Chapter 2 Mineralized Zones

2-1 General Outline

The major mineralization of the surveyed area is skarn, vein and dissmination. The major metal concentration is iron, copper, lead, zinc, molybenum, iron sulphides and barite. Most of the mineralization occurs in the Upper Cretaceous Zigana Formation or from the granodiorite intrusive bodies to the Zigzna Formation.

Skarn mineralization of this area is related to the limestone of the Zigana Formation. Iron minerals are predominant in most cases as in the case of Demirdere mineralized zone, but Copper, lead and zinc minerals are associated in some localities for example at Belen tepe.

Vein type (fissure-filling) mineralization occurs very widely from the Gümüşhane Granite and Kırıklı Formation in the lower horizon to the Venk Yayla Formation in the higher part. The deposits are small but of high grade and the ores are copper, lead, zinc, silver, antimony and barite. The general trend of these veins are E-W. Typical vein deposits of this area are Köstere Cu,Pb,Zn mine, Mastra argentiferous galena mine and Midi sphalerite mine. Only the Midi mine is presently worked. Stibnite veins were discovered recently at Avliyana, but only trenching was conducted.

Barite is found in Gümüşhane Granite and high grade veins consisting only of barite are of relatively small scale. Barite has been mined recently and detailed prospecting is been conducted by MTA in this area.

Metal dissemination in this area is related to Tertiary granodiorite and the mineralization occurs from the granodiorite stock to the Zigana Formation in the vicinity. Mineralized zones are at Hasandere (Mo,Cu), Karadag mine(Cu, Zn), Beşkise, Sarıdere, Degırmen dere (all py). Hasandere is noted as porphyry type copper mineralization.

Many bedded deposits are known in the Pondids Fold Belt and mineralization in the Upper Cretaceous acidic rocks is reported to be Kuroko type although the age is different from those of Japan. In the Trabzon area immediately north of the the surveyed area, mineralization similar to the Kuroko type is reported from the 1974-1976 survey. But in the present area, only the İstala mineralized zone is of similar nature. The outline of the mineralization of the surveyed area is laied out in Table 2.

2-2 Mineralized Zones

(1) Hasandere mineralized zone(Table 2, No. 1)

This mineralization occurs along Mat and Hasan Streams 4km southeast of Hamsiköy. These Streams are the tributaries of the Maden River. The host rocks of this mineralization are porphyritic granite and the andesites of the Zigana Formation (A1 Member) distributed near the intrusive bodies. There are two types of porphyritic granite. One (pg2) contains Mo-Cu mineralization along the minor fissures and the other (pg1) is very weakly altered and mineralization is not observed. These two types have very similar appearance to the unaided eyes, but there is a small difference in the time of intrusion. The former type associated with mineralization is limited in its distribution and intruded after the latter granite which is distributed widely in the southern part with NE-SW trend. The microfractures which were formed during the intrusion. It occurs in three forms, veins which developed together with quartz veins,films of ore minerals along the fissures and dissemination throughout the whole rock.

The mineralization 400m south of the confluence of the Maden River and Hasandere occurs as films of chalcopyrite and molybdenite or associated with quartz veinlets along the joints and fissures of the andesite of A1. The rock is sericitized and is in a phyllic zone. On the other hand, along the downstream part of the Hasan Steram, thin films of ore minerasls are developed in the porphylitic granite of the biotite zone. The biotite here is fine-grained and blackish without reddish tint.

Sericite and chlorite were found by X-ray diffraction from meta-andesite with pyrite veinlets (sample M-60) and altered granite with pyrite dissemination(sample K-23)(Table 3).

Regarding alteration, the porphyry copper model is generally applicable and detected from the the soil samples collected by MTA over an area of 1.7km X 1.4km Cu,Mo anomalous zone is expected to extend outward (north and northwestward)from the above into the propylitic zone(Fig.17).

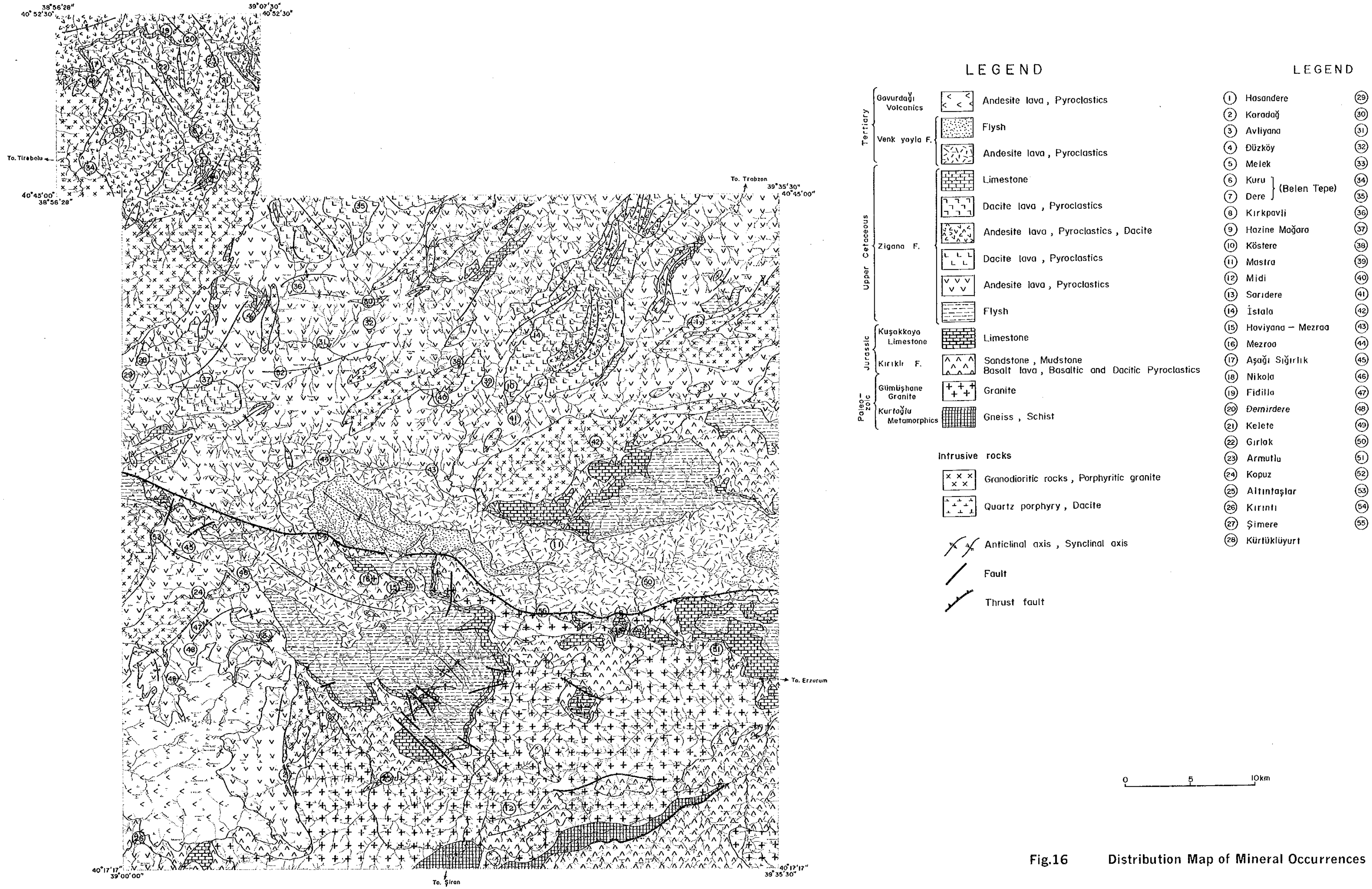
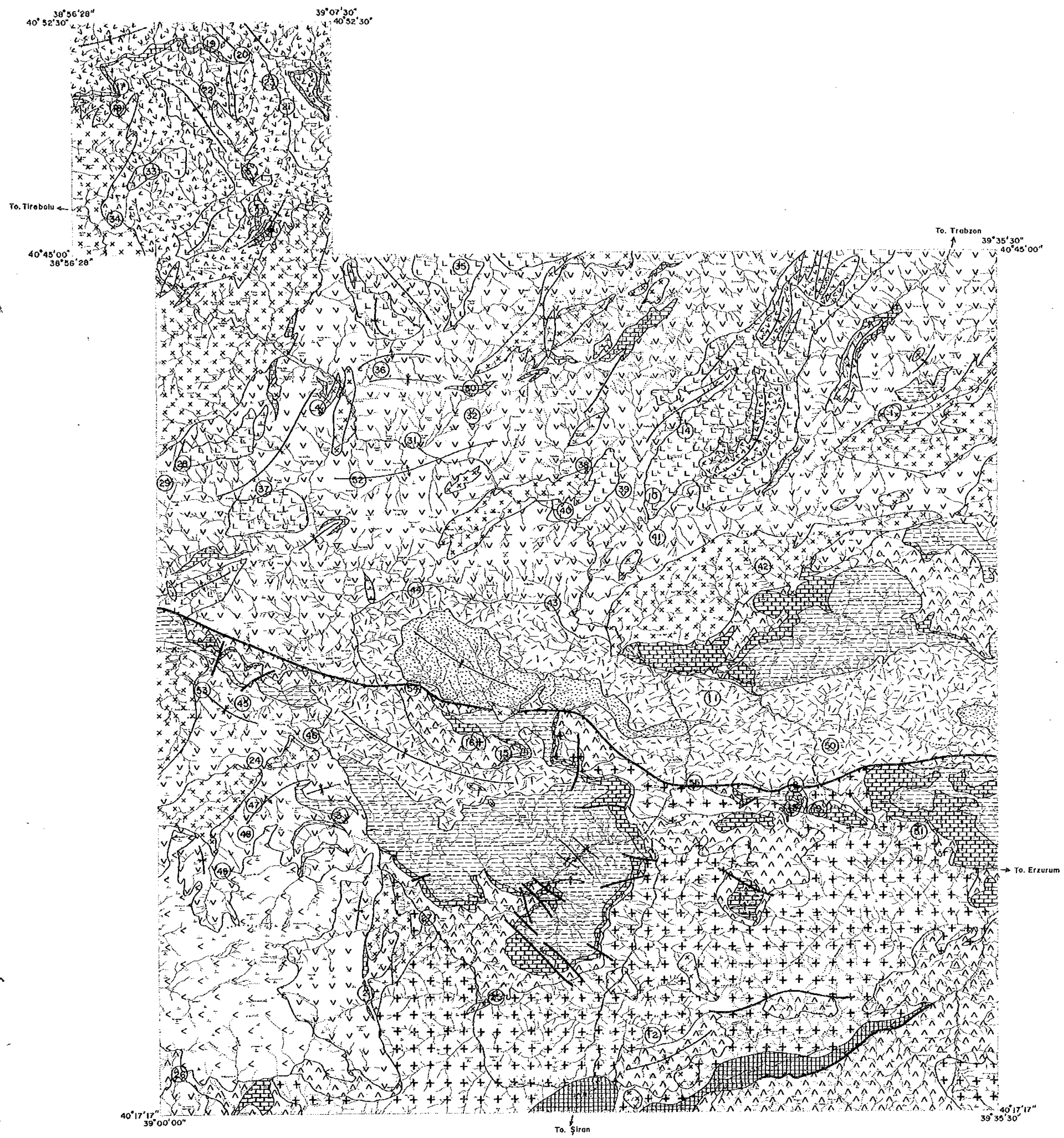


Fig.16 Distribution Map of Mineral Occurrences



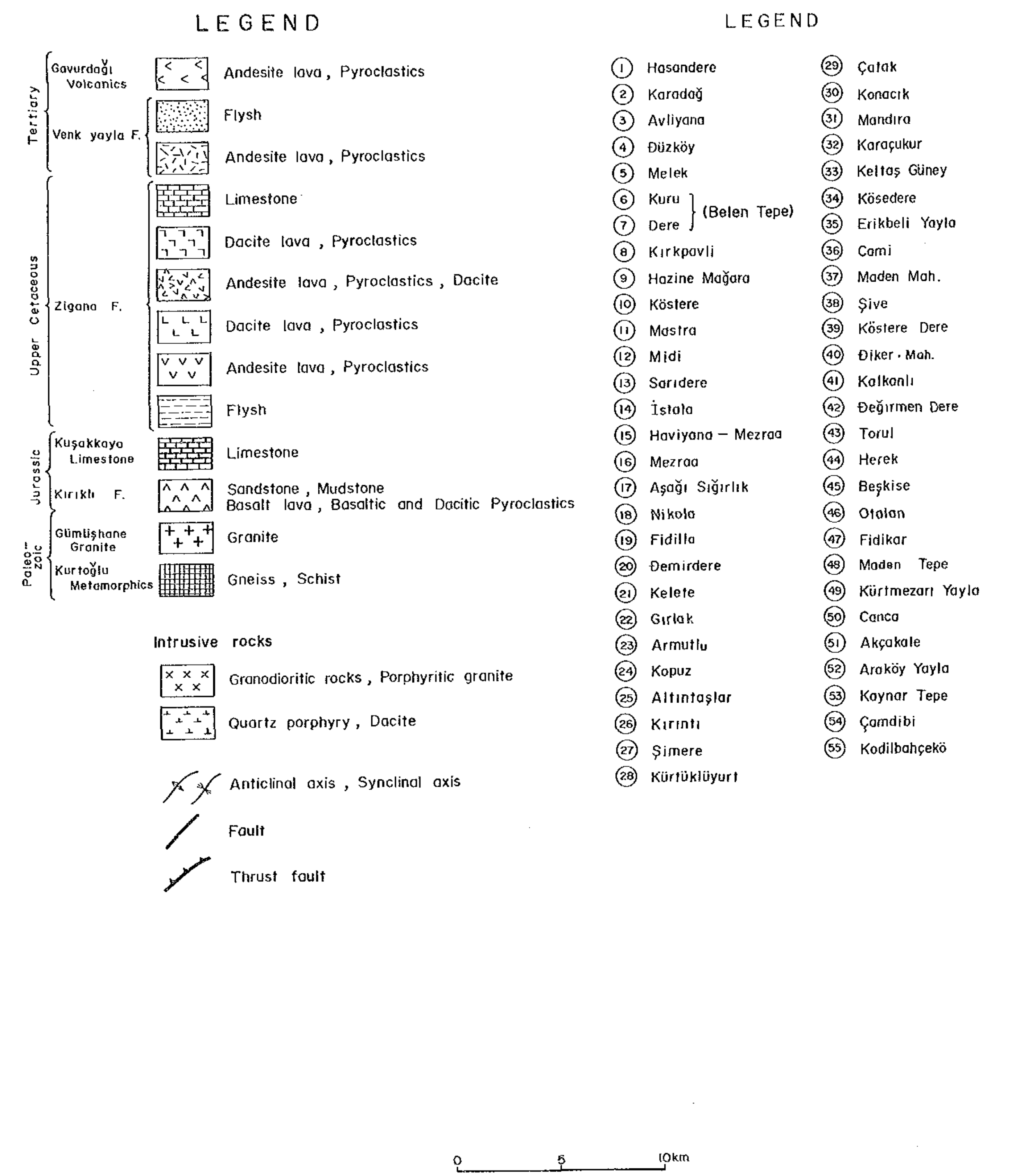


Fig.16 Distribution Map of Mineral Occurrences

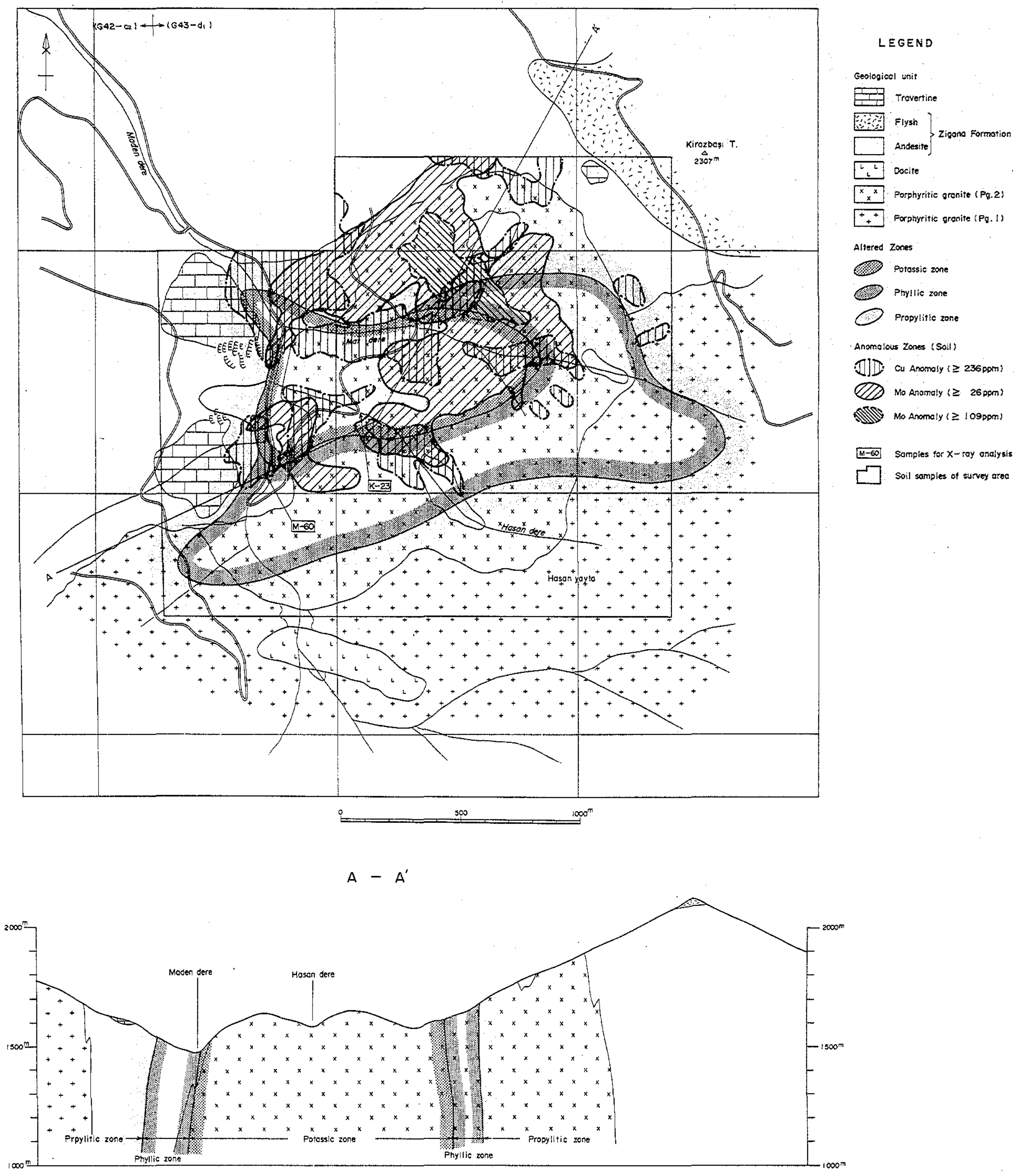


Fig.17 Geological Map of the Hasandere Mineralized Area

(2) Karadag mine(Table 2, No. 2)

This mine is located 8km west of Altıntaşlar, at the upstream part of the Maden Stream which is a tributary of Galiz Stream. The remains of the old mine is at around 2,500m above sea level. The geology consists of Upper Cretaceous andesite and limestone (A1) of the zigana Formation. The contact of the andesite and limestone is skarnized, garnet and epidote are observed. Quartz porphyry and porphyritic granodiorite have intruded into A1 near the mine. Quartz porphyry is in contact with the Gümüşhane Granite and occurs in an area of 4km N-S and 1 km E-W from Galiz to Maden Strem. The porphyritic granodiorite occurs in an oval shape(long diameter 250 m) at the upstream part of Maden Stream.

These ore deposits related to intrusion were formed in the skarn zone in the contact between andesite and limestone of the Zigana Formation. The ore minerals are almost all oxidized, but secondary copper oxides occur in network in the garnet skarn sample of the mine dump. Chalcopyrite-sphalerite are also found sometimes. Mineral showings are found in the southern part of the mine with an extention of 400m the strike direction of the limestone. Those in the northern part extend for 700m . The grades of the mine waste and the outcrop in the south are low.

A large amount of tourmaline occurs in three localities in the quartz porphyry where the rock is brecciated. These have the appearance of breccia pipes and small crystal of (tourmaline) and muscovite are also associated in other parts. Small porphyritic granodiorite bodies which intruded a little later is also fairly strongly sericitized and small grains of pyrite are observed.

The garnet collected from the mine waste was identified by X-ray diffraction to be grandite with composition close to grossular. The unit cell dimension calculated from (642), (640),(444) reflections is 11.91 Å.

The Karadag mine was worked underground in very old times (B.C.?) and it seems that the high grade parts were selectively mined. The ore was smeltered at the site and there is a very large amount of slag (estimated to be 150,000t). From the boulders near the old mine, it is inferred that the magnetite, pyrite content was small and that copper was the main target of operation. The sulphide mineral and leached metals from the dump mixed with the river sands and thus Cu,Pb,Zn geochemical anomalies are detected in this general area.

There are no information concerning the old operation and only MTA report on reconnaissance survey and report of the geochemical prospecting by the UN are available. Prospecting has not been conducted in recent years. It is inferred from the geology and ore deposits of the Karadag mine that the copper mineralization(include iron)in this part is of large scale. And since the host rock is limestone, it is similar to the porphyry copper type deposit with skarn association in USA. The following are the similar points.

a. Of the major porphyry deposits of USA, nearly half of them have limestone as the host rock of the intrusion.

b. The limestone near the ore body are skarnized containing garnet, diopside and epidote. In some cases, silica-pyrite are associated. Generally mineralization is observed along the microfissures in these parts.

c. As for intrusive bodies of porphyry copper deposits, quartz porphyry, adamellite and granite porphyry stocks are the most common.

d. Porphyritic intrusive bodies occur near the ore deposits, biotite is often associated in the potassic zone, but in some cases only sericitization is observed in the alteration zone near the intrusion, for example the Morenci mine.

(Fig.18)

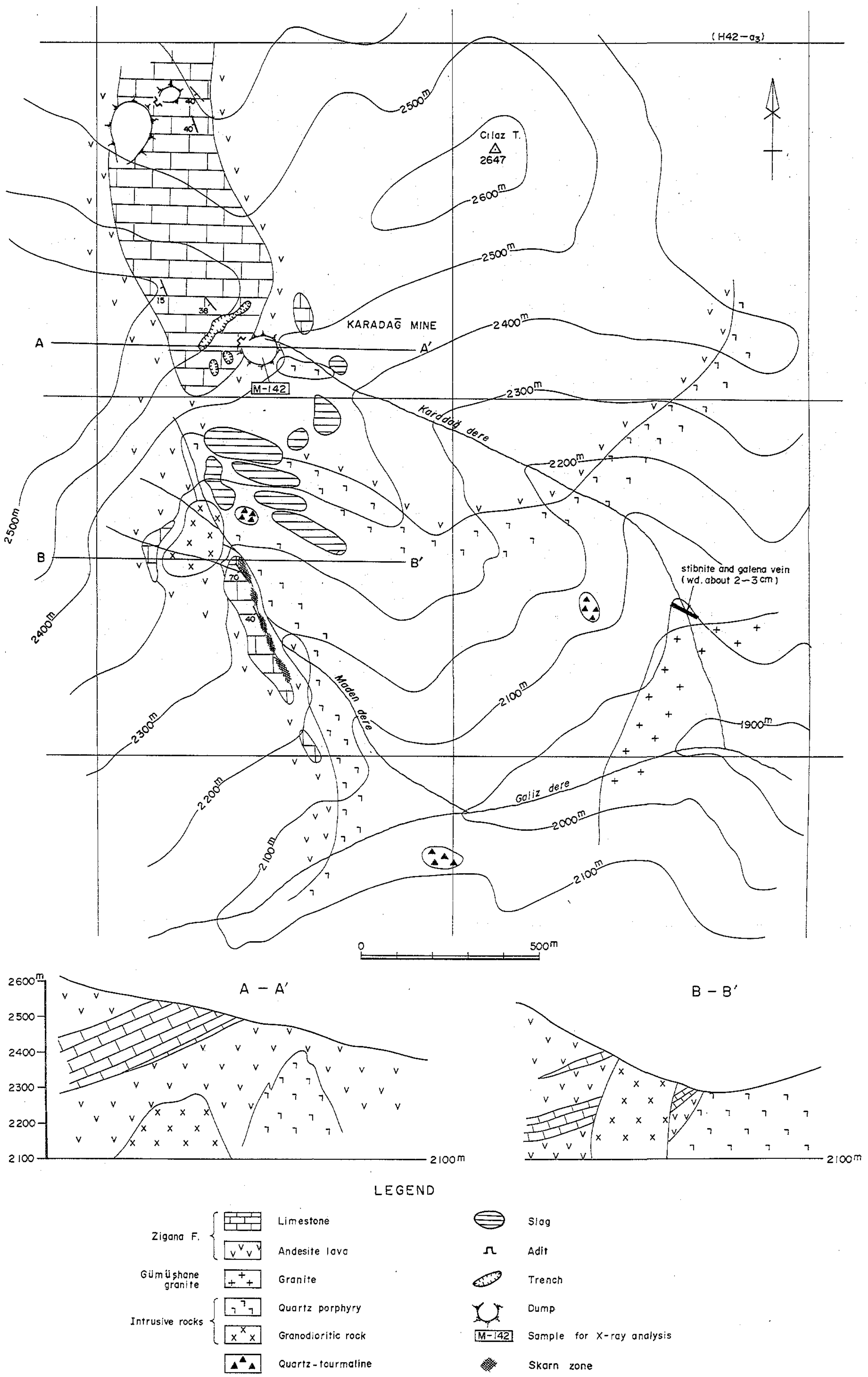


Fig.18 Geological Sketch of the Karadağ Mine

(3) Avliyana mineralized Zone (Table 2, No. 3)

This zone is located 1km southwest of Avliyana Village and veins are developed on both sides of the Avliyana Stream. Granodiorite and quartz porphyry have intruded into the Zigana Formation.

