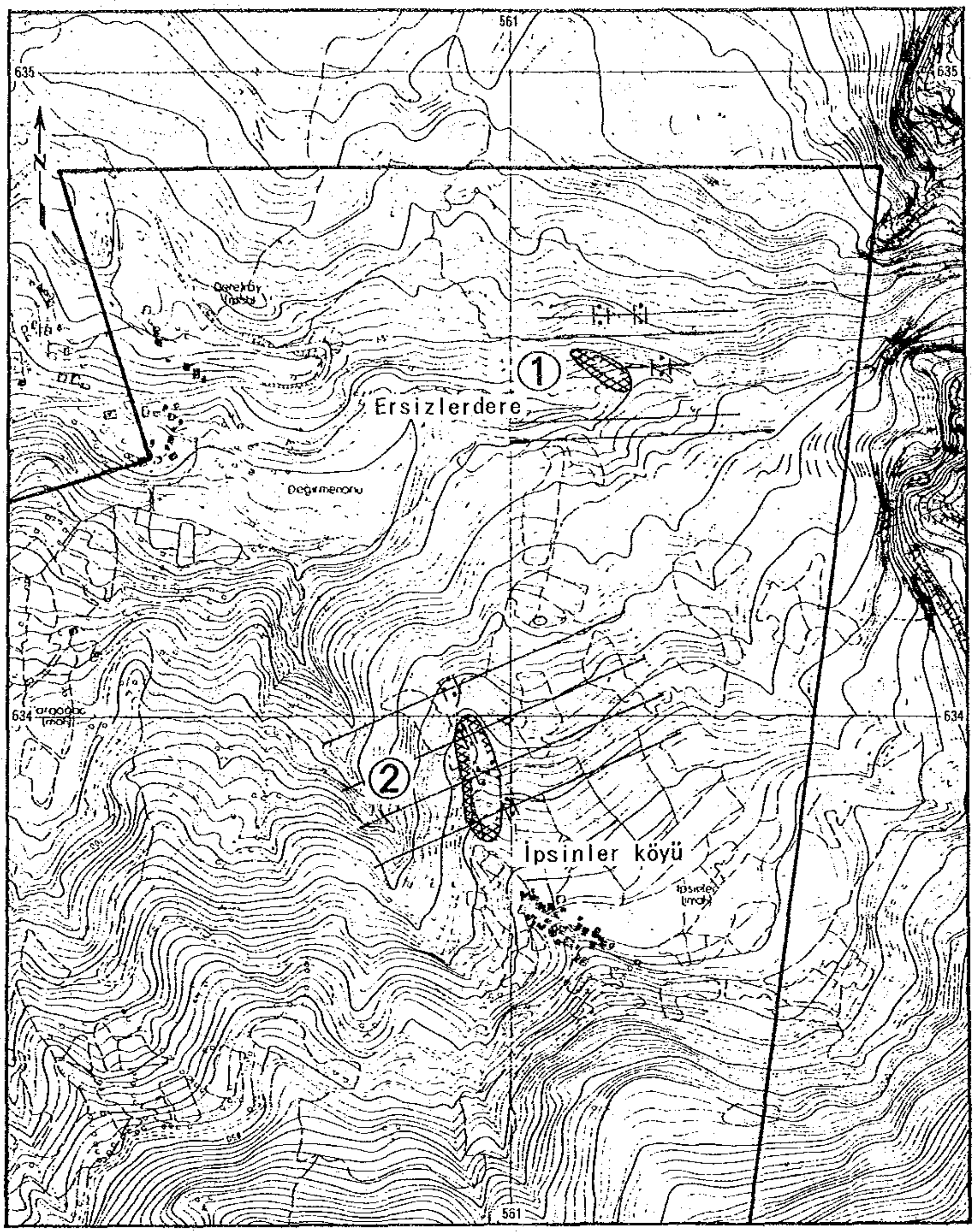
Ⓒ Aşıkoy~Bakibaba
① 1964, EM Method
② 1969, IP Method
③ 1973, IP Method
④ 1976, IP Method

Ⓓ North East of Bakibaba
① 1966, SP, IP Method
② 1981, IP Method

Ⓔ Zenberekler
① 1966, SP, IP Method
② 1985, IP Method
③ 1987, IP Method

Ⓕ Kızılsu
① 1964, SP, EM Method
② 1969, IP Method
③ 1988, IP Method
④ 1989, IP Method

Figure 2-23 Index Map of Previous Work related to Geophysical Prospecting



SCALE 1:10.000

0 100 200 300m

LEGEND

①	1989, IP Method (RN 1351) Ersizlerdere Area	[dotted box]	FE 3～5.5% IP weak anomaly
②	1989, IP Method (RN 1351) Ipsinler Koyu Area	[hatched ellipse]	Gossan and Mineral showing

Figure 2-24 Geophysical Compiled Map of Ersizlerdere and İpsinler

Ersizler and İpsinler Mineralized Zones

Small mineral showings have been known here and IP exploration was carried out for these showings. There is one report on this zone and Figure 2-24 shows the results.

(1) Name of Report: Küre bakırlı Pirit İşletmesi Müessesesi 1988 Yılı Jeofizik Etüd Raporu.

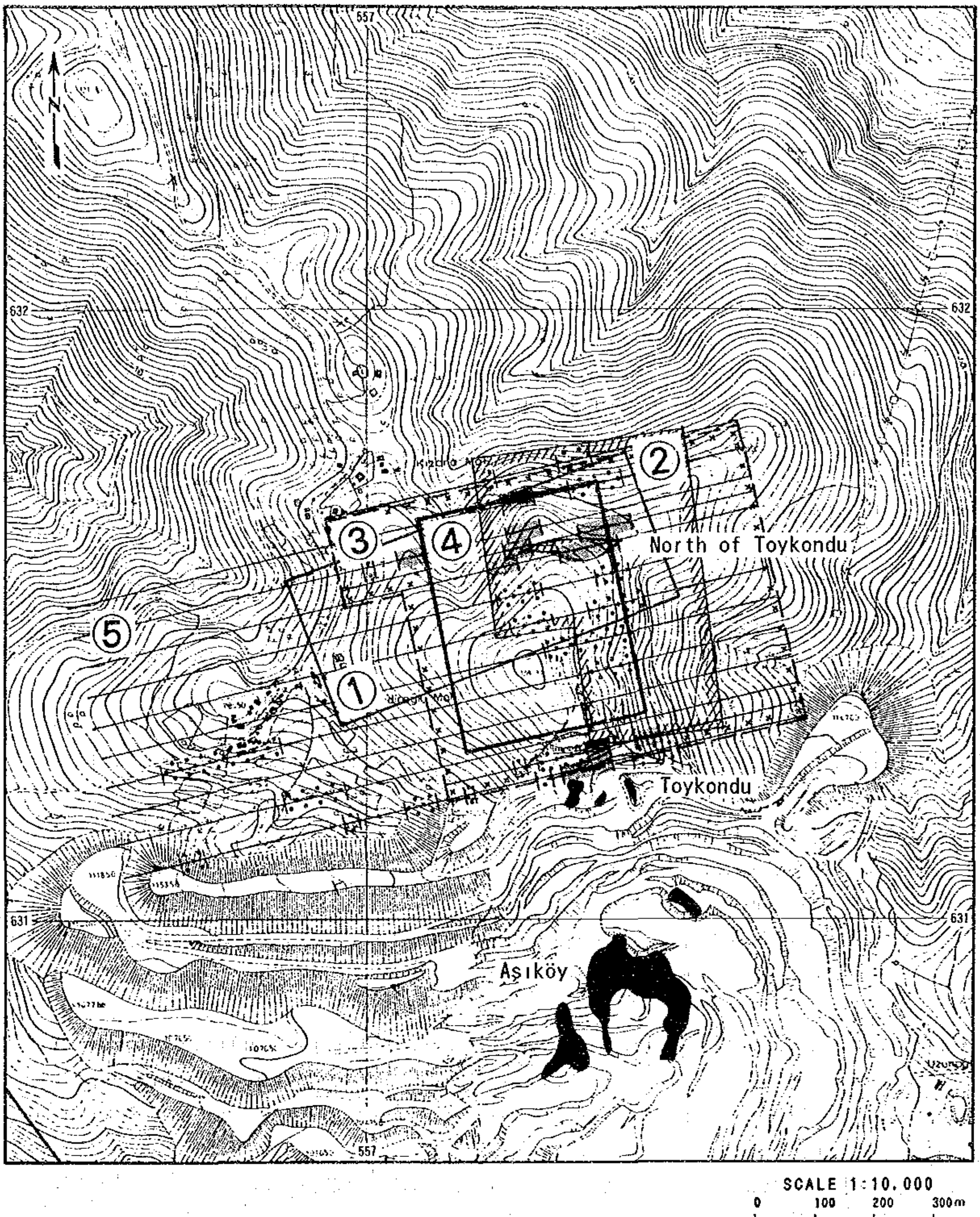
Implementation: 1988, Report: 1989
Operator: Akkuş,T. ve Diğerleri
Method: IP Method
Specifications:
Total line Length : 3.5 km, Survey area : 0.2 km^2
Line Spacing : 50m, 75m Electrode spacing : 10m, 25m
Electrode coefficient : n=1-5
Electrode Configuration : dipole-dipole

Results: The FE background values are about 0.5% for both zones and weak anomalies of 3-4% have been identified in two localities in Ersizler. In Ipsinler, continuous weak FE anomalies of 2-----6.5% occur corresponding to the surface mineral showing. But these are not considered as promising. (Etibank MAD R.N.1351)

Toykondu Orebody

Five reports regarding this zone have been published since 1969. SP, EM, resistivity, and IP have been applied. The traverse line maps and analysis maps have been lost from all the reports. And therefore, the results of IP carried out in 1977 and 1988 are compiled and shown in Figure 2-25.

(2) Name of Report : 1977 Yılı Küre Toykondu Mevkii Jeofizik Etüd Raporu.
Implementation: 1977, Report: 1978
Operator: Borağan,H. ve Diğerleri
Method: IP Methods
Specifications:
Total line Length : 8.25km, Survey area : 0.32 km^2
Line Spacing : 50m, Electrode spacing : 50m
Electrode coefficient : n=1-5
Electrode Configuration : dipole-dipole



LEGEND

① 1969, IP Method (RN 596)
② 1973, SP Method (RN 597)
③ 1978, IP Method (RN 608)
④ 1979, Gradient Resistivity Method (RN 1013)
⑤ 1988, IP Method (RN 1275)

FE 5.5~11.5% IP anomaly
FE 3~5% IP weak anomaly
Massivi Ore
Gossan and Mineral showing

Figure 2-25 Geophysical Compiled Map of Toykondu Ore Zones

Results:There are mineral showings on the northern slope of the Mt. Toykondu and the Toykondu Orebody occurs on the southern slope which is located to the north of Aşıköy Orebody.

Anomalies were detected over a wide area extending in the N-S direction. FE anomaly of 5-22.5% and that corresponding to the Toykondu Orebody of 5.5% were confirmed. Several holes were drilled for the northern anomaly and pyrite dissemination was confirmed. Also this anomaly is continuous to the east of the Toykondu Orebody and massive sulfide ores have been confirmed in several boreholes at this site (Etibank MAD R.N. 608 and 1275).

Aside from the above, there are reports on IP (Etibank MAD RN.596), resistivity and SP (Etibank MAD RN.597) 1973, and IP (Etibank MAD RN.1013) 1979.

Aşıköy and Bakibaba Deposits

Six geophysical surveys have been conducted in an area including the Aşıköy and Bakibaba Deposits since 1964. These include; SP, EM, Wenner array resistivity, and IP methods. Of the reports obtained, the results of the SP/EM of 1964 and of IP of 1976 are compiled and shown in Figure 2-26.

(3-1) Name of Report : Küre Self Potansiyel ve Elektromagnetik Etüd

Implementation: 1964, Report: 1964

Operator: Haydaroğlu,H

Method: SP and EM Methods

Specifications:

Total line Length :18.8 km, Survey area :SP 3.5 km^2, EM 1.58 km^2

Line Spacing : 25m, 50m Electrode spacing :10m, 25m, 50m

Results: Relatively clear EM anomalies were detected directly over the old Bakibaba Orebody, 150m to the north and 200m to the southwest. SP anomalies of -220mV - -380mV are detected directly over the old Bakibaba and the vicinity. And at the slag dump 600m east of Mt. Bakibaba, -600mV - -1000mV clover-shaped anomalies are confirmed. Five holes were drilled at locations with overlap of SP and EM anomalies, but mineable ores were not found (Etibank MAD RN. 614).

(3-2) Name of report :Küre Bakırlı Pirit Müessesesi Aşıköy-Bakibaba Sahaları Jeofizik Etüd Raporu.

Implementation: 1976, Report: 1976

Operator: Bolgun,M., Akkuş,T.

Method: IP Method

Specifications:

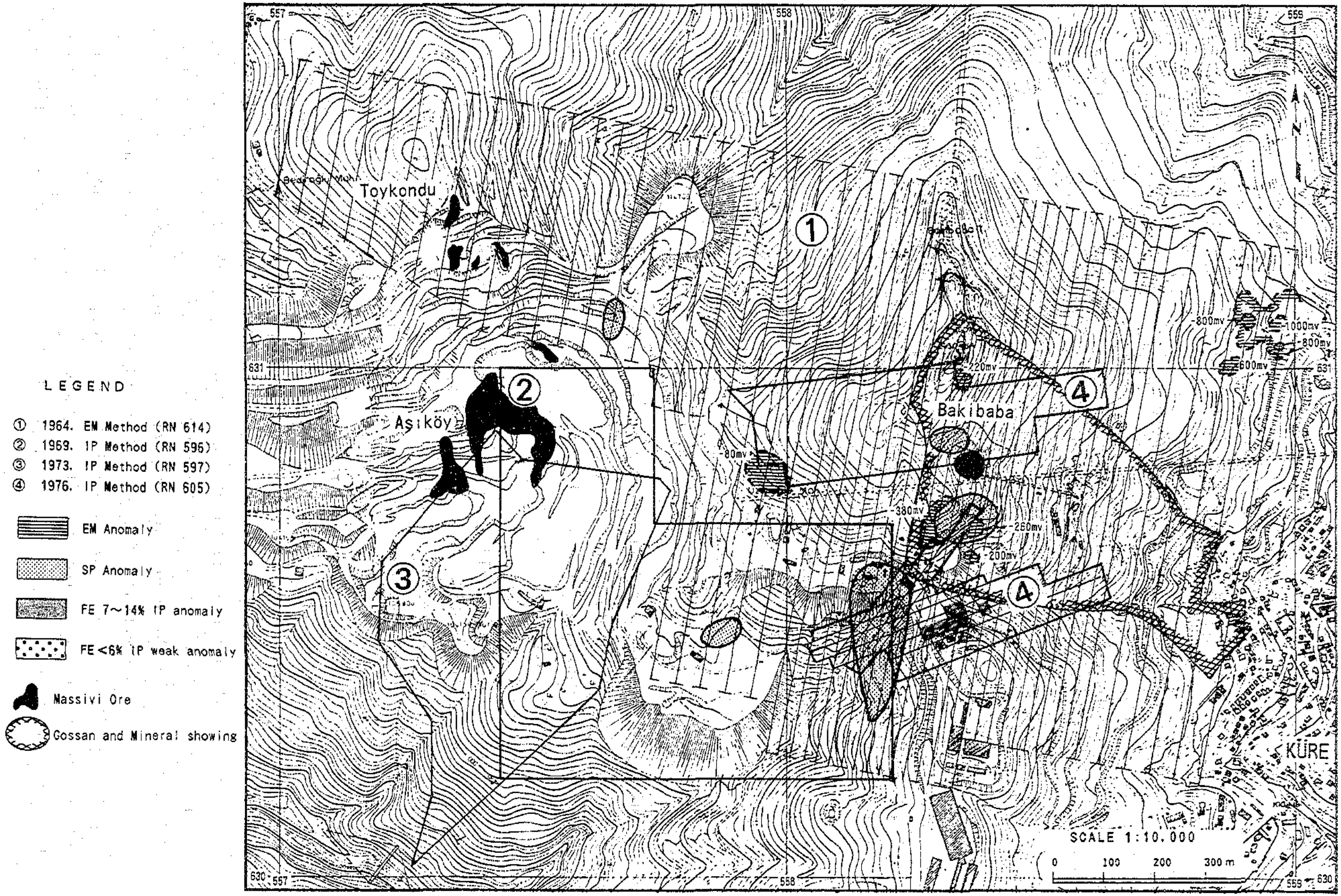


Figure 2-26 Geophysical Compiled Map of Aşıköy-Bakibaba Ore Zones

Total line Length : 11.5 km, Survey area : 0.48 km^2
Line Spacing : 25m, 50m Electrode spacing : 10m, 20m, 40m, 50m
Electrode coefficient : n=1-5
Electrode Configuration : dipole-dipole

Results: This report concerns the IP prospecting carried out in the vicinity of the Bakibaba Orebody and in the zone north of the Ore dressing plant. With the FE background of about 1.5%, there is a weak anomaly of 3 - 5% and of 5 - 7.8% to the northwest of the ore dressing plant (Etibank MAD RN.605).

