Landsat images mostly agreed with the ground survey, but there were cases where the areal extent of the silicified zones read from the images tended to be somewhat smaller than the actual dimensions. Also, the existence of some silicified bodies was confirmed on the ground which could not be read from the images.

(b) Regarding the lineaments which indicated fractures on Landsat images, it was inferred geologically and geomorphologically that such fractures should exist, and such information played very effective roles for understanding the regional tectonics of the area.

(C) Regarding the annular structures read from the images, it was found that they do not necessarily indicate identical geologic phenomena. Some of the annular structures are the form of silicified bodies, anticlinal structures and distribution of young volcanic activities.

CHAPTER 2 GEOCHEMICAL PROSPECTING OF ÇANAKKALE AREA

2-1 Geochemical Prospecting of Stream Sediments

2-1-1 Geochemical Prospecting Carried out by MTA

The geochemical prospecting carried out by MTA in the Çanakkale in the northwestern part of Biga Peninsula was done by stream sediments. This work covered the 3,400km^2 area which was studied by Landsat image analysis during the first-phase work. Contents of six elements, copper, lead, zinc, molybdenum, arsenic and antimony, were analyzed and a geochemical anomaly map of 1:100,000 scale was prepared. The anomalies within this 3,400km^2 area were extracted and are listed in Table 1-2.

The objective of the work at Çanakkale was prospecting for metal deposits, and the commodities were copper, lead, and zinc. Thus the anomalies were mostly distributed in or near the granodiorite zones and most of them were showings of copper-lead-zinc vein-type mineralization.

2-1-2 Reanalysis of the Previous Samples

Small lead-zinc veins occur and the previously worked Madendagı gold mine and Kartaldagı mine exist in Çanakkale, and the area has been attracting attention for its gold potential. In the first-phase work, eight elements, gold, silver, fluorine, mercury, thallium, selenium, arsenic and antimony were newly determined from the remaining samples of the previous MTA project.

The remaining samples were less than 10g. Since the analysis of gold required 10g of sample, two to three original samples from the same streams were combined to prepare new samples of more than 20g each for analysis. Samples were mostly selected from Zones A, B and C, and a total of 304 samples including those from the vicinity of the above zones were analyzed.

2-1-3 Statistical Analysis of the Chemical Results

Basic statistical values and the correlation matrix of the chemical values of the stream sediments were calculated and the principal component analysis (a method of multivariate analysis) was carried out.

The average, dispersion, standard deviation, maximum and minimum values were calculated for each element and are listed in Table 2-3.

The aim of the principal component analysis is to represent the large number of variables by a smaller number of factors with a minimum loss of information. This will provide a greater efficiency in terms of information compression over the original data, and will yield interpretability of the relations among the original variables. In applying this method for mineral prospecting, the relations among the variables (elements) and the variables caused by identical phenomena are compressed into a small number of factors, the eigenvectors, unique to the factors, and the scores of the samples are calculated. Then the nature or characteristics of the mineralization or significant regional information can be obtained by studying and interpreting the results of the calculation. The calculation is done either by the correlation matrix or covariance matrix. Here, the correlation matrix was used.

Basic statistical values and correlation coefficients for the eight components with a population of all 304 samples were calculated. Of the eight elements, gold content was, at times, below the limit of detection, and 5ppb was used for samples below 10ppb and 2.5ppb was used for these below 5ppb. In general, the arsenic, mercury and selenium values were high, but the fluorine and thallium values were low for the stream sediment samples. The basic statistical values are listed in Table 2-3 and the correlation among the elements in Table 2-4.

The values for gold, many of which were below the detection limit, were processed by the same method as for the basic statistical values. The principal component analysis with all 304 samples as the population was carried out. Computation shows that the eigenvalue exceeds 0.841, and the population exceeds 10.5% when the components up to an accumulated proportion of 78% are taken. Thus, those up to the fourth principal component express the major variations of this area.

First principal component: Components with large absolute eigenvector are arsenic, antimony, selenium, fluorine and thallium.

Second principal component: Gold, silver, arsenic, and mercury show positive, selenium and fluorine negative values.

Third principal component: Gold, mercury, and fluorine show positive, arsenic negative values.

Fourth principal component: Gold and selenium show positive while silver, mercury, and antimony negative values.

The above are the components with large absolute eigenvector. The first principal component is affected by weathering and it represents the variations of dispersion throughout relatively far areas. The second and third principal components express the variation of the mineralization of the sampled stream area, and the components are those elements with high analytical values in the known mineral showings. The third and the fourth components express the variation of specific components judging from the proportion of 10% and the large eigenvector for mercury in the third component and for gold in the fourth component. From the above considerations, the score distribution for the second principal component clearly shows the variation of the area.

Table 2-3 Basic Statistical Values of Stream Sediments

Element	Mean	Dispersion	S. D.	Min.	Max.
Au (ppb)	3. 975	0. 176	0. 420	0. 000	400. 000
Ag (ppm)	0. 111	0. 026	0. 162	0. 100	1. 200
As (ppm)	18. 317	0. 166	0. 407	3. 000	2100. 000
Hg (ppb)	100. 739	0. 062	0. 248	30. 000	4700. 000
Sb (ppm)	0. 432	0. 355	0. 596	0. 000	26. 000
Se (ppm)	0. 241	0. 116	0. 341	0. 000	5. 000
F (ppm)	354. 745	0. 161	0. 402	0. 000	1150. 000
Tl (ppm)	0. 314	0. 185	0. 430	0. 000	2. 100

S. D. :Standard Deviation

Table 2-4 Coefficient and Covariance Matrix of Stream Sediments

	Au	Ag	As	Hg	Sb	Se	F	Tl
Au	0. 176	0. 20003	0. 21644	0. 16656	0. 15775	0. 02232	-0. 03149	0. 05826
Ag	0. 014	0. 026	0. 27036	0. 10751	0. 22549	-0. 02520	-0. 15653	0. 09481
As	0. 037	0. 018	0. 166	0. 14344	0. 69940	0. 17248	0. 04533	0. 35578
Hg	0. 017	0. 004	0. 015	0. 062	0. 11441	-0. 12591	-0. 03791	-0. 11749
Sb	0. 039	0. 022	0. 170	0. 017	0. 355	0. 42080	0. 39225	0. 61919
Se	0. 003	-0. 001	0. 024	-0. 011	0. 085	0. 116	0. 52914	0. 49799
F	-0. 005	-0. 010	0. 007	-0. 004	0. 094	0. 072	0. 161	0. 50813
Tl	0. 011	0. 007	0. 062	-0. 013	0. 159	0. 073	0. 088	0. 185

Table 2-5 Eigenvector and Eigenvalue of Stream Sediments

	Z(1)	Z(2)	Z(3)	Z(4)	Z(5)	Z(6)	Z(7)	Z(8)
Au	0.12364	0.40089	0.23778	0.84141	-0.23328	-0.06559	-0.00126	0.02761
Ag	0.12757	0.47852	-0.44295	0.07817	0.72734	-0.04277	-0.13839	-0.04922
As	0.38755	0.38596	-0.14752	-0.29249	-0.45173	0.18346	-0.23748	-0.54719
Hg	0.01542	0.39637	0.77500	-0.32495	0.28468	0.05114	0.22205	-0.05899
Sb	0.52627	0.15705	-0.02560	-0.21901	-0.16127	-0.04669	-0.12367	0.77863
Se	0.40617	-0.31158	0.05356	0.19728	0.21903	0.78868	0.15755	-0.03675
F	0.37101	-0.39917	0.32779	0.08769	0.23792	-0.34703	-0.60801	-0.20291
Tl	0.48828	-0.15218	-0.11789	0.01425	0.02944	-0.46149	0.68217	-0.21243
Eigenvalue	2.78590	1.66552	0.95171	0.84090	0.70506	0.48233	0.36842	0.20016
Proportion	0.34824	0.20819	0.11896	0.10511	0.08813	0.06029	0.04605	0.02502
Accum. Prop.	0.34824	0.55643	0.67539	0.78050	0.86864	0.92893	0.97498	1.00000

2-1-4 Stream Sediments and Mineralization

The stream sediment samples previously collected by MTA were analyzed for the additional eight elements, namely gold, silver, fluorine, mercury, thallium, selenium, arsenic and antimony, with the purpose of searching for gold deposits as mentioned previously in the report.

The samples collected mainly from Zones A, B and C, with some additions from other parts, totalled 304 analyzed samples. Gold content of over 20 ppb was detected from 14 samples: three samples from Zone A, four from Zone B, one from Zone C and seven from outside the area of semi-detailed survey. The details are as follows (Table 2-6).

Table 2-6 Significant Analytical Results of Stream Sediments

Area	Location	Sample No.	Au (ppb)	Ag (ppm)	As (ppm)	Hg (ppb)	Sb (ppm)	Se (ppm)	F (ppm)	Tl (ppm)
Zone A	Kundakçılarobası(vein-type)	JT 153	25	0.1	25	100	1.0	0.2	360	0.3
	Eastern part	JT 155	40	0.3	33	270	3.2	1.0	360	0.3
	Balcılar(vein-type)	JT 158	375	0.1	17	110	0.1	0.2	400	0.1
Zone B	Kestane Dağı	JT 003	205	0.5	2100	260	26.0	0.2	250	2.1
	Kestane Dağı	JT 004	30	0.1	1000	180	18.4	0.2	240	1.3
	Southwest of Karaibrahimler	JT 065	20	0.1	36	60	0.4	0.2	310	0.5
	Denizgözüken Tepe	JT 039	40	0.1	14	210	0.7	0.2	480	0.1
Zone C	Southeast of Ovacık	JT 298	30	0.1	23	90	1.2	0.2	560	0.4
Out of Area	South of Zone B	JT 131	40	0.1	29	90	2.4	0.2	570	0.6
	Southeast of Zone B	JT 144	400	0.1	25	430	0.1	0.2	360	0.8
	Between Zones A and C	JT 258	20	0.1	10	60	0.2	0.2	470	0.2
	ditto	JT 263	200	0.3	140	270	2.8	0.2	400	0.4
	ditto	JT 264	30	0.7	520	120	5.8	0.2	340	0.5
	ditto	JT 275	50	0.2	16	90	1.1	0.2	440	0.5

Zone A: Samples which contained gold are JT153, 155 and 158. JT158 was collected in the Balcılar Volcanics, downstream of the Balcılar Veins. JT153 came from Çamyayla Volcanics in a locality considered to be a part of the halo zone of the Kundakçılarobası mine area. Both are from the vicinity of confirmed ore veins. JT155 was collected from an area where gold showings have not been confined, however, since the sample contained gold, although in minor amount, it is inferred that vein-type mineralization occurs in the vicinity.

Zone B: Gold was confirmed from two samples (JT003, JT004) collected from a stream west of Kestane Dagı. Gold was also found in the southeastern part of Karaibrahimler. Both locations are in the Şapçı Volcanics, and gold occurs in stream sediments as well as in rock samples. It is thus inferred that gold mineralization occurs in this area.

Zone C : Although in minor amount, gold was found in the southeastern part of Ovacık. Mineral showings have not been located in the area, but the Dikmen Fault transects the area, and this may have affected the gold content.

It was clarified from the above that gold and silver were detected from the vicinity of lead-zinc vein deposits in Zone A. The gold mineralization in Zone B is associated with arsenic, mercury, antimony and barium. Together with the results of X-ray diffraction, it is seen that the mineralization is acidic-sulfate-type epithermal activity.

In Zone C, the Dikmen zone (copper, lead, molybdenum), which had already been delineated by MTA as an anomalous zone, was the only mineralization found.

2-2 Geochemical Prospecting of Rock Samples

2-2-1 Sampling

Rock samples were collected from the 500km^2 zone of semi-detailed survey and from the vicinity of the MTA concession in the south of Zone B. A sampling density of two samples per square kilometer was the ides. In Zones A and B, mostly silicified and argillized zones were sampled, and in Zone C, mostly Dikmen Granite area was sampled. A total of 2,075 samples were collected.

All the samples were analyzed by Chemex Labs Ltd., of Canada. Gold was analyzed by wet method and atomic absorption, fluorine by ion polilize and other elements by atomic absorption spectrometry. The limits of detection of the elements are as follows.

Table 2-7 Detection Limit and Analytical Element on Rock Samples

Element	Detection Limit	Element	Detection Limit
Cu	1ppm	Pb	1ppm
Zn	1ppm	Au	5ppb
Ag	0.2ppm	Mo	1ppm
Hg	10ppb	As	1ppm
F	20ppm	Ba	10ppm
Tl	0.1ppm	Se	0.2ppm

2-2-2 Statistical Analysis of the Chemical Results

Basic statistical values and the correlation matrix of the chemical values of the rock samples were calculated, and the principal component analysis was carried out in the same manner as in the case of stream sediments.

Basic statistical values for the 12 components with a population of all 2,075 samples (these were divided into the three populations of Zones A, B and C) were calculated. Of the 12 components, gold content was at times below the detection limit and thus below 2.5ppb was used for samples below 5ppb. The content of copper, lead, fluorine and barium was high in Zone A, arsenic, mercury and barium in Zone B and molybdenum and zinc in Zone C. The basic statistical values are shown in Tables 3-1, 3-4 and 3-8. The values for gold, many of which were below the detection limit, were processed by the same method as for the basic statistical values. Also as in the case for stream sediments, the principal component analysis was carried out for all samples in the three populations.

	V	Zone A	Zone B	Zone C
Mineralization	-	Vein Type	Epithermal	Epithermal + P.M.
First Principal	+	Au,Cu,Pb,Zn,Ag,Hg	Cu,Pb,As,Se,Hg	Cu,Pb,Zn,Ag,As,Hg
Component	-			
Second P.	+	Zn,F,Ba,Tl	Zn,F,Tl	Mo,Ba
Component	-		Ag,Hg	Zn,As,Se
Third P.	+	Mo,As,Ba	Au	F,Tl
Component	-	Cu	Hg,Ba	Ag
Fourth P.	+	Se,F	Au,F,Ba	Cu,Mo,Se
Component	-		Zn	Ba
Fifth P.	+	Mo	Mo,Se	Cu
Component	-	Se,Hg	Au,Ag	Pb,Se

V:Value, P.M.:Porphyry Molybdenum Type

The first principal components are metallic elements, and they express the variation caused by epithermal mineralization. These are the elements with

Table 2-8 Significant Analytical Results of Rock Samples (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
Arlik Stream	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
Karaibrahimler	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
Mt. Kestane	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
Piren Hill	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

Table 2-8 Significant Analytical Results of Rock Samples (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
Piren Hill	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
Tepeköy	Y640	94100 25190	2790	41	1	12	6	<0.5	1320	3.4	170	410	2750	<0.1
	Y734	94015 24910	1810	22	4	148	8	<0.5	400	1.6	120	70	720	<0.1
	Y611	93980 24910	1680	43	17	90	14	<0.5	3900	8.2	260	220	3200	0.5
	Y639	94100 25190	1230	14	1	2	2	<0.5	340	2.4	50	300	680	<0.1
	Y653	94125 25195	1060	29	2	4	4	<0.5	310	2.2	120	300	1300	<0.1
	Y647	94085 25185	1050	12	1	6	<2	<0.5	76	0.4	240	60	1520	<0.1
	Y638	94100 25190	1000	12	<1	6	<2	<0.5	260	1.6	40	160	700	<0.1
	Y738	93960 24910	990	49	7	140	6	<0.5	3850	0.8	220	70	>10000	0.7
	Y607	93965 24845	800	110	1	150	48	<0.5	3200	0.2	90	210	6900	0.3
	Y733	94020 24925	790	26	7	260	8	<0.5	1450	1.6	600	70	2300	0.3
	Y648	94085 25185	740	22	1	8	<2	<0.5	216	1.8	90	220	1000	<0.1
	Y606	93970 24845	725	52	1	54	18	<0.5	940	1.6	150	120	2800	0.8
	Y621	94035 25050	690	64	3	6	2	<0.5	1250	<0.2	260	170	400	0.3
	Y732	94020 24930	655	21	13	162	22	<0.5	2700	2.8	220	200	2500	0.3
	Y652	94125 25195	590	50	2	8	2	<0.5	340	1.0	130	130	1080	<0.1
	Y645	94085 25185	575	20	1	2	<2	<0.5	610	4.6	100	170	2000	<0.1
	Y613	94030 24780	570	135	13	1300	36	<0.5	2920	1.2	150	150	5400	0.3
	Y605	93985 24850	500	39	1	30	4	<0.5	340	1.0	490	120	2900	0.1
	Y737	93990 24915	430	6	1	148	2	<0.5	160	<0.2	510	50	8600	<0.1
	Y651	94125 25195	400	18	3	2	2	<0.5	76	<0.2	50	60	4300	<0.1
	Y634	94110 25175	385	9	1	2	<2	<0.5	60	<0.2	60	110	580	<0.1
	Y666	94300 25230	380	15	1	24	18	<0.5	2510	0.6	710	560	3200	<0.1
	Y642	94085 25185	375	5	1	<2	<2	<0.5	100	<0.2	90	60	700	<0.1
	Y735	93990 24920	370	10	2	60	2	<0.5	176	<0.2	270	70	1700	0.4
	Y635	94110 25175	340	2	<1	<2	<2	<0.5	23	<0.2	40	40	440	<0.1
	Y643	94085 25185	340	12	1	2	<2	<0.5	300	0.8	50	160	1550	<0.1
	Y646	94085 25185	340	8	1	2	<2	<0.5	44	0.2	150	160	1370	<0.1
	Y636	94110 25175	335	5	1	2	<2	<0.5	50	<0.2	40	50	720	<0.1
	Y622	94035 25055	310	33	5	2	4	<0.5	1130	<0.2	320	70	170	0.1
	Y637	94100 25190	305	6	1	4	<2	<0.5	90	0.6	50	200	2450	<0.1
	Y608	93945 24845	280	23	1	60	12	<0.5	1000	11.2	170	120	2950	0.1
	Y644	94085 25185	265	6	1	2	<2	<0.5	156	<0.2	160	160	1680	<0.1
	Y630	94110 25175	240	6	1	4	<2	<0.5	60	<0.2	30	100	390	<0.1
	Y650	94125 25195	210	12	1	2	<2	<0.5	36	<0.2	40	70	440	<0.1
	Y632	94110 25175	185	23	2	26	<2	<0.5	100	<0.2	90	150	550	<0.1
	Y610	93945 24865	175	73	9	62	32	<0.5	3200	<0.2	90	400	870	0.2
	Y686	94000 25050	175	2	<1	6	<2	<0.5	44	<0.2	50	60	500	<0.1
	Y682	93980 25090	175	74	6	14	12	<0.5	1100	6.4	100	50	660	<0.1
	Y680	93940 25095	130	3	1	6	2	<0.5	14	<0.2	50	40	600	<0.1

Table 2-8 Significant Analytical Results of Rock Samples (3)

	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
Tepeköy	Y691	93925 24890	110	4	2	8	<2	<0.5	240	<0.2	20	50	260	<0.1
	Y678	93995 25110	110	3	1	2	<2	<0.5	18	<0.2	30	50	540	<0.1
	Y631	94110 25175	110	5	<1	14	<2	<0.5	44	<0.2	50	80	450	<0.1
	Y620	94045 24980	100	90	10	66	8	<0.5	4000	16.8	420	160	1900	1.9
	Y677	93980 25125	100	4	1	2	<2	<0.5	11	<0.2	60	50	300	<0.1
Halilaga	P665	88510 20890	2380	37	40	5040	30	3.0	1600	14.6	43000	80	3450	3.2
	S705	86530 17890	1060	>10000	6	16	118	25.5	72	<0.2	10	110	200	<0.1
	P660	88530 20950	960	9	3	334	6	3.0	234	2.2	19000	50	3800	0.4
	P666	88505 20900	930	71	14	2870	122	<0.5	1000	6.6	14000	320	880	6.2
	P668	88365 20825	620	59	12	204	16	60.0	300	6.6	61000	50	2250	0.2
	P653	88700 20930	440	23	7	140	2	17.5	52	1.2	42000	30	1560	0.1
	P664	88515 20885	390	27	17	962	12	1.0	370	6.6	21000	110	960	1.0
	P667	88310 20865	330	34	5	128	12	8.5	90	1.8	14000	40	2800	0.2
	C626	88755 20795	320	7	9	296	12	1.5	880	2.4	4500	80	1700	<0.1
	P670	88395 20880	295	37	21	2870	34	8.5	610	5.0	8200	100	1200	0.9
	P656	88120 20990	265	8	20	440	4	0.5	100	2.8	4800	50	1100	1.3
	P659	88520 20965	205	14	13	542	8	<0.5	232	2.0	22000	40	2120	0.4
	P663	88520 20885	200	30	11	776	12	3.0	270	2.6	6100	60	1920	0.9
	P658	88580 20960	180	22	6	176	6	4.0	110	7.0	28000	70	430	<0.1
	P655	88610 21000	175	9	15	342	8	0.5	156	2.4	5700	60	1360	0.6
	T665	87850 18120	125	75	2	92	10	<0.5	200	17.6	1300	320	940	<0.1
	C631	89175 21200	105	24	12	632	18	1.5	500	4.2	5200	90	820	5.6
Dikmen	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
	C344	13340 41340	20	87	2100	>10000	1070	15.5	2350	<0.2	>100000	40	240	84.0
	S367	14895 42685	10	37	1010	10	<2	0.5	10	<0.2	550	50	80	0.1
	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
	BB007	14910 43275	5	12	600	15	9	0.1	5	0.2	230	70	70	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

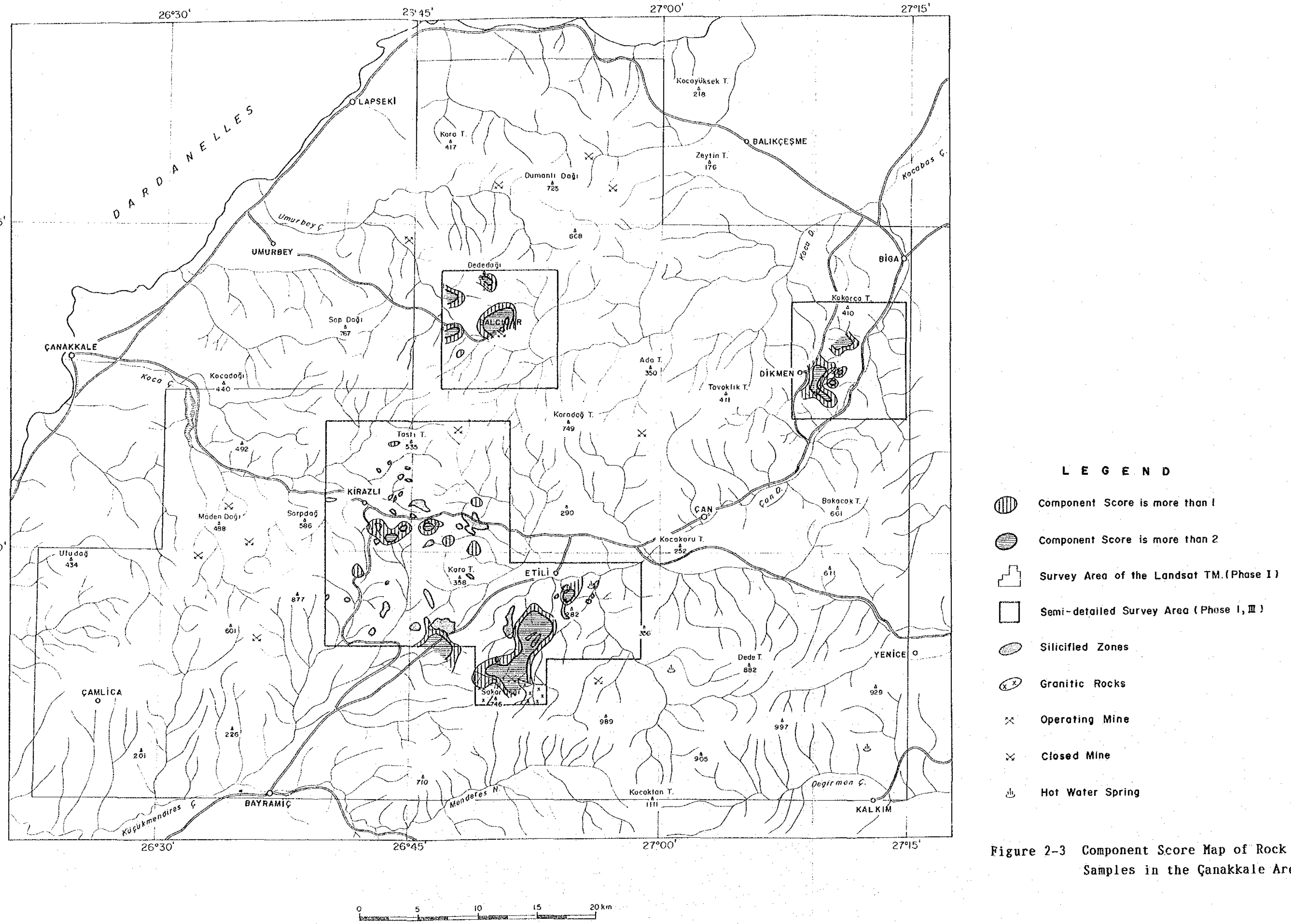


Figure 2-3 Component Score Map of Rock Samples in the Çanakkale Area

high content in the mineral showings in all three zones.

