REPORT
ON
THE MINERAL EXPLORATION
IN
THE CANAKKALE AREA
REPUBLIC OF TURKEY

PHASE II

FEBRUARY 1990

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

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PREFACE

In response to the request of the Government of the Republic of Turkey, the Japanese Government decided to conduct a Mineral Exploration Project in the Çanakkale Area and entrusted the survey to Japan International Cooperation Agency (JICA) and Metal Mining Agency of Japan (MMAJ).

The JICA and MMAJ sent a survey team headed by Mr. Hisashi Mizumoto to the Republic of Turkey from 26 June to 30 November, 1989.

The team exchanged views with the officials concerned of the Government of the Republic of Turkey and conducted a field survey in the Çanakkale area. After the team returned to Japan, further studies were made and the present report is the result.

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

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

February 1990

Kensuke Yanagiya

Kensuke YANAGIYA
President,
Japan International Cooperation Agency

Gen-ichi FUKUHARA
President,
Metal Mining Agency of Japan

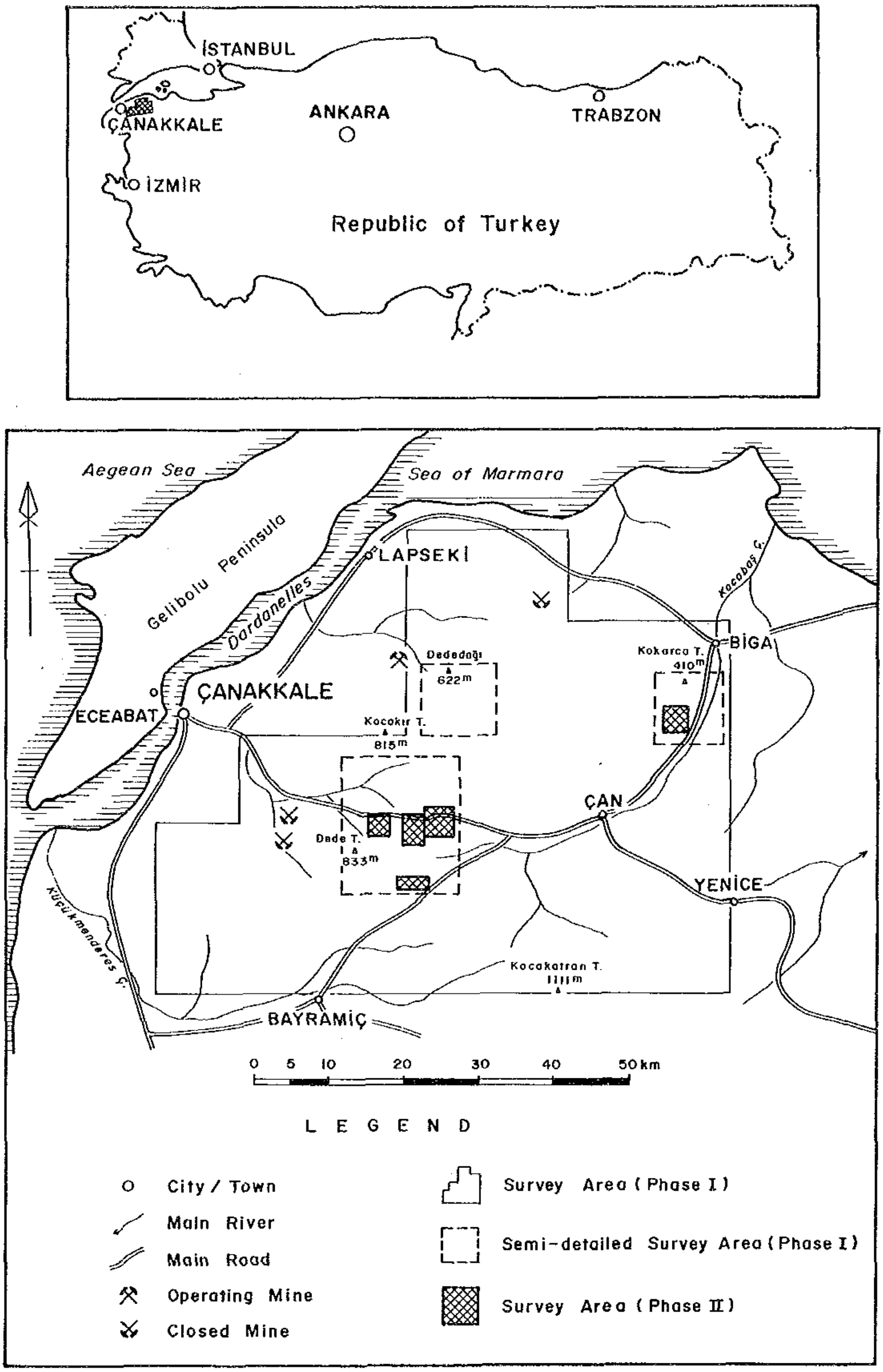

Fig. 1-1 Index Map of the Survey Area

Summary

The objective of the present survey was to clarify the mode of occurrence of various metal deposits of the Çanakkale Area.

Prior to the survey in the first phase, Landsat images totaling 3,400km^2 in areal extent were analyzed and interpreted; available data regarding previous work on geology and geochemical prospecting were acquired and studied. From the results, Zones A and B were isolated as warranting investigation for precious metals, and Zone C for metallic deposits.

In addition to the geological survey, chip samples were systematically collected for geochemical prospecting, and heavy mineral investigation was carried out. Also, the remainder of the stream sediment samples previously collected by MTA was analyzed for gold and other additional elements. As a result of the survey in the first phase, four localities (Arlık Dere, Karaibrahimler, Kestane Dagı and Piren Tepe) in Zone B and one (Dikmen) in Zone C were isolated as promising.

In the second phase, surveys were as follows:

Localities	Route Length	Geophysical Prospecting	Drill Survey
Arlık Dere	76km		604m(4 holes)
Karaibrahimler	69km		
Kestane Dagı	58km		
Piren Tepe	62km		302m(2 holes)
Dikmen	64km	8km(4 lines)	
Total	329km	8km	906m(6 holes)

(1) Arlık Dere: Many rock samples containing gold were found in the silicified zones, and gold mineralization zones of low grade were detected by drill survey conducted in the Güvemalanı silicified zones.

(2) Karaibrahimler: Significant amounts of gold were detected in the down-stream section from Karaibrahimler Village, but rock samples containing gold were not found.

(3) Kestane Dagı: Many more rock samples containing gold were found in the silicified zones, but the Tüprag Co.(Turkey) has commenced exploration with a foreign company (West German) in this locality.

(4) Piren Tepe: Rock samples containing gold were found in the western and eastern parts of silicified zones. Gold mineralization zones of low grade were detected by drill survey carried out in the western parts.

(5) Etili: Significant amounts of gold were detected in heavy mineral samples (soil) collected from the vicinity of the hot spring.

(6) Dikmen: A porphyry molybdenum-copper mineralization associated with the intrusion of the Dikmen Granite and porphyry was discovered. The subsurface extent of mineralization from the outcrop downward was shown by delineating the PFE anomalies by geophysical methods.

The mineralizations of the survey areas are largely divided into epithermal and dissemination (porphyry molybdenum-copper) types. Epithermal-type mineralization is low-grade large-scale gold deposits in Zone B. The dissemination type is found in Zone C. It is associated with the intrusion of Dikmen Granite and porphyry, and also, low-grade (molybdenum-copper) mineralization is developed in the host rocks.

Concerning the relationship between geologic structure and mineralization, serpentinite and Dikmen Granite, together with the associated porphyry, and epithermal mineralization are arranged in the direction of the major lineaments, NE-SW and E-W. In Zone B, gold mineralization is observed associated with the NE-SW faults near the uplifted basement and with the younger NEN-SWS and NW-SE fractures.

As for the geochemical anomalies and mineralization zones, it was concluded that rock chips are more effective indicators, and delineation was carried out by component scores of a multivariate analysis method. This conclusion is based on the analysis of 605 chip samples and the results of the analysis of 52 heavy mineral samples. Gold grains were found in heavy mineral samples about 1~2km downstream of the exposures and this agrees with the results of rock chip analysis.

A comprehensive study of the above work resulted in delineation of the following zones for future prospecting.

Zone B: Geochemical anomalies of gold were discovered in the silicified and argillized alteration zones in the Miocene Şapçı Volcanics which are distributed in the vicinity of the basement complex. The basement is composed of the Taşdibek Formation and granites. From the mineralization and extent of the geochemically anomalous zone, the four localities (Arlık Dere, Kestane Dağı, Piren Tepe and Etili) are expected to bear large-scale low-grade gold deposits.

Zone C: A porphyry molybdenum-copper deposit associated with the intrusion of Dikmen Granite and porphyry was discovered in this zone. Molybdenite, chalcopyrite, pyrite and other sulfide minerals occur in minor amounts and analysis of rocks showed the association of gold, arsenic, and other metals. Thus it is considered that epithermal mineralization occurred after the porphyry molybdenum mineralization, and that the two overlapped. It is supposed that this type of mineralization extends to the lower parts and should prove to be a large-scale low-grade deposit. If gold can be found in significant amounts in the overlapped part, this would be an important future target.

The objective of the third phase is to clarify the subsurface extension of the mineralized zone. It is recommended that drill survey be conducted in the promising areas delineated above.

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PART I OVERVIEW

CHAPTER 1 INTRODUCTION

1-1 Background and Objective of the Survey

The survey was conducted with the purpose of clarifying the metal deposits and of assessing the metallic resource potential of the Çanakkale Area. Prior to the field survey, data related to previous geoscientific work were studied, and Landsat image analysis of an area of 3,400km^2 was carried out. As a result of these studies, three promising Zones, A, B and C, were delineated for field work of the first phase. Geological survey and geochemical prospecting were conducted in these zones.

1-2 Conclusions and Recommendations of the First Phase

1-2-1 Conclusions of the First Phase

Geological survey was carried out over a total area of 500km^2 consisting of Zones A(100km^2), B(300km^2) and C(100km^2). Mineralized zones and alteration zones were located, and the dimensions and the nature of mineralization were clarified. Regarding geochemical prospecting, data from both previous MTA work and the first phase survey were analyzed. The results revealed the scale and grade of mineralization and the promising anomalies. Four localities in Zone B and one in Zone C were isolated as promising. The geologic environment and the extent of the geochemical anomalies indicate that these localities listed below, have high resource potential and warrant further detailed survey.

(1) Arlık Dere	epithermal gold mineralization
(2) Karaibrahimler	epithermal gold mineralization
(3) Kestane Dagı	epithermal gold mineralization
(4) Piren Tepe	epithermal gold mineralization
(5) Dikmen	porphyry molybdenum-copper mineralization and epithermal gold mineralization

Localities (1)～(4) above are located in the Şapçı Volcanics, and gold anomalies were delineated in the alteration zones during the first phase survey.

(1) Arlık Dere: A significant amount of gold grains was found from the heavy mineral samples collected from Arlık Stream. Also, fairly large silicified and argillized zones were found in the upstream parts of this locality, and many rock samples from the silicified zones also contained gold.

(2) Karaibrahimler: A significant amount of gold was detected in all samples collected from the section downstream of Karaibrahimler Village, a locality upstream of the village where the three streams join and from the silicified, argillized alteration zones nearby. The Şapçı Volcanics have suffered hydrothermal alteration in this vicinity. The gold grains are, in some cases, as large as over 300μm, but most of them are smaller than 50μm. Their shapes are irregular, amoebic, and they are presumed to have been transported from 1～2km upstream. Gold grains were also found in Şarp Stream in the western part of the silicified body. At two localities here, the ore is accompanied by barite.

(3) Kestane Dagı: Gold grains were found from five localities, two from the western stream and three from western part of Kestane Mountain. Large grains exceeding 300μm were found. These gold grains are inferred, from the shape, to have been transported from 2～3km upstream. Here also, the Şapçı Volcanics have suffered silicification and argillization. Galena is the associated heavy mineral.

(4) Piren Tepe: Gold anomalies were detected in the silicified zone which is located in the south of the large alteration zone. The zone extends in the E-W direction in the vicinity of the Piren Hill.

(5) In Zone C, a porphyry molybdenum-copper deposit associated with the intrusion of the Dikmen Granite was discovered. The mineralization extends from the eastern side of the Dikmen Granite, which extends in a NW-SE direction to the Emeşe Formation in the Sıgırirek Stream. The Emeşe Formation is altered and minor amounts of sulfides such as molybdenite, chalcopyrite, wolframite, sphalerite and pyrite occur in the quartz veinlets. The analytical results show the existence of gold, arsenic, mercury and antimony. This indicates that epithermal mineralization occurred after the porphyry-molybdenum mineralization and they now overlap spatially.

The results of the first phase work summarized above in (1)～(4), indicate the possibility of large-scale low-grade gold deposits in the alteration zones near the basement rocks. The porphyry molybdenum deposit mentioned in (5) is also expected to be a large-scale low-grade deposit as this type of mineralization is extensive at depth. This deposit locally contains gold and antimony, and it may turn out to be a very important target if significant gold is found in the overlapping portion.

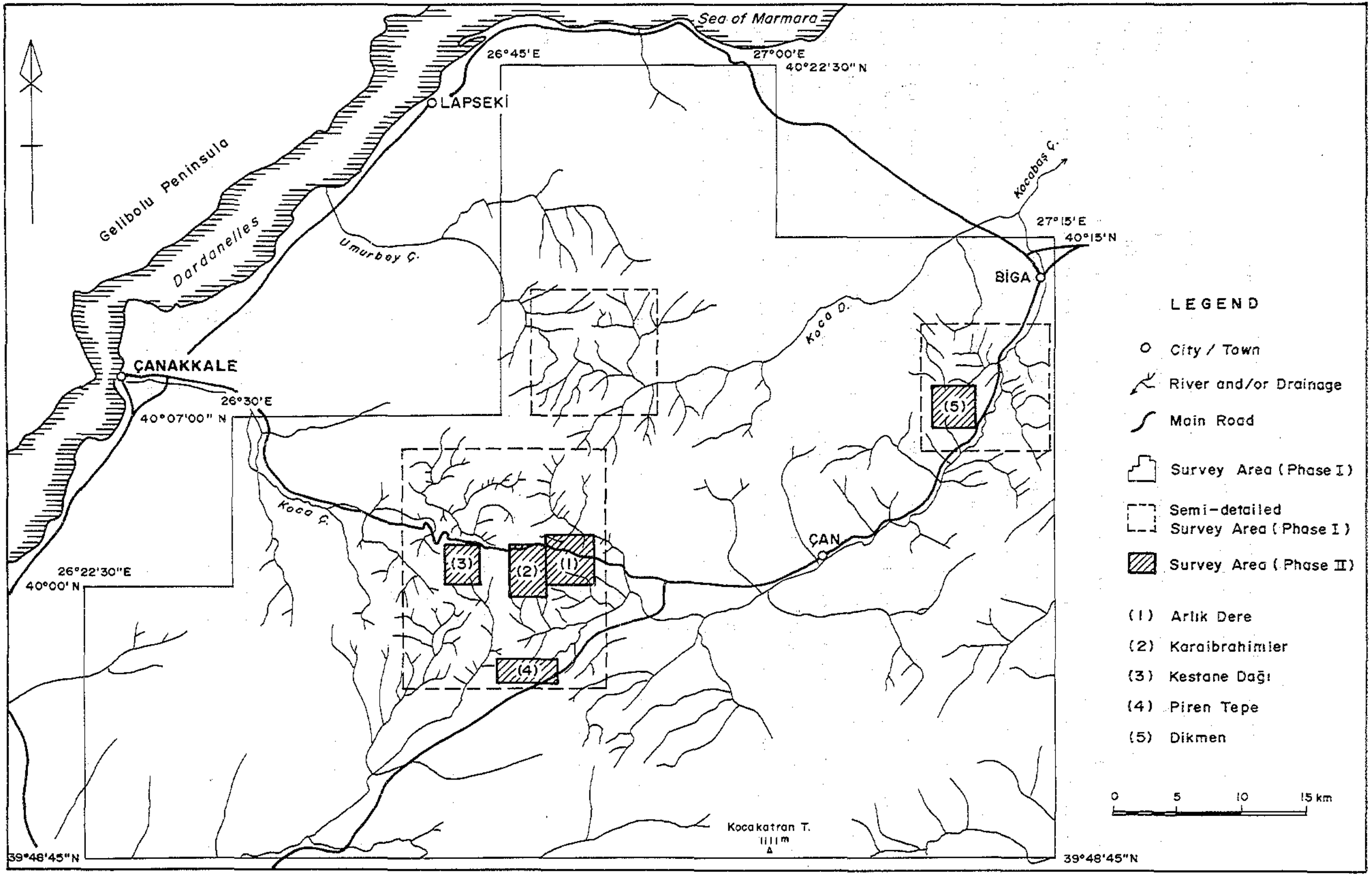

Fig. 1-2 Location Map of the Survey area

1-2-2 Recommendations of the First Phase

It was recommended that the following work be conducted in the promising areas delineated above (Figure 1-2).