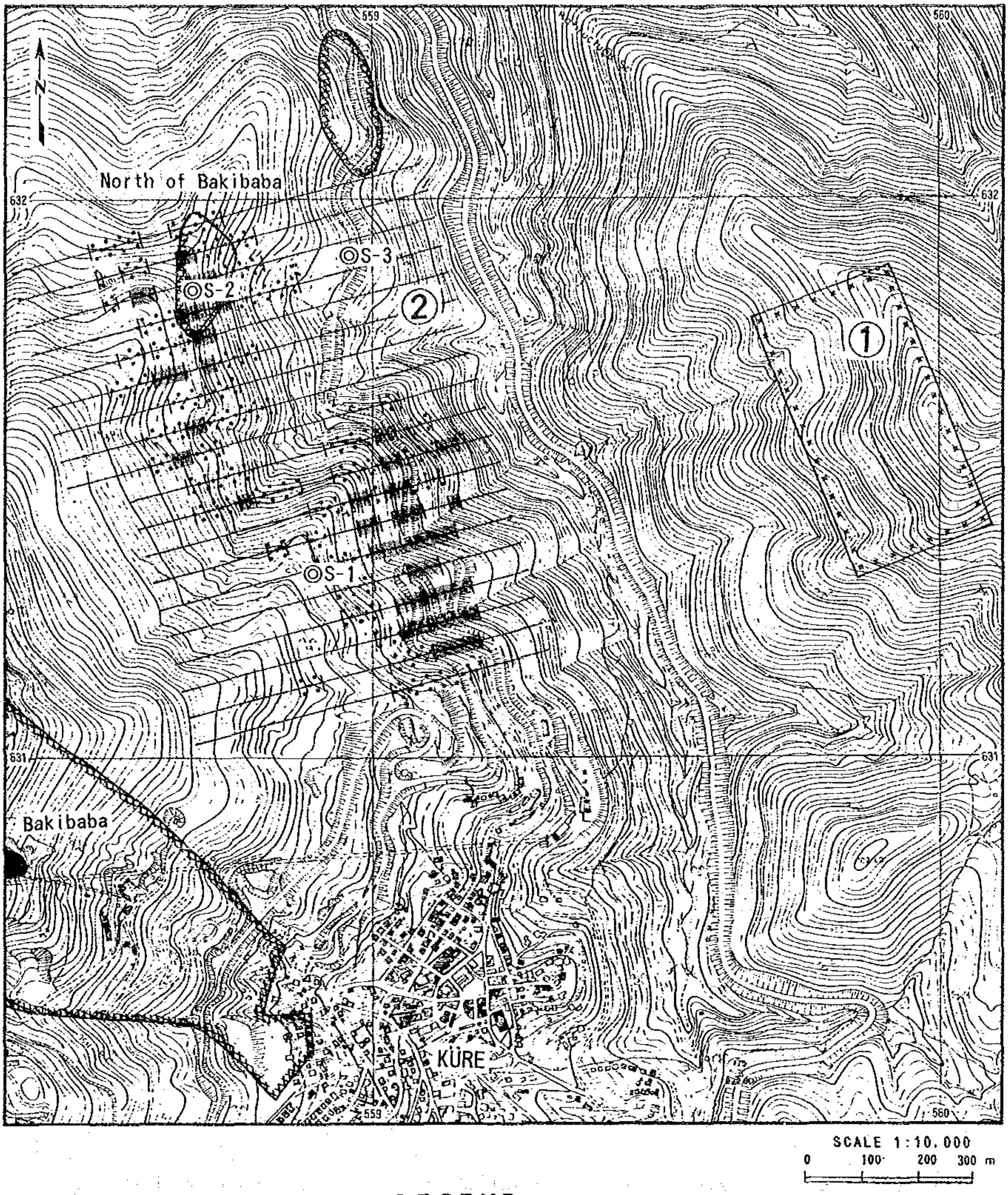
Other reports concerning this orebody are; IP (Etibank MAD RN.596) 1969, IP (Etibank MAD RN.600) 1969, IP (Etibank MAD RN.597) 1973, and Wenner array resistivity in 1974.

Northeast of Bakibaba Deposit

This is a mineral prospect 1km north of MT. Bakibaba and three geophysical work have been carried out in this zone. A compiled map is laid out in Figure 2-27.

(4) Name of Report:Küre-İnebolu yolu üstü 1979-1980 Jeofizik Etüd Raporu.
Implementation: 1979-1980, Report: 1981
Operator: Akkuş,T., ve Diğerleri.
Method: IP Method
Specifications:
Total line Length : 13.3 km, Survey area : 0.63 km^2
Line Spacing : 50 m, Electrode spacing : 50 m
Electrode coefficient : n=1-5
Electrode Configuration : dipole-dipole

Results:In this zone, a road runs approximately in the N-S direction. Basaltic rocks occur widely to the east of this road and shale and sandstone is distributed to the west. The FE background of this zone is 1 - 1.5%. FE anomalies were extracted; 3.5 - 5% as weak anomalies and over 5.5% as anomalies. There is an anomalous zone extending in the NNW-SSE direction in the southeastern part of this area and another zone extending in the same direction in the northwestern part of the zone. These two anomalous zones occur in en echelon fashion. The latter zone corresponds to the mineral showings. Three holes, S-1 - S-3 were drilled here, but the reasons for selecting the sites are not clear with the exception of S-2. Also the drilling was stopped after confirming weak pyrite dissemination (Etibank



LEGEND

① 1966, SP, IP Method (RN 610)
② 1981, IP Method (RN 481)

FE 5.5~9.5% IP anomaly
FE 3～5% IP weak anomaly
Drilling Site
Massivi Ore
Gossan and Mineral showing

Figure 2-27 Geophysical Compiled Map of Northeast of Bakibaba

MAD RN.481).

In this area, IP (Etibank MAD RN.610) 1966 and IP (Etibank MAD RN.1079) 1985 were also carried out.

Zemberekler Stream Mineralized Zone

This prospect is located adjacent to the Küre Town on the eastern side. Route 39 to İnebolu traverses through the zone. There are three reports concerning geophysical work of this zone including SP in 1966 and 1985, and IP in 1987. The results are compiled and shown in Figure 2-28.

(5) Name of Report : Küre Bakılı Pirit İşletmesi Müessesesi Jeofizik Etüde Raporu.

Implementation: 1985, Report: 1985

Operator : *Dur,İ., ve Diğerleri*

Method: IP Method

Specifications:

Total line Length : 12 km, Survey area : 0.75 km^2

Line Spacing : 50 m, Electrode spacing : 50 m

Electrode coefficient : n=1-5

Electrode Configuration : dipole-dipole

Results: Basaltic rocks widely occur in the western side, black shale extends in the N-S direction in the central part and mainly sandstone in the east. The resistivity and FE values of the zones of these rocks are as follows.

Rock	Resistivity(ohm-m)	F E (%)
Basalt	40 - 120	1 - 2.5
Black shale	5 - 15	-0.5 - 0.5
Sandstone	10 - 20	-0.5 - 2.0

FE anomalies were extracted, 3 - 5% as weak and 6 - 23% as anomalies. A strong FE anomalous zone is detected in the southwestern part of the prospect, while in the northwest weak anomalies occur sporadically. The former anomalies were traced and the zone was confirmed by the survey in 1987. Three holes KT-1 - KT-3 were drilled *in this zone. Pyrite was confirmed at* 237-242m depth of KT-2 and weak pyrite dissemination was found in KT-1 and -3. The sites of these holes, however, are different from the FE anomalies which have not yet been confirmed (Etibank MAD RN. 1079).

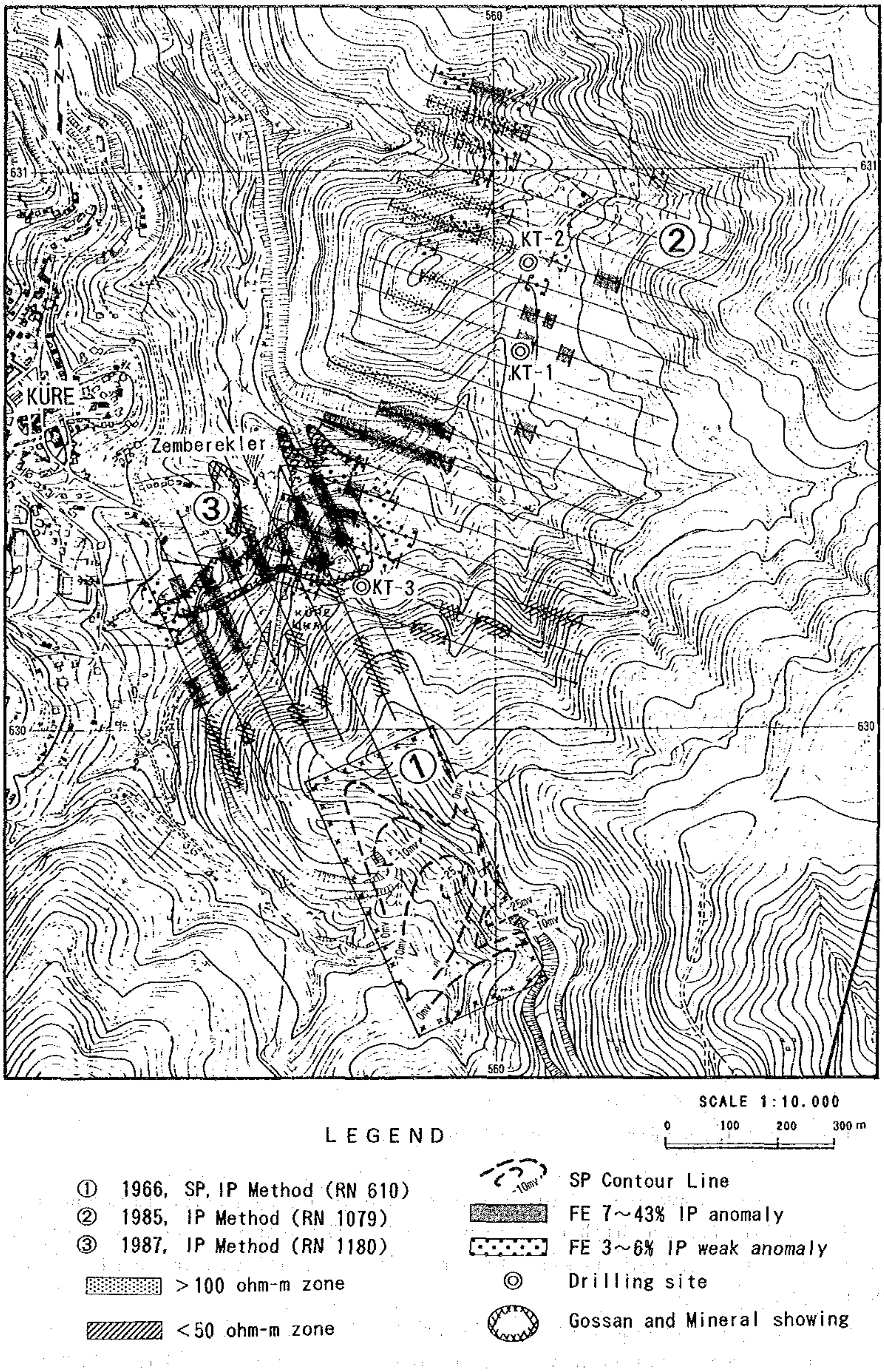


Figure 2-28 Geophysical Compiled Map of Zemberekler

Kızılsu Orebody

This is the most notable mineral showing and thus various types of geophysical prospecting have been carried out since 1964 including SP, EM, and IP methods. The results of IP carried out in 1987 and of IP, SP, and EM methods of 1988 are compiled and shown in Figure 2-29.

(6-1) Name of Report:Küre Bakırlı Pirit İşletmesi Kızılsu Sahası Jeofizik Etüd Raporu.

Implementation: 1964, Report: 1964

Operator:

Method: SP and EM Methods

Specifications:

Total line Length : 15.45 km, Survey area : 0.56 km^2

Line Spacing : 25m, 50m Electrode spacing : 50m, 100m

Frequency : 220/660 Hz

Results: EM anomalies have been detected over an area covering 200m diameter and an SP anomaly has been detected overlapping parts of the above. At the maximum SP anomalous zone, negative -240mV anomalies occur at two locations and positive anomaly of 100mV is paired and forms a typical SP anomaly. This indicates the shallow depth of the ore deposit (Etibank MAD RN.613).

(6-2) Name of Report : Küre Bakirlı Pirit İşletmesi Müessesesi 1987 Yılı Jeofizik Etüd Raporu.

Implementation: 1987, Report: 1988

Operator: Dur,İ., ve Diğerleri

Method: IP Method

Specifications:

Total line Length : 7.15 km, Survey area : 1.2 km^2

Line Spacing : 50 m, Electrode spacing : 50 m

Electrode coefficient : n=1-5

Electrode Configuration : dipole-dipole

Results: The eastern half of the zone is covered by pillow lava and the resistivity values are high at 100-200ohm-m. The central part is covered by black shale, the west by sandstone and these constitute low resistivity zone of 50ohm-m.

FE anomalies occur connected in the NW-SE direction in the central part of the zone. The anomalies are in the order of 5~13.5% (Etibank MAD RN. 1275).

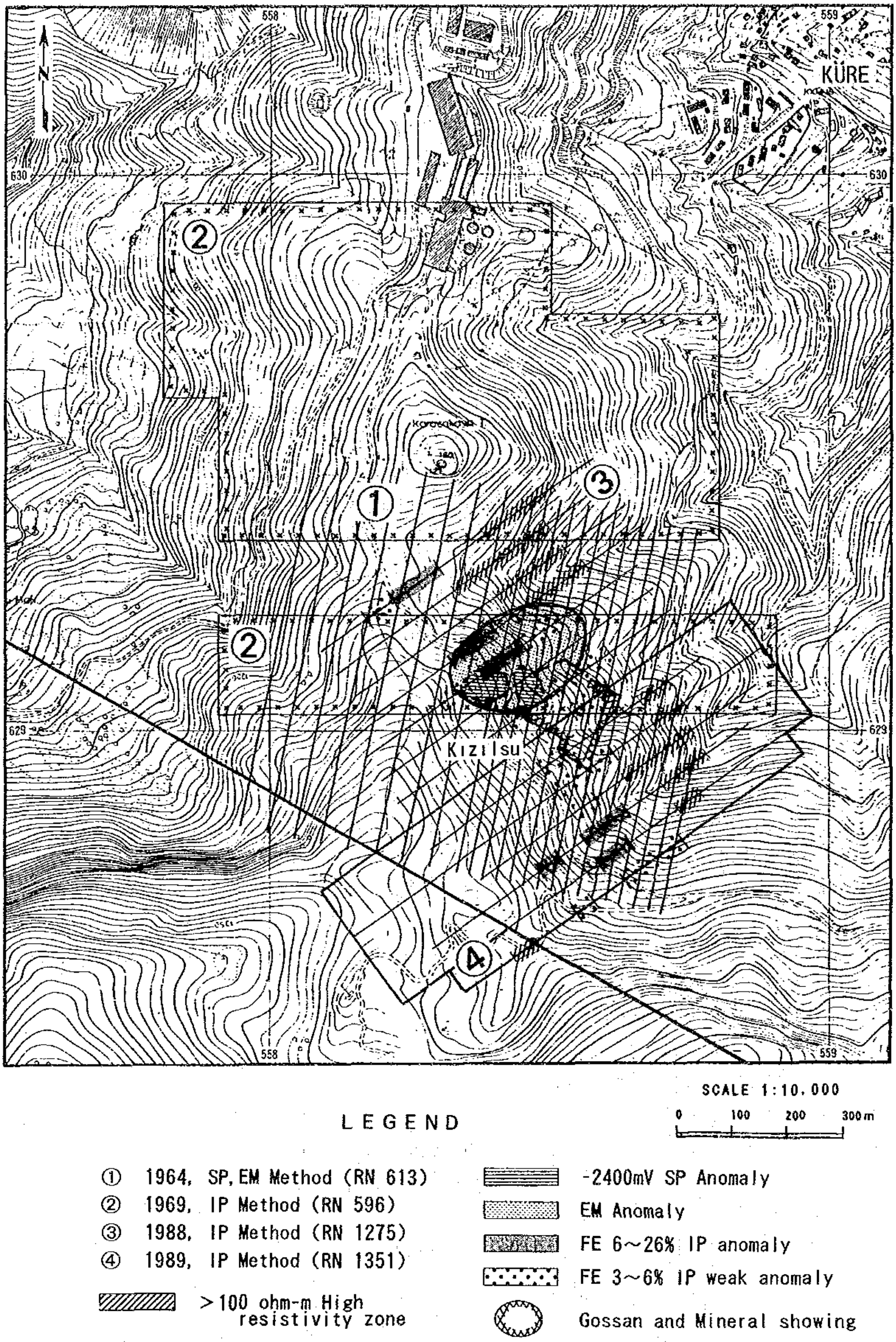


Figure 2-29 Geophysical Compiled Map of Kızılsu Ore Zones

(6-3) Name of Report : Küre Bakırlı Pirit İşletmesi Müessesesi 1988 Yılı Jeofizik Etüd Raporu.

Implementation: 1988, Report: 1989

Operator: Akkuş, T., ve Diğerleri

Method: IP Method

Specifications:

Total line Length : 5.75km, Survey area : 0.27km^2

Line Spacing : 50m Electrode spacing : 50m ,100m

Electrode coefficient : n=1-5

Electrode Configuration : dipole-dipole

Results:This is the report of the IP prospecting carried out in the southern half of the survey area of the previous year. The electrode spacing was widened to obtain data from the deeper zones. However, the input potential was low and data could not be acquired because of the noise in some stations. FE anomalies of 6-26% are detected in the central part.

More than 50 holes were drilled here and massive sulfide and pyrite dissemination zones were confirmed. FE anomalies also have been clarified (Etibank MAD RN.1351).

Sey Yayla Mineralized zone of Taşköprü Zone

The mineralized zone is located to the south of Musabozarmut which is 25km north of Taşköprü. Recently SP and IP work was carried out here as a part of an integrated exploration of the Zone. The results of the geophysical work is compiled and shown in Figure 2-30.

(7)Name of Report : Kastamonu-Taşköprü-Musabozarmut Sahası Jeoloji ve Jeofizik Etüdleri Raporu.

Implementation: 1991, Report: 1991

Operator: Akkuş,T., Ersöz,O.