The proportion is somewhat low but the eigenvalues are high. The second principal component is mostly nonmetallic with high scores in all areas except the alteration zones. Thus these are considered to express variations caused by igneous activity and other factors. The third principal component is believed to show the variation of the silicified and argillized zones. The fourth and fifth principal components are believed to indicate a part of the mineralization because they contain metals although the proportion and the eigenvalues are low. By showing the localities with the first principal component exceeding 1 on maps (Figure 2-3), the known vein deposits in Zone A, most of the localities where gold was detected in Zone B and the mineralization associated with Dikmen Granite in Zone C are covered.

2-2-4 Rocks and Mineralization

Rock composition and mineralization: More than two thousand samples were collected from the semi-detailed survey area and ten samples from the MTA prospects outside of the above. The analyzed elements were, gold, silver, fluorite, mercury, thallium, selenium, arsenic, copper, lead, zinc, molybdenum, and barium. The samples were collected from the alteration zones (silicification, argillization) in Zones A and B, Dikmen Granite and the mineralized zone near this intrusive body in Zone C. The localities with samples exceeding 50 ppb gold and 100 ppm molybdenum are as follows (Table 2-8).

Zone A: From this zone, 138 rock samples were analyzed. Of these, 15 samples contained gold in excess of 50 ppb. These are gold associated with vein-type mineralization of Kundakçılarobası and Balcılar veins.

Zone B: From this zone, 1,625 rock samples were analyzed. It is noted that almost all of these samples contained small amounts of copper, lead, and zinc while the content of arsenic, mercury, antimony, bismuth and barium were relatively higher, together with gold (Table1-8). The localities of the samples are Karaibrahimler, Arlık River, Mt. Piren and Mt. Kestane. There are samples from other localities which contained significant metals, but these were isolated and the minerals have not been confirmed by heavy mineral investigation. Thus they are considered to be of smaller-scale mineralization.

Zone C: From this zone, 312 rock samples were analyzed. Most of the samples were collected from the Dikmen Granite and the alteration zones in the vicinity. There is porphyry molybdenum-copper mineralization in the quartz veinlets in and near the Dikmen Granite. 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.

Other zones: Ten samples from the MTA prospect south of Zone B were analyzed, but noteworthy results were not obtained.

2-3 Geochemical Prospecting by Heavy Minerals

2-3-1 Outline of Heavy Mineral Prospecting

Heavy mineral prospecting was carried out with the objective of searching for gold deposits. There are Madendagı and Kartaldagı mines in the survey area, and the work started with clarifying the nature of gold grains scattered in the stream sediments and soil near these mines.

As the investigation progressed, silicified and argillized zones were found, and the collected heavy mineral samples increased in Zones A and B. In Zone B, many silicified bodies were found, which exceeded the expectation from the Landsat image studies. Most of the sampling points of these heavy minerals were several kilometers downstream of the silicified bodies.

Three to eight kilograms (average 5kg, dry weight) of heavy minerals smaller than 2mm were sampled. In the survey area, many streams were dry. Thus water was supplied to the sampling points, and the minerals were sized to -2mm. These samples were first classified into "dry stream sediments", "flowing stream sediments" and "sediments due to flooding of streams". Then the samples were further grouped into "well-sorted sediments with large proportion of -2mm grains", "ill-sorted sediments with large amount of over 2mm grains", and "sediments from streams where soil and sands have flowed in". These samples were washed at the flowing streams or Çeşme, and carefully sized to under 1mm.

Samples (100-500kg; average 200g dry) were carried to the camp, and panned. The extraction of heavy minerals by panning was done carefully by using a stereomicroscope since the grains were small. The final result was several grams of heavy minerals. The gold grains were counted, and those with a size of several tens of microns were measured.

The major part of heavy mineral sampling was done in Zone B where strongly silicified alteration zones are distributed from the Madendagı and Kartaldagı mines, but some samples were collected in Zone A as well. The summarized results of the study of the total 188 samples collected are shown in Appendix Table 4.

Table 2-9 Contents in Heavy Minerals Sampled

	Classification	Test No	Percentage(%)
Zone	Zone A	14	7(%)
	Zone B	144	77
	north of Zone A	4	2
	neighboring part of Zone B	26	14
Sediments	stream sand	125	66
	soil	63	34
Classification by stream condition	dry stream sediments	110	59
	flowing stream sediments	21	11
	sediments due to flooding of stream	57	30
Classification by sample condition	well sorted sediments	52	28
	ill-sorted sediments	115	61
	sediment from streams where soil and sand flowed in	21	11

The following items were studied, measured and recorded for each sample.

(1) The nature of the pebbles at the sampling points.

(2) The geology (formation name) of the sampling point and the drainage area upstream.

(3) The mineral composition of the sample.

(4) The size and amount of gold grains if any gold was observed.

(5) The form of gold grains in order to estimate the distance of transportation.

2-3-2 Study Results

The results of the above study are in Appendix Table 3, and summarized in Table 2-10.

Table 2-10 Contents of Gold Grains Observed

	Count of Gold Grains	Samples	Remarks	
Gold Grains Observed	1- 3	47		
	4-19	47		
	20-		Madendagı mine area	2
			Kartaldagı mine area	4
			Zone A(Pb-Zn veins)	1
			inside of Zone B	10
			around Zone B	4
Gold Grains not Observed		73		

Heavy mineral samples which indicate the possible existence of gold deposits in the upstream areas were selected from the 188 samples, and are listed locality-wise in Appendix Table 3. Also, the number of gold grains and the stream are indicated in Figure 2-6. The promising areas are as follows.

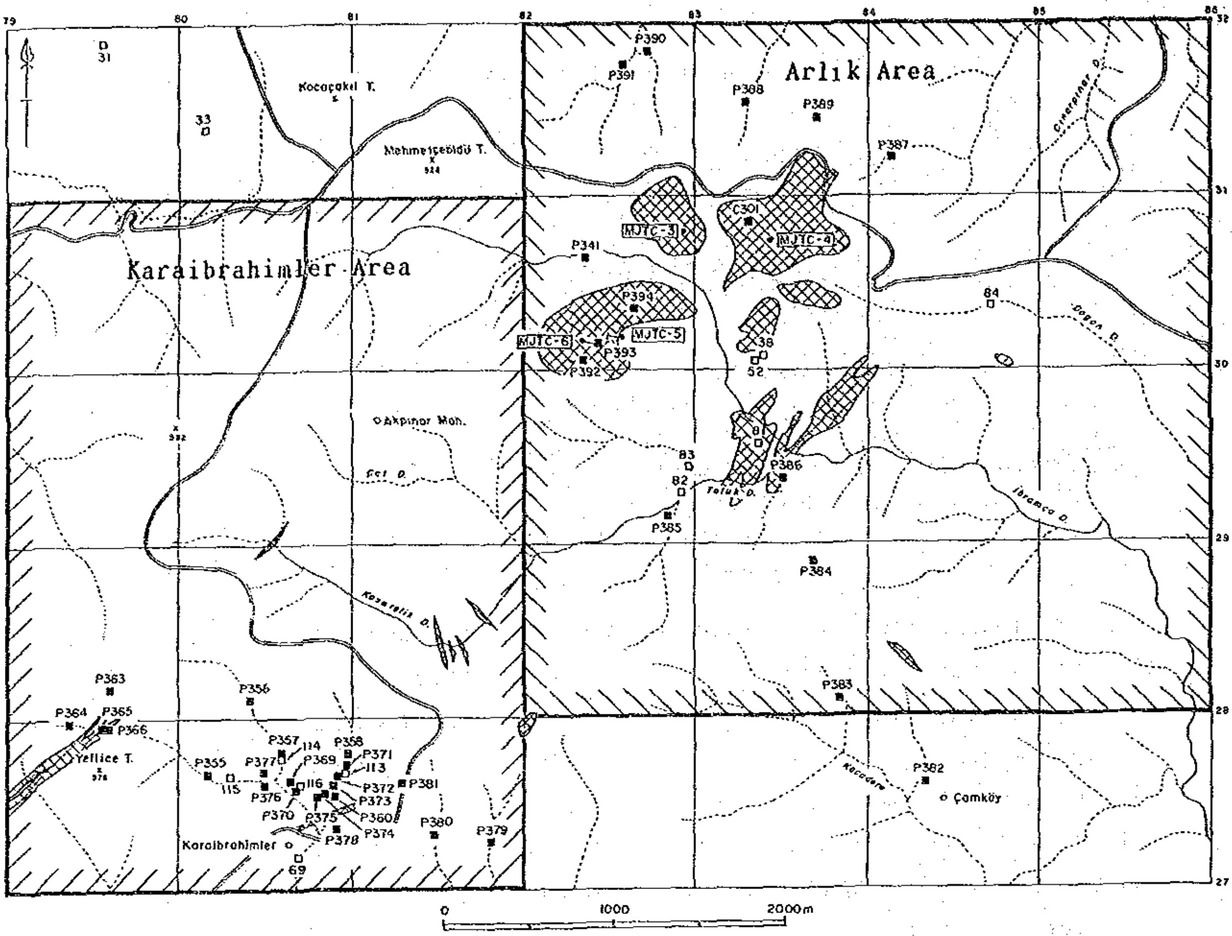


Figure 2- 4 Map of Panning Sample Locations(Arlık Stream and Karaibrahimler)

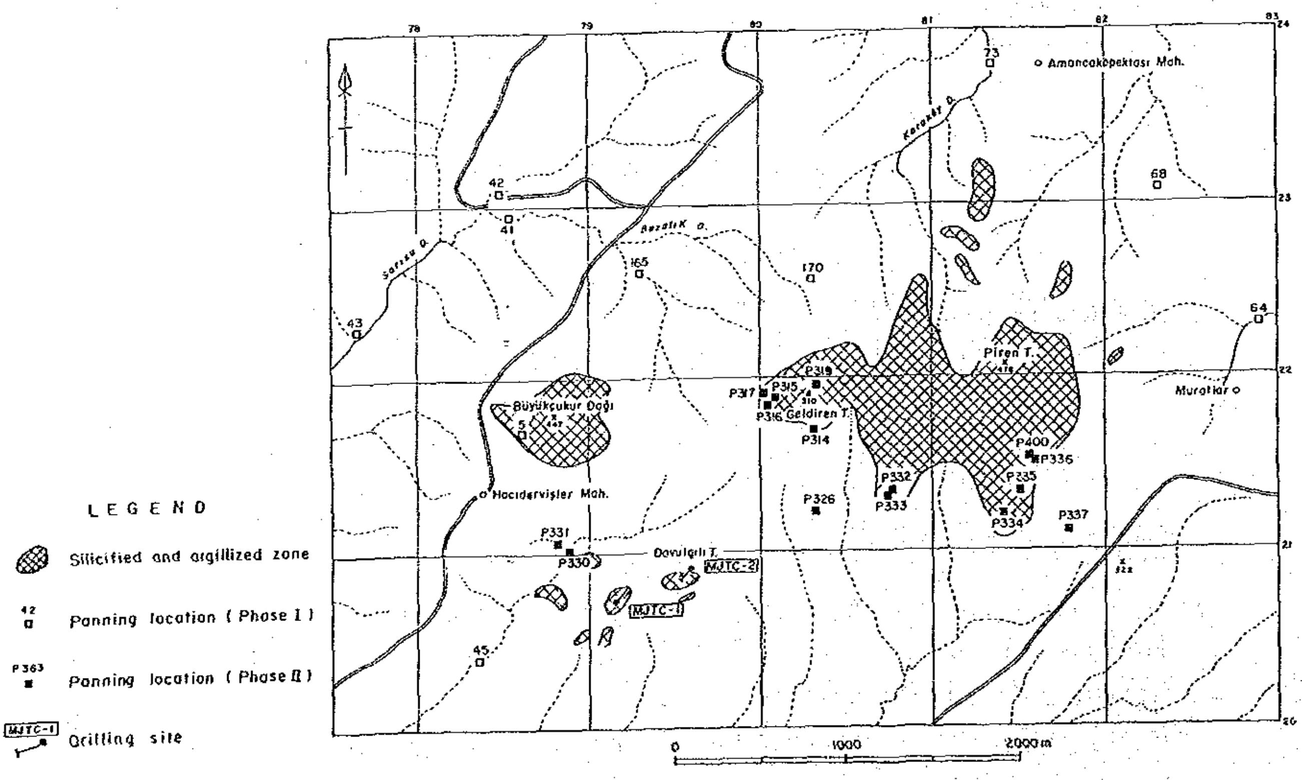
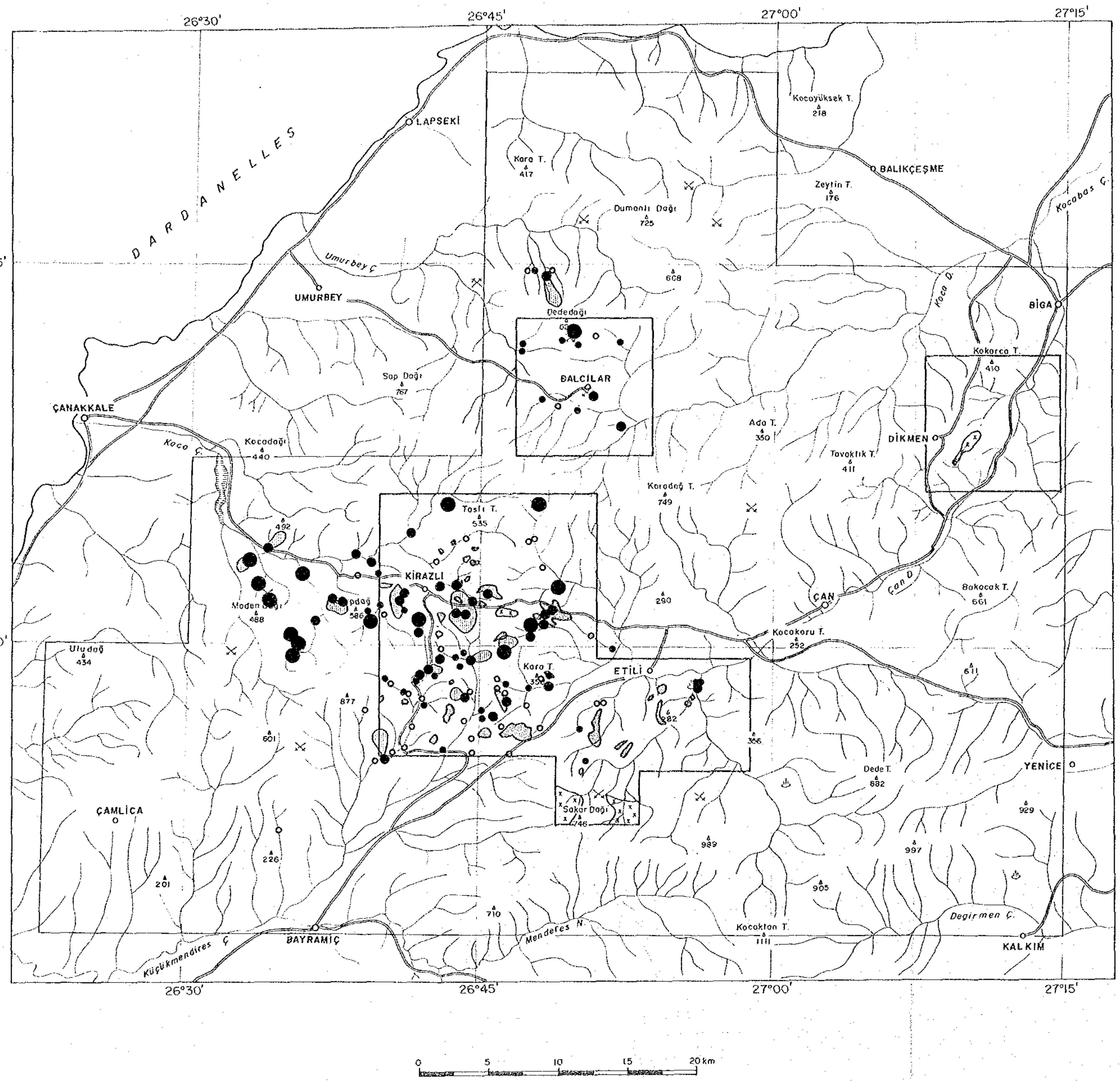


Figure 2- 5 Map of Panning Sample Locations (Piren Tepe)



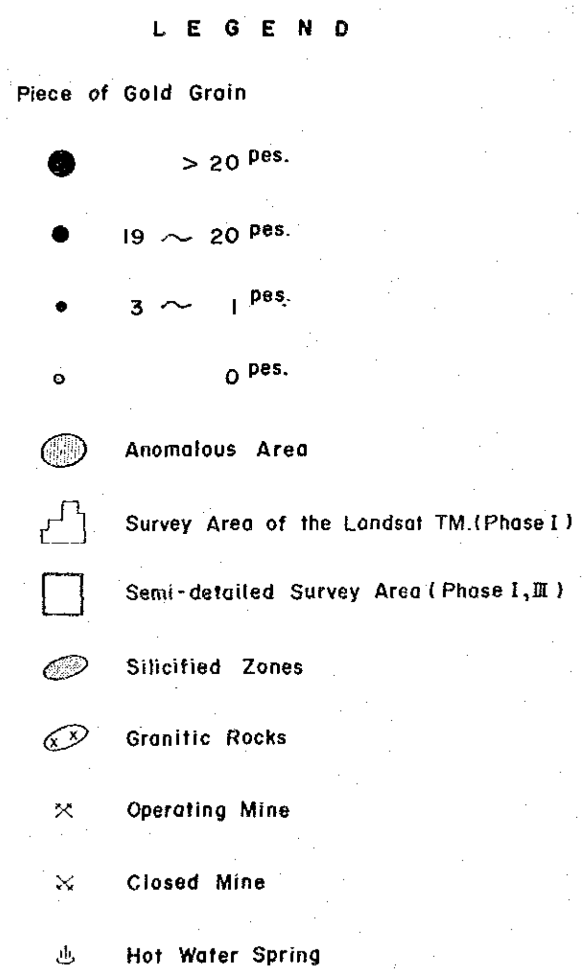


Figure 2-6 Map of Gold Grain Occurrence

(1) Karaibrahimler: Sample TA069D collected downstream of Karaibrahimler Village contained many gold grains, and thus samples (TA113D, TA114D, TA115D) were collected upstream where three streams join. These all contained gold grains, and the soil (TA116T) of the silicified and argillized zone also contained gold grains. Adjacent to this point, Şapçı Volcanics has undergone silicification and argillization. Although there are gold grains exceeding 300μm in size, most of them are smaller than 50μm. The shape is euhedral to subhedral, and it is inferred that these grains have been transported for 1-2km. A silicified zone is confirmed here, and it is probably the source of the gold grains. Gold grains are also found in Sarp Stream which lies to the west of the silicified body. This is accompanied by a large amount of barite, and it characterizes this occurrence.

(2) Kestane Mt.: Gold grains were found at two localities (TA075D, TA076D) in the stream west of Kestane Mt. TA075D contained grains larger than 300μm. Gold grains were also found at three points of the stream to the north of Kestane Mt. These are more rounded than the gold grains of (1), and they were probably transported for 2-3km. Kestane Mt. could be the source of this gold. Kestane Mt. is strongly silicified and thus forms this protruding topography. Şapçı Volcanics is also distributed in the vicinity and is altered. Galena is included in the heavy mineral fraction.

(3) Kocataş Hill: A large number of gold grains were extracted from the sample (TA0083D) collected from İncirlik Stream. Upstream there is a silicified rock of Kocataş Hill which could be the source of this gold. Epidote is abundant in the heavy fraction, while barite is rare.

(4) Arlık Stream: Gold grains were found in the sample (TA037D) collected at Arlık Stream. There is a large silicified zone in the upstream section of this stream. The silicified zone of (1)-(3) formed the protruding topography, but this zone occurs in a pine forest, and thus could not be identified by Landsat analysis.

(5) Koracaören Hill: Gold grains were found in the samples collected at Gökyakan Stream (TA039D) and Egri Stream (TA095D). These are near the southern ridge of Koracaören Hill. TD039D contains abundant barite, and the distance of transportation is estimated to be on the order of 2km, but the geological investigation shows the general area to consist of Şapçı Volcanics, and silicified zones which could be the source of the gold are not yet found.

(6) Other localities: Gold grains have been found from five localities in the argillized Çamyayla Volcanics. They are Kirazlıçamtepe TA009D, Armutçuk TA013D, Karacalar TA066D, Çeşmetepe TA049D, and Çaltıkara TA066D. The grains from samples other than TA049D are fine grained - less than 50μm - and somewhat rounded. They were probably transported from silicified bodies for a distance of 1-2km. The above names are localities of the silicified bodies except Armutçuk which is a sampling point. A silicified body has been found by geological survey to the north of Armutçuk, and this is considered to be the source of the gold.

(7) Madendagı mine to Kartaldagı mine zone: The survey of this zone was conducted for the purpose of clarifying the mode of occurrence of gold grains. Large amount of gold grains dispersed between the two mines were found. Gold was found in six localities at some distance from the mines, and these are inferred to be strongly silicified parts in the Şapçı Volcanics area.

(8) Dededag: This is located at the northern end of Zone A, and the elevation is 622m. The geology consists of Dededag Volcanics (dacite, dacitic pyroclastics). Gold grains are found from the downstream section on the northern side. This locality is outside of the survey area, and the details of alteration are not clear.

2-4 Evaluation of Geochemical Prospecting Methods

The significant results of stream sediment, rock analysis and heavy mineral studies are shown in Tables 2-3～2-10. It is seen from these tables that the stream sediment analyses are effective for copper, lead, and zinc deposits (for example, vein type), but for epithermal gold prospecting, the grade is lowered by silicification and the dispersion from the outcrop is difficult to clarify. Whereas with rock samples, the halos of the gold and associated elements are easier to understand, and is more effective than using stream sediments. But at the same time, in the brecciated zones where gold appears to be concentrated, the limonite, hematite and clay are difficult to use; thus the rock analysis is not effective in these cases, the reason being the strong oxidation of the rocks. Heavy mineral analysis is effective in these cases, and the combination of rock and heavy mineral investigations is a very effective method for gold prospecting. The relationship of these methods together with X-ray diffraction results are shown in Table 2-11.

Table 2-11 Evaluation of the Geochemical Prospecting

Zone	Locality	Stream Sediment	Rock Sample	Heavy Mineral	Alteration
A	Balcılar	◎	◎	◎	Sericite
	Kumarkçılarobası	△	○	×	Kaoline
B	Karaibrahimler	△	△	◎	Cristobalite
	Arlık Stream	×	◎	◎	Alunite
	Piren Hill	×	◎	△	Pyrophyllite
	Kestane	○	◎	◎	Barite
	Etili	×	◎	◎	
C	Dikmen		◎	−	Kaoline,Sericite
Madendagı-Kaltardagı		n.d.	n.d.	◎	

Indication of gold : ◎: Common, ○: Rare, △:Trace, ×: No indication
n.d.:not determined

CHAPTER 3 RESULTS OF LABORATORY EXAMINATIONS

3-1 Results of Whole Rock Analysis

A total of eighteen samples, two granites and sixteen volcanic rocks, were analyzed. The granite samples were upper Cretaceous-Eocene granite samples (Çavus Granite) collected from the south of Halilaga. The volcanic rocks consisting of Miocene Şapçı Volcanics were eleven andesite samples from Etili (including three drill core samples), and three drill core samples from the Emeşe Formation of the Dikmen Area. Thirteen 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 Appendix Table 2. The analyzed samples were also studied microscopically.

(1) Granitic rocks

The chemical composition of the upper Cretaceous-Eocene Çavus Granite was studied using the diagrams in Figures 2-7～2-13. The results are as follows.