In the four localities of Zone B, epithermal gold mineralization is anticipated from the gold showings of the alteration zones which were identified by geological and geochemical surveys. The hydrothermal gold mineralization is expected to extend both horizontally and vertically. Here, detailed geological survey can clarify the distribution and extent of the alteration zone and the investigation of the heavy minerals in the vicinity should locate the position of the gold mineralization. On the basis of the findings of these surveys, inclined drilling should be carried out in order to clarify the state of subsurface mineralization.

Regarding the Dikmen Granite of Zone C, geophysical prospecting should be carried out together with detailed geological survey and geochemical prospecting. Detailed geological survey should clarify the distribution and conditions of gold occurrence, argillized zones and skarnization. The geochemical work should clarify the two types of mineralization. By geophysical methods, the subsurface extent of mineralization from the outcrop downward may be shown by delineating the low resistivity zone and FE anomalies by IP; then detailed SIP work is expected to provide the necessary information.

1-3 Areal Extent and Work Operation of the Second Phase Survey

1-3-1 Coordinates and Contents of the Survey Areas

The five localities surveyed during the period of this report is 61km^2 bounded by the following coordinates (Figure 1-2):

	Latitude	Longitude	Area
(1) Arlık Dere	40° 02′ 15″	26° 47′ 21″	16km^2
	40° 02′ 15″	26° 50′ 09″	
	40° 00′ 05″	26° 50′ 09″	
	40° 00′ 05″	26° 47′ 21″	
(2) Karaibrahimler	40° 01′ 41″	26° 45′ 14″	12km^2
	40° 01′ 41″	26° 47′ 21″	
	39° 59′ 32″	26° 47′ 21″	
	39° 59′ 32″	26° 45′ 14″	
(3) Kestane Dagı	40° 01′ 41″	26° 41′ 44″	9km^2
	40° 01′ 41″	26° 43′ 50″	
	40° 00′ 05″	26° 43′ 50″	
	40° 00′ 05″	26° 41′ 44″	
(4) Piren Tepe	39° 57′ 22″	26° 44′ 33″	12km^2

	39°57′22″	26°47′44″	
	39°55′45″	26°47′44″	
	39°55′45″	26°41′33″	
(5) Dikmen	40°08′44″	27°08′27″	12km²
	40°08′44″	27°10′55″	
	40°06′50″	27°10′55″	
	40°06′50″	27°08′27″	

Localities	Route Length	Geophysical Prospecting	Drill Survey
Arlık Dere	76km		604m (4 holes)
Karaibrahimler	69km		
Kestane Dağı	58km		
Piren Tepe	62km		302m (2 holes)
Dikmen	64km	8km(4 lines)	
Total	329km	8km	906m (6 holes)

1-3-2 Priority Activities of the Survey

(1) Geological Survey

The following problems and items were the priority activities during the second phase survey.

① Collection of geochemical chip samples with emphasis on delineated altered zones.

② Relationship between geochemical anomalies and mineralization.

③ Extent of mineralization at depth.

④ Determination of geochemically anomalous zones and clarification of their characteristics.

(2) Geophysical Prospecting

The individual line name and line length of the Dikmen area are as follows:

Locality	Method	Line Name	Length(m)	Number of Points
Dikmen	IP	A	2,000	80
	SIP	B	2,000	80
	SIP	C	2,000	80
	IP	D	2,000	80

The following specifications were applied for this survey.

① IP Method

a. Electrode Configuration: Dipole-Dipole

b. Electrode Spacing : 100m, horizontal

c. Electrode Separation Coefficient : 1 to 5

d. Frequency : 0.125 and 1 Hz

② SIP Method

a. Electrode Configuration: Dipole-Dipole

b. Electrode Spacing : 100m, horizontal

c. Electrode Separation Coefficient : 1 to 5

d. Frequency : 0.125 and 88 Hz

(Three fundamental frequencies of 0.125, 1 and 8 Hz were adopted, and the frequencies of the 3rd, 5th, 7th, 9th and 11th harmonics of each fundamental frequency were measured.

e. Laboratory rock measurements were conducted with the same frequencies on representative rock and ore samples collected in the field. Thirty-four samples were measured.

(3) Drilling Survey

The following holes were drilled.

Area	No.	Coordinates		Length	Direction	Dip
Piren Tepe	MJTC-1	79580	20920	151.0m	N40° E	-50°
	MJTC-2	79150	20760	151.0m	S40° W	-50°
Arlık Dere	MJTC-3	82920	30800	151.0m	–	⊥
	MJTC-4	83450	30730	151.1m	–	⊥
	MJTC-5	82600	30190	151.0m	N80° W	-50°
	MJTC-6	82340	30180	151.0m	S80° E	-50°

(4) Laboratory Work

Table 1-1 List of Laboratory Studies

Kind of Sample	Type of Study	Amount	Elements from Chemical Analysis	Arlık Dere	Karaibrahimler	Kestane Dagı	Piren Tepe	Dikmen
Rock Samples	① Chemical Analysis of Chip Samples	605pcs	Cu, Pb, Zn, Au, Ag, Mo Hg, As, F, Ba, Tl, Se	221	64	74	134	112
	② Ore Analysis	10pcs	Au, Ag, Cu, Pb, Zn, Sb, Hg, Mo					10
	③ Total Rock Analysis	10pcs	SiO_2, TiO_2, Al_2O_3, Fe_2O_3, MnO, MgO CaO, Na_2O, K_2O, P_2O_5, LOI, FeO	2	2	2	2	2
	④ Thin Section	10pcs		2	2	2	2	2
	⑤ Polished Section	10pcs		10				
	⑥ X-Ray Diffraction	25pcs		8	4	3	7	3
	⑦ Isotopic Age	5pcs	K/Ar Method	2		1		2
Panning	Stream/Soil	52pcs		15	22		15	
SIP	Rock Measurements	34pcs						20

Drilling	Type of Study	Amount	Element from Chemical Analysis	MJTC-1	MJTC-2	MJTC-3	MJTC-4	MJTC-5	MJTC-6
Cores	① Ore Analysis	301pcs	Au, Ag, Cu, Pb, Zn, Sb, Hg, Mo	50	50	50	51	50	50
	② Thin Section	5pcs		1	1	1	1	1	1
	③ EPMA Examination	5pcs		1	1	1	1	1	1
	④ Total Rock Analysis	10pcs	SiO_2, TiO_2, Al_2O_3, Fe_2O_3, MnO, MgO, CaO, Na_2O, K_2O, P_2O_5, LOI, FeO	2	2	2	2	2	2
	⑤X Ray Diffraction	30pcs		5	5	5	5	5	5
	⑥ Fluid Inclusion	6pcs		4	1	1	1	1	1
	⑦Panning	53pcs		15	10	10	8	5	5

1-4 Members of the Second Phase Survey

(1) Survey Period

Geological and Geochemical Survey	June 28~October 23
Geophysical Prospecting	June 28~August 13
Drill Survey	August 9~November 18

(2) Members participating in the Project

【MTA (MADEN TETKİK ve ARAMA GENEL MÜDÜRLÜĞÜ) at Ankara】

Head Office	General Director	Orhan BAYSAL
	Deputy General Director	Özer ÖLÇER
	Deputy General Director	Temel NEBİOĞLU
Metallic Minerals D.	Director	Ramiz ÖZOCAK
	Deputy Director	Asim GÖKTEPELİ
Geophysics D.	Director	Ferit ERDEN
Drilling D.	Director	Abdullah GÜLGÖR
NW Anadolu Branch	General Manager	Mehmet Abid GENÇ
	Deputy Manager	Nizamettin ÇETİNKAYA
	Deputy Manager	Sinan ASLAN

【Turkish Survey Members of MTA】

Coordinator	Necmi YÜCE
Geologist	Necip PEHLİVAN
Geologist	Abdullah TUFAN
Geologist	Ahmet ÇETİN
Geophysicist	Kadircan AKTAŞ
Mining Engineer	Mustafa CANTÜRK
Mining Engineer	Hasan Ali ERDAL

【Metal Mining Agency of Japan】

Coordinator	Morihiro KURUSHIMA
Coordinator	Naoki SATO

【Japanese Survey Members of NED】

Team leader	Hisashi MIZUMOTO
Geologist	Ken OBARA
Geologist	Kazuyasu SUGAWARA
Geophysicist	Masao YOSHIZAWA
Geophysicist	Tsuyoshi YAMAISHI
Geophysicist	Tadanori IWASAKI
Drilling Engineer	Saichi ISHII
Driller	Tadateru SUGIBUCHI
Driller	Mitsuo NOMURA

CHAPTER 2 GEOGRAPHY

Çanakkale is the capital of the province and is the largest city on the Biga Peninsula. It is located approximately 550km west of Ankara and about 250km southwest of the largest city in Turkey, Istanbul. The population of Çanakkale is about 50,000. Çan is the second largest city of Çanakkale Province, and its population is more than 20,000.

By road, the distance from Ankara to Çanakkale is approximately 600km through Eskişehir and Bursa; long-distance bus takes 11 hours. The survey area is under the jurisdiction of the MTA Balıkesir Office (Kuzeybatı Anadolu Bölgesi). The major highway between Balıkesir and Çanakkale is paved and the approximately 250km can be covered by car in about three hours. The base camp for the second phase survey was set in Çanakkale, and the field work for geological and geophysical surveys were conducted using jeeps for transport from Çanakkale. The travel time from Çanakkale to Arlık Stream,Karaibrahimler, Kestane Mountain and Piren Hill was one hour, to Zone B one hour and to Dikmen two hours.

The area delineated for detailed survey in the second phase is located inland. It has relatively gentle topography with elevation ranging from 200-800m. There are many villages in the flat area below the 200m elevation, and vegetables and fruits are actively cultivated. Above 200m, in the higher lands, cultivation of wheat and raising various cattle are very prominent.

The annual precipitation of the survey area amounts to 700mm, and there is a large area of fertile land where cultivation of vegetables, fruits and wheat and breeding of cows, sheep, goats and other cattle are very active. The annual average temperature is warm (14.6℃), and climate is close to Mediterranean type.

At Çanakkale, the temperature rises above 30℃ during the four months from

June to September, and during September to November when the field survey was carried out, the climate gradually shifted from the relatively dry season to relatively wet season, and the average monthly temperature dropped from 19.7℃ in September to 11.8℃ in November. The average monthly temperature and precipitation published by the Çanakkale Meteorological Station are as follows.

Temperature (℃)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Annual
Max.	16.7	15.2	18.1	20.7	28.8	32.0	38.8	34.2	30.0	24.2	18.8	17.6	1988
Min.	-1.7	-2.2	-0.2	1.4	5.4	12.3	14.6	13.3	11.0	2.0	-2.4	-5.8	
Ave	7.9	6.7	9.3	11.5	16.8	22.7	26.8	25.5	20.8	14.8	7.7	6.9	14.8

Temperature (℃)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Annual
Max.	13.7	17.4	19.5	24.3	26.6	32.2	32.8	33.5	30.0				1889
Min.	-4.0	-4.7	2.0	8.0	5.6	12.0	16.4	14.6	13.2				
Ave	4.4	2.1	10.1	15.2	16.7	21.3	24.6	24.9	21.0				

Precipitation(mm)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Annual
1988	87	51	75	56	1	37	4	-	30	21	202	139	703
1989	2	3	58	9	28	19	-	25	33				

CHAPTER 3 OUTLINE OF THE SURVEY AREA

3-1 Outline

The stratigraphy of the Çanakkale Area was compiled by Behçet AKYÜREK and Yılmaz SOYSAL of the Geology Division of MTA Ankara in 1980 (report of First Phase).

The basement of the area consists of pre-Triassic metamorphic rocks - the Kazdag Group. It is mainly composed of gneiss, metamorphic rocks derived from basic volcanic rocks and crystalline limestone. This basement is unconformably overlain by Mesozoic sedimentary formations and Miocene intermediate volcanic rocks. Silicified and argillized alteration zones were identified in some sections (Arlık Stream, Karaibrahimler, Kestane Mountain and Piren Hill) of the area where volcanism was active during the Eocene to Miocene, and andesite, dacite, rhyolite and pyroclastic rocks are developed. These are widely distributed in the central part of the survey area. During the beginning of this volcanic period, granodiorite intrusions occurred in many parts of the area, and iron, copper, lead and zinc mineralizations are found associated with this type of intrusion in the Dikmen.

In 1987, the exploration group of the Turkish Petroleum Co. conducted a geological survey of the entire Biga Peninsula prior to drilling for oil in dremit Bay (bay at the southern part of the Biga Peninsula). It was shown by this work that the volcanic rock widely distributed in the central part of the area can be grouped as the product of three major volcanic activities aged Eocene, Miocene and post-Pliocene. Also, there are two stages of granite activities : Triassic and Cretaceous to Eocene. The ages were determined through the study of fossils in the vicinity.

The geology of Biga Peninsula, as mentioned above, has been investigated by MTA and the Turkish Petroleum Co. It is seen that the stratigraphy compiled during the first phase study agrees with that prepared by the Turkish Petroleum Co. The geologic map of the Çanakkale Area, correlation list and schematic column of Zones B and C are shown in Figure 1-3, Table 1-2, Figures 1-4 and 1-5.

The lowermost geologic unit of northwestern Biga is the pre-Triassic metamorphics (Kazdag Group) which consist mainly of metamorphic rocks of basic volcanic origin and are distributed to the north of Zone A and west of Zone B, both outside of the first phase survey area. In Zones B and C, the Triassic Karakaya Group and unconformably overlying Eocene and later intermediate volcanic rocks are widely distributed, while in Zone A, Eocene and later intermediate volcanic rocks occur widely. Most of the geologic units of these zones are Eocene to Miocene andesites and andesitic pyroclastics accompanied by a small amount of Late Tertiary to Quaternary dacite and basalt. The intrusive rocks are Triassic and Cretaceous to Eocene granodiorite, and they are distributed in Zones B and C.

The geology of the major part of the survey area consists of Eocene and younger volcanic rocks. The host rocks of the silicified and argillized zones are Miocene volcanics. These alteration zones have characteristics similar to those of the Madendagı and Kartaldagı mines. They extend into the survey area. The age of the alteration is inferred to be latest Tertiary, and the center of the Tertiary volcanic activity is very clearly identified.