Antimony minerlization along the fissures of the intrusive body was found recently. Trenching was conducted at the limonite zone(50cm wide) on the western slope,and stibnite was found in Trench Nos 1, 2 at the silicified part of the granodiorite. The stibnite is massive with of 2 ~10cm and minor amount of cinnabar is associated. Romeite $(Cu,Fe,Mn,Na)_2$ $(Sb,Ti)_2O_6$ (O,OH,F) was identified by X-ray diffraction. This is a secondary oxidized mineral of antimony and occurs here associted with stibnite. The strike of vein is N70 °W and dip 80°E . Trench No. 3 was dug on the other side,the eastern slope, but ore minerals have not been found. Some of boulders

	I		II	
hkl	d (Å)	I	d (Å)	I
111	5.9	s	6.0	80
113	3.09	s	3.09	70
222	2.96	vs	2.95	100
004	2.57	m	2.57	60
133	2.36	w	2.36	10
333	1.973	m	1.977	40
044	1.817	m	1.827	80
135	1.737	w	1.740	30
335	1.564	w	1.568	20
226	1.544	m	1.549	70
444	1.480	w	1.485	30
155	1.435	w	1.439	30
355	1.335	w	1.339	30
008	1.282	vw	1.286	30
662	1.176	w	1.182	50
840	1.145	w	1.152	40
753	1.125	vw	1.132	20
931	-	-	1.080	20
844	1.046	vw	1.051	40
771	-	-	1.035	10
1022	0.987	w	0.990	50
953	-	-	0.959	10
775	-	-	0.929	10
880	-	-	0.910	20
971	-	-	0.900	10
1062	0.867	w	0.869	60
884	0.854	vw	0.854	40
a_0(Å)	10.251 ± 0.006		10.284	

I: Romeite from Avliyana antimony deposits

II: Romeite from Långban, Sweden (ASTM Card, 27-89)

on the eastern slope, however, are good ores and it is inferred from these thatthe veins here would be more than 20 cm wide massive ores.

The distance between the No.2 trench on the western slope and the boulders on the eastern side is about 500 m and including the limonite zone of the west it will be even larger. The eastern extension is a forest and covered by soil, thus the extension or outcrops are not known. The boulders indicate that the mineral showings on the eastern side should be significant. The results of the geological survey show that although thin, the veins are firm and the grade is estimated to be higher then Sb 60%. The width of this zone of veins varies considerably, but it is continuous and has the characteristics of an area with minable deposits. Also in the

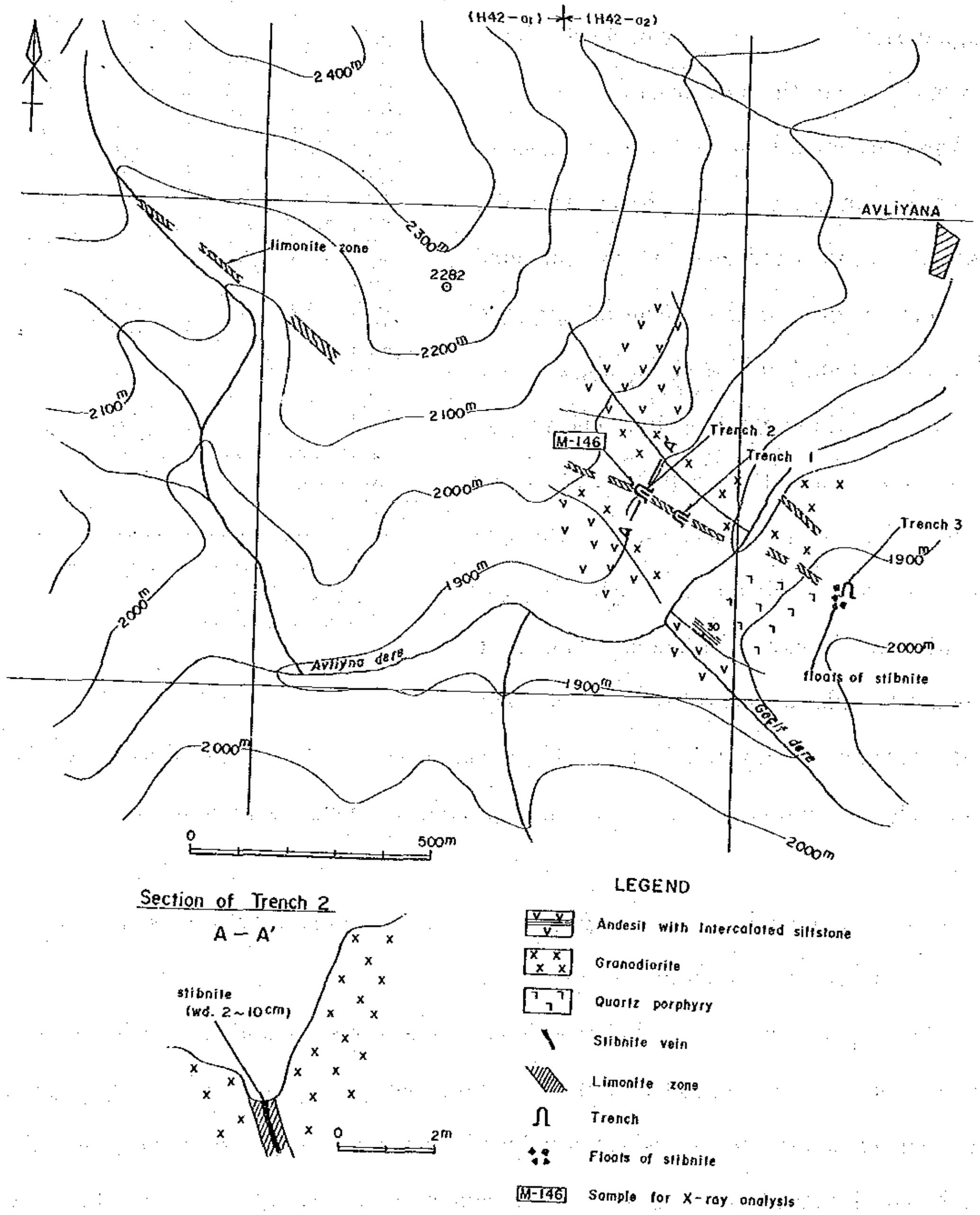


Fig.19 Geological Sketch of the Avliyana Mineralized Zone

vicinity,there is a parallel limonite zone and there is a possibility of antimony veins in the lower parts (Fig.19).

The discovery of romeite provides a clue as to the behaviour of antimony during oxidation and it is expected that the element would be fixed in the soil as romeite. There is a possibility that this mineral be useful for geochemical prospecting.

(4) Düzköy mineralized zone (Table 2, No. 4)

This zone is located at the steep ridge between Düzköy Village and Sevincek Village 2.5 km west of Kürtün. This locality can be reached from Kürtün via Düzköy Village. The geology of this area consists of Upper Cretaceous andesite, massive limestone (Zigana Formation, A1 Member) and granodiorite which intruded the above rocks. The mineralization occurs in the skarn zone which is developed near the contact. The ore minerals are specularite, galena, pyrite and small amount of sphalerite and chalcopyrite. The skarn zone consists mainly of garnet-epidote-calcite and extends in N40 °E direction. The exposure is discontinuous but the outcrops can be traced for a distandce of more than 500 m . There are remnants of old workings at two localities. Probably the high grade parts were selectively mind. Small amounts of smelting slag are scattered throughout this area. Secondarily enriched zone is developed in the outcrops, cerussite and galena are found in porous limonite. The limestone is coarse-grained crystalline near the mineralized zone, but is gray, compact and fine-grained near Ismiulu Village which is at a distance of 1 km. The granodiorite is a small body with N30 °E strike. It is related to activity of the "Kürtün Igneous Body" which is developed in a large scale from Kürtün to Dogankent(Fig.20).

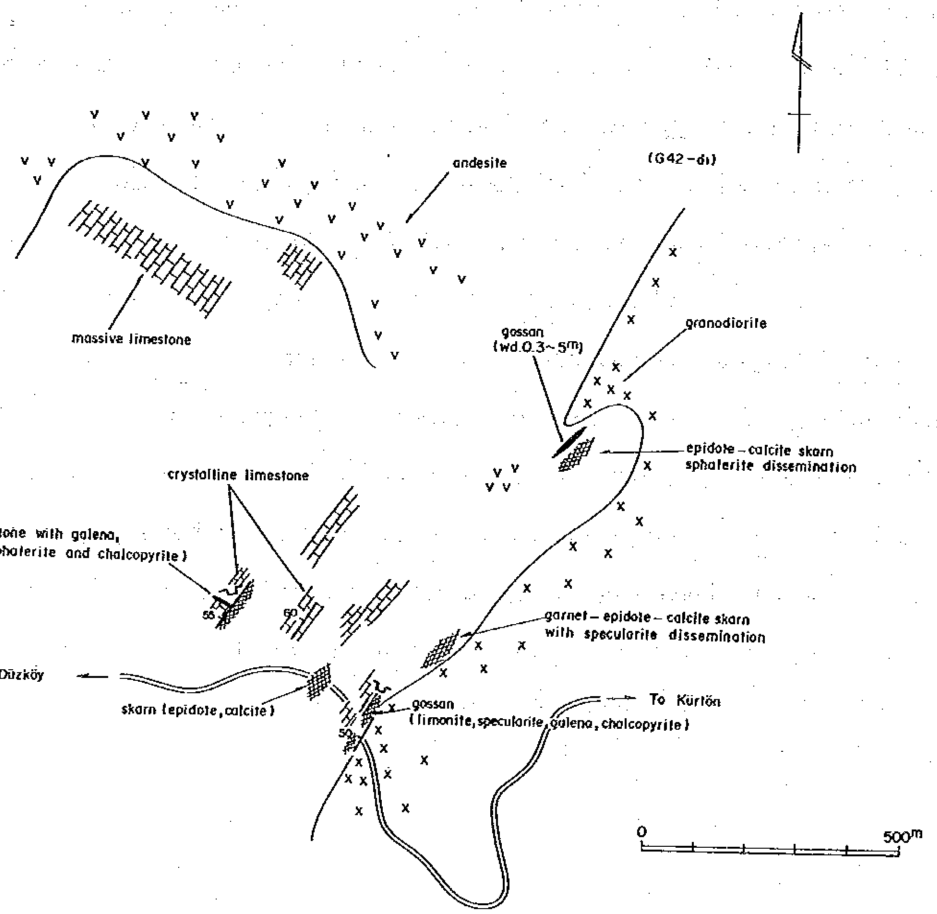


Fig.20 Geological Sketch of the Düzköy Mineralized Area

(5) Melek mineralized zone(Table 2, No. 5)

This zone is located on the left bank of the upstream Deregözu River 15 km north-northwest of Kürtün. The altitude of this area is 1,400m-1,600m and outcrop was recently found at newly constructed timber road. D1 and A2 of Zigana Formation constitute the geology of this area and two mineralized zones were found by surface survey,at 1,450 m and 1,600m above sea level. Both occur at the contact of limestone and epidotized, chloritized andesite with large amount of specularite and magnetite. Copper mineral increases toward the limestone. At 1,450 m ,chalcopyrite dissemination is observed and the Cu grade is several percent. Chalcopyrite occurs in a belt of 3m wide in specularite and magnetite. Similar occurrence is found at 1,600m and here, the copper minerals are oxidized. These are believed to be two parallel mineralized zones (Fig.21).

The garnet was identified to be of grossular-hydroglossular series with composition close to glossular. The unit cell dimension obtained from three reflection,(642),(640),(444),is 12.07Å.

(6) Belen Tepe mineralized zone

This zone is distributed at elevation of 1,600-2,000 m,10km north-northwest of kürtün. The mineralization is iron, copper, lead, zinc skarn. Many mineral showings,old mines are distributed in an area of 3 km E-W, 2 km N-S around the Belen-Tepeyurt mountains in the southeastern part of Zone A . The access to this locality is by timber road from Kürtün through Mindidi to Alanobası Yayla, then by foot for about an hour.

The geology of the area mainly consists of Upper Cretaceous andesitic pyroclastics, massive limestone (A2,Zigana Formation) and granodiorite which intruded into the former. Mineralization is developed at the contact between the limestone and the andesitic rocks. The limestone is diveded into two horizons. The thickness are both in the order of several tens of meters to over one hundred meters and the layers are more or less horizontal. The granodiorite body is NE-SW direction and is a part of the "Kürtün Batholith" which is developed on a large scale from Kürtün to Dogänkent.

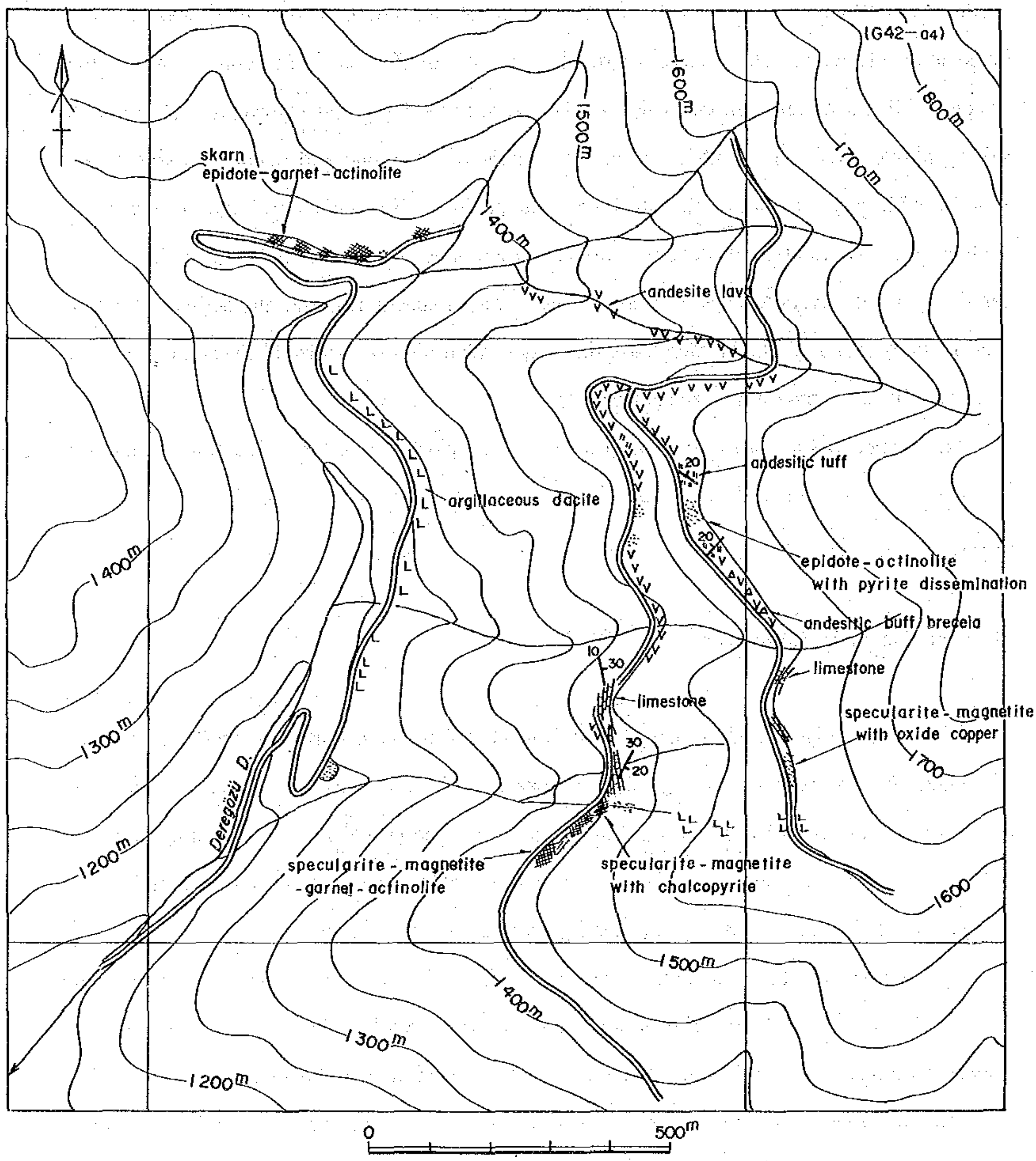


Fig.21 Geological Sketch of the Melek Mineralized Area

This mineralized zone consists of mineral showings and old mines. They are from the north:Dere mine,Kuru mine,old adit near Sulucaoba Yayla, old adit east of Körukalamobası Yayla and others.

These are described below(Fig.22).

a) Kuru mine(Table 2, No. 6)

This mine is located at a tributary of the Maden Stream 1,900 m above sea level. Several old adits are observed, but they are all buried and closed, it is inferredthat the boundary of upper limestone and andesite was mined. Mine waste could not be found, and several remnants of slag dumps are found. Copper oxides occur in the interstices of these slags, and this suggests the low level of the smelting technology. Only a few boulders containing copper oxides and galena are found in the vicinity and there are very few mined ores. Analytical data from MTA records show that high grade ores contain Cu 7.18%, Pb 1.38%, Zn 18.57%.

b) Dere mine (Table 2, No. 7)

This is located 2 km south of the Merek mineralized zone at upstream of the Soguksu River. There is an old adit at the contact of lower massive limestone and andesite with elevation of 1,450m and another old working in the massive limestone at an elevation of 1, 550m . High grade chalcopyrite-pyrite ores are observed in the limestone(strike N40°W, dip 30°NE) and andesite of the adit at 1, 450m .

There are outcrops along the Soğuksu Stream, but they are small with several meters in the strike direction and 1m thick. Specularite,magnetite and small amount of chalcopyrite occur along the N50°W, 80°SW fissures(1 cm wide) of the massive limestone at 1,550m . MTA report indicates that Russian engineers operated the mine before World War I.

c) Old adit north of Sulcaoba Yayla

This is located upstream Demir Sream at 1,850 m above sea level. There are two old adits, but they cannot be entered and the details are unknown. It is inferredthat the mineralization at the boundary of upper linestone and andesite was mined asin the case of Kuru mine. Copper,lead and zinc probably were the major commodities. During the course of the present work, we found limonitization at the boundary of the upper limestone and the low andesite, but could not find ore minerals.

d) Old adit north of Alanobası Yayla

This is located 400m north of Alanobası. It is the most promising outcrop in the Belen Tepe mineralized zone. The deposit is a skarn type developed at the contact between the upper limestone and the lower andesite lava. The dimensions of unit ore bodies are in the order of 50m long and several to 10m wide at the outcrop. The outcrop is limonitized and copper oxides occur fairly widely. The major ore mineral is specularite with association of pyrite,chalcopyrite and galena. The major skarn mineral is actinolite. There are traces of mining at several places of this exposure. The remaining southernmost excavation site is in the scale in the order of 15m in strike direction, 10m in dip and several meters wide. Galena-specularite mineralization in limestone is observed at a old excavation north of this exposure.

e) Old adit east of Körukalamobası Yayla

There are old adits at 300m east and 500m southeast of Körukalamobası Yayla. It is inferred from the geology of the area that the former adit worked the contact zone of granodiorite and limestone,strike N-S and the dip vertical. Ore minerals are specularite, pyrite, magnetite and oxidized copper. Width is in the order of 1.2m . The latter deposit has a similar mode of occurrence. High grade chalcopyrite and slag are found in the boulders of the vicinity and oxidized copper ore is also observed. It is believed from the slags that chalcopyrite was mined on a small scale.

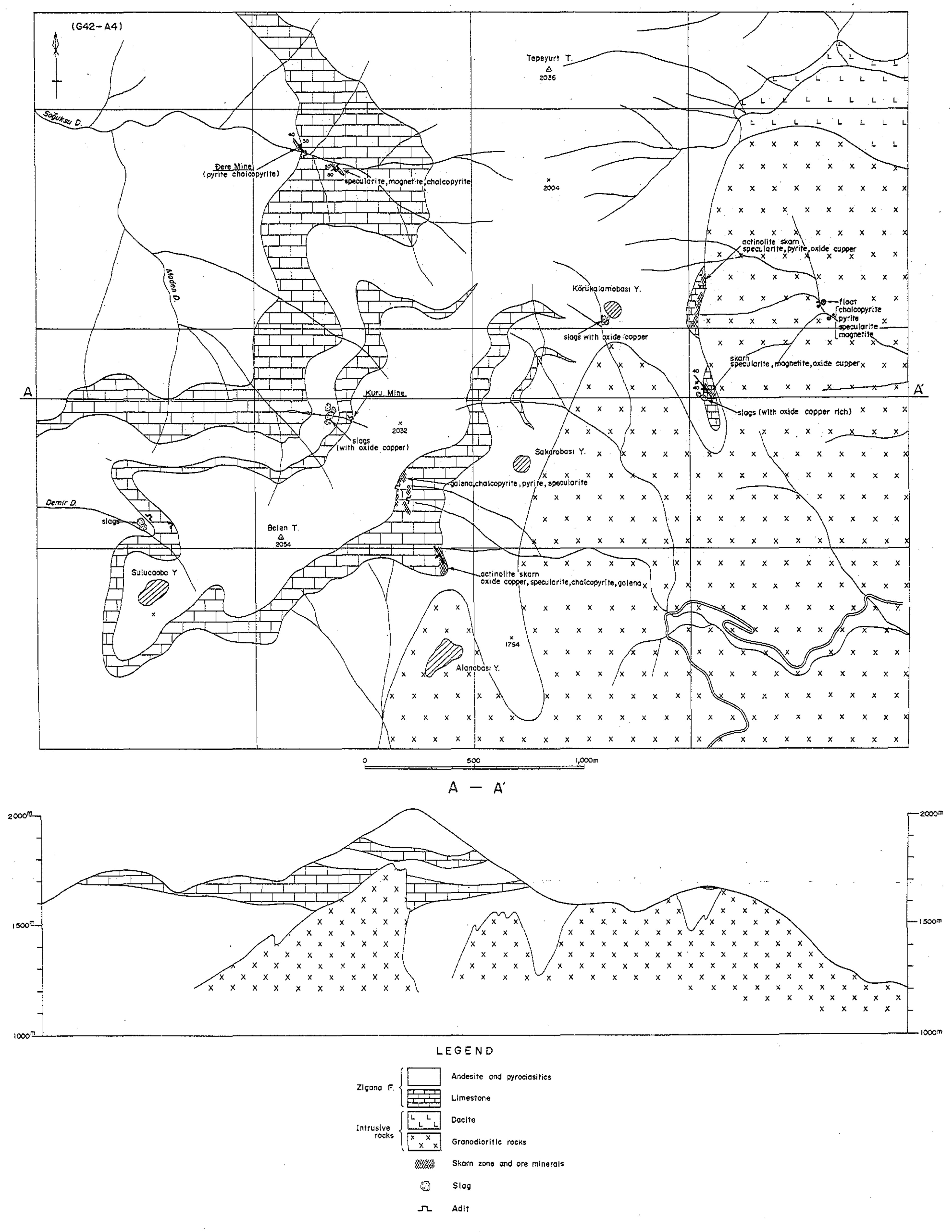


Fig.22 Geological Map of the Belen Tepe Area

(7) Kırkpavlı mine(Table 2, No. 8)

This mine is located at Eski Gümüşhane, 1,350m elevation and 3km west of Gümüşhane City. The deposit is vein type and Kırıklı Formation is the country rock. Thesubsurface geology consists of limestone, andesite,conglomerate (not observed on surface, inferred to be pyroclastics from 1937 data). There is a silicified zone of approximately 20m and quartz vein containing large amount of pyrite occur in this zone. According to old documents, this mine had a cross cut extending 250m and four drifts which were all short. This is due to the quartz-pyrite veins which are not continuous. The width of the veins are not known. The assay of samples collected from the left and right walls of the silicified zone show;Au 3.2/t, Ag 16g/t, Pb 0.8%, Zn 0.2% and Au 4.9g/t, Ag 22.5g/t, Pb 0.0%. It is not clear from the documents of Kovenko (1937) how much gold and silver were mined(Fig.23).

(8) Hazine Magara mine (Table 2, No. 9)

This mine is located 1km southwest of Gümüşhane City, at 1,500-1,620m above sealevel. This is a replacement deposit formed by the brecciation of Kuşakkaya Limestone by parallel E-W trending faults and galena and pyrite mineralization in the matrix. Underground mining was done by joing the adits 80m below the outcrops.

Most of the ore bodies consists of massive pyrite with local concentration of galena and tetrahedrite. D'Andria of MTA surveryed the deposit in 1940 and reported that it's major constituent is pyrite and the dimensions are 100m long, 5m hick and 100m in dip direction. The reserve is 200,000t with the grade of Au 2.55g/t, Ag89g/t, Cu 0.8%, Pb 3.04%, Zn 2.0%. The silver content is high where tetrahedrite is concentrated, up to Ag 1,600g/t. Also orebody was confirmed by two drilling and the extent of the orebody was determined to be 75m in N55 °W, 1.6m wide and average grade Pb 5.03%. It is thought to be continuation of a signal orebody, but the relationship of the data is not completely clear. The basement consisting of Gümüşhane Granite occurs below the ore deposit, and the ores occur only where the Kuşakkaya Limestone has dropped by faults. Therefore, the downward extension of the orebodies cannot be expected(Fig.24).