① The granites of this survey area are between the granodiorite and quartz monzonite 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 granite has a clear range of compositional variation in the D.I.-

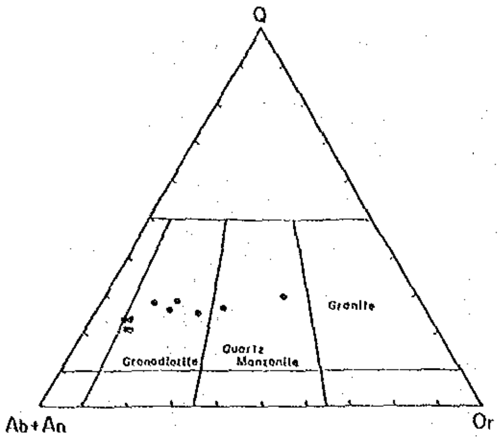


Figure 2- 7 Normative Qz-(Ab+An)-Or Diagram for Granitic Rocks

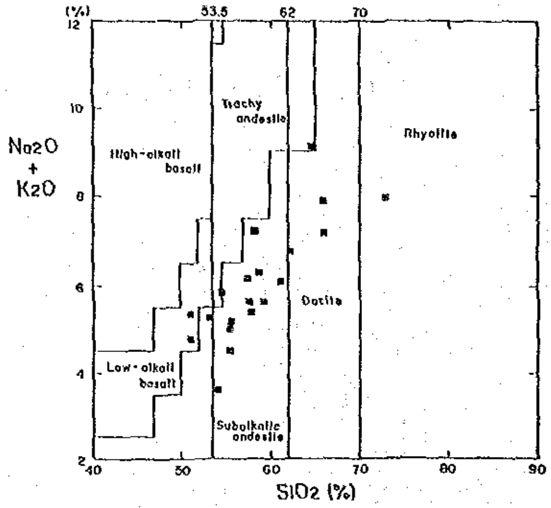
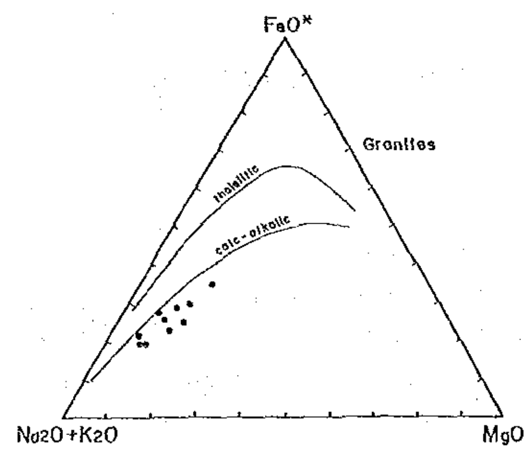


Figure 2- 8 SiO_2-(Na_2O+ K_2O) Diagram for Volcanics



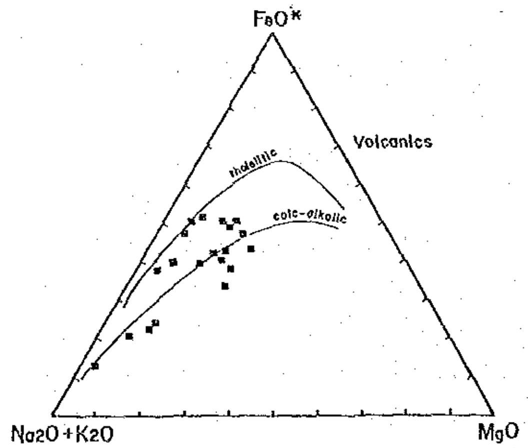
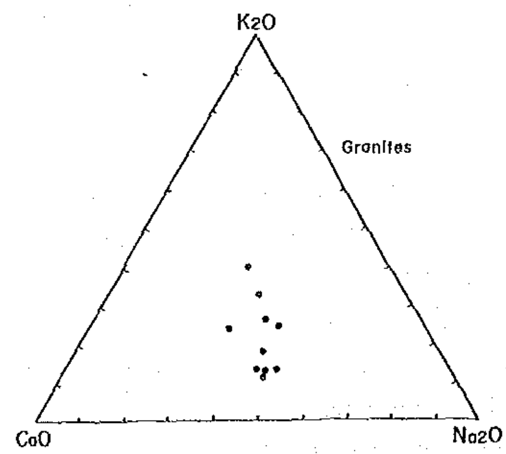


Figure 2- 9 MFA Diagrams



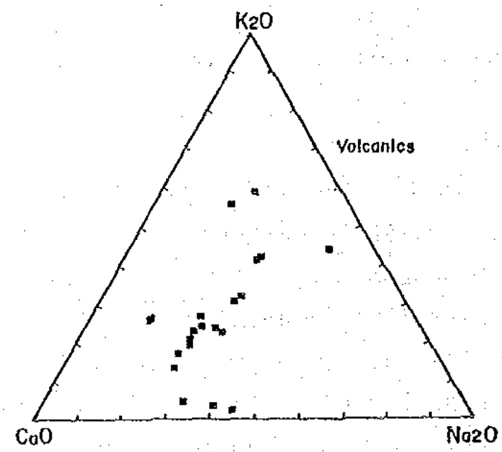


Figure 2-10 CaO-Na_2O-K_2O Diagrams

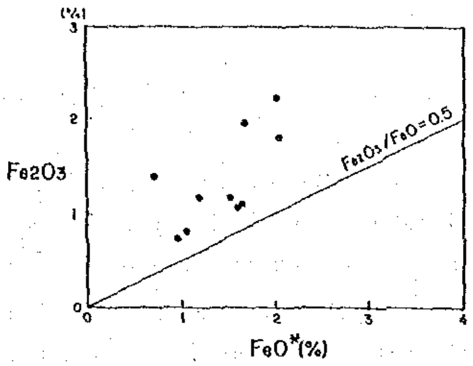


Figure 2-11 Fe_2O_3-FeO Diagram for Granitic Rocks

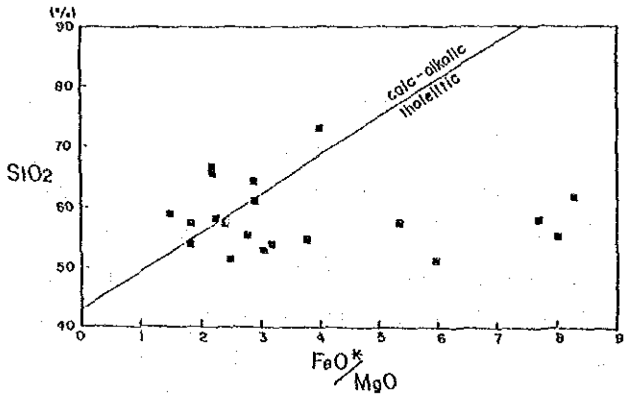


Figure 2-12 Si-FeO* /MgO Diagram for Volcanics

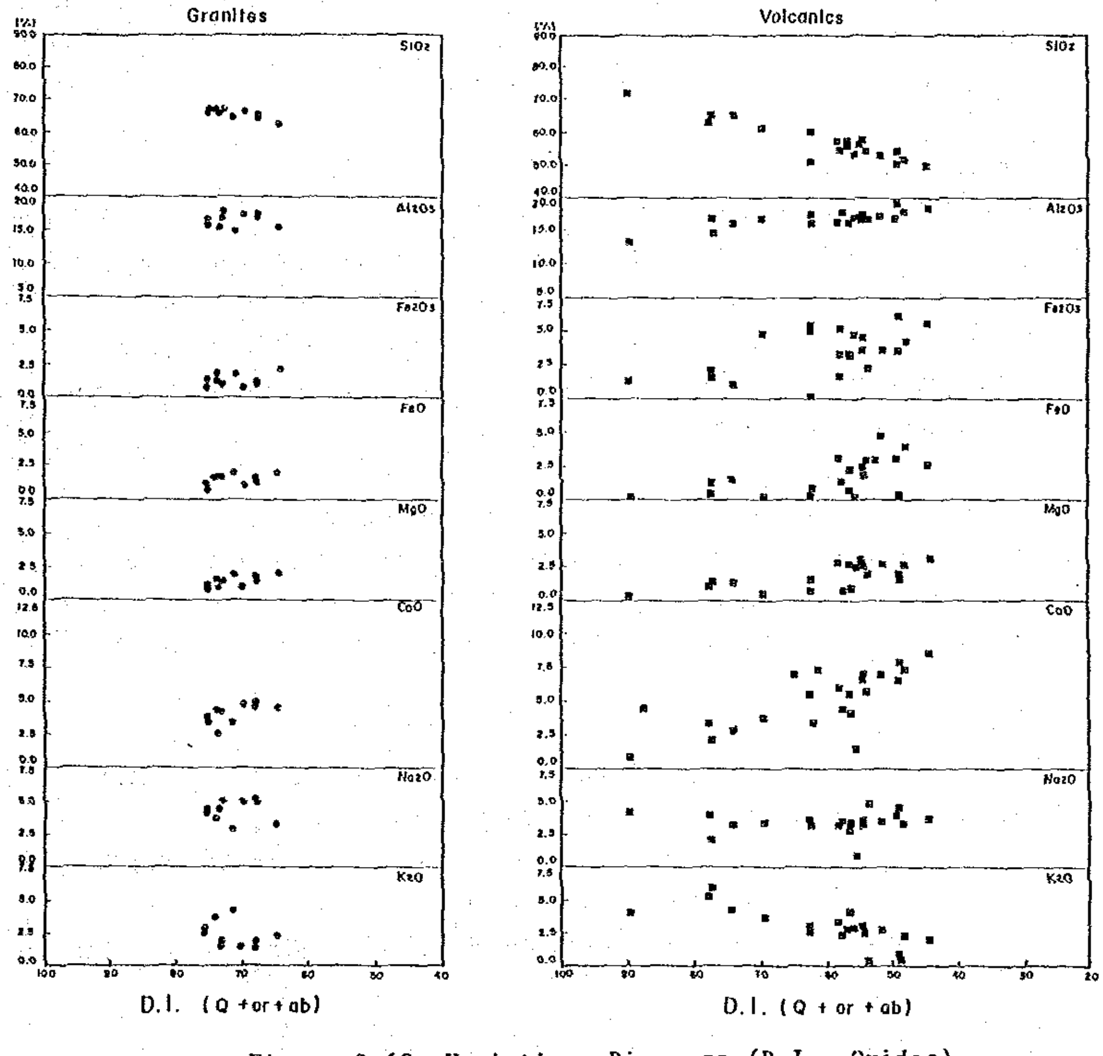


Figure 2-13 Variations Diagrams (D.I.- Oxides)

Symbols (same as in Fig.2-7 ~ Fig.2-13)

Granites

● Granodiorite (Triassic ~ Eeocene) Phase I ~ Phase III

Volcanics

■ Andesite rocks (Eocene ~ Pliocene) Phase I ~ Phase III oxides chart.

③ A similar tendency exists for the CaO-alkali ratio, and the granites are in a high CaO zone (Figure 2-7).

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 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 third-phase work, the mode of opaque minerals and the Fe_2O_3-FeO^* diagram (Figure 2-11) indicate the granites of the survey area to be of the magnetite series.

(2) Volcanic rocks

Şapçı Volcanics is andesite. In the $SiO_2 \cdot (Na_2O+K_2O)$ diagram (Figure 2-8), 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 2-9) and the SiO_2-FeO^*/MgO diagram (Figure 2-12) show that the volcanic rocks of this area belong to the calc-alkali series.

(3) Compositional variation in the alteration zones

The 32 samples of Şapçı Volcanics were classified into three groups; 13 unaltered (A), nine strongly silicified (B) and nine altered andesitic rocks (C). The averages of the chemical components are shown in Table 1-8.

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

3-2 Fluid Inclusions

Although quartz veins and veinlets were observed from silicified zones of six drill holes, 11 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 2-12 Fluid Inclusion Samples

Drill No.	m	Description	L.I.
MJTC-1	84.50	Dark grey porous silicified rock	×
	126.00	Dark grey andesite with calcite veinlet	○
	150.00	ditto	×
MJTC-2	5.70	White massive silicified rock	○
MJTC-3	33.65	L.grey massive sil rock with py diss	×
	136.20	ditto	○
	137.10	ditto	×
MJTC-4	24.00	L.grey massive sil rock	○
	60.50	ditto	○
MJTC-5	59.70	Grey porous silicified rock with py diss	×
	79.30	ditto	×

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

Silicified samples and those accompanied by pyrite were collected from cores MJTC-1 to MJTC-6, and were polished. 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 2-13.

Table 2-13 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

3-3 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 an 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 2-14). 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 these different ages might reflect possible changes in chemical composition of alunite during weathering after alteration.

Table 2-14 Isotopic Ages

Area (rock) Coordinates	Sample No.	Material Analyzed	$^{40}Ar^*$ Iscc/gmx^{-5}	% $^{40}Ar^*$	% K	Isotopic Age [Ma]
Arlık Stream (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 Stream (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 Mt. (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

*:Alunitic silicified rock

3-4 Results of X-ray Powder Diffraction

Two hundred and twenty-nine samples collected from survey areas during three years five localities and 76 samples from drill cores were studied by X-ray powder diffraction.

The samples of Zone A were collected from argillized zones; altered minerals mainly consist of kaoline and sericite and small amounts of montmorillonite and chlorite. Thus, it is considered that these minerals were produced by vein-type alteration because of exclusion of pyrophyllite, alunite and cristobalite.

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 Zone C were collected from the Dikmen Granite and porphyry intrusion. Altered minerals consist mainly of 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. On the basis of these results, the map as shown in Figure 2-3 was compiled.

CHAPTER 4 MINING ACTIVITIES OF 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 survey, geochemical prospecting, mining study and other various MTA projects.

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

Within the 3,400km² area analyzed by Landsat images, there are the well-known gold deposits of the Madendagı and Kartaldagı mines, although they are presently closed and operated on a very small scale respectively. Çataltepe mine (lead-zinc veins) is also operating in the above area. In Zone C, a porphyry molybdenum deposit (Dikmen mineralized zone) was discovered during the present survey. Immediately outside of the Landsat image area, there are the presently operating Koru Köyü mine and the Yenice gold deposit which is now being explored.

Madendagı mine: Located 50km southwest of Çanakkale, the mine was operated by a British company, Astyra Gold Mining Co., during 1914-1918 (Molly, 1958). It had been worked prior to 1914, but the situation is not clear. MTA, during 1960-1962, conducted a geological survey, tunneling and drilling, and delineated a small ore reserve of 15,000t (Au,5.8-6.8g/t). At present, the Turkey-West Germany joint venture, Tüprag Co., is exploring the silicified zone in the Miocene andesitic pyroclastics to the west of the old mine. They are using trenching and drilling.

The old deposit of this mine is quartz veins in the pre-Triassic brecciated schist. These quartz veins are considered to have formed in association with the Tertiary andesitic volcanism. The brecciated zone is strongly silicified, and the main vein is along the fracture with a N60°-70°W trend and southward dip. It is accompanied by limonitic clay forming a bonanza and fissures were formed during the volcanic activity in N20°-30°E and N60°E directions. The quartz veins spread out along these subsequently formed fissures. In this locality, a network of quartz veins is also developed and pyrite dissemination is observed, forming a low-grade gold mineralized zone. The locality, presently being explored by this project, is in the Miocene andesitic rocks where silicification-limonitization (oxidation of sulfides)-argillization and pyritization are significant. Silicified zones are highly fractured. Trenching at 50m intervals, grid drilling and other exploratory work are being carried out here for epithermal gold. The heavy mineral study of the soil of the silicified and argillized zone revealed the existence of large amounts of gold grains during the present survey.

Kartaldagı mine: Located 55km southwest of Çanakkale, this mine was also operated by the British Astyra Gold Mining Co. during 1914-1918 (Molly, 1958). This mine was operated prior to 1914, but the details are unknown. Stone mortars which were probably used for crushing gold ores and as conduits for concentrates in the very old days are found scattered in the vicinity. MTA conducted a geological survey, trenching, drilling and other exploration of this prospect during 1960-1962 and delineated a small reserve of 50,000t (Au; trace to 5.5g/t). Since August 1987, seven workers of Çanakkale Mining Co. have been in the process of reopening the old adits. As of mid-November, 1988, the work had progressed to 130m below ground level. In the mine area, andesite lava is widely distributed and E-W, NE-SW trending faults occur in the lava. A silicified alteration zone is developed along these faults. The old ore body is lens-shaped within the fault with a N20°-30°E strike and NW70° dip. There are significant amounts of pyrite in the gold-rich zone and kaolinization is very strong in the vicinity (MTA, 1970). It is considered to be a deposit similar to the Madendagı from the fact that significant amounts of gold grains are found in the stream sands and soil near the mine, and also that the kaolinized zones also contain gold.

Yenice gold deposit: This is located in the southern part of Yenice Village. Etibank holds the mining rights and requested MTA to undertake prospecting. MTA has been conducting geological survey, geochemical prospecting (including panning), trenching and other exploratory activities since 1987. The dimensions of the deposit, grade and other factors are not yet clear, but panning proved the existence of a considerable amount of gold grains of 10-

500μm. The geology near the deposit consists of widely distributed andesite lava and pyroclastics near Kayatepe which lie at the centre of gold mineralization. Silicification, argillization and pyritization are strong extending in an E-W direction. A silica cap was formed as a result of the above alteration. Thus the deposit is considered to be epithermal gold.

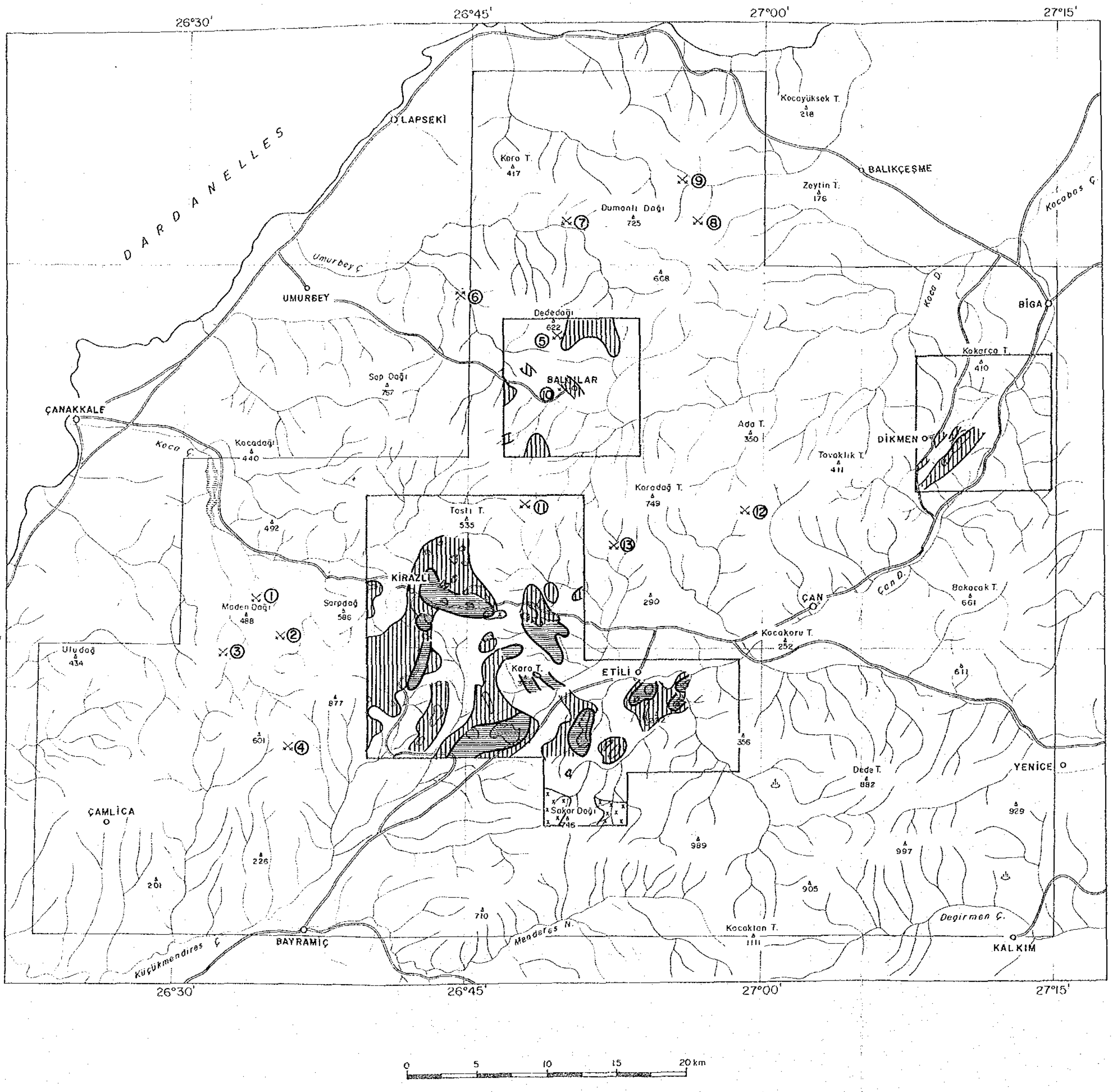
Koru Köyü mine: The mine is located northwest of Koru Village, and is a small lead-zinc vein deposit presently worked by Çanakkale Mining Co. The company employs 70 workers and produces 100-150t of massive crude ore monthly, which is separated at the mine, sent to a dressing plant in the suburbs of Çanakkale, and is then shipped to Italy as lead and zinc concentrates.

Çataltepe mine: This is located 20km east of Lapseki and was operated on a small scale by Çanakkale Mining Co., but was recently closed. Details are not known.

Other deposits: Resources known in this area include kaoline deposits and lignite seams.

Table 2-15 Main Ore Deposits of the Çanakkale Area

Name	Kind of Ore Deposits	Host Rocks	Type of Ore Deposits	Age of Mineralization
Madendağı Kartaldağı	Au	Breccia zones of schist(Pre-Triassic)/ Andesite lava & pyroclastics(Miocene)	Epithermal	Tertiary
Karapınar	Cu	Schistose marbles (Pre-Triassic)	Hydrothermal (Shear zones)	Miocene
Kuşçayırı	Fe-As	Ayrışmış andesitic tuff(Miocene)		Upper Miocene
Kundakçı-larobası	Pb-Zn-Ag	Andesitic lava & pyroclastics(Eocene)	Epithermal (Vein)	Tertiary
Koru Köyü	Pb-Ba-Ag	Andesitic lava pyroclastics(Eocene)	Meso-epithermal (Vein)	Tertiary
Çamyurt	Cu	Schist(Pre-Triassic)/ Qz diorite	Meso-epithermal (Qz vein)	Tertiary
Çataltepe	Pb-Zn-Cu	Andesitic lava & pyroclastics(Eocene)	Epithermal (Vein)	Tertiary
Nusretiye	Pb-Zn-Cu	Andesitic lava pyroclastics(Eocene)	Epithermal	Tertiary
Balcılar	Ag-Pb-Zn	Andesite (Miocene)	Epithermal (Vein)	Tertiary
Kocalar	Pb-Zn	Andesitic lava pyroclastics(Eocene)	Epithermal (Vein)	Tertiary
Kocayayla	Zn-Pb-Cu	Volcanic rock(Miocene)/ phyllic schist(Triassic)	Mesothermal (Brecciated zone)	Miocene
Doğancılar	Cu-Pb-Zn	Block-faulted volcanic rocks	Qz vein/veinlet	



LEGEND

- Survey Area of the Landsat TM. (Phase I)
- Semi-detailed Survey Area (Phase I, III)
- Silicified Zones
- Granitic Rocks

Alteration Zone

- Kaoline, Alunite and Pyrophyllite Zones
- Kaoline Zones
- Operating Mine
- Closed Mine
- Hot Water Spring

Location of Ore Deposits

No.	Name	Kind of Ore Deposits	Host Rocks
①	Madendagı	Au	Breccia zones of schist(Pre-Triassic)/
②	Kartaldagı		Andesite lava & pyroclastics(Miocene)
③	Karapınar	Cu	Schistose marbles (Pre-Triassic)
④	kuşçayırı	Fe-As	Ayrısmıs andesitic tuff(Miocene)
⑤	Kundakçı-larobası	Pb-Zn-Ab	Andesitic lava & pyroclastics(Eocene)
⑥	Koru Köyü	Pb-Ba-Ag	Andesitic lava pyroclastics(Eocene)
⑦	Çamyurt	Cu	Schist(Pre-Triassic)/ Qz diorite
⑧	Çataltepe	Pb-Zn-Cu	Andesitic lava & pyroclastics(Eocene)
⑨	Nusretiye	Pb-Zn-Cu	Andesitic lava pyroclastics(Eocene)
⑩	Balcılar	Ag-Pb-Zn	Andesite (Miocene)
⑪	Kocalar	Pb-Zn	Andesitic lava pyroclastics(Eocene)
⑫	Kocayayla	Zn-Pb-Cu	Volcanic rock(Miocene)/ phyllite(Triassic)
⑬	Dogancılar	Cu-Pb-Zn	Block-faulted volcanic rocks

Figure 2-14 Distribution Map of Mineral Occurrences and Alteration

PART Ⅲ

GEOLOGY AND PROSPECTING

OF ZONE A, B AND C

PART III GEOLOGY AND PROSPECTING OF ZONES A, B AND C

CHAPTER 1 ZONE A

1-1 Outline of Geology

The geology of Zone A consists mostly of volcanic rocks: Çamyayla Volcanics, Balcılar Volcanics, Dededag Volcanics and Balaban Basalt in ascending order. The flat region between Dondurma Village and Balcılar Village is covered by alluvium. Fossils indicating Middle Eocene were found from the calcareous silt in the Çamyayla Volcanics, correlating it to the Akçaalan Volcanics. The geologic map and cross sections, and stratigraphic column are shown in Figures 3-1 and 3-2.

1-2 Stratigraphy

Çamyayla Volcanics : This is stratigraphically the lowest volcanic unit in Zone A and it occupies more than 3/4 of the total area. It does not occur in the southeastern part of the zone. It shows a variety of colours, dark grey, dark green and chocolate. The lithology also varies considerably. Andesite lava, andesitic agglomerate and tuff breccia are the major rocks with intercalations of tuff and sandy tuff. The lava and pyroclastics are sometimes transitional horizontally or exist mixed together, and there are no clear boundaries between the two. Also, dark grey calcareous silt and greyish white limestone occur from the central to the upper part of the volcanic body. Nummulites sp. fossils which indicate Middle Eocene were discovered from the dark grey calcareous silt.

Balcılar Volcanics : This is distributed from the Balcılar Village at the central part of the zone to Eçi Village in the east. It is dark green to dark greyish green at Balcılar and Eçi Villages, consisting of basaltic-andesitic lava and agglomerate. There is notable filmy calcite in the agglomerate. Pale green tuff containing green patches is the main component to the north of Eçi Village. The green patches are weakly argillized, and bedding with NW～N-S strike and 10°-20° dip are observed in this part. This unit overlies the Çamyayla Volcanics unconformably and is overlain by alluvium.