3-2 Outline of Mining Activity in the Biga Peninsula

The Biga Peninsula, including the Çanakkale Area, is considered to be the most important lead-zinc metallogenic province of the Republic of Turkey. Also, antimony, gold, silver, mercury, iron and other metallic deposits as well as ceramic material resources have been found in the peninsula. Thus, this peninsula has been the target of geological surveys, geochemical

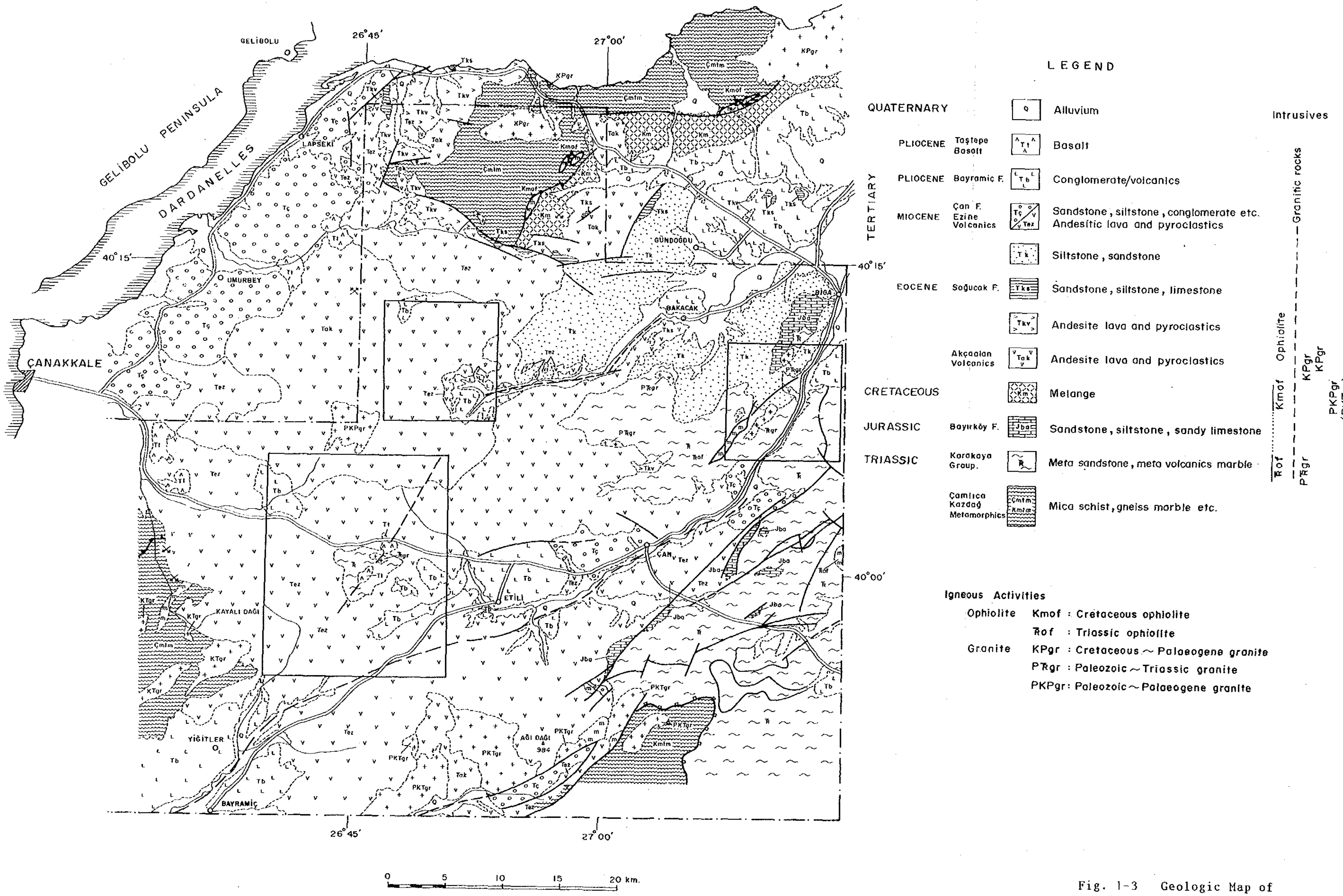

Fig. 1-3 Geologic Map of the Çanakkale Area

Table 1-2 Correlation List of the Biga Peninsula

Geologic Age		Turkish Petroleum Co. Exploration Group (1987)	Yılmaz SOYSAL Behçet AKYÜREK (1980)	Turkish-Japanese Joint Project (1989) Zone A	Zone B	Zone C
Cenozoic	Quaternary Holocene	Alluvium Tastepe Basalt	Alluvium	Alluvium Balaban B.	Alluvium Kocaçakıl B.	Alluvium
	Quaternary Pleistocene	Gülpınar F.	Olivine Basalt		Karaköy F. Osmanlar V.	Bakacaklı V.
	Pliocene	Bayramiç F. / Ergene G.	ng/nd Göl Sediment Agps Agglomerate Arag Agglomerate	Dededag V.		Akkayrak V.
	Miocene	Alçıtepe F. Kirazlı F. Gazhanedere F. Küçükkuyu F. Çan F.	DR Dacite/Rhyolite A_2+T_2 Volcanics Tsi Silicified tuff			
	Miocene	Ezine Volcanics / Hisarlıdag Volcanics	A_2+T_2 Volcanics	Balcılar V.	Şapçı V.	
	Oligo-cene	Yenimu-hacır G.: Osmancık F. Mezardere F.				
	Eocene Middle~Upper	Keşan G.: Volcanics Ceylan F. Soğucak F. Koyunbaba F.	Efl Sandstone & Conglomerate			Kirazlıgecit M. Kızılcık M.
	Eocene Lower	Akçaalan Volcanics Fıçıtepe F. Karaagaç F.	A_1+T_2 Andesite & Tuff	Çamyayla V.	Çamyayla V.	
	Palaeocene					
Mesozoic	Jurassic~ Cretaceous	Manyas Melange (Ophiolite & Limestone) Vezirhan F. Bilecik Limestone Bayırköy F.			Kirazlı Conglomerate	Sarısuvat F.
	Triassic	Granite Karakaya Group: Yalindi F., Armutcuk M., Çal F., Limestone Spilite, Torasan F., Karaasik F., Sazak M.	Granite Hasanlar F. Çınarcık Limestone Karakaya F.		Taşdibek F.	Emeşe F.
Pre-Triassic		Kazdag Metamorphics	Kazdag Group			

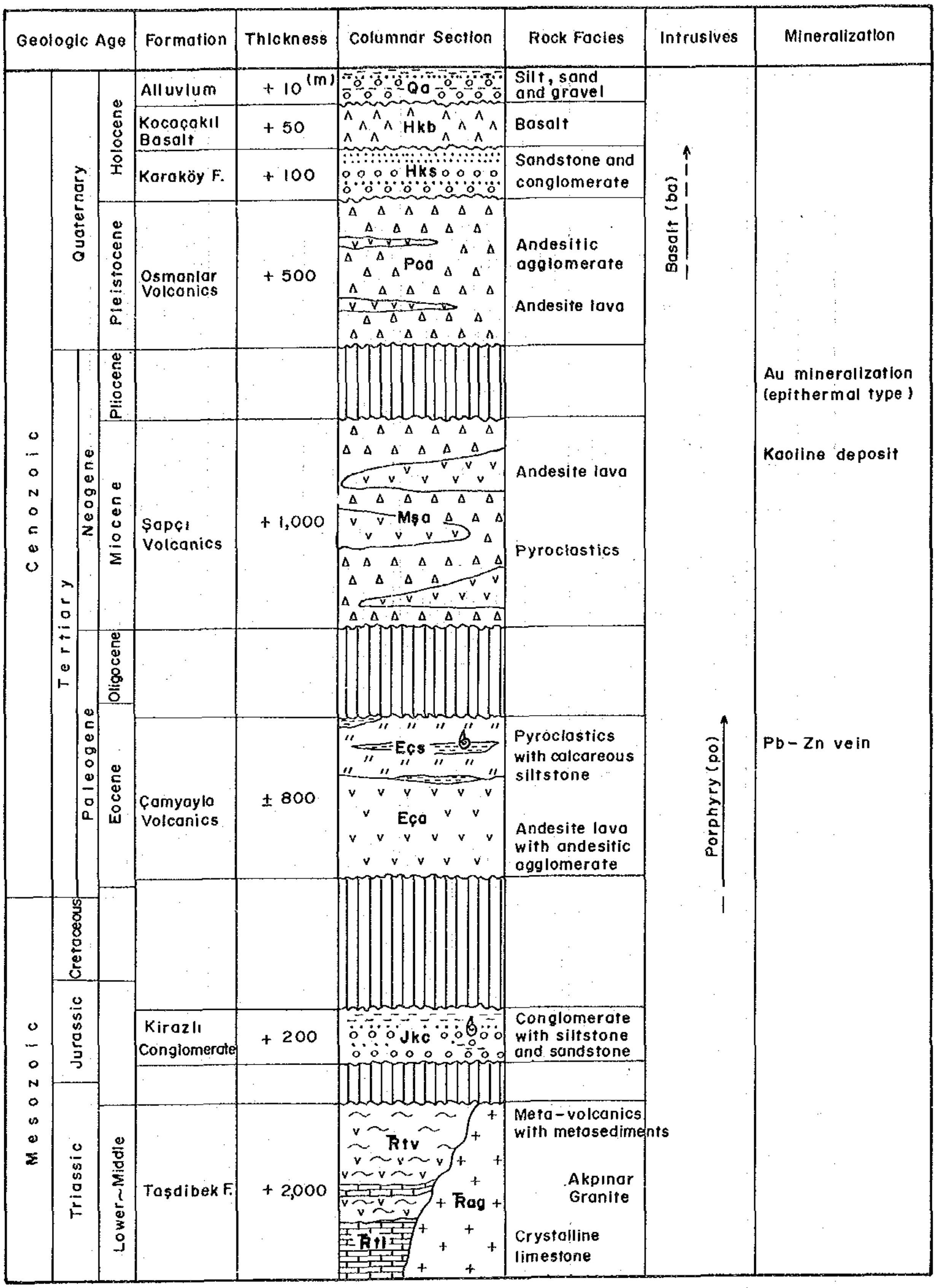

Fig. 1-4 Schematic Column of Zone B

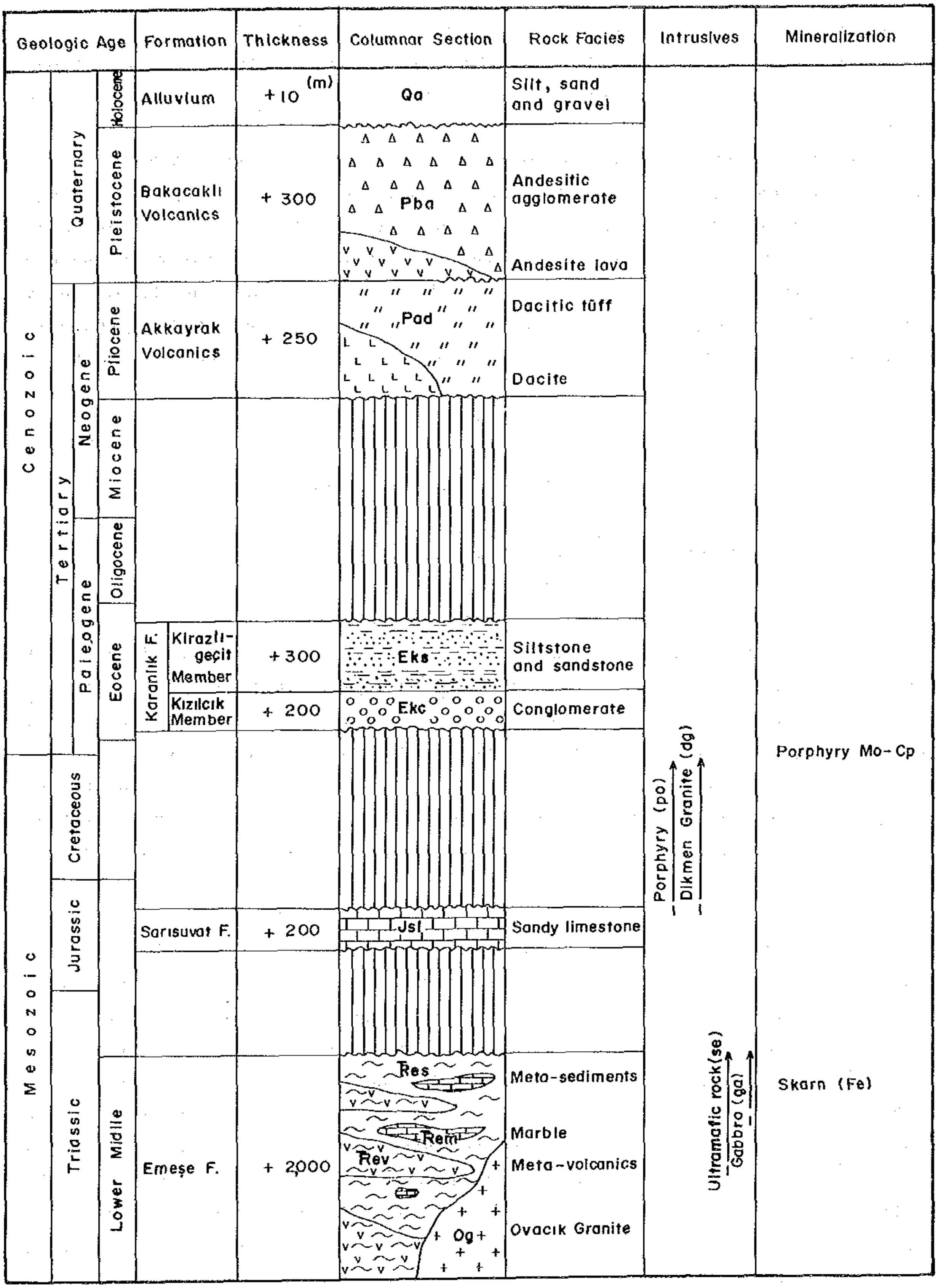

Fig. 1-5 Schematic Column of Zone C

prospecting, mining studies and various other MTA projects.

The area has been the site of the Turkey/Federal Republic of Germany Cooperative Project which resulted in the discovery of promising lead-zinc deposits of the Yenice-Kalkım.

Within the 3,400km² area analyzed by Landsat images, there are the well-known gold deposits of the Madendağı and Kartaldağı Mines. Also, although presently closed and previously operated on a very small scale, Çataltepe Mine (lead-zinc veins) is in the above area. In Zone C, a porphyry molybdenum deposit (Dikmen mineralized zone) was discovered during the first phase survey. Immediately outside of the Landsat image, there are the presently operating Koru Köyü Mine and the Yenice gold deposit which is now being explored.

CHAPTER 4 REVIEW OF THE SURVEY RESULTS

4-1 Geochemical Nature of Mineralization

Six hundred and five samples collected from the detailed survey localities in the second phase and three hundred and ninety one samples located inside of the above area in the first phase were analyzed together. The analyzed elements are; gold, silver, fluorite, mercury, thallium, selenium, antimony, arsenic, copper, lead, zinc, molybdenum and barium. The samples were collected from the silicification zones in the four localities of Zone B; Dikmen Granite and the mineralized zone near this intrusive body were sampled. The localities with samples exceeding 50 ppb gold and 100 ppm molybdenum are as follows (Table 1-3).

Arlık Dere: From this locality, 282 rock samples were analyzed. Of these, 68 samples collected from Kocataş, Sartaş and Güvemalanı silicified zones (the locationa are shown in Figure 1-15.) contained gold in excess of 50 ppb; this is gold associated with epithermal mineralization. It is noted that almost all of these samples contained small amounts of copper, lead, zinc and molybdenum, while the content of arsenic, mercury, and barium were somewhat higher when found with gold. Silicified bodies are characterized by massive, brecciated and porous parts. The massive part generally locates in the center of the silicified zones, and silicified veins were observed in the periphery of silicified zones. It is thus considered that their shapes are "jellyfish-like" in geologic section.

Karaibrahimler: From this locality, 98 chip samples were analyzed. Of these, 14 samples collected from the skarn zone in the periphery of Akpınar Granite and Köserelik Stream contained gold in excess of 50 ppb. There are samples from silicified vein-type mineralization which contained significant amounts of metals, but their occurrence is isolated, and the minerals have not been confirmed by heavy mineral investigation. Thus they are considered to be the lower part of the silicified bodies.

Kestane Dağı: From this locality, 140 rock samples were analyzed. Of these, 35 samples collected from Kestane and Çatalkaya silicified zones contained gold in excess of 50 ppb. This gold is associated with epithermal mineralization. Silicified zones are characterized by massive, brecciated and porous parts; the massive part generally locates in the center of the silicified zones. Silicified veins were not observed in the periphery of silicified zones. It is thus considered that their shapes are "mushroom-like" in geologic section.