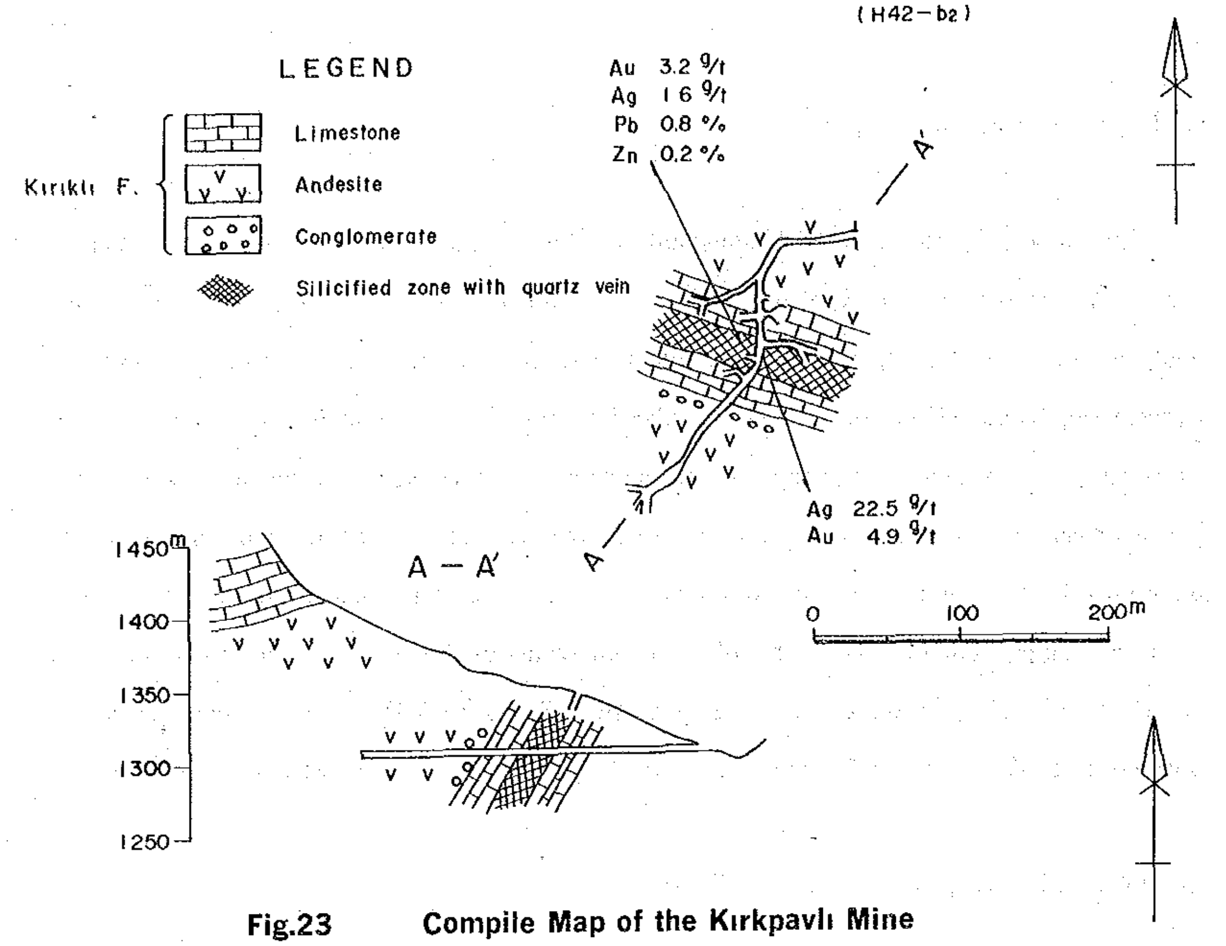


Fig.23 Compile Map of the Kırkpavlı Mine

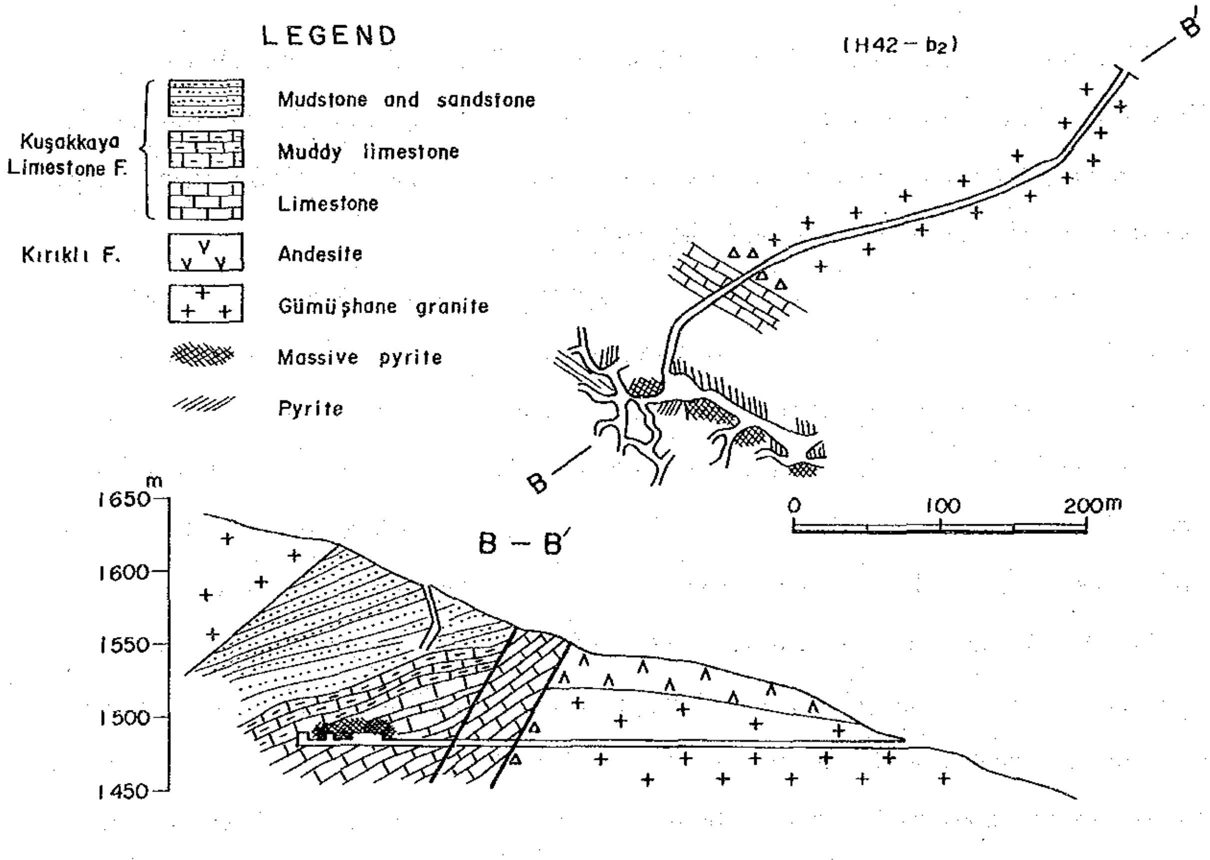


Fig.24 Compile Map of the Hazine Mağara Mine

(9) Köstere mine (Table 2, No.10)

This mine is located approximately 1.5km northwest of Kalkanli Village. The deposit consists of fissure-filling veins in the Upper Cretaceous dacite lava (Zigana Formation, D1). The major ore minerals are galena, chalcopyrite, pyrite and small amount of sphalerite. The veins strike N85°W, dip 60 °N, are 1-2m (maximum 3.5m) thick at the outcrop. The western side is cut by a fault and the eastrn side pinches out rapidly. The host rock is strongly silicified, small pyrite dissemination is observed and there are, in places, quartz veinlets containing galena and chalcopyrite. There are three old adits,but it is not possible to enter them. They ate all cross cuts. They are at three levels, namely 10, 40m ,and 75m below the outcrop. We are told by local people that this mine operated for a year from 1978. The veins, however, deteriorated in the lower parts and mining was ceased(Fig.25).

(10) Mastra mine (Table 2, No.11)

This mine is located in the central part of the surveyed area 10km south of Torul, at the steep northern slope approximately 1.2 km northwest of Mt.Aktas. The access to this mine is by the road to Siran which branch out from the national high way between Torul-Gümüshane. It is about 4 km from the fork of the national high way throug Mastra Village. The deposit consists of veins in the hornblende-andesite lava of Eocene Venk Yayla Formation. The major ore minerals are chalcopyrite and sphalerite associated with pyrite. This mine was worked until recently. Of the seven adits, four (G-1～G-4) can be entered. Three veins were mined in past and the dimensions are as follows.

Vein	Strike	Dip	Length	Width
V-1	E-W	80°S/N	80m +	1-50cm
V-2	N65°W	85°SW	40m +	1-60cm
V-3	N70°W	70-85°NE	35m +	5-150cm

V-1 is a clay-quartz vein and sulphide minerals, mainly galena, is locally condentrated.

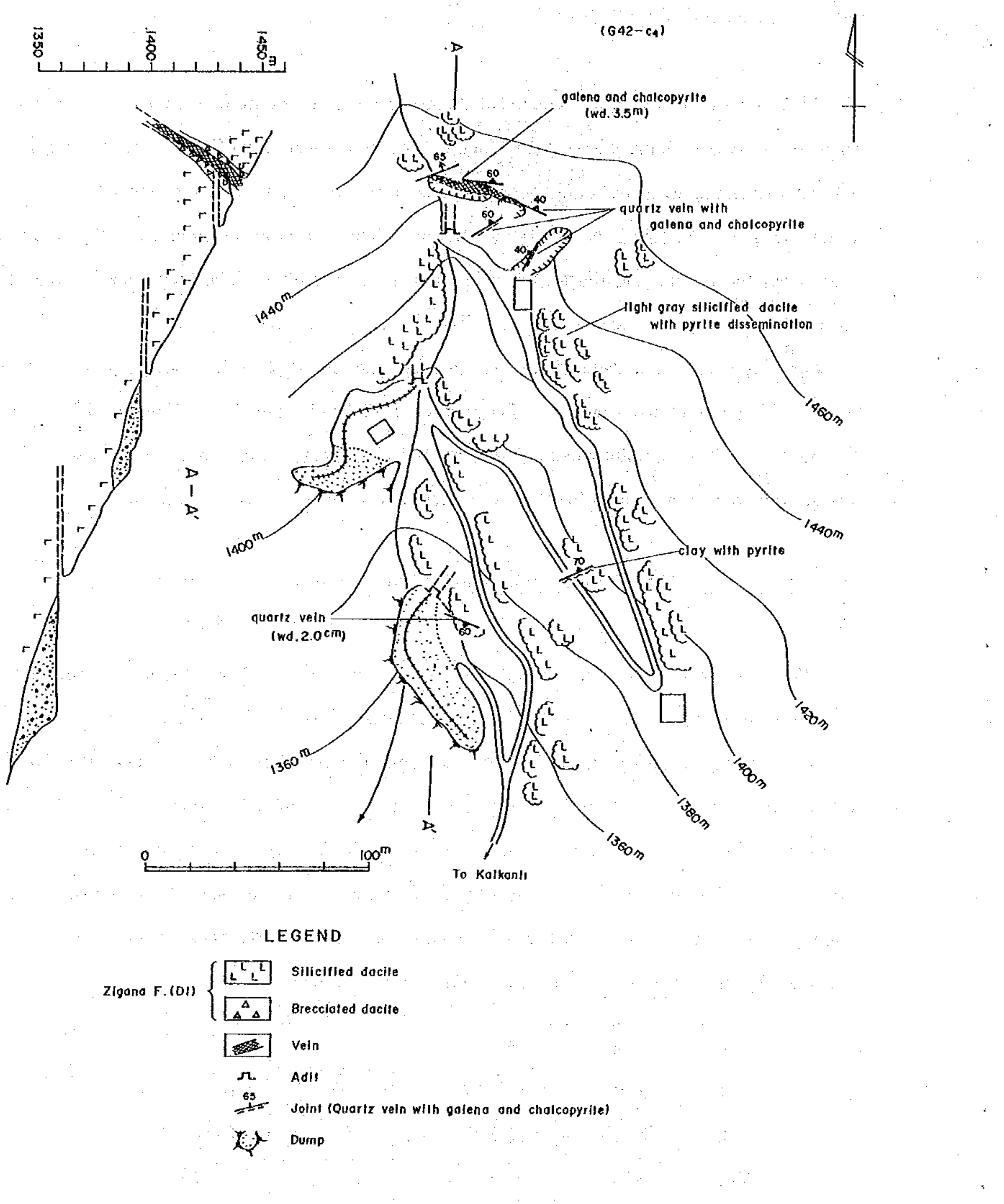


Fig.25 Geological Sketch of the Köstere Mine

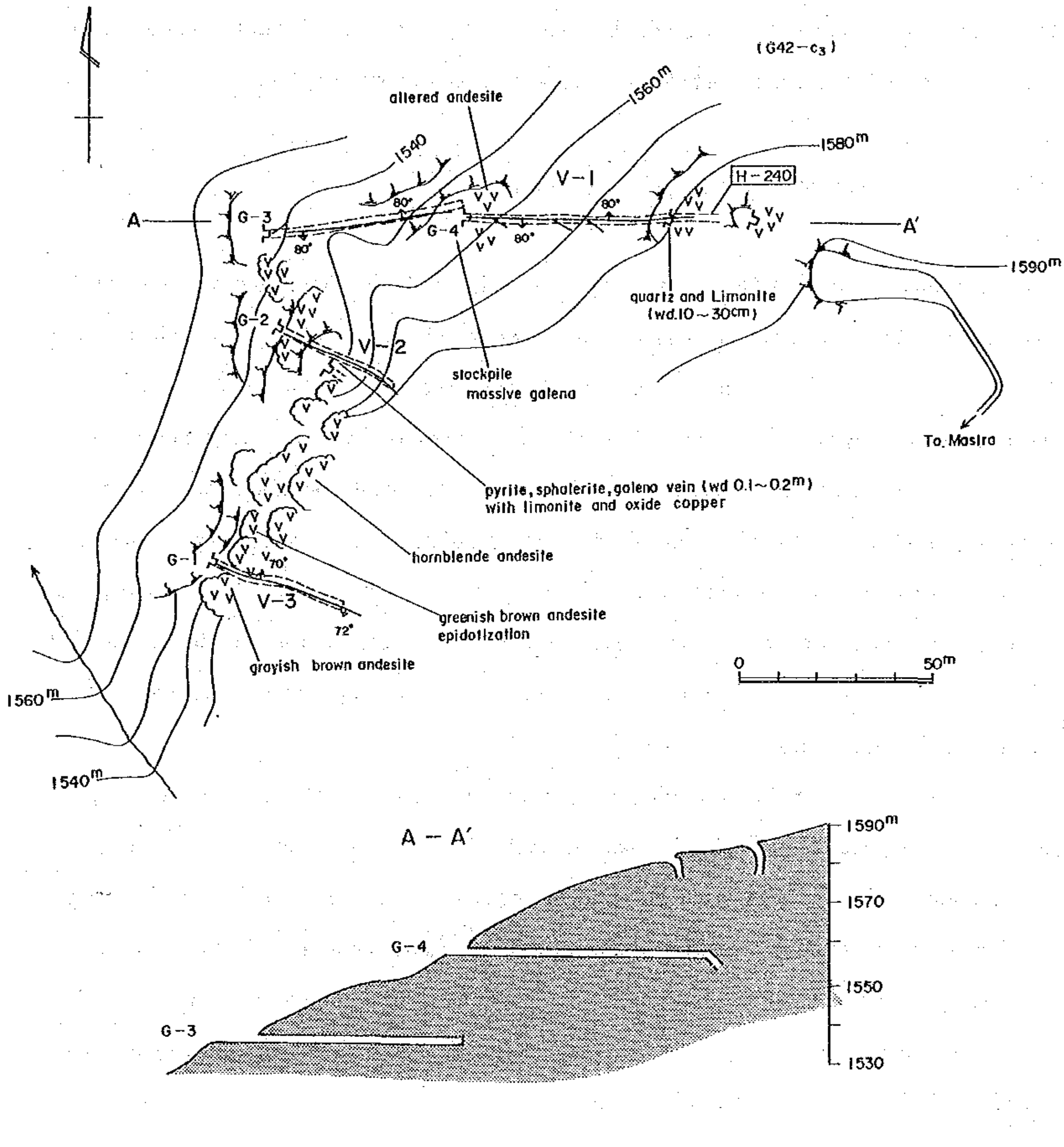


Fig.26 Geological Sketch of the Mastra Mine

V-2 is similar to V-1, but it changes to network-dissemination towards the end of G-2 Adit. Both hanging and foot walls of V-3 are strongly silicified and the vein is a concentration of network-veinlets and a large amount of pyrite is associated with galena, sphalerite and chalcopyrite.

It seems that only silver rich galena was mined and copper, zinc containing ores are dumped near the adits. Argillized zone consisting of white clay ($2M_1$ sericite was identifed by X-ray diffraction.) and associated with weak silicification is developed from south of the mine to Mastra Village, but sulphide mineralization is not known(Fig.26).

(11) Midi mine (Table 2, No. 12)

This mine is located 1.5Km south-southeast of the Midi Village and access is possible by cars to the mine. The deposit consists of veins with N80°E strike and 60-70°N dip in Jurassic Kirikli Formation. The main ore mineral is sphalerite with minor amounts of galens, chalcopyrite and pyrite. The vein is oxidized near the outcrop and secondary minerals such as limonite and smithsonite ($ZnCO_3$) are observed. The host rocks are basalt lava and basaltic pyroclastics with calcareous siltstone intercalation. The hanging wall is epidotized and the footwall is argillized (white clay). The process leading to the discovery of the deposits is not clear. Small scale mining was started in 1984. At present, open cut mining is carried out near the outcrops and these are five mining sites. The shipment in 1984 was 400t of hand-picked concentrates with 26% Zn.

The vein is 100m+ in strike direction and 2～10m wide. The vein deteriorates rapidly to the northeast changing to epidotized galena-pyrite dissemination zone. On the other hand, underground drift has been cut for the southwestern extension of the vein for several meters, but further investgation is necessary in this direction. Skarnization associated with lead-zinc is observed in the Kusakkaya Limeston 500 m north of this vein and traces of mining is found in several places. The relation between the mineralization associated with this skarn and the veins of the Midi mine is not clear(Fig.27).

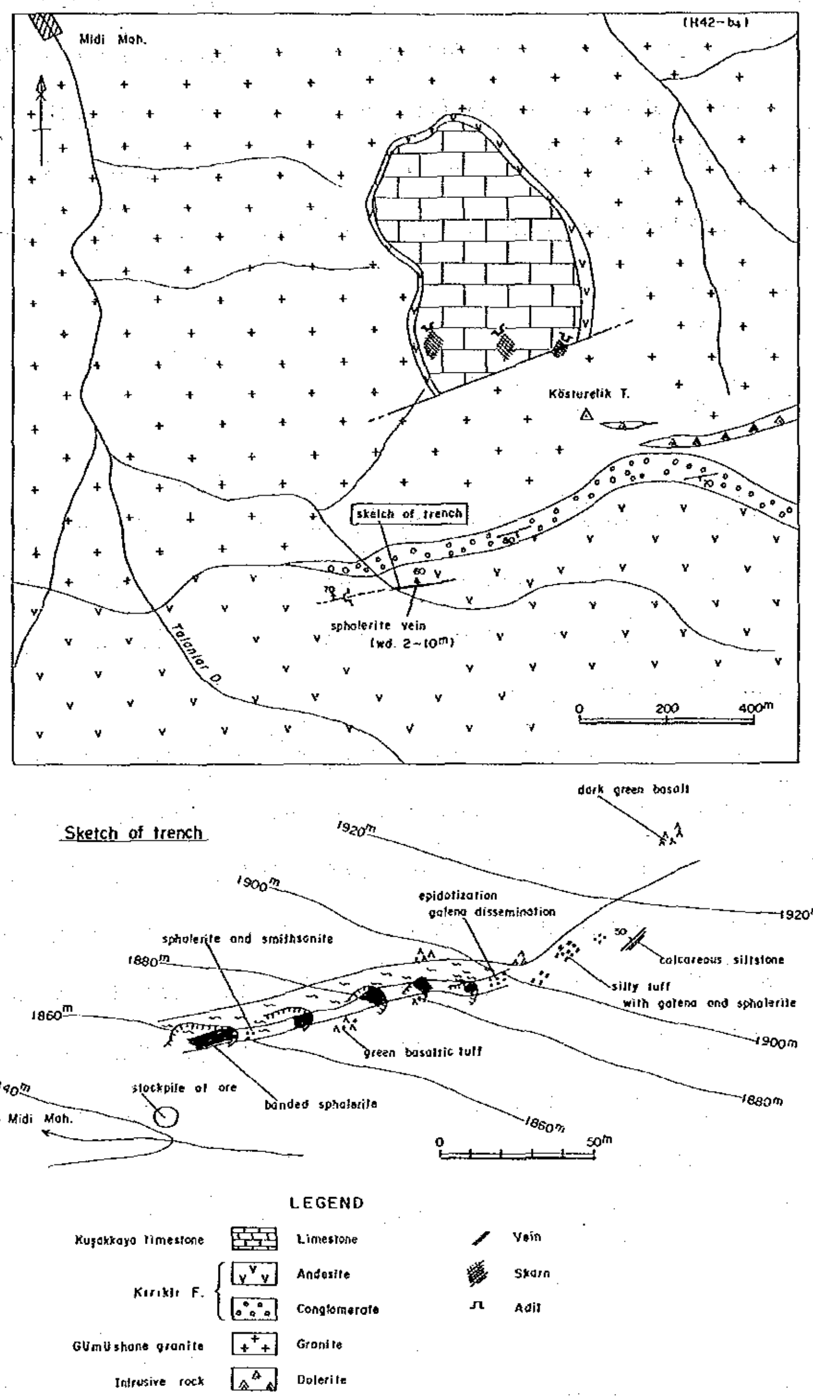


Fig.27 Geological Sketch of the Midi Mine

(12) Sarıdere mineralized zone (Table 2, No. 13)

This zone is located at 1,600-1,800m elevation upstream of Sarı Stream. The Kırkpavlı mine is located downstream of this mine. A large amount of pyrite is associated with Tertiary granodiorite (8Km X 4Km) which intruded into the Gümüşhane Granite. The pyrite occurs in the fractures of granodiorite, dissminated in the matrix and also in some places associated with quartz veins. Only pyrite can be identified by unaided eyes. Whole host rock is argillized and the mineral is probably sericite. MTA has collected soil and rock samples and they are being analysed.

(13) İstala mine (Table 2, No. 14)

This mine is located 13 Km north-northwest of Torul at elevation of 1,800m on the tributary of Soğanı Stream 1Km southeast of İstala Village. Access from Torul is by jeep via Zigana Pass. The topography of the vicinity is rugged. The geology of this area is composed of dacite (D1) of Zigana Formation. The deposit is Kuroko type which occur in this D1 Member. There are four old adits in this mine as shown in Fig.12 .

One of the adits opens at 50m above the right bank of the stream, another is at the extension of the first adit. These adits are numbered Adit Nos 1,2,3 and 4 from north. Adits 2 and 3 can be confirmed although they have collapsed. Adits 1 and 4,however, have completely collapsed and the entrance can be inferred form the slight depression and the dump. Of the four adits, Nos.3 and 4 are on the opposite sides of the ridge and they are probably continuous inside. Adit 3 probably was most productive and a large amount of dump covers the slope below the entrance (Fig.28).

Adit 1:It is inferred from depression on the surface that the direction of this adit is N35 °E. The details are not known.

In the dump near the entrance of this adit, pyrite, chalcopyrite, galena and sphalerite are identified together with secondary minerals in the silcified dacite.

Adit 2:The direction of this adit is N5°E. In the vicinity, there are faults with same strike as the adit and 70°W dip. The entrance has collapsed and parts of the adit is under water, thus the depth of the adit could not be confirmed. As the adit is located immediately on the left bank of the stream, mine dump is not seen pyrite, sphalerite and galena are observed in the fault fractured zone in the wall of the adit entrance.

Adit 3:The adit extends in S10°E direction. The waste near the adit is scattered over 40m ×20m . There are outcrops in the direction of the adit where three faults whose trends are S20 °W, N-S and N80 °W are developed and the mineralization is most intense along the N-S and N 80 °W faults where oxidized copper ores are noted. Old adit is found along the N-S fault and here veinlets of secondary oxidized copper minerals, galena and sphalerite occur in the fractured zone with a width of about 2m . Barite occurs in the hanging wall of this zone and also in the mine wastes. The adit stops at 5m . Collapsed old underground mining site 3m wide and several meters long was found in the N80°W fault zone, and this indicates that a fairly large scale mining was done in the lower part of the ore body.

Only small scale veinlets are observed along the faults now, but since there are massive ores in the waste, probably massive, Kuroko-type ores were mined in lower parts of this deposit.

Adit 4:This adit is located at the southern extension of the direction of Adit 3 and they are considered to be continuous. But now the tunnel has collapsed and is impossible to ascertain .

The direction of the adit is inferred to be about N40°E from the observable traces. A fault trending N70°E with vertical dip occurs on the east side of the adit and its extension probably coincides with the fault on the eastern side of Adit 3. Secondary oxidized copper minerals observed along this fault is the only trace of mineralization observable at present. Mine waste is found on the slope below the adit and as in the case of Adit 3, massive Kuroko is also observed.

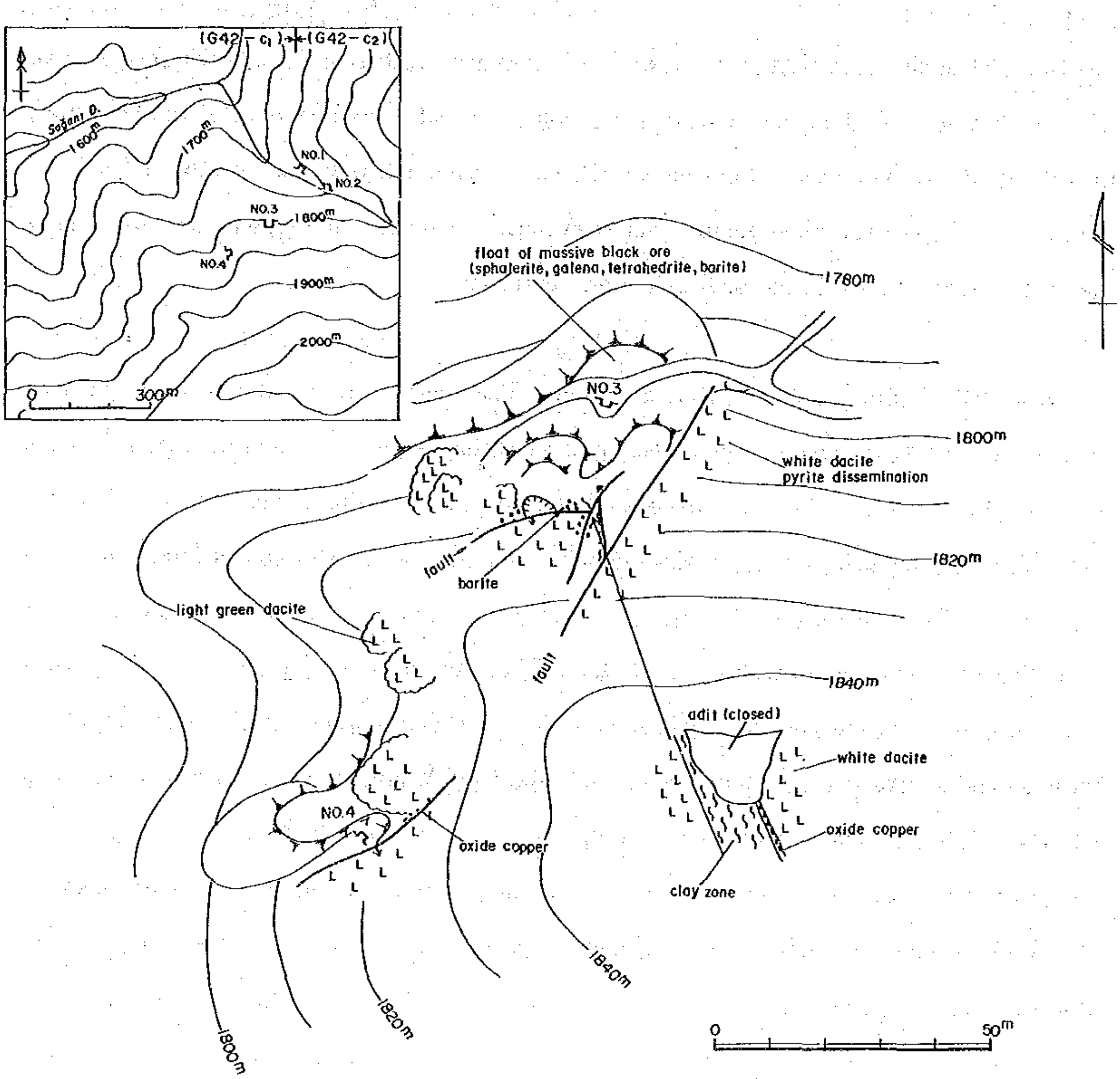


Fig.28 Geological Sketch of the İstala Mine

(14) Haviyana-Mezraa-mine (Table 2, No. 15)

This mine is located approximately 500m west of Haviyana Village. The deposit consists of veins composed mainly of barite. It occurs in basaltic andesite in Kırıklı Formation. In the open pit, barite veins and quartz veinlets occur and the former veins are 3.0m wide, 5m long with N 5m long with N50°W strike and 60°SW dip. Small amount of galena and oxidized copper minerals occur in the barite veins. A large argillized zone of 300m x 600m scale is associated. In this alteration zone,network of quartz veinlets are predominant and limonite and minor pyrite dissemination is associated with the network. From some silicified boulders galena and tetrahedrite are observed(Fig.29).