Dededag Volcanics : This is distributed in a small area from Dededag in the northernmost part of the area to the southern part of Balaban Hill, and consists of pale brown to greyish white biotite dacite and dacitic pyroclastic rocks. It is mostly massive, but partly has vertical flow structure. Dededag (elevation 719m) is composed of this lava and forms an independent peak. It is therefore inferred that an intrusive dome was formed after extrusion during the earlier phases of volcanism. This unit intrudes the Çamyayla Volcanics and is covered by Balaban Basalt.

Balaban Volcanics : This is distributed in three localities at the northeastern margin of this zone, forming topographic highs. It has blocky fine-grained, compact lithology, and overlies the Dededag and Çamyayla Volcanics unconformably. Dikes trending E-W with 1.2-3m width are exposed at several localities in the downstream part of Eçi River. The lithology is glassy in this part. This unit intrudes the Çamyayla Volcanics.

Alluvium : There is flat topography in the vicinity of Kavsara Stream in the upstream part of the Kocabaş River which flows westward from Biga, and the alluvium is distributed in a wide area from Dondurma Village to Balcılar Village. It consists of a sand gravel layer composed of silt, sand and gravel. A part of this alluvium covers the Balcılar Volcanics along the stream. The flat alluvial area is suited for cultivation, and vegetables and wheat are grown.

1-3 Intrusive Bodies

Basalt dikes which are inferred to be the intrusive part of the Balaban Basalt occur at a locality 1km northwest of Balcılar Village and in the downstream section of Eçi Stream. There are no other intrusive bodies observed in this zone.

1-4 Geologic Structure

The investigation of geologic structure is very difficult in this zone because of the predominant volcanic rocks. From the strike and dip measured in some localities, however, it is inferred that there is an undulating structure. A gently wavy and parallel anticline-syncline system in a NW-SE direction was observed from Kocataş Hill to Koru Village. Also near Eçi Village, the structure is E-W trending and southward dipping, while at the Kavsara Stream, a basin structure is inferred, and thus a synclinal axis is anticipated in this part of the zone.

1-5 Mineralization and Alteration

The Çamyayla Volcanics is generally argillized (kaoline, sericite, chlorite) and medium to strongly altered parts are locally accompanied by iron hydroxide. Quartz veins containing galena, sphalerite, chalcopyrite and pyrite (Kundakçılar obası mine) are developed in an E-W direction in the Çamyayla Volcanics 1km southeast of Dededag. It seems to have been mined systemati-cally in the past, but now the adit (at approximately right angles to the veins N20°W) is collapsed. Veinlets are observed near the entrance, but the details are unknown except for a small amount of stored ores.

There is an iron orebody consisting mainly of hematite at 1km east of Koru Village, and there is a trace of small-scale digging in the N65°W direction carried out some time ago. This iron oxide concentration is considered to have been formed by replacement of the small limestone beds intercalated in the andesitic rocks. There is an outcrop of weakly recrystallized limestone approximately 300m northwest of the locality. The iron oxide body, however, is limited in size because the underlying andesite is exposed on the surface.

Galena-sphalerite-barite-bearing quartz veins are developed (Balcılar mine) in a NW-SE to E-W direction in the Balcılar Volcanics.

The thick parts of the veins are 20-30cm thick. Although the veins are thin, there are parts with very high silver content. There are stock piles of ores along the road from Balcılar Village running parallel to Eşekuçdu Stream. According to the local people, the ores were mined 10 to 15 years ago and only the high-grade ores were shipped.

Table 3-1 Basic Statistical Values of Rock Samples of Zone A

(Number of Samples:138)

Element	Mean	Dispersion	S.D.	Min.	Max.
Au(ppb)	5.310	0.404	0.636	2.5	2150.0
Cu(ppm)	26.329	0.919	0.959	1.0	10000.0
Mo(ppm)	1.546	0.146	0.383	1.0	26.0
Pb(ppm)	40.587	0.741	0.861	2.0	10000.0
Zn(ppm)	29.210	0.721	0.849	1.0	10000.0
Ag(ppm)	0.238	0.448	0.670	0.1	74.0
As(ppm)	13.014	0.260	0.510	3.0	1400.0
Se(ppm)	0.449	0.260	0.510	0.2	18.0
Hg(ppb)	38.433	0.299	0.546	10.0	4600.0
F (ppm)	209.379	0.156	0.395	40.0	7400.0
Ba(ppm)	276.366	0.336	0.580	20.0	10000.0
Tl(ppm)	0.401	0.246	0.496	0.1	3.0

1-6 Geochemical Prospecting of Rock Samples

A total of 138 rock samples were collected from Zone A. Basic statistical values and correlation matrices of the chemical values of rock samples were

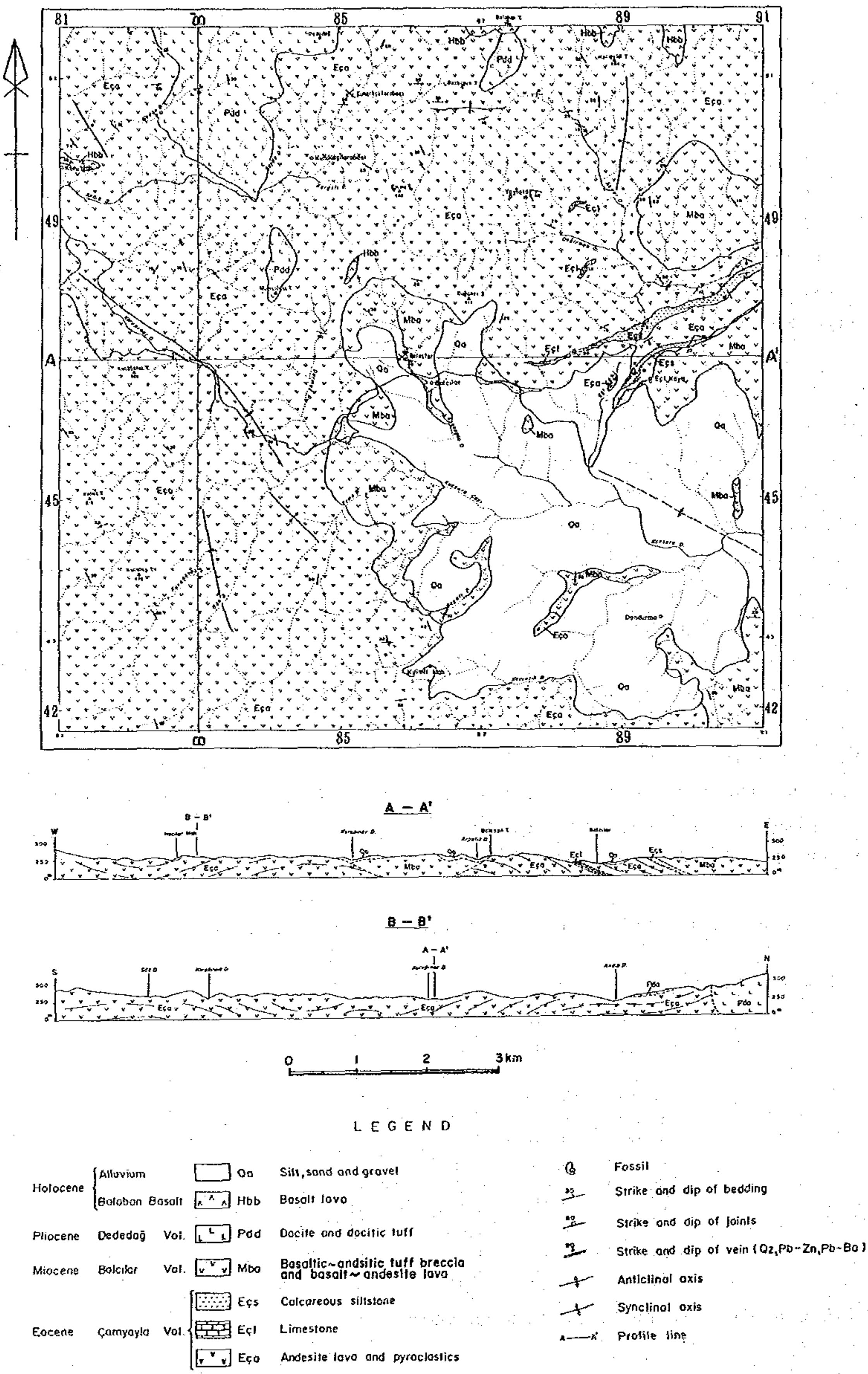


Figure 3- 1 Geologic Map and Cross Sections of the Zone A

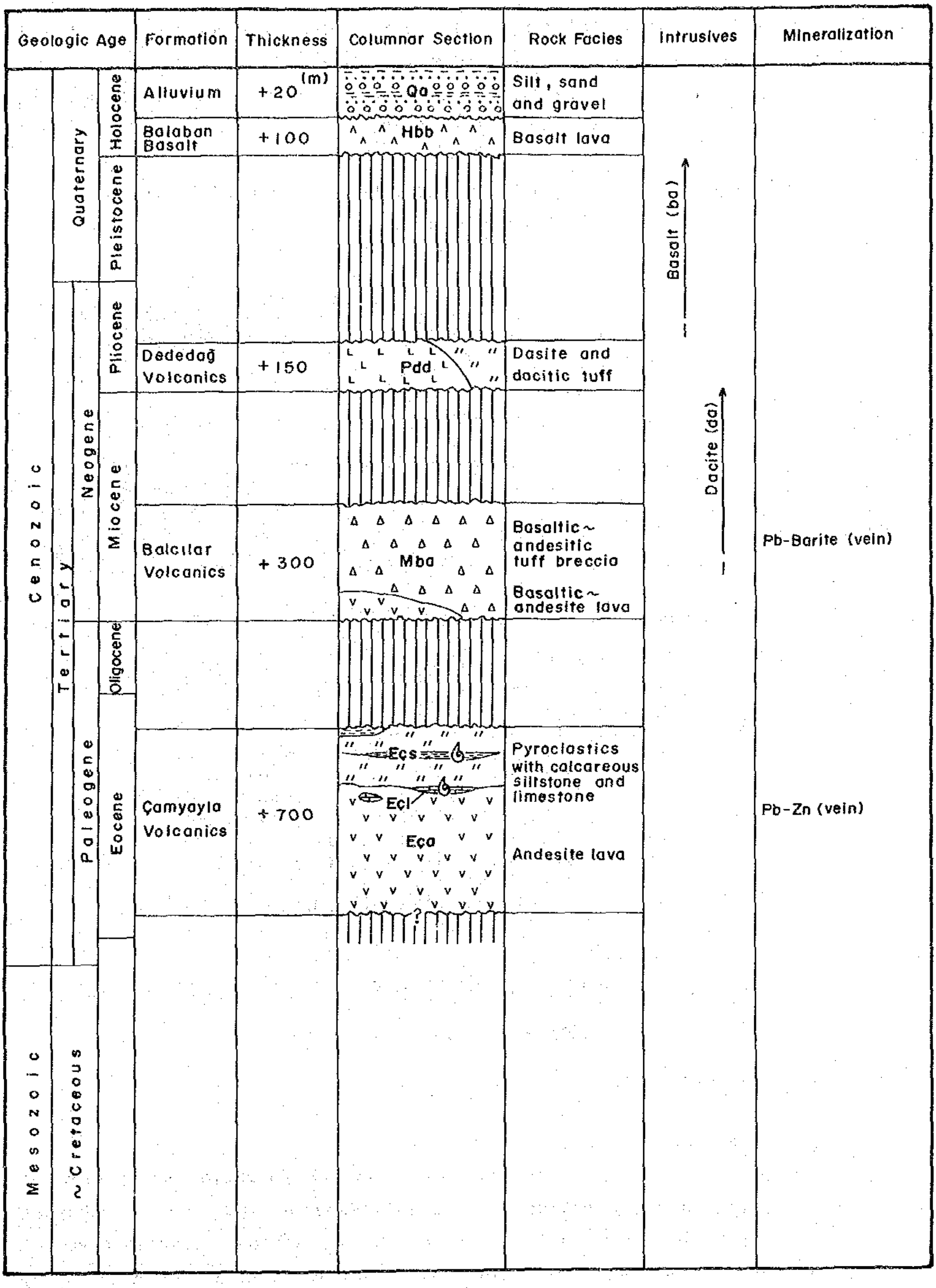


Figure 3- 2 Schematic Column of the Zone A

calculated, and the principal component analysis was carried out. These are listed in Tables 3-1, 3-2 and 3-3. By showing the localities with the first principal component exceeding 1 on the map (Figure 2-3), most of the localities where gold was detected are covered.

Table 3-2 Correlation(upper) and Covariance(lower) Matrix of Rock Samples of Zone A

	Au	Cu	Mo	Pb	Zn	Ag	As	Se	Hg	F	Ba	Tl
Au	0.404	0.51344	0.20959	0.62518	0.56684	0.64749	0.20375	0.03648	0.47526	-0.07700	0.05817	-0.04690
Cu	0.313	0.919	0.14258	0.46796	0.56949	0.61481	0.23687	0.07654	0.27632	0.09447	0.03340	0.00675
Mo	0.051	0.052	0.146	0.26863	0.04498	0.28287	0.37594	0.05857	0.14932	-0.11541	-0.01756	-0.04882
Pb	0.342	0.386	0.088	0.741	0.59488	0.57092	0.38859	0.09782	0.50045	-0.09971	0.18416	0.03651
Zn	0.306	0.464	0.015	0.435	0.721	0.44024	0.13949	-0.04319	0.23603	0.00710	0.23355	0.22096
Ag	0.276	0.395	0.072	0.329	0.250	0.448	0.39032	0.02182	0.59367	-0.15341	-0.01877	-0.16888
As	0.066	0.116	0.073	0.171	0.060	0.133	0.260	0.11408	0.44127	-0.18729	0.11528	0.01464
Se	0.012	0.037	0.011	0.043	-0.019	0.007	0.030	0.260	0.12431	0.12635	0.10522	-0.04229
Hg	0.155	0.145	0.031	0.235	0.109	0.217	0.123	0.035	0.299	-0.23835	0.11164	-0.18946
F	-0.019	0.036	-0.017	-0.034	0.002	-0.041	-0.038	0.025	-0.051	0.156	0.07619	0.22099
Ba	0.021	0.019	-0.004	0.092	0.115	-0.007	0.034	0.031	0.035	0.017	0.336	0.51631
Tl	-0.015	0.003	-0.009	0.016	0.093	-0.056	0.004	-0.011	-0.051	0.043	0.148	0.246

Table 3-3 Eigenvalues and Eigenvectors of Rock Samples of Zone A

	1	2	3	4	5	6	7	8
Au	0.40233	0.01918	-0.22300	-0.00880	-0.04612	-0.20727	-0.34674	0.03730
Cu	0.35436	0.11344	-0.30783	0.18244	0.17124	0.11530	0.47267	-0.42707
Mo	0.18622	-0.17414	0.37449	0.04726	0.70931	-0.33985	-0.27244	-0.18095
Pb	0.41496	0.08056	0.02165	-0.02622	-0.03690	-0.16382	-0.13989	0.52872
Zn	0.34170	0.31226	-0.27582	-0.14383	-0.00313	-0.23814	0.21694	0.26145
Ag	0.42363	-0.14296	-0.11595	0.01876	0.01715	0.17918	-0.02795	-0.36974
As	0.27029	-0.12142	0.50538	-0.01018	0.15731	0.46058	0.40355	0.32120
Se	0.05458	0.03533	0.29167	0.76569	-0.31064	-0.39265	0.20308	0.00684
Hg	0.34557	-0.19116	0.18468	-0.00734	-0.41309	0.34202	-0.33471	-0.06316
F	-0.08385	0.36906	-0.21665	0.54557	0.29452	0.47797	-0.38304	0.16468
Ba	0.08211	0.51782	0.39471	-0.14231	-0.25561	-0.01905	-0.19929	-0.40492
Tl	-0.01580	0.61248	0.21903	-0.19582	0.14067	0.02210	0.11025	0.02402
Eigen	3.93702	1.79399	1.29912	1.10531	0.93295	0.66372	0.57808	0.47621
Propo.	0.32809	0.14950	0.10826	0.09211	0.07775	0.05531	0.04817	0.03968
Cum. prop	0.32809	0.47758	0.58584	0.67795	0.75570	0.81101	0.85918	0.89887

CHAPTER 2 ZONE B

2-1 Outline of Zone B

2-1-1 General Geology

The basement rocks of this zone are the Taşdibek Formation consisting of weakly metamorphosed green schist and crystalline limestone, and the Akpınar Granite which intrudes into the Taşdibek Formation. Although fossils have not been found this formation, it is correlated to the Triassic Karakaya Group because of the weakly metamorphosed lithology. The granite is not associated with mineralization, but the crystalline limestone in the vicinity underwent contact metasomatism and has been skarnitized. Kirazlı Conglomerate covers these basement rocks unconformably, and although the age determination using fossils discovered during this survey is not yet completed, it is inferred to be Jurassic. The intermediate volcanic activity began in the Eocene and the units continue from the Çamyayla Volcanics, Şapçı Volcanics to Osmanlar Volcanics, then to the Karaköy Formation consisting of conglomerates deposited during the long volcanic interval. Quaternary volcanic rocks --Kocaçakıl Basalt-- is observed as small outcrops where the Taşdibek Formation is distributed. The geologic map, geologic cross sections, and stratigraphic columns zones are shown in Figures 3-3～3-6.

2-1-2 Geologic Structure

In the central part of this zone, the basement composed of Taşdibek Formation and Akpınar Granite is uplifted and Tertiary volcanic rocks overlie unconformably. The volcanic rocks are often massive and it is not easy to understand the geologic structure, but the Çamyayla Volcanics in the northern part of the zone gently dips southward. Although the Şapçı Volcanics does not have bedding and the structure is not clear, it is assumed that the structure is gentle and wavy.

Anticlinal structure is not clearly observed except in the above uplifted part, and the synclinal structures are observed in the Osmanlar Volcanics and the Karaköy Formation.

The fractures in this zone occur in various directions, but the frequencies are low. Lineaments in the NE-SW direction in the southeastern part of the zone, (the central part of the remote-sensing zone) were delineated from Landsat data. Although it was not confirmed by surface study, a fault was inferred in the NNE-SSW and NW-SE directions associated with those lineaments.

The NNE-SSW faults transect the central part of the zone, and they cut through the Şapçı Volcanics, but are covered by Kocaçakıl Basalt.

The NW-SE faults are inferred to run through the Kirazlı Conglomerates to the east of Mt.Kestane and to the west of Dededag (elevation 883m).

The existence of anticlinal axes was not confirmed, but synclines were inferred from the trends of the Osmanlar Volcanics and Karaköy Formation.

2-1-3 Geochemical Prospecting of Rock Samples

A total of 1,625 rock samples were collected from Zone B. Basic statistical values and correlation matrices of the chemical values of rock samples were calculated, and the principal component analysis was carried out. These are listed in Tables 3-4, 3-5 and 3-6. By showing the localities with the first principal component exceeding 1 on the map (Figure 2-3), most of the localities where gold was detected are covered.

Table 3-4 Basic Statistical Values of Rock Samples of Zone B

(Number of Samples:1,625)

Element	Mean	Dispersion	S.D.	Min.	Max.
Au(ppb)	7.205	0.475	0.689	2.5	3660.0
Cu(ppm)	11.413	0.316	0.562	0.5	10000.0
Mo(ppm)	2.713	0.269	0.519	0.5	573.0
Pb(ppm)	14.621	0.621	0.788	1.0	10000.0
Zn(ppm)	6.171	0.402	0.634	1.0	10000.0
Ag(ppm)	0.217	0.142	0.377	0.1	100.0
As(ppm)	33.370	0.527	0.726	1.0	10000.0
Se(ppm)	0.453	0.398	0.631	0.1	100.0
Hg(ppb)	108.979	0.652	0.807	10.0	77999.2
F (ppm)	128.630	0.191	0.437	20.0	3400.0
Ba(ppm)	248.447	0.292	0.541	10.0	10000.0
Tl(ppm)	0.212	0.315	0.561	0.05	34.0

Table 3-5 Correlation(upper) and Covariance(lower) Matrix of Rock Samples of Zone B

Au	Cu	Mo	Pb	Zn	Ag	As	Se	Hg	F	Ba	Tl	
Au	0.475	0.13742	0.17202	0.23950	-0.02232	0.30494	0.19048	0.13516	0.09804	0.04239	0.05942	-0.11790
Cu	0.053	0.316	0.14697	0.35736	0.61205	0.22511	0.42620	0.39642	0.21062	0.17031	0.22968	0.31940
Mo	0.061	0.043	0.269	0.28219	0.01806	0.28023	0.31087	0.18533	0.24598	-0.11042	0.03239	-0.03077
Pb	0.130	0.158	0.115	0.621	0.35303	0.41648	0.42345	0.30179	0.43439	0.04506	0.20393	0.31237
Zn	-0.010	0.218	0.006	0.177	0.402	0.10460	0.25237	0.21527	0.01058	0.27037	0.07520	0.35225
Ag	0.079	0.048	0.055	0.124	0.025	0.142	0.31750	0.15055	0.45273	-0.23599	0.14983	-0.07295
As	0.095	0.174	0.117	0.242	0.116	0.087	0.527	0.35302	0.44075	-0.10922	0.34325	0.13743
Se	0.059	0.140	0.061	0.150	0.086	0.036	0.162	0.398	0.25640	0.21866	0.21374	0.22771
Hg	0.055	0.096	0.103	0.276	0.005	0.138	0.258	0.131	0.652	-0.31875	0.29237	0.12469
F	0.013	0.042	-0.025	0.016	0.075	-0.039	-0.035	0.060	-0.112	0.191	0.15527	0.32864
Ba	0.022	0.070	0.009	0.087	0.026	0.031	0.135	0.073	0.128	0.037	0.292	0.24136
Tl	-0.046	0.101	-0.009	0.138	0.125	-0.015	0.056	0.081	0.056	0.081	0.073	0.315

Table 3-6 Eigenvalues and Eigenvectors of Rock Samples of Zone B

	1	2	3	4	5	6	7	8
Au	0.16582	-0.19353	0.61197	0.41570	-0.32558	0.04734	0.02324	-0.41260
Cu	0.37603	0.23358	0.13714	-0.24555	-0.06855	-0.38048	-0.05013	0.00754
Mo	0.21944	-0.25850	0.22578	-0.04267	0.69785	0.22617	-0.47259	0.12898
Pb	0.39742	-0.03749	0.05434	-0.10268	-0.11975	0.49149	0.06218	-0.08900
Zn	0.27569	0.37063	0.17189	-0.47570	-0.17526	-0.14151	-0.14985	0.09489
Ag	0.29328	-0.35556	0.12695	-0.08709	-0.33537	0.11422	0.05847	0.60449
As	0.38881	-0.12169	-0.11106	0.01663	0.11858	-0.35971	-0.19497	-0.44369
Se	0.31262	0.12957	0.06584	0.25901	0.42978	-0.23665	0.66789	0.15901
Hg	0.32403	-0.31731	-0.39264	-0.01392	-0.04541	0.11358	0.26069	-0.03411
F	0.04161	0.52261	0.25425	0.38407	0.05533	0.18513	-0.07920	0.27567
Ba	0.24574	0.07214	-0.42904	0.55243	-0.20187	-0.18508	-0.42860	0.21996
Tl	0.21673	0.40666	-0.29588	-0.02030	0.01131	0.51029	0.04295	-0.28820
Eigen	3.45314	2.01445	1.12255	1.01610	0.85001	0.78109	0.68537	0.57225
Propo.	0.28776	0.16787	0.09355	0.08468	0.07083	0.06509	0.05711	0.04769
Cum. prop	0.28776	0.45563	0.54918	0.63385	0.70469	0.76978	0.82689	0.87458