Piren Tepe: From this locality, 207 rock samples were analyzed. Of these, 15 samples collected from Piren and Davulgılı silicified zones contained gold in excess of 50 ppb, which is gold associated with epithermal mineralization. Silicified zones are characterized by massive, brecciated and porous parts. The massive part generally locates in the center of the silicified zones, and silicified veins were observed in the periphery of silicified zones. It is considered that their shapes are "jellyfish-like" in geologic section.

Dikmen: From this locality, 269 chip samples were analyzed. Of these, 56 samples collected from the Dikmen Granite, porphyry and the alteration zones in the vicinity contained gold in excess of 50 ppb and molybdenum in excess of 100 ppm. There is porphyry molybdenum-copper mineralization in the quartz veinlets in and near the Dikmen Granite and porphyry. Elements of lower-temperature mineralization, such as gold, mercury, antimony and barium were detected; and it is inferred that two different types of mineralization occurred in the same locality at different times.

Table 1-3 Significant Analytical Results of Chip Samples

Arlık Dere (1)

Sample	Coordinates	Au ppb	Cu ppm	Mo ppm	Pb ppm	Zn ppm	Ag ppm	As ppm	Se ppm	Hg ppb	F ppm	Ba ppm	Tl ppm
KB088	83475 29520	3050	7	1	34	7	0.1	5	0.2	30	80	30	0.5
M303	82400 30235	1310	9	3	20	2	<0.5	11	<0.2	150	40	1080	<0.1
M306	82640 30280	1150	3	1	700	6	<0.5	110	<0.2	40	250	80	<0.1
T411	83690 31800	760	10	8	165	<2	0.5	65	7.2	35000	70	3700	<0.1
C304	82415 30150	690	22	7	50	4	<0.5	90	2.0	540	60	40	0.1
K431	83810 30240	440	2	3	5	2	<0.5	1	<0.2	40	120	60	0.1
S320	82995 30825	340	61	78	5	8	0.5	150	1.2	50	500	360	0.1
K482	83195 30075	280	68	6	55	36	<0.5	60	0.2	70	150	900	<0.1
C307	82445 30075	275	2	2	35	2	<0.5	15	<0.2	30	320	100	0.1
P351	82735 30470	260	4	6	140	2	<0.5	63	1.2	100	210	80	2.3
HB060	83500 30640	240	17	36	31	19	0.1	30	0.2	10	140	110	0.2
K325	83625 30485	240	3	2	<5	2	<0.5	3	<0.2	10	50	20	<0.1
M326	82455 29980	205	4	1	35	8	<0.5	6	<0.2	30	220	140	0.4
SR127	85385 29355	200	7	1	5	2	0.1	5	0.2	60	90	90	0.1
M305	82570 30240	185	13	2	100	12	<0.5	50	0.2	360	270	260	<0.1
KS132	84220 30500	170	6	25	37	11	0.1	14	0.2	50	300	690	0.4
K467	82725 29880	160	70	12	20	26	<0.5	100	0.4	20	90	160	1.0
KS205	82720 30380	145	3	2	68	3	2.2	9	0.4	40	60	90	0.2
T435	83125 29340	140	15	<1	20	<2	<0.5	45	0.4	70	620	200	0.1
K491	83255 29760	130	80	9	25	116	<0.5	320	9.8	40	140	420	0.1
M311	82450 30435	130	12	4	25	6	<0.5	10	<0.2	100	140	140	0.1
KS210	83180 30045	130	28	1	67	6	1.0	32	6.0	430	350	200	0.1
C305	82495 30155	125	3	2	5	2	<0.5	9	0.2	100	520	60	0.3
M324	82235 30015	125	20	<1	<5	2	<0.5	41	1.0	40	80	80	<0.1
M325	82345 29975	125	8	3	25	10	<0.5	51	0.2	100	580	220	0.2
M424	83055 29785	125	3	1	10	<2	<0.5	2	<0.2	40	70	40	<0.1
K327	83705 30460	110	2	2	5	<2	<0.5	1	<0.2	10	70	40	<0.1
HB061	83500 30665	95	6	1	53	2	0.1	4	0.2	10	110	70	0.2
K323	83555 30465	95	1	2	<5	<2	<0.5	1	<0.2	10	60	20	<0.1
P352	82765 30505	95	4	8	5	<2	<0.5	9	1.2	100	130	40	0.1
T415	84495 31055	90	3	4	<5	<2	<0.5	2	<0.2	90	70	140	0.1
T442	83165 29620	90	16	197	95	8	<0.5	29	1.0	50	560	200	0.4
K473	83060 30135	80	3	1	30	2	<0.5	35	0.2	30	110	220	0.1
K322	83535 30475	80	2	2	<5	2	<0.5	2	<0.2	10	190	40	<0.1
M418	82825 29775	75	155	4	15	42	<0.5	55	<0.2	20	340	280	1.2
S316	82800 30865	75	7	44	15	2	<0.5	24	1.6	20	500	360	<0.1
S395	83045 30565	75	39	125	15	4	<0.5	12	3.2	20	270	580	0.1
KS217	83050 30505	70	25	7	120	24	0.1	50	0.4	20	110	990	0.3
P346	82420 30375	70	3	6	10	<2	<0.5	9	0.4	70	50	520	<0.1
K484	83185 30075	70	12	1	45	6	<0.5	11	1.8	80	360	240	0.5
T443	83135 29620	70	8	3	25	<2	<0.5	14	3.6	30	500	320	0.3
HB057	83685 30455	65	5	9	14	4	0.1	6	0.2	20	120	30	0.2
M312	82420 30375	65	4	6	15	<2	<0.5	5	1.0	40	190	140	<0.1
K324	83595 30465	65	2	7	<5	<2	<0.5	1	<0.2	10	70	20	<0.1
KB081	82530 30185	65	14	1	74	6	0.1	12	0.2	40	80	140	0.1
K321	83520 30525	65	26	11	35	12	<0.5	11	5.2	10	150	240	0.2
T438	83520 29500	65	14	1	25	46	<0.5	9	0.2	90	240	40	0.1
Y302	83400 30645	65	16	1	10	<2	<0.5	5	<0.2	20	240	500	0.2
Y368	83400 30285	65	4	6	5	4	<0.5	9	0.2	20	150	80	<0.1
S318	82765 30870	60	8	17	5	<2	<0.5	16	2.8	110	80	1940	<0.1

Table 1-3 Significant Analytical Results of Chip Samples

Arlık Dere (2)

Sample	Coordinates	Au ppb	Cu ppm	Mo ppm	Pb ppm	Zn ppm	Ag ppm	As ppm	Se ppm	Hg ppb	F ppm	Ba ppm	Tl ppm
S398	82905 30790	60	12	23	20	<2	0.5	19	2.8	50	50	660	<0.1
K436	83315 30165	60	3	3	30	2	<0.5	1	<0.2	20	190	140	0.1
T412	83505 31335	60	1	55	<5	28	<0.5	140	0.2	70	170	60	<0.1
M304	82520 30255	60	5	1	50	6	<0.5	7	1.0	30	60	100	<0.1
T418	84510 31240	60	20	7	100	14	<0.5	130	4.8	820	120	2500	0.2
M329	83080 29980	60	24	1	165	22	<0.5	29	3.2	340	150	160	<0.1
T437	83120 29680	60	15	3	35	20	<0.5	23	0.4	100	600	520	0.4
KS134	83780 30900	60	4	1	3	3	0.1	4	0.2	30	320	30	0.1
K492	83260 29750	60	29	<1	20	18	<0.5	23	0.2	20	70	340	<0.1
K303	83510 30765	60	22	34	<5	12	<0.5	23	<0.2	40	290	60	0.2
Y366	83840 30745	60	2	1	5	<2	<0.5	2	<0.2	50	440	740	0.5
KS133	84055 30525	55	3	1	26	3	0.1	5	0.2	40	570	270	0.2
S404	83200 31010	55	57	10	20	2	<0.5	9	2.0	80	670	720	1.6
S314	82925 30885	55	4	2	<5	<2	<0.5	9	0.2	50	280	60	<0.1
KS218	82800 30700	50	7	3	22	6	0.1	11	0.2	20	120	50	0.1
HB062	83320 30845	50	2	1	3	2	0.1	11	0.2	10	70	50	0.1
S394	83125 30670	50	1	18	15	<2	<0.5	15	<0.2	20	370	400	<0.1
M307	82600 30325	50	5	3	205	6	<0.5	38	0.6	40	450	220	0.1

Table 1-3 Significant Analytical Results of Chip Samples

Karaibrahimler

Sample	Coordinates	Au ppb	Cu ppm	Mo ppm	Pb ppm	Zn ppm	Ag ppm	As ppm	Se ppm	Hg ppb	F ppm	Ba ppm	Tl ppm
K506	81525 28420	490	27	7	50	6	2.0	65	12.0	3000	100	20	0.4
K510	80505 29665	295	44	3	795	40	<0.5	510	<0.2	2400	40	60	2.8
KS186	80110 29750	225	6800	41	>10000	9000	100.0	630	0.4	950	140	20	0.1
K525	81370 28670	125	77	8	110	32	<0.5	620	1.0	2800	120	160	0.7
K507	81740 28530	120	19	1	50	4	2.0	55	0.2	20	40	20	0.2
C372	79910 29950	110	18	3	5	42	<0.5	1	<0.2	20	260	620	0.5
XB065	80705 27505	80	7	1	10	3	0.1	25	1.0	150	780	70	0.1
T452	80840 30260	80	143	404	9070	4360	68.5	46	7.2	640	280	60	0.1
K524	81340 28710	80	64	<1	20	208	<0.5	1650	1.2	620	380	100	2.6
M435	80850 28150	65	38	<1	5	84	<0.5	295	<0.2	120	230	220	1.7
K461	81970 28980	65	183	1	120	430	<0.5	120	0.4	150	50	60	0.2
T445	81205 30070	55	79	5	660	508	<0.5	38	0.2	430	280	140	1.0
M432	80980 27910	50	45	4	15	52	<0.5	235	3.0	160	210	220	0.8
KB072	80920 30295	50	51	21	750	93	1.5	1000	4.0	1900	220	1000	3.9

Table 1-3 Significant Analytical Results of Chip Samples

Kestane Dagı

Sample	Coordinates	Au ppb	Cu ppm	Mo ppm	Pb ppm	Zn ppm	Ag ppm	As ppm	Se ppm	Hg ppb	F ppm	Ba ppm	Tl ppm
T501	75465 30170	3660	482	6	2210	38	71.0	880	22.0	46000	60	1300	0.2
T470	75350 28515	1450	118	3	730	10	<0.5	80	2.0	460	400	940	0.2
T477	75525 29055	645	119	18	1060	8	<0.5	200	12.0	240	60	60	0.1
T474	75585 28800	370	10	12	1760	<2	<0.5	29	1.0	80	400	140	<0.1
K560	76000 28305	350	130	49	65	16	<0.5	65	0.4	30	670	700	2.2
T506	75005 30590	310	64	3	425	218	6.5	350	8.0	24000	60	300	0.1
T475	75580 28820	190	12	10	4840	<2	<0.5	22	0.2	150	200	140	0.1
K565	75055 29550	170	4	5	5	<2	0.5	5	<0.2	140	80	40	0.1
HS185	76045 28730	170	150	32	830	14	0.1	70	7.0	80	1300	360	5.0
T500	75460 30145	160	51	3	420	6	15.5	33	12.0	6000	70	2200	0.1
K564	75865 28310	145	28	86	15	8	<0.5	9	1.2	290	480	320	2.1
T469	75305 28490	140	17	12	15	<2	1.0	5	3.4	23000	240	140	0.1
T476	75520 28910	140	58	7	55	2	<0.5	22	30.0	380	370	40	<0.1
Y395	75055 28385	135	153	9	15	10	1.0	50	0.4	30	120	60	0.7
NY128	74185 30075	115	108	3	1	8	0.1	60	26.0	20	670	400	0.4
HS176	75655 29480	110	33	1	492	20	6.1	240	4.4	4200	70	710	0.4
HS194	75205 29680	100	29	3	26	13	0.1	36	0.8	80	840	30	0.2
NY116	74925 28510	90	10	1	20	103	0.2	150	0.2	20	320	90	0.6
T483	75470 28910	85	2	11	250	<2	0.5	3	0.8	760	950	80	<0.1
T478	75530 29045	80	78	7	440	2	<0.5	245	4.0	90	670	540	0.1
Y405	75250 29475	75	19	2	15	4	<0.5	15	5.4	320	1720	780	<0.1
T508	75035 30650	75	6	4	190	6	5.0	55	4.0	22000	80	600	<0.1
TS099	75025 28165	75	32	1	5	13	0.4	63	5.0	30	160	110	0.4
T480	75640 28860	75	2	1	240	<2	<0.5	39	0.4	130	770	100	4.9
HS179	75660 28970	75	148	3	4600	15	0.1	120	6.2	80	760	310	0.2
T504	75380 30270	70	44	6	975	54	<0.5	280	9.0	12000	60	240	0.6
HS183	75750 28810	65	8	2	71	10	0.1	16	2.4	140	1700	130	0.1
HS184	75795 28745	60	8	3	80	4	0.1	6	0.2	160	450	310	0.1
T497	75315 30775	60	8	16	135	4	<0.5	30	4.8	100	140	620	<0.1
HS187	76000 28950	60	5	2	186	3	0.1	33	0.2	230	2000	600	5.2
S457	75725 30050	55	35	4	15	2	<0.5	265	<0.2	40	50	20	<0.1
Y403	74980 29335	50	47	<1	15	2	<0.5	125	1.0	20	80	80	<0.1
T460	75580 29375	50	106	2	5	12	<0.5	71	1.6	120	190	600	0.7
S455	75715 29330	50	2	9	10	<2	<0.5	7	0.2	30	590	360	2.3
TS100	74810 28300	50	47	1	7	42	0.1	60	2.2	20	340	180	1.2

Table 1-3 Significant Analytical Results of Chip Samples

Piren Tepe

Sample	Coordinates	Au ppb	Cu ppm	Mo ppm	Pb ppm	Zn ppm	Ag ppm	As ppm	Se ppm	Hg ppb	F ppm	Ba ppm	Tl ppm
HB073	82120 21440	2060	3	1	9	1	0.1	80	0.2	70	60	70	0.1
HB072	82120 21440	1630	6	4	11	2	0.1	79	0.2	110	60	50	0.1
Y343	81435 21815	560	6	9	25	<2	<0.5	100	0.2	8600	60	1400	<0.1
KB182	79535 20900	470	70	5	200	21	1.0	1600	1.2	290	200	880	1.1
Y349	81570 21525	450	4	6	150	2	0.5	60	0.2	90	50	120	0.2
K394	81755 21790	315	3	11	60	2	<0.5	32	<0.2	60	40	1400	<0.1
K308	79560 20770	275	19	10	5	10	<0.5	200	0.7	20	210	40	0.1
KB190	80650 21015	260	25	1	10	7	1.8	110	4.0	2400	60	1680	0.1
Y344	81390 21765	190	6	27	45	2	<0.5	140	2.2	540	70	100	0.1
HB076	82075 21540	175	10	2	12	6	0.5	140	0.2	110	60	70	0.2
K390	81540 21785	155	4	3	10	2	<0.5	41	<0.2	800	60	400	<0.1
K395	81770 21730	150	3	2	<5	<2	<0.5	10	<0.2	90	30	20	<0.1
KB180	79135 20805	140	12	2	20	6	0.1	110	2.2	500	820	550	0.3
HB077	82075 21540	135	11	1	27	2	0.2	530	0.2	50	50	1420	0.1
K405	81705 22050	130	9	5	<5	2	1.0	19	<0.2	30	30	80	0.1
HB075	82075 21540	115	12	1	12	5	0.3	130	0.2	660	50	180	0.1
K398	81560 21560	100	8	5	25	14	<0.5	65	<0.2	320	70	780	0.1
KB181	79165 20795	100	57	2	12	14	0.1	370	4.2	100	1600	490	0.3
M402	80770 21325	90	16	7	50	<2	<0.5	170	1.0	70	100	400	<0.1
P327	80760 21315	90	35	6	30	4	<0.5	580	4.0	310	130	120	0.1
P322	80200 21075	90	5	17	855	6	<0.5	120	1.4	1200	40	180	1.8
K396	81740 21700	90	4	4	5	4	<0.5	41	<0.2	40	30	60	<0.1
K389	81460 21810	90	5	4	10	2	<0.5	50	<0.2	1100	60	880	0.1
K388	81445 21825	70	2	6	20	<2	<0.5	22	n.s.s.	120	n.s.s.	180	0.2
Y348	81490 21475	65	15	66	5	2	<0.5	95	0.6	1800	40	160	0.1
M401	80745 21355	65	11	4	25	<2	<0.5	180	0.2	50	60	100	<0.1
K406	81705 22065	65	3	3	<5	<2	<0.5	16	<0.2	60	30	20	<0.1
P325	80325 21240	60	24	13	80	4	<0.5	110	8.0	50	340	640	0.6
T307	78965 20565	55	23	2	95	2	<0.5	820	3.6	400	60	2800	11.0
K392	81720 21830	55	4	14	5	<2	<0.5	16	<0.2	80	40	120	<0.1
HB078	81795 21385	55	21	1	3	12	0.1	4	0.2	20	40	310	0.1
KB187	80340 21200	50	20	15	76	3	0.1	24	4.0	30	580	380	0.2

