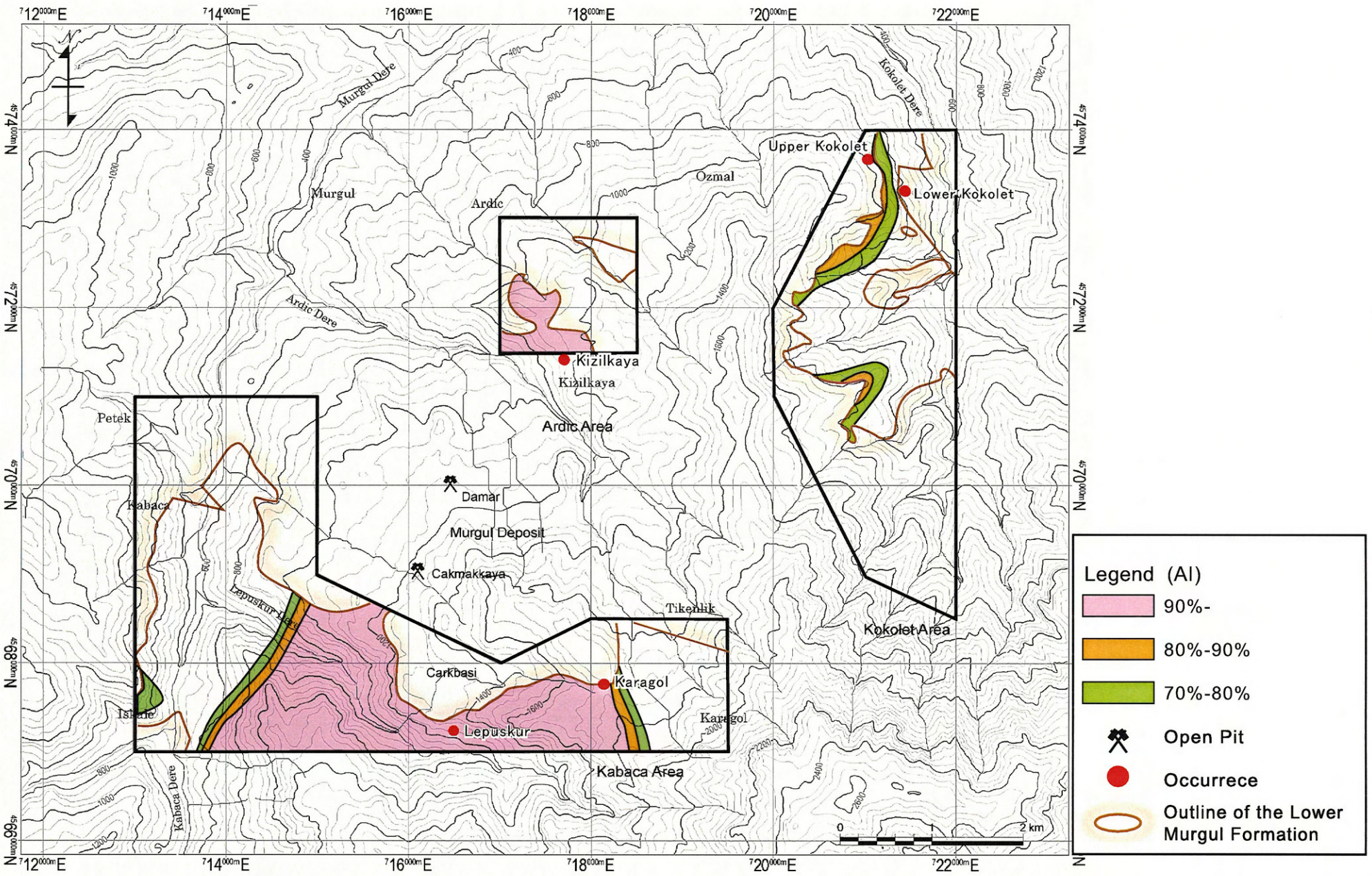


Fig. Ⅱ-1-10 Distribution Map of Alteration Index of the Murgul Area

characteristics of mineralization in the area. A total number of 60 specimens have been selected mainly form dacite and its pyroclastics of the lower Murgul Formation for analysis. The analysis (ICP-AES method) for followings 28 elements (with detecting limit) has been asked for ALS Chemex.