(15) Mezraa mine (Table 2, No. 16)

This mine is located 500m north of the Mezraa Village and the ore deposit consists of barite veins in the contact between Gümüşhane Granite and Kırıklı Formtion. The barite veins and quartz veinlets contain small amounts of galena, sphalerite and chalcopyrite. At the outcrop, the veins are arranged irregularly without constant strike direction and the maximum width is 2.5m and the length is about 20m . They either rapidly thin out or are cut by faults. The host rock, granite, is white to gray, silicified, the feldspars are argillezed to white clay and quartz grains are conspicuous. Open cast mining has been conducted at five localities. They all seem to have mined in N40°-60°E direction. Approximately 10,000t(BaSO4 approximately 85 %) of ore was mined during 1983-84(Fig.30).

(16) Kalkanlı alteration zone (Table 2, No. 41)

Mineralized alteration zone is distributed widely in Zigana-Torul area. Andesitic lava, pyroclastics and other rocks of Zigana Formation were altered, mainly silicification and argillization. They are generally grayish white to white. Pyrite dissemination and sericitization are observed. Oxidzed copper minerals occur locally in the pyrite dissemination zone NE-SW or E-W trending pyrite veinlets are developed in some parts. Sericite and chlorite

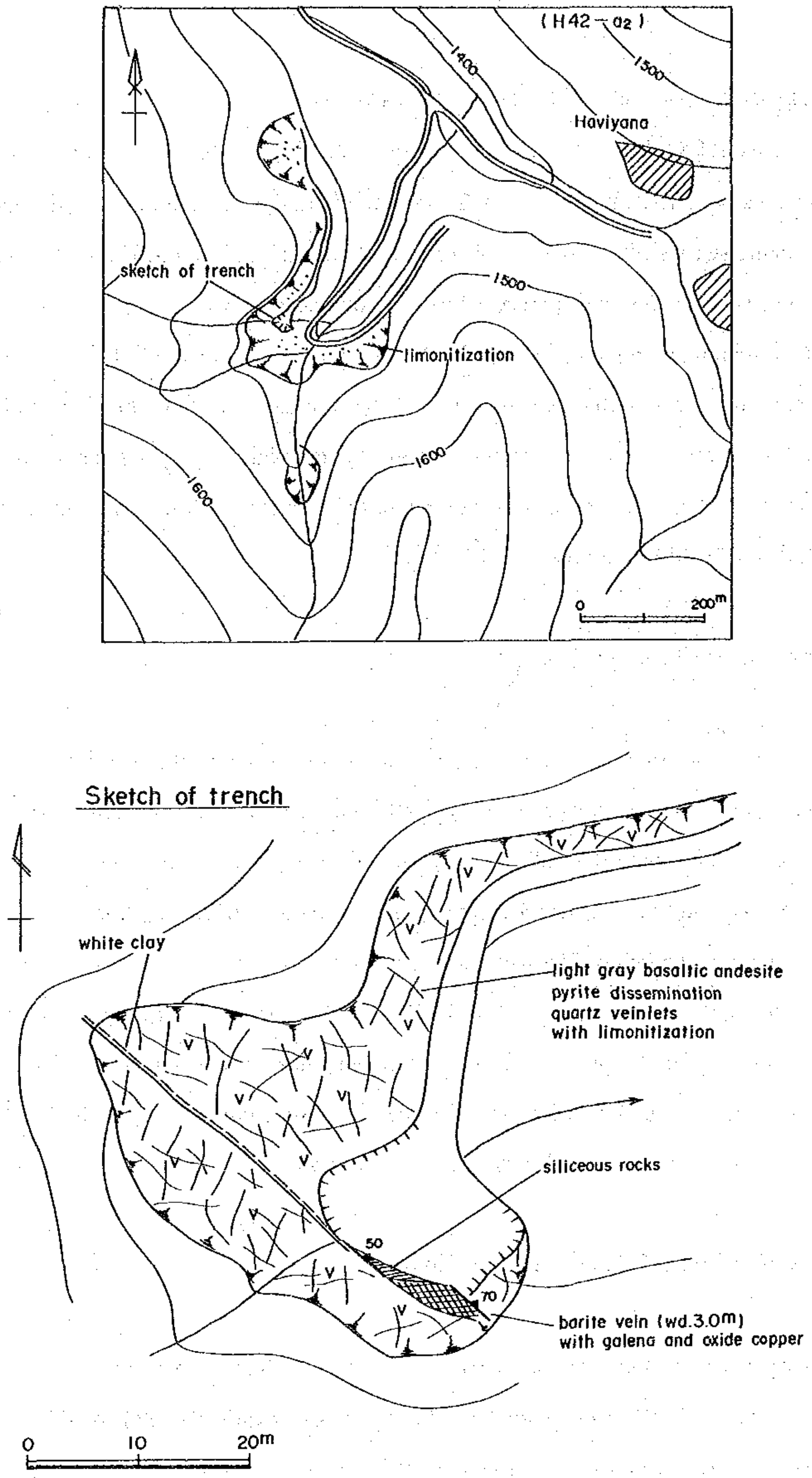
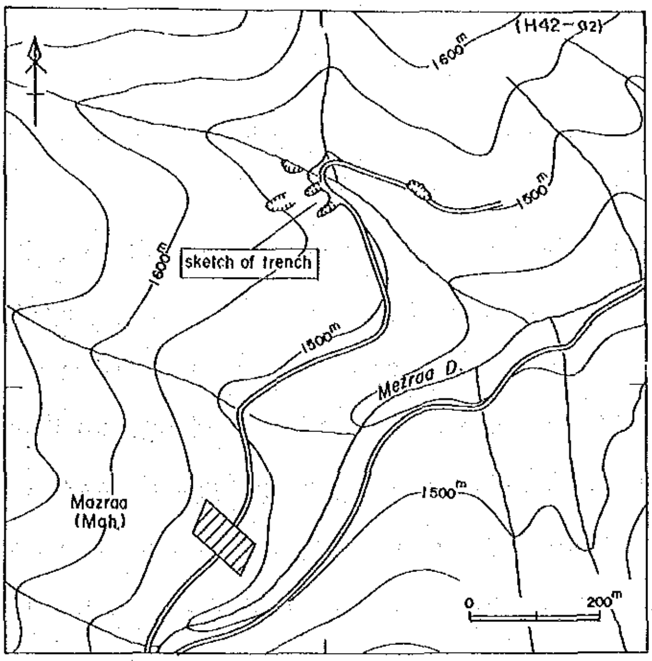


Fig.29 Geological Sketch of the Haviyana-Mezraa Mine



Sketch of trench

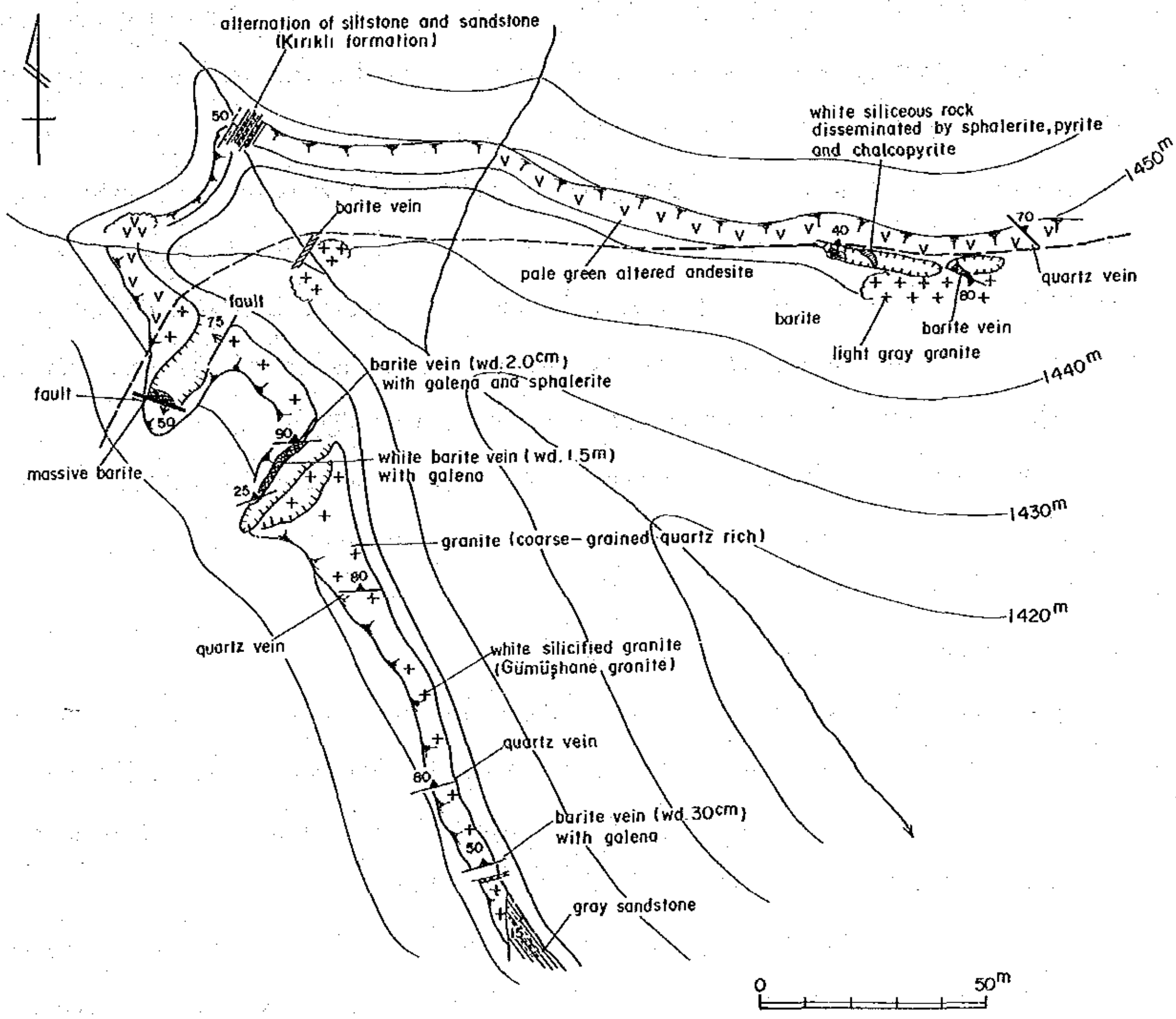


Fig.30 Geological Sketch of the Mezraa Mine

were identified by X-ray diffraction from white argillaceous andesite sample collected from 15Km northeast of Torul.

Many alteration zones similar to that of Kalkanli occur in the vicinity,for example along the Köstere River (Köstere altered zone), Sive River (Sive altered zone), near Torul (Torul altered zone). When we consider these zones as one large altered area, it covers 10Km NE-SW and 7km NW-SW, and the central part is strongly argillized where as silicification becomes stronger outward. This is located between granodiorite masses which are elongated in NE-SW direction. It also coincides with the lead anomalous zone which extends over 107km^2, this will be later reported in the section on geological prospecting.

(17) Herek alter tion zone (Table 2, No. 44)

This zone is widely developed along the Der River in the central part of the surveyed area. In this zone, andesitic tuff breccia and lava are strongly altered to white clay and the texture of the orignal rocks cannot be observed. Silicification is weak.

Several galena-sphalerite-chalcopyrite-pyrite veinlets(1-2cm wide) associated with pyrite dissemination occur in the white altered zone north of Herek Village, but they are not continuous. There are oxidized copper stains in this area. Sericite, chlorite and montmorillonite were identified by X-ray diffraction from the altered rock associated with these veinlets.

Also similar altered zones are developed near the Omruk Village 2km southwest of this zone. when we consider Herek-Omruk as ore zone, it extends 6km NE-SW and 3km NW-SE and coincides with the Derdere geological anomalous zone which covers 40Km^2.

(18) Beskise mineralized zone (Table 2, No.45)

This zone is located 3Km southwest of Akçakilise Village in the western part of the surveyed area. The geology consists of andesite and granodiorite of Zigana Formation. Granodiorite and the andesite in the vicinity are silicified with notable pyrite dissemiation. The surface is limonitized and extends for about 2Km×1Km.

Small boulders containing secondary oxidized copper were found in the stream flowing through this zone, but outcrops were not found. Small fragments of slag were also found, but details are not known.

Table 2 List of Mineral Occurrences (1)

No.	NAME	LOCATION	FORMATION	KIND OF MINERAL DEPOSITS	HOST ROCKS	TYPE OF MINERAL DEPOSIT	THICKNESS OR WIDTH	ORE MINERAL	GANGUE MINERALS	GRADE OF ORE	DIRECTION OF VEIN STRIKE / DIP	REMARKS
1	Hasandere	Hamsiköy Güzelyayla	Porphyritic gr. Zigana	Mo,Cu	Porphyritic granite Andesite	Dissemi.	1.7 km × 1.4 km	Molybdenite Chalcopyrite Pyrite				Soil sampling by MTA
2	Karadağ	Galiz D.	Zigana	Cu,Pb,Zn, Fe	Basaltic Andesite	Dissemi.		sphalerite Oxide copper Galena	Quartz Garnet Epidote			Float of slag
3	Avliyana	Avliyana	Intrusives Zigana	Sb	Qz porphyry Andesite	Vein	wd:+20 cm	Stibnite Cinnabar	Quartz Clay	Sb_2S_3 60%	N 70°W,80°N	
4	Düzköy	Düzköy	Zigana	Fe,Pb	Limestone Andesite	Skarn		Specularite Galena Chalcopyrite	Calcite Garnet Epidote			
5	Melek	Deregözü (Kürtün)	Zigana	Fe,Cu	Limestone Andesite	Skarn	wd;2.0 m	Specularite Magnetite Chalcopyrite	Actinolite Epidote Garnet	Cu:1～2%		
6	Kuru Tepe (Belen Tepe)	Deregözü (Kürtün)	Zigana	Cu,Pb	Limestone Andesite Granodiorite	Skarn		Chalcopyrite Galena Specularite Pyrite	Actinolite			Gallery direction; N 60°E
7	Dere (Belen Tape)	Deregözü (Kürtün)	Zigana	Cu	Limestone Andesite	Skarn		Chalcopyrite Pyrite		Cu:1～2%	N 40°W, 30°NE	
8	Kırkpavlı	Eski Gümüşhane	Kırıklı	Au,Ag	Limestone	Vein	<1.0 m?	Pyrite	Quartz	Au:3～5 g/t Ag:16～22 g/t		
9	Hazine Mağara	Eski Gümüşhane	Kuşakkaya	Ag,Pb,Cu	Limestone	Replacement		Tetrahedrite Pyrite Galena	Barite		N 70°W,40°S?	
10	Köstere	Kalkanlı Zigana D.	Zigana	Pb,Cu,Zn	Dacite	Vein	wd;3.5 m l ;50 m	Galena Chalcopyrite Sphalerite Pyrite	Quartz Clay	Cu:2～3% Pb+Zn:10%	N 85°W,60°N	3 old grarleries and dumps
11	Mastra	Mastra Mah.	Venk Yayla	Ag,Pb	Andesite	Vein	wd;20 cm l;40～80 m	Galena Sphalerite Chalcopyrite Pyrite	Quartz Clay		80°S E-W～ 80°N	Shut down last year
12	Midi	Midi Mah. TalanlarD.	Kırıklı	Zn,Pb	Basalt～ Basaltic tuff	Vein	wd;2～10 m l; 100 m+α	Spahlerite Galena Smithsonite	Epidote Clay Quartz Calcite	Zn:20%	N 80°E 60～ 70°N	Working mine, another skarn zone with Pb+Zn
13	Sarıdere	Eski Gümüşhane	Granodiorite	Py	Granodiorite	Dissemi.	2.0 km × 1.0 km	Pyrite	Quartz			Soil sampling by MTA, Argillization
14	İstala	İstala Mah.	Zigana	Cu,Pb,Zn	Dacite	Massive	1.0 m ～2.5 m	Galena Chalcopyrite Pyrite	Quartz Clay		S 10°W,65°W N 80°W,50°S	Veins along fault

Table 2 List of Mineral Occurrences (2)

No.	NAME	LOCATION	FORMATION	KIND OF MINERAL DEPOSITS	HOST ROCKS	TYPE OF MINERAL DEPOSIT	THICKNESS OR WIDTH	ORE MINERAL	GANGUE MINERALS	GRADE OF ORE	DIRECTION OF VEIN STRIKE DIP	REMARKS
15	Haviyana-Mezraa	Haviyana Mah. Acısu D.	Kırıklı	Ba,Pb,Cu	Basaltic andesite	Vein	Wd:3.0 m l:5 m+α	Galena Chalcopyrite Tetrahedrite Pyrite	Barite Quartz		N 50°W,60°SW	Quartz veinlets with limontization
16	Mezraa	Mezraa Mah. Mezraa D.	Gümüşhane granite	Ba,Pb	Granite	Vein	Wd:1.0~1.5 m l:100+α	Sph.,Py., Gal.,Chal.	Quartz Barite		N 50°E,50°NW N 70°W,50°SW	3~5 old trenches
17	Asağı Sığırlık	Gülpinar Mah.	Zigana	Fe,Cu	Limestone Andesite	Skarn		Malachite Azurite Pyrite				N 40°w of old gallery
18	Nikola	Çatak Köyü	Zigana	Fe,Cu	Limestone Andesite	Skarn	l:3~4 m	Specularite Magnetite Malachite	Epidote	E-W 35°N		
19	Fidilla	Karabörk Mah.	Zigana	Fe	Limestone Andesite	Skarn	+50 cm	Specularite Magnetite Oxide copper	Actinolite Epidote	Fe:25%		
20	Demirdere	Deregözü (Görele)	Zigana	Fe	Limestone Andesite	Skarn		Specularite Magnetite	Actinolite Epidote	Fe:40%		
21	Kelete (Deregözü)	Deregözü (Görele)	Zigana	Fe,Cu	Limestone Andesite	Skarn		Specularite Chalcopyrite Pyrite				
22	Gırlak	Karabörk Mah.	Zigana	Fe	Limestone Andesite	Skarn	10 cm~1.0 m	Specularite Magnetite Oxide copper	Actinolite Epidote			
23	Armutlu	Deregözü Mah.	Zigana	Cu	Dacite Limestone	Vein		Chalcopyrite Specularite Pyrite	Quartz	Ag:2.0~170 g/t Cu:1% Zn:1%	N 55°W 90°	wd:15 m mineralized zone
24	Kopuz	Kopuz Mah.	Zigana	Fe	Limestone Andesite	Skarn	?	Magnetite	Epidote	Fe:67%		
25	Altıntaşlar	Kocadal Köyü	Kırıklı	Cu	Dacitic tuff	Vein	wd:0.5 m l:100~200 m	Chalcopyrite Pyrite	Quartz	Cu:9.80% Pb:0.20% Zn:0.40%	N-S 70~80° E	
26	Kırıntı	Kırıntı Yayla	Kırıklı	Pb	Andesite	Vein		Pyrite Galena				Old dump
27	Şimere	Şimere Mah.	Kırıklı	Cu,Ba	Andesite	Vein		Chalcopyrite Pyrite	Barite			Old dump
28	Kürtüklüyurt	Kürtüklü-yurt yayla	Zigana	Fe	Limestone Andesite	Skarn	wd:1.5 m l:5~10 m	Specularite Magnetite	Epidote Actinolite			
29	Çatak	Çatak Yayla	Zigana	Fe	Limestone Andesite	Skarn		Specularite Magnetite	Epidote Actinolite			Old gallery
30	Konacık	Büyük Yayla	Zigana	Fe,Cu	Andesite	Skarn	wd:0.5~1 m	Pyrite 0xide copper Sphalerite	Epidote			Slag

Table 2 List of Mineral Occurrences (3)

No	NAME	LOCATION	FORMATION	KIND OF MINERAL DEPOSITS	HOST ROCKS	TYPE OF MINERAL DEPOSIT	THICKNESS OR WIDTH	ORE MINERAL	GANGUE MINERALS	GRADE OF ORE	DIRECTION OF VEIN STRIKE / DIP	REMARKS
31	Mandıra	Mandıra Mah.	Zigana	Zn	Andesite	Vein	Wd:0.5~1.0 m l:50~60 m	Pyrite,Spha. Chalcopyrite	Quartz		N 85°W, 65~86°N	
32	Karaçukur	Dolumlu Mah	Zigana	Fe	Andesite Limestone	Skarn		Magnetite Specularite Pyrite	Actinolite Tremolite		N 60°E	Old dump Old gallery (100 m)
33	Keltaş günay	East of Dreyatak Mah.	Zigana	Cu,Fe	Dacite	Vein		Malachite Py. Chalco	Quartz			
34	Kösedere	Piredill Mah.	Zigzna	Fe	Limestone Andesite	Skarn		Magnetite	Epidote			
35	Erikbeli Yayla	Virankilise Tepe	Zigana	Fe	Dacite Andesite	Dissemi.		Pyrite				Argillization
36	Cami	Cami Mah. (Kürtün)	Zigana	Fe	Andesite	Dissemi.		Pyrite Malachite				
37	Maden Mah.	Maden Mah.	Zigana	Fe,Cu	Andesite	Vein		Pyrite Malachite	Quartz		N 45°E,60°NW	Old gallery
38	Şive	Şive Mah.	Zigana	Fe	Andesite Granodiorite	Dissemi.		Pyrite				Silicification Argillization
39	Köstere dere	Ayur dere	Zigana	Fe,Cu	Andesite	Dissemi.		Oxide Copper				Silicification Argillization
40	Diker Mah.	Kızılcık Mah.	Granodiorite	Fe	Granodiorite	Dissemi.		Pyrite				Silicification
41	Kalkanlı	Kalkanlı Mah.	Zigana	Cu,Fe	Andesite,Lim., Granodiorite	Skarn Dissemi.		Py.Mag.specul. Oxide copper				Argillization
42	Değırmen dere	Kuplu Mah.	Granodiorite	Fe	Granodiorite	Dissemi.		Pyrite				Silicification Limonitization
43	Torul	Torul	Zigana	Cu,Fe	Andesite	Dissemi.		Oxide copper				Silicification
44	Herek	Herek Mah.	Zigana	Cu,Fe Zn	Andesite	Dissemi.		Oxide copper				Silicification Argillization
45	Beşkise	Beşkise	Zigana Granodiorite	Fe	Andesite Granodiorite	Dissemi.		Pyrite				Silicification Limonitization
46	Otalan	Otalan Mah.	Zigana	Fe	Andesite	Dissemi.		Pyrite				Silicification
47	Fidikar	Fidikar Mah.	Zigana	Fe	Andesite	Dissemi.		Pyrite				Silicification
48	Maden Tepe	South of Fidikar	Zigana	Fe	Andesite	Dissemi.		Pyrite				Limonitization
49	Kürtmezarı Yayla	South of Fidikar	Zigana	Fe	Andesite	Dissemi.		Pyrite				Argillization
50	Canca	Davunnu Mah.	Venk Yayla	Fe	Andesite	Dissemi.		Pyrite				Argillization Limonitization
51	Akçakale	Asağı Mah.	Gümüşhane granite	Cu,Zn Ba,Pb	Granite	vein		Chalcopyrite Galena Pyrite	Barite			

Table 2 List of Mineral Occurrences (4)

No	NAME	LOCATION	FORMATION	KIND OF MINERAL DEPOSITS	HOST ROCKS	TYPE OF MINERAL DEPOSIT	THICKNESS OR WIDTH	ORE MINERAL	GANGUE MINERALS	GRADE OF ORE	DIRECTION OF VEIN		REMARKS
											STRIKE	DIP	
52	Araköy Yayla	Araköy yayla	Zigana	Cu,Fe	Andesite	Dissemi.		Oxide copper pyrite					Silicification
53	Kaynar Tepe	Kaynar Tepe	Zigana	Fe	Limestone	Skarn		Specularite Hematite					
54	Çamdibi	Çamdibi Mah.	Zigana	Cu	Andesite	Vein	Wd:10 cm	Chalcopyrite Oxide copper	Quartz		N 20°W		
55	Kodilbahçekö	Kodil Mah.	Gümüşhane granite	Fe	Granite	Skarn ?		Specularite Magnetite					

Table 3 Results of X-ray Diffractive Analyses

Sample No.	Name	Locality & Description	Detected Minerals												Remarks
			m	mix	ch	se	k	q	pl	grs	ro	ce	be	py	
M-60	Argillized Andesite	Hasandere area. Strongly argillized with py-veinlets	○		◯	◯		◯	○						
K-23	Altered porphyritic gd.	Hasandere area. Pl changed to white clay, with py-diss			○	○		◯	◯						Hydromica
M-142	Garnet	Karadag area. Greenish yellow dodecahedron crystal.						•	•	◎					a_o= 11.91
M-87	Garnet	Melek area. Greenish yellow dodecahedron crystal with quartz + specularite.						○		◎					a_o= 12.07
M-146	Secondary mineral	Avliyana Sb Mine. Accompanied with stibnite.						○			◎				
H-240	White mineral	Mastra Mine. White clay in Ag-Pb-Zn-Cu vein										◎	○ ?		
H-241	Argillized rock	South of Mastra Mine. Altered zone.				◯*		◎							* $2M_1$ type
M-155	Argillized rock	Kalkanli altered zone in Kzal				◯	○	◎							
H-37	Arg. rock	Herek altered zone in Kzal				◯*		◎						○	* $2M_1$ type
T-101	Arg. rock	Cami altered zone in Kzal		○*	○	○		◎							* Se/m

m: montnorillonite, mix: mixed layer mineral, ch: chlorite, se: sericite
k: kaoline mineral, q: quartz, pl: plagioclase, grs: hydrogrossular-grossular
py: pyrite, se/m: sericite-montmorillonite mixed layer mineral ce: cerussite $PbCO_3$
ro: romeite $(Ca,Fe,Mn,Na)_2(Sb,Ti)_2O_6(O,OH,F)$
be: beaverite $Pb(Cu,Fe,Al)_3(SO_4)_2(OH)_6$ ◎: Abundant ◯: Common ○ : few •: rare