Table 1-3 Significant Analytical Results of Chip Samples

Dikmen (1)

Sample	Coordinates	Au ppb	Cu ppm	Mo ppm	Pb ppm	Zn ppm	Ag ppm	As ppm	Se ppm	Hg ppb	F ppm	Ba ppm	Tl ppm
NY032	13805 42995	>10000	730	>500	>10000	150	>100.0	2500	0.2	61000	160	2900	1.3
HB016	14395 42010	4600	>10000	35	360	3800	28.0	4200	0.4	2300	60	530	0.1
KB020	14605 43435	3100	90	13	94	13	8.0	19	0.2	5200	80	380	0.1
K372	14720 43055	2670	283	9	530	36	11.5	16	<0.2	2600	70	1100	<0.1
TS025	14170 41530	560	29	1	7	100	0.2	60	0.2	90	100	200	0.1
KB026	14315 41550	530	50	1	8	114	0.1	240	0.2	140	320	140	0.3
C337	13255 41000	490	159	6	60	398	<0.5	45	<0.2	3500	150	140	<0.1
K369	14705 42945	465	202	267	3740	1585	8.5	16	<0.2	1700	70	20	<0.1
KS060	12750 41060	400	>10000	144	50	1200	13.8	8900	0.2	43000	90	50	0.4
HM032	13275 41635	350	498	140	1200	498	10.5	60	2.0	2900	380	30	0.6
Y337	13615 41905	315	133	278	1595	594	7.5	125	<0.2	6400	410	2400	0.4
T348	14595 42670	300	45	30	2080	3590	3.0	7	<0.2	21000	30	120	0.1
Y316	13795 42995	220	132	3550	>10000	88	153.5	480	<0.2	14000	570	>10000	1.8
Y314	13805 42995	170	178	2400	8090	104	149.0	3400	<0.2	12000	490	3400	1.2
Y315	13805 42995	160	105	792	6160	210	40.0	1800	0.8	18000	520	>10000	0.6
Y313	13805 42995	150	103	1495	4280	64	121.5	1650	0.4	8300	370	4100	1.0
K329	14500 43730	140	46	118	585	52	16.5	20	<0.2	2000	70	40	<0.1
K373	14760 43025	130	36	19	10	4	<0.5	6	<0.2	250	150	340	0.3
M354	14305 41640	120	99	5	10	326	<0.5	275	<0.2	360	220	80	0.1
HB017	14395 42010	120	3000	4	263	1700	2.9	500	0.2	430	270	380	1.5
KB035	14800 43260	120	40	2	255	20	0.9	25	0.2	3300	320	110	0.4
NY033	13945 42970	100	19	59	182	69	1.5	15	0.2	600	240	470	0.3
C348	14655 40775	95	4	8	100	44	<0.5	22	<0.2	400	120	280	0.4
TS026	14185 41600	90	46	1	11	90	0.4	39	0.2	70	150	220	0.5
HB008	14895 43165	65	21	8	4	27	0.1	4	0.2	40	270	690	1.1
M362	14225 42130	60	262	10	>10000	3160	68.0	280	1.0	2100	180	>10000	0.7
M355	14305 41605	60	4	1	<5	20	0.5	5	<0.2	100	60	80	<0.1
T359	14360 42575	55	3	37	<5	<2	<0.5	2	<0.2	50	40	20	<0.1
KS036	12815 41235	55	207	28	50	76	0.1	70	0.2	17000	1350	90	0.5
C342	13770 41605	55	5	3	75	52	<0.5	50	<0.2	120	40	180	0.1
HS049	14025 40930	50	18	1	23	228	0.1	110	0.2	530	270	290	0.6
M345	13125 41125	40	>10000	197	40	702	<0.5	1600	0.2	6300	50	60	<0.1
C344	13340 41340	20	87	2100	>10000	1070	15.5	2350	<0.2	>100000	40	240	84.0
KB056	15125 42820	15	870	200	415	1200	0.1	600	0.6	32000	360	110	0.4
HB022	15035 41950	15	26	140	3	10	0.1	10	0.2	130	50	30	0.2
M372	14075 42830	15	38	104	245	58	13.5	36	0.2	47000	280	2100	0.1
S367	14895 42685	10	37	1010	10	<2	0.5	10	<0.2	550	50	80	0.1
NY039	13850 42260	10	16	240	6	6	0.1	19	0.2	2800	180	420	0.3
HB005	13075 41530	5	5	>1000	5	5	0.1	4	0.2	140	60	50	0.2
M371	14060 42865	5	31	840	5	6	<0.5	39	0.8	1100	620	200	0.5
HB007	14910 43275	5	12	600	15	9	0.1	5	0.2	230	70	70	0.2
HB020	14470 41970	5	19	130	6	17	0.1	23	0.2	230	60	30	0.2
NY035	14010 42770	<5	62	>500	16	52	0.1	16	0.2	840	840	220	1.5
Y325	13975 42490	<5	13	629	30	4	0.5	33	0.4	560	300	300	0.4
Y326	13920 42465	<5	53	603	275	10	1.0	39	0.4	3600	470	180	0.2
K385	14620 42895	<5	8	473	<5	4	<0.5	2	<0.2	100	60	80	<0.1
S365	14720 42770	<5	49	295	5	106	<0.5	6	<0.2	2400	160	240	0.4
HM026	13110 41390	<5	105	270	18	135	0.1	50	0.2	890	320	30	0.3
S359	13845 42850	<5	53	242	590	122	11.0	29	<0.2	5200	30	>10000	0.1
HM031	13240 41600	<5	326	150	1	35	0.1	90	0.2	510	270	70	0.2

Table 1-3 Significant Analytical Results of Chip Samples

Dikmen (2)

Sample	Coordinates	Au ppb	Cu ppm	Mo ppm	Pb ppm	Zn ppm	Ag ppm	As ppm	Se ppm	Hg ppb	F ppm	Ba ppm	Tl ppm
KS032	13000 41285	<5	24	130	29	104	0.1	19	0.2	910	80	110	0.1
HB039	14690 43440	<5	10	120	2	2	0.1	6	0.2	40	40	20	0.1
Y323	13990 42595	<5	89	110	10	16	0.5	50	0.2	8000	510	320	0.3
HM030	13220 41565	<5	10	110	3	12	0.1	7	0.2	360	70	20	0.2
HM034	13370 41690	<5	105	110	8	103	0.1	22	0.2	2000	330	140	0.3
NY040	13780 42015	<5	64	108	4	104	0.1	38	0.2	300	300	290	0.2

Table 1-4 Results of Chemical Analysis of Ore in the Dikmen Area
(Microscopic Observation of Polished Sections)

Sample No.	Ore Name	Au ppb	Ag ppm	Cu ppm	Pb ppm	Zn ppm	Sb ppm	Hg ppm	Mo ppm
K382	Granite with qz veinlet(Py, Mo, W)	1760	20.0	286	2460	1660	220	6.9	57
M363	Qz-Py-Mo vein in the granite	30	1.0	311	30	32	63.0	6.7	2360
M364	ditto	35	0.5	24	70	16	9.4	3.0	1235
S366	Qz-Mo vein in the granite	35	<0.5	16	<5	4	4.0	4.0	1755
T349	Qz-Mo in the argillized granite	45	0.5	39	5	6	10.2	2.0	1510
T350	Qz-Py-Mo in the granite(float ?)	5	0.5	108	<5	4	32.0	2.9	156
T358	Chalcopyrite film in the unaltered granite	30	<0.5	471	<5	44	0.8	0.09	18
T360	Qz-Mo vein in the argillized granite	10	<0.5	9	<5	2	2.4	0.09	27
T361	Qz-Mo-Py vein in the argillized granite(float)	45	1.5	277	5	10	295	11.0	250
Y322	Qz-Mo vein in the granite	<5	<0.5	41	<5	14	3.0	0.10	1535

4-2 Alteration Zones

Twenty-five samples collected from five localities and thirty samples from drill cores were studied by X-ray powder diffraction. The samples of Zone B were collected from argillized zones; altered minerals mainly consist of kaoline, alunite and cristobalite and small amounts of sericite, pyrophyllite and chlorite. Thus these minerals were produced by acidic alteration. The samples of Dikmen were collected from the Dikmen Granite and porphyry intrusion. Altered minerals consist of mainly sericite, kaoline and montmorillonite, minerals associated with porphyry-molybdenum mineralization, but kaoline is considered to be associated with gold mineralization in the Çanakkale Area and montmorillonite with meteoric water.

Table 1-5 Results of Microscopic Observation of the Polished Sections

NO.	Ore	Cp	Co	Cc	Bo	Ma	Wo	Sp	Ga	St	Mo	Mt	He	Po	Py	Su-m	H-Fe	Qz	Pl	Bi	Se	Ch	Ep	Ca	Gy	Ah	Remarks
K382	Qz veinlet	△	○	△?				○	□								◎	◎									
M363	Qz-Py-Mo vein	○	□		△?			○			◎				◎		○	◎									
M364	ditto										◎				◎		○	◎									Mo dissemination
S366	Qz-Mo vein										◎						△	◎									Mo dissemination
T349	ditto										○				△			◎									Mo→relict
T350	Qz-Py-Mo veinlet	□	△					○			○				◎		◎	◎									Mo→relict
T358	Cu film	○						○			□				◎		○	◎	◎	◎							
T360	Qz-Mo vein							△			○				△			◎									
T361	Qz-Mo-Py vein	△						□			○				○			◎									
Y322	Qz-Mo vein										◎						○	◎	◎	◎							

Abbreviations:

◎:Abundant ○:Common □:Few △:Rare

Cp:Chalcopyrite, Co:Covelline, Cc:Chalcocite, Bo:Bornite, Ma:Malachite, Cu:Native copper, Sp:Sphalerite, Ga:Galena, St:Stibnite

Mo:Molybdenite, Mt:Magnetite, He:Hematite, Po:Pyrhotite, Py:Pyrite, Su-m:Sulphide Mineral, H-Fe:Hydroxide Iron

Qz:Quartz, Pl:Plagioclase, Bi:Biotite, Se:Sericite, Ch:Chlorite, Ep:Epidote, Ca:Calcite, Gy:Gypsum, Ah:Anhydrite

Wo:Wolframite

4-3 Results of Laboratory Examinations

4-3-1 Total rock analysis

A total of twenty samples, two granite and eighteen volcanic rocks were analyzed. The granite samples were upper Cretaceous～Eocene granite samples from the Dikmen. The volcanic rocks consisting of Miocene Şapçı Volcanics were eight andesite samples from Arlık Stream, Karaibrahimler, Kestane Mountain and Piren Hill, and ten drill core samples. Fifteen elements were analyzed including BaO. The analytical method used was potassium permanganate titration for FeO, and ICP-AES for other elements. The results of the analysis, calculated norm, differentiation index (D.I.) and solidification index (S.I.) are shown in Table 1-6. The analyzed samples were also studied microscopically.

(1) Granitic rocks

The chemical composition of the upper Cretaceous～Eocene Dikmen Granite was studied with the diagrams in Figures 1-6～1-12. The results are as follows.

① The granites of this survey area are the granodiorite of Bateman et al. (1963), namely, those with low normative orthoclase in the quartz-plagioclase-orthoclase diagram. The results of the Gümüşhane Project (1984-1987) show that the older granite (Devonian Gümüşhane Granite) is quartz monzonite while the younger (Upper Cretaceous～Eocene) is granodiorite. There was a significant difference between these granitoids, but in the Çanakkale Area, the difference in composition by age was not observed.

② Neither granites have a clear range of compositional variation in D.I.-oxide.

③ A similar tendency exists for the CaO-alkali ratio, and the granites are in a high CaO zone (Figure 1-15).

Genetic classification of the granitoids has been proposed by Chappell and White(1974), Ishihara (1977) and others. In Chappell and White's classification, the $Al_2O_3/(Na_2O + K_2O + CaO)$ molar ratio, normative diopside and normative corundum values are used as the basis of the grouping. On this basis, both the older and younger granites of the survey area belong to type I. Ishihara uses the mode of opaque minerals observed under the microscope and the Fe_2O_3/FeO^* ratio for his classification. Although microscopic study of polished sections has not been done in the second phase's work, the mode of opaque minerals and the Fe_2O_3-FeO^* diagram (Figure 1-11) indicates the granites of the survey area to be of the magnetite series.