Ag(0.2ppm), Al (0.01%), As(2ppm), Ba(10ppm), Be(0.5ppm), Bi(2ppm), Ca(0.01%), Cd(0.5ppm), Co(1ppm), Cr(1ppm), Cu(1ppm), Fe(0.01%), K(0.01%), Mg(0.01%), Mn(5ppm), Mo(1ppm), Na(0.01%), Ni(1ppm), P(10ppm), Pb(2ppm), S(0.01%), Sb(2ppm), Sr(1ppm), Ti(0.01%),), V(1ppm), W(10ppm), Zn(2ppm), and Au(0.001ppm).

Appendix 4 shows results of chemical analysis for rock specimens. Most of these elements include Ag, Bi, Cd, Mo, Sb and W shows the values of less than the detection limit value. Univariate analysis has been applied for chemical analytical data. The statistic data and results are shown in Table Ⅱ-1-5～Table Ⅱ-1-6 and appendix 5. The values lower than the detection limit has been calculated, being regarded as the half of the limit value.

Standard deviation value (σ) is applied for set the threshold value. The anomaly is over threshold (geometric mean + 2 σ) in most case, but if there is no + 2 σ value then geometric mean + 1.5 σ is used. The values over detection limit are applied for these elements include Ag, B, Be, Bi, Cd, Hg, La, Mo, S, Sb, U and W.

The followings are threshold values for each element,

Au : 0.048 ppm	Ag : 1.5 ppm	Al : 9.20%	As : 36 ppm
Ba : 949 ppm	Be : 1.1 ppm	Bi : 2 ppm	Ca : 5.03%
Cd :1.5 ppm	Co : 23 ppm	Cr : 193 ppm	Cu :264 ppm
Fe : 6.04%	K : 2.23%	Mg : 3.59%	Mn : 1,576ppm
Mo : 10 ppm	Na : 2.84%	Ni : 16 ppm	P : 1,045 ppm
Pb : 49 ppm	S : 3.08%	Sb : 5 ppm	Sr : 387 ppm
Ti : 0.36%	V : 183 ppm	W : 7 ppm	Zn : 484 ppm

The characteristics of the distribution of main elements, such as Au, Ag, Cu, Pb, Zn, Ba, S, As and Cd, are described below.

(i) Au, Cu, Pb

Anomalies of these elements are distributed in the vicinities of the Kızılkaya Occurrence. The highest value of Au (2.02 ppm) was obtained at the K111 point, the

Table Ⅱ-1-5 List of Statistic Data (Murgul Area)

Whole Rock	Au ppm	Ag ppm	Al %	As ppm	Ba ppm	Be ppm	Bi ppm	Ca %	Cd ppm	Co ppm
No. of samples	60	60	60	60	60	60	60	60	60	60
Arithmetric Max.	2.020	11.4	9.82	71	960	1.2	3	20.00	27.8	27
Arithmetric Min.	0.001	0.5	0.87	5	30	0.5	1	0.01	0.5	1
Arithmetric Mean	0.044	0.6	6.47	10	248	0.5	1	1.16	0.8	5
Arithmetric σ	0.263	1.5	1.93	15	186	0.2	0	3.73	3.6	5
Geometric Mean	0.001	0.3	6.06	5	187	0.4	1	0.13	0.3	3
Geometric σ	6.158	2.1	1.52	3	2	1.6	1	6.23	2.2	3
Geometric $\mu+\sigma$	0.008	0.7	9.20	14	421	0.7	1	0.81	0.7	9
Geometric $\mu+1.5\sigma$	0.020	1.0	11.34	22	632	0.9	2	2.02	1.0	14
Geometric $\mu+2\sigma$	0.048	1.5	13.97	36	949	1.1	2	5.03	1.5	23