Table 4 Results of Microscopic Observation of Thin Sections

Sample No.	Rock Name	Rock unit	Texture	Phenocryst										Groundmass							Alteration
				Q	Af	Pl	Bi	Ms	Ho	Aug	Hy	Px	Op	Q	Pl	Px	Ms	Op	Glass	Sec	
H-1	Ho-Bi Mon	Pgg	Hol:Eqi	○	◎	◎			◎				□								Ho,Bi →Epi,Chl
H-3	Bi-Ms Mon	Pgg	Hol:Por	◎	◎	◎	○	○					□								Pl→Ser
H-5	Bi Mon	Pgg	ditto	◎	◎	◎	○	○					□								Af→Ser
H-6	Bi Mon	Pgg	ditto	◎	◎	◎		□					□								Bi→Chl
H-7	Bi Mon	Pgg	Hol:Eqi	◎	◎	◎	○		□				□								Bi→Chl
A-2	Bi Mon	Pgg	ditto	◎	○	◎	○						□								Pl→Ser
A-3	Bi Mon	Pgg	ditto	◎	○	◎	○						□								Bi→Epi
A-5	Bi Mon	Pgg	ditto	◎	◎	◎	○						□								
T-107	Bi Mon	Pgg	ditto	○	◎	◎	□	□					□								Bi→Chl,Pl→Ser
E-198	Ho Gd	gd	ditto	◎	○	◎	□		○				□								Ho→Chl,Epi
S-69	Bi Gd	gd	ditto	◎	○	◎	□						□								Bi→Chl,Epi
E-3	Ho Mon	gd	ditto	○	○	◎	□		○				□								Ho→Epi,Chl
M-30	Bi-Ms Gd	gd	ditto	◎	○	◎	○	□					□								Pl,Af st.altered
H-141	Ho-Bi Gd	gd	ditto	○	○	◎	○		○				□								Ho→Epi
Y-2	Por Gd	pgl	Por	◎		◎						□		◎				□			Px→Chl,Gm→Ser
H-38	Ho Gd	gd	Hol:Eqi	◎	○	◎	□		○				□								Ho→Chl,Epi
T-1	Ho Gd	gd	ditto	○	○	◎	□		○				□								
E-202	Ho Gd	gd	ditto	◎	○	◎	□		○				□								Ho→Chl,Epi
E-201	Ms Qp	qp	Hol:Por	◎				○						◎			○	□			
H-31	Aug-Ho Da	Tva				◎	□		◎	○					○			□	◎	○	Aug →Cly:Zeol
H-108	Bi-Hy-Aug-Ho Da	Tva				◎	□		◎	○	□				◎			□	◎		
E-204	Ho And	Tva		○		◎	○		◎	○	○				◎	□		□	◎		
E-205	Basalt	Kz	Hy-pil			◎								□	○			□	◎	◎	Glass →Chl,Cal
E-158	Basalt	Kz	ditto			◎						□			◎			□	◎	◎	Pl→Ser,Chl
Y-70	And	Kz				◎								○				□		◎	St.Altered
M-74	Rhyolite	Kz		○		◎								◎			□	□			Altered
E-113	Rhyolite	Kz		◎		○								◎			□	□		○	Altered
A-172	Basltic And	Jkb	Hy-pil			◎							□		○				◎	◎	Altered
A-173	Hy-Aug Bas.And	Jkb				◎				○	△				◎	□		□		◎	Pl→Chl,Cal,Px→Chl
E-203	Bas.And	Jkb				◎								○	◎			□	○	○	Pl→Chl,Cal
A-162	Qp	qp		◎		○			□			□		○				□		○	Ho,Px,Pl→Chl,Ser
E-124	Dacite	Kz				○								◎			○	□		◎	Altered
T-13	Bi-Ms Schist	PKg	Lep-blas	◎		○	○	□					□								
M-140	Bas And Tf	Kz		Fragment:Glass,Pl										Matrix:Chl							Pl→Chl,Glass →Chl
T-12	Acidic Tf	Jkb		Fragment:Glass,Pl,Pumice,Q,Perlite										Matrix:Chl							Pl→Chl,Glass →Chl,Cal

Abbreviations of Rock Unit same as in the geological maps

◎:Abundant
○:Common
□:Few
△:Rare

Mon:Quartz monzonite
Gd:Granodiorite
Qp:Quartz porphyry
Da:Dacite
And:Andesite
Bas:Basaltic
Tf:Tuff

Hol:Holocrystalline
Eqi:Equigranular
Por:Porphyritic
Hy-pil:Hyalopilitic
Lep-blas:Lepidoblastic
Pheno:Phenocryst
Gm:Groundmass
Q:Quartz
Af:Alkali feldspar
Pl:Plagioclase
Bi:Biotite
Ms:Muscovite
Ho:Hornblende
Aug:Augite
Hy:Hypertbene
Px:Pyroxene
Op:Opaque minerals
Chl:Chlorite
Ser:Sericite
Epi:Epidote
Cal:Calcite
Py:Pyrite
Cly:Clay
Zeol:Zeolites
Sec:Secondary minerals

Part 3 GEOCHEMICAL PROSPECTING

PART III GEOCHEMICAL PROSPECTING

Chapter 1 Re-examination of UNDP Data

1-1 Outline of UNDP Project

Mineral prospecting projects were conducted in two areas, namely Menderes Massif and Merzifon-İspir jointly by the Government of Turkey and UNDP (United Nations Development Programme) during the period of 1970-1974. As a part of these projects, geochemical reconnaissance survey was conducted and 19,282 geochemical samples were collected from the stream sediments of the Merzifon-İspir area (2,400km^2) which includes the Gumuşhane area. The sampling density was 1.2km^2 per one sample.

In the Merzifon-İnspir area, 47 geochemical anomalies were detected on the basis of the threshold values of Cu:100ppm, Mo:5ppm, Pb:70ppm, Zn:220ppm. There are 12 anomalies in the surveyed area excluding Zone A and eight are believed to be promising(UNDP technical Report 2, 1974). The promising anomalous zones in the surveyed area for fiscal 1985 are shown in Figure 31 and Table 5.

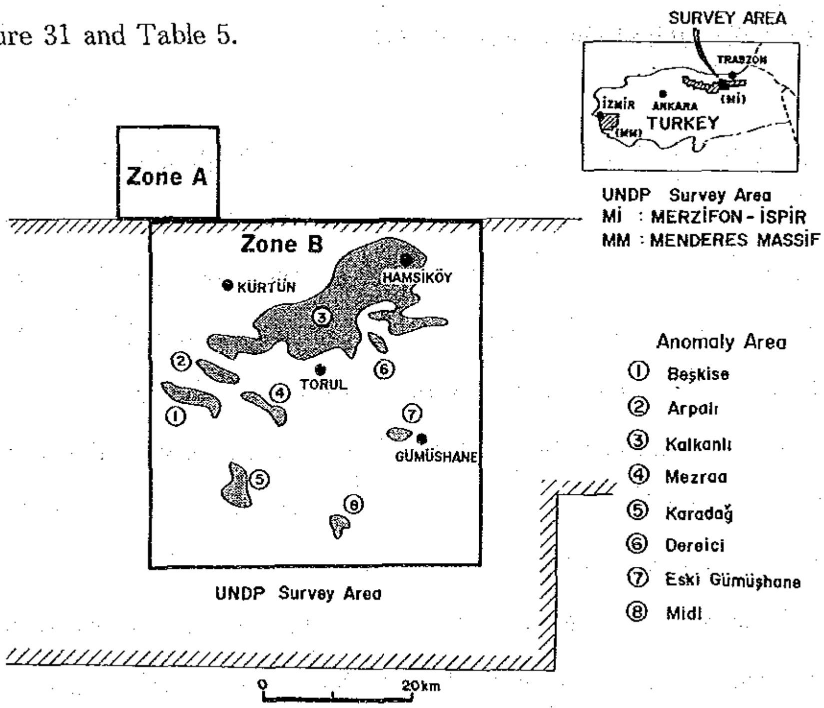


Fig.31 Geochemical Anomalous Areas Extracted by UNDP

Table 5 List of Geochemical Anomalous Area Extracted by UNDP

Anomaly Area	Area(km^2)	Geochemical Values (ppm)
① Beşkise	5.1	Cu:110～290(6),Mo:10～29(4),Pb:90～110(3)
② Arpail	6.0	Mo:29(1)Pb:70～200(5),500(1),Zn:550,800(2)
③ Kalkanlı	114.8	Cu:110～650(19),Mo:10～15(3) Pb:70～250(6),260～850(14)Zn:250～400(6)1200(2)
④ Mezraa	10.3	Cu:110～240(4),Pb:75～230(6),430～1,000(2) Zn:550(1)
⑤ Karadağ	20.5	Cu:120～320(11),Mo:38(1),Pb:70～200(10) Pb:450～1,000(7),Zn:230～450(2),700～1,100(5)
⑥ Dereici	5.0	Mo:8～38(3)
⑦ Eski Gümüşhane	6.6	Cu:130～350(3),Pb:75～200(6),300～1,300(6) Zn:250～300(4),1,300～1,700(2)
⑧ Midi	9.7	Pb:110～700(10),Zn:2,500,3,500(2)

( ) : Number of anomalous values

1-2 Re-analysis of UNDP Geochemical Data

The analysis by UNDP was done using only one threshold value for Merzifon-İspir area. But for a particular area, the threshold values change by the range of overlap of the distribution of the background population and the anomaly population.Thus it is necessary to clarify the distribution of the two populations and to select new thhreshold values.

Before conducting geochemical prospecting, we processed statistically and re-analysed the UNDP geochemical data of our area for 1985. The elements considered were Cu, Mo, Pb and Zn which are closely related to mineralization. The number of samples were Cu 2,018 samples, Mo 1,777, Pb 1,095 and Zn 1,312.

Re-analysis was done by Lepeltier's (1969) method which will be explained later.The cumulative frequency distribution curve for all elements consists of two populations, both showing approximate lognormal distribution. They are anomaly population and background population. The threshold values (t) and other statistical parameters obtained from the cumulative frequency distribution are as follows.

Element	N	Mean(M)	M+σ	M+2σ	Max.value	Min.value	t	t'
Cu	2,018	32	68	144	650	1	90	100
Mo	1,777	2.2	3.6	6.0	50	1	6	5
Pb	2,095	40	96	230	1,900	3	105	70
Zn	1,312	88	171	331	3,500	9	215	220

σ: standard deviation assuming lognormality (ppm)

N:Number of Samples, t: Threshold of Surveyed Area, t':Threshold of UNDP

1-3 The Results of the Re-analysis and the Objective of Geochemical Prospecting for 1985

Geochemical anomalous zones were clearly extracted in Zone B as a result of re-analysis using the newly obtained threshold values. Of these zones, those with Cu and Mo overlap and with Cu, Pb, Zn overlap were noted, the former having posibility of indicating porphyry copper and the latter skarn-vein type mineralizations. The details will be considered together with the results of our survey in Chapter 4

Considering the nature and distribution of the extracted anomalous zones we laid emphasis on the following points for our geochemical prospection in 1985.

a. Zone B. As anomalous zones were clearly extracted, it will not be necessary to sample the whole Zone.

b. Zone B. Geochemical prospecting will be conducted with emphasis in the three zones (Hasandere, Kalkanlı, Beşkise) where Cu-Mo anomalies are strong.

c. Southern part of Zone B. Gümüşhane Granite is widely distributed and sampling will be conducted in the area of distribution in order to check the possibility of greisenization.

d. Zone A. Geochemical work on stream sediments has not been conducted in the past. Therefore homogeneous sampling will be mede for the whole zone with Cu, Mo, Pb, Zn and Ag as the indicators and the geochemical characteristics of the zone willbe clarified.

Chapter 2 Sampling and Analysis

2-1 The Area of Geochemical Prospecting

Zone A: As geochemical sampling has not been carried out, sampling was done with 0.5km²/ sample and Cu, Mo, Pb, Zn, Ag indicators.

Zone B: UNDP sampled the area at 1.3km²/ sample and geochemical anomalies have been detected. Three zones with strong Cu-Mo anomalies and the area of Gümüşhane Granite distribution were sampled.

2-2 Sampling

Samples were collected during geological survey, stream sediments under 80 mesh were sieved at site and 20-50g were collected at each point. Samples were dried under the sun at base camp, quartered, halves were used for analysis and the other halves preserved.

The number of collected samples was 406 in Zone A and 504 in Zone B.

2-3 Analytical Methods

The samples from Zone A were analysed for five elements Ag, Cu, Mo, Pb, Zn, those from Zone B for nine elements Ag, Cu, Mo, Pb, Zn, Sn, W, As, F considering greisenization. All samples were analysed by atomic absorption method by Chemex Labs. Ltd., of Canada. The limits of detection area as follows.

Ag	0.1ppm	Sn	1ppm
Cu	1ppm	W	1ppm
Mo	1ppm	As	1ppm
Pb	1ppm	F	20ppm
Zn	1ppm		

The analytical results area shown in Table 10.

Chapter 3 Processing and Examination of Data

3-1 Processing and examination of data

Sampling density is a very important factor in assessing the population during statistical treatment of geochemical prospecting data. More than 3,000 geochemical samples have been collected including UNDP data from the surveyed area. But there arre local variations of sampling density, 2 samples/km^2 in Zone A and 1.0～0.7 samples/km^2 in Zone B. As the densities are different, data should be treated separately. Considering two populations, one for Zone A and the other for Zone B,we studied whether significant difference existed between the mean values of the two populations.

We used the following statistical method

① Hypothesis: Ho :$\mu A = \mu B$ (Mean values of the two populations are equal.)

② Obtain to by following equation :

$$t_0 = \frac{|\chi_A - \chi_B|}{\sqrt{\frac{V_A}{n_A} + \frac{V_B}{n_B}}}$$

, where χ_A, χ_B : Mean values of populations, A and B, respectively.

V_A, V_B : Variance of populations, A and B, respectively.

n_A, n_B : number of populations, A and B, respectively.

$$1/\phi = \frac{C^2}{n_A - 1} + \frac{(1-C)^2}{n_B - 1}, \quad C = \frac{V_A / n_A}{V_A / n_A + V_B / n_B}$$

③ Result : If to $\geqq t(\phi, 0.01)$, there is diffrence between the mean values of population A and B at significant level 1 %.

It has shown that the mean values of the two populations is different for common elements Cu, Mo, Pb, Zn (significant level 1%) and thus the data of Zone A and B were treated separetely.

Geochemical Data — Zone A:Ag、Cu、Mo、Pb、Zn
Zone B:Ag、Cu、Mo、Pb、Zn、As、W、Sn、F

↓

Read All Data with Coordinates

↓

Max A(I)、Min A(I)

↓

Conversion of Arithmetric Data into logarithmic values

↓

Classification of the populations into 16 intervals
Logarithmic interval:(log {max A(I)} -log {min A(I)})/16

↓

Calculation of Mean(M)、Standard Deviations(σ)、Frequency、Cumulative Frequency、Cumulative Frecuency % and Correlation Coefficient

↓

Drawing of Histogram、Cumulative Frequency Distribution Curve、and Correlation Diagram

↓

Determination of thereshld Values

↓

Drawing of Anomalous Sample Points on the Map 1/50,000 scale

↓

Extraction of Geochemical Anomalous Zones

↓

Evaluation of Anomalous zones

Fig.32 Flow Chart of statistical Treatment of Geochemical Data

3-2 Data Processing

All analytical data were converted to logarithmic values, mean value (M), standard deviation (σ), frequency, cumulative frequency were calculated by computor for each element together with the correlation coefficients between each element pairs. The results are laid out by X-Y plotter as histograms, cumulative frequency distribution curves and correlation diagrams (Figs 33-37). The flow of this process is shown in figure 32.

3-3 Correlation

The coefficients with good correlation are laid out in correlation diagram (Figs. 36, 37).

Strong positive correlation is observed for Pb-Zn in both Zones A and B, the coefficicent is higher than 0.7. Weak positive correlation is observed for Ag-Pb, Cu-Zn, Cu-Pb, Cu-Mo, Cu-As, Pb-As, Zn-As. As for W, Sn (Ag, Mo), they exist in most of the samples below the limit of detection and thus clear correlation is not shown. There are no element pairs with negative correlation.

3-4 The Determination of Threshold Values of Each Element

The threshold values of each element were determined by C.Lepelier's (1969) method. That is when the cumulative frequency distribution is expressed as a straight line decreasing to the right, the 2.5% point was taken as the threshold value; when the line bent at a point below 50%, the breaking point was taken; and when there were two breaking points, the mid-point between the two was used. For Ag, W, Sn, Mo, however, most values were below the limit of detection and thus frequency distribution is not clear, and $M+2\sigma$ was used as threshold value.

The cumulative frequency distribution of Cu, Pb, Zn show clear positive skewess for both zones and the values for these elements are divided into background unit groups and anomaly unit groups for both zones (Fig. 35).

For F and As, however, it became almost straight and it was not possible to distinguish the plural groups.

The determined thereshold values are as follows.

	Ag	Cu	Mo	Pb	Zn	As	W	Sn	F
Zone A	0.5	174	7	154	293	–	–	–	–
Zone B	0.6	100	6	100	227	105	5	3	631

(ppm)

Table 6 Statistical Parameters of Geochemical Samples

Zone A

	N	Mean(M)	Min.Value	Max.Value	σ	M+σ	M+2σ
Ag	406	0.12	0.1	10.7	0.290	0.2	0.5
Cu	406	48.4	1	5,500	0.471	143.0	422.8
Mo	406	1.5	1	120	0.317	3.0	6.3
Pb	406	41.0	1	9,000	0.524	137	457.9
Zn	406	105.2	2	3,140	0.360	241.2	552.9

Zone B

	N	Mean(M)	Min.Value	Max.Value	σ	M+σ	M+2σ
Ag	504	0.12	0.1	6.7	0.306	0.29	0.58
Cu	2,522	30.2	1	780	0.361	69.3	159.0
Mo	2,281	2.0	1	50	0.245	3.4	6.1
Pb	2,599	38.0	1	3,250	0.395	94.5	234.8
Zn	1,816	89.2	9	3,500	0.293	175.4	344.6
As	504	12.1	1	190	0.466	35.3	103.4
W	504	1.3	1	125	0.255	2.4	4.2
Sn	504	1.1	1	18	0.142	1.5	2.1
F	504	327.5	100	1,900	0.152	464.3	658.3

(ppm)

N:Number of Samples, σ:Standard deviation,assuming lognormality

Table 7 Correlation Coefficients for Trace Elememts of Stream Sediments

Zone A

	Ag			
Cu	0.433	Cu		
Mo	0.430	0.424	Mo	
Pb	0.500	0.364	0.325	Pb
Zn	0.452	0.605	0.273	0.727

Zone B

	Ag							
Cu	0.404	Cu						
Mo	0.181	0.430	Mo					
Pb	0.622	0.540	0.165	Pb				
Zn	0.514	0.555	0.104	0.739	Zn			
As	0.456	0.437	-0.029	0.573	0.536	As		
W	0.092	0.013	0.164	0.041	0.028	-0.022	W	
Sn	0.090	-0.144	-0.055	-0.039	-0.038	-0.083	0.138	Sn
F	0.108	-0.092	0.014	0.068	0.026	0.242	0.143	0.076

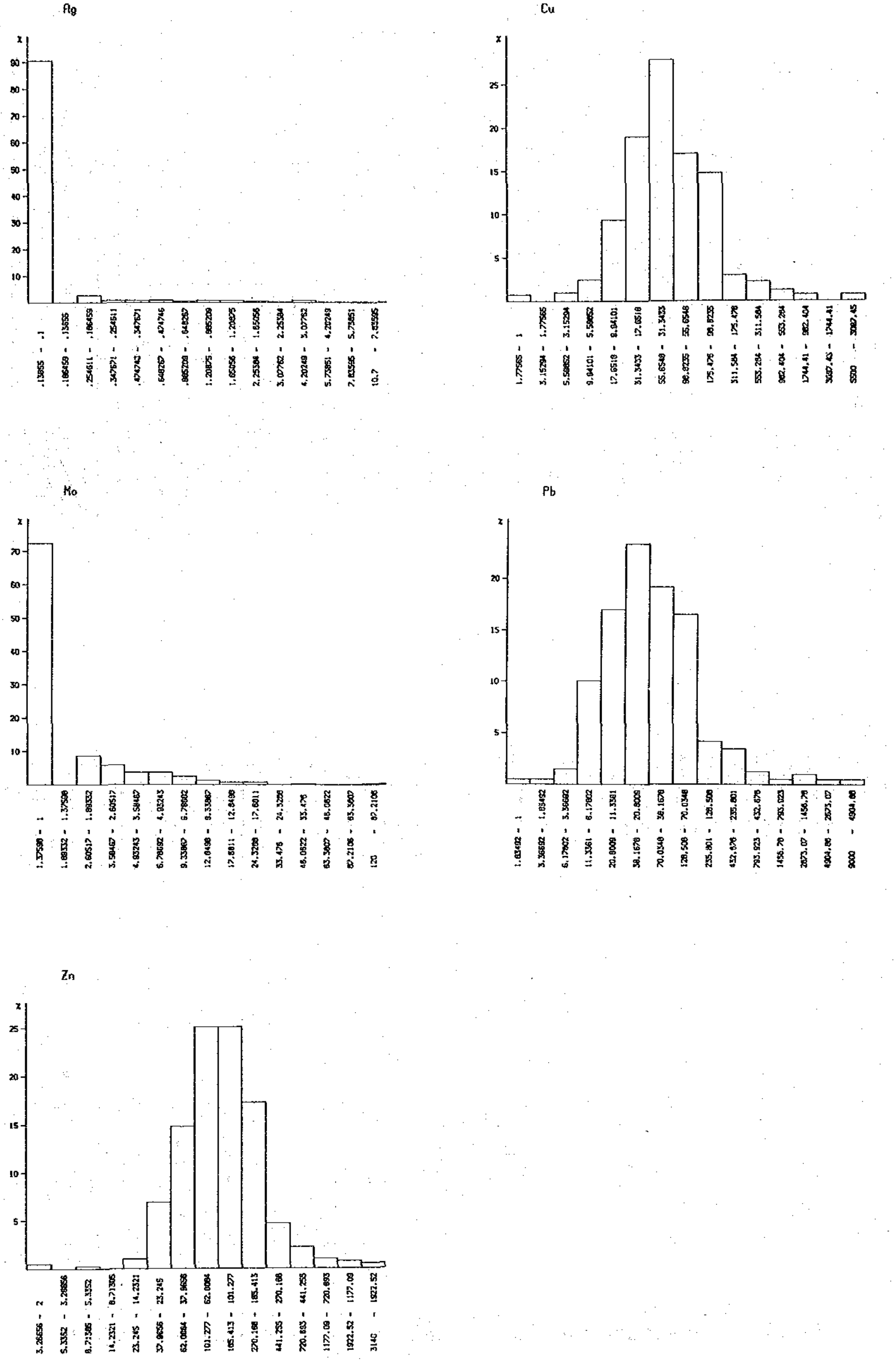


Fig.33 Histgrams for Trace Elements of Stream Sediments in Zone A

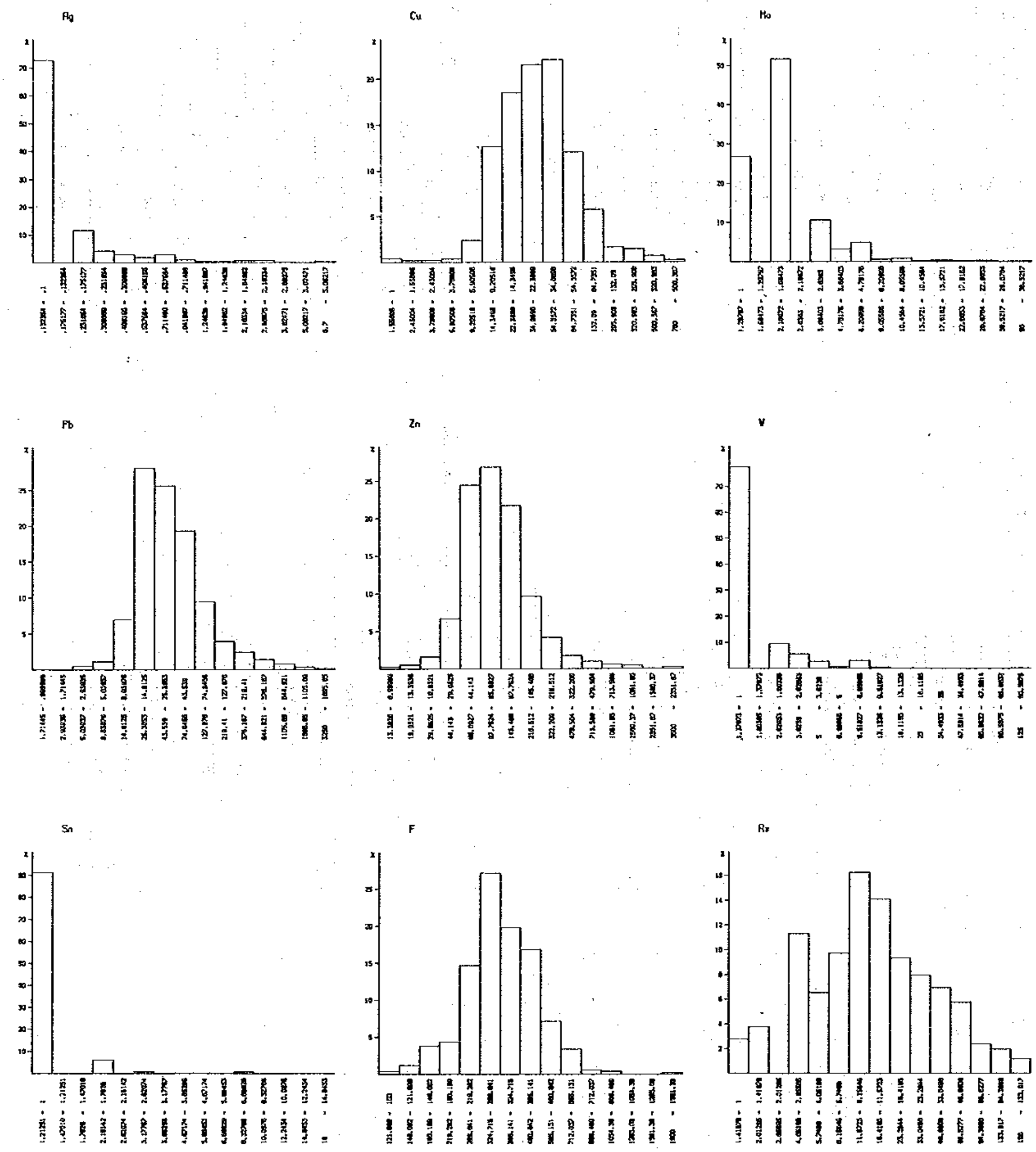
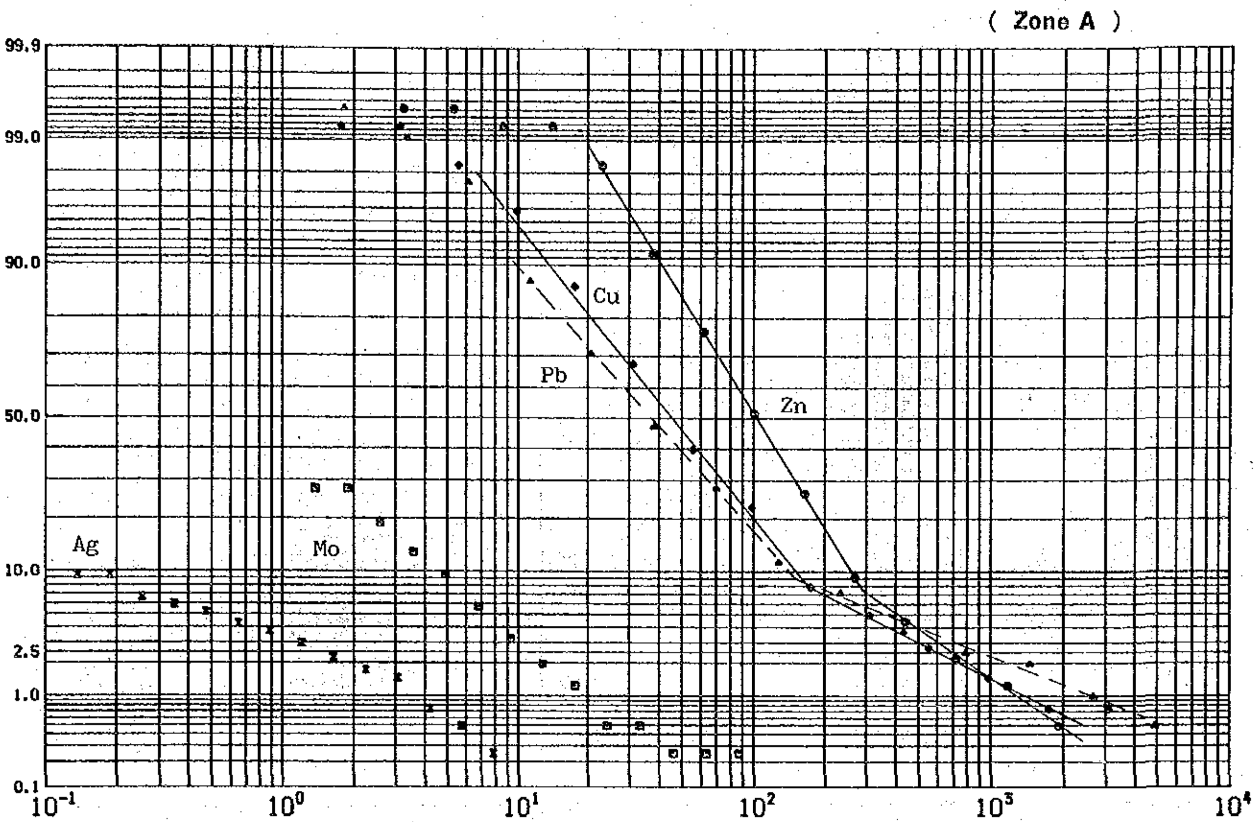