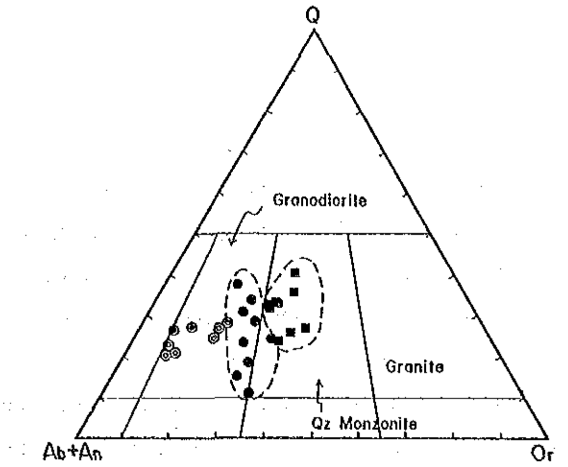

Fig. 1-6 Normalized Qz-(Ab+An)-Or Diagram for Granitic Rocks

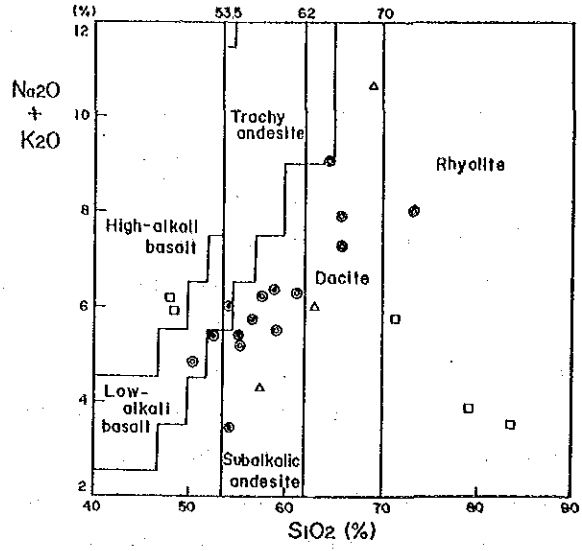

Fig. 1-7 $SiO_2 \cdot (Na_2O + K_2O)$ Diagram for Volcanics

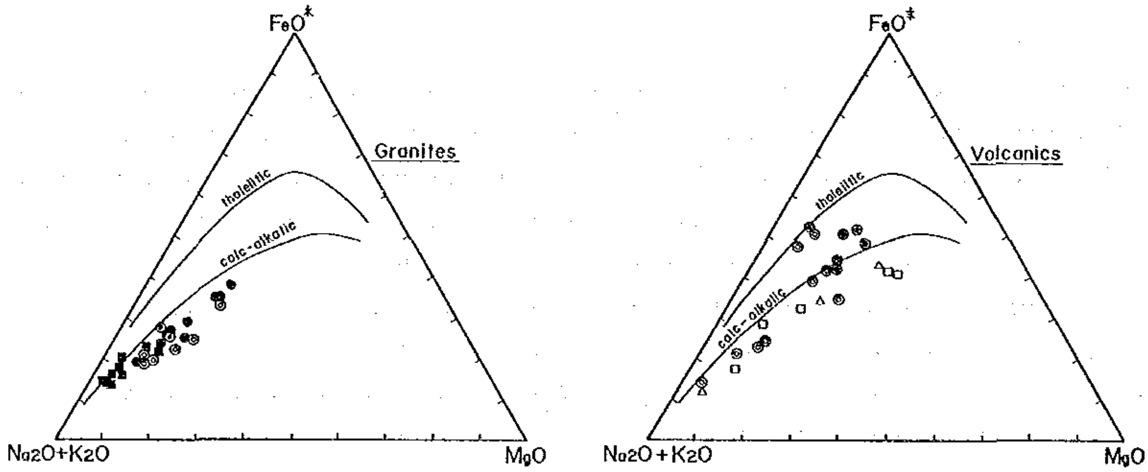

Fig. 1-8 MFA Diagrams

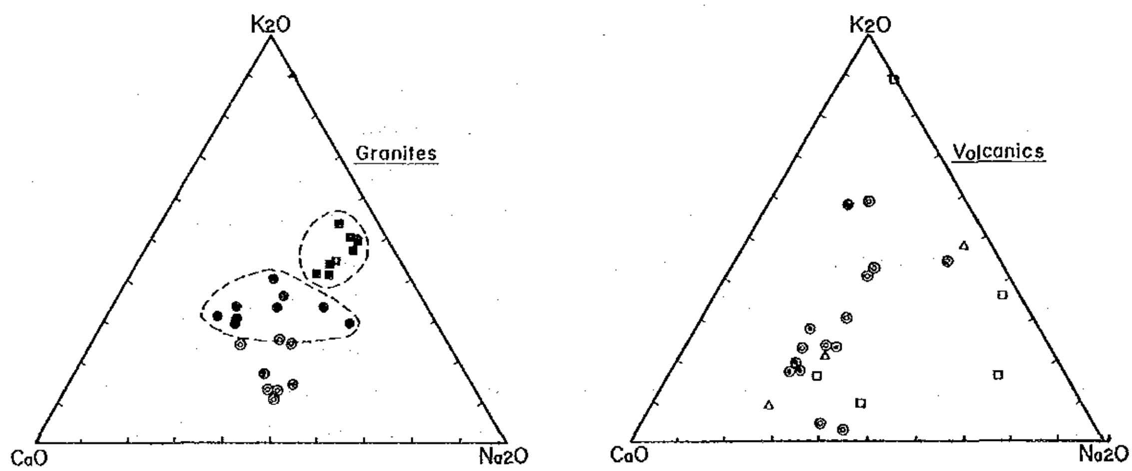

Fig. 1-9 CaO-Na_2O-K_2O Diagrams

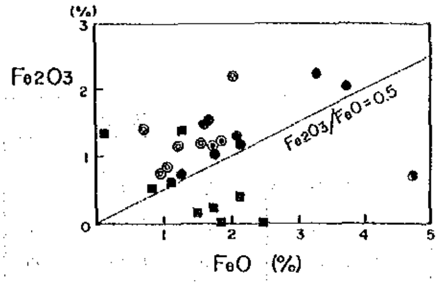

Fig. 1-10 Fe_2O_3-FeO* Diagram for Granitic Rocks

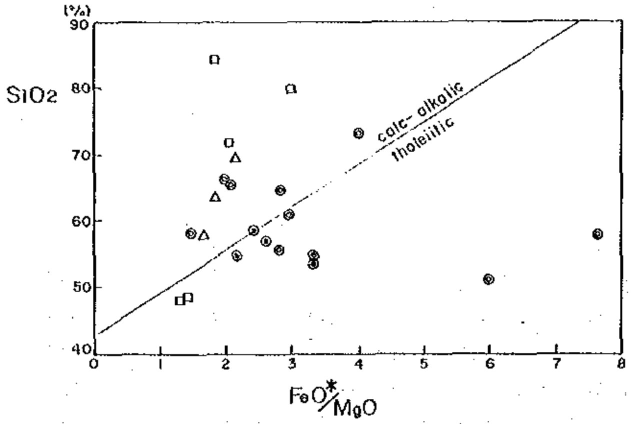

Fig. 1-11 SiO_2-FeO*/MgO Diagram for Volcanics

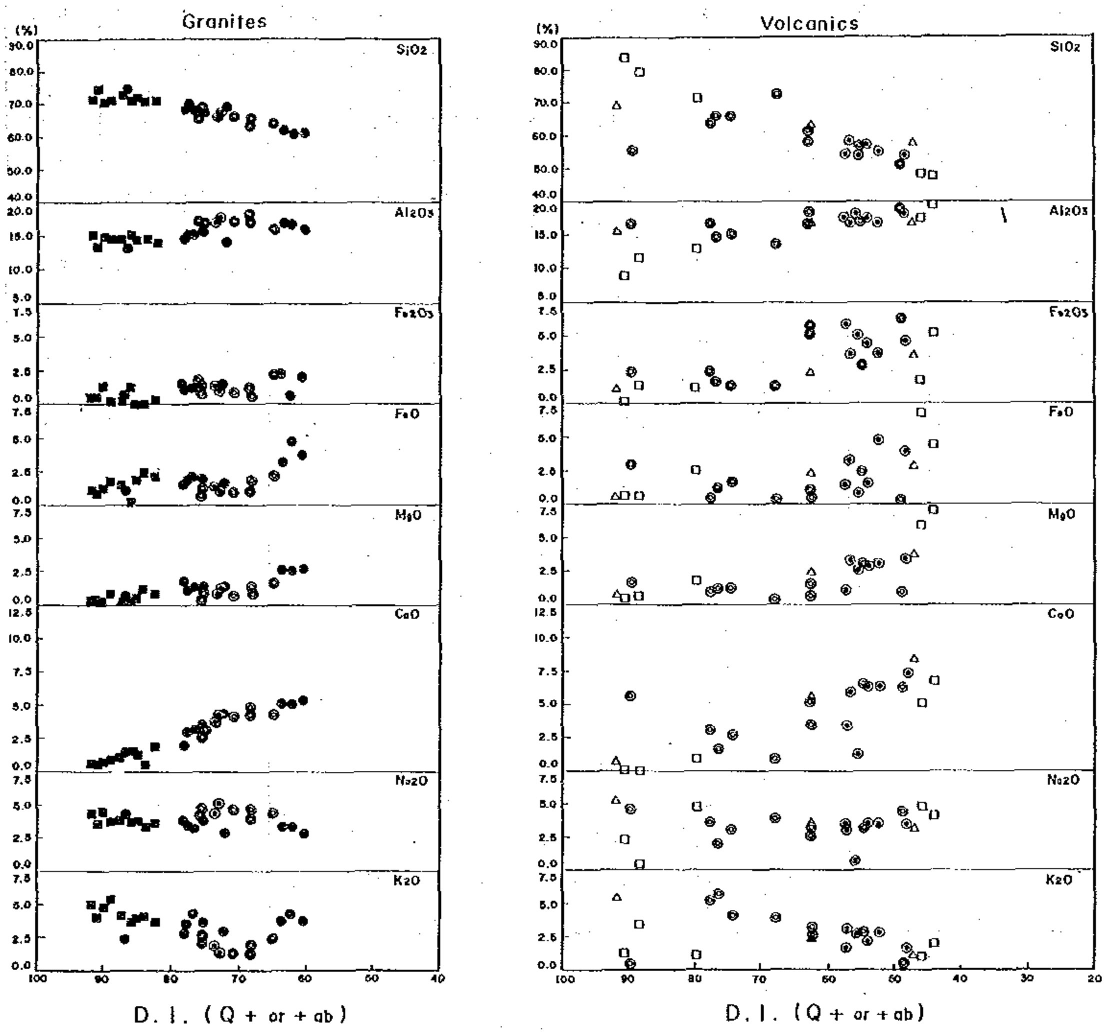

Fig. 1-12 Variations Diagrams (D.I.- Oxides)

Symbols (Same as in Fig.1-6 ~Fig.1-12)

	Granites	Volcanics
Çanakkale Area	◎:Granodiorite (Triassic-Eocene) Phase I	◎:Andesitic rocks (Eocene-Pliocene) Phase I
	◉:Granodiorite (Triassic-Eocene) Phase II	◉:Andesitic rocks (Eocene-Pliocene) Phase II
Gümüshane Area	■:Gümüshane Granite (Devonian ?)	▲:Venk Yayla Formation (Eocene, Andesite)
	●:Younger Granitic rocks (Upper Cretaceous~Eocene)	△:Zigana Formation (Uppur Cretaceous, Andesite)

Table 1-6 Chemical Analysis and CIPW Norms for Granitic Rocks and Volcanics

Sample	1	2	3	4	5	6	7	8	9	ACC※		
No.	S405	559	S415	S373	158	159	259	K328	Y309	A	B	C
SiO_2	58.58%	54.17%	54.44%	57.54%	78.00%	53.32%	55.50%	67.09%	67.64%	55.59%	82.43%	53.96%
TiO_2	0.71	0.71	0.38	0.86	0.71	0.88	0.96	0.33	0.33	0.75	0.87	0.72
Al_2O_3	16.74	17.53	17.65	17.53	2.54	18.03	18.45	17.98	17.24	17.66	7.39	16.50
Fe_2O_3	3.59	5.05	3.79	4.79	9.14	4.50	5.40	1.10	1.11	4.52	3.07	1.68
FeO	3.07	0.49	4.79	2.03	0.94	4.07	1.30	1.62	1.66	2.63	0.35	0.11
MnO	0.15	0.19	0.24	0.09	0.01	0.24	0.03	0.07	0.08	0.16	0.01	0.01
MgO	2.78	2.50	2.57	2.61	0.06	2.62	0.77	1.12	0.83	2.31	0.09	0.02
CaO	6.04	1.27	6.79	6.82	0.12	7.40	4.41	4.19	4.11	5.46	0.13	0.20
Na_2O	3.07	0.84	3.21	3.27	0.22	3.13	3.06	5.08	4.32	2.76	0.22	0.87
K_2O	3.29	2.70	2.58	2.41	0.04	2.15	2.21	1.40	1.88	2.56	0.77	3.43
P_2O_5	0.35	0.24	0.35	0.27	0.15	0.32	0.24	0.18	0.23	0.30	0.17	0.30
BaO	0.13	0.07	0.11	0.10	0.08	0.12	0.09	0.05	0.09	0.10	0.05	0.17
LOI	0.43	4.61	1.82	0.59	6.95	1.54	3.98	0.54	0.04	2.16	2.56	17.20
H_2O+	1.21	4.66	0.47	0.64	0.96	1.08	1.78	0.48	0.50	1.64	1.64	5.88
H_2O-	0.06	5.98	0.42	1.41	0.17	1.04	3.16	0.08	0.13	2.01	0.26	0.05
Total	100.20	101.02	99.61	100.96	100.09	100.44	101.34	101.31	100.19	100.61	100.01	101.10
Q	13.23	33.18	9.53	12.87	76.64	9.30	19.33	21.97	25.84			
C	0.00	11.49	0.00	0.00	2.27	0.00	3.58	0.92	1.18			
or	19.44	15.96	15.25	14.24	0.24	12.71	13.06	8.27	11.11			
ab	25.96	7.10	27.15	27.65	1.86	26.47	25.88	42.96	36.53			
an	22.19	4.75	26.14	26.04	0.37	28.80	20.32	19.62	18.90			
di-wo	2.30	0.00	2.20	2.52	0.00	2.43	0.00	0.00	0.00			
di-en	1.99	0.00	1.85	2.18	0.00	2.10	0.00	0.00	0.00			
di-fs	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00			
hy-en	4.93	6.22	4.55	4.32	0.15	4.42	1.92	2.79	2.07			
hy-fs	0.00	0.00	0.19	0.00	0.00	0.00	0.00	0.20	0.22			
mt	8.33	0.14	13.20	4.34	0.92	11.35	1.51	4.15	4.28			
hm	1.26	5.49	0.00	4.05	9.54	1.19	5.80	0.00	0.00			
il	1.35	1.35	1.67	1.63	1.41	1.67	1.82	0.63	0.63			
ap	0.83	0.57	0.83	0.64	0.36	0.76	0.57	0.43	0.55			
S.I.	17.59	21.59	15.17	17.27	0.58	15.90	6.04	10.85	8.47			
D.I.	58.63	56.24	51.93	54.76	78.74	48.48	58.27	73.20	73.48			

ACC※:Average of chemical component

A : Unaltered andesite (Sample Nos. 1, 2, 3, 4, 6, 7)

B : Altered andesite (Sample Nos. 5, 10, 11, 12, 13, 16, 18, 19, 20)

C : Altered andesite (Sample Nos. 14, 15, 17)

Table 1-6 Chemical Analysis and CIPW Norms for Granitic Rocks and Volcanics

Sample	10	11	12	13	14	15	16	17	18	19	20
No.	M419	358	359	460	558	658	S463	M460	T485	M378	258
SiO_2	96.51%	60.72%	70.16%	65.33%	56.23%	57.90%	83.38%	47.75%	95.41%	96.98%	95.41%
TiO_2	1.81	0.90	0.81	0.72	0.57	0.64	0.61	0.95	0.71	0.81	0.74
Al_2O_3	0.29	19.08	14.23	17.36	14.45	15.32	12.06	19.74	0.29	0.32	0.31
Fe_2O_3	0.68	6.44	3.56	5.48	4.54	0.04	0.17	0.47	1.44	0.38	0.30
FeO	0.71	0.20	0.10	0.12	0.14	0.06	0.18	0.12	0.26	0.50	0.16
MnO	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
MgO	0.01	0.55	0.02	0.10	0.03	0.01	0.01	0.01	0.01	0.01	0.01
CaO	0.04	0.36	0.17	0.13	0.15	0.24	0.11	0.21	0.10	0.09	0.05
Na_2O	0.11	0.58	0.38	0.16	1.22	0.49	0.19	0.91	0.15	0.15	0.01
K_2O	0.05	2.99	1.00	2.13	2.16	4.04	0.50	4.09	0.10	0.05	0.06
P_2O_5	0.07	0.39	0.12	0.35	0.33	0.18	0.17	0.38	0.09	0.10	0.06
BaO	<0.01	0.16	0.04	0.07	0.09	0.11	<0.01	0.31	0.01	<0.01	0.08
LOI	<0.01	3.87	6.07	3.52	15.42	16.98	0.20	19.21	0.74	0.31	1.35
H_2O+	0.04	3.11	3.63	3.95	5.40	5.46	2.62	6.78	0.32	0.04	0.05
H_2O-	0.01	1.00	0.06	0.72	0.10	0.04	0.31	0.01	0.04	0.01	0.03
Total	100.36	100.36	100.36	100.15	100.84	101.52	100.53	100.95	99.68	99.77	98.63

No.	Location	No.	Description	Formation
1	Arlık Dere	S405	Fresh basaltic andesite	Şapçı V.
2	MJTC-5(114.25m)	559	Pale green weak arg andesite with py diss	Şapçı V.
3	Karaibrahimler	S415	Fresh basaltic andesite	Şapçı V.
4	Piren Tepe	S373	Fresh andesite	Şapçı V.
5	MJTC-1(42.20m)	158	Dark grey porous silicified rock	Şapçı V.
6	MJTC-1(126.00m)	159	Dark grey andesite	Şapçı V.
7	MJTC-2(96.60m)	259	Dark green fractured andesite	Şapçı V.
8	Dikmen	K328	Dikmen granodiorite	Intrusive
9	Dikmen	Y309	Dikmen granodiorite	Intrusive
10	Arlık Dere	M419	Massive silicified rock	Şapçı V.
11	MJTC-3(30.00m)	358	Grey arg rock with py diss	Şapçı V.
12	MJTC-3(140.20m)	359	Grey massive rock with limonite	Şapçı V.
13	MJTC-4(100.00m)	460	Grey arg rock with py diss	Şapçı V.
14	MJTC-5(63.40m)	558	Grey porous silicified rock with py diss	Şapçı V.
15	MJTC-6(77.80m)	658	Light brown porous s silicified rock	Şapçı V.
16	Karaibrahimler	S463	Porous silicified rock	Şapçı V.
17	Kestane Dagı	M460	Alunitic silicified rock	Şapçı V.
18	Kestane Dagı	T485	Porous silicified rock	Şapçı V.
19	Piren Tepe	M378	Massive silicified rock	Şapçı V.
20	MJTC-2(5.70m)	258	White massive silicified rock	Şapçı V.