Whole Rock	Cr ppm	Cu ppm	Fe %	K %	Mg %	Mn ppm	Mo ppm	Na %	Ni ppm	P ppm
No. of samples	60	60	60	60	60	60	60	60	60	60
Arithmetric Max.	217	2,690	6.3	2.61	4.85	2,840	54	4.83	63	1,150
Arithmetric Min.	15	2	0.6	0.03	0.11	17	1	0.02	2	10
Arithmetric Mean	70	89	2.31	1.11	1.15	466	3	1.31	6	223
Arithmetric σ	47	370	1.34	0.64	1.19	534	9	1.36	8	194
Geometric Mean	59	16	1.99	0.82	0.65	248	1	0.47	4	153
Geometric σ	2	4	1.74	2.74	3.12	3	3	5.99	2	3
Geometric $\mu+\sigma$	106	65	3.46	2.23	2.03	851	3	2.84	8	400
Geometric $\mu+1.5\sigma$	143	132	4.57	3.70	3.59	1,576	6	6.95	11	646
Geometric $\mu+2\sigma$	193	264	6.04	6.12	6.35	2,920	10	17.01	16	1,045

Whole Rock	Pb ppm	S %	Sb ppm	Sr ppm	Ti %	V ppm	W ppm	Zn ppm
No. of samples	60	60	60	60	60	60	60	60
Arithmetric Max.	119	6.52	8	1,585	0.43	243	10	4,670
Arithmetric Min.	1	0.01	3	7	0.04	1	5	4
Arithmetric Mean	14	0.44	3	98	0.15	35	5	142
Arithmetric σ	20	1.05	1	213	0.09	42	1	599
Geometric Mean	9	0.05	3	50	0.13	21	5	45
Geometric σ	2	7.77	1	3	1.67	3	1	3
Geometric $\mu+\sigma$	21	0.40	4	139	0.21	62	6	148
Geometric $\mu+1.5\sigma$	32	1.11	4	232	0.28	106	7	268
Geometric $\mu+2\sigma$	49	3.08	5	387	0.36	183	7	484

Table Ⅱ-1-6 Correlation Coefficient (Murgul Area)

	Au	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Sr	Ti	V	W	Zn
Au	1.00																											
Ag	0.96	1.00																										
Al	-0.44	-0.51	1.00																									
As	0.52	0.66	-0.48	1.00																						(N=60)		
Ba	-0.04	-0.12	-0.15	-0.18	1.00																							
Be	-0.17	-0.18	0.54	-0.24	-0.17	1.00																						
Bi	0.69	0.67	-0.58	0.51	0.08	-0.35	1.00																					
Ca	-0.04	-0.02	-0.16	0.08	0.04	0.18	-0.02	1.00																				
Cd	-0.01	0.02	-0.09	0.00	-0.17	0.01	-0.02	0.00	1.00																			
Co	-0.04	0.01	0.27	0.18	-0.12	0.07	-0.18	0.37	0.04	1.00																		
Cr	0.46	0.56	-0.65	0.58	-0.01	-0.32	0.55	-0.19	0.14	-0.18	1.00																	
Cu	0.39	0.59	-0.42	0.67	-0.17	-0.19	0.20	0.00	-0.02	0.08	0.51	1.00																
Fe	-0.01	-0.02	0.20	0.00	-0.23	0.10	-0.07	0.00	-0.07	0.18	0.09	0.00	1.00															
K	-0.19	-0.22	-0.03	-0.13	0.42	-0.07	-0.03	-0.30	0.10	-0.30	0.08	-0.12	-0.09	1.00														
Mg	-0.14	-0.14	0.26	-0.12	0.12	0.07	-0.25	0.20	0.00	0.47	-0.43	-0.13	-0.14	-0.40	1.00													
Mn	-0.11	-0.12	0.09	-0.07	0.14	0.24	-0.26	0.75	0.04	0.59	-0.32	-0.09	-0.09	-0.30	0.48	1.00												
Mo	0.72	0.80	-0.54	0.56	-0.10	-0.28	0.67	-0.08	0.04	0.03	0.58	0.42	-0.01	-0.05	-0.22	-0.21	1.00											
Na	-0.16	-0.21	0.53	-0.31	-0.27	0.37	-0.32	-0.14	-0.09	0.15	-0.25	-0.19	0.27	-0.32	-0.06	0.03	-0.27	1.00										
Ni	0.00	0.05	0.09	0.18	-0.13	0.35	-0.03	0.65	-0.01	0.46	-0.01	-0.01	0.01	-0.37	0.26	0.63	-0.02	-0.08	1.00									
P	-0.13	-0.16	0.39	-0.14	0.05	0.11	-0.29	0.12	-0.01	0.54	-0.31	-0.11	0.01	-0.06	0.24	0.48	-0.21	0.33	0.13	1.00								
Pb	0.74	0.83	-0.50	0.86	-0.20	-0.18	0.60	0.00	0.14	0.03	0.60	0.59	0.01	-0.20	-0.15	-0.12	0.63	-0.25	0.09	-0.17	1.00							
S	0.20	0.34	-0.31	0.35	-0.22	-0.18	0.25	-0.10	0.31	0.12	0.49	0.30	0.14	0.11	-0.19	-0.20	0.69	-0.24	-0.09	-0.19	0.33	1.00						
Sb	0.34	0.43	-0.03	0.43	-0.20	0.23	0.13	0.34	-0.04	0.24	0.22	0.52	0.16	-0.23	-0.06	0.31	0.24	0.01	0.48	0.07	0.39	0.13	1.00					
Sr	-0.03	-0.02	-0.22	-0.02	0.37	-0.02	-0.08	0.46	-0.01	0.14	-0.15	0.04	-0.11	-0.25	0.27	0.36	-0.05	0.06	0.05	-0.05	-0.03	-0.05	0.00	1.00				
Ti	-0.20	-0.22	0.61	-0.13	-0.05	0.12	-0.33	0.09	0.01	0.63	-0.37	-0.17	0.14	-0.08	0.22	0.29	-0.25	0.26	0.27	0.50	-0.21	-0.22	0.06	-0.06	1.00			
V	-0.09	-0.21	0.35	0.06	-0.04	0.00	-0.18	0.22	-0.01	0.86	-0.27	-0.07	0.19	-0.17	0.38	0.39	-0.13	0.14	0.30	0.47	-0.06	-0.15	0.02	0.07	0.80	1.00		
W	0.47	0.48	-0.17	0.21	-0.02	-0.09	0.25	-0.05	-0.03	0.00	0.08	0.16	-0.10	-0.19	0.13	0.15	0.25	-0.11	-0.02	0.22	0.28	-0.02	0.29	-0.07	-0.11	-0.08	1.00	
Zn	-0.02	0.01	-0.08	-0.03	-0.17	0.02	-0.04	-0.01	1.00	0.04	0.11	-0.03	-0.10	0.09	0.03	0.06	0.02	-0.09	-0.01	0.00	0.12	0.28	-0.05	-0.01	0.01	-0.01	-0.02	1.00