Method: EM and IP Methods

Specifications:

Total line Length : 6.9 km, Survey area : 0.35 km^2

Line Spacing : 50m, Electrode spacing : 50m

Electrode coefficient : n=1-5

Electrode Configuration : dipole-dipole

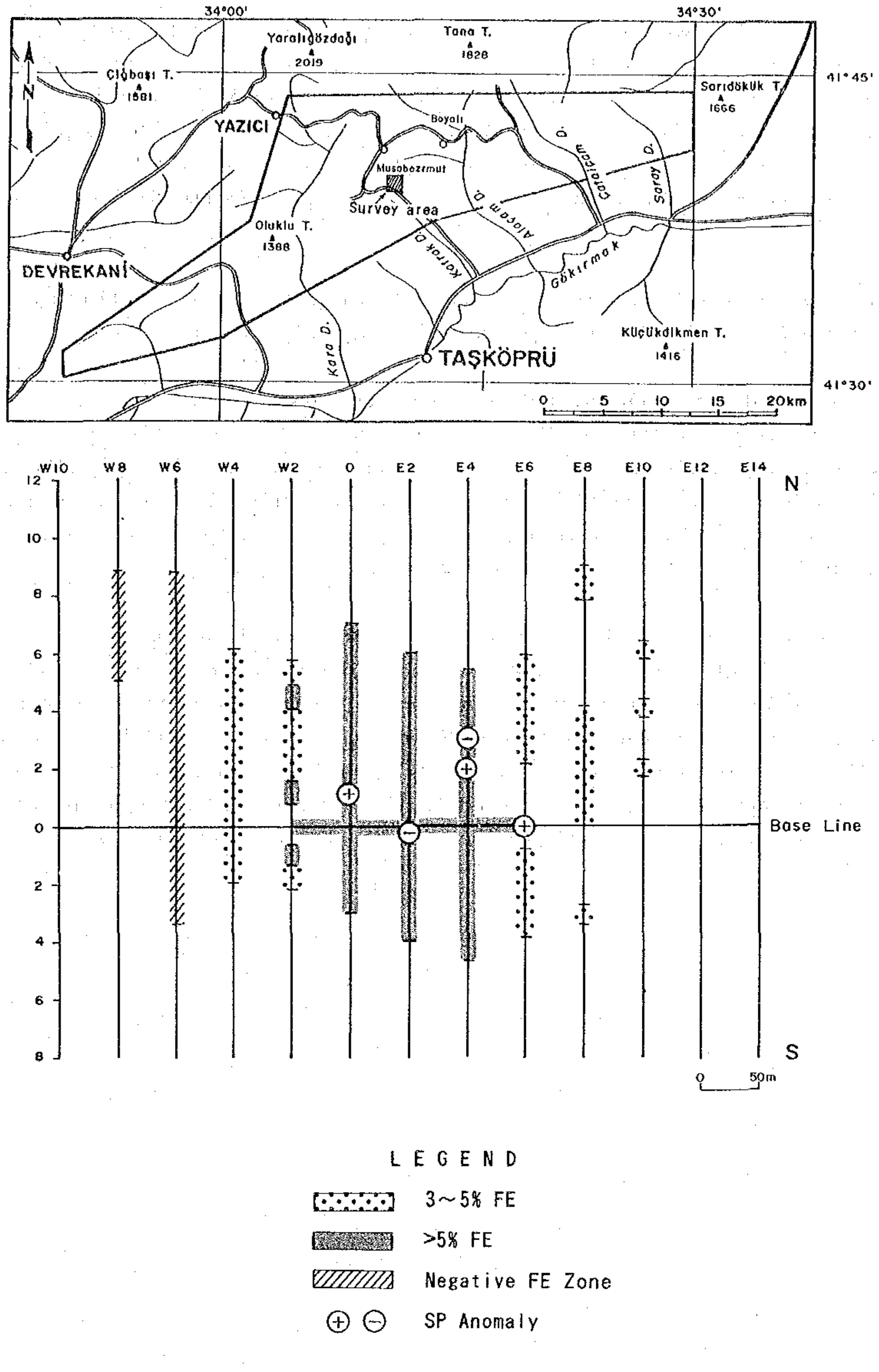


Figure 2-30 Geophysical Compiled Map of Sey Yayla

Results:The FE background of this are was 1-2% and anomalies exceeding 5% have been detected in W2-E4 profiles. In two profiles to the west of the above W2-E4 and in three profiles to the east, there are weak anomalies of 3-5%. SP anomalies occur in almost identical localities as the FE anomalies, and N1, N2, and 0 of profiles 0, E4, and E6 respectively contained positive anomalies. And negative ones at 0 and N3 of E2N and E4 respectively.

The above geophysical data were acquired in the past, the following is recommended regarding the interpretation of the information.

1) IP method was often applied, the equipment used, however, was somewhat obsolete and the measurement of the weak signals was difficult. Thus electrode configuration factor had to be kept relatively low, and the SN ratio could not be improved by stacking and the exploration of the deeper parts was not possible. It is necessary to use high output transmitter and high sensitivity receiver with stacking capability.

2) The apparent resistivity obtained from the results of IP, is affected to a significant degree by topography when dipole-dipole array is used in steep terrain such as the Küre Mining Zone. Terrain correction is necessary. The correction had not been made in the presently available reports and the apparent resistivity data cannot be used effectively. The terrain correction program can be inserted to the data processing system, then these data can be reprocessed and the area can be re-evaluated geophysically.

CHAPTER 3 COMPILE OF THE KÜRE MINE

(1) Küre'deki Eski Bakır Yatağı İle Yeni Keşfedilen Aşıköy Yatağının ve Karadeniz Orta ve Doğu Kesimleri Sahil Bölgesinin Metallojenisi (1944)
(The Metallogenie of the Old Copper Deposit, New Discovered Aşıköy Deposit in Küre and Shore Lines of Middle and East Black Sea)
V.Kovenko (MTA)

He deal with the metallogenie of the copper deposits in Küre. One of these deposits has already been consumed. The second deposit (Aşıköy mine) was discovered by the author in 1938.

While the regional geological map of the Küre region was being made, he have recognized a red colored outcrop within the Liassic schists. He walked toward the west and found a limonite outcrop. After he passed through another passage without limonite, he found large blocks representing the gossan.

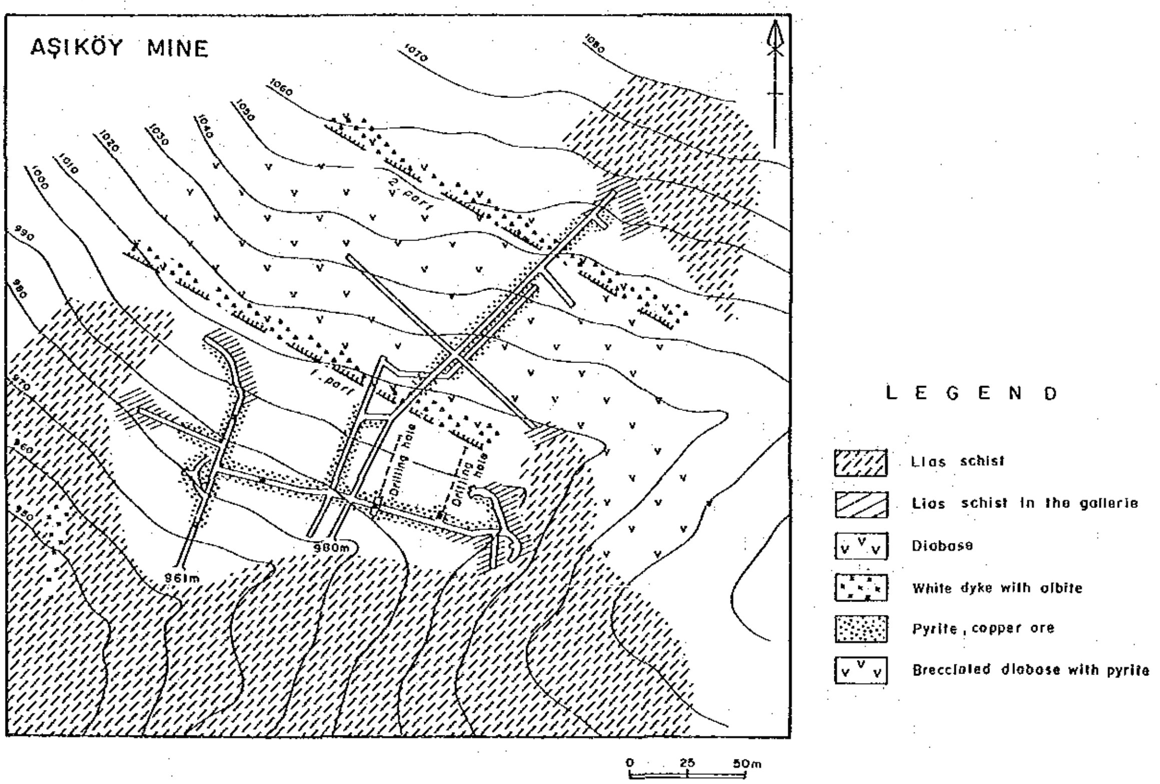


Figure 2-31 Exploration Map of the Aşıköy Orebody

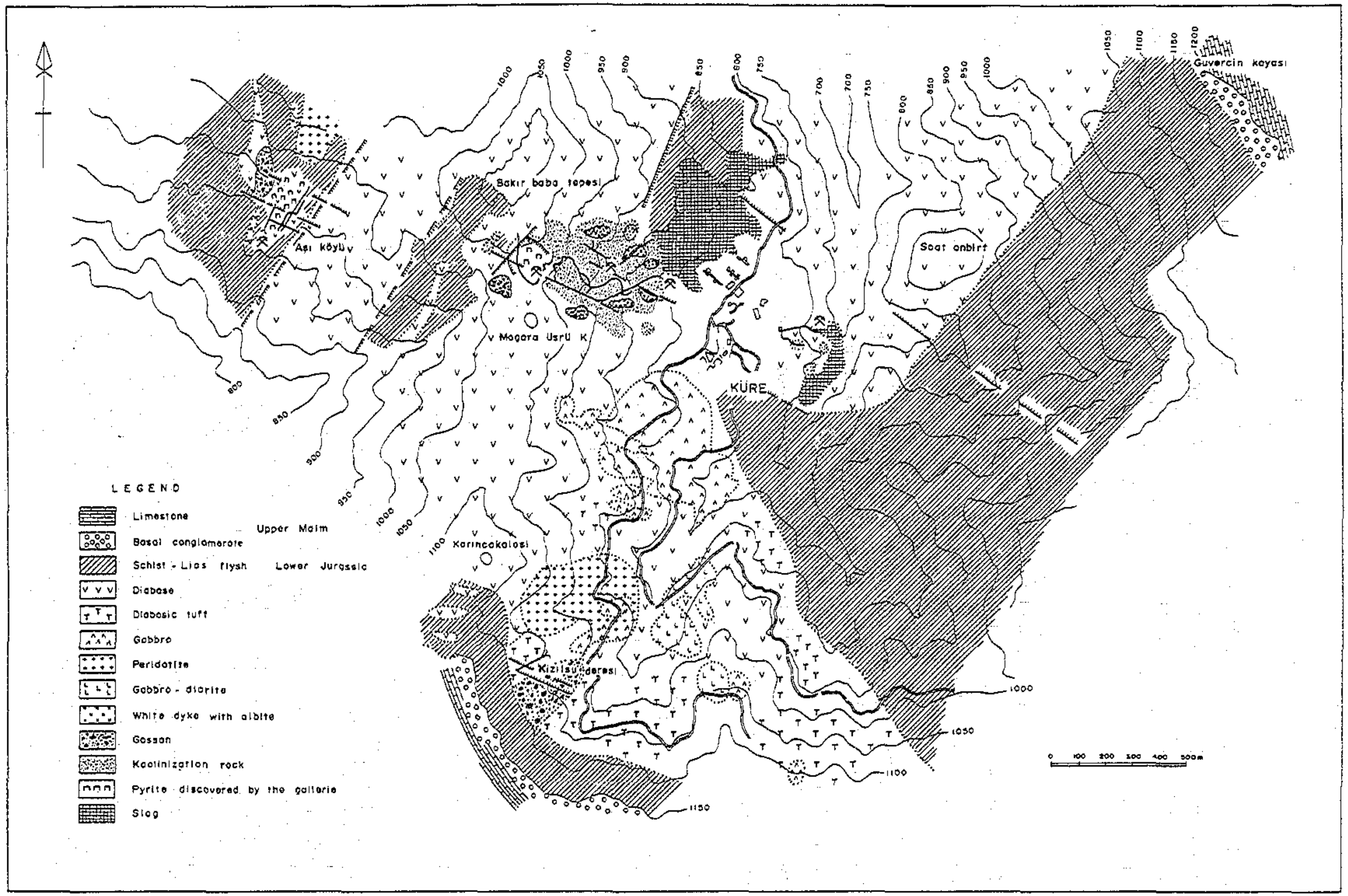


Figure 2-32 Geologic Map of the Küre Mine Area

In this deposit which was once an important mine, contains 2-2.5 million ton slag with 66.5 % FeO (Nikitin).

The first studies here had been done by the Hellens and Romans. The mine re-opened by the Ottomans 500 years ago. Before World War I, French Balya-Karaaydın Company made big scaled studies, but could not find anything. After the war, V. Nikitin and O. Czezat, the professors of the Leningrad Mining School, detected this region in behalf of Poland Government. Lastly M.T.A. continued the studies which were triggered by the Balya Company and found out the big column. Although copper containing parts of the deposit were taken by the old miners, the relict poorly pyritic zone is still used for the sulfuric acid production in Karabük by the M.T.A.

(2) Kastamonu-Küre Piritli Bakır Yatakları (Bakibaba-Aşıköy) ve çevresinin Jeoloji Raporu (1985)

(Improvement of the Known Copper Deposits around Küre)

H. Pehlivanoğlu, A. Çamaşırcıoğlu, N. Tezel, N. Çetinkaya (MTA)

ABSTRACT

This study was carried out to improve the known copper deposits (Küre-Aşıköy, Küre-Bakibaba) of the Küre province and to prospect whether there are other mineralized areas, apart from these deposits.

Within the study area metamorphics composed of probable Paleozoic aged gneiss, schist and quartzite; Pre-Lias and Lias serpentinites; volcanic sequence composed of massive and pillow lavas; ophiolitic rocks that is composed of intrusive gabbro and diabase cutting the volcanic sequence and sedimentary rocks crop out. Again within the study area, granitic rocks intruded into this volcano-sedimentary sequence; alternations of Upper Jurassic-Lower Cretaceous shallow marine carbonates beginning with basal conglomerate and Lower Cretaceous rocks. Upper Cretaceous flysch type rocks Eocene and Neogene sediments and alluvial deposits make up the younger deposits of the study area.

Küre copper-pyrite deposits whose detailed geological surveys done formed network structure in the upper levels of the volcanic sequence and massive lenses in the sedimentary sequence covering the volcanics. Main minerals of the deposits are pyrite and chalcopyrite. According to the detailed mineralogical studies, the deposits were proved to contain cobalt minerals (linneite, bravoite) and native gold over the economical values beside these minerals.