Table 1-7 Results of Microscopic Observation of the Thin Sections

Sample No.	Rock Name	Rock unit	Texture	Phenocryst									Groundmass									Alteration
				Qz	Kf	Pl	Bi	Ho	Au	Hy	Mf	Op	Qz	Pl	Bi	Ho	Au	Hy	Mf	Op	G	
S405	Fresh basaltic andesite	Msa	porpyritic			◎		○	○	□	□	□		◎					○	○	○	Ch. Ep
M419	Massive silicified rock	Msa	granular										◎						△	□		silicified, Ch
S415	Fresh basaltic andesite	Msa	porpyritic			◎		□	○	○	□	□		◎					◎	○		Ch, Ep
S463	Porous silicified rock	Msa	granular										◎						◎	○	△	Ch. vs Ep
M460	Alunitic silicified rock	Msa	granular										◎						○			
T485	Porous silicified rock	Msa	granular										◎						○	□		
M378	Massive silicified rock	Msa	granular	○							□		◎						○	△		Ser (Ch?)
S373	Fresh andesite	Msa	porpyritic			◎		○	○			□		◎		○	○			◎		Ch
K328	Dikmen granodiorite		hypodiomorphic	◎	○	◎	□	△				△										Ser
Y309	Dikmen granodiorite		hypodiomorphic	◎	○	◎	○	△	△			□										Ser (Ch?)
156	Dark grey andesite	Msa	porpyritic	□		◎		□	□		□	□		◎					◎	○		
256	Fractured andesite	Msa	porpyritic	○		◎					□?	□		◎					◎	○		phenocryst Mf→relict
356	Silicified rock	Msa	granular										◎							□		silicified
457	Silicified rock	Msa	granular										◎							○		vs silicified,
556	Silicified rock	Msa	porpyritic								◎	○	◎						◎	○		Ch, Ep
656	Silicified rock	Msa	porpyritic										◎						◎	◎	○	Ch

S405, M419 : Arlık Dere
M460, T485 : Kestane Dagı
K328, Y309 : Dikmen
156 : MJTC-1 126.00 Dark grey andesite
356 : MJTC-3 129.30 L.grey vs silicified rock with py diss
556 : MJTC-5 63.40 Grey porous silicified rock

S415, S463 : Karaibrahimler
M378, S373 : Piren Tepe
256 : MJTC-2 96.60 Dark green fractured andesite
457 : MJTC-4 62.20 L.grey massive silicified rock
656 : MJTC-6 67.80 Light brown porous s silicified rock

Abbreviations:

◎:Abundant ○:Common □:Few △:Rare

Qz:Quartz, Kf:Potassium feldspar, Pl:Plagioclase, Bi:Biotite, Ho:Hornblende, Au:Augite, Hy:Hypersthene, Py:Pyrpxene,

Mf:Mafic mineral Op:Opaque minerals Ser:Sericite Ch:Chlorite Ep:Epidote C:Calcite Ah:Anhydrite G:Glass

vs:very strong arg:argillization

(2) Volcanic rocks

Şapçı Volcanics are all andesite. In the $SiO_2 \cdot (Na_2O+K_2O)$ diagram (Figure 1-7), however, they are in the dacite range. The reason for these rocks being chemically in the dacite and rhyolite ranges is believed to be the increase of SiO_2 content by 5~6% through alteration. Also, the MFA diagram (Figure 1-8) and the SiO_2-FeO*/MgO diagram (Figure 1-11) show that the volcanic rocks of this area belong to the calc-alkali series.

(3) Compositional variation in the alteration zones

The eighteen samples of Şapçı Volcanics were classified into three groups, six unaltered, nine strongly silicified and three altered andesitic rocks. The averages of the chemical components are shown in Table 1-6.

Stable element	:Ti	
Increased component	:SiO_2	(center of silicified zones are high.)
Decreased element	:Al	(unchanged in alunite zones.)
	Fe	(strongly silicified zones are low.)
	Mg•Ca	(marked decrease.)
	Na+K	(marked decrease, but unchanged alunite zones.)

4-3-2 Fluid Inclusions

Although quartz veins and veinlets were observed from silicified zones of six drill holes, eleven samples for measuring fluid inclusions were collected from the cores, and fluid inclusions were found in five samples, all diameters of fluid inclusions were less than 10 μm; measurable fluid inclusions were not detected.

Table 1-8 Fluid Inclusion Samples

Drill No	m	No.	Description	L. I.
MJTC-1	84.50	161	Dark grey porous silicified rock	×
	126.00	162	Dark grey andesite with calcite veinlet	○
	150.00	163	ditto	×
MJTC-2	5.70	260	White massive silicified rock	○
MJTC-3	33.65	360	L.grey massive sil rock with py diss	×
	136.20	361	ditto	○
	137.10	362	ditto	×
MJTC-4	24.00	461	L.grey massive sil rock	○
	60.50	462	ditto	○
MJTC-5	59.70	560	Grey porous silicified rock with py diss	×
	79.30	562	ditto	×

L. I. :Liquid Inclusion ○ : detected, × : not detected

4-3-3 EPMA

Silicified samples and those accompanied by pyrite were collected from cores MJTC-1 to MJTC-6, and were polished. They are listed in Table 1-9.

Table 1-9 EPMA Samples

Drill No.	Depth	Sample No.	Description
MJTC-1	42.20	157	Dark grey porous silicified rock
MJTC-2	60.20	257	Black silicified rock with py diss
MJTC-3	142.20	357	Pyrite ore
MJTC-4	142.00	458	Grey silicified rock with py diss & hema
MJTC-4	151.00	459	ditto
MJTC-5	70.00	557(A)	Grey porous silicified rock with py diss
	98.70	557(B)	ditto
MJTC-6	119.50	657(A)	Grey sandstone with py vein
	123.50	657(B)	Grey mudstone with py vein

Table 1-10 Microscopic Observation of the Polished Section

Sample No.	Shape of Pyrite	Size (max)	Accessory Mineral	Ratio of Minerals
157	euh. ~s. euh.	0.1×0.1mm	goethite(euh.)	
257	s. euh.	2.4×1.0mm	marcasite(?)	
357	s. euh. ~anh.	φ0.9mm	tetrahedrite-tennantite chalcopyrite sphalerite	
458	euh. ~s. euh.	0.4×0.2mm	goethite(euh.) magnetite sphalerite	py≫go>sp>mt
459	anh.	φ0.06 mm	ilmenite(s. euh.) arsenopyrite(euh.) magnetite goethite(anh.) sphalerite(anh.)	il, py≫ap, mt, go, sp
557(A)	euh. ~s. euh.	φ0.1mm	hematite(~mafic m.) chalcopyrite goethite(in py) hematite(in py) sphalerite(anh., φ0.02mm)	
557(B)	euh. ~s. euh.	0.7×0.2mm	marcasite sphalerite(anh., φ0.02mm)	
657(A)	pyrite-marcasite vein		sphalerite(drop-shape φ0.02mm)	
657(B)	pyrite-marcasite vein		magnetite(φ<0.02mm)	

euh.:euhedral, s. euh.:sub-euhedral, anh:anhedral

As a result of microscopic observation in polished section, a gold-coloured mineral was observed in the pyrite of sample 657(A), but gold was not detected by means of EPMA. Chemical components of pyrite in this sample are shown in Table 1-11.

Table 1-11 Chemical Components of Pyrite

	Position No. 1		Position No. 2		Position No. 3	
	Wt.%	Atom	Wt.%	Atom	Wt.%	Atom
Cu	0.000	0.0000	0.001	0.0007	0.005	0.0029
Ag	0.015	0.0055	0.000	0.0000	0.000	0.0000
In	0.003	0.0012	0.000	0.0000	0.000	0.0000
Fe	46.535	33.1965	44.300	31.7108	46.031	32.7871
Zn	0.009	0.0057	0.031	0.0189	0.000	0.0000
Mn	0.000	0.0000	0.089	0.0650	0.000	0.0000
Cd	0.031	0.0111	0.005	0.0019	0.000	0.0000
As	0.000	0.0000	0.012	0.0063	0.011	0.0058
Sn	0.005	0.0017	0.017	0.0058	0.000	0.0000
Sb	0.000	0.0000	0.000	0.0000	0.017	0.0054
Bi	0.000	0.0000	0.000	0.0000	0.105	0.0200
S	53.736	66.7784	54.684	68.1906	54.140	67.1788
Se	0.000	0.0000	0.0000	0.0000	0.000	0.0000
Total	100.334	100.0000	99.139	100.0000	100.309	100.0000

4-3-4 Isotopic Analysis

Five samples for isotopic age analysis were collected from three localities, two samples from Dikmen Granite, two alunite-quartz samples from Arlık Stream and a alunite-quartz sample from Kestane Mountain. Isotopic ages were determined by Teledyne Isotopes (USA).

The results indicated that Dikmen Granite intruded from the latest stage of the Upper Cretaceous to the first stage of the Eocene (Table 1-12). On the other hand, the alunite-quartz samples from the silicified zones of Şapçı Volcanics exhibited isotopic ages of Oligocene (two samples) and latest Miocene to Pliocene (one sample). It is considered that alunite is not suitable for isotopic age analysis.

Table 1-12 Isotopic Ages

Area (rock) Coordinates	Sample No.	Material Analyzed	$^{40}Ar*$ Iscc/gmx^{-5}	% $^{40}Ar*$	% K	Isotopic Age [Ma]
Arlık Dere (alunite-SiO_2) 84100 29735	K318	Whole rock	0.303 0.306 0.302	60.0 70.2 63.5	2.50 2.54	30.7±1.5
Arlık Dere (alunite-SiO_2) 82500 31485	Y306	Whole rock	0.104 0.111	35.1 20.0	2.03 2.03	13.6±1.7
Kestane Dagı (alunite-SiO_2) 76595 29085	M460	Whole rock	0.348 0.337	84.9 85.6	2.85 2.84	30.7±1.5
Dikmen (granodiorite) 14440 42755	K328	Whole rock	0.201 0.200	56.6 40.8	0.98 0.98	51.9±2.6
Dikmen (granodiorite) 13960 42975	Y309	Whole rock	0.295 0.305	59.7 84.6	1.65 1.62	46.6±2.3

4-3-5 Heavy Mineral Study

In order to make contributions to the second phase studies of the project carried out this year, 57 soil and stream sediment samples were analyzed. The distribution of the collected samples are as follows:

Study Area	Number of collected samples	Stream sediments	Soil samples
Piren Tepe	15	1	14
Arlık Dere	15	9	6
Karaibrahimler	22	10	12
Etili	5	-	5
Total	57	20	37

The result of binocular microscope study for the samples are given in Table 6 of the Appendix. It was conducted on the basis of colour, shape and associated minerals of the gold grains of which there are two types of mineralizations. They are epithermal- and vein-type occurrences. The gold grains considered to have epithermal origin are lighter colour. The finer grains are sheet-like and needle shaped, the relatively coarse grains are irregular, rough-surfaced and dendritic. They generally occur with barite and rutile-zircon. The grains considered to be vein type are reddish-yellow, rounded and massive. These are generally found with garnet, epidote, magnetite, malachite and, occasionally, scheelite. Rutile-zircon is less abundant than in the former. Therefore, the Piren Tepe and Etili areas have epithermal mineral paragenesis whereas the Arlık Stream and Karaibrahimler areas have epithermal- and vein-type mineral paragenesis.

Arlık Dere Area : A total of 22 samples has been collected. Gold has been detected in all six soil samples and six of nine stream sediment samples. The light-yellow colour and irregular shape of the gold grains and coexistence of gold with barite and rutile-zircon indicate an epithermal origin for the northern part of the area, and the assemblage of gold with garnet, epidote, magnetite and small amount of scheelite and barite indicate a vein-type origin for the southern part of the area. Of the minerals, garnet, epidote, magnetite and scheelite which are found in the stream sediments of the southern section, may be assessed to have originated from skarn mineralization.

Karaibrahimler Area : A total of 22 samples has been collected in the field. Gold has been detected in six of 10 stream sediment samples and three of 12 soil samples. Barite and rutile-zircon were observed in some samples and $PbCO_3$ in some others; the shape and varying colour of the gold grains suggest the coexistence of epithermal- and vein-type mineralization in the area. Even though a nearly anomalous number of gold grains has been determined by panning, the area is not very promising as extensive silicification for epithermal mineralization and significant veins for vein-type mineralization

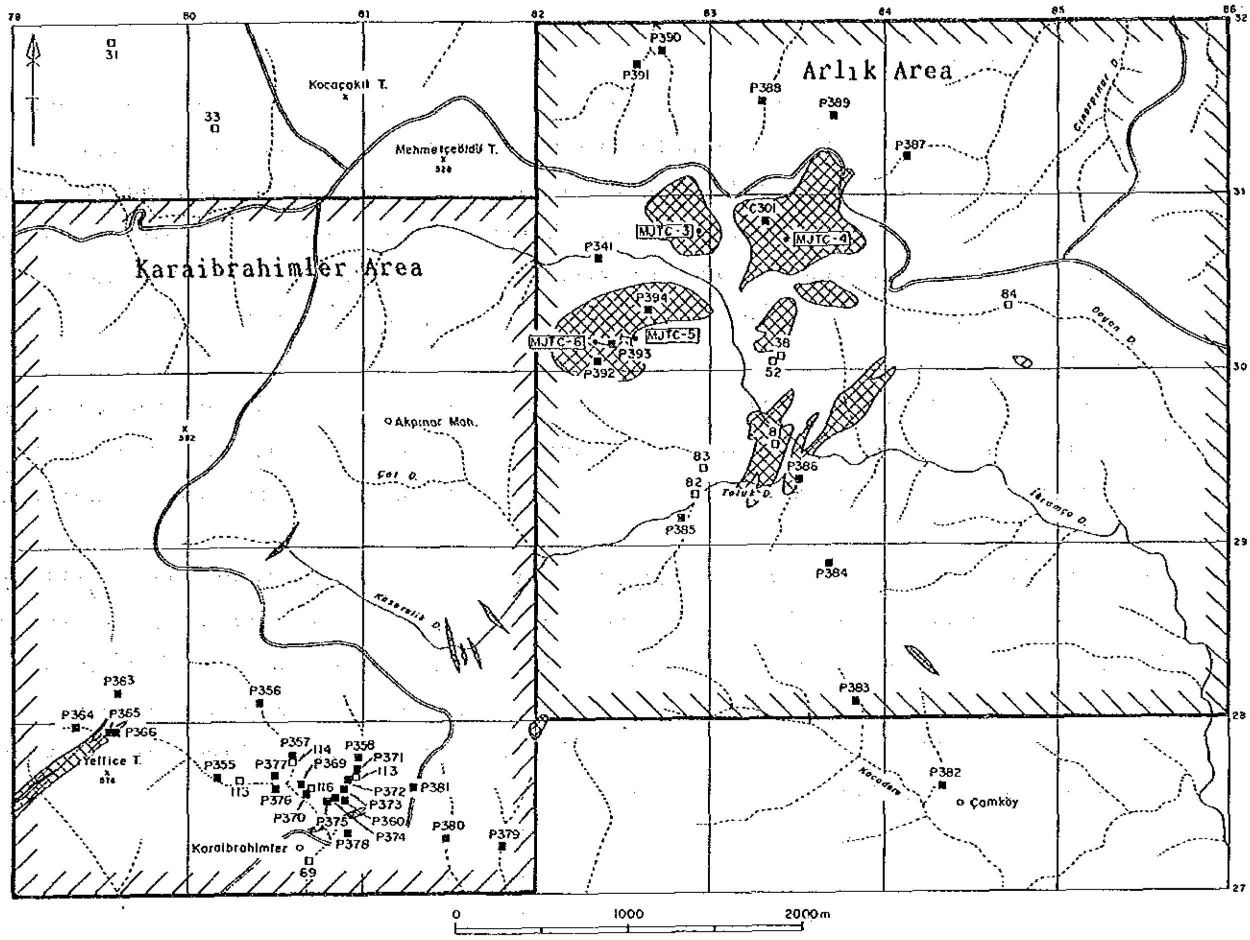

Fig. 1-13 Map of Panning Sample Locations(Arlık Dere and Karaibrahimler)