highest value of Cu (2,690 ppm) was obtained at the K153 points, and the highest value of Pb (119 ppm) was obtained at the K111 point.

(ii) Ag, As

Ag and As show same tendency with Au. Anomalies are distributed in the vicinities of the Kızılkaya Occurrence. In addition, anomalies are distributed in the vicinities of the ore horizon in the southwestern part of the Çakmakkaya Deposit (Ag: J019 point, As: J017 point). The highest value of Ag and As were obtained in Kızılkaya Occurrence, i.e. Ag (11.4 ppm, K111) and As (71 ppm, K153).

(iii) Ba

High Ba content points (more than +1.5 σ) are distributed in the vicinities of the upper Kokolet Occurrence. There exist stratiform shaped barite bearing zone that might relate to the volcanogenic massive sulphide mineralization in the upper Kokolet Occurrence, there is a possibility that there are some mineralizations, being accompanied with barite extensively. A zone of high Ba content (more than +1.5 σ) is also distributed in the Lepüskür Occurrence. Meanwhile, vicinities of the Kızılkaya Occurrence have values rather higher than the average value.

(iv) Zn, Cd

Anomalies zone of these elements are distributed in the upper stream of the Kokolet River and in the vicinities of the Kızılkaya Occurrence. The highest values of Zn (4,670ppm) and Cd (27.8ppm) were obtained at the K010 point, which is situated in just below the upper Murgul Formation.

(v) S

High S content points (more than +1.5 σ) are distributed in the vicinities of the Kızılkaya Occurrence and the middle reaches to the upper stream of the Kokolet River. The lower Murgul Formation has extensively undergone alteration, being accompanied with pyrite dissemination, along the river. High S content zone (more than +1.5 σ) continues from the K010 point, that is top of the Murgul Formation, toward northeast or east direction, that is the inner zone of the lower Murgul Formation. The highest value of S (6.52 %) was obtained at the K150 point at the

Kızılkaya Occurrence.