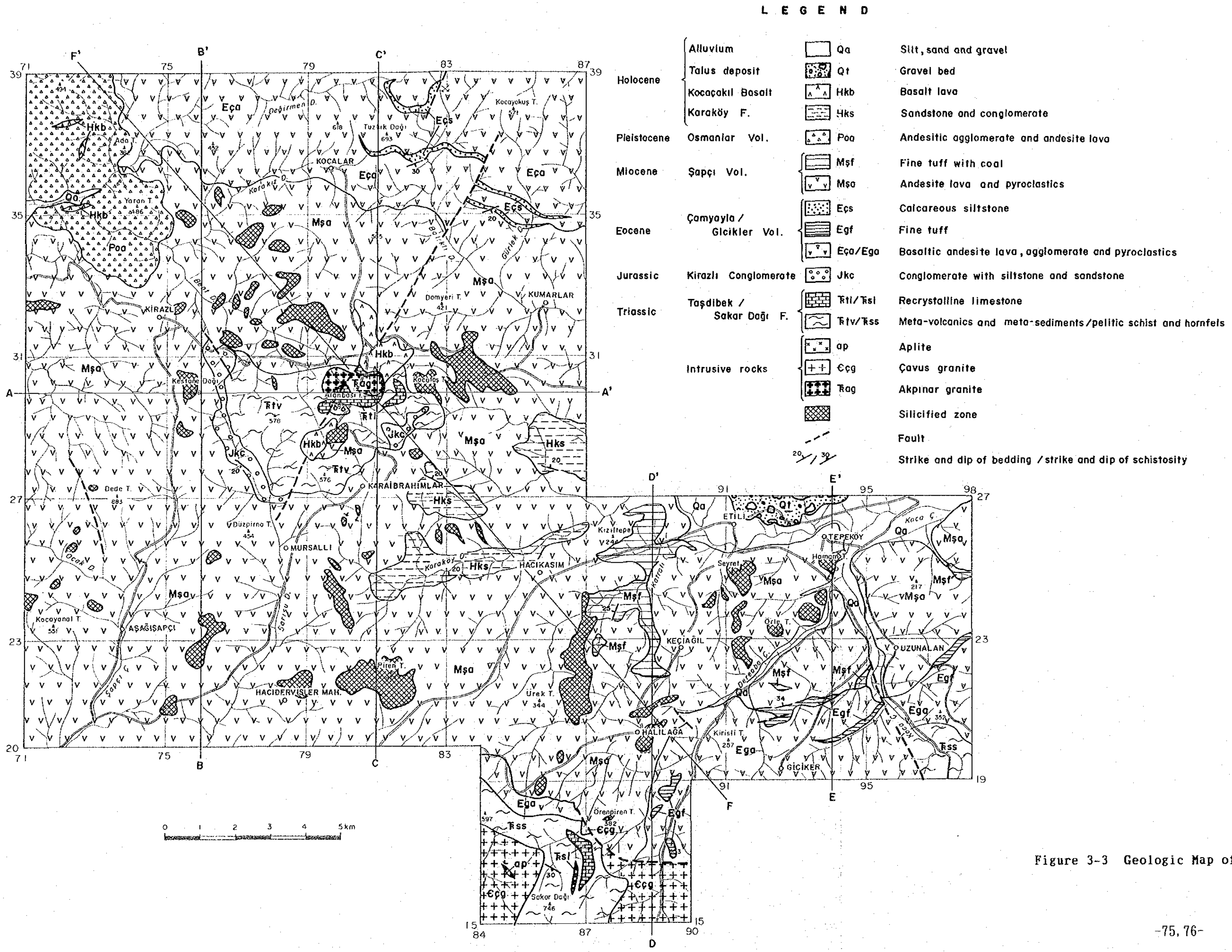


Figure 3-3 Geologic Map of Zone B

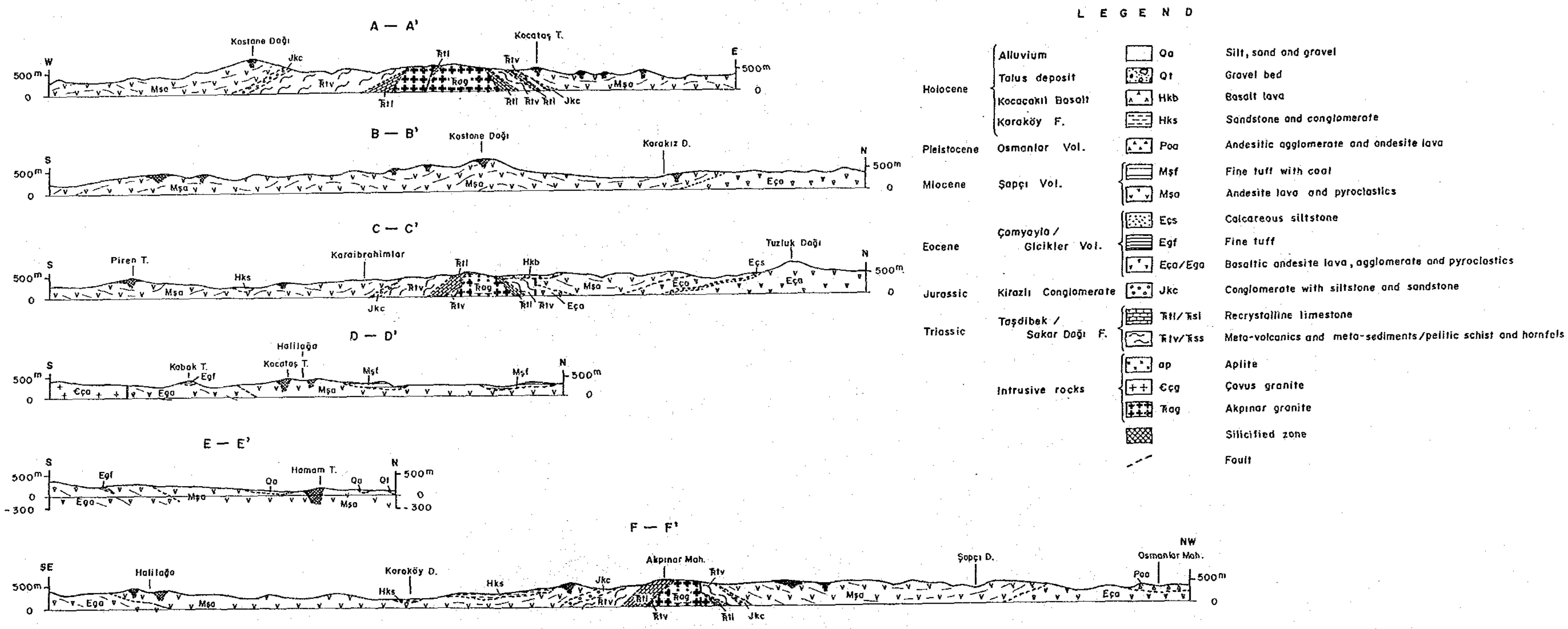


Figure 3-4 Cross Sections of Zone B

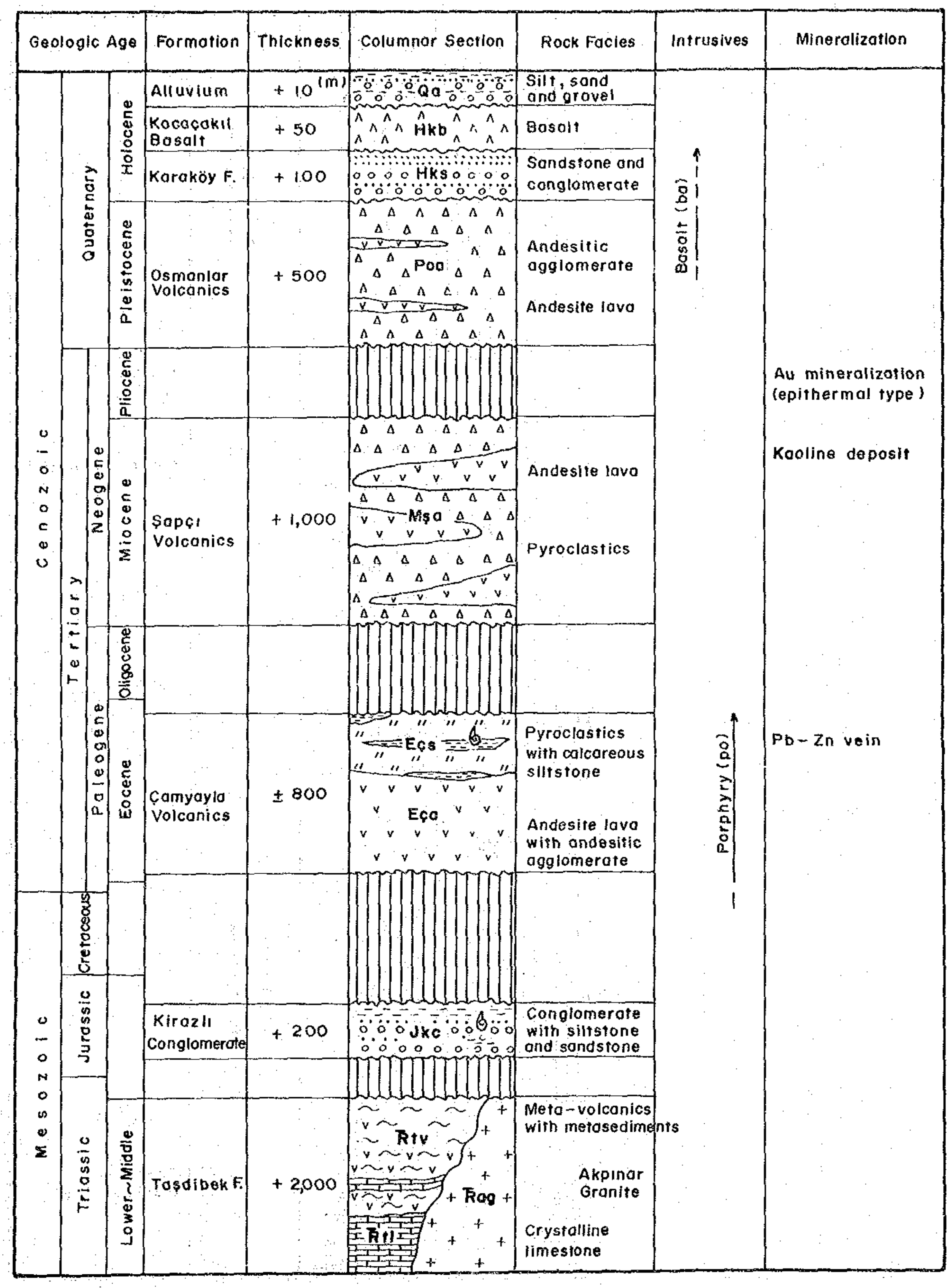


Figure 3-5 Schematic Column of Zone B

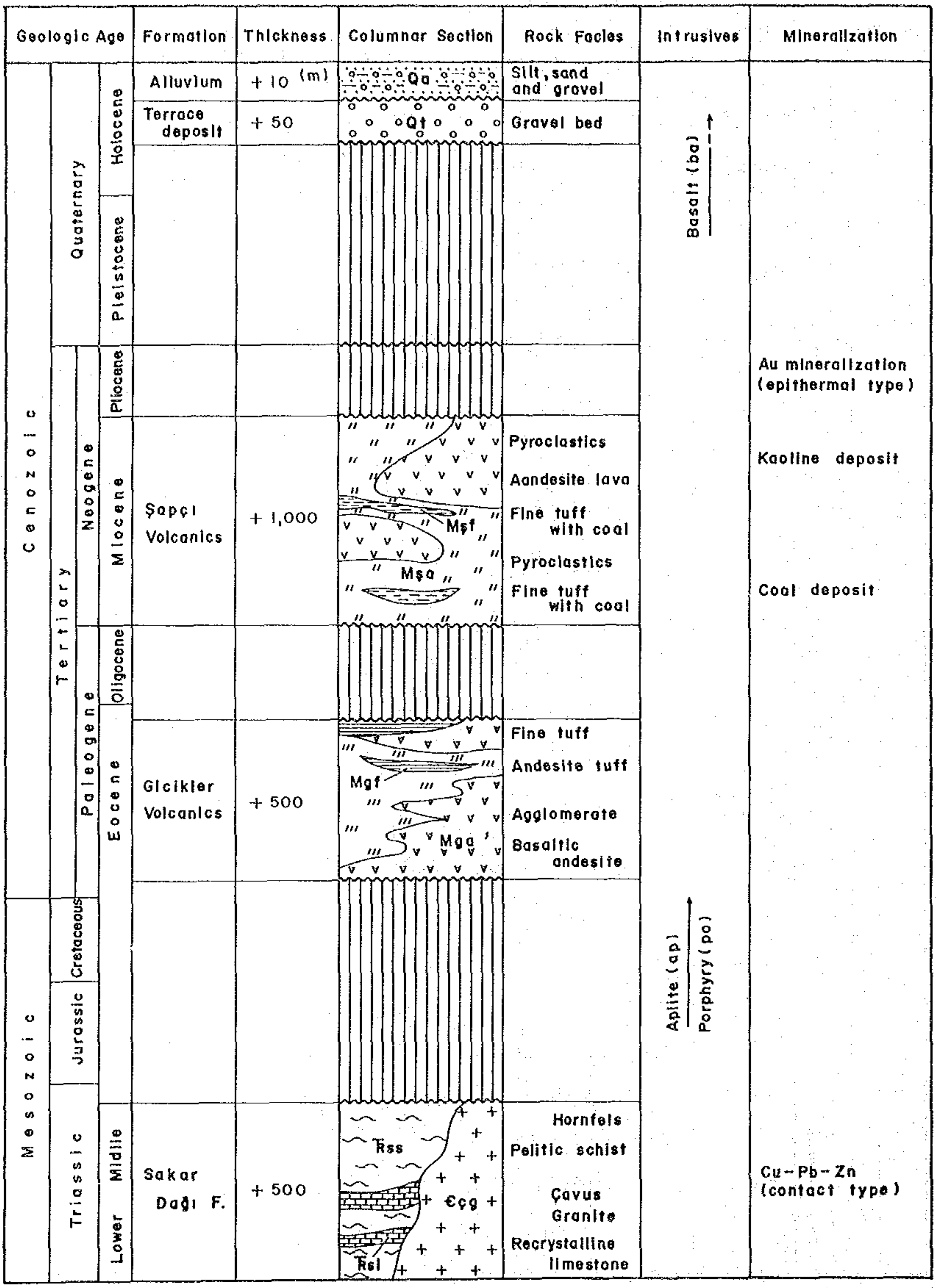


Figure 3- 6 Schematic Column of the Etili Area

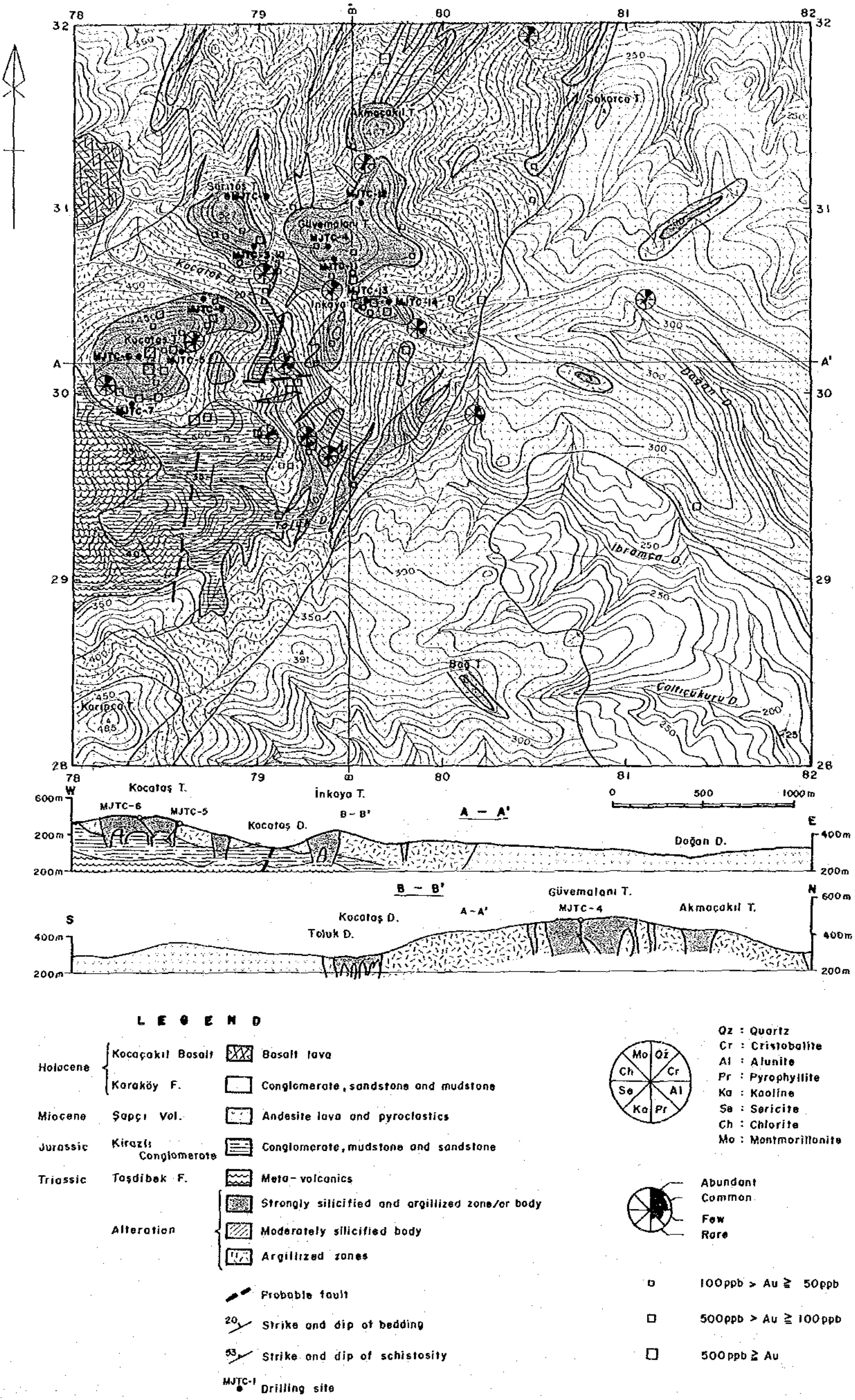


Figure 3-7 Gold Occurrence and Alteration Map of the Arlık Area

2-2 Arlık Stream Area

2-2-1 Stratigraphy

Taşdibek Formation : Dark green-grey metavolcanics are predominant in the upstream part of Oluk Stream, while in the southeastern part where the Taşdibek Formation is distributed, green schist and creamy yellow to greyish white equigranular crystalline limestone is dominant.

In general, small-scale silicified zones along minute fractures (system NE-SW and NWN-SES) are developed in this formation, and rocks are altered into chlorite and disseminated with pyrite.

Kirazlı Conglomerate : This formation consists of pale green siltstone, fine-grained tuff and greyish white to dark grey conglomerate. The pebbles are mostly chert, green schist and quartzite, and they are in various shapes (from weakly angular to well rounded). They are mostly 1～3cm, but there are cobbles of 20～30cm. They are commonly fractured, locally well layered, and show silicification and limonitization. The rock is argillized and pyrite occurs scattered in the conglomerate. As well as bearing crosscutting irregular calcite veinlets which are sometimes a few mm in thickness, they also show iron stains as fracture fillings.

Şapçı Volcanics : The major part of these rocks are andesite lava accompanied by andesitic pyroclastics, mainly tuff. The unaltered part of these rocks are dark grey, and generally, they are argillized and silicified from weak to medium intensity with strong alteration in some parts. Detailed lithological division is thus difficult.

This volcanic unit has a general vertical trend of change from pumice tuff through biotite andesite to andesite with notable plagioclase phenocrysts in ascending order. Some of the andesite has notable biotite phenocrysts while the biotite in others cannot be seen by the unaided eye. Also, in some localities, such as in the southeastern part of this zone, the area shows flow structure.

Argillization of these rocks can be grouped into unaltered to weakly altered parts and intermediate to strongly altered parts. Generally, the argillized parts are leucocratic, but hematitized or limonitized parts are reddish brown to brown. Native sulfur occurs in some localities.

Silicification zones often result in the formation of isolated mountains, and some examples are Sartaş, Güvemalanı, and Kocataş Hills. The original rocks of these localities are difficult to identify. Many of the joints and fissures in this zone trend NE-SW, although the strike is generally not discernible.

The structure of these volcanic rocks is mostly massive, but the strike of the fine-grained tuff varies in many directions (N-S, NE-SW, E-W), and the dip is 20-35° near Akpınar Village in the central part of this zone.

Karaköy Formation : Most of the formation is grey to greyish white, and locally yellowish brown with pale green parts. The formation is generally poorly consolidated and consists of tuffaceous conglomerate, sandstone and siltstone. It is generally unaltered. These beds form alternating dips of 10°- 20° and the dominant trend is NW. The pebbles of the conglomerate found in this zone are, in some cases, silicified and argillized.

Kocaçakıl Basalt : The rock is a black-dark green, fine-grained and compact basalt. Joints are developed, and the many pyroxene phenocrysts are unaltered. It forms blocks of 20-30cm in diameter and seems to have flowed to the depressions, with structure parallel with the topography.

2-2-2 Geologic Structure

In the central part of this zone, the basement, composed of the Taşdibek Formation and Akpınar Granite, is uplifted, and unconformably overlain by Tertiary volcanic rocks. The Şapçı Volcanics is often massive, and it is not easily to understand the geologic structure, but it is assumed that the structure is gentle and wavy and that the thickness of this volcanic increases with distance from the basement rocks.

The fractures in this area occur in various directions, but the frequency is low. Lineaments in the NE-SW direction in the northwestern part of the area (the central part of the remote-sensing zone) were determined from Landsat data. Although it was not confirmed by surface study, the fault direction was inferred as NEN-SWS and NW-SE, in association with those lineaments.

The NEN-SWS faults transect the western part of the area, and they cut through the Şapçı Volcanics, but are covered by Kocaçakıl Basalt.

The NW-SE faults are inferred to run through the Kirazlı Conglomerates to the east of Mt.Kestane and to the west of Dededag (elevation 883m).

2-2-3 Alteration Zones

The silicified and argillized zones of the Arlık Stream area are distributed in the Kocataş, Sartaş and Güvemalanı Hills. The Kocataş alteration zone is the largest in the vicinity, its dimensions being 2km long east-west and 1km wide north-south. The gold content was determined from rock samples collected during two years. The auriferous samples were significant in the Arlık alteration zones. The silicified bodies consist of massive, brecciated and porous parts, which gradually change into each other. Generally, the massive part is centered in the silicified body; the porous and brecciated parts occur at the margin. The silicified zones often result in protruding topography and they can be identified on air photographs. They are accompanied by limonite and hematite due to oxidation. The quantity of limonite is low in the massive part, and high in the porous part.

It is significant that gold was detected in the rock samples collected from the Arlık alteration zones, in soil from heavy mineral study and in MJTC-4. The results of the second and third phases indicate the possibility of large-scale low-grade gold deposits in the alteration zones.

2-2-4 Trench Survey

(1) Outline of Trench Survey

Trench survey was carried out on the Sartaş and Güvemalanı Hills where the strongly silicified zones were intersected by drill survey in the second and third phases. These localities consist of drill sites of MJTC-4, 10, 11, 12, 13 and 14. The locations of trenches are shown in Figure 2-1. The interval of channel samples collected from the bottom of trenches is three meters, and the length of each trench and number of samples are as follows:

Location of Trench	Sample No.	Length	Quantity
Direction of MJTC-10	A1001～A1055	165m	55pcs
Direction of MJTC-11	A1101～A1170	210m	70pcs
Direction of MJTC-12	A1201～A1271	213m	71pcs
Direction of MJTC-13	A1301～A1355	165m	55pcs
Direction of MJTC-14	A1401～A1451	153m	51pcs
Parallel with MJTC-11	AA01～ AA48	144m	48pcs
Cross with MJTC-11	AB01～ AB63	195m	54pcs
Total		1,245m	404pcs

After the stripping (depth of one meter) of overburden using a bulldozer, further trenches were scooped out by a rock drill, and trench samples were collected from the B-C layer of soil. The depth of the trench is 1m to 1.5m. Sampling density was 404 samples from 1,224m of trench. The location of most samples corresponds vertically to strongly silicified zones.

(2) Interpretation

From the result of trench survey, the characteristics of mineralization are considered to be as follows:

Gold-bearing zones were clarified by the trench survey. These zones were divided into massive silicified and brecciated types. The former is inferred to range from drill hole MJTC-4 (Güvemalanı Hill) to MJTC-10 (Sartaş Hill), and locates in the limonitic parts of the massive silicified bodies which form the center of silicified zones. On the other hand, the latter ranges from MJTC-12 (Güvemalanı Hill) to MJTC-13 and 14 (İnkaya Hill) and locates in the limonitic-hematite parts of the brecciated zones which form the periphery of southeastern silicified zones.