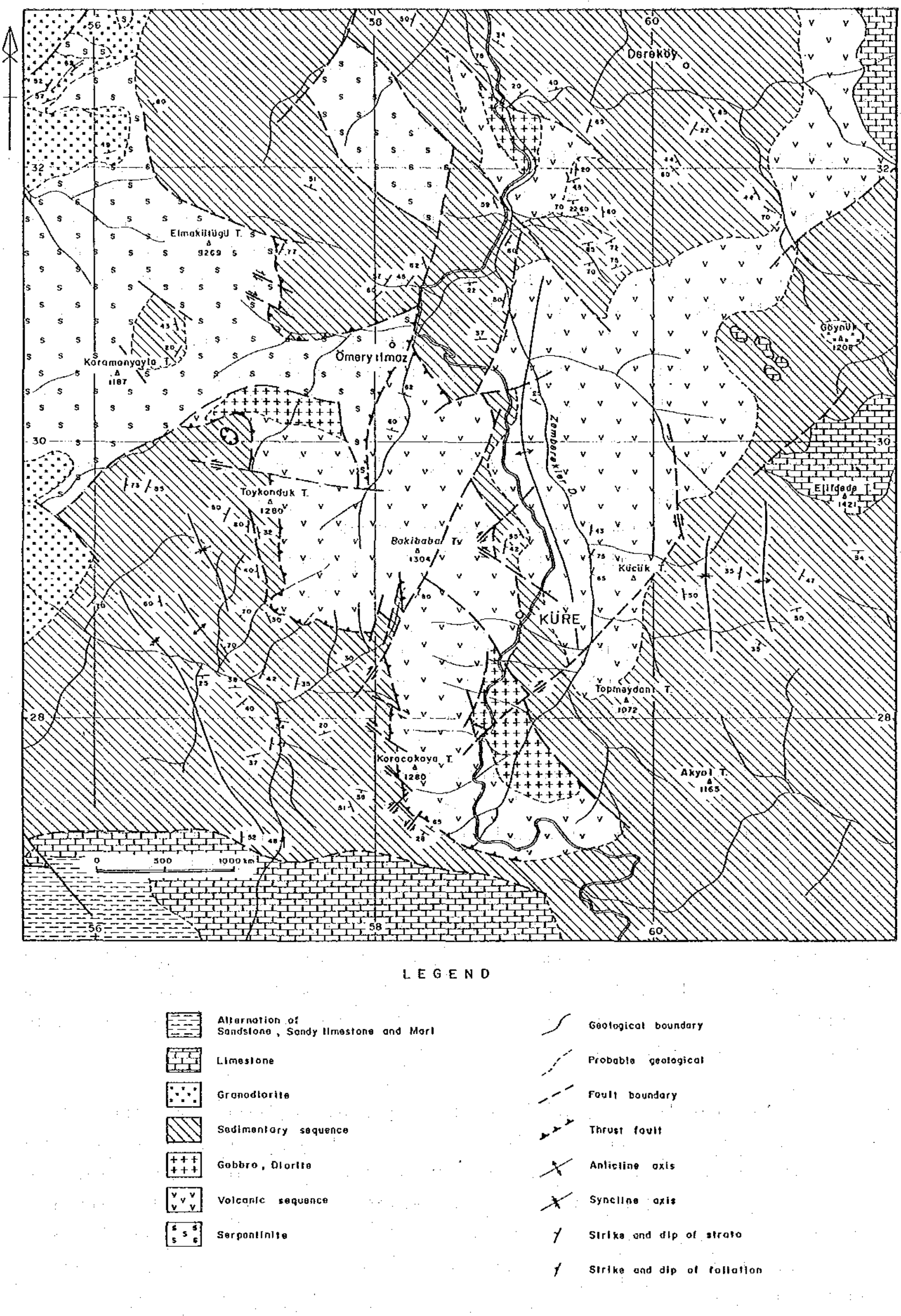


Figure 2-33 Geological Map of the Küre Mine Area

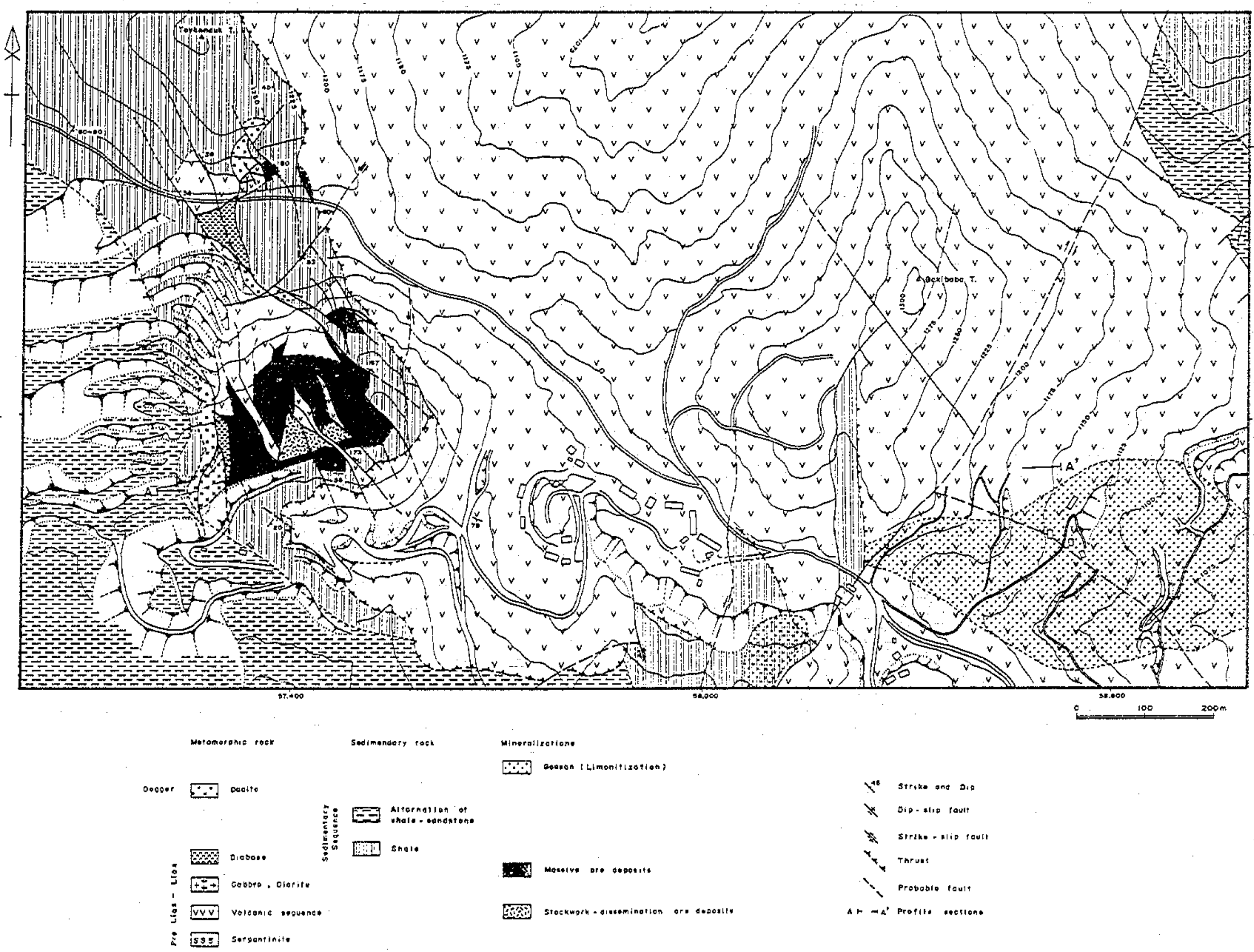


Figure 2-34 Geologic Map of the Aşıköy-Bakibaba Deposits

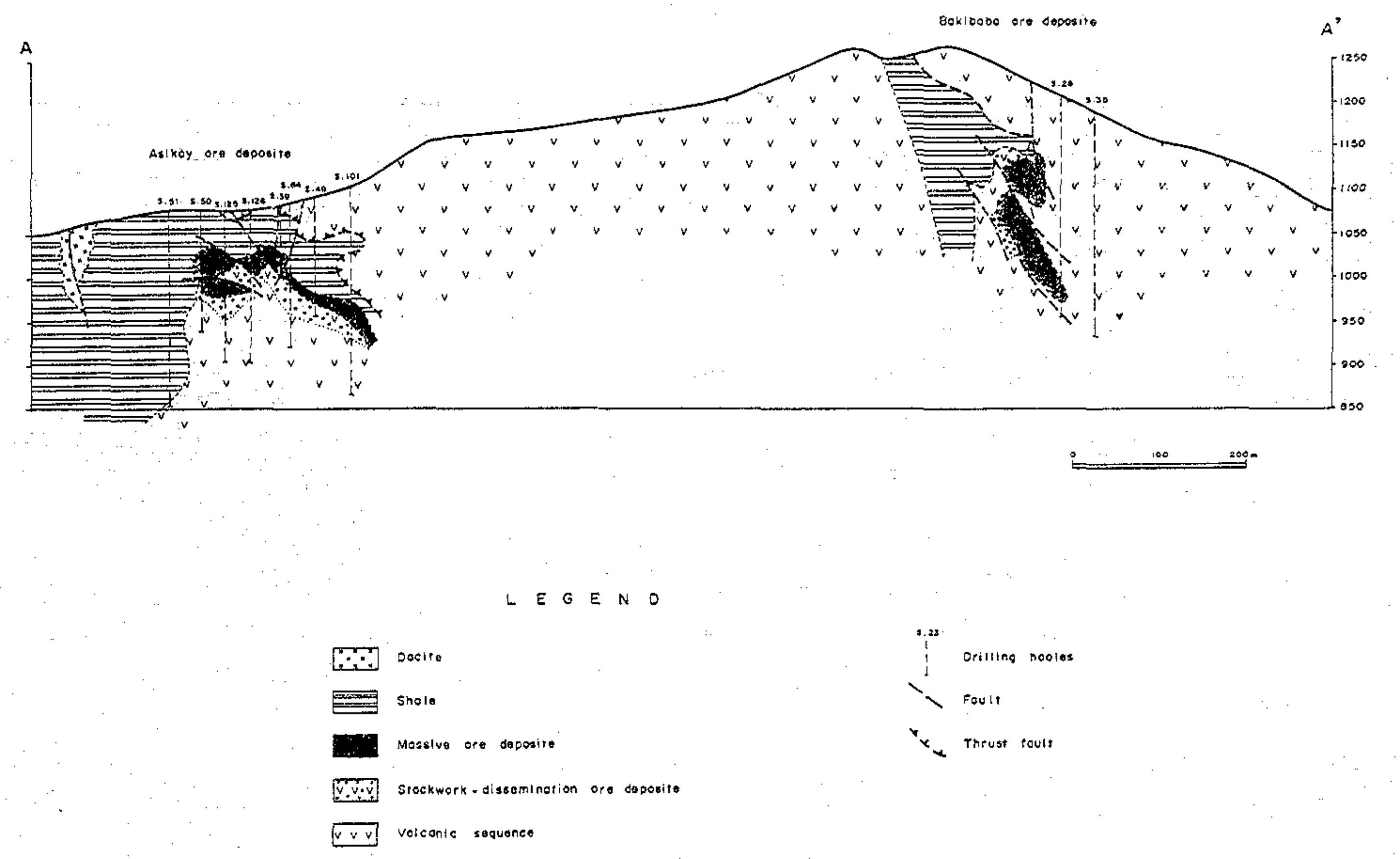


Figure 2-35 Geologic Cross Sections of the Aşıkōy-Bakibaba Deposits

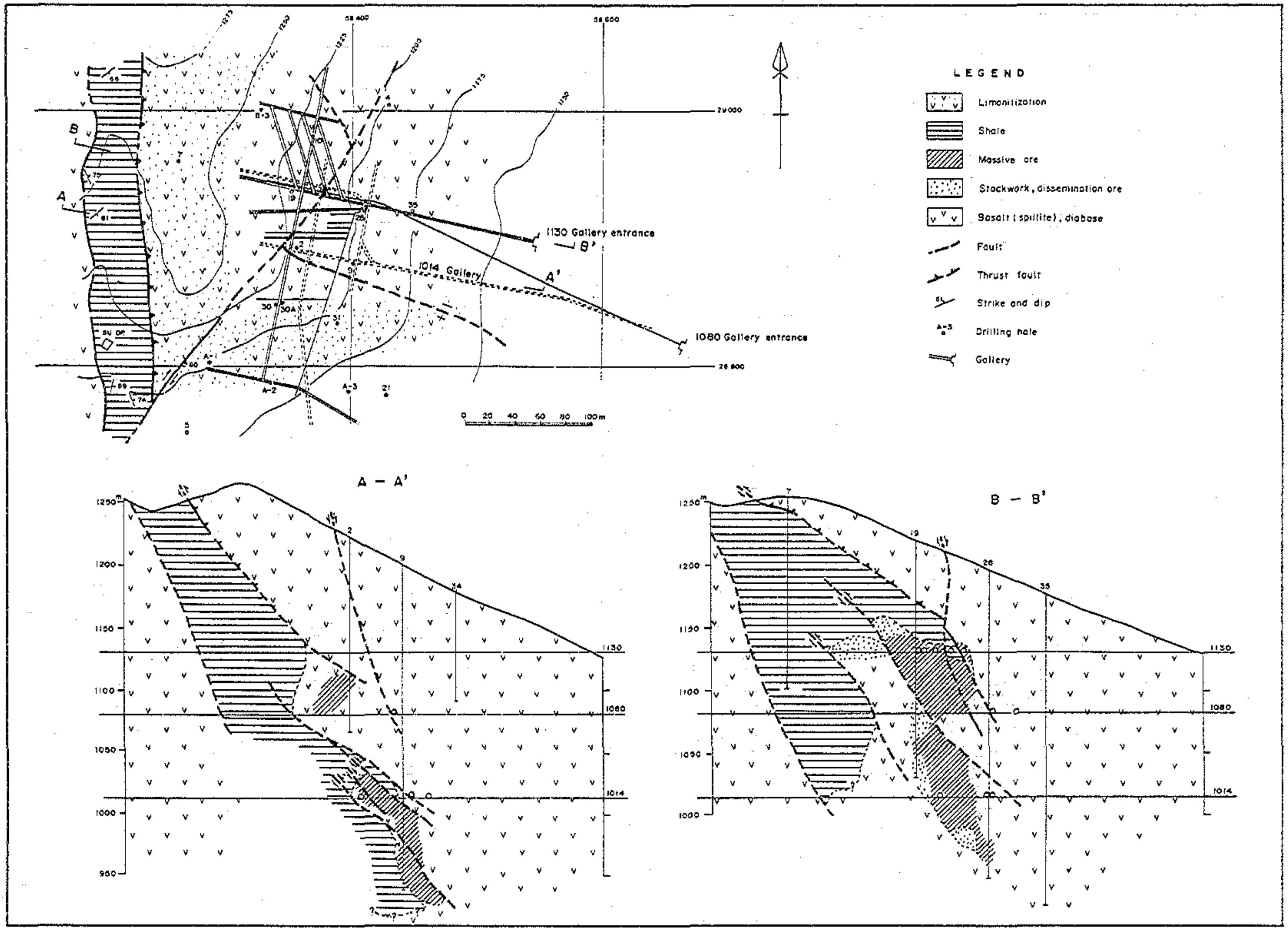


Figure 2-36 Geologic Map and Cross Sections of the Bakibaba Deposit

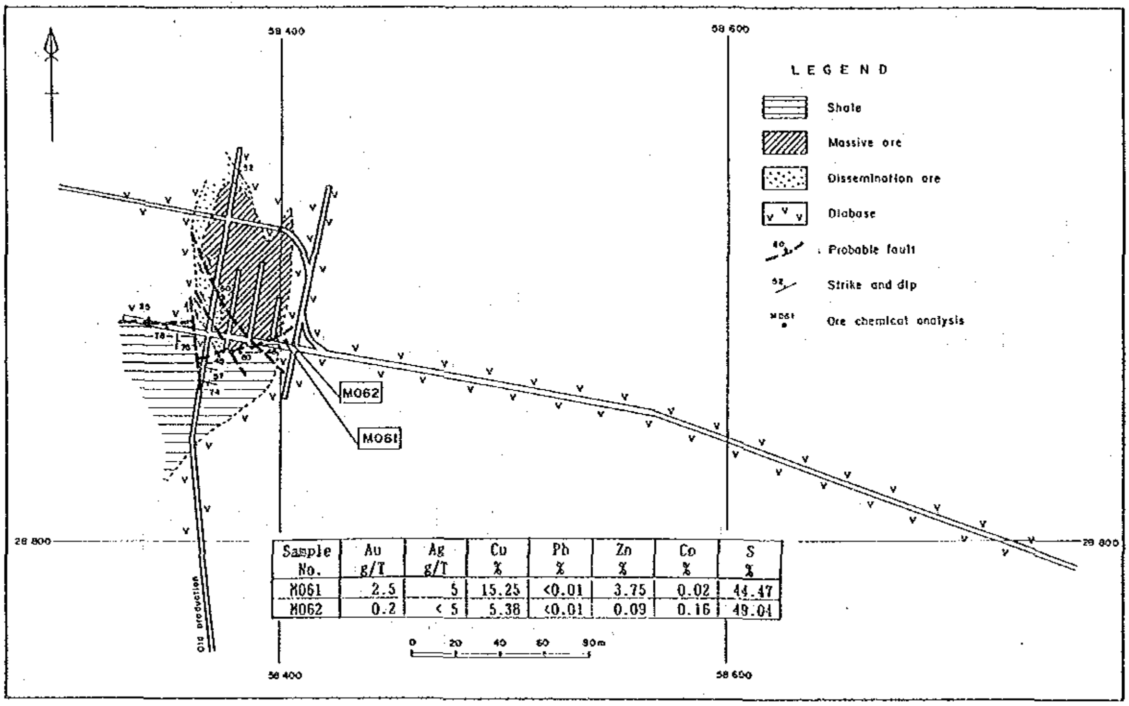


Figure 2-37 Galley Map of the Bakibaba Orebody (1,014ML)

Sample No.	Au g/T	Ag g/T	Cu %	Pb %	Zn %	Co %	S %
M061	2.5	5	15.25	<0.01	3.75	0.02	44.47
M062	0.2	< 5	5.38	<0.01	0.09	0.16	49.04

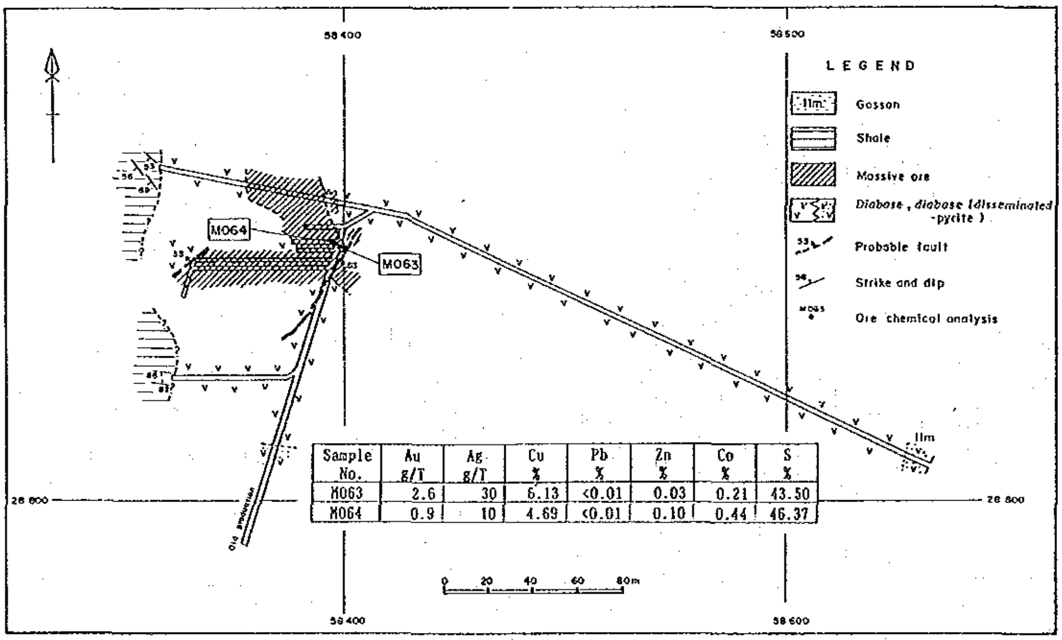


Figure 2-38 Galley Map of the Bakibaba Orebody (1,080ML)

Sample No.	Au g/T	Ag g/T	Cu %	Pb %	Zn %	Co %	S %
M063	2.6	30	6.13	<0.01	0.03	0.21	43.50
M064	0.9	10	4.69	<0.01	0.10	0.44	46.37