(vi) Survey Result

Fig. II-1-11 shows the distribution map of the geochemical anomaly zones of the Murgul area. Many anomalies of elements except for Ba were distributed in the vicinities of the Kızılkaya Occurrence. Dardanel Company once had carried out an exploration targeting for Au and Ag in this occurrence. Furthermore, anomaly zone of the major elements (more than +2 σ) are distributed in the Lepüskür Occurrence and the upper Kokolet Occurrence. Moreover, anomalies of Ag and As were distributed in just below (J019, J017) the upper Murgul Formation to the southwest of the Çakmakkaya Deposit. Anomaly zone (more than +1.5 σ) of Zn, S, and Cd are distributed in the vicinities of the K010 point. These zone are just below the upper Murgul Formation, where is ore horizon of the volcanogenic massive sulphide deposits. Anomaly zones of Zn, S, and Cd at the K010 point are presumed to expand to the Ardiç area in the west.

(d) Isotopic Data of Ore Lead

The Isotopic composition of lead has been carried out to estimate the origin of metal elements in deposits by using the SIMS method. A total number of 8 specimens have been selected. They are from the Tunca Deposit, Tunca South Occurrence, Damar Deposit, Çayeli Deposit, Kettara Deposit (Morocco), Hajar Deposit (2 specimens, Morocco), and Capire Deposit (Mexico). These deposits and occurrence are related to the volcanogenic massive sulphide minelarization.

Table II-1-7 shows the results of lead isotope analysis, and Fig. II-1-12 shows $^{207}Pb/^{204}Pb$ vs. $^{206}Pb/^{204}Pb$ and $^{208}Pb/^{204}Pb$ vs. $^{206}Pb/^{204}Pb$. The Tunca Deposit and the Tunca South Occurrence are close to each other, and the Tunca Deposit and Damar Deposit are about 40 km away.

Concerning the Japanese Kuroko leads, they were from crust and were found to occupy a narrow isotopic range (Sato, 1982). As Fig. II-1-12 shows, $^{207}Pb/^{204}Pb$ ratios of individual specimens in this area are almost equal. And $^{206}Pb/^{204}Pb$ ratios of the Tunca Deposit and Damar Deposit are almost equal, but the ration of the Tunca South Occurrence is low compared with the Tunca and Damar Deposits. $^{208}Pb/^{204}Pb$ ratios of the Tunca Deposit and the Tunca South Occurrence are similar, while the Damar