Fig.34 Histgrams for Trace Elements of Stream Sediments in Zone B



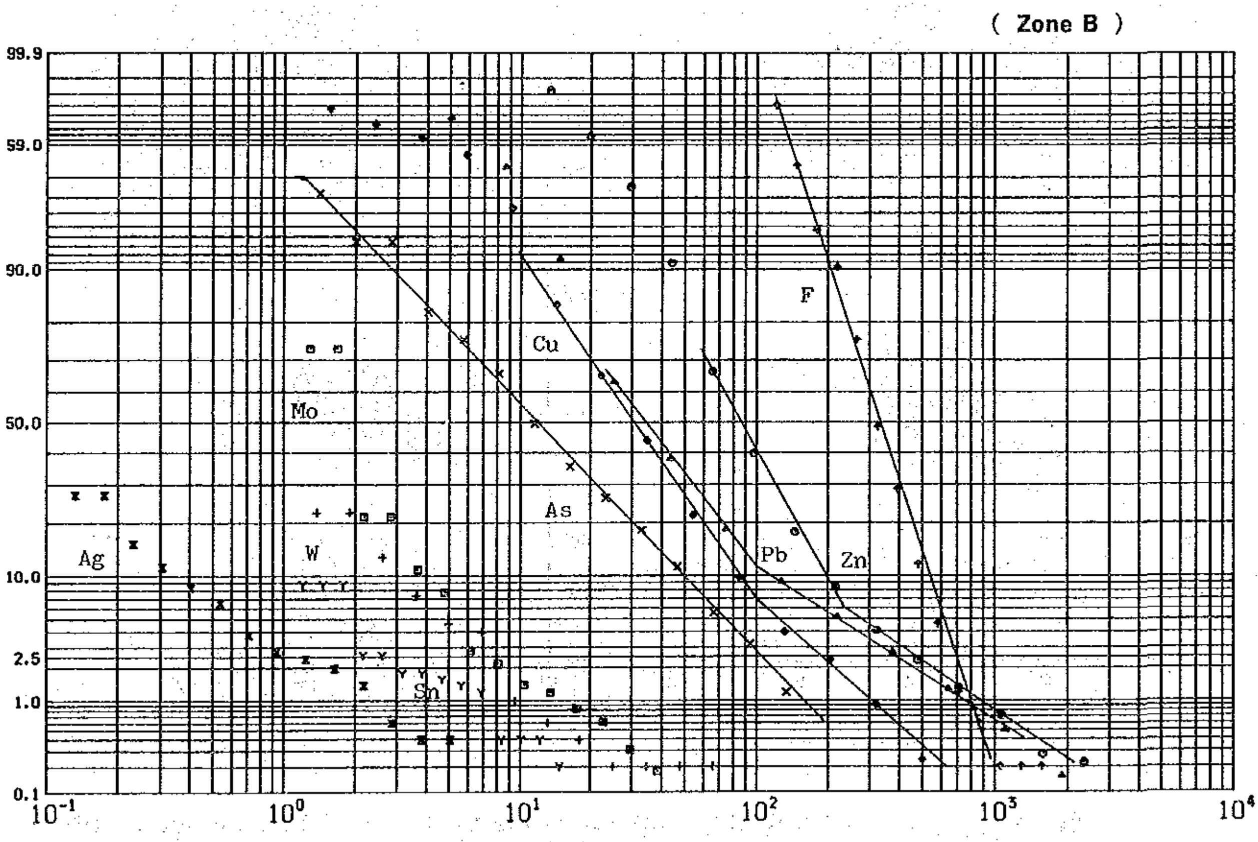


Fig.35 Cumulative Frequency Distribution Curves for Trace Elements of Stream Sediments

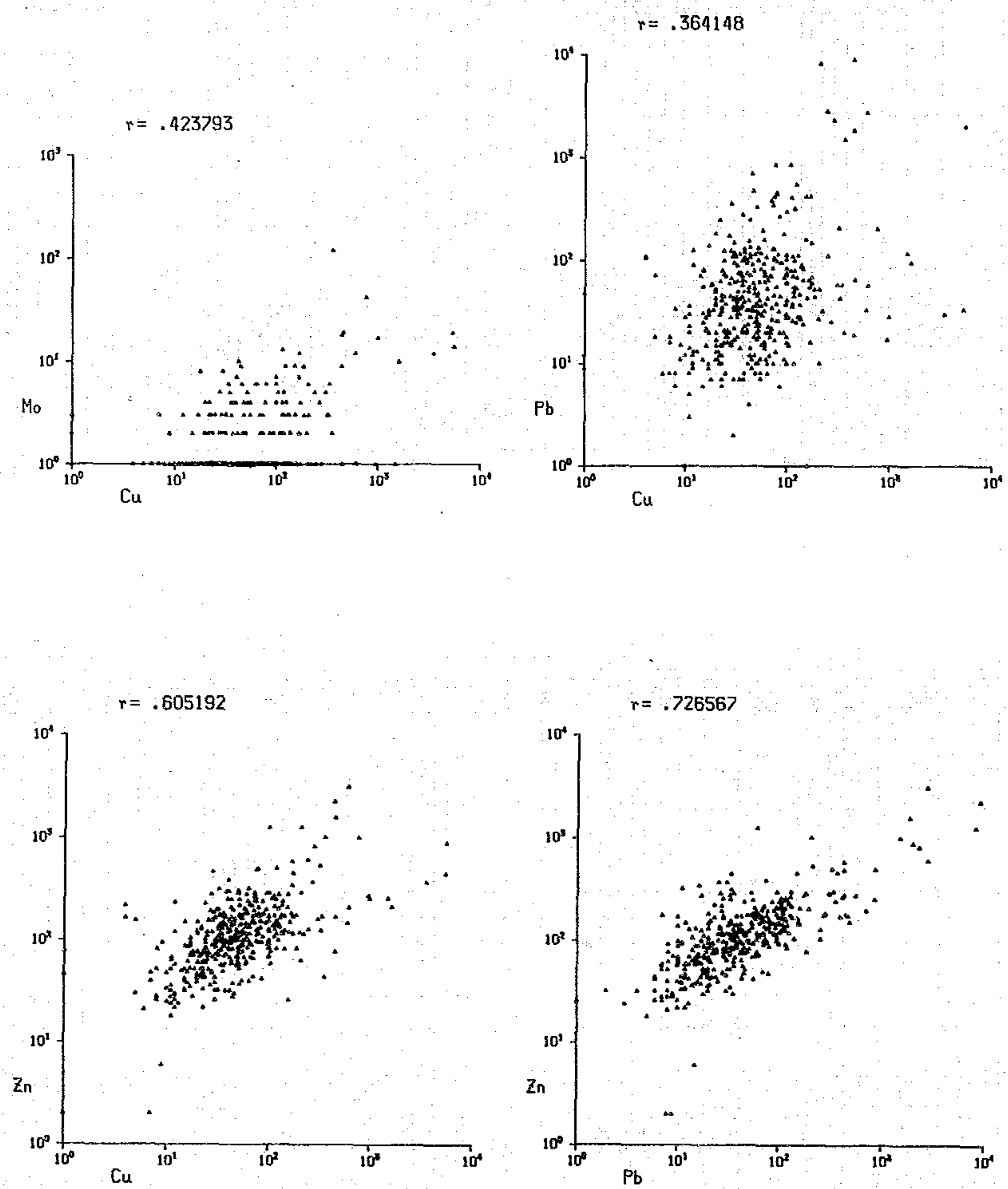


Fig.36 Correlation Diagrams for Trace Elements of Stream Sediments in Zone A

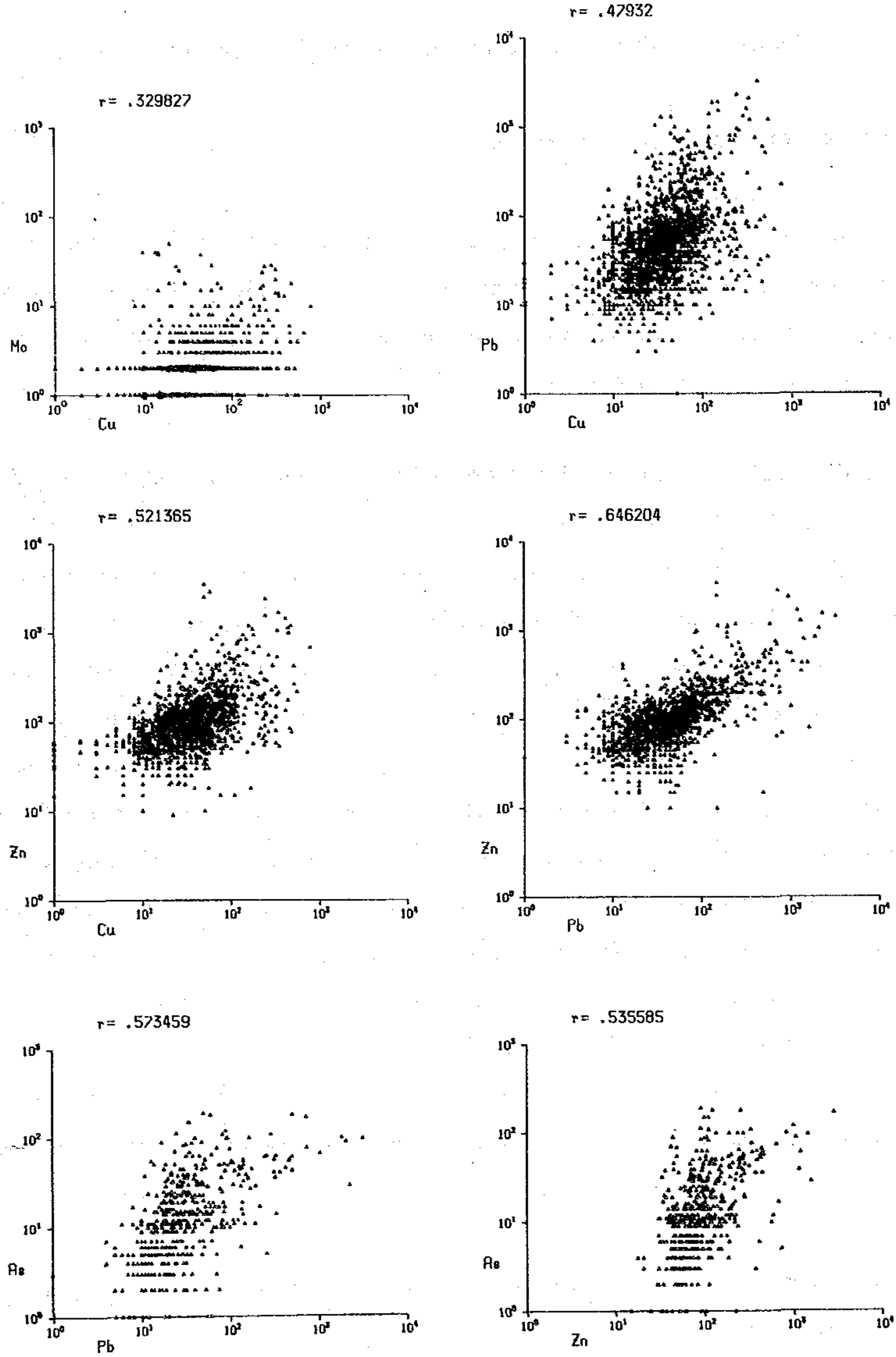


Fig.37 Correlation Diagrams(selected) for Trace Elements of Stream Sediments in Zone B

Chapter 4 Extraction and Evaluation of Anomalous Zones

4-1 Extraction of Anomalous Zones

Anomalous zones were delineated using the threshold values for each element. The extracted zones are shown in the attached map. The anomalous zones are defined here as those areas where anomalies of two or more elements overlap or where two or more adjoining sampling sites show anomalous values.

4-2 Distribution Characteristics of Anomalies and Anomalous Zones

There are not many anomalus zones in the southern part of the surveyed area where Pre-Cretaceous formations are distributed while fair number of such zones occur in the northern part where Upper Cretaceous units are widely distributed. These zones in the north exist where combination of andesite-limestone and intrusion of young granodiorite occur, and is related to the large scale while alteration zone in the Zigana Formation and in the vicinity of young intrusive bodies. Of these zones Kalkanlı (Anomaly zone B-11) and Der dere(Anomaly zone B-15) are elongated in NE-SW direction and it is noted that this trend agrees with that of the young intrusive body. Also some Wf, Sn, As, F anomalies were detected in the south, but most of them were for only one element, sporadic. Only a very few formed anomalous zones consisting of overlaps of more than one element.

The characteristics of the anomalies according to elements are as follows.

Ag : Ag Anomalies are found associated with high Pb-Zn anomalies, maximum is 10.7ppm. Very few anomalous zones are formed by Ag alone.

Cu : Anomalies of Cu only are usually low close to the threshold value. High anomalies occur in Pb-Zn or Mo anomaly zones.

Mo : Occur often with Cu anomalies and is closely related to the young intrusive bodies. Also occur sporadically in Pb anomaly zones and rarely independently.

Pb : There is a tendency to form fairly wide anomalous zones and Cu, Zn form narrowanomaly zones within the Pb zones. Pb often forms independent anomaly zones, but the values are low 1-2 times (less than M+2 σ) the threshold value. Also the distribution of Pb anomalies coincides with that of regional white alteration zone.

Zn : The anomalous zones either coincide with those of Pb or occur as narrow belts within wide Pb anomalous zones. Zn rarely formes independent anomalies.

As , W, Sn, F: Strong correlation is not observed among the distributions of these four elements. The only notable relation of the weak overlap of Sn-W distribution. Many of the anomalies of these elements occur in the southern part where the Gümüşhane Granite is distributed, but they are scattered and sporadic. There is no correlation with the distribution of Ag, Cu, Mo, Pb, Zn and the only observed relationship is the occurrence of As anomalies in Pb-Zn zones (Midi and Kalkanlı Anomalous Zones). Also in some cases W anomaly coincides with that of Mo (Hasandere Anomalous Zone).

4-3 Assessment of Anomalous Zones

Anomalous zones were classified into four ranks, namely A, B, C, D, by the geochemical data such as number of anomalies in the zone, the strength of the anomalies, the number of elements which overlap, the size of the zones and the geochemistry conditions of the known mineralized and alteration zones. All the delineated anomalous zones are listed in Table 9. The zones ranked A and B are set out in Table 8 and Figure 38.

Table 8 List of Remarkable Geochemical Anomalous Areas in the Project Area

Name of Anomaly (No.)	Area (km²)	Number of Anomalous Values (Max. Value) ppm									Geological Enviroments	Evaluation
		Ag	Cu	Mo	Pb	Zn	As	W	Sn	F		
Hasandere (B−17)	5.3	2 (1.4)	8 (780)	6 (28)	1 (222)	3 (685)	—	4 (13)	1 (5)	—	Kza 1, pg 1, pg 2	A
Karadağ (B−37)	10.8	4 (2.4)	13 (340)	1 (8)	14 (2,100)	9 (1,060)	—	1 (9)	—	—	Kzl, Kza 1, qp,gd	A
Belen Tepe (A-8)	6.5	3 (2.4)	7 (620)	4 (19)	3 (9,000)	6 (2,270)	N.A.	N.A.	N.A.	N.A.	Kzl, Kza 2, gd	A
Midi (B−40)	11.2	2 (2.3)	—	3 (6)	13 (780)	6 (3,500)	1 (170)	—	—	—	Jkb, pgg	A
Euliya Tepe (A−1)	5.5	8 (10.7)	5 (600)	3 (12)	9 (2,800)	6 (3,140)	N.A.	N.A.	N.A.	N.A.	Kzl, Kza 2, qp	A
Eski Gümüşhane (B−33)	5.7	3 (6.7)	4 (350)	—	13 (1,300)	8 (2,400)	—	—	1 (3)	—	Jkb, Jkvl, pgg,gd	B
Armutlu (A−2)	1.1	—	1 (770)	2 (42)	2 (205)	1 (1,020)	N.A.	N.A.	N.A.	N.A.	Kza 2, Kzd 1	B
Kökbükü Tepe (A−9)	2.1	1 (0.6)	1 (960)	2 (120)	—	—	N.A.	N.A.	N.A.	N.A.	Kza 2, Kzd 1	B
Kakıllı (B−5)	11	N.A.	1 (229)	8 (50)	5 (140)	1 (250)	N.A.	N.A.	N.A.	N.A.	gd	B
Kalkanlı (B−11)	103	10 (2.0)	46 (650)	7 (28)	97 (3,250)	51 (1,560)	4 (180)	—	—	1 (770)	Kza 1, Kzd 2, Kza 2, gd	B
Derdere (B−15)	39.5	N.A.	3 (125)	3 (15)	31 (900)	4 (550)	N.A.	N.A.	N.A.	N.A.	Kza 1, gd	B
Beşkise (B−26)	12	—	13 (480)	11 (26)	4 (160)	—	—	—	—	—	Kza 1, gd	B

N.A.: Not analyzed; Abbreviation of Geological enviroment shown in Fig. 5

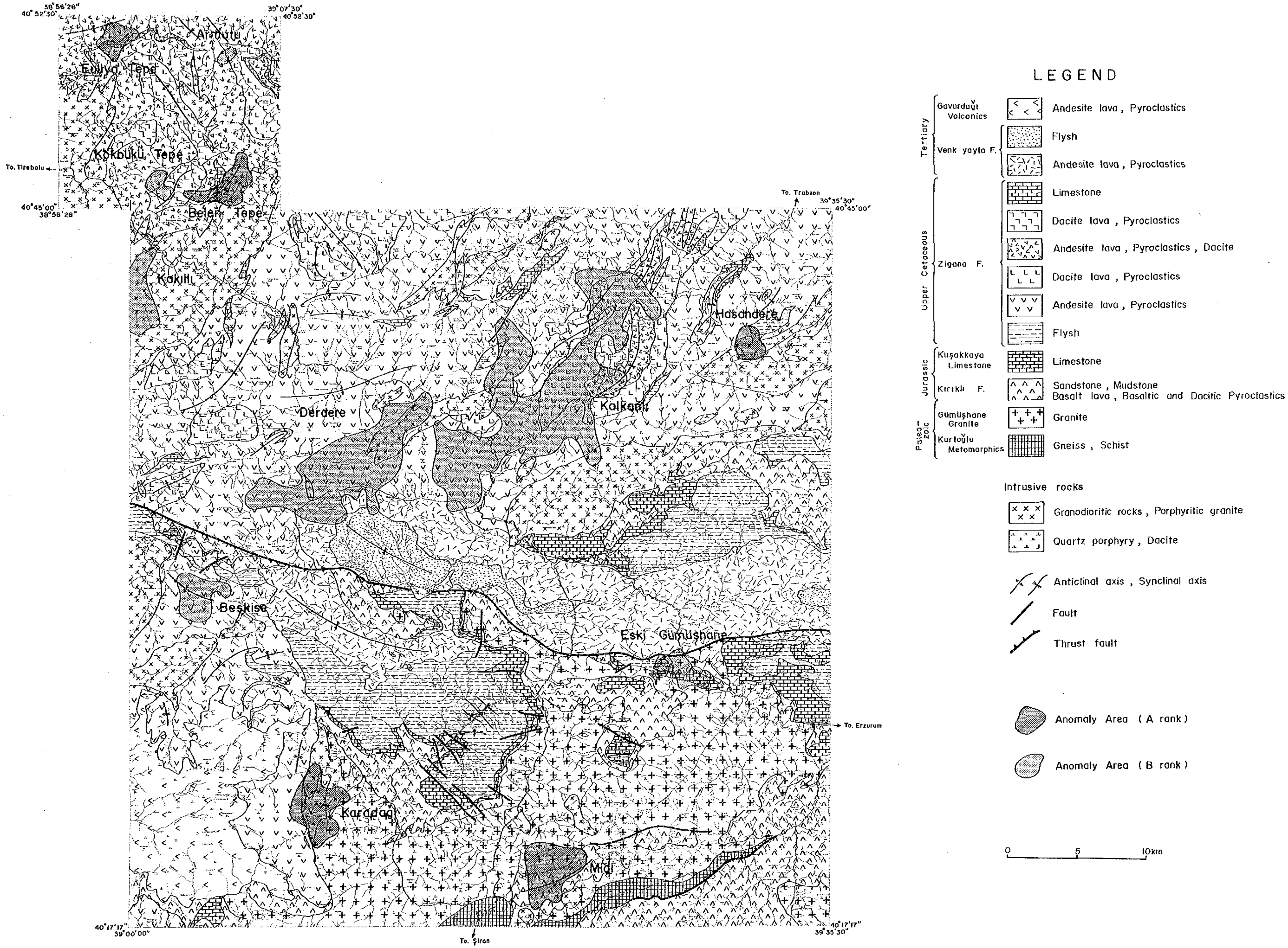


Fig.38 Remarkable Geochemical Anomalous Areas in the Project Area

The outline of the important anomalous zones (A and B ranks) are as follows.

(1) Hasandere anomalous zone

Significant geochemical anomalies of seven elements Ag, Cu, Pb, Zn, Mo, W, Sn are found. Strong Cu, Mo anomalies accompanied by W are particularly notable.

The anomalies of this zone are correlated to the porphyry type dissemination which develops in the young prophyritic granodiorite bodies (pg2) and vicinity alongthe Hasan and Mat Streams. Anomly was found in the stream sediments about 3km from the Hasandere anomalous zone which indicates the large scale of this zone. Thus this alnomalous zone was assessed to A rank.

(2) Karadag anomalous zone

There are Ag, Cu, Mo, Pb, Zn, W anomalies in this zone. High Pb, Zn anomaly of over 5-10 times the threshold value is found near Mt. Cilaz. This high anomaly is caused by the pollution from the old Karadag mine.

The effect of this mine can be traced as Pb, Zn anomaly for more than 5km along the main stream of Dörene to the north and Galiz to the south of the mine.

This zone was evaluated as A from the overlap of anomalies of many elements,high values and the conditions near the deposit.

(3) Belen Tepe anomalous zone

This is the most significant anomalous zone of the surveyed area. High anomalies for Ag, Cu, Pb, Zn, Mo are found in the many streams surrounding Mt. Belen- Mt. Tepeyurt and Cu, Pb, Zn show anomalies of several thousand ppm. These anomalies correspond to the skarn type mineralized zone near Mt. Belen and pollutionfrom the old workings probably contributed to the high metallic content. The zone extends for $6.5km^2$. All the indicators overlap and with the large scale of the zone, this was ranked A.

(4) Midi anomalous zone

High Pb-Zn anomalies are observed, Zn content is particularly high, up to 2 ~3,000 ppm. The highest Pb, Zn and As anomalies occur in the stream where the Midi zinc vein is located. Also the UNDP stream sediment sample from a stream where the south-western margin of the vein occur, shows high Pb, Zn anomalies. Also this zone was ranked A, because the zone was large compare to the known deposit and existense of veins parallel to the known deposit could be expected.

(5) Eulia Tepe anomalous zone

High Ag, Cu, Mo, Pb, Zn anomalies were found in many streams near Mt. Eulia. The Pb-Zn anomalies were particularly good reaching several thousand ppm. These high anomalies are believed to be the result of pollution from the old vein and skarn mines in the vicinity such as Asaği Siğilik mine. The zone was ranked A because the anomalies of all indicator elements overlap and the scale is large.

(6) Eski Gümüşhane anomalous zone

This zone is located near Eski Gümüşhane Village and consists of Cu-Pb-Zn anomalies related to Hazine Mağara mine, Kırıkpaulı mine and Sarıdere mineralized zone and Ag-Pb-Zn is particularly high. Mine water flows out from the old adits and this plays a major role in the formationof the high anomalies. This zone was evaluated as B from the scale of the known deposits and the extent of the anomalous zone.