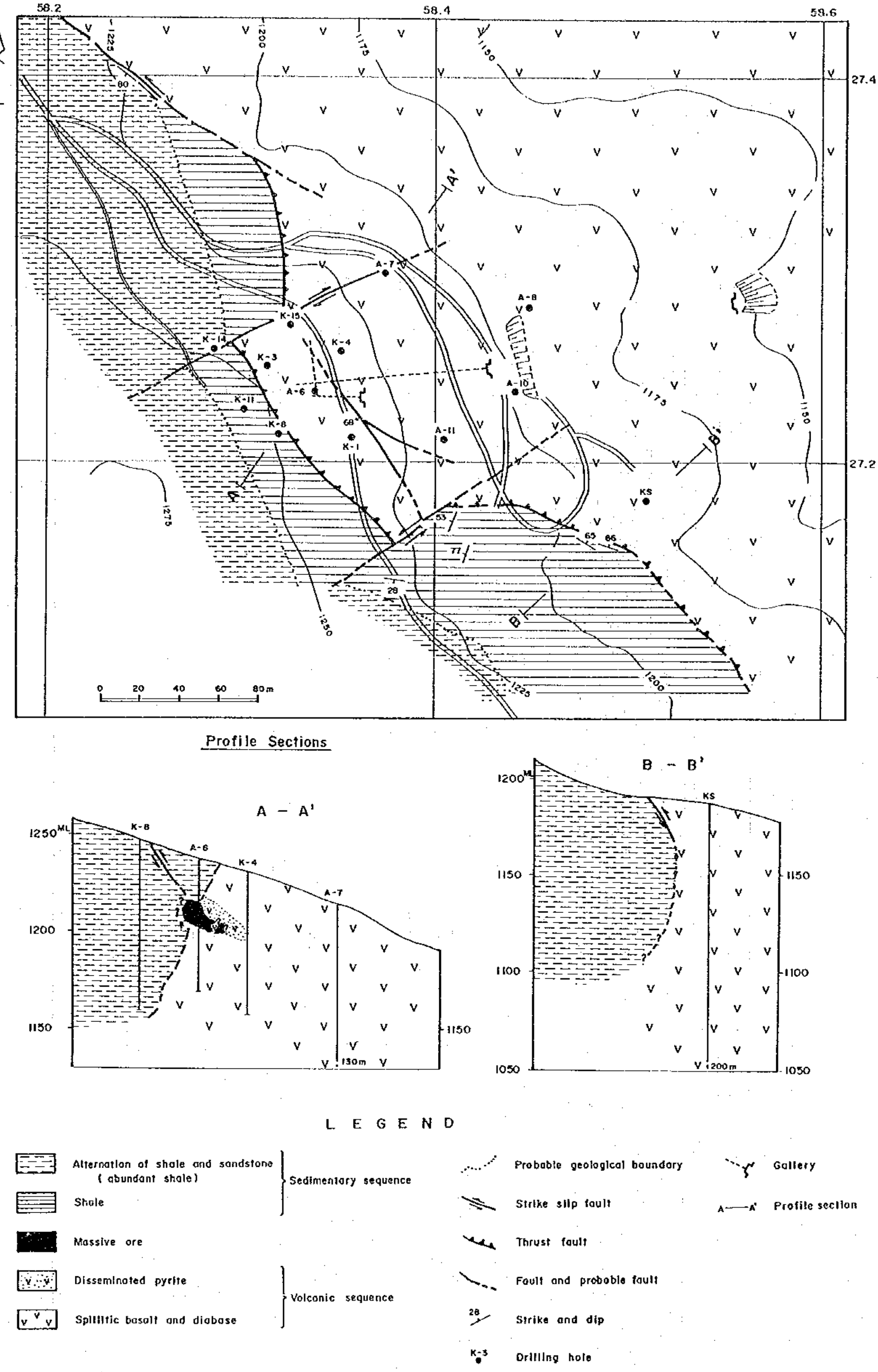


Figure 2-39 Geologic Map and Cross Sections of the Kizilsu Deposit

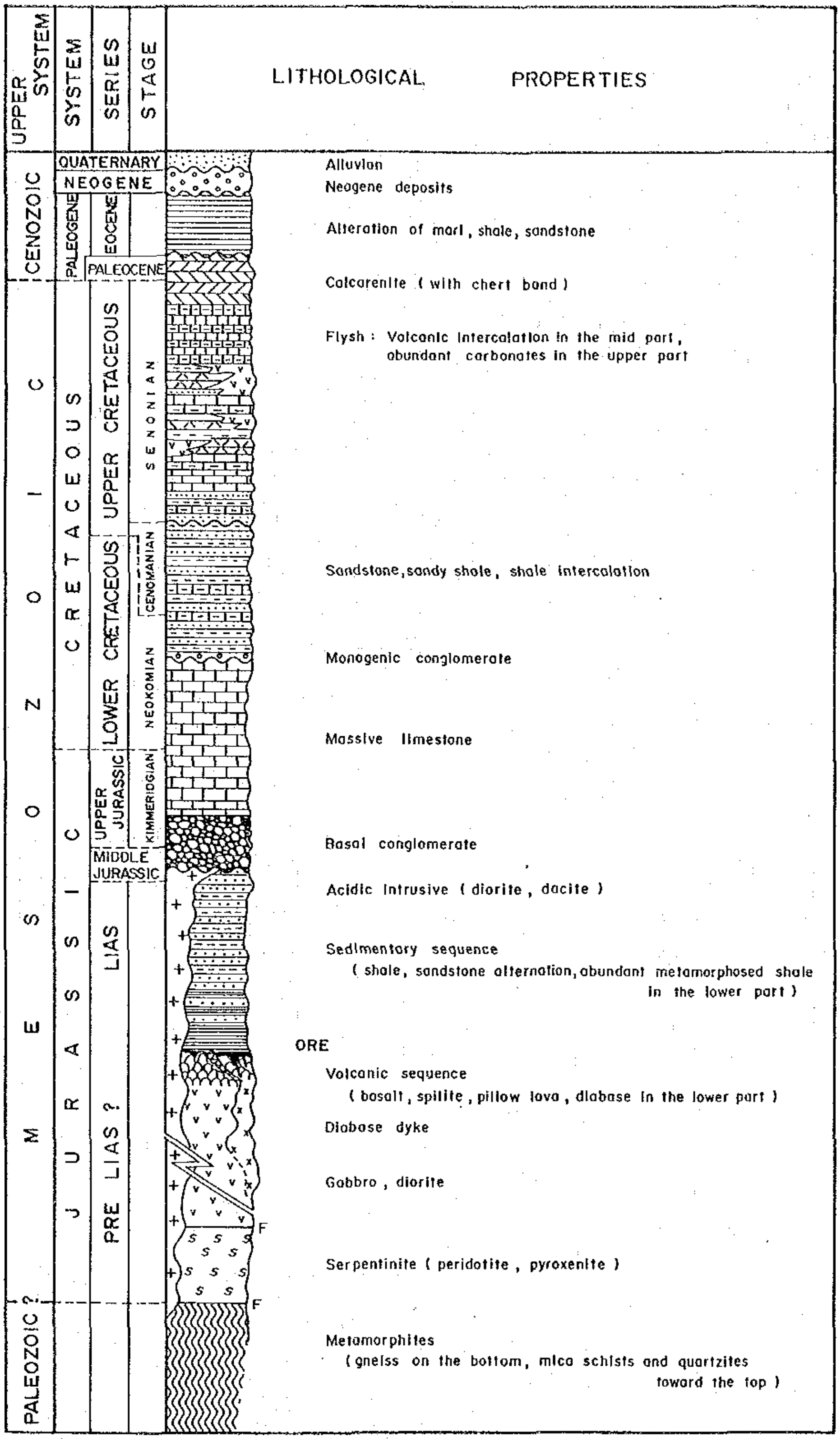


Figure 2-40 Schematic Column in the Küre Area

In the Küre-Aşıköy deposit of Etibank there are 15,238,337 tons reserve containing 1.69 % Cu and 36.73 % S in the "observed-probable" category. In the Küre-Bakibaba deposit of KBİ, total 1,805,702 ton reserve having 3.59 % Cu, 43.51 % S is known.

Again during this study, concentrations and dimensions of Cu and Co of the old dump slags in the Küre were estimated. According to this, in Küre about 1,800,000 ton slag having average 1.30 % Cu and average 0.36 % Co is waiting for being evaluated.

RESULTS AND SUGGESTIONS

The aim of this study is prospecting for new deposit possibilities beside known ones and improving the old known deposits. Therefore within a large area including İnebolu and Küre towns, general works and in a part containing Küre deposits, detailed works were planned and completed.

The following conditions were determined at the end of these works; Litho-stratigraphic unit identification of a large area between İnebolu and Küre were made. The place of the Küre copper pyrite deposits in the geological sequence were determined. Deposits probably take place within the pillow lavas of the Lower Mesozoic ophiolitic rocks.

Again in this study, detailed mineralogy of the deposits were given ; rock sequences and similarities of the ore constituents of the deposits were clarified. The dimensions of the deposits have proved to be changeable by the studies around Küre deposits and vicinity (eg. the southward extension of the Aşıköy deposit was determined by drill number 136) and the areas with are possibility were determined. This area contains black-shale and is in the west of the tectonic line starting from Kızılsu, passing through the Aşıköy deposit and Mt.Toykondu and reaching to the serpentinite mass in the North.

In the area, granitoide (granite, granodiorite) and its derivative rocks; dacite and rhyodacite ; were mapped and it was observed that this rock unit sometimes form very weak sulfur mineralizations.

In the northern parts ; it can be said that Upper Cretaceous Flysch, is not important for the mineralization of the volcanics, on the other hand, manganese outcrops on the bottom of the Upper Cretaceous flysch can be important.

The detailed works in the Küre deposits showed that the rocks in which these deposits take place and associated rocks, with their structural conditions, have supported restrictive and recognizing effect for the geologic environments which can contain ore deposits. This geological environment laterally extend out of the study area.

In the East of the study area, the units which were not separated as metamorphics in 1/500,000 scale Geological Map of Turkey are known to contain oceanic rocks (Ketin, 1962 ; Yılmaz, 1980). The sedimentary sequence showing a wide distribution within the study area and completing its accumulation in Lias extends to the east. The study of this oceanic rock assemblage of the area can be useful.

(3) Etibank Küre Masif Sülfid Yatakları(Aşıköy-Toykondu-Bakibaba) Jeoloji ve Rezerv Kalite Raporu (1986)
(Geology and Reservoir-grade Report)
Teknomad

The massive sulfide deposits of the Küre area are in Aşıköy. Bakibaba, Kızılsu, Toykondu tepe and Zemberekler dere. These deposits are found in the pillow lavas, tuffs and breccias which make up the upper parts of basalt sequence of the Küre Ophiolite.

In the report, first of all, the geology of the Etibank-Küre (Aşiköy-Toykondu-Bakibaba) massive sulfide deposits were done and generalized from the a) regional geological, b) stratigraphical, c) massive sulfide deposit formation point of views, by examining the reports of old works and evaluated by preparing profile documents of all the surface and underground made until the end of 1986. Later by calculating in situ value of the ore and the cut-off, the reservoir categories were determined and the reservoir were estimated by evaluating the latitudinal and longitudinal cross-sections of the chosen "target areas" and by dividing into three categories as a) observed, b) observed-operative, c) observed-profitable.

	Amount(ton)	Cu %	S %
Aşıköy open pit	7,761,964	1.55	35.64
Aşıköy underground pit	3,138,204	3.72	40.36
Bakibaba open pit	1,464,608	2.55	36.56
Bakibaba underground pit	338,584	3.09	39.60
TOTAL	12,752,763	2.25	37.03

According to these, in Küre, total 12,752.763 tons reservoir is present. By insisting on that the concentration of the reservoir can only supply

13-15 years raw material demand ; as being parallel to the Aşıköy operation activities exploration programs were suggested to clarify the Bakibaba project data and to determine the boundaries and the grade of the mineralization zone.

(4) Aşıköy-Toykondu-Bakibaba Masif Sülfid Yatakları, Cevherleşmenin Oluşum Modeli ve Arama Programı Raporu (1987)
(Aşıköy-Toykondu-Bakibaba Exploration program)
Teknomad

Küre massive sulfide deposits take place in the basaltic sequence which makes up the uppermost unit of the Küre Ophiolite Massif. This sequence which is massive at the bottom and passes into the pillow lavas toward the top was determined to have oceanic ridge basalt character geochemically and structurally (Güner, 1980). The basalts which display alternations of hyaloclastic and tuffaceous layers in the upper levels are discontinuously overlain by a pelagic sedimentary sequence with sandstone-shale intercalations.

The ore deposits in the Aşıköy and Toykondu areas generally are observed as the amorphous and discontinuous patches between the basalts and shales within the upper levels of the basaltic sequence. Beneath the shale which is the roof rock there is high grade massive ore, underlying it the low grade; first partially network-like then disseminated ore take place.

Mineralization in the Bakibaba area is mainly controlled by Bakibaba strike-slip normal fault and related fracture systems. The ore which is generally observed as broken pyritic fill-in with varying dimensions within N30°E directed fault zone become widespread in the basalt-shale boundary and turns into the greater high grade massive ore bodies.

Structurally. the Aşiköy massif seems to be a ridge that has NW-SE directed axial plane, sliced by the northward dipping normal faults. The massif is surrounded by the shale in three directions and seems to be rotated around NW-SE directed axis. In the NW part, in the raised Toykondu massif lower levels of the basaltic sequence crop out by the erosion of the ore levels. In the collapsed SW part basalt-ore-shale together dip beneath the basalts. Toykondu massif represents the levels that were collapsed relative to the raised Aşıköy massif.

Bakibaba deposit in reality seems to be related to fracture zones and basalt-shale transition within the Bakibaba basalts which were thrusted over the Aşıköy massif.

Aşıköy and Bakibaba deposits include 12,752,763 tons of with 2.25 % Cu and 37.03 % S in the "observed-profitable" category. Main ore minerals are pyrite and chalcopyrite. It is possible to find economically important cobalt minerals like linneite and bravoite and also native gold minerals (Çağatay and the others; 1980, 1982). Other sulfides and oxides of the primary minerals and secondary minerals are not economically important.

Ore mineralization is mainly thought to be the result of hydrothermal processes caused by submarine volcanism of Pre-Lias age and remobilized due to the plutonic intrusions in Dogger.

(5) Kastamonu-Küre-Bakibaba Maden Yatağı Rezerv Hesapları Raporu (1990)
(Economical Geology and Reserve Calculations of the Kastamonu-Küre Mine Deposit)
Z. Dağcı, T. Iıdız

With the IR-351 license number and Bakibaba copper, pyrite, cobalt operation permission mining area takes place within the borders of Kastamonu city, Küre town. The mineralization in Bakibaba area begins with a network structure on the bottom and passes into massive ore towards the top. It takes place within the pillow lava, tuffs and breccias which make upper parts of the volcanic sequence. Abundant ore minerals are chalcopyrite and pyrite.

Bakibaba mine area is known to be operated since the very old dates. Exploration and evaluation works have been completed in 1968. Operating preparations continued until 1972 and operation started within the same year.

Beginning reserve was found to be 1,805,725 tons with 3.60 % Cu. 574,120 tons of Cu with 4.93 % Cu grade and 200,281 ton pyrite with 43.61 % grade was produced until 1.5.1990.

In order to lower the operation losses different methods were applied. However pit fires arose and some parts were closed. Therefore, they stayed out of production. There appeared differences between the 1968 estimated reserve and the production. On the bottom of the 926 ML, a small mineralization was detected and prospecting for the real dimensions of the mass was suggested.

For these reasons, new data were collected during the operation of Bakibaba area. Under the light of these information and reports operative reserve of the Bakibaba mine area was recalculated and operative reserve was found to be 956,201 ton with 3.26 % Cu grade with the date 1.5.1990.

(6) Küre piritleri bakır yataklarının kobalt-altın mineralleri ve yatakların bu metaller açısından ekonomik değeri (1980)

(Kastamonu Province, North Turkey and Their Economic Values)

Ahmet Çağatay, Hüseyin Pehlivanoğlu and Yilmaz Altun

Survey Area:Küre Mine

Survey method:Ore Minerals

Objective:Cobalt-gold minerals in Küre deposits and their economic values

Pyrite copper deposits found in Küre as stockwork-disseminated ore at the upper levels of spilites and as massive lenses between the spilites and argillites (black shale). A strong tectonic movement appear to have been resulted in the formation of complex structures in the neighborhood of the deposit.

Up to the present day, the deposits have been mined for copper and pyrite, the main ore-bearing minerals being chalcopyrite and pyrite. In addition to these, linneite, bravoite (cobalt minerals) and native gold, which are all of the grade above economic cut-off, have been obtained. The deposits have an approximately 13 million ton of ore with the cobalt and gold content of 0.3% and 2.48 g/ton respectively. According to the estimates based on March 1981 prices, cobalt, gold and copper content of the deposits are equivalent to US$ 2,194,155,000, US$ 592,200,000, and US$ 544,194,770 respectively. Thus, in the deposits, gold has an economic value slightly more than copper and cobalt has an economic value approximately four times of copper.

Chalcopyrite: It is the second most abundant mineral after pyrite. Chalcopyrite which is unhedral, fills the cataclastic fractures of the euhedral pyrites. Sometimes it shows cataclastic pattern. It is a problem from the ore enrichment point of view that the chalcopyrite makes kidney-like, long, shell-like spheres together with the jelly pyrite. Moreover chalcopyrite is observed as swells and pinches in the sphalerite. Ordering of the chalcopyrite swells along the crystallographic directions of the sphalerite clarifies the zonal structure of the sphalerite. Chalcopyrite in some places turns into the neodejenite and covelline along the fractures and joints. The goethite released as the result of this transformation is found together with the covelline.

Bravoite: It is in lesser amount than pyrite and chalcopyrite. There are two different bravoites in the deposits. The bravoites which makes zonal structure with the euhedral pyrite is more abundant. The thicknesses of the bravoite zones in these pyrites vary between 5 and 30 micron. The bravoites resulted from the substitution of linneites with the euhedral pyrites are mostly seen as thin films at the linneite contact and as wedges in these pyrites. According to the chemical data, the bravoites in these deposits have cobalt more than nickel, therefore they are kattiterite.

Linneite: It is more abundant in the parts of the deposit where chalcopyrite is enriched. Mostly the linneites which its pieces are about 200 micron are observed as euhedral, subhedral and unhedral crystals in the chalcopyrite. Linneite which is also found in joints and fractures of euhedral pyrites, makes veins instead of euhedral crystals. Large linneite crystals can sometimes be substituted by chalcopyrite along joints and cataclastic fractures. In this situation, the smallest pieces of the linneite can be as small as 5 microns. Sometimes it is possible to observe chalcopyrite and pyrite pieces within the euhedral linneite crystals. Some of the pyrites observed in the linneite have completely turned into bravoite. The chemical data proves the Küre deposit linneites are very rich in cobalt.

Native gold: Approximately in the half of the samples taken from the deposits are the small pieces of the native gold. It is mostly is seen as small pieces within the cataclastic fractures of and between the chalcopyrite, bornite and euhedral pyrites and as small pieces within the chalcopyrite; in sphalerite which fills the cataclastic fractures of the pyrites and as being intruded into the pyrite slices. The largest measured gold pieces are about 25-30 micron.

CHAPTER 4 INTERPRETATION OF DATA COMPILE

4-1 Evaluation of Ore Deposits and Mineral Occurrence

4-1-1 Introduction

Küre takes its name from the abbreviation of the name Küre-i Nühas (copper mine). The oldest of the ore deposits in Küre is Bakibaba and its history is thought to go back to the Roman Civilization. The active works were done B.C. 1,300 and B.C. 1,500, the brightest period is the Fatih's time. It is understood from the old papers that the copper used in the construction of the balls that were used in the conquest of the Istanbul came from Küre.

The Aşıköy, Bakibaba and Kızılsu locations in which Etibank activates were found by the M.T.A. in 1939. The activities were conducted by the M.T.A. as a worksite until 1955, after this date till 1959, it was operated as an underground mine by "Küre Piritleri Türkiye A.Ş.". In the beginning of 1959 the area was transferred by Etibank and became an Establishment. From 15.2.1962 date on, it is operating as an Küre Bakirlı Pirit İşletmesi (Küre Copper Mine). Bakibaba mine concession was transferred to K.B.İ. in 1968 and started production. The Bakibaba mine which was in operation was again transferred to Etibank on 1.6.1991.

In order to produce copper-pyrite concentrates from the ore body an agreement was signed with the Outokumpu Firm of Sweden in 1977 and operation of mill plant was began in 1987, its production capacity has the treatment of crude ore of 930,000 ton/year, it's planned to take 600,000 tons from Aşıköy open pit, 270,000 tons from Aşıköy undergroun mining and 60,000 tons from Bakibaba.

The life of concentrated foundation is 15-17 years when the available reserve conditions are taken into consideration, then additional reserve is necessary in order to lengthen the life of the Foundation. Therefore, the exploration studies have to be accelerated.

4-1-2 Küre Mining Zone

(1) Aşıköy-Toykondu Deposits and around

In 1939, in the region, Kovenko who started to study in behalf of M.T.A., determined gossans in Aşıköy and he was the one who determined the deposit by the geophysical survey and underground exploration works. Late between 1961 and 1968, Etibank made drills in the area for determination of the ore reserve, which is 1.5 million ton with 1.92 % Cu and 47.9 % S grade.