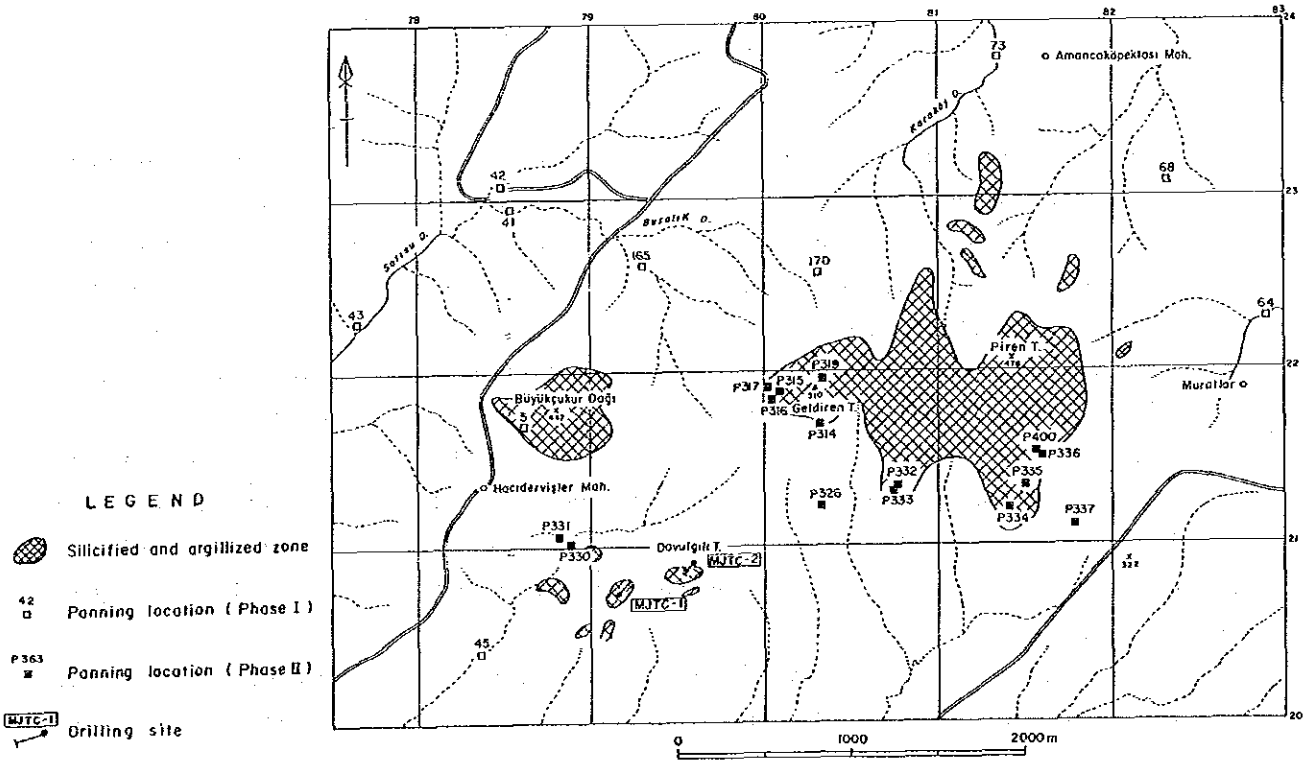

Fig. 1-14 Map of Panning Sample Locations(Piren Tepe)

have not been determined.

Piren Tepe Area : Gold has been detected in three of ten samples. The number of gold grains is very few. The gold grains are pale and light yellow and fine and sheet-like. The sheet-like finer grains of gold found with barite and rutile-zircon may be an indicator of epithermal origin. However, gold found by panning is not considered an anomaly with respect to the numerical results if gold which cannot be detected by panning is common in the silicified rocks in the field.

Etili Area : Gold has been determined in fine soil samples collected from this area, which is outside of the study area. Barite and cinnabar in the samples and existence of a hot spring indicate epithermal gold mineralization.

In addition to these, some samples have been taken from the drilling sediments in order to collect data from drilling before the chemical analysis of the cores. Initially it was planned to take sediment samples at 6 m intervals; however, this become impossible because of mud leakage from the drilling as well as some other problems. The distribution of samples according to the drilling is given below:

MJTC-1	15 samples
MJTC-2	10 samples
MJTC-3	10 samples
MJTC-4	8 samples
MJTC-5	5 samples
MJTC-6	5 samples
Total	53 samples

Binocular microscope studies of the collected samples have been completed and heavy mineral distributions are listed in Table 6 of the Appendix. Some gold-like grains have been detected in some of the rock bit sediment samples, however, definitive gold determination has not been performed. The reason for this is that a yellow-coloured matrix present in the rock bit is too abundant. These grains are very much like gold, e.g., malleability colour, low hardness and reaction with chloritic and nitric acids. Therefore, they must be treated very cautiously. Gold has not been determined in the panning samples of the sediments taken between the 24th and 30th meters of MJTC-4; however, the same samples were amalgamated with mercury and a very small amount of gold was detected. It will be more accurate to use the grinded core samples for gold determinations.

In conclusion, heavy mineral studies (panning) is a useful method for the natural samples. The implementation of this method with the drill core samples is prevented because of various factors and their negative effects.

4-3-6 Rock Property Measurement

SIP measurements were conducted on 34 rock samples. In addirion, their phase spectra, resistivities and PFE were measured. The result revealed that many samples had high resistivity. Marble, silicified rock and the quartz vein showed very high values, over 10,000 ohm-m. On the other hand, low resistivity is represented by the 20~270 ohm-m range of serpentinite, meta-volcanics and metasediments (green schist).

The PFE values ranged from the maximum of 8.8% (quartz vein) to the minimum of 0.3% (sandstone). Porphyry and granodiorite showed 2.2%, and the values over 4% were shown by silicified rock, the quartz vein and limestone (marble).

As for the phase spectrum, the mountain-shape type (Type A) was characteristic, the flat-lying type was also seen. The flat-lying spectra can be classified into seven kinds, but these are not necessarily correlative to rock types. No correlation was noticed either with the PFE values or phase values. This may be because the rocks distributed in this area have very high resistivity and low sulfide minerals content.

4-4 Mineralized Zones inferred from Geophysical Prospecting

Electric prospecting with the IP•SIP method was conducted in the Dikmen district. Lines A and D each 2km in length, were measured by the IP method and Lines B and C, totaling 4km for 4 lines, by the SIP method. From the results of these measurements the following could be inferred.

The values of PFE around 1% were dominant throughout the entire area. A PFE anomaly of over 3% was found in the central to southeastern part of Line C. A weak anomaly of over 2% was confirmed at about the midpoint of Line D. These anomalies correlate with the distribution of limestone, granodiorite and porphyry extending NE-SW in the central part of the area. The result of the simulation analysis showed that the sources of these anomalies have PFE values of 5~8%, and that the depth of occurrence of the mineralized zone is deep at Line D, becoming shallower toward Lines C and B.

Resistivity values were, in general, high. A zone of resistivity $\geqq$ 300 ohm-m, probably attributable to limestone, was noted in the southeastern end of Lines B, C, and D. A low resistivity zone ($\leqq$ 30 ohm-m) was found in an area of green schist and limestone in the central-eastern part of Line A.

As for the SIP response, no significant spectrum was recognized either for phase or magnitude. The phase and magnitude spectra after the decoupling process were nearly flat-lying. The Cole-Cole diagram, which is supposed to have a semicircle form, showed only very slight arcs due to small variations of phase. The insufficient SIP response is attributed to the high resistivity of rocks of this area and to the law content of sulfide minerals.

4-5 Resource Potential of Gold and Porphyry Molybdenum Deposits

4-5-1 Gold Potential

The geologic characteristics of this area is the predominance of Eocene to Miocene intermediate volcanic rocks. In Zone A, Eocene Çamyayla volcanics are developed and small-scale vein mineralization associated with the volcanism of this period is observed, while in Zone B, Miocene Şapçı volcanics are developed, and silicified and argillized zones related to epithermal gold mineralization is widely developed. In the Çanakkale area, there are the Madendagı and Kartaldagı gold mines, and the alteration zone extends from these mines to Zone B.

It was shown by Landsat image analysis that there are many silicified and argillized alteration zones in the survey area, but the alteration zones are not necessarily accompanied by gold mineralization. Gold occurs only in limited localities.

The major localities where gold mineralization was confirmed from geochemical samples are shown in Table 1-3. The potential of these areas will be clarified by subsequent surveys. The characteristics known to date are as follows.

(1) In the central part of Zone B, the basement which consists of Taşdibek Formation and Akpınar Granite forms an uplifted zone and gold mineralization is observed in the altered zone surrounding the basement complex.

(2) The X-ray diffraction study of samples from the alteration zone showed that gold mineralization occurs in the acidic alteration whose products are kaoline, alunite and pyrophyllite with associated cristobalite.

(3) In the silicified zones, the gold content is low in the massive part, but is generally high along the fissures of the brecciated part with limonitic and hematitic clay associations.

(4) The components with large absolute values of the eigenvector of the principal component analysis are, aside from gold, copper, lead, zinc, silver, mercury, arsenic, and molybdenum; these elements are considered to be associated with gold.

From the above, it is anticipated that low-grade large-scale gold deposits occur in the silicified and argillized alteration zones near the basement rocks in Zone B.

4-5-2 Porphyry Molybdenum Potential

Porphyry molybdenum-copper deposits associated with the Dikmen Granite and porphyry intrusion were discovered in Zone C. The mineralization extends from the eastern side of the Dikmen Granite, which is elongated in the NEN-SWS direction to Emeşe Formation of the Sığırirek Stream. The rocks are decoloured white at Sığırirek, and minor amounts of sulfide minerals such as molybdenite, chalcopyrite, sphalerite and pyrite occur in association with quartz veinlets. Although invisible under the microscope, analysis (Table 1-9) shows the existence of gold, silver, arsenic, mercury and antimony. Sericite and kaoline were identified by X-ray diffraction indicating epithermal activity after the porphyry mineralization. The two mineralizations could be overlapping.

The porphyry-type mineralization extends to the lower horizons and this is expected to be the low-grade large-scale deposit. This deposit locally contains gold. If gold can be found to be contained in significant amounts in the overlapped section, this would be an important future target.

4-6 Geologic Structure, Characteristics and Control of Mineralization.

The central part of Zone B consists of the Taşdibek Formation and Akpınar Granite which forms the geological basement. The basement is uplifted. The silicified and argillized zones of Şapçı Volcanics occur around the basement. The alteration zone extends further outward, but the gold mineralization is observed near the uplifted zone. In these zones, acidic alteration consisting of cristobalite, alunite and pyrophyllite is observed. Analysis of rocks shows copper, lead, zinc, silver, mercury, arsenic and molybdenum together with gold. These elements are considered to have been associated with gold mineralization.

Quaternary Kocaçakıl Basalt lava intruded along the fault which extends through the uplifted zone of the basement. This is further evidence that conduits for hydrothermal fluids formed in the vicinity of the basement, and gold mineralization associated with the acidic alteration occurred.

Triassic Emeşe Formation is predominant in the southern part of Zone C. There are lineations trending NEN-SWS parallel to the Dikmen Fault. Serpentinite intruded along these latent faults, and Dikmen Granite and porphyry also intruded in the same direction in latest Cretaceous to Eocene. Parts of the limestone and metavolcanics of the Emeşe Formation were skarnitized, argillized and silicified by the intrusion of the granitic rocks and porphyry. Molybdenite and other sulfide minerals occur in the quartz veinlets along the fissures formed by the intrusion of Dikmen Granite and porphyry.

The intermediate volcanism became active in the Tertiary, and large amounts of lava and pyroclastic material were deposited during the Eocene to Miocene. The structure with the NEN-SWS trend clearly remained later into the time of silicification, argillization and associated gold mineralization (inferred to be latest Tertiary to Quaternary). Gold-rich zones are locally observed along this direction, and the range of this mineralized zone is 4 km long and 2~3 km wide elongated in a NEN-SWS direction.

CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS

5-1 Conclusions

During the second phase, geological and geochemical surveys were conducted in the Arlık Stream, Karaibrahimler, Kestane Mountain, Piren Hill and Dikmen Areas. Further geophysical prospecting was carried out in the Dikmen, and drill survey in the Arlık Stream and Piren Hill. Compiled maps of those areas were shown Figures 1-15 and 1-16, list of geological and geochemical chracteristics in the Table 1-13, summary of five areas are as follows:

(1) Arlık Dere: Silicified and argillized zones occur in Şapçı Volcanics and part of Kirazlı Conglomerate. The Kocataş silicified zones occurring in Şapçı Volcanics were evident to 100m in MJTC-5 and 6, after which Kirazlı Conglomerate was intersected, but the SartaŞ silicified zones continued for at least 150m in MJTC-4. Altered zones with limonite are predominant on the outcrops, but pyrites are not observed. Of the results of the drill survey, the following are significant: fine-grained pyrites are developed in the section underneath the surface, limonitic silicified zones with open spaces (caves) were found by drill hole MJTC-4 and the low-grade auriferous zones continued from near surface to bottom in hole MJTC-4. Therefore, it is considered that the potential of gold deposits is high.

Generally, auriferous mineralization in the silicified body did not extend further downward, and silicified veins were observed in the periphery of the silicified zones. Thus it is considered that their shapes are "jellyfish-like" in geologic section.

(2) Karaibrahimler: The Şapçı Volcanics and Kirazlı Conglomerate have suffered hydrothermal alteration in the vicinity. Altered zones with limonite and hematite are predominant on the outcrops, and pyrites are rarely observed because of oxidation. It is considered that the Şapçı Volcanics becomes thin because of proximity to the basement rocks. Silicified veins occur in Şapçı Volcanics and Kirazlı Conglomerate and are exposed rock from lower levels of the formation after erosion of the upper levels.

(3) Kestane Dağı: The Şapçı Volcanics and Kirazlı Conglomerate have suffered hydrothermal alteration in this vicinity. In particular, the Şapçı Volcanics have suffered strong silicification and argillization. Altered zones with limonite and hematite are predominant on the outcrops, and pyrites are usually not observed due to oxidation. Silicified bodies which form the hills consist of massive, porous and brecciated parts. Silicified veins were not observed in the periphery of silicified bodies. Thus it is considered that their shapes are "mushroom-like" in geologic section.

(4) Piren Tepe: The geology consists of Şapçı Volcanics in this vicinity. The original rocks cannot be distinguished in the altered zones. The volcanic rocks become thick with distance from the geologic basement. Altered zones with limonite and hematite are predominant on the outcrops, and pyrites are not observed because of oxidation.

Gold anomalies were detected in the silicified zones located in the southern part of the large alteration zone. The zones extend in an E-W direction in the vicinity of Piren Hill. The auriferous zones, which occur in limonitic clay such as those in fault zones, were detected by drill hole MJTC-2. Silicified zones are considered to be "jellyfish-shaped" in geologic section.

(5) Dikmen: Geophysical prospecting was carried out together with a detailed geological survey and geochemical prospecting. The detailed geological survey has clarified the distribution and conditions of gold occurrence, argillized zones and skarnization. The geochemical work has revealed two types of mineralization. By geophysical methods, the subsurface extent of mineralization from the outcrop downward was shown by delineating the low-resistivity zone and FE anomalies by IP; detailed SIP work provided the promising section by the interpretation of simulations.

A porphyry molybdenum-copper deposit associated with the intrusion of the Dikmen Granite and porphyry was discovered. The mineralization extends from