(7) Armutlu anomalous zone

There are high Cu, Mo anomalies attaining Mo 42 ppm. This is related to the Armutlu altered zone. Pyrite-chalcopyrite dissemination was obsereved during surface reconnaissance survey but Mo mineralization could not be confirmed by the unaided eyes. The zone was evaluated B because of the high Mo value in spite of the small size.

(8) Kökbükü Tepe anomalous zone

Cu, Mo anomalies associated with pyrite dissemination were detected in D1, A2 ofZigana Formation. Although only two Mo anomalies were located, the values are high (maximum 120 ppm) and thus the zone was evaluated B.

(9) Kakilli anomalous zone

This consists of Cu-Mo (Pb-Zn) anomalies in the Kürtün granodiorite body. Thereare three points with Mo:40-50ppm and five with Mo:6-10ppm. Although Mo mineralization was not confirmed during reconnaissance survey, these concentrated Mo anomalies probably are significant and the zone was evaluated B.

(10) Kalkanlı anomalous zone

Pb anomalies are observed over a wide area of $103km^2$. In this zone, Cu, Zn anomalies are locally overlapping. Generally the Pb anomalies are low near the threshold value, but there are point which reach several thousand ppm. The extensive but low anomalous zone include white altered zones between Ziganga and Torul, such as Kalkanlı, Torul, Şive alteration zone. Most of the high anomalies are caused by old adits (Köstere and İstala mines), but those not related to known deposits should be further studied. From the scale of the known deposits of this zone, it is considered that the possibility of large metal concentration in this zone is small, thus rank B.

(11) Derdere anomalous zone

This zone is similar to Kalkanlı and consists of extensive but low Pb anomalies. It includes Herek and Omruk alteration zones. In the outcrops, Pb-Zn veinlets are locally observed and the possibility of the existence of large-scale ore deposits are small, thus rank B.

(12) Beşkise anomalous zone

This zone is correlated to the Beşkise alteration Zone and Cu, Mo anomalies are significant. This alteration zone is related to small granodiorite bodies and is accompanied by silicification, limonitization and pyritization. The geological environment and the geochemical anomalies are similar to Hasandere mineralized zone but only pyrite dissemination and no Mo mineralization was observed in the outcrops,thus rank B.

Also some small Cu, Pb, Zn anomalies were detected mainly between Zone A and Kürtün. But the values were low and the overlap of anomalies of different elements is small,thus rank C or D.

Generally, F, As, W anomalies are not concentrated in this zone and although some weak anomalies were found in Gümüşhane Granite areas, anomalies of any significance were not found. For example, zones such as Karamustafa and North of Tozlu Tape Anomalous zones. The former contains W: 8-14ppm and the latter W: 7-21,Sn: 4-18ppm. It is inferred from these data that mineralization accompanying greisenization is very weak.

The following five geochemical anomalous zones are noted as the result of the above evaluation.

(1) Hasandere geochemical anomalous zone

(2) Karadağ geochemical anomalous zone

(3) Belen Tepe geochemical anomalous zone

(4) Midi geochemical anomalous zone

(5) Eulia geochemical anomalous zone

Hasandere, Karadağ, Midi zones are of particular interest as related indicator elements are traced for several kilometers from the known mineralized zones along the main stream.

Chapter 5 Soil Geochemical Prospecting of Hasandere Mineralized Zone

5-1 Outline

Soil geochemical prostecting was conducted for the Hasandere Mineralized Zone byMTA in 1984. The analytical results of this work was processed and analysed. The area is 3.63km^2 around the Mat~Hasan Stream where Mo-Cu mineralization is observed. Sampling was done at 50m interval along the 50m horizontal contours. B-C soil horizons were collected and Cu and Mo were analysed.

5-2 Statistical Treatment of Data

The analytical results were processed by a computor and the distribution was studied following C.Lepeltier's (1969) method. Cu, Mo concentration contour maps were prepared. The statistical parameters are shown below.

The histogram, cumulative frequency distribution curve and dispersion curve are shown in Figure 24.

Concentration contour maps were drawn for both elements for the study of the distribution of high anomalies. The concentration contours (Fig.40) were drawn by a computor by the following process. The area of study was divided into 50m grid, when there were analysed valued at the intersection of the grid, such values were used, is not the value for the intersection was calculated from the nearby analysis and the contours were drawn. The calculation when the intersection lacked analysis was done as follows.

Analysis closest to the intersection in the first and third quadrant and the second and fourth quadrand were taken, the values were calculated using parameters inversely proportional to the distance from the intersection. The value obtained from the first and third quadrant and those from the second and fourth quadrant were arithmatically averaged.

Element	N	Mean(M)	M+σ	M+ 2σ	Min.value	Max.value	γ
Cu	942	78	236	718	4	3,820	0.51
Mo	942	6	26	109	1	272	

σ: standerd deviation,assuming lognormality ,γ: correlation coefficient,(ppm)

N:Number of Samples

5-3 Results

The cumulative frequency distribution curve for Cu is almost straight and is considered to be a single population. But that for Mo has two breaks at t1 (11ppm) and t2 (26ppm). The t2 coincides approximately with M+σ. It is considered that values higher than t2 belong to anomaly population, those lower than t1 belong to backgroround population and t1 ~t2 is the range of overlap of the two populations.

It was shown that distribution of Cu and Mo are not harmonious. There is a tendency of Cu being distributed at the fringe of Mo anomalies. This is also indicated from the correlation coefficients and the dispersion diagram.

High concentration is clearly shown at Mat - Hasan Streams in the concentration contour map. Mo values higher than M+2 σ are concentrated on the northern side of Mat Stream. But high Cu anomalies (M+2 σ) are not concentrated, they tend to disperse.

The distribution of M+σ for Cu is not closed, and it indicates that the possibility of extending the survey northward should be studied throughly.

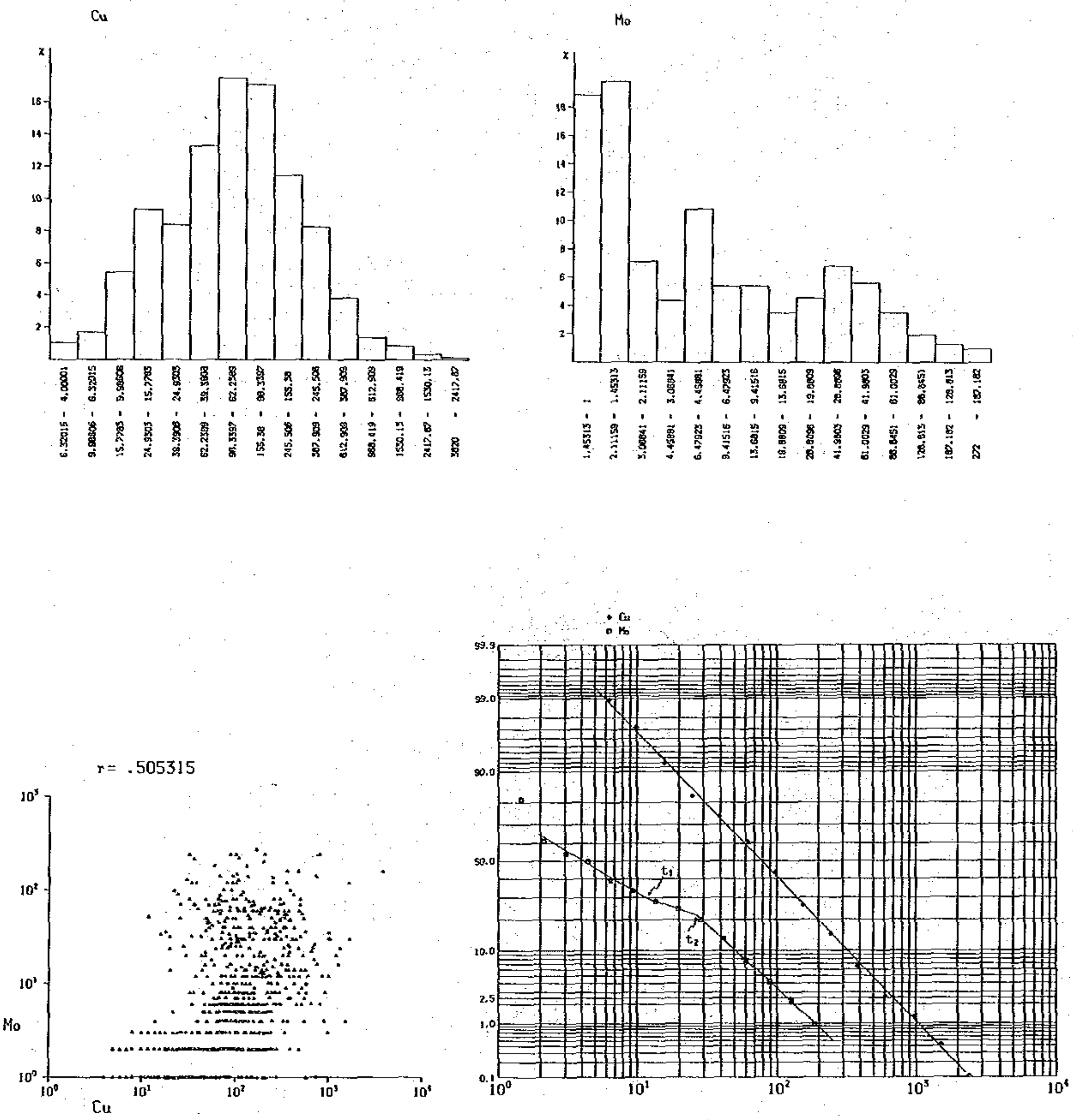
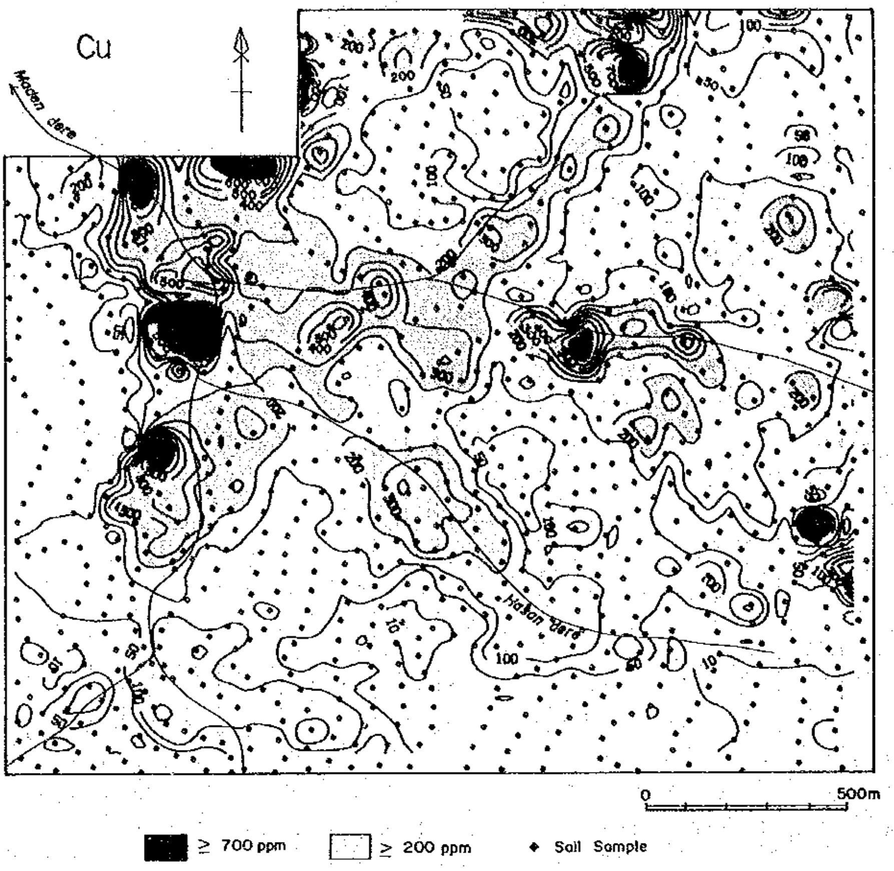


Fig.39 **Histrogram, Cumulative Frequency Distribution Curves and Correlation Diagram for Soil-geochemical Exploration in Hasandere Area**



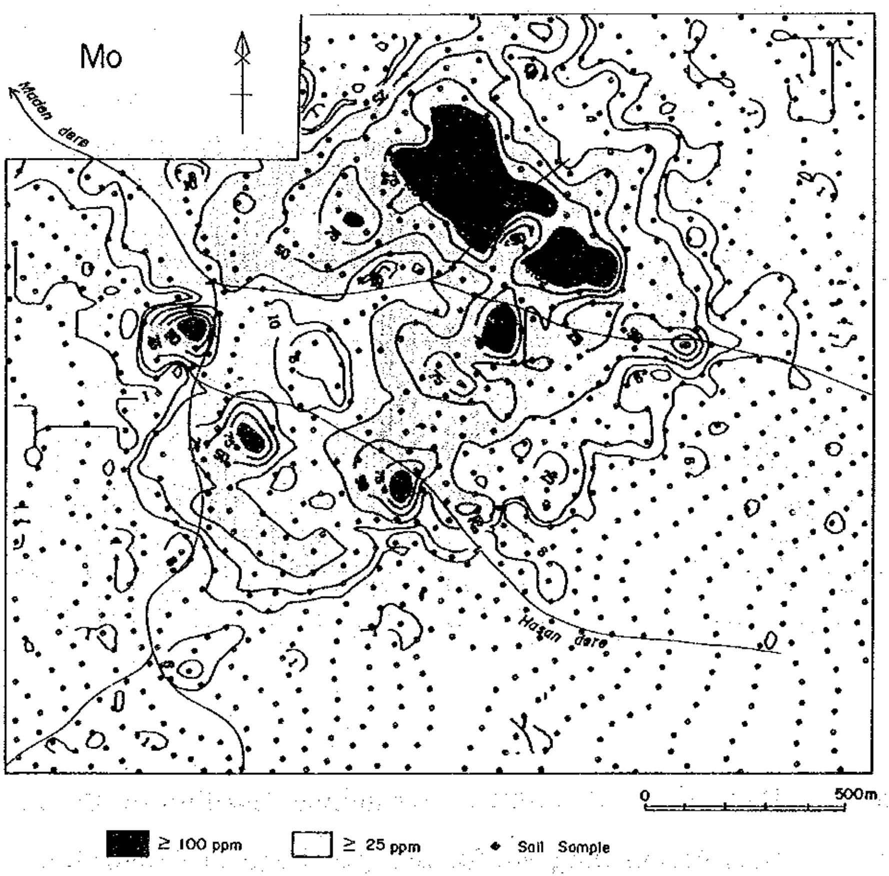


Fig.40 Geochemical Contour Map of Cu-Mo Soil Anomalies in Hasandere Area

Table 9 List of Geochemical Anomalous Areas in the Project Areas (1)

No.	Name of Anomaly	Area (km²)	Amount of Anomalous Points	Range of Anomalous Values ※1 (ppm) Cu	Mo	Pb	Zn	Other elements	Geological enviroments and Related mineral occurences※2	Rank of※3 evaluation
A-1	Euliya Tepe	5.5	10	245~600(5)	9~12(3)	1,500~2,800(5) 350~ 860(4)	1,060~3,140(4) 610~830(2)	Ag:0.5~ 3.9(6) Ag:6.3~10.7(2)	Kzl, Kza 2, qp; Aşağı Sıgırlık Mine(vein, Skarn,Cp-Py-Gn-Spec)	A
A-2	Armutlu	1.1	2	770(1)	9, 42(2)	160, 205(2)	1,020(1)	—	Kzd 1, Kza 2: Armutlu altered zone (sili, limo.Py-Cp-Oxcp)	B
A-3	Gecür	1.4	3	190 455(2)	9, 19(2)	180(1)	—	—	Kzd 1, Kza 2	C
A-4	Gırlak	1.8	3	1,000 175(2)	7, 17(2)	—	—	—	Kza 2, gd: Gırlak(Skarn, Spec, Oxcp)	C
A-5	Kurtbeli Dere	1.2	2	210(1)	—	330(1)	295, 305(2)	—	Kzd 1, gd: argillized tuff	D
A-6	South of Büyük Tepe	2.3	1	—	—	185(1)		Ag:1.1(1)	Kza 2, Kzd 2: week silicification, Py-diss in D 2	D
A-7	Keltaş Tepe	1.3	3	—	—	360~420(3)	467~490(2)	—	Kzd 2: Keltaş günay Mine(vein,Py-Cp)	D
A-8	Belen Tepe	6.5	9	270~620(5) 1,640(1) 5,400(1)	10~19(4)	210~420(2) 9,000(1)	320~590(5) 2,270(1)	Ag:1.2~2.4(3)	Kzl, Kza 2, gd: Dere and Kuru Mines (Skarn, Cp-Gn-Py-Spec)	A
A-9	Kökbükü Tepe	2.1	4	960(1) 360(1)	7(1) 120(1)	—	—	Ag: 0.6(1)	Kzd 1, Kza 2: week Py-diss	B
B-1	Mindizli	3	3	164, 197(2)	—	249(1)	319(1)		gd(kürtün body)	D
B-2	Nabaşa	20	16	117~296(4)	6(1)	527~1,320(4) 100~435(12)	430~760(4) 230~390(8)		Kza 1, Kzd 1 Erikbeli Yayla altered zone (Py-diss)	C

Table 9 List of Geochemical Anomalous Areas in the Project Areas (2)

No.	Name of Anomaly	Area (km²)	Amount of Anomalous Points	Range of Anomalous Values (ppm)					Geological enviroments and Related mineral occurences	Rank of evaluation
				Cu	Mo	Pb	Zn	Other elements		
B-3	Konacik	3.6	2	440(1)	6(1)	202(1) 530(1)	1,140(1)	—	Kzl,Kza 1, qp,gd	C
B-4	Düzköy	6	4	140~234(4)	6(1)	115(1)	—	—	Kzl,Kza 1, gd: Düzköy (skarn,Spec-Cp-Py-Gn)	C
B-5	Kakilli	11	9	229(1)	6~10(5) 40~50(3)	110~140(5)	250(1)	—	gd	B
B-6	Dikme Tepe	6.5	7	—	—	102~280(6) 475(1)	230~246(2) 545~685(2)	—	Kza 1, Kzl,Kzd 1, gd: Çatak and Kürtüklüyurt (Skarn,Spec-Mag)	C
B-7	Zıyarel Tepe	4	3	115(1)	—	381~442(2)	425~444(2)	—	Kza 1	C
B- 8	Dolumlu	1.7	2	147,320(2)	—	—	—	—	Kza 1 Dolumlu (Skarn,Spec-Py-Oxcp)	D
B-9	Kızılağaç Yayla	0.5	1	180(1)	10(1)	—	—	—	Kza 1, gd	D
B-10	İspana	2.3	3	109(1)	—	100~260(3)	240,290(2)	—	Kza 1	D
B-11	Kalkanlı	103	110	400~650(10) 240~332(6) 100~200(30)	9~15(6) 28(1)	750~3,250(7) 300~606(17) 100~297(73)	1,000~1,560(4) 400~650(15) 230~385(32)	Ag:0,6~2,0(10) As:110~180(4) F:770(1)	Kza 1, Kzd 1, Kza 2, gd: Köstere,İstala Mines Şive,Kalkanlı,Köstere and other altered zones	B
B-12	East of Büyükdüz Tepe	6.3	3	111,186(2)	—	129,174(2)	240,290(2)	—	Kza 1, Kzd 1, gd: silicification with Py	D
B-13	Araköy Yayla	3.2	3	—	6(1)	—	228(2) 520	—	Kza 1, Kzd 1, gd: silicification with Py	D

Table 9 List of Geochemical Anomalous Areas in the Project Areas (3)

No.	Name of Anomaly	Area (km²)	Amount of Anomalous Points	Range of Anomalous Values (ppm)					Geological enviroments and Related mineral occurences	Rank of evaluation
				Cu	Mo	Pb	Zn	Other elements		
B-14	Mandıra	0.5	1	159(1)	6(1)	110(1)	—	—	Kza 1	D
B-15	Derdere (Herek)	39.5	33	104~125(3)	6~15(3)	500~900(9) 300~450(7) 120~298(15)	291~550(4)	—	Kza 1, gd: Herek altered zone (sil. and arg. with Py-Cp-Gn-Sph)	B
B-16	Sarsaman	2.5	6	—	6~10(5)	—	—	W:6, 9(2)	gd: silicification and limonitization	C
B-17	Hasandere	5.3	8	780(1) 182~346(7)	14~28(4) 8~10(2)	222(1)	600, 685(2) 293(1)	W:7 ~13(4) Sn:5(1) Ag:0.6~1.4(2)	Kza 1, pg 1, pg 2: Hasandere mineralized zone (Py-Cp-Mo stockworks)	A
B-18	Bakımlı Yayla	4.5	4	107, 110(2)	6(1)	105~150(3)	—	—	Kza 1, pg 2	D
B-19	Derindere	5.7	5	100~110(3)	—	114~290(5)	256(1)	—	Kza 1	D
B-20	İstvrit Dere	8.5	7	100~220(4)	—	100~190(4)	—	W:125(1)	Kza 1, gd: silicification and limonitization with Py	D
B-21	Köydere (Torul)	3.2	5	100, 130(2)	6~10(4)	—	—	W:9(1) F:890(1)	Kza 1, gd: silicification and argillization	D
B-22	Tüfekçili	0.7	1	—	—	245(1)	239(1)	—	Kzl, Kza 1, qp, gd	D
B-23	Görükse	1.8	2	—	29(1)	196, 200(2)	268, 850(2)	—	Kza 1, gd	C
B-24	West of Makrelbaşı Tepe	1.2	1	—	—	500(1)	550(1)	—	Kza 1, gd	D

Table 9 List of Geochemical Anomalous Areas in the Project Areas (4)

No.	Name of Anomaly	Area (km²)	Amount of Anomalous Points	Range of Anomalous Values (ppm) Cu	Mo	Pb	Zn	Other elements	Geological enviroments and Related mineral occurences	Rank of evaluation
B-25	Çamdibi	3.5	3	120(1)	—	120,230(2) 1,000(1)	550(1)	—	Tva,Jkb: Qzvein with Cp,Oxcp	C
B-26	Beşkise	12	19	320～480(5) 219～265(4) 100～107(4)	26(1) 13～18(3) 6～9(7)	110～160(4)	—	—	Kza 1, gd: Beşkise altered zone(Sil.,limo. with py)	B
B-27	Otalan	7.5	9	100～140(6)	6～11(3)	100～110(4)	230～245(3)	—	Kza 1, gd: Otalan altered zone(Sil.,limo. with py)	C
B-28	Kopuz	0.9	1	—	—	265(1)	740(1)	—	Kza 1, gd:	D
B-29	Avliyana	2.3	2	122(1)	10(1)	—	—	—	Kzf,Kza 1, gd:	D
B-30	South of Haviyana	2.3	2	110,120(2)	—	450(1)	—	—	Tva,Kzf,gd:	D
B-31	Zaimli	1.3	2	—	—	1,000(2) 100(1)	—	—	Jkb,Jkul:	C
B-32	Soğuksu	0.8	2		18(1)	200(2)	—	—	Jkb,Jkul:D	
B-33	Eski Gümüşhane	5.7	14	130～350(4)	—	750～1300(4) 252～510(3) 150～220(5)	950～2400(6) 300(2) Sn:3(1)	6.7(1) 0.6～0.9(2)	Jkb,Jkul,Pgg,gd.: Kırkpavlı(Au,Ag), Hazine Mağara (Ag,Gn,Sph,Cp,Tet)	B
B-34	Karamustafa	2.8	2	—	—	—	—	W:8,14(2)	Pgg:	D
B-35	Işik	0.6	2	110,205(2)	—	110,145(2)	250,265(2)	—	Pgg:	D

Table 9 List of Geochemical Anomalous Areas in the Project Areas (5)

No.	Name of Anomaly	Area (km²)	Amount of Anomalous Points	Range of Anomalous Values (ppm)					Geological environments and Related mineral occurences	Rank of evaluation
				Cu	Mo	Pb	Zn	Other elements		
B-36	Manador Tepe	7.5	4	120(1)	38(1)	350(1)	—	W:8(1) As:113(1) F:640(1)	Jkb,Pgg,Kza 1, gd:	C
B-37	Karadağ	10.8	210~340(7) 16	120~180(6)	8(1)	700~1,060(6) 450~800(8) 200(2)	230~450(3)	W:9(1)	Kzl,Kza 1, qp,gd: Karadağ Mine (Skarn,Cp-Gn,Sph-Spec)	A
B-38	Altıntaşlar	2.4	5	100(2)	—	220~475(4)	240~400(3)	Ag:0.7~0.9(2)	Jkd,Pgg,gd: Altıntaşlar mineralized zone (cp-py)	C
B-39	Hatipler	0.6	1	110(1)	—	260(1)	—	—	Jkb,Pgg:	D
B-40	Midi	11.2	14	—	6(3)	336~780(4) 110~150(9)	2,500~3,500(3) 228~400(3)	Ag:0.6,2.3(2) As: 170(1)	Jkb, Pgg Midi Mine vein(Sph-Gn)	A
B-41	North of Tozlu Tepe	5.6	5	—	—	—	—	W:7~21(4) Sn:4,18(2)	Pgg:	C

※ 1 Figures in parentheses are amount of anomalous samples.
※ 2 See abbreviations in Fig. 5
※ 3 Priority:A,B,C,D,in order.