In and around Aşıköy, 174 drill holes were done up to the present; of these drills, 155 are in Aşıköy, 15 are in Toykondu, 3 are in Karacakaya and 1 is in Sapdere. Of these drill holes 117 on Aşıköy, 10 in Toykondu cut the ore.

The detailed underground service related to the Aşıköy underground mining project, was controlled by Sweden Boliden Firm and their suggestions about general geology of the deposit, mineralization, structure, ore geometry and reserve estimations were examined by Etibank and it was decided to divide the mineralization types in the deposit, develop the geological model and to re-estimate the reserve by the section method. In the method that will be applied to this project to determine the gallery path and rock mechanics data a 270.25 m survey drill was made and its core was examined.

With the aim of developing the Aşıköy closed pit under the enforcement of Boliden Firm and Etibank's ideas, an agreement was signed with Teknomad Company in 2.1.1991. The firm gives reports to Etibank according to the agreement. The submitted reports are examined by the Project Foundation Department. From this point of view, map and drill logs control report, the surface survey of 920 gallery, exploration and reserve development program and rock mechanics works report were examined and meetings related to the subjects were made with the firm. Furthermore in Aşıköy pit, 1/1,000 scale geological mapping and its control were completed.

Now, within the project circumstances, gallery opening is directed by the Establishment. The exploration gallery, control drills and Foundation test gallery will be done in 1992, during these activities, necessary support will be supplied by Etibank's Chairmanship.

(2) Bakibaba Deposit

Bakibaba is an area known and operated from the very old dates. Etibank prepared a new exploration program in 1963, started drilling operations by making an agreement with the M.T.A. in 1965 and 3,576 m surface drilling, 1,636 m gallery opening and 2,345 m underground drilling were made until 1968 and in the end of this study, total 1,865,752 ton ore reserve with 3.59 % Cu and 43.51 % S contents are determined.

In November 1968, Bakibaba ore deposit was transferred to the K.B.İ.. The projecting and operating preparations continued until 1972 and in this date production began.

With the drilling survey made in 1980, the ore was determined to go down to the 920 ML and the drills that can descend to deeper contours could not be made due to technical impossibilities.

After the transfer of this deposit from K.B.İ. to Etibank in 1.6.1991, all the exploration works done before were collected and examined. It was observed that previous works were about the determination of massive ore not the disseminated ore. Before deciding the open pit project in Bakibaba deposit and modernization of the closed pit; exact determination of dimensions of the disseminated ore body and examination of limonitic zone from Au point of view can be useful. From this point of view, exploration project which will be applied in 1992 and 1993.

(3) Kızılsu Deposit

This area, in 1939, was explored by Kovenko who studied in behalf of M.T.A.. Later, here 3 galleries (total 425 m) were opened. From 1964 year on, Etibank started geological, geophysical surveying and in the first plan, by making 11 drills, a small-scale massive ore was determined and approximately 15,000 ton (9.42 % Cu grade) production was done together with the closed pit.

In the same field, geological and geophysical surveys were conducted from 1985 to the end of 1990, total drilled length of 4547.20 m was made in 50 locations. As the result of pre-evaluation of the present data, 1.5 million ton reserve with 1.3 % Cu grade was determined and the ore said to be profitable with the open pit.

In the area, in 1991, exploration activities were completed by making 4 new drills (346 m). Redetermination of 54 drills made from 1987 to the present day and 1/1,000 scale (25 Ha) surface geology of the area was carried out.

(4) Zemberekler

It is observed in the Zemberekler Creek, in the east of Küre. In the same place there is also slags. In the old report it is explained that a drift was opened and ore could not be found.

(5) Ersizlerdere

Öner (1971) made a 1/25,000 general geology map of the area and a 1/1,000 scale detailed geological map with a geochemical prospecting around Ersizlerdere village. In his study, he indicated that copper and specularite outcrops were observed in spilite and diabase formation. In the place where Karadana spring passes through the spilites, in the steep Northern slope, a pyrite outcrop was recognized and chalcopyrite and malachite were present in the pyrite mineralization zones. He suggested a geophysical survey in the area.

Esen (1989) made a detailed geological mapping in 1/1,000 scale and indicated that the mineralization was related to a NW-SE directed fault system within the diabase unit, that the pyrite dissemination was observed, that the limonitization and kaolinization were recorded in pyritized zones. In three samples taken from these places 0.05 % - 0.62 % Cu values were recorded.

Akkuş and the others (1989) made a geophysical IP survey in the area and determined that the geologically determined small limonitic zones were not continuous laterally and vertically.

The area was observed in the geophysical study and the altered, limonitized and kaolinized places were concluded to be shallow.

(6) İpsinler

Esen (1989) made a 1/1,000 scale geological mapping in the area and found limonitized and kaolinized outcrops in the intensely weathered diabase. In this area where distinctive mineralization was absent, and limonitization and black-brown iron sulfate covers were observed. From the analyzed samples 0.05% Cu and 2.05% S values were obtained.

Akkuş and the others (1989) conducted IP surveying in the area and determined the weak mineralization which didn't continue in the deep.

Exploration of the area was done by our team, previously studied areas were seen; moreover, new Ipsinler village trench was visited and in the road slope, there were observed alteration, pyritization and a small slag. In a sample from pyrite mineralization zones 0.06% Cu value was detected.

4-1-3 Taşköprü Zone

(1) Cozoğlu Mineral Occurrence

It is located 22 km in the northeast of Taşköprü. Hoore (1913) saw the old productions in the area and estimated approximately 40,000-60,000 tons of slag. Therefore, he insisted that the mineralization could be important and suggested to open two galleries.

Pilz (1937) provided that in the mineralized fields, there should be lenses of Cu with pyrite but that the reserve was not enough for a profitable plant.

Coronini (1964) recorded that the old dump material and slag seen in Cozoğlu were related to a NW-SE directed fault zone and in one of the trenches there was a copper mineralization being composed of malachite and fahlerz within a one meter wide zone.

Konya and the others (1988) indicated that Cozoğlu pyrite-copper mineralization developed in the tectonic zone of lava accumulation site of Elekdağ metaophiolite and was a vein type hydrothermal mineralization and that there were about 80,000 tons of slag.

Ünsal and Dirim (1990) saw the old production and indicated that the mineralization is not large enough and they recorded 0.74% Cu and 0.06% Co in the old dump slags.

(2) Boyalı Mineral Occurrence

It is located 25 km in the north of Taşköprü. Konya and the others (1988) found a first degree anomaly field as a result of 1/25,000 geological and geochemical studies carried out in the area. Later they made a detailed geochemical study in 1/5,000 scale. Abundant mineralizations in the anomaly field are the vein and bedded pyritization. Furthermore, discontinuous, amorphous silicified rocks (jasper) were said to be widespread. Mineralizations in general are veins tectonic origin and hydrothermal type. They can be conformable with the schistosity planes. The places from which 3,000-7,000 ppm Cu and 700-1,100 ppm Zn values were obtained were suggested to be important for the ore mineralization.

The area is being studied by the ITÜ (Istanbul Technical University) research team and it's been learned that they are studying to find out the ore potential of the area.

The exploration of the area was done by our team and it was understood that the mineralizations are related to the hydrothermal fluids which effect metalavas within the metapelites and are present as very minute pyrite and chalcopyrite veins and with a later oxidation these turned into malachite and cuprite. The metalavas observed mineralizations have a few meters dimensions. In one sample 0.29% Cu value was obtained.

(3) Musabozarmut Mineral Occurrence

It is in the vicinity of Musabozarmut Village. Konya and the others (1988) found a second degree anomaly field as a result of 1/25,000 geological and geochemical studies carried out in the area. Abundant mineralizations in the anomaly field are the vein type pyritization. Mineralizations in general are veins tectonic origin and hydrothermal type to be widespread. They can be conformable with the schistosity planes.

(4) Sey Yayla Mineral Occurrence

It is located 4 km in the south of Musabozarmut. Konya and the others (1988) recorded pyrite mineralization in their study and determined ore mineralization as being hydrothermal vein type within the Elekdağ metaophiolite.

Akkuş and the others (1991) carried out geological and geophysical surveys in the area and indicated the alteration, pyritization and limonitization was observed in a 300 m long zone, that small amount of slag was present within this zone. The recorded anomaly in the IP and SP surveys done and suggested one drill in the area.

(5) Kepez Mineral Occurrence

It is located 22 km in the northeast of Devrekani. Senocak (1974) made a geological mapping in 1/2,000 scale in a 0.6 km^2 area and recorded widespread alteration in basic volcanics and lack of copper mineralization and that no anomalies were obtained in the IP survey.

Özgüneyli (1974) has made 1/2,000 scale geological mapping and indicated that pyrite and limonite were seen discontinuously in the schist.

Arvas and Bozkiran (1974) made detailed geophysical survey (IP, SP) in total 126 Ha area in Kepez and Doğanderesi and they suggested three drills.

Tokashima (1975) indicated that Kepez mineralization area is very weak and pyritization developed due to the replacement of mafic rocks.

(6) Cünür Mineral Occurrence

It is located 35 km in the northeast of Kastamonu.

Konya and the others (1988) found a first degree anomaly field as a result of 1/25,000 geological and geochemical studies carried out in the area.

Later they made a detailed geochemical study in 1/5,000 scale. The mineralization is hydrothermal type and was controlled by NE-SW directed parallel faults and that the kaolinization, chloritization, silicification and pyritization were observed in an 200 x 600 m wide area.

Çevikayak (1980) made IP and SP surveys in the 0.5 km^2 license area and concluded that they couldn't obtain values which can be evaluated as anomaly and that the surface alteration was shallow.

(7) Alayürek Mineral Occurrence

It is located 8 km in the southeast of Devrekani. Konya and the others (1988) found a first degree anomaly field as a result of 1/25,000 geological and geochemical studies carried out in the area. Abundant mineralizations in the anomaly field are the vein-type and bedded pyritization. They found the high copper grade of the slags in the Yaybey Stream.

4-1-4 Dikmendağ Zone

(1) Masköy Mineral Occurrence

It is located in the southern part of Masköy Village. Ünsal and Dirim (1990) saw the mineralization zones and slags in their places and even though the surface data are not very important, because volcanics are seen in the area it was found to be interesting to search for the buried type deposition. In the slags 0.68% Cu, 0.69% Co with 2.02% Cu and 0.69 % Co were obtained.

(2) Kale Mineral Occurrence

It is located in the southeastern part of Kale Mountain. Uzluk (1969) made a 1/5,000 scale map of the area and suggested a geophysical work in the sites where slags, weak pyritization and kaolinization occurs.

(3) Öcür Mineral Occurrence

It is located in the eastern part of Öcür Village. Kamitani and Çamaşircioğlu (1976) studied the geology of the area and examined the mineralizations and alterations in three groups as Yaylabeli, Kızılkaya Tepe-Yaylabeli village and Öcür village outcrops.

(4) Furuncuk Mineral Occurrence

It is located in the vicinity of Furuncuk Village. Arda (1968) made a exploration in the area and recognized three different old dump slags of 10,000-15,000 tons and indicated that there were no mineralization and old mining work.

Öner (1971) has made a geological survey and geochemical prospecting in the area. Kirkbudak area was found to be important for having basic volcanics and slags. In the slag analysis 1% Cu and 0.5% Co were obtained.

4-2 Summary of Compiled Data

4-2-1 Küre Mining Zone

Table 2-3 Evaluation List of the Küre Mineralized Zones

Locality	Scale of orebody	Excavation	Minable Ore Reserves	Potential
Aşıköy	16,000,000T Cu:1.79%	3,000,000T Cu:2.00%?	13,000,000T Cu:1.74%	Expect satellite orebody in the neighborhood of mineralized zones
Toykondu	400,000T Cu:3.00%?	-	400,000T Cu:3.00%?	Small scale mineralized zones
Bakibaba	1,700,000T Cu:3.00%	800,000T Cu:4.95%	900,000T Cu:2.09%	Expect satellite orebody below gossan
Kızılsu	1,500,000T Cu:1.30%	15,000T Cu:9.42%	1,500,000T Cu:1.30%	Expect the deeper parts below black shale
Zemberekler	?	No information	?	No location of geophysical prospecting near the Küre town
	No previous work and exploration			
Ersizlerdere	Argillization and limonitization along fracture of diabase. IP was conducted, but no drill hole			Low potential (weak mineralized zones)
İpsinler	Argillization and limonitization along fracture of diabase. IP was conducted, but no drill hole			Low potential (weal mineralized zones)

All mineral occurrence of the Küre Mining Zone is conducted by the geophysical prospecting and drilling survey, but the dimensions and nature of mineralization are clarified in the shallow part of surface.

4-2-2 Taşköprü Zone

Table 2-4 Evaluation List of the Taşköprü Mineralized Zones

Locality	Characteristic Mineralized Zones	Potential
Cozoğlu	Copper mineral occurrence Adit and slag were detected. No data of previous work	Proposal of future exploration (geophisic prospecting)
Boyali	Copper-pyrite mineral occurrence Dimension of Mineralized zone:2km x 500m Geochemical anomalies were detected by stream sediments and detailed soil samples.	Zones extracted as promising are low potential.
Musabozarmut	Limonitization, pyritization & silicification Dimension of mineralized zones:7km x 3km Cu-Zn anomalies detected by stream sediments	Low potential because of regional mineralization
Sey Yayla	Promising anomalies were detected by SP and IP geophysical prospectings.	Zones extracted as anomalies are pyrite dissemination.
Kepez	Limonitization and pyritization A small scale silicified zones No geophysical anomaly (IP method ?)	Zone reported as copper occurrence is weak.
Cünür	Dimension of mineralized zones:7km x 500m Geochemical anomalies were detected in the eastern part of Cünür by soil samples.	Whole area of mineralized zones is not conducted.
Alayürek	The slag of high copper grade were detected in the Yaybey Stream (24.16% and 2.24% Cu).	The extent of minerali-zation is not delineated.

4-2-3 Dikmendağ Zone

Table 2-5 Evaluation List of the Dikmendağ Mineralized Zones

Locality	Characteristic Mineralized Zones	Potential
South of Masköy	Mineralized zones of pyrite were observed in the Küre Formation which is correlated with the Küre mining zone.	Cyprus type mineralization throughout the zone, which occur in slopes with thick vegetation
Mt.Kale(?)	The slag of old mining activity was detected in the two localities. No mineralization in the zones	
Öcür	The alternation of black shale and sandstone of Küre Formation is predominant. The mineralizations of pyrite are observed in basaltic rocks of the Küre Formation. The geochemical anomalies are detected in these zones.	
Furuncuk		

The previous work is not conducted geophysical prospecting and drilling survey in the Dikmendağ Zone.

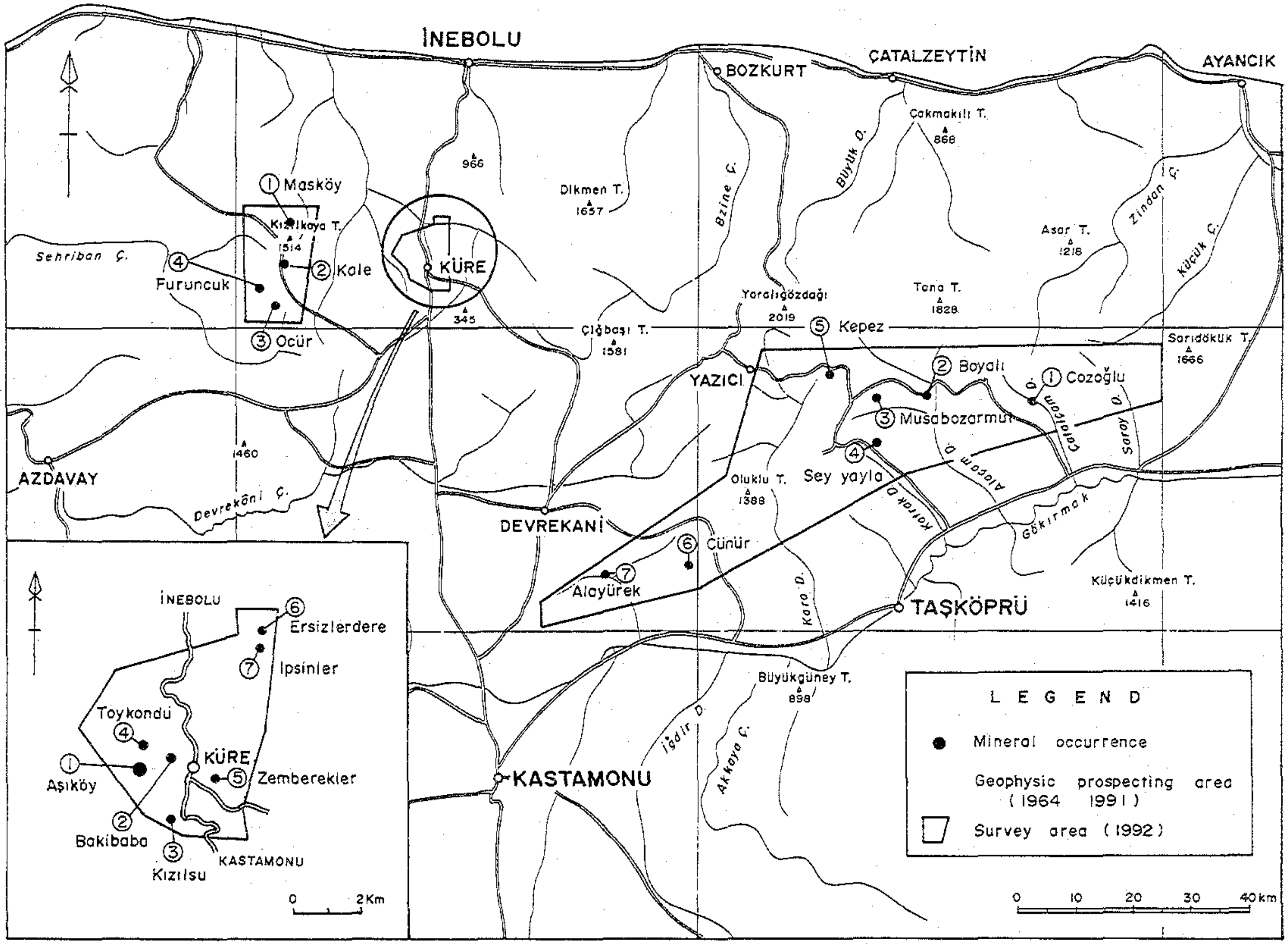


Figure 2-41 Compiled Map of the Previous Works in the Küre Area

PART 3 KÜRE MINING ZONE

PART 3 KÜRE MINING ZONE

CHAPTER 1 GEOLOGY OF KÜRE MINING ZONE

1-1 Outline

Prior to the field survey of the first year, all existing data and information regarding the geology and mineral resources of the area were studied and analyzed. As there is an operating mine, the Küre Mining Zone is considered to be a very promising part of the country. And the field work was carried out in semi-detail with 1:5,000 scale geological mapping over 22km^2 and 500 stations for CSAMT array and 3km of IP.