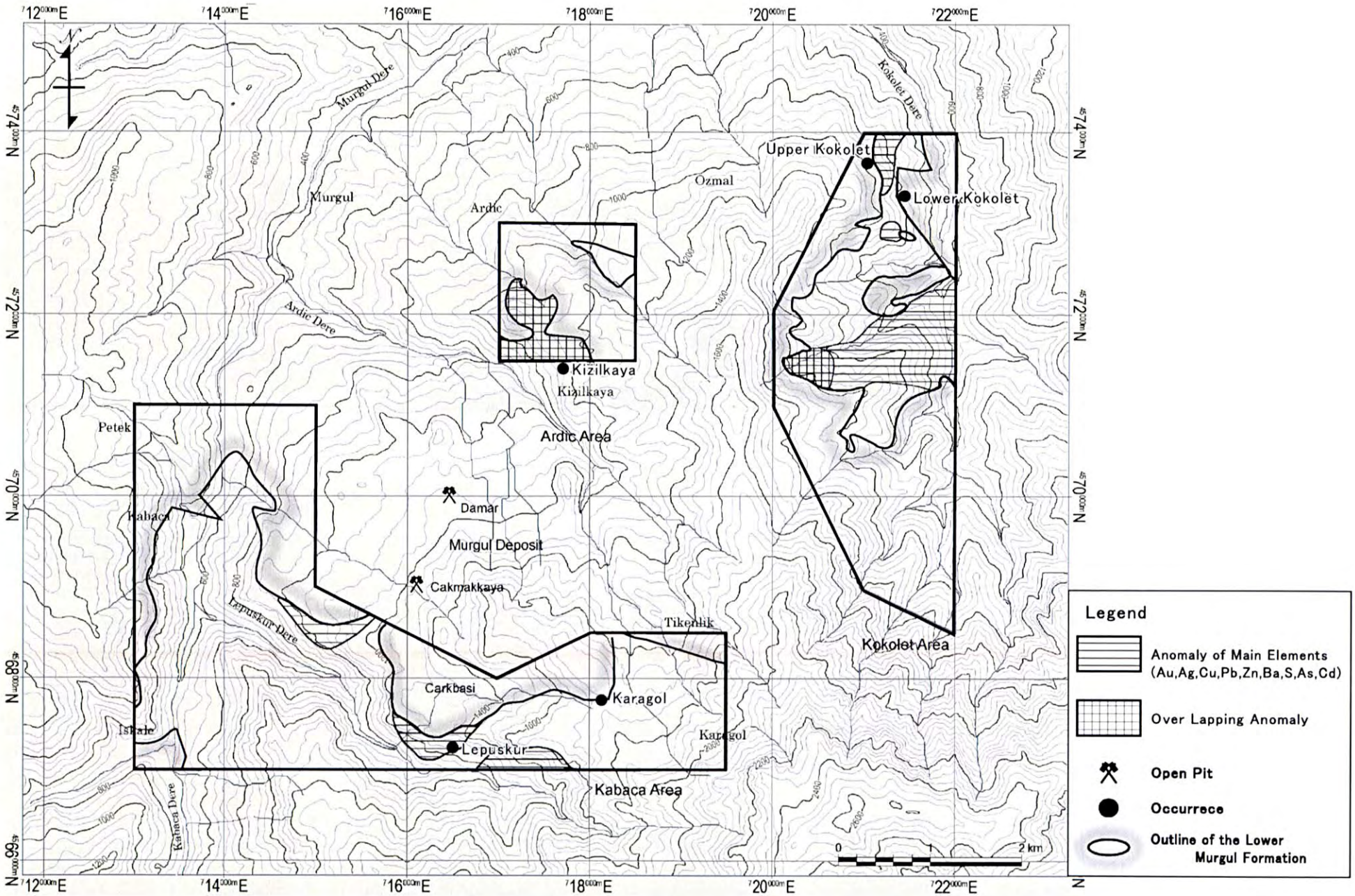
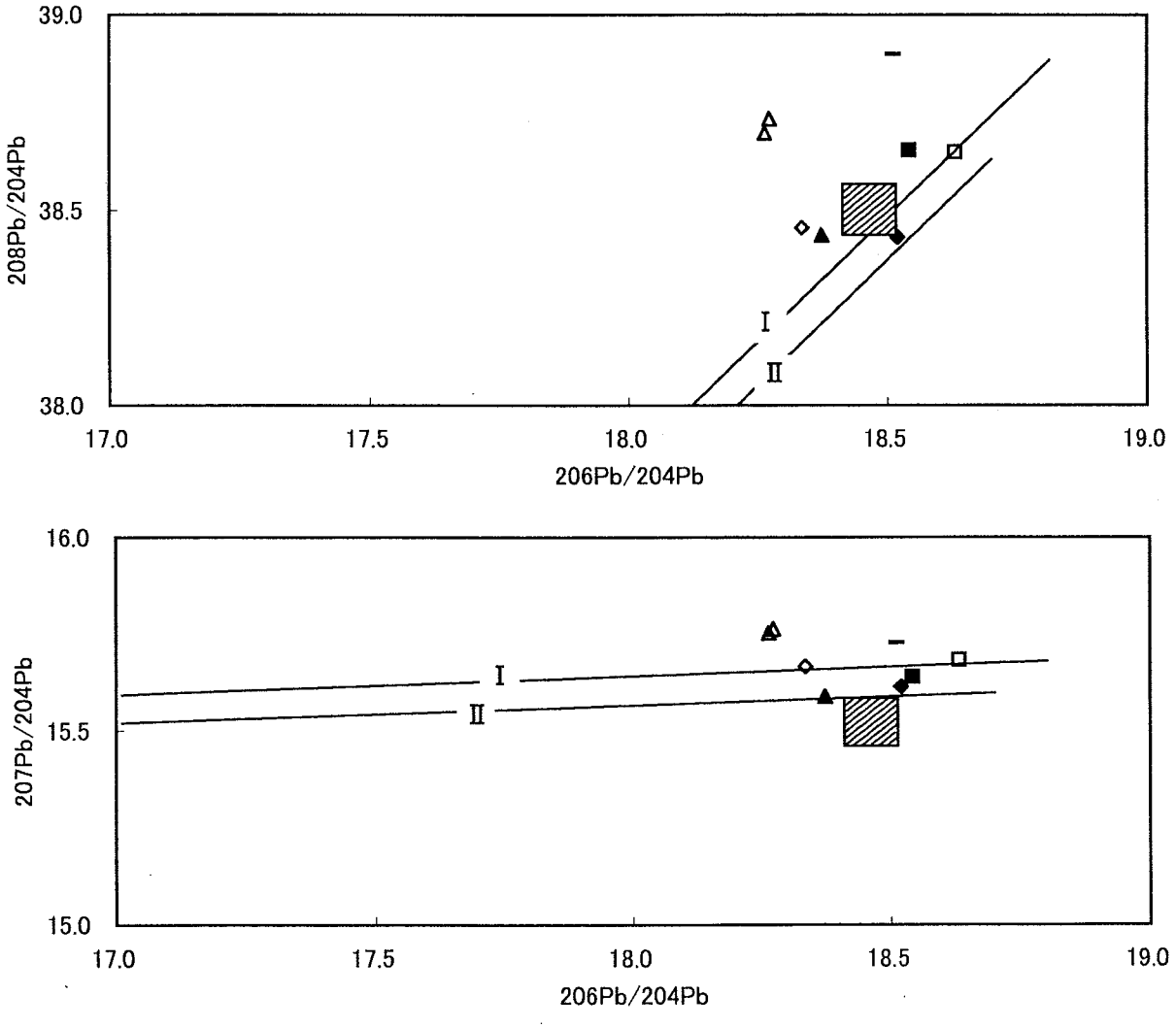