Table 3-7 Significant Analytical Results of Trench Samples

Arlık Au > 100ppb (Trench)

Sample No.	Description	Au ppb	Cu ppm	Mo ppm	Pb ppm	Zn ppm	Ag ppm	As ppm	Se ppm	Hg ppb	F ppm	Ba ppm	Tl ppm
AB30	Soil B	270	12	14	30	8	<0.5	12	1.2	30	520	260	1.3
AB31	Soil B	100	15	22	40	12	<0.5	22	1.6	40	470	220	1.5
AB33	Soil B	140	4	7	16	4	<0.5	8	0.2	30	190	200	0.2
AB38	Soil B	100	8	24	30	6	<0.5	26	2.0	40	550	320	0.7
AB43	Soil B	110	5	24	36	2	<0.5	18	3.4	30	540	460	1.9
AB48	Soil B	110	14	29	82	20	<0.5	38	4.2	20	160	360	1.2
AB50	Soil B	195	8	68	472	8	<0.5	13	3.4	20	130	480	3.2
AB51	Soil B	105	21	52	176	8	<0.5	25	4.0	10	190	420	1.9
A1005	Soil B	170	60	32	24	40	<0.5	40	1.0	40	230	100	0.1
A1006	Soil B	345	47	41	10	16	<0.5	154	7.2	20	370	120	0.2
A1007	Soil B	205	65	16	18	22	<0.5	32	4.0	20	850	560	0.4
A1029	Soil B	115	19	62	10	4	<0.5	31	2.0	20	250	120	0.4
A1141	Soil B	110	6	39	8	6	<0.5	23	1.2	30	100	160	0.3
A1145	Soil B	110	11	14	20	6	<0.5	16	5.0	40	290	180	1.1
A1149	Soil B	105	8	12	44	2	<0.5	8	6.8	50	270	440	1.5
A1256	Soil B	225	11	37	26	10	<0.5	26	2.6	50	190	400	0.3
A1306	Talus D	100	3	144	50	6	<0.5	25	0.6	20	200	480	0.2
A1309	Talus D	100	<1	22	6	<2	<0.5	4	<0.2	10	80	40	<0.1
A1320	Talus D	200	1	21	14	<2	<0.5	5	<0.2	20	90	50	<0.1
A1321	Talus D	220	3	20	10	2	<0.5	5	<0.2	10	120	50	<0.1
A1322	Talus D	200	2	18	8	2	<0.5	6	<0.2	10	100	60	<0.1
A1326	Talus D	100	<1	1	<2	<2	<0.5	1	<0.2	10	50	30	<0.1
A1330	Talus D	100	<1	2	4	<2	<0.5	1	<0.2	10	50	30	<0.1
A1332	Talus D	170	<1	4	8	<2	<0.5	1	<0.2	10	50	880	<0.1
A1333	Talus D	110	<1	3	14	<2	<0.5	2	<0.2	10	60	60	<0.1
A1342	Talus D	115	3	13	16	6	<0.5	6	<0.2	20	90	120	0.1
A1441	Talus D	125	4	18	34	<2	<0.5	10	0.2	20	240	520	0.3
A1445	Talus D	110	1	9	14	<2	<0.5	4	<0.2	20	120	60	0.1
A1450	Talus D	110	<1	6	8	<2	<0.5	2	<0.2	20	60	40	0.1

2-2-5 Diamond Drilling

(1) Outline of Drilling Survey

As a result of geological and geochemical surveys carried out, an epithermal-gold-type ore deposit is expected as a promising target for future exploration in the Arlık Stream Area. In the second and third phases, a drilling survey consisting of 12 holes (total hole length: 1,800m) was planned and subsequently carried out in order to explore underground emplacement of the epithermal-gold-type ore deposit, and to investigate and unravel the

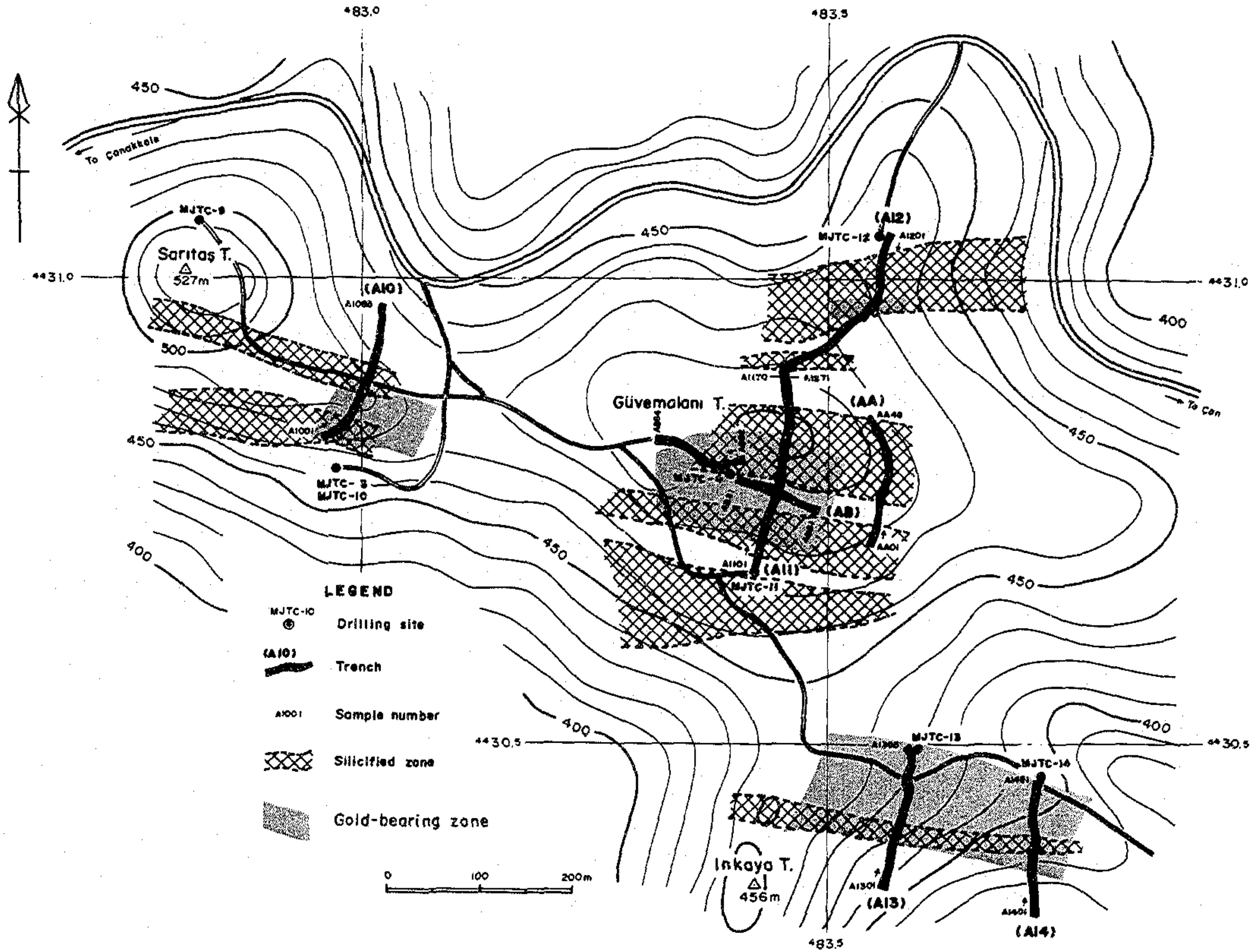


Figure 3-8 Location Map of Trenches of Arlık Stream Area

relationship between the emplacement conditions of the ore deposit and the results of geological and geochemical surveys.

	No.	Y	X	Z(m Sea Level)	Direction	Dip
Phase II	MJTC-3	82980	30790	454	-	-90°
	MJTC-4	83400	30790	489	-	-90°
	MJTC-5	82620	30220	452	N80°W	-50°
	MJTC-6	82340	30170	491	S80°E	-50°
Phase III	MJTC-7	82325	29948	446	N10°E	-50°
	MJTC-8	82726	30548	412	S10°W	-50°
	MJTC-9	82848	31059	510	N10°E	-50°
	MJTC-10	82971	30796	454	N10°E	-50°
	MJTC-11	83426	30694	471	N10°E	-50°
	MJTC-12	83554	31037	464	N10°E	-50°
	MJTC-13	83597	30497	427	S10°W	-50°
	MJTC-14	83729	30464	403	S10°W	-50°

Longyear L-38 and Acker were used for the drilling operation. The types and specifications of machines, engines, pumps and equipment, and amount of consumables, drilling meterage of diamond bit and working time breakdown of the drilling operation are shown in Appendix Tables 5, 6 and 7.

	No.	Length Drilled	Surface Soil	Core Length	Core Recovery	Period
Phase II	MJTC-3	151.00m	11.15m	145.75m	96.5%	23 Oct- 6 Nov
	MJTC-4	151.10m	3.00m	130.05m	86.1%	16 Oct-31 Oct
	MJTC-5	151.00m	0.00m	151.00m	100.0%	27 Sep- 7 Oct
	MJTC-6	151.00m	3.15m	135.00m	94.5%	20 Sep-13 Oct
Phase III	MJTC-7	151.00m	2.00m	140.55m	94.3%	31 Aug-13 Sep
	MJTC-8	151.10m	0.00m	150.80m	99.9%	25 Aug-31 Aug
	MJTC-9	151.00m	0.00m	138.55m	91.8%	19 Sep- 5 Oct
	MJTC-10	151.00m	19.20m	119.95m	84.9%	14 Jul-31 Jul
	MJTC-11	151.00m	0.00m	150.70m	99.8%	14 Jul- 4 Aug
	MJTC-12	151.10m	0.70m	142.70m	94.9%	6 Sep-14 Sep
	MJTC-13	151.00m	42.40m	126.50m	99.5%	10 Aug-25 Aug
	MJTC-14	151.00m	47.00m	121.95m	80.8%	5 Aug-18 Aug

(2) Assay Results of Cores

MJTC-3: Expected gold mineralization was not detected by any drill hole, but a zone containing gold and copper was found in the silicified body in the range from 120.00m to 144.00m. The grades are 53ppb Au and 290ppm Cu. It is significant that the components related to gold mineralization were detected in the lower section.

MJTC-4: Low-grade mineralization continued from surface to 151.10m at the bottom of the hole; average grade of gold is 134 ppb. It is significant that the content of gold and molybdenum in the strongly silicified zones is higher than that in the other zones.

MJTC-5: Gold mineralization was not detected by this drill hole.

MJTC-6: Mineralization containing gold in excess of 50 ppb was detected in the silicified and argillized zones from 57.00m to 99.00m. These zones corresponded to the descending silicified body seen at the surface, and the content of silver is high.

MJTC-7 and 8: Gold mineralization was not detected by this drill hole.

MJTC-9: The expected gold mineralization was not detected by any drill hole, but a zone containing mercury and copper was found in the silicified body in the range from 138m to 150m. It is significant that the components related to gold mineralization were detected in the lower section.

MJTC-10: Mineralization containing gold in excess of 100 ppb was detected in the silicified and argillized zones from 95m to 138m. These zones corresponded to the descending silicified body seen at the surface, and the content of mercury and antimony is high. Also, below 120m, the content of copper is very high.

MJTC-11: Mineralization containing gold in excess of 100 ppb was detected in the silicified zone from 138m to 147m. This zone corresponds to the descending gold-bearing silicified part detected by drill hole MJTC-4 of the second phase.

MJTC-12: Mineralization containing gold in excess of 100 ppb was detected in the silicified-argillized zones from 105.8m to 130.25m. The content of molybdenum is high in the range from 90m to 123m.

MJTC-13: Low-grade mineralization continued from surface to 151m, the bottom of the hole; average grade of gold is 77 ppb. It is significant that the content of gold, lead and molybdenum in the talus deposits and fractured silicified-argillized zones is higher than that in the other zones, but the content of mercury is low.

MJTC-14: Low-grade mineralization continued from surface to 151m, the bottom of the hole; average grade of gold is 121 ppb. It is significant that the content of gold, lead and molybdenum in the talus deposits and fractured silicified-argillized zones is higher than that in the other zones, but the content of mercury is low.

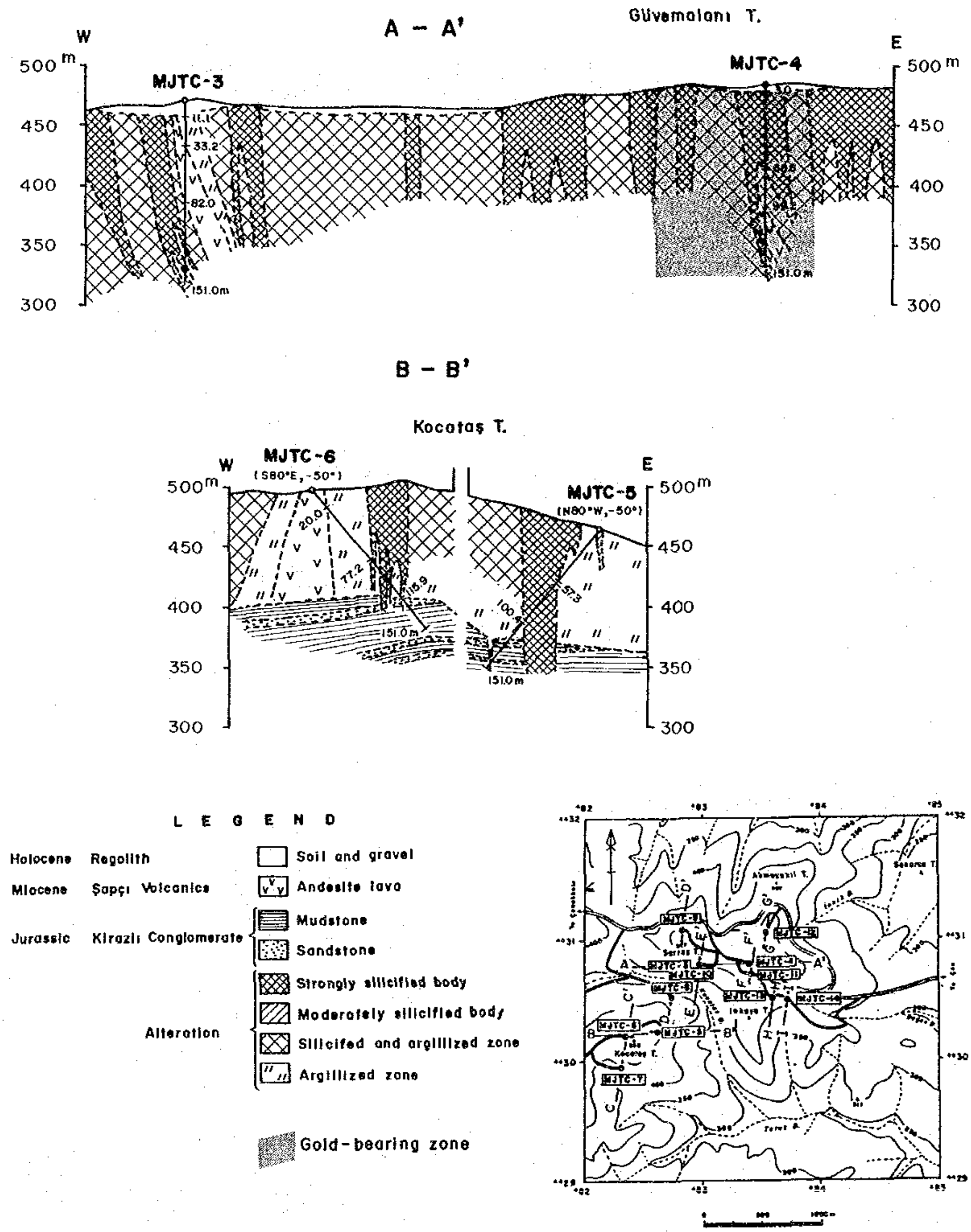
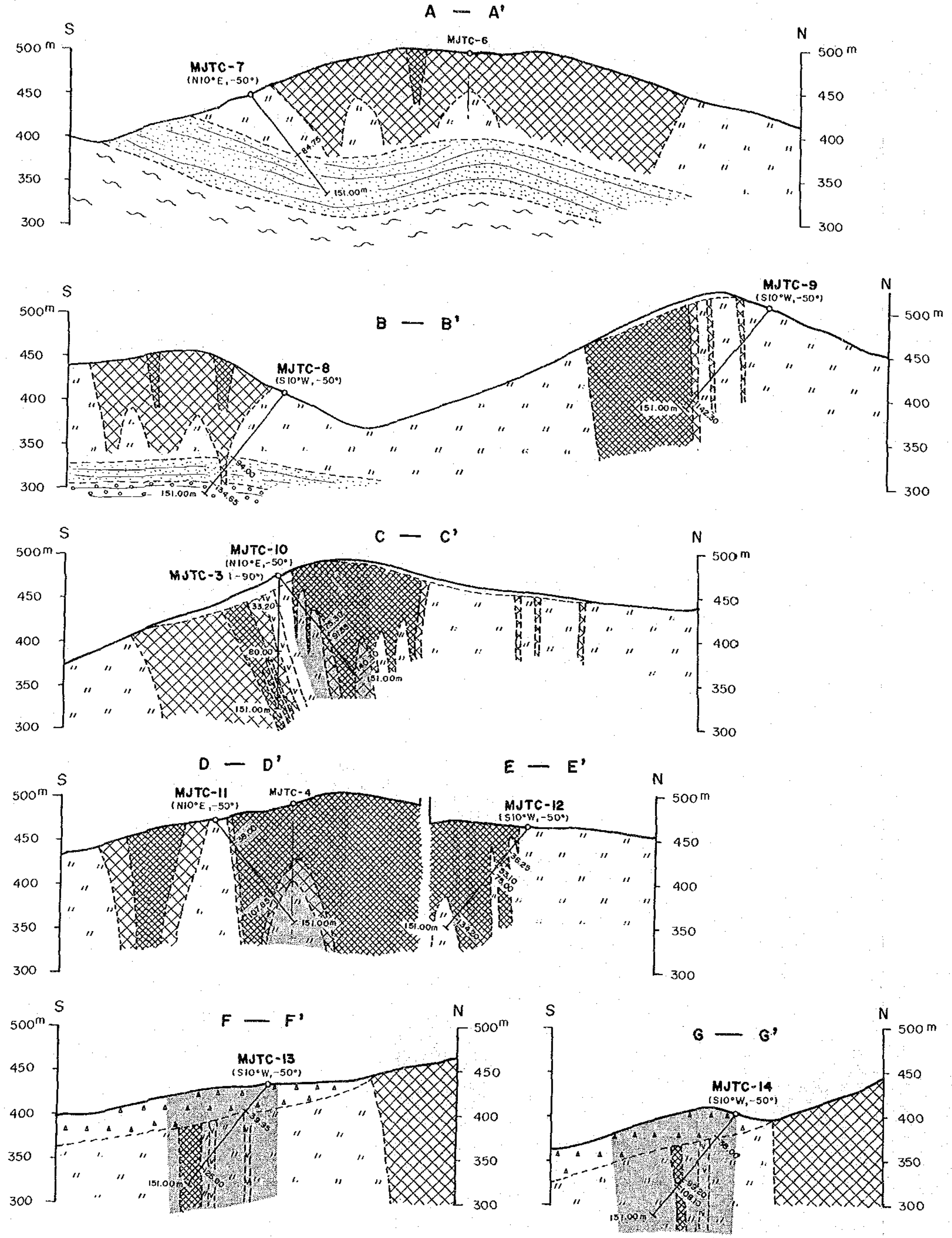
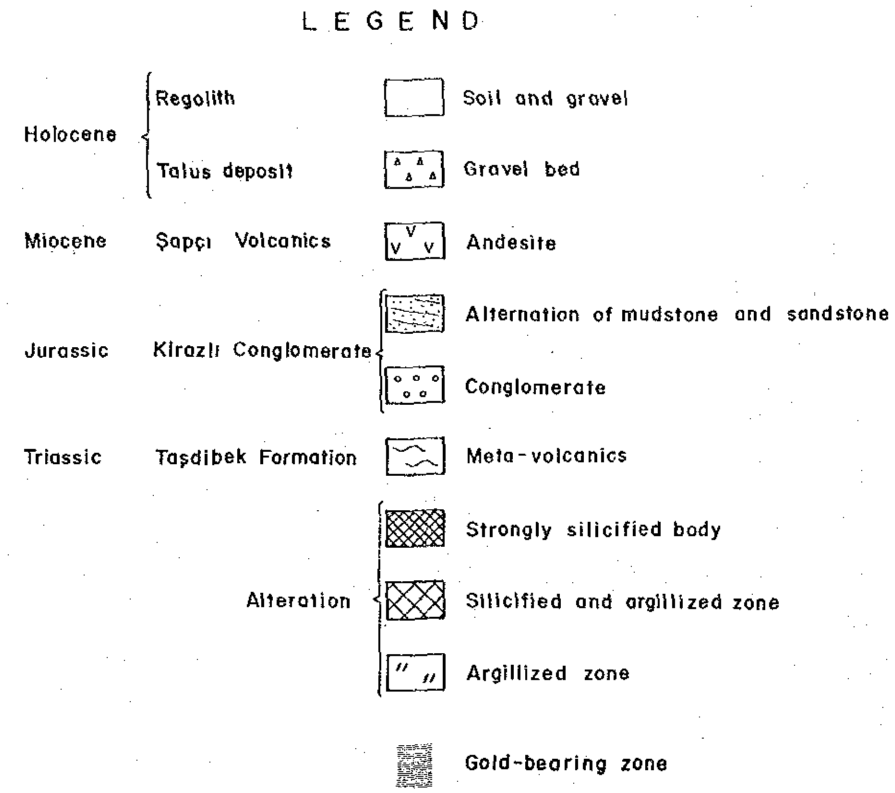


Figure 3-9 Geologic Cross Section of Drill Holes (from MJTC-3 to MJTC-6)





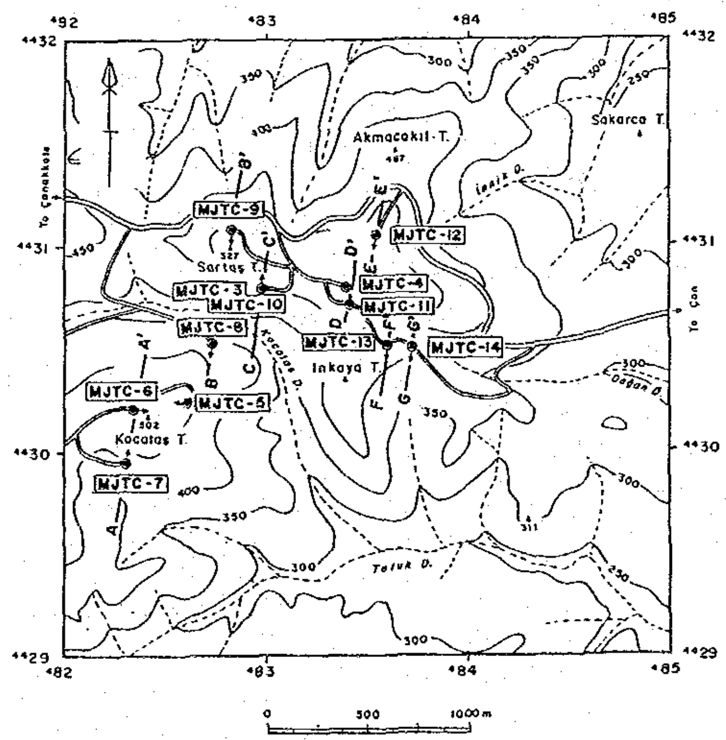


Figure 3-10 Geologic Cross Sections of Drill Holes (from MJTC-7 to MJTC-14)

2-3 Karaibrahimler Area

2-3-1 Stratigraphy

Taşdibek Formation : Green schist is predominant in the northern part of Karaibrahimler Village, while in the southeastern part where the Taşdibek Formation is distributed, green schist and creamy yellow to greyish-white equigranular recrystallized limestone is dominant. Akpınar Granite intrudes into the limestone. In general, minute fractures are developed in this formation. Skarns are observed near the contact of the limestone with the granite and there are hematite concentrations. There are quartz-limonite veins (strike N10°W, dip 55°E, 46cm thick) in the granitic body.

Metamorphosed volcanics and sedimentary rocks are usually greyish-green in colour, intensively fractured and locally display schistosity. They are highly rigid in places, having intensive hematitization, limonitization and silicification along some fractures. Quartz veinlets occur in a widespread area parallel to schistosity, although they occasionally intersect the schistosity.

Recrystallized limestone outcrops occur in the vicinity of Akpınar Village, and are grey, greyish-white coloured, intensively fractured, locally very hard to break down and bear dissolution cavities. A saccharoidal texture is developed in some sections of the limestone due to the effect of the granitic intrusion in the skarnization of some parts.

Kirazlı Conglomerate : This formation consists of pale green siltstone, fine-grained tuff and greyish-white to dark grey conglomerate. The pebbles are mostly chert, green schist, and quartzite, and they are well rounded. They are mostly 1-3cm, but there are cobbles of 20-30cm. The rock is argillized, and pyrite occurs scattered in the conglomerate. The formation is without bedding throughout most of the zone. From the pebbles and the relationship with the overlying Tertiary system, this is inferred to be a Jurassic formation.

Şapçı Volcanics : The major part of these rocks is andesite lava accompanied by andesitic pyroclastics, mainly tuff. The unaltered part of these rocks is dark grey and purple and locally blackish in colour, and generally they are argillized and silicified from weak to medium intensity with strong alteration in some parts.

Generally, the argillized parts are creamy yellow, but hematitized or limonitized parts are reddish brown to brown. Altered minerals consist of mainly kaoline and a small amount of montmorillonite and sericite.

Silicification zones often result in the formation of isolated mountains. The original rocks of these localities are difficult to identify. Many of the joints and fissures in the southwestern part of the zone trend E-W, although the strike is generally not discernible.

Kocaçakıl Basalt : The rock is a black-dark green, fine-grained compact basalt. Joints are developed and the many pyroxene phenocrysts are unaltered. It forms blocks of 20-30cm in diameter and seems to have flowed to the depressions with a structure that follows the topography.

Akpınar Granite : Akpınar Granite is observed in the northern part of Akpınar Village stretching in an east-west direction. A small outcrop of Cemiyetalanı at Çap Stream shows microcrystalline texture, although microcrystalline-texture-showing granites are traced in the vicinity. The granite is hard and tough in general and arenitized along its contact with the limestone. The jointing and fracturing system is conspicuous. Skarnization is observed over a extensive area along the contact between limestone and granite, exhibiting garnet, quartz, calcite and ore minerals, galena, hematite, malachite and azurite, particularly south of Dabanlı Çeşme.

Chemically, this granitoid has granodiorite composition. It is hornblende diorite in the northern part of Alanbaş Hill. It is relatively fine-grained and holocrystalline. Weak chloritization is observed microscopically.

2-3-2 Geologic Structure

In the central part of this zone, the basement composed of the Taşdibek Formation and Akpınar Granite has been uplifted and is unconformably overlain by Tertiary volcanic rocks. The volcanic rocks are often massive, and it is not easy to understand the geologic structure. Although the Şapçı Volcanics does not have bedding and the structure is unclear, it is assumed that the structure is gentle and wavy.