The zone was previously surveyed geologically by Güner (1980) of MTA and Pehlivanğlu (1985) of Etibank. The maps produced are shown in Figures 2-8 and 2-25. Both of these are lithofacies maps with neither formation names nor correlation with adjacent areas.

Regarding previous geophysical work, SP, electromagnetic, and IP methods targeted on shallow subsurface zones were carried out from the surface for all known deposits and mineral showings. But the deeper zones have been left unexplored.

Exploration for satellite orebodies in the vicinity of known deposits by exploration adits was not carried out because of the costs involved. Drilling was carried out for reserve calculation of Aşıköy, Toykondu, Bakibaba and Kızılsu Deposits, but these are all known ores and search for new orebodies has not been made.

The present first-year survey clarified that the geology of the major part of the zone consists of Küre Formation comprising Lias basalts and sandstone-shale alternation. Also mineralization was found to occur in the Küre Formation at the boundary between hyaloclastite and black shale and within the hyaloclastite. The deposit is formed of massive ore and network ore both composed of large amount of pyrite and minor chalcopyrite. CSAMT measurements revealed anomalies indicating promising prospects in the vicinity of the known deposits.

1-2 Survey Methods

The geological and geophysical field survey was planned after detailed analysis and interpretation of existing information and data including satellite images.

Geological route maps were prepared using 1:5,000 scale topographic maps. The Aşıköy Deposit was surveyed using 1:1,000 scale open pit maps. The results of the geological survey are expressed as 1:5,000 scale geological maps. The total length of survey route was 110km. The laboratory works carried out on samples collected during the geological survey are; thin section observation 65, polished section observation 56, total chemical analysis 16, ore assay 89, EPMA analysis 7, X-ray diffraction 9, sulfur isotope analysis 7, resistivity IP measurement 43.

CHAPTER 2 GEOLOGY OF THE KÜRE MINING ZONE

2-1 Outline of Geology and Ore Deposits

The geology of the zone consists of pre-Jurassic ultramafic rocks, Jurassic basalts, black shale and sandstone of the Küre Formation, Lower Cretaceous greyish white fossiliferous limestone of Karadana Formation, pale brown and white marl and talus deposits of the Çağlayan Formation, and also intrusive diorite and dacite. The Jurassic Küre Formation occupies the major part of the zone and its basalts are pillow lava, hyaloclastite, and massive basalt.

The geologic structure of this zone is characterized by a large number of faults. These are mainly grouped into N-S and E-W systems, the latter transects the former system. With the exception of the diorite and dacite intrusive bodies and the Karadana Formation, the boundaries of all geologic units, including the ultramafic bodies, have been displaced. Also within the Küre Formation, displacement is observed as scaly cleavage of the black shale. Because of the above, the existence of fold structure is not clear. The surface elongation of the intrusive bodies is harmonious with the strike of the faults in the vicinity and particularly with the boundary between the sediments and the basalts of the Küre Formation.

Aşıköy, Toykondu, Bakibaba, and Kızılsu are the known ore deposits in this zone. These deposits occur at the boundary between the hyaloclastite and black shale of the Küre Formation and also within the hyaloclastite. They consist of massive ore containing a large amount of pyrite with smaller amount of chalcopyrite and minor sphalerite and network ore with similar mineral content. The geologic environment, occurrence, and the mineral composition of these orebodies indicate the characteristics of the Cyprus-type ore deposits.

A schematic geological column, a geological map, and a geological cross section of the zone are shown in Figures 3-1, 3-2, and 3-3 respectively.

2-2 Stratigraphy

2-2-1 Ultramafic Rocks

Distribution:The ultramafic bodies are distributed widely in the vicinity of Mt. Karamanyayla, Mt. Elmakütüğü, and Ömeryılmaz Village. They also occur in small bodies to the north and to the south-southwest of Bakibaba.

Lithology and occurrence:These rocks are the oldest rocks exposed in the zone and comprise black massive pyroxenite, peridotite and serpentine. They are holocrystalline and contain serpentinized pyroxene, olivine, and small amount of plagioclase. They are in fault contact with the Küre Formation. These rocks do not have banded structure and have not exerted thermal metamorphism to the surrounding bodies. Thus they are considered to have intruded in solid state.

2-2-2 Küre Formation

Type locality:The middle to upper reaches of the Zemberekler Stream in the central part of the zone.

Thickness:Over 2,000m

Distribution:This formation occurs in the major part of the zone with the exception of; the vicinity of the Mt. Elmakütüğü in the eastern part of the zone, the southernmost part, near the Mt. Karamanyayla, Mt. Elmakütüğü, and the Ömeryılmaz Village.

Lithology and occurrence:This formation is composed of basalts, black shale, and sandstone.

The basalts are largely divided into pillow lava, hyaloclastite, and massive basalt. They are shown separately in the geological map where by the predominant rock type.

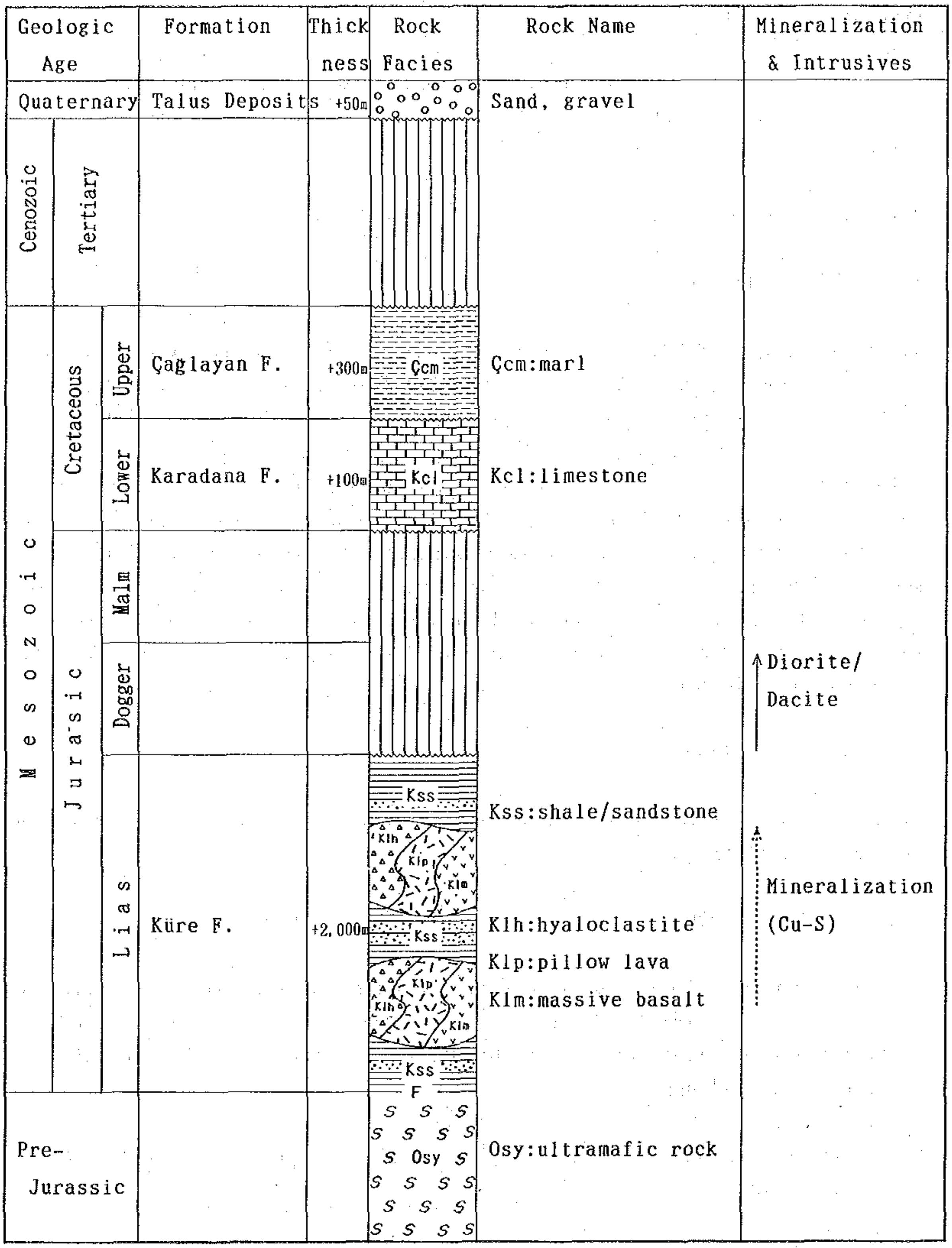


Figure 3-1 Schematic Column in the Küre Mining Zone

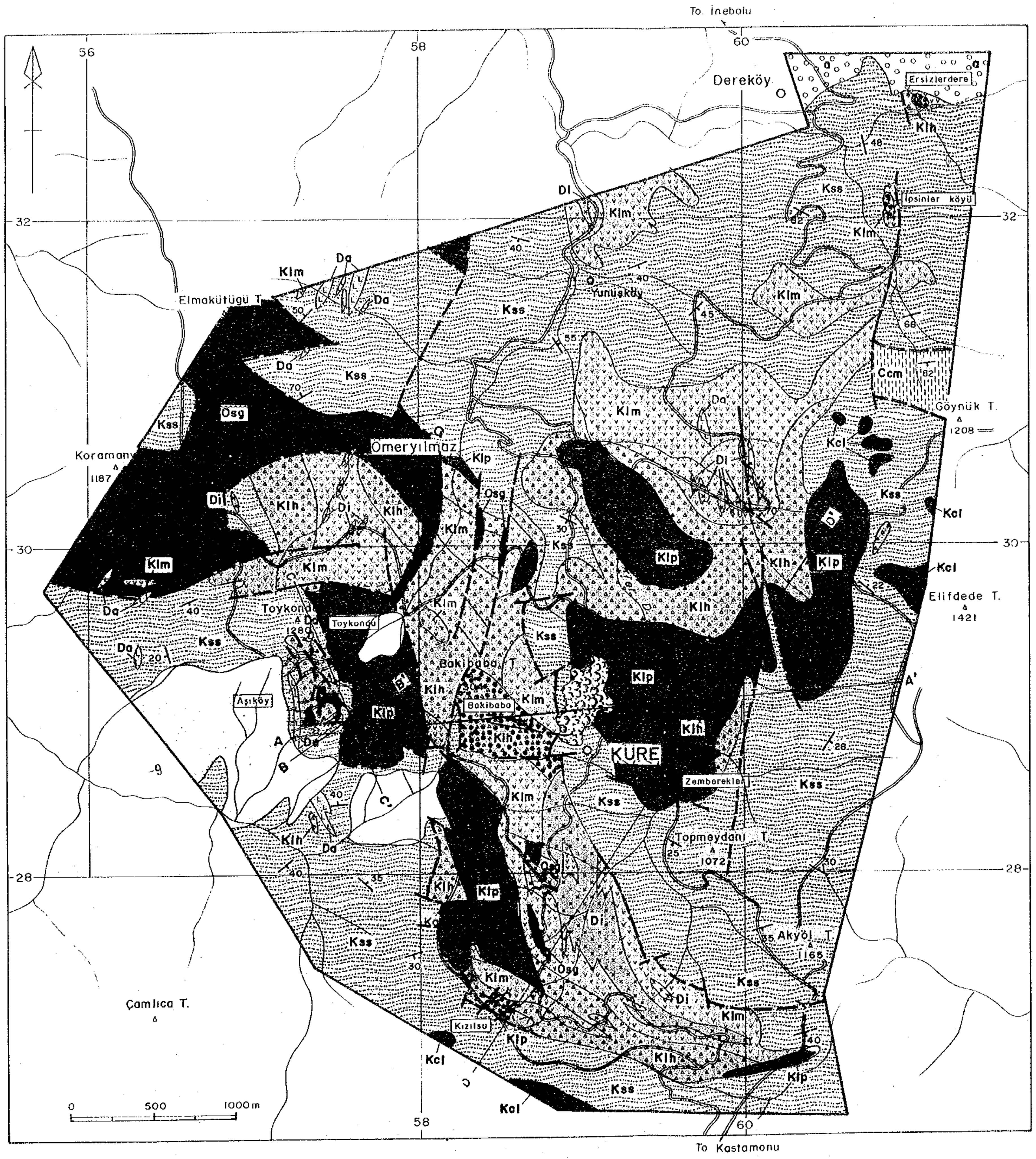


Figure 3- 2 Geologic Map of the Küre Mining Zone

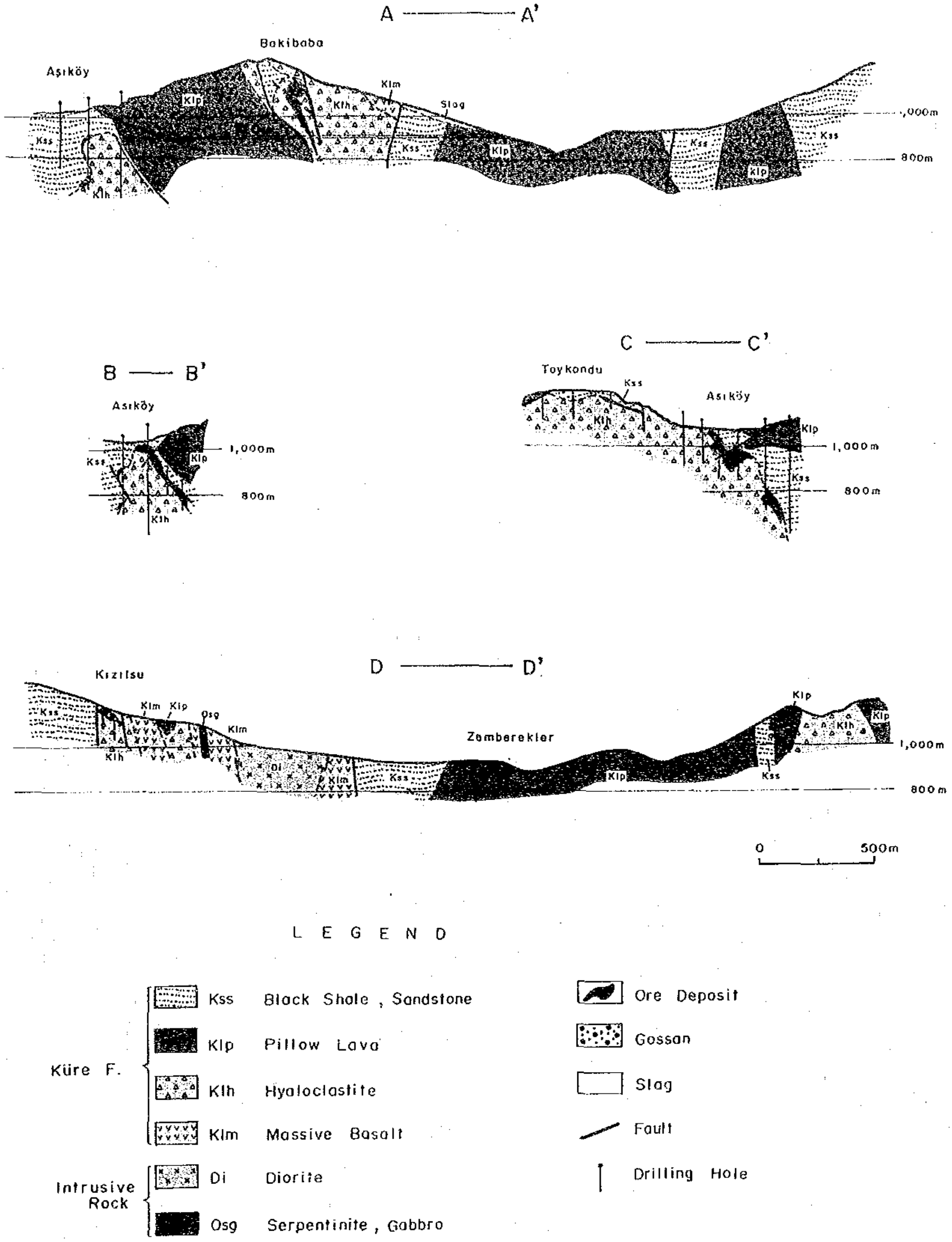


Figure 3-3 Geologic Cross Sections of the Küre Mining Zone

The pillow lava is dark grey to dark greenish grey. It occurs as close-packed pillow lava, pillow breccia, or pillow lava. The pillows are oval or spherical and the long diameter is 1.5 - 2m. Where close-packed pillows occur, they are partly accompanied by massive basalt and rarely is associated with hyaloclastite. These are distributed in the upper reaches of the Zemberekler Stream and to the east of Aşıköy Orebody. The pillows of the pillow breccia and pillow lava are often spherical and the maximum diameter is about 1m. These rocks are often accompanied by massive basalt and hyaloclastite and occur in the middle reaches of Zemberekler Stream and near the Mt. Karacakaya.

The hyaloclastite is greenish grey. It contains lapilli-size rock fragments and the matrix is fine-grained. It also include many fragments of pillows. The lapilli-size fragments are mafic glass and basalts and their color is similar to that of the matrix. It is often accompanied by massive basalt. Peperite with argillaceous matrix is found to the east of the upper part of the Zemberekler Stream.

Massive basalt is dark grey to greenish grey and the outcrops appear homogeneous under observation by unaided eyes.

Although the mode of occurrence of the basalts are distinct as described above, there seems to be no characteristic microscopic texture associated with these types of occurrence. These rocks show various textures with plagioclase and Egypt phenocrysts and matrix consisting of plagioclase, clinopyroxenes and opaque minerals. Even those appearing fresh contain alteration minerals such as calcite and other carbonates, sericite, chlorite, epidote and rarely prehnite. Parts of the pillow lava are spilitized.

Sandstone is fine- to medium-grained quartz wacke and it occurs as thick beds, alternation with black shale, or as lenses in black shale.

The black shale often has scaly cleavage particularly when lenses of sandstone are intercalated.

This formation is in fault contact with the lower ultramafic bodies.

2-2-3 Karadana Formation

Type locality:Karadana Village to the south of the Küre mine (outside of the survey area).
Thickness:Over 100m.

Distribution:This unit occurs unconformably overlying the lower Küre Formation in the vicinity of the Mt. Elifdede in the easternmost part and at the southernmost part of the zone.

Lithology and occurrence:The formation consists of greyish white fossiliferous limestone.