Fig. Ⅱ-1-11 Distribution Map of Geochemical Anomaly Zones of the Murgul Area

Table Ⅱ-1-7 Results of Lead Isotope Analysis

No.	Locality	Country	Ore Type	$^{206}Pb/^{204}Pb$	$^{207}Pb/^{204}Pb$	$^{208}Pb/^{204}Pb$	$^{207}Pb/^{206}Pb$	$^{208}Pb/^{206}Pb$
1	Tunca	Turkey	Massive Pyrite Ore	18.5192	15.6136	38.4317	0.8425	2.0752
2	Tunca South	〃	Spharelite, Barite disseminated Ore	18.3714	15.5886	38.4358	0.8475	2.0921
3	Damar,Murgul	〃	Sulfide Vein in Footwall Dacite	18.5407	15.6389	38.6534	0.8429	2.0848
4	860mL,Çayeli	〃	Sphalerite dominant Massive Sulfide Ore	18.5102	15.7271	38.8998	0.8490	2.1014
5	Kettara	Morocco	Pyrite Ore	18.3336	15.6653	38.4548	0.8539	2.0975
6	Hajar	〃	Pyrrohtite, Pyrite Ore	18.2713	15.7628	38.7347	0.8621	2.1199
7	〃	〃	〃	18.2618	15.7529	38.6984	0.8620	2.1190
8	Capire	Mexico	Sphalerite, Galena dominant Massive Sulfide Ore	18.6305	15.6831	38.6494	0.8412	2.0745



INDEX

◆ Tunca ▲ Tunca South ■ Damar, Murgul — Çayeli ◇ Kettara △ Hajar1 ▲ Hajar2 □ Capire

▨ The Kuroko ore data from the northeast Japan (Sato,1983)

Ore-lead growth curves; Ⅰ, by Cumming and Richards(1975) ; Ⅱ, by Stracey and Kramers(1975)

Fig. Ⅱ-1-12 Lead Isotope Compositions

Deposits is a higher ratio. The meanings of similarities and differences of individual isotope ratio in this area are unknown. However, specimens of the Tunca Deposit and Damar Deposits mainly contain pyrite while specimen from the Tunca South Occurrence contain sphalerite. This may indicate that $^{207}Pb/^{204}Pb$ ratios depend on the ore type while the $^{208}Pb/^{204}Pb$ ratios depends on the locality. Isotope ratios of the volcanogenic massive sulphide deposits in this area indicate a value close to the value of Japanese Kuroko deposits, compared with isotopic ratios of other localities.