An anticlinal structure is not clearly observed except in the above uplifted area, and synclinal structures are observed in the Karaköy Formation.

The fractures in this zone occur in various directions, but the frequencies are low. Lineaments in the NE-SW direction in the central part of the zone were determined from Landsat data. Although it was not confirmed by surface study, faults with NE-SW and NWN-SES directions were inferred to be associated with those lineaments, as well as with Kocaçakıl basalt dykes with these directions.

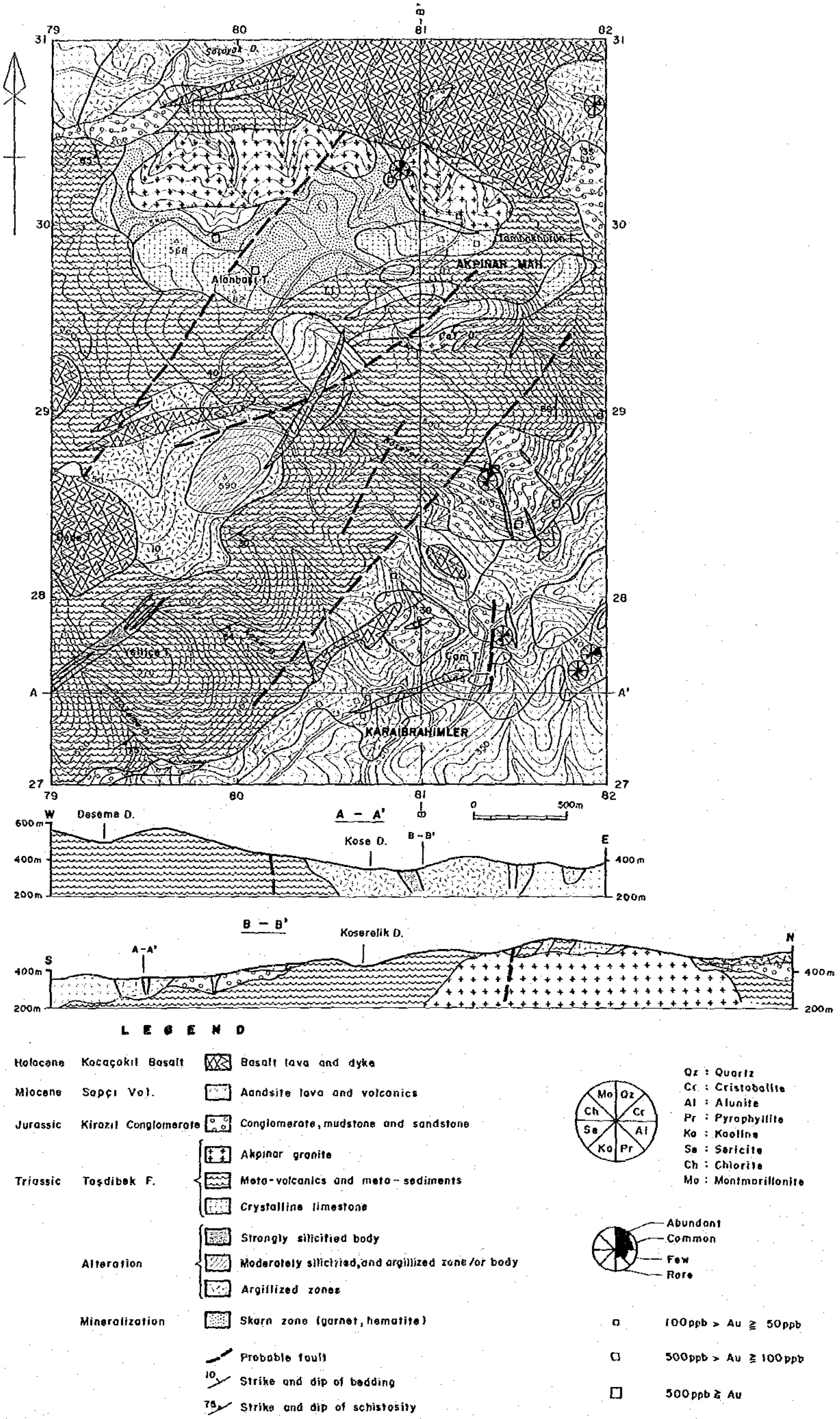


Figure 3-11 Gold Occurrence and Alteration Map of the Karaibrahimler Area

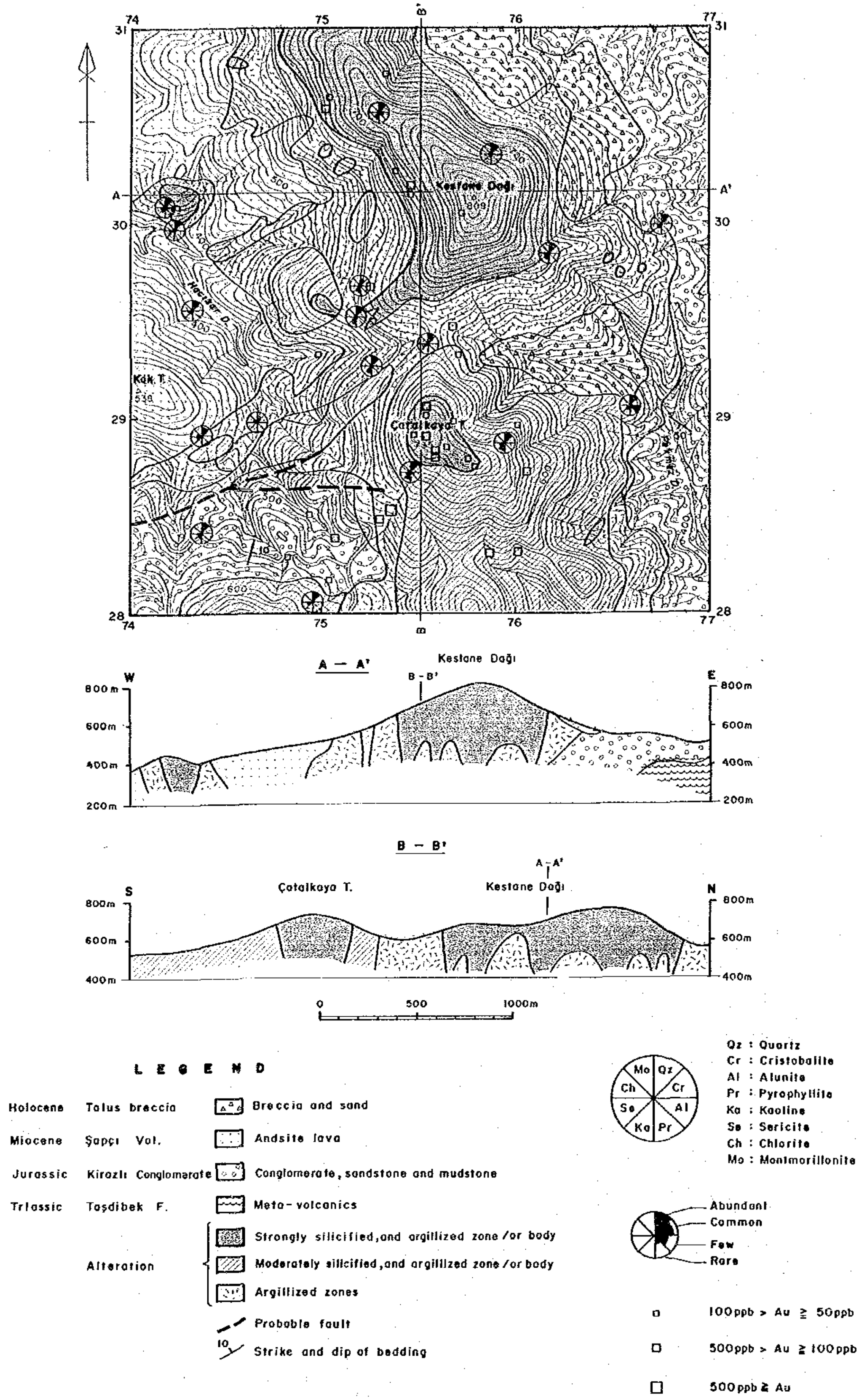


Figure 3-12 Gold Occurrence and Alteration Map of the Kestane Mt. Area

2-3-3 Alteration Zones

The silicified and argillized zones of the Karaibrahimler area are mainly distributed in the vicinity of Karaibrahimler Village. Small-scale silicified veins occur along the Köserelik Stream and in the upstream part of Doşeme Stream. The gold content was determined from a few rock samples collected during two years. These auriferous samples were mainly found in the silicified veins of Köserelik Stream. The silicified veins consist of massive, brecciated and porous parts which gradually change into each other. Generally, the massive part is in the center of the silicified zones; porous and brecciated parts occur in the margin, and the silicified zones are accompanied by limonite and hematite due to oxidation. The quantity of limonite is low in the massive part but high in the porous part.

As auriferous samples were found in Köserelik Stream and gold grains were detected in the vicinity of Karaibrahimler Village, the results of the second phase indicate the possibility of small-scale low-grade gold mineralization in the alteration zones.

2-4 Kestane Mt. Area

2-4-1 Stratigraphy

Kirazlı Conglomerate : This conglomerate is observed along the eastern part of the area as well as southwest of the area. In the eastern part, their colours are light greyish-brown, green and greenish-grey. Locally they are a conglomerate and sandstone, respectively. Bedding is sometimes distinctive. They are well packed and rather rigid, bearing hematite, limonite and sometimes pyrite along the fractures. Argillization, silicification and pyritization are locally observed, but not intensely. They are generally dark green in colour and show alteration of sandstone and siltstone in the southwestern part of the area. They are highly fractured and bear quartz veins with thicknesses of a few cm to 20 cm, especially within the moderately silicified sections. The quartz veins also bear pyrite. Fine-grained sections of the formation have been silicified. Where silicification has taken place, the colours are greyish-white and light brown. Disseminated pyrite, which is mostly limonitized, is also observed in these silicified parts.

Şapçı Volcanics : The major part of these rocks is andesite lava accompanied by andesitic pyroclastics, mainly tuff. The unaltered part of these rocks is dark greyish-purple and locally blackish, and generally they are argillized and silicified with weak to medium intensity with strong alteration in some parts.

Argillization of these rocks can be grouped into unaltered to weakly altered parts and intermediate to strongly altered parts. There are parts to the west of Kestane Mt. where the two types of alteration occur mixed. Generally, the argillized parts are creamy yellow to white, but hematitized or limonitized parts are reddish brown to brown.

Silicification zones often result in the formation of isolated mountains and examples are, among others, Kirazlı Mountain, Kestane Mountain and Çatalkaya Hill. The original rocks of these localities are difficult to identify. Many of the joints and fissures in the southern and southwestern parts of the area trend E-W, although the strike is generally not discernible.

The structure of these volcanic rocks is mostly massive, but the strike of the Kirazlı Conglomerate is, in general, a N-S direction, and the dip is 20-30° west in the vicinity of Pekmez Stream into the eastern part of this area. Hence it is inferred that the thickness of the Şapçı Volcanics increases westward.

Talus Deposits : The deposits consist of limonitic brownish silicified rock and massive grey silicified rock. The shape of these rocks is angular, and the matrix material is limonitic sand. Talus deposits are consolidated but not hard.

2-4-2 Geologic Structure

In the central part of Zone B, the basement composed of the Taşdibek Formation and Akpınar Granite is uplifted and are unconformably overlain by Tertiary volcanic rocks. The volcanic rocks are often massive and it is not easy to understand the geologic structure, but the Çamyayla Volcanics in the northern part of the zone dip gently southward. Although the Şapçı Volcanics does not have bedding and the structure is not clear, it is assumed that the dip of Şapçı Volcanics is 20-30° west due to the structure of Kirazlı Conglomerate. The fractures in this area occur in various directions, but the frequencies are low. Lineaments in a NE-SW direction in the southeastern part of the zone (the central part of the remote-sensing zone) were determined from Landsat data. Although it was not confirmed by surface study, faults were inferred in the NE-SW and N-S directions associated with those lineaments.

2-4-3 Alteration Zones

The silicified and argillized zones of the Kestane Mountain area are extensively distributed in the vicinity of mountains and hills. Silicified zones occur in the 1km-east-west and 2km-north-south directions. Gold was found in a few rock samples collected during two years, and auriferous samples were mainly detected in the silicified zones. The silicified zones consist of massive, brecciated and porous parts, which gradually change into each other. Generally, the massive part is the center of the silicified zones, and porous and brecciated parts occur in the margin. The silicified zones are accompanied by limonite and hematite due to oxidation. The quantity of limonite is low in the massive part but high in the porous part.

The auriferous samples were found in alteration zones of Kestane Mountain and Çatalkaya Hill. Gold grains were also detected in the upstream section of Hacıkar Stream. The amount of arsenic, lead and barium is high in comparison with other areas. The results of the second phase indicate the possibility of large-scale low-grade gold mineralization in the alteration zones.

2-5 Piren Hill Area

2-5-1 Stratigraphy (Şapçı Volcanics)

The Şapçı Volcanics consists mainly of andesite, andesitic agglomerate and tuff, and outcrops in a large area. It shows grey and purplish grey colours, while the argillized parts show white and creamy yellow, and tuffaceous parts greyish colour.

The andesites are generally coarsely crystallized and locally arenaceous and appearing like granite, especially in a small area southwest of Geldiren Hill. Exfoliated agglomerates and lavas of andesites also were observed in the area. The unaltered part of these rocks is dark grey and generally argillized and silicified to weak to medium intensity with strong alteration in some parts. The unaltered andesites are rather hard to break down and partly fractured. However, their tuffs locally have distinctive bedding and also show argillization. The tuffaceous layers which were observed in the southwestern part of Geldiren Hill and southeastern part of Hacıdervişler district are used as building stones.

Silicification zones often result in the formation of isolated mountains and examples are, among others, Büyükçukur Mountain, Geldiren Hill and Piren Hill.

The original rocks of these localities are difficult to identify. Many of the joints and fissures in the alteration zones trend NE-SW, although the strike is generally not discernible.

2-5-2 Geologic Structure

In the Piren Hill area in the southern part of Zone B, geologic structure is not distinct because of the extensive distribution of Şapçı Volcanics.

The anticlinal structure is not clearly evident as there is no obviously, and the synclinal structures are only observed in the Osmanlar Volcanics and the Karaköy Formation.

The fractures in this area occur in various directions, but the frequencies are low. Lineaments in the NE-SW direction in the southeastern part of the area (the central part of the remote-sensing zone) were taken from Landsat data. Although it was not confirmed by surface study, faults were inferred in the NEN-SWS and NW-SE directions associated with those lineaments.

2-5-3 Alteration Zones

The alteration zones of the Piren Hill area distributed at Piren Hill, Büyükçukur Mountain, and Davulgılı Hill. Piren alteration zones are the largest scale in the vicinity; it is 2km long east-west and 1km wide north-south. Gold was detected from rock samples collected during two years. The auriferous samples were significant at Davulgılı Hill and southeast of Piren Hill.

The silicified zones consist of massive, brecciated and porous parts, which gradually change into each other. Generally, the massive part is in the center of the silicified zones, and the porous and brecciated parts occur in the margin. The silicified zones often result in protruding topography and they can be identified on air photographs. The silicified zones are accompanied by limonite and hematite due to oxidation, and the quantity of limonite is low in the massive part and high in the porous part.

It is significant that gold was detected in the rock samples collected from the Davulgılı and Piren alteration zones, as well as in drill hole MJTC-2. The results of the third phase indicate the possibility of small-scale low-grade gold deposits in the alteration zones.

2-5-4 Trench Survey

(1) Outline of Trench Survey

The trench survey was carried out on the Davulgılı Hills, where a limonitic argillized zone was intersected by the drill survey of the second phase. The locations of trenches are shown in Figure 3-1. The intervals of channel sampling collected from the bottom of trenches are three and six meters.

After stripping the overburden using a bulldozer, trench samples were collected from the B-C layer of soil. The depth of the trench was one meter. Sampling density was 104 samples in the length of 334m. The location of most samples corresponds vertically to strongly argillized zones.

(2) Interpretation

As a result of trench survey, the characteristics of mineralization are considered to be as follows.

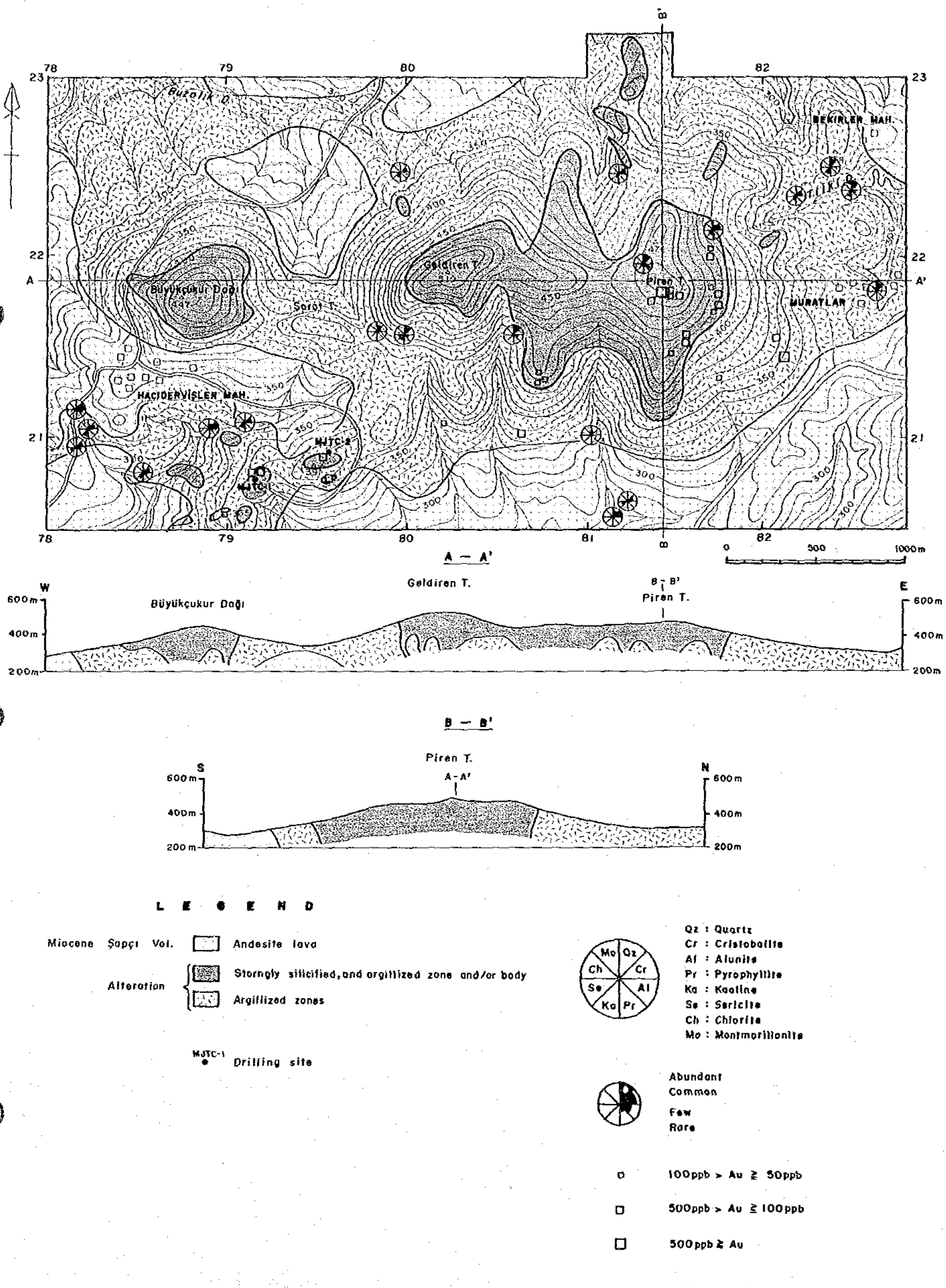


Figure 3-13 Gold Occurrence and Alteration Map of the Piren Hill Area

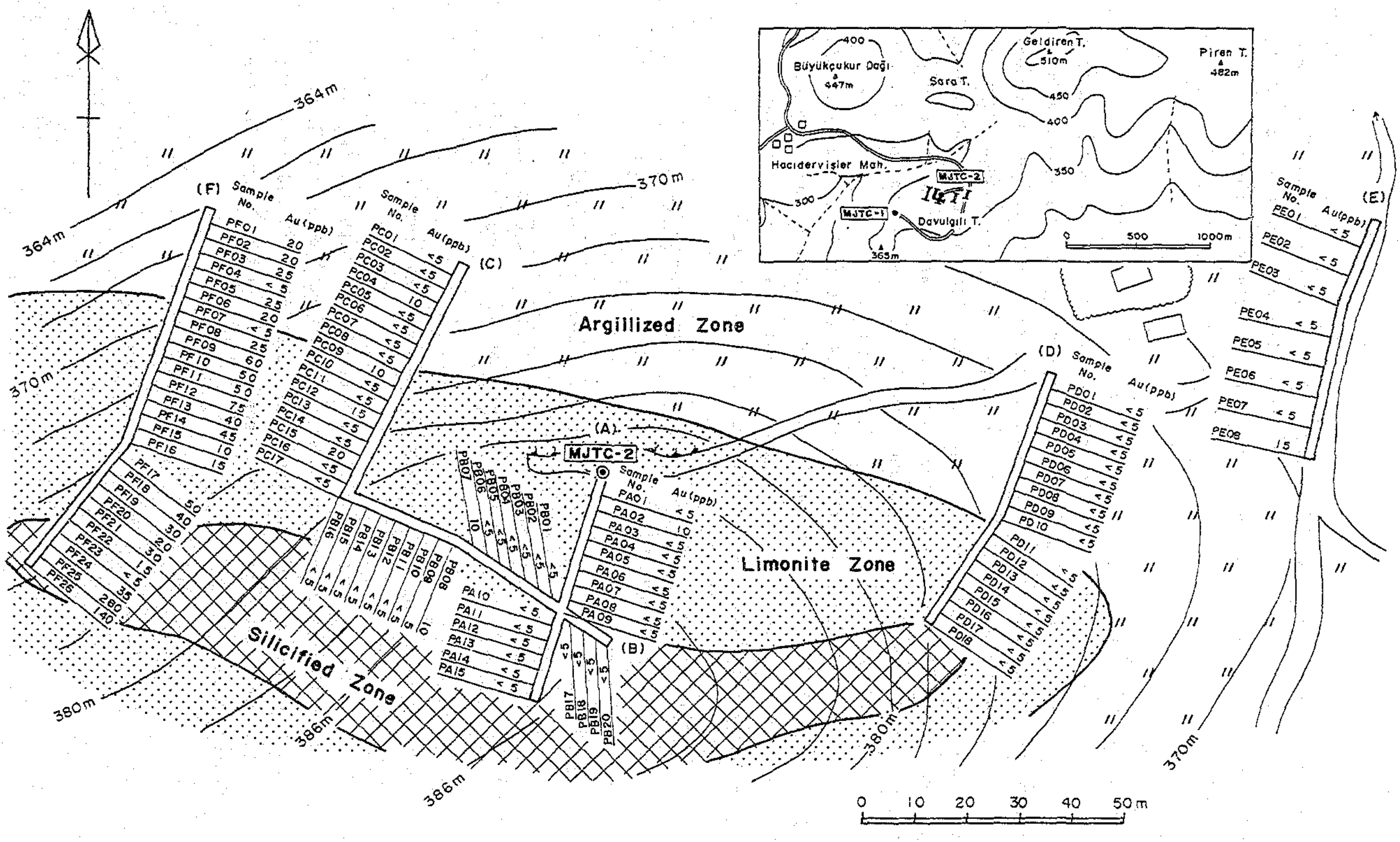


Figure 3-14 Location Map of Trenches of Piren Hill Area

An auriferous limonitic argillized zone, which contains Au 0.7g/T, with a width of 36m was intersected by drill hole MJTC-2. It locates on the Davulgılı Hill. However, an auriferous zone on the surface was not detected by the trench survey.

2-5-5 Diamond Drilling

(1) Outline of Drilling Survey

As a result of geological and geochemical surveys carried out in the initial phase of the project, an epithermal-gold-type ore deposit was expected as a promising target for future exploration in the Piren Hill Area. In the second phase, a drilling survey consisting of two holes (total hole length 300m) was planned and subsequently carried out in order to explore underground emplacement of the epithermal-gold-type ore deposit, and to investigate and unravel the relationship between the emplacement conditions of the ore deposit and the results of geological and geochemical surveys.

Longyear L-38 and Acker were used for the drilling operation. The types and specifications of machines, engines, pumps and equipment, and amount of consumables, drilling meterage of diamond bit and working time breakdown of the drilling operation are shown in Appendix Tables 5, 6 and 7.

No.	X	Y	Z [m Sea Level]	Direction	Dip
MJTC-1	79150	20760	364	N40° E	-50°
MJTC-2	79580	20920	382	S40° W	-50°

No.	Length Drilled	Surface Soil	Core Length	Core Recovery	Period
MJTC-1	151.00m	0.00m	145.75m	96.5%	Aug.14~Sep.12
MJTC-2	151.00m	0.00m	130.05m	86.1%	Aug.14~Sep.19

(2) Assay Results of Core

MJTC-1: Gold mineralization was not detected by drill hole MJTC-1.