2-2-4 Çağlayan Formation

Type locality:Çağlayan Village to the east of the Küre mine (outside of the survey area).

Thickness:Over 300m.

Distribution:This formation occurs in small scale on the northwestern side of Mt. Göynük in the eastern part of the zone. It is in fault contact with the lower Küre Formation.

Lithology and occurrence:It consists of stratified pale brown marl.

2-2-5 Talus Deposits

Thickness:Over 50m.

Distribution:This occurs in the northeasternmost part of the zone.

Lithology and occurrence:The talus is developed at the foot of the mountains formed by Çağlayan limestone in the northeastern part of the zone. It contains a large amount of limestone breccias.

2-3 Intrusive Rocks

2-3-1 Diorite

Diorite occupies 0.2 x 2km of the eastern part of Mt. Karacakaya and also occur as small bodies in various parts of the zone. It often is intruded into the massive basalt of the Küre Formation. These bodies consist of pale green diorite and dark green gabbro, they are holocrystalline with phenocrysts of plagioclase, hornblende, and augite.

2-3-2 Dacite

Dacite bodies occur as relatively thin dykes in the Küre volcanics or in mudstones near Mt. Elmakütüğü in the northwesternmost, in the westernmost parts, to the west of Aşıköy, and to the northeast of Bakibaba. Dacite is grey and has porphyritic texture with phenocrysts of quartz, plagioclase, biotite, and matrix consisting of secondary fine-grained quartz and chlorite.

2-4 Geologic Structure

2-4-1 Fold Structure

The attitude of the boundary between the black shale and the sandstone of the Küre Formation vary considerably. It can be said from the frequency distribution of the attitude of the boundary that NE-SW and NW-SE and 30°-60°S would be the most frequent strike and dip throughout the zone. In the northern part of the zone NW-SE strike and southward dip are most common, while in the south NE-SW strike and southward dip are often observed.

Folds are not observed in the outcrops. There are many faults in this zone as will be mentioned later. The scaly cleavages of the black shale is considered to be shear plane with small displacement. The beds of this zone are displaced considerably by faults including the shear planes and thus the existence of fold structures is not clear.

2-4-2 Fault Structure

With the exception of diorite and dacite intrusives and Karadana Formation, the boundaries of all geological units including the ultramafic bodies are displaced. Also displacement is confirmed within the Küre Formation by the scaly cleavages of the black shale.

The faults observed in the Küre Formation are grouped into N-S and E-W systems, the latter transecting the former system. It is considered from the results of the prospecting at Aşıköy Pit and other points, that the former fault system has a larger vertical displacement. The boundary between the ultramafic and the Küre Formation appears to be a junction of the three fault systems, namely NW-SE, N-S and NE-SW.

The direction of surface elongation of the intrusive bodies is harmonious with the strike of the faults in the vicinity, particularly the boundary of the sedimentary rocks and the basalts of the Küre Formation.

CHAPTER 3 KÜRE DEPOSIT

3-1 Aşıköy-Toykondu Deposits

These orebodies are distributed in an area extending northward from the vicinity of the Aşıköy Pit. The Toykondu Orebody extends to the north from the northern part of the Pit and the Aşıköy Orebody is located from the central part of the Pit to the south. The Aşıköy Orebody is observed at the open pit and the lower and lateral extension is confirmed by drilling. A part of the Toykondu Orebody can be observed at the open pit, but the major part is explored only by drilling.

A planar map and cross section of the Aşıköy Orebody and a sketch of the Toykondu Orebody at the open pit are shown in Figures 3-4 and 3-5 respectively.

3-1-1 Geology and Geologic Structure

The geology of the vicinity of the Aşıköy Orebody is composed of black shale, sandstone, hyaloclastite, and pillow basalt of the Küre Formation and of dacite which intruded into the shale and sandstone. Pillow lava occurs to the east of the open pit; orebody, black shale, sandstone, hyaloclastite in the central part of the open pit; and black shale and sandstone and dacite occur elongated in the north-south direction in the western part of the open pit.

The geology of the vicinity of the Toykondu Orebody consists of black shale and sandstone of the Küre Formation and dacite.

Many faults are developed near the Aşıköy-Toykondu Deposits. These are grouped into the following three systems, namely N-S, E-W, and NE-SW systems. The dip is not constant, but is generally steep (50°-80°). There are many scaly cleavages in the black shale, but the shale is massive without cleavages directly over massive ore.

3-1-2 Orebodies and Alteration

The Aşıköy Orebody occurs at the boundary of black shale and hyaloclastite of the Küre Formation or in the hyaloclastite. The ore occurs as massive, boulder, conglomeratic, and network types. The massive ore is more or less homogeneous to the unaided eyes, the boulder ore is subrounded to subangular ores of 10-30cm and occur in black shale, conglomeratic ore occurs with chalcopyrite and pyrite filling the interstices of the boulder ore, the network ore is emplaced in hyaloclastite.

The Aşıköy Orebodies are composed of a body situated in the central part of the open pit, that on the northern side of the open pit, and another to the southwest of the open pit. The northern orebody consists of massive ore extending 70 x 20m laterally and conglomeratic ore in the black shale adjacent to it to the south. The central body extends 380m east-west and 200m north-south, the ore is of massive and network type. The lateral distribution of the massive ore is convex southward.

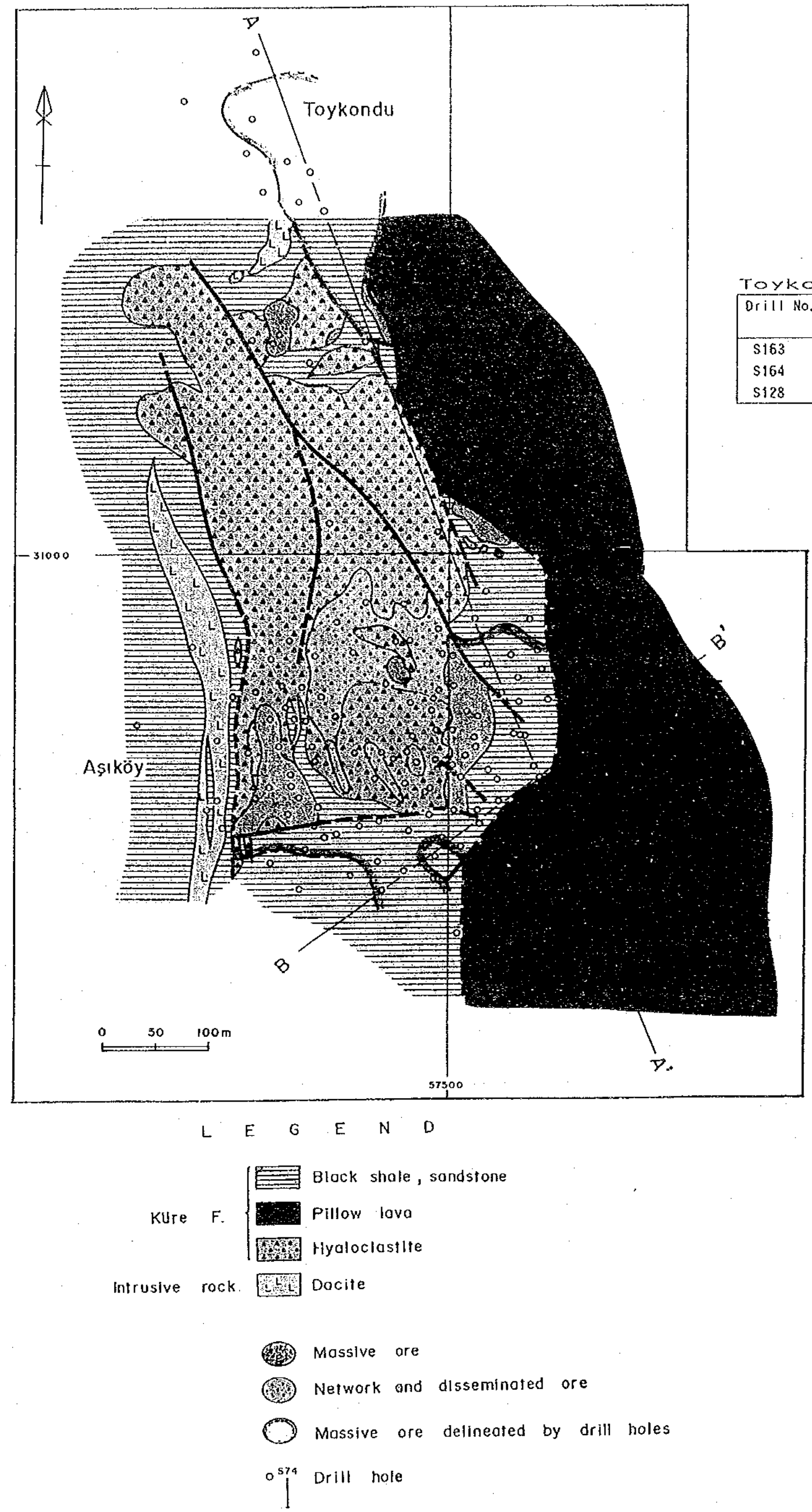
The attitude of the boundary between the massive ore in the eastern part of the open pit and the overlying black shale is N-S strike and 50°-70° E and the thickness of the orebody is 15-35m. The grade of the massive ore in the drill cores is Cu 1-9%, S 40-48%. The network ore occurs as 0.1-1cm thick pyrite, chalcopyrite, quartz veinlets in hyaloclastite with dissemination of the sulfide minerals. The host rock of the network ore is generally green, but it is bleached and silicified where the network is dense and strongly disseminated. Most of the altered minerals is quartz with minor amount of sericite (Table 1-15). The results of the chemical analysis of the massive and network ores are laid out in Table 1-18 (1) and (2).

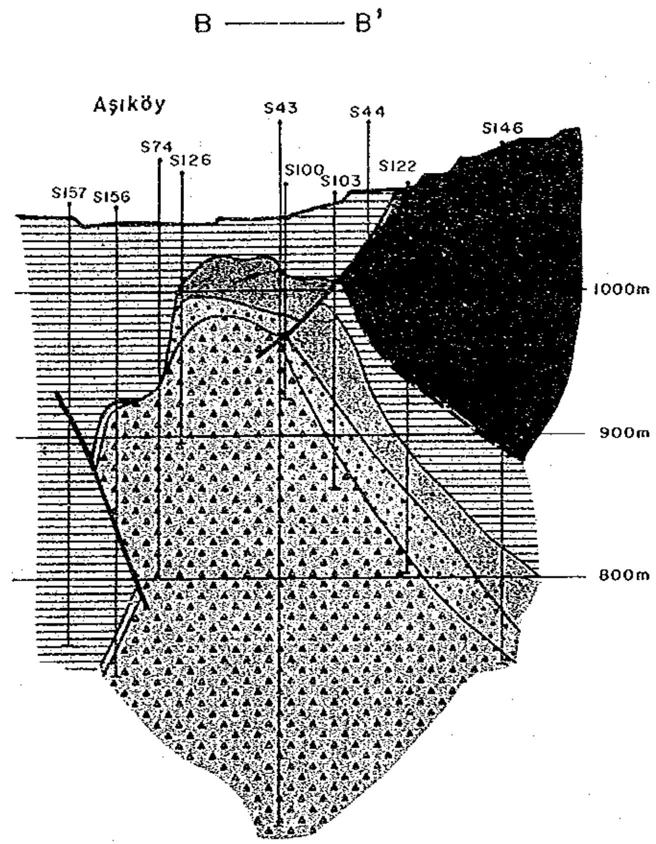
The hyaloclastite on the footwall side of the massive ore is sometimes silicified for a thickness of 1-3cm with large amount of quartz and minor sericite.

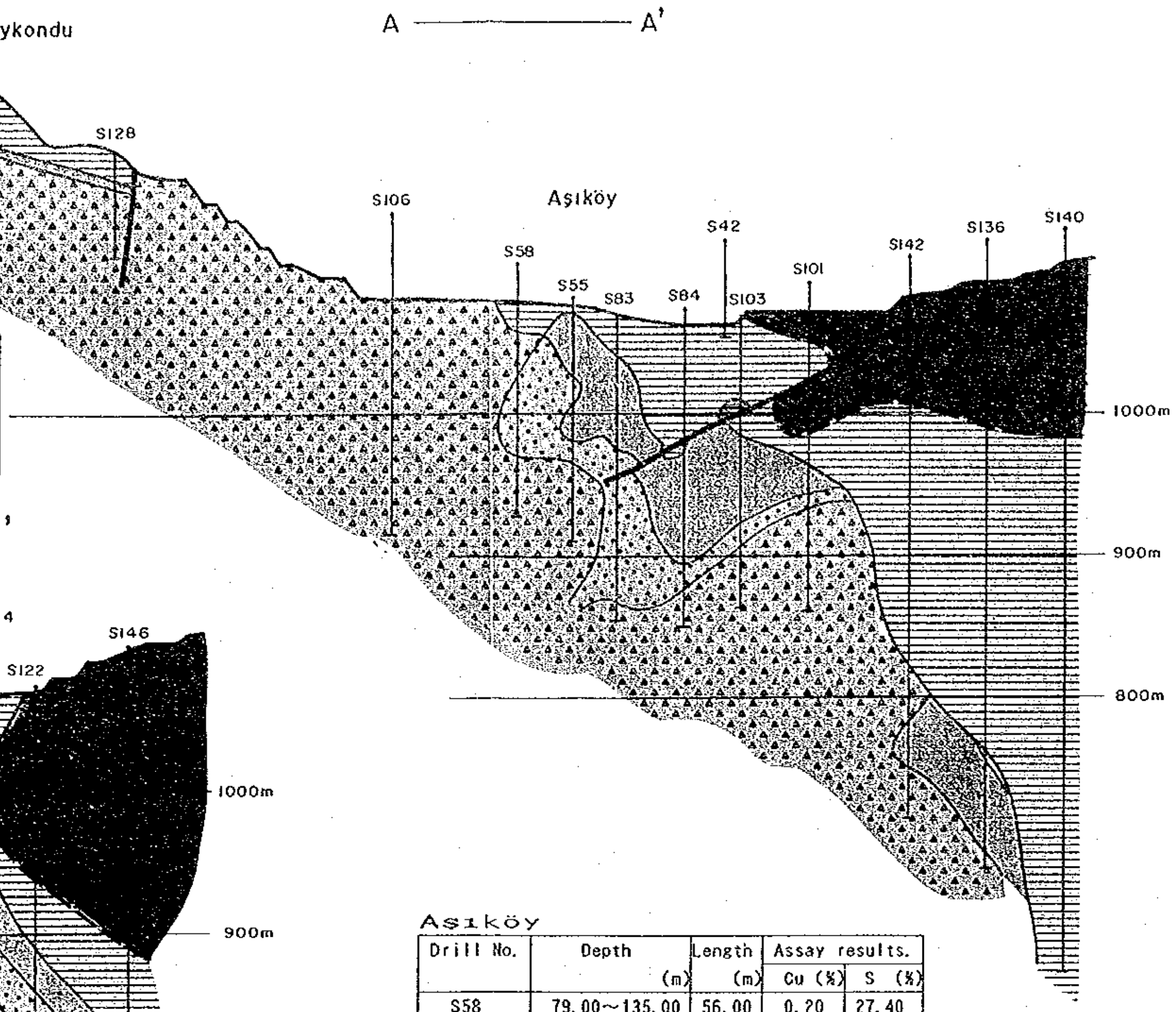
The orebody to the southwest of the open pit consists of massive and network ore confirmed by drilling. The southwestern extent of the body is not yet confirmed.

The massive ores of the Aşıköy Orebody is composed of a large amount of pyrite, smaller amounts of chalcopyrite, sphalerite, marcasite, minor amounts of covelline, tetrahedrite, and pyrrhotite. The gangue minerals are mostly quartz, rarely rutile, leucoxene, clay and carbonate minerals. The constituents of the network and disseminated ores are the same as massive ores.

The Toykondu Orebodies consists of massive orebodies with 200 x 50m lateral extent and several smaller ones of 50 x 20m or less. These are situated to the north of the open pit. The thickness confirmed by drilling of these bodies is 3-15m, the grade of the cores is Cu 1-4%, S 32-51%.







Toykondu

Drill No.	Depth (m)	Length (m)	Assay results. Cu (%)	S (%)
S163	22.00～ 25.70	3.70	4.34	44.65
S164	39.20～ 47.50	8.30	6.92	45.35
S128	23.00～ 29.10	6.10	2.60	35.77

Aşıköy

Drill No.	Depth (m)	Length (m)	Assay results. Cu (%)	S (%)
S156	135.00～142.00	7.00	3.15	28.08
	300.50～313.80	13.30	2.47	26.95
S126	72.35～ 88.10	15.75	1.99	44.62
	88.10～116.25	28.15	0.70	21.66
S43	90.30～138.20	47.90	1.31	48.52
S100	58.00～ 85.40	27.40	1.76	46.32
	85.40～ 99.65	14.25	0.84	18.37
	120.80～144.00	23.20	0.25	8.81
S103	61.50～ 73.40	11.90	1.36	46.44
	86.75～149.00	62.25	1.22	45.15
	149.00～167.50	18.50	0.08	27.51
S122	186.00～209.50	23.50	8.53	42.65
	209.50～234.00	24.50	3.71	26.90
	234.00～258.00	24.00	0.44	10.18
S146	279.00～326.00	47.00	5.00	43.92
	335.50～361.00	25.50	0.36	12.04

Aşıköy

Drill No.	Depth (m)	Length (m)	Assay results. Cu (%)	S (%)
S58	79.00～135.00	56.00	0.20	27.40
S55	10.08～ 42.00	31.92	3.62	44.71
	42.00～ 66.00	24.00	2.48	38.14
	66.00～ 76.00	10.00	1.43	31.06
	76.00～106.50	30.50	0.61	49.94
	106.50～118.50	12.00	0.83	35.02
S83	32.00～ 46.00	14.00	9.40	36.44
	46.00～102.00	56.00	1.85	40.99
	104.00～210.50	106.50	0.37	19.16
S84	103.90～184.60	80.70	3.09	47.02
	184.60～189.70	5.10	0.59	18.15
S103	61.50～ 73.40	11.90	1.39	46.44
	86.75～149.00	62.25	1.23	45.15
	149.00～167.50	18.50	0.08	27.50
S101	127.75～151.80	24.05	2.53	42.03
	151.80～166.10	14.30	1.64	18.42
S142	294.00～295.65	1.65	3.66	38.30
	328.00～357.50	29.50	0.47	42.66
	357.50～397.00	39.50	0.09	35.21
S136	372.50～435.25	62.75	3.19	47.54

Figure 3- 4 Geologic Map and Cross Sections of the Aşiköy Orebody