Concerning other areas, it is notable that the specimen from the Çayeli Deposit had a higher $^{207}Pb/^{204}Pb$ ratio and a higher $^{208}Pb/^{204}Pb$ ratio compared with other specimens in this area. Meanwhile, values of the two specimens from the Hajar Deposit occupy narrow isotopic range.

It is well known that the $^{207}Pb/^{204}Pb$ ratio and $^{208}Pb/^{204}Pb$ ratio are extremely low in deposits originated from the mantle. Measurement values of the volcanogenic massive sulphide deposits in this area are plotted into the Ore-lead growth curves or rather higher points. The volcanogenic massive sulphide deposits in this area are presumed to originate from the crust, like the Japanese Kuroko deposits.

(e) Deposits and Occurrence

The Upper Cretaceous Murgul Formation is correlated to the Kızılkaya Formation, which is the host rock of the volcanogenic massive sulphide deposits in the eastern Pontides.

There are many deposits and occurrences related to the volcanogenic massive sulphide mineralization including the Murgul Deposit. Moreover another type of mineralization is found in the northern Kokolet area, which seems to have formed by the intrusion of andesite. (the lower Kokolet Occurrence).

(i) Murgul Deposit Swarm

This deposit swarm is situated almost in the central part of the survey area. The deposit is of volcanogenic massive sulphide deposit, consisting of the Damar, Çakmakkaya, and Çarkbasi deposits. The host rocks of the deposits are composed of autobrecciated dacite and its pyroclastic rocks of the lower Murgul Formation. The deposits lacks the upper massive sulphide part, and consist of dissemination and stockwork mineralization of chalcopyrite, pyrite and quartz. The host rocks in the

vicinities of the deposits have undergone silicification, sericitization, and kaolinization.

The upper part of the deposits underlies pumice tuff of the upper Murgul Formation and the Karatepe Dacite.

Its initial ore reserve was about 50 million tons and its grade of ores was 1.2 % Cu. At present, the Damar Deposit is undergoing open-pit mining. The annual product of crude ores were 1,677,500 tons of grade of 0.64% Cu in 2002. KBI operates the Murgul mine.

(ii) Kızılkaya Occurrence

This occurrence is 2 km northeast of the Damar Deposit. The occurrence is mainly underlain by dasitic pyroclastics of the lower Murgul Formation, which underlies basalt lava of the Ardiç Formation. Dacitic pyroclastic rocks of the Murgul Formation have undergone mineralization and alteration, producing quartz, sericite, and kaolinite. Mineralization consists of pyrite dissemination and stockwork type. Sulphide minerals are mainly consists of pyrite with small quantity of chalcopyrite.

Under microscopic observation, chalcopyrite, sphalerite, galena, tetrahedrite, covellite, chalcopyrite and marcasite are seen. Alteration indexes of 4 specimens range from 97 to 98%, intensely mineralized and altered. The assay results of the sulphide dissemination specimens (K150, K153) are 0.12 - 0.39g/t Au, 2.60 - 3.35g/t Ag, 0.02 - 0.03% Cu, 0.01 - 0.03% Pb, 0.001 - 0.08% Zn, 0.08 - 0.59% Ba, and 0.24 - 7.15% S, The grade of Au and Ag are relatively high.

As the result of geochemical survey, anomalies of Au, Ag, Cu, Pb, Zn, S, As, and Cd were obtained in vicinities of this occurrence.

Dardanel Company had carried out IP, HLEM, drilling and trenching surveys, targeting for Au in this area.

(iii) Karagöl Occurrence

This occurrence is in the vicinities of Karagöl, situated in 2 km southeast of the Çakmakkaya Deposit. The Dacitic pyroclastic rocks of the Murgul Formation, being accompanied with pyrite dissemination, underlie this area.

Under microscopic observation, pyrite, a small quantity of chalcopyrite, bornite, and marcasite are seen. The occurrence has undergone silicification and