MJTC-2: Mineralization containing gold in excess of 100 ppb was detected in the limonitic argillized zones accompanying silicified blocks from 18.00m to 54.20m. The average grade of gold is 0.7g/T for 36.20m in width. In these zones, silver, antimony and mercury content is higher than in other mineralization zones.

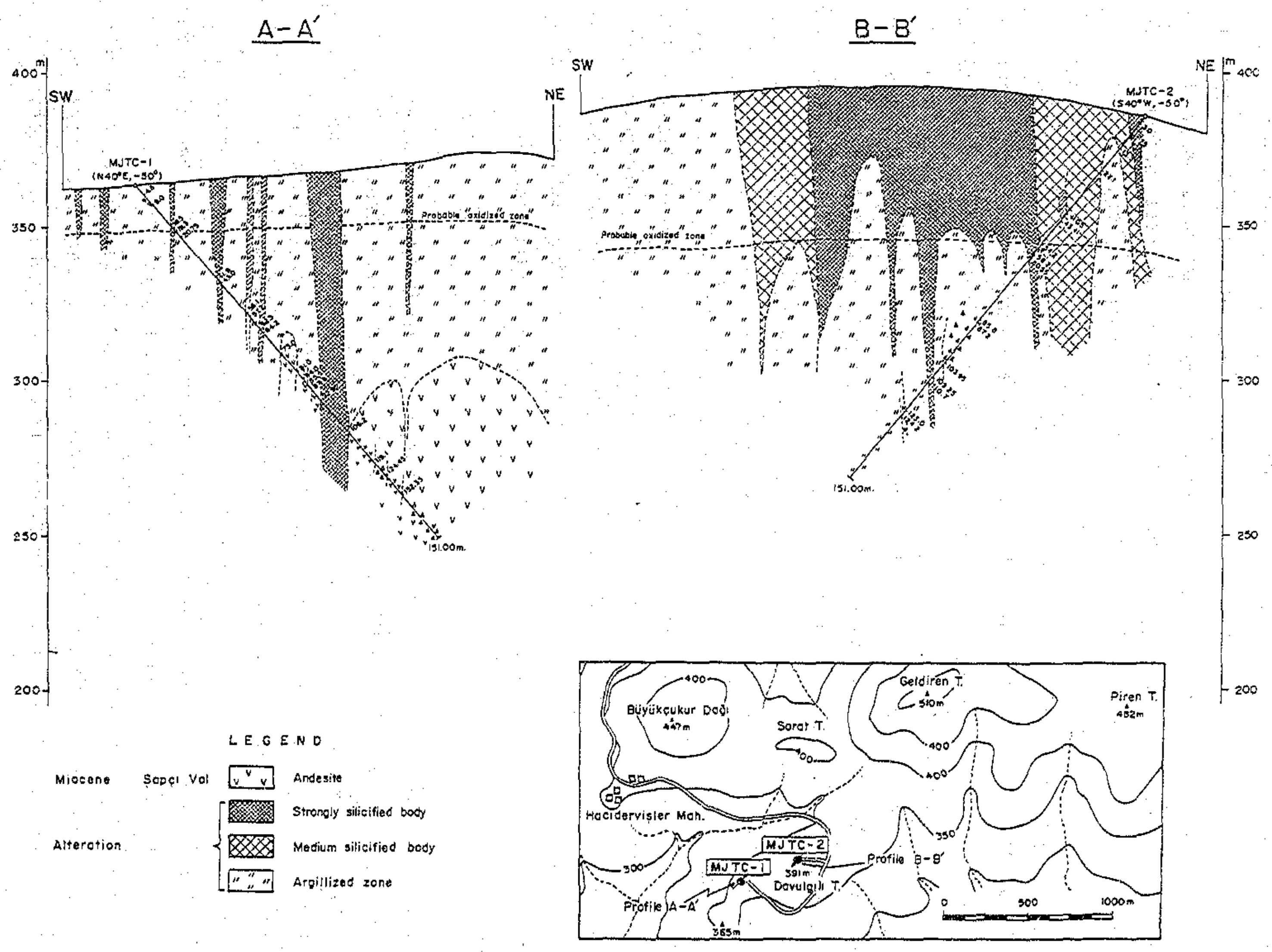


Figure 3-15 Geologic Cross Section of Drill Holes (MJTC-1 & 2)

2-6 Etili Area

2-6-1 Stratigraphy

Sakar Dagı Formation : The formation crops out in the southwestern and southeastern parts of the Etili Area and is composed mainly of pelitic schists, calcareous schists, crystallized limestones and meta-basic rocks. Schists are comprised of pelitic schists, amphibole schists and sericite schists which have already been converted into hornfels along granodiorite contacts. Schists are generally grey, dark grey and black in colour except near the contacts where they are light coloured due to the effects of silicification and contact metamorphism. Recrystallized limestones occur as lenses in schists. They are usually dark grey, greyish black and locally white in colour and consist mainly of fine-grained crystals and irregular calcite veins. The limestone becomes lighter in colour and locally saccharoidal in texture near the contact. Skarns identified as garnet, garnet-actinolite and actinolite-garnet-diopside contain a scarce amount of pyrite, hematite (specularite), magnetite, wollastonite and several secondary minerals such as limonite, malachite and azurite. Wollastonite mineralizations, locally already mined out, were, in particular, formed together with silicification during the recrystallization phase. Meta-basic rocks, exposed at upper parts of schists and locally transitional to them, are usually dark colored, except in areas near the granodiorite where they are greenish black in colour. They are silicified, pyritized and epidotized and are more compact around granodiorite contacts. Away from the contacts, their colour becomes darker and their texture is revealed to be looser.

Gicikler Volcanics : This is widely exposed around Gicikler and Bilaller Villages in southern and southeastern parts of the Etili Area. The unit unconformably overlies the Sakar Dagı Formation. The oldest units are generally composed of an alternation of tuffites, argillized tuffites, agglomerates and basaltic andesites. Tuffites and agglomerates are mainly dark greyish green in colour, intermediate in thickness and distinctively bedded. Tuffites are partly argillized. Volcanic pebbles in agglomerates are rounded to subrounded and also occur occasionally as blocks.

Basaltic andesites occur at several different levels in the unit, are purple and dark grey in colour and massive in appearance. They show flow structures which accord with bedding. They have generally not undergone any alteration.

Şapçı Volcanics : This is the unit covering most of the Etili Area and consists chiefly of andesitic lavas, andesitic agglomerates, tuffs and

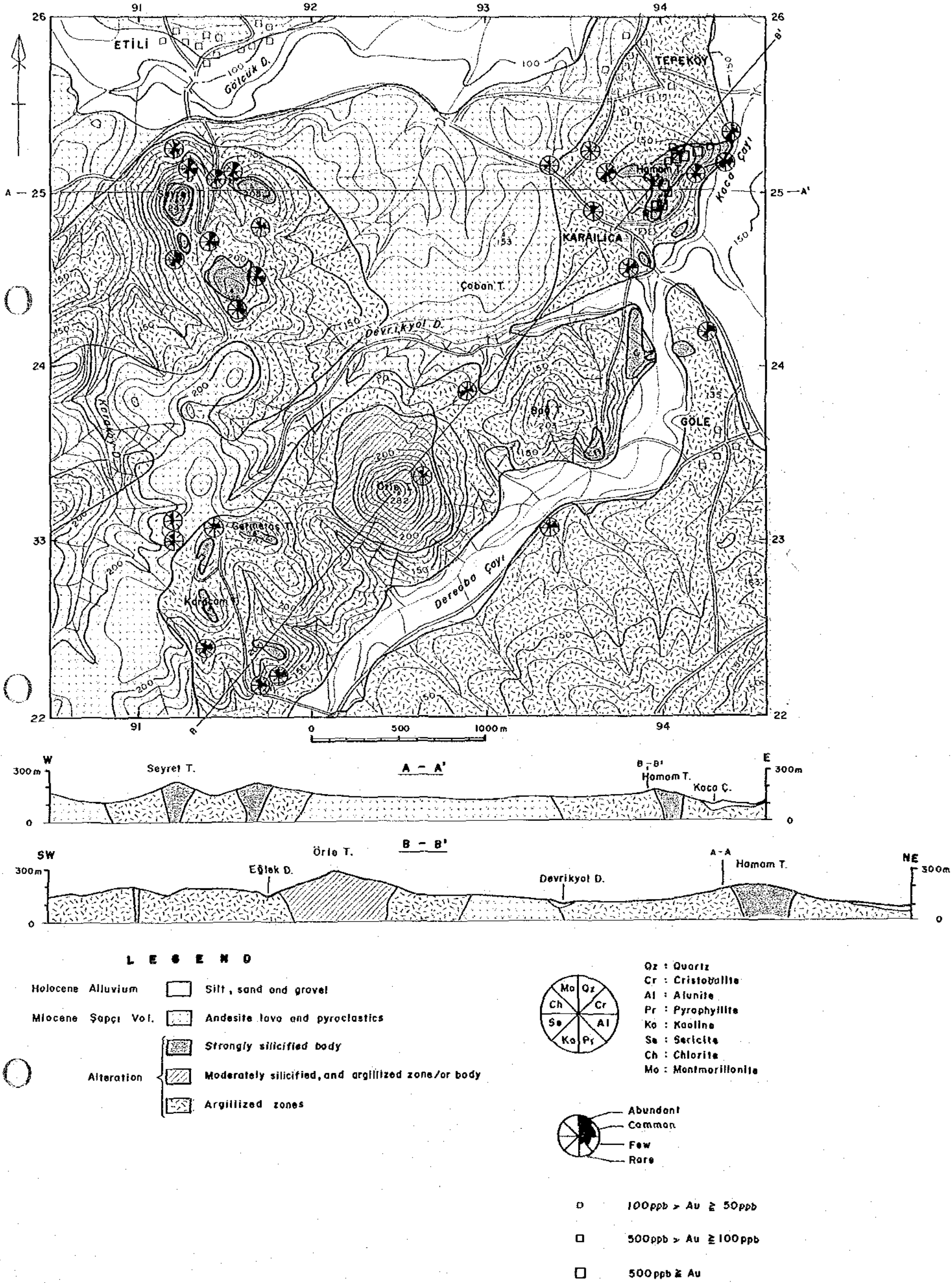


Figure 3-16 Gold Occurrence and Alteration Map of Tepeköy Area

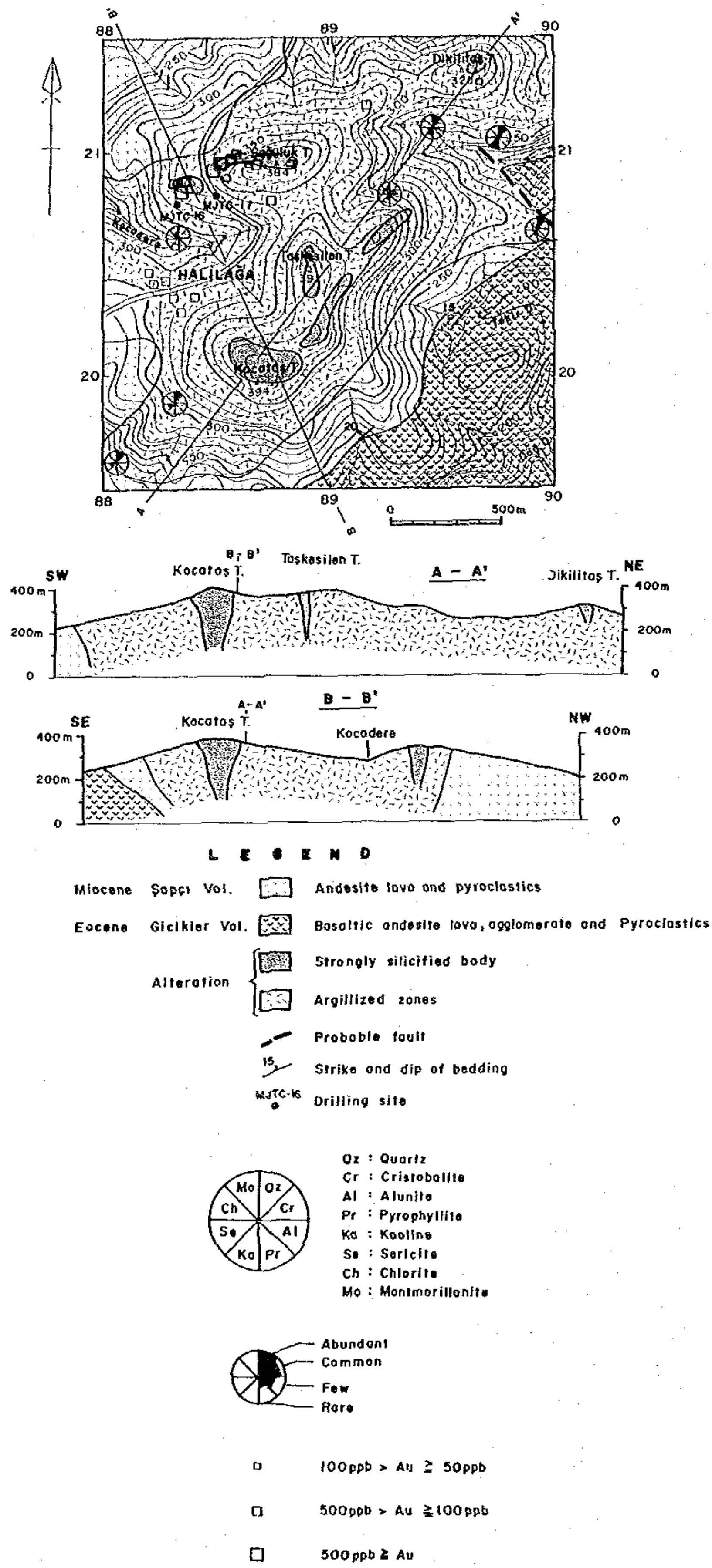


Figure 3-17 Gold Occurrence and Alteration Map of Halilaga Area

tuffites. It shows a lava characteristic around Tepeköy and Hamam Hill and is basically dark grey, and dark green when fresh. Lava flow surfaces can locally be observed. Plagioclase phenocrysts are largely argillized to various degrees. Biotite phenocrysts, except in intensely altered parts of andesitic lavas, can commonly be recognized all over the rock. The unit is characterized by agglomerates in the north of Tepeköy. It is mainly represented by andesitic tuffs and tuffites which also locally include bedded tuffitic marls and volcanic mudstones and coal occurrences in between them as large and small pockets from the west to southwest of the survey area. The unit when having undergone argillization usually becomes light coloured and varies from light brownish green, yellowish white to white in colour depending upon the degree of alteration. Silicification usually within the silicified and argillized zones is observed to be more advanced towards the center. Porphyritic texture formed by coarse biotite and plagioclase crystals can be observed if the rock has only been slightly altered.

The protruding relief is formed by silicified zones. Silicified rocks locally occur as massive bodies. Brecciated parts generally reported around faults and fractures are intensively limonitized. They are also intensively fractured and are coated by limonite along fracture planes. The north part of silicified rocks cropping out at Hamam Hill is light grey and grey coloured and generally massive. However, the rocks in this region have been locally intensively disrupted by fissures and fractures trending N10°-20°W, N20°-30°E and N60°-80°W. Argillization and limonitization are traced in fracture zones. The silicified rocks south of Hamam Hill have been even more violently broken by fractures and fissures extending in the same directions as mentioned above.

Silicified zones exposed at Örle, Karaçam and Seyret Hills located in westward and southwestward extensions of Hamam Hill in south Etili are aligned over the same tectonic zone. A silicified zone outcropping north of Halilaga village trends nearly in a N70°-80°E direction. It is usually reddish grey, light brown colored and highly fractured and locally brecciated. Fissures and fractures generally extend in N70°-80°E and N10°-20°W directions. Limonitization is basically observed along its fractured and brecciated portions. The silicified zone is densely fractured, fissured and sheared at the top of the hill, north of the Halilaga village cemetery. Towards the outer portions or edges, it gradually becomes porous and brecciated and grades into an argillized zone.

Alluvium : Alluvium is observed in the vicinity of Etili Village in the north of the survey area. It appears to be composed of very loosely cemented pebbles of various sizes. Pebbles consist mainly of silicified rocks and some andesitic rocks.

Intrusive Bodies

(1) Çavus Granite

This crops out around Darı Stream and Kızılcık Hill in the southeastern part of the survey area. This granite mainly lies in the south Etili Area and was named the Çavus pluton by previous researchers but is described hereafter as Çavus granodiorite for its part enclosed in the survey area. The granite, in fault contact with the Şapçı volcanics on the north side, has brought about local metamorphic fingerprints in the Sakar Dagı Formation of Triassic age. Primary textures of the rocks, due largely to contact metamorphic overprints, have already been obliterated; schists have been converted into hornfelses, calcareous schists into skarns, limestones locally into skarns as well as being partly recrystallized. After the Triassic the granite, probably Cretaceous in age, usually is altered at the surface. Feldspars and micas are especially intensely altered. The granodiorite, white and yellowish white in colour, shows a friable fabric like sand. However, in the valleys, unaltered, rather massive, spotty, fractured greyish white coloured fresh granodiorite outcrops can also be traced. Aplitic dykes cross-cutting the granodiorite have also been observed. Although the rock appears unaltered to the unaided eye, alteration of potash feldspars to chlorites and epidotes is observed microscopically.

(2) Porphyry and Aplite

In this area, porphyry occurs as NE-SW and NW-SE trending dikes in the southwestern part where the Sakar Dagı Formation is distributed.

(3) Basalt

Basalt occurs as dikes which are inferred to be correlated with the intrusive part of Kocaçakıl Basalt of Zone B in the area where the Sakar Dagı Formation is distributed.

2-6-2 Geologic Structure

In the southern part of the Etili Area, the basement composed of the Sakar Dagı Formation and Çavus Granite is uplifted, and Tertiary volcanic rocks overlie unconformably. The volcanic rocks are often massive and it is not easily to determine the geologic structure, but the Gicikler Volcanics in the southern part of the Etili Area dips gently northward. Although the Şapçı

Volcanics does not have bedding and the structure is not clear, it is assumed that the structure is gentle and wavy.

Anticlinal and synclinal structures are not clearly observed except in the above-mentioned uplifted part. From the regional viewpoint, it is inferred that the distribution area of Şapçı Volcanics corresponds to the south wing of the synclinal structures.

The fractures in this area occur in various directions, but the frequencies are low. Lineaments in the NE-SW direction in the central part of the area (the central part of the remote-sensing zone) are from Landsat data. Although not confirmed by surface study, faults in the NNE-SSW and NW-SE directions were inferred to be associated with these lineaments.

The NNE-SSW faults transect the central part of the area, and they cut through the Şapçı Volcanics, but are covered by an alluvium deposit.

The NW-SE faults are inferred to run through the Koca River to the east of Etili Village.

2-6-3 Alteration Zones

The silicified and argillized zones of the Etili Area are distributed in the Seyret, Hamam, Örle, Kocataş-Taşkesilen and Şaguluk Hills. Tepeköy alteration zones are the biggest in the vicinity, the dimensions being 4km long east-west and 3km wide north-south. The gold content was determined from rock samples collected during 1990. The auriferous samples were significant in the Hamam Hill of Tepeköy and Şaguluk Hill of Halilağa alteration zones. The silicified bodies consist of massive, brecciated and porous parts with gradual transitions. Generally, the massive part is centered in the silicified body; the porous and brecciated parts occur at the margin. The silicified zones often result in protruding topography and they can be identified on air photographs. The silicified zones are accompanied by limonite and hematite due to oxidation. The quantity of limonite and hematite is low in the massive part, and high in the porous and brecciated parts.

It is significant that gold was detected in the rock samples collected from the Tepeköy and Halilağa alteration zones, in soil of heavy mineral study and in drill hole MJTC-16. The results of the third-phase survey indicate the possibility of medium-scale low-grade gold deposits in Tepeköy alteration zones. However, gold-bearing zones detected on the surface remain thin due to advanced erosion in the Halilağa.

2-6-4 Diamond Drilling

(1) Outline of Drilling Survey

As a result of geological and geochemical surveys carried out in the third phase of the project, an epithermal-gold-type ore deposit was expected as a promising target at Tepeköy and Halilaga in the Etili Area. At Halilaga, a drilling survey consisting of two holes (total hole length 302m) was planned and subsequently carried out in order to explore underground emplacement of the epithermal-gold-type ore deposit, and to investigate and unravel the relationship between the emplacement conditions of the ore deposit and the results of geological and geochemical surveys.

No.	X	Y	Z [m Sea Level]	Direction	Dip
MJTC-16	88338	20785	316	N20°E	-50°
MJTC-17	88500	20805	332	N20°W	-50°

No.	Length Drilled	Surface Soil	Core Length	Core Recovery	Period
MJTC-16	151.00m	2.80m	136.45m	92.1%	17 Sep- 2 Oct
MJTC-17	151.00m	1.80m	135.90m	90.6%	3 Oct-16 Oct

Two sets of Longyear L-38 were used for the drilling operation.
Amount of consumables, drilling meterage of diamond bit and working time breakdown of the drilling operation are shown in Appendix Tables 5, 6 and 7.

(2) Assay Results of Core

MJTC-16: Mineralization containing gold in excess of 100 ppb was detected in the limonitic argillized zones accompanying silicified blocks from 2.80m to 16.65m. The average grade of 13.85m width is Au 581ppb, Ag 1.3ppm, Pb 294ppm, Sb 80.6ppm and Hg 7104ppb. The content of these zones is higher than in other mineralization zones.

MJTC-17: Gold mineralization was not detected by drill hole MJTC-17.

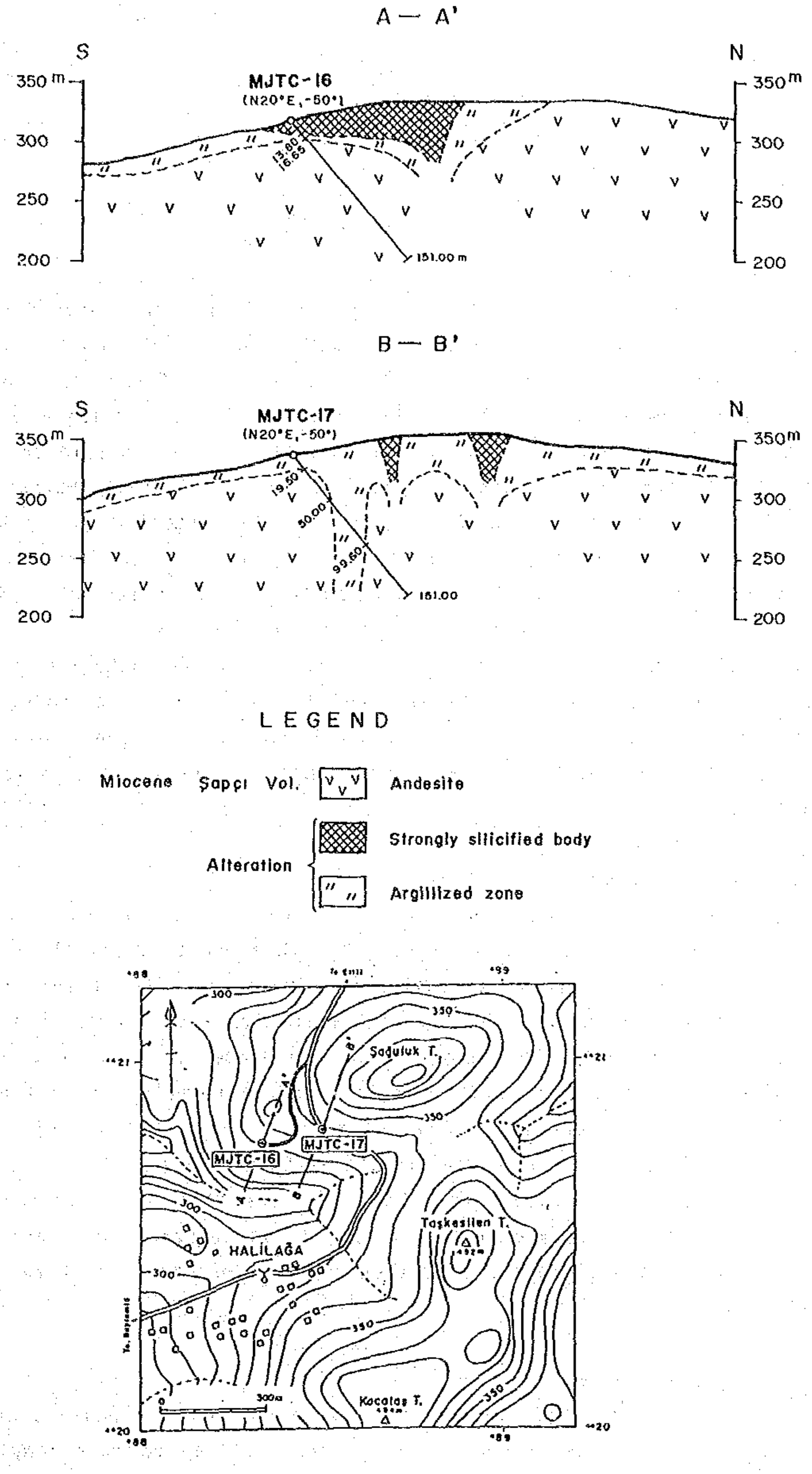


Figure 3-18 Geologic Cross Section of Drill Holes(MJTC-16 and 17)