Table10 Chemical Analyses of Stream Sediments (1)

Sample No.	Ag ppm	Cu ppm	Mo ppm	Pb ppm	Zn ppm
AA-1	0.1	22	4	24	44
AA-2	0.1	35	5	73	104
AA-3	0.1	32	3	44	78
AA-4	0.1	12	1	90	120
AA-5	0.1	32	3	30	32
AA-6	0.1	9	2	15	8
AA-7	0.1	1	3	9	2
AA-8	0.1	7	3	8	2
AA-9	0.1	120	2	80	154
AA-10	0.1	160	1	43	120
AA-11	0.1	65	1	54	134
AA-12	0.2	85	1	270	176
AA-13	0.1	100	1	84	154
AA-14	0.4	80	1	440	180
AA-15	0.1	135	1	37	116
AA-16	0.1	102	1	41	122
AA-17	0.1	120	1	45	116
AA-18	0.1	125	1	25	101
AA-19	0.2	100	1	60	1280
AA-20	0.1	90	1	96	180
AA-21	0.1	145	1	64	172
AA-22	0.1	126	1	68	205
AE-1	0.1	15	1	6	32
AE-2	0.1	47	1	80	163
AE-3	0.1	34	1	34	102
AE-4	0.1	23	1	7	52
AE-5	0.1	23	1	6	44
AE-6	0.1	20	1	15	61
AE-7	0.1	24	1	16	60
AE-8	0.1	62	1	20	85
AE-9	0.1	60	1	15	59
AE-10	0.1	12	1	9	29
AE-11	0.1	100	4	37	86
AE-12	0.1	20	2	20	46
AE-13	0.1	15	1	25	40
AE-14	0.1	23	2	46	52
AE-15	0.1	12	1	10	26
AE-16	0.1	23	1	12	43
AE-17	0.1	45	1	92	148
AE-18	0.1	10	1	12	34
AE-19	0.1	16	1	22	86
AE-20	0.1	11	1	5	18
AE-21	0.1	11	1	3	24
SE-22	0.1	23	1	32	76
AE-23	0.1	13	1	13	24
AE-24	0.1	12	1	12	22
SE-25	0.1	6	1	8	21
AE-26	0.1	20	1	37	116
AE-27	0.1	11	1	14	36
AH-1	0.1	36	4	58	70
AH-2	0.1	30	8	62	72
AH-3	0.1	18	8	58	71
AH-4	0.1	24	1	100	94
AH-5	0.1	17	1	33	35
AH-6	0.1	41	1	33	156

Sample No.	Ag ppm	Cu ppm	Mo ppm	Pb ppm	Zn ppm
AH-7	0.1	73	3	85	148
AH-8	0.1	88	2	96	108
AH-9	0.1	40	1	74	390
AH-10	0.1	60	1	62	188
AH-11	0.1	42	1	41	98
AH-12	0.1	30	1	42	64
AH-13	0.1	71	1	22	44
AH-14	0.1	36	1	44	56
AH-15	0.2	30	1	2	32
AH-16	0.1	52	1	18	53
AH-17	0.1	20	1	17	60
AH-18	0.1	53	1	24	77
AH-19	0.1	22	1	63	72
AH-20	0.1	16	1	21	62
AH-21	0.1	28	1	360	467
AK-1	0.1	115	13	110	128
AK-2	0.1	17	3	9	70
AK-3	0.1	115	2	110	145
AK-4	0.1	41	7	10	68
AK-5	0.1	100	1	103	124
AK-6	0.1	145	1	83	124
AK-7	0.2	120	1	100	144
AK-8	0.6	360	120	20	44
AK-9	0.1	100	1	75	100
AK-10	0.1	26	1	16	74
AK-11	0.1	17	1	10	83
AK-12	1.3	1640	10	96	214
AK-13	0.1	140	2	90	116
AK-14	0.1	37	1	7	59
AK-15	0.1	110	2	80	138
AK-16	0.1	50	2	26	290
AK-17	0.1	29	3	110	186
AK-18	0.1	52	1	48	178
AK-19	0.1	73	1	130	270
AK-20	0.1	15	2	80	88
AK-21	1.1	20	4	185	78
AK-22	0.1	32	1	33	315
AK-23	0.1	60	1	32	280
AK-24	0.1	35	1	76	132
AK-25	0.1	30	1	95	100
AK-26	0.1	15	1	31	52
AK-27	0.1	24	1	45	84
AK-28	0.1	32	2	63	110
AK-29	0.2	36	1	280	184
AK-30	0.1	48	2	48	100
AK-31	0.2	95	2	180	290
AK-32	0.1	95	2	68	200
AK-33	0.1	190	9	44	84
AK-34	0.1	455	19	65	170
AK-35	0.1	120	5	55	250
AK-36	0.2	770	42	205	1020
AK-37	0.1	50	1	32	114
AK-38	0.1	32	1	18	71
AK-39	0.1	32	1	36	100
AK-40	0.1	55	1	82	124

Sample No.	Ag ppm	Cu ppm	Mo ppm	Pb ppm	Zn ppm
AK-41	0.1	59	1	93	135
AK-42	0.1	30	1	150	166
AK-43	0.1	32	1	28	71
AK-44	0.1	45	1	33	103
AK-45	0.1	65	1	10	40
AK-46	0.1	160	1	1	26
AK-47	0.1	100	1	16	70
AK-48	0.1	87	1	6	42
AK-49	0.1	34	1	116	145
AK-50	0.1	22	1	15	132
AK-51	0.1	30	1	33	86
AK-52	0.1	57	1	29	68
AK-53	0.1	27	1	175	280
AK-54	0.1	46	1	60	102
AK-55	0.1	43	1	135	168
AK-56	0.1	83	1	115	154
AK-57	0.1	55	1	117	164
AK-58	0.1	100	1	61	172
AK-59	0.1	115	4	38	174
AK-60	0.1	23	3	80	48
AK-61	0.1	52	1	120	250
AK-62	0.1	35	1	35	116
AK-63	0.1	33	1	76	175
AK-64	0.1	63	1	108	240
AK-65	0.1	100	7	72	100
AK-66	0.1	38	1	8	32
AK-67	0.1	42	1	4	32
AK-68	0.1	75	1	102	240
AK-69	0.1	70	1	20	66
AM-1	4.7	5500	14	2000	900
AM-2	0.1	250	1	110	128
AM-3	0.1	25	1	38	110
AM-4	0.1	32	1	35	128
AM-5	0.1	46	1	32	144
AM-6	0.1	100	1	114	128
AM-7	0.1	130	1	112	135
AM-8	0.1	83	1	26	132
AM-9	0.1	36	1	20	98
AM-10	0.1	30	1	22	94
AM-11	0.1	49	1	8	62
AM-12	0.1	85	1	32	152
AM-13	0.1	88	1	45	240
AM-14	0.1	130	3	28	166
AM-15	0.1	80	1	56	172
AM-16	0.1	22	1	12	52
AM-17	0.1	50	1	10	68
AM-18	0.1	20	1	17	44
AM-19	0.1	52	4	18	87
AM-20	0.1	25	3	20	64
AM-21	0.1	36	3	21	88
AM-22	0.1	43	1	14	63
AM-23	0.1	60	1	70	116
AM-24	0.1	40	1	76	96
AM-25	0.1	100	6	30	86
AM-26	0.1	43	1	28	98

Table10 Chemical Analyses of Stream Sediments (2)

Sample No.	ppm Ag	ppm Cu	ppm Mo	ppm Pb	ppm Zn
AM-82	0.1	138	1	27	220
AM-83	0.1	115	4	70	215
AM-84	0.1	100	1	300	290
AM-85	0.1	30	1	7	26
AM-86	0.1	80	1	100	210
AM-87	0.1	55	1	30	78
AM-88	0.1	100	1	18	68
AM-89	0.1	80	1	26	115
AM-90	0.1	52	1	31	142
AM-91	0.1	52	1	23	76
AM-92	0.1	56	1	36	100
AS-1	0.1	170	2	16	345
AS-2	0.1	120	1	10	138
AS-3	0.1	34	1	14	80
AS-4	0.1	63	1	11	320
0	0.0	0	0	0	0
AS-5	0.1	450	1	19	78
AS-6	2.4	5400	19	33	450
AS-7	0.1	48	3	12	58
AS-8	0.2	320	3	210	540
AS-9	0.1	270	4	25	370
AS-10	0.1	78	1	13	128
AS-11	0.1	34	1	7	57
AS-12	0.1	102	1	10	170
AS-13	0.1	68	1	12	148
AS-14	0.1	55	4	8	40
AS-15	0.1	28	1	16	89
AS-16	0.1	55	3	7	176
AS-17	0.1	21	1	13	69
AS-18	0.1	60	1	14	106
AS-19	1.7	3500	12	30	370
AS-20	0.1	75	2	10	38
AS-21	0.1	43	1	12	59
AS-22	0.1	97	1	11	92
AS-23	0.1	9	1	11	95
AS-24	0.1	170	12	420	590
AS-25	0.1	54	1	41	144
AS-26	0.1	1	1	12	46
AS-27	0.1	175	1	148	455
AS-28	0.1	65	1	8	92
AS-29	0.1	26	1	21	156
AS-30	0.1	28	5	67	156
AS-31	0.1	17	1	140	105
AS-32	0.1	12	3	125	235
AS-33	0.1	17	1	32	73
AS-34	0.1	27	1	60	192
AS-35	0.1	23	1	35	62
AS-36	0.1	15	1	83	150
AS-37	0.1	17	1	30	96
AS-38	0.1	20	1	53	150
AS-39	0.1	11	1	30	64
AS-40	0.1	10	1	28	48
AS-41	0.1	20	2	50	124
AS-42	0.1	36	1	70	92
AS-43	1.4	285	1	2300	830

Sample No.	ppm Ag	ppm Cu	ppm Mo	ppm Pb	ppm Zn
AS-44	0.1	42	2	155	152
AS-45	0.1	60	1	16	62
AS-46	0.1	41	1	24	81
AS-47	0.1	11	1	36	68
AS-48	0.1	7	1	18	48
AS-49	0.1	12	1	13	58
AS-50	0.1	8	1	34	82
AS-51	0.1	1	2	48	78
AS-52	0.1	51	2	45	75
AS-53	0.1	11	1	23	52
AS-54	0.1	73	2	350	245
AS-55	10.7	245	5	2800	610
AS-56	0.5	155	3	420	280
AS-57	0.1	43	10	250	104
AS-58	0.1	33	1	120	142
AS-59	0.2	46	6	480	153
AS-60	0.2	28	2	45	48
AS-61	0.1	52	5	100	170
AS-62	0.1	22	3	30	46
AS-63	0.3	45	9	700	198
AS-64	1.4	78	4	860	500
AS-65	0.1	68	1	18	90
AS-66	0.1	70	2	385	173
AS-67	3.7	360	2	1500	1020
AS-68	0.4	80	6	460	176
AS-69	0.1	94	1	20	148
AS-70	0.1	80	1	38	96
AS-71	0.6	125	9	550	280
AS-72	0.1	100	1	38	92
AS-73	3.9	445	9	1850	1590
AS-74	6.3	600	12	2750	3140
AT-1	0.1	50	1	38	85
AT-2	0.1	30	2	116	92
AT-3	0.1	22	1	250	128
AT-4	0.1	23	1	15	62
AT-5	0.1	126	4	54	144
AT-6	0.1	70	1	22	76
AT-7	0.1	36	1	20	50
AT-8	0.1	23	1	12	33
AT-9	0.1	5	1	18	30
AT-10	0.1	7	1	16	40
AT-11	0.1	25	1	8	77
AT-12	0.1	8	1	8	52
AT-13	0.1	21	1	11	44
AT-14	0.1	22	2	10	60
AT-15	0.1	15	1	56	42
AT-16	0.1	14	1	70	50
AT-17	0.1	11	1	20	32
AT-18	0.1	12	1	9	30
AT-19	0.1	15	1	11	33
AT-20	0.1	8	1	8	28
AT-21	0.1	16	1	15	38
AT-22	0.1	38	2	130	300
AT-23	0.1	112	1	410	270
AT-24	0.1	75	1	420	490

Sample No.	ppm Ag	ppm Cu	ppm Mo	ppm Pb	ppm Zn
AT-25	0.1	34	1	42	172
AT-26	0.1	20	1	13	42
AT-27	0.1	43	1	108	250
AT-28	0.1	32	1	90	198
AY-1	0.1	30	1	35	86
AY-2	0.1	140	2	87	240
AY-3	2.2	40	1	20	132
AY-4	0.3	26	1	18	51
AY-5	0.1	38	1	23	168
AY-6	0.1	44	1	28	82
AY-7	0.1	16	1	28	49
AY-8	0.1	66	1	23	225
AY-9	0.1	72	1	27	194
AY-10	0.1	62	1	20	184
AY-11	0.1	66	1	20	68
AY-12	0.1	72	1	35	290
AY-13	0.1	76	1	46	113
AY-14	0.1	10	1	1	25
AY-15	0.1	20	1	11	39
AY-16	0.1	23	1	10	22
AY-17	0.1	25	1	20	64
AY-18	0.1	25	1	18	70
AY-19	0.1	42	1	50	124
AY-20	0.1	19	1	33	52
AY-21	0.1	28	1	15	68
AY-22	0.1	11	1	8	28
AY-23	0.1	8	1	6	26
AY-24	3.5	24	1	125	230
AY-25	0.1	18	1	60	77
AY-26	0.1	5	1	72	156
AY-27	0.1	4	1	106	220
AY-28	0.1	4	1	110	166
AY-29	0.1	24	1	74	102
AZ-1	0.1	210	3	10	64
AZ-2	0.1	170	7	55	184
AZ-3	0.7	1000	17	28	260
AZ-4	0.2	175	4	68	172
AZ-5	0.1	340	6	58	172
AZ-6	0.1	175	2	60	118
AZ-7	0.1	28	1	28	49
AZ-8	0.1	45	1	9	28
AZ-9	0.1	38	1	40	99
AZ-10	0.1	310	5	58	162
AZ-11	0.1	30	1	43	43
AZ-12	0.1	105	5	15	59
AZ-13	0.1	63	6	70	100
AG-1	0.1	960	1	17	276
AG-2	0.1	65	1	43	94
AG-3	0.1	56	1	30	117
AG-4	0.1	36	1	100	152
AG-5	0.1	65	1	65	116
AG-6	0.1	60	1	78	197
AG-7	0.1	45	1	11	38
AG-8	0.1	27	1	20	36
AG-9	0.1	115	3	26	138

Table10 Chemical Analyses of Stream Sediments (3)

Sample No.	Ag ppm	Cu ppm	Mo ppm	Pb ppm	Zn ppm
AG-10	0.1	47	2	18	112
AG-11	0.1	330	3	43	126
AG-12	0.1	205	2	27	120
AG-13	0.1	600	1	33	148
AG-14	0.1	50	1	17	100
AG-15	0.1	225	1	32	116
AG-16	0.1	86	1	20	95
AG-17	0.1	69	3	72	220
AG-18	0.1	65	6	20	96
AG-19	0.1	23	1	41	78
AG-20	0.1	36	1	36	142
AG-21	0.1	42	1	55	94
AG-22	0.1	28	1	125	120
AG-23	1.2	110	2	860	256
AG-24	0.1	23	1	41	75
AG-25	0.1	75	1	130	177
AG-26	0.1	40	1	33	254
AG-27	0.1	60	1	158	146
AG-28	0.1	53	1	61	112
AG-29	0.1	145	1	24	82
AG-30	0.1	190	3	52	178
AG-31	0.1	165	1	64	150

Table10 Chemical Analyses of Stream Sediments (4)

Sample No.	ppm Ag	ppm Cu	ppm Mo	ppm Pb	ppm Zn	ppm As	ppm W	ppm Sn	ppm F
SA-1	0.1	37	1	31	130	9	1	1	280
SA-2	0.6	78	1	155	1150	39	2	2	310
SA-3	6.7	48	1	510	193	43	1	2	310
SA-4	0.9	165	4	252	1200	61	1	1	380
SA-5	0.1	49	1	25	100	11	1	1	370
SA-6	0.2	28	1	32	110	12	1	3	290
SA-7	0.2	13	1	25	84	9	1	2	420
SA-8	0.2	23	1	58	85	19	1	1	290
SA-9	0.1	14	1	42	87	33	3	1	380
SA-10	0.1	9	1	37	88	3	1	1	270
SA-11	0.1	10	1	21	66	3	1	2	510
SA-12	0.1	7	1	17	60	4	1	1	580
SA-13	0.2	50	1	110	178	12	1	1	290
SA-14	0.1	9	1	19	48	3	1	2	410
SA-15	0.1	8	10	12	43	3	1	1	1900
SA-16	0.1	6	2	14	55	2	1	2	420
SA-17	0.1	6	2	14	53	3	1	1	420
SA-18	0.1	15	1	22	83	6	3	2	340
SA-19	0.1	16	1	15	72	6	4	2	390
SA-20	0.1	20	1	14	75	6	8	1	340
SA-21	0.1	23	1	39	121	22	1	1	300
SA-22	0.1	38	1	78	170	27	1	1	260
SA-23	0.1	37	2	33	52	36	1	1	450
SA-24	2.3	58	1	730	2860	170	1	1	320
SA-25	0.1	30	1	30	130	45	1	1	220
SA-26	0.4	25	1	19	90	51	1	1	180
SA-27	0.1	60	1	21	52	5	1	1	500
SA-28	0.2	32	1	45	62	7	1	1	540
SA-29	0.1	19	3	14	35	2	7	1	250
SA-30	0.1	85	1	57	54	12	1	1	610
SA-31	0.1	34	1	20	42	11	1	1	470
SA-32	0.1	37	1	28	59	10	1	1	440
SA-33	0.1	24	1	60	92	1	125	1	160
SA-34	0.1	11	1	58	104	1	1	1	150
SE-1	0.2	25	1	24	93	6	1	1	370
SE-2	0.1	34	1	10	105	11	1	1	280
SE-3	0.1	31	1	15	105	15	1	1	270
SE-4	0.1	22	1	17	83	19	1	1	270
SE-5	0.1	23	5	23	81	9	1	1	300
SE-6	0.1	15	1	6	44	11	1	1	270
SE-7	0.1	17	1	16	102	17	1	1	300
SE-8	0.1	18	1	15	55	10	1	1	300
SE-9	0.1	38	1	33	125	11	1	1	430
SE-10	0.1	13	1	22	48	11	1	1	210
SE-11	0.1	15	1	20	72	15	1	1	260
SE-12	0.1	25	2	50	35	20	1	1	310
SE-13	0.1	10	1	24	59	4	1	2	280
SE-14	0.2	5	2	20	47	4	1	2	340
SE-15	0.1	11	1	25	69	4	3	2	300
SE-16	0.2	10	1	28	93	7	1	8	420
SE-17	0.1	20	1	25	65	7	1	7	420
SE-18	0.1	14	1	49	67	7	3	3	290
SE-19	6.2	12	2	48	72	5	1	13	310
SE-20	0.1	114	1	27	154	14	1	1	300
SE-21	0.2	14	1	20	43	6	2	1	250

Sample No.	ppm Ag	ppm Cu	ppm Mo	ppm Pb	ppm Zn	ppm As	ppm W	ppm Sn	ppm F
SE-22	0.1	24	1	18	43	9	6	1	250
SE-23	0.3	23	1	35	100	150	1	1	560
SE-24	0.2	7	1	34	112	150	1	1	530
SE-25	0.1	10	1	23	73	12	1	1	340
SE-26	0.1	17	2	26	48	12	4	2	280
SE-27	1.1	205	1	145	265	33	1	2	340
SE-28	0.4	33	2	48	107	90	1	1	610
SE-29	0.5	16	1	58	69	14	1	1	390
SE-30	0.2	12	2	20	62	9	3	1	310
SE-31	0.3	28	2	37	100	88	1	1	500
SE-32	0.2	19	1	17	57	7	3	1	390
SE-33	0.1	8	1	27	94	7	1	2	300
SE-34	0.1	13	1	26	95	11	1	1	320
SE-35	0.2	38	1	42	212	46	1	1	310
SE-36	0.1	21	2	22	95	5	1	1	270
SE-37	0.1	22	1	18	118	6	1	1	280
SE-38	0.1	30	1	15	91	6	1	1	280
SE-39	0.2	18	1	15	128	15	1	1	290
SE-40	0.1	20	1	15	132	12	1	1	250
SE-41	0.2	33	1	18	210	12	1	1	240
SE-42	0.1	19	1	13	420	6	1	1	230
SE-43	0.1	24	1	26	158	19	1	1	350
SE-44	0.1	23	1	12	115	5	1	1	160
SE-45	0.2	18	2	20	90	33	2	1	460
SE-46	0.1	16	1	29	88	30	2	1	440
SE-47	0.3	21	2	27	70	23	1	1	540
SE-48	0.1	25	1	19	97	29	1	1	390
SE-49	0.1	13	1	37	93	22	1	1	410
SE-50	1.9	15	1	28	98	45	3	1	420
SE-51	0.2	11	1	32	92	85	1	1	420
SE-52	0.1	14	2	23	80	32	2	1	470
SE-53	0.4	27	1	50	122	51	1	1	650
SE-54	0.1	21	3	30	114	45	1	1	970
SE-55	0.1	18	1	11	180	7	1	1	350
SE-56	0.1	17	1	15	155	7	1	1	250
SE-57	0.4	25	1	38	95	63	1	2	430
SE-58	0.1	87	1	75	135	50	1	1	350
SE-59	0.1	36	1	21	110	15	1	1	270
SE-60	0.1	8	1	38	55	6	2	1	450
SE-61	0.1	16	1	65	100	10	9	1	270
SE-62	0.1	32	1	32	95	15	3	1	320
SE-63	0.1	40	2	28	94	15	2	1	300
SE-64	0.1	27	2	14	75	5	1	1	260
SE-65	0.1	22	4	40	52	10	2	1	310
SE-66	0.2	20	5	43	68	16	6	1	440
SE-67	0.1	22	6	62	84	7	4	1	330
SE-68	0.1	26	6	23	80	7	4	1	380
SE-69	0.1	11	1	10	48	4	1	1	640
SE-70	0.1	16	1	20	70	24	1	1	620
SE-71	0.1	8	1	10	53	4	1	1	450
SE-72	0.1	9	1	11	43	5	1	1	360
SE-73	0.1	6	1	15	58	10	1	1	380
SE-74	0.1	6	1	11	55	2	1	1	370
SE-75	0.1	7	1	6	48	2	1	1	520
SE-76	0.1	9	1	8	48	5	1	1	350

Table10 Chemical Analyses of Stream Sediments (5)

Sample No.	Ag ppm	Cu ppm	Mo ppm	Pb ppm	Zn ppm	As ppm	W ppm	Sn ppm	F ppm
SE-77	0.1	13	1	7	44	5	1	1	290
SE-78	0.1	9	1	9	39	4	1	1	330
SE-79	0.1	12	1	8	48	3	1	1	400
SE-80	0.1	18	1	14	76	11	1	1	300
SE-81	0.1	11	1	12	59	5	1	1	340
SE-82	0.9	78	3	14	280	51	2	1	290
SE-83	0.9	26	1	30	76	25	1	1	290
SE-84	0.1	24	1	19	33	16	1	1	350
SE-85	0.3	36	2	175	133	27	1	1	300
SE-86	0.1	35	1	19	126	15	2	1	450
SE-87	0.3	45	2	24	136	11	1	1	380
SE-88	0.1	26	1	15	90	10	1	1	320
SE-89	0.1	16	1	12	83	5	1	1	250
SE-90	0.1	18	1	13	38	11	1	1	400
SE-91	0.1	21	1	23	47	14	2	6	430
SE-92	0.2	26	2	39	63	11	2	1	240
SE-93	0.8	73	1	470	190	55	1	1	260
SE-94	0.1	43	1	60	168	17	2	1	580
SE-95	0.6	82	1	430	258	46	1	1	310
SE-96	0.1	19	1	55	110	12	1	1	380
SE-97	0.6	68	4	370	200	41	1	1	330
SE-98	0.2	28	1	41	200	12	1	1	250
SE-99	0.7	70	1	475	205	57	1	1	280
SE-100	0.1	14	1	15	45	5	1	1	330
SE-101	0.1	11	1	22	70	10	1	1	280
SE-102	0.1	16	1	19	88	11	1	1	260
SE-103	0.1	8	2	19	65	9	1	1	270
SE-104	0.1	15	1	19	78	33	1	1	360
SE-105	0.1	15	1	8	55	11	2	1	360
SE-106	0.1	12	1	10	54	7	3	2	330
SE-107	0.1	23	1	15	40	23	1	1	430
SE-108	0.1	29	1	5	32	6	1	1	190
SE-109	0.1	80	3	265	740	5	1	1	320
SE-110	0.1	24	1	70	110	5	1	1	250
SE-111	0.4	20	1	75	62	2	1	1	230
SE-112	0.1	25	1	17	57	2	1	1	250
SE-113	0.1	20	1	13	52	9	1	1	230
SE-114	0.1	29	1	20	68	6	1	1	160
SE-115	0.1	110	4	32	112	4	1	1	180
SE-116	0.1	40	1	17	42	4	1	1	250
SE-117	0.1	55	1	32	59	2	1	1	280
SE-118	1.2	220	1	510	355	61	1	1	290
SE-119	0.2	75	2	95	138	100	1	1	410
SE-120	2.9	340	3	2100	1060	90	2	1	230
SE-121	0.1	20	1	23	88	3	1	1	170
SE-122	0.1	81	4	100	118	10	1	1	180
SE-123	0.2	83	4	83	192	12	1	1	240
SE-124	0.2	100	5	110	230	30	1	1	210
SE-125	0.4	290	3	125	230	12	1	1	320
SE-126	0.1	20	1	26	60	5	1	1	270
SE-127	0.1	38	2	28	72	15	1	1	190
SE-128	0.1	16	1	40	72	2	1	1	230
SH-1	0.1	19	2	10	47	2	1	1	210
SH-2	0.1	25	1	9	48	3	1	1	260
SH-3	0.1	56	1	8	53	1	1	1	230

Sample No.	Ag ppm	Cu ppm	Mo ppm	Pb ppm	Zn ppm	As ppm	W ppm	Sn ppm	F ppm
SH-4	0.1	52	4	10	44	1	1	1	220
SH-5	0.1	25	1	23	93	16	1	1	460
SH-6	0.2	28	1	39	235	35	1	2	460
SH-7	0.1	29	2	23	120	19	4	1	440
SH-8	0.1	6	1	33	62	23	2	1	420
SH-9	0.1	38	1	56	138	29	1	1	480
SH-10	0.1	10	1	35	85	14	1	1	430
SH-11	0.1	24	1	14	168	10	1	1	350
SH-12	0.1	15	1	25	102	14	1	1	420
SH-13	0.1	50	1	30	148	39	7	1	620
SH-14	0.1	13	1	34	93	30	1	1	560
SH-15	0.1	25	1	14	175	10	1	1	350
SH-16	0.1	7	1	24	68	22	1	1	370
SH-17	0.1	9	1	19	75	12	1	1	290
SH-18	0.1	7	1	23	72	33	2	1	390
SH-19	0.1	8	1	17	60	10	1	1	360
SH-20	0.1	11	1	14	65	11	1	2	350
SH-21	0.1	7	1	13	62	7	1	1	360
SH-22	0.1	2	1	28	62	11	1	1	290
SH-23	0.1	14	1	19	80	6	1	1	250
SH-24	0.1	12	1	20	100	9	1	1	440
SH-25	0.1	12	1	13	70	7	1	1	440
SH-26	0.1	21	1	18	153	20	1	1	350
SH-27	0.1	16	1	13	382	3	1	1	290
SH-28	0.1	14	1	18	110	9	1	1	360
SH-29	0.1	72	1	38	290	20	1	1	250
SH-30	0.1	15	1	14	105	11	1	1	400
SH-31	0.1	13	1	22	96	41	2	1	320
SH-32	0.1	17	1	15	105	15	1	2	340
SH-33	0.1	8	1	30	110	32	1	1	390
SH-34	0.1	10	1	26	94	38	1	3	340
SH-35	0.2	23	1	31	115	36	1	1	330
SH-36	0.1	17	1	30	105	24	2	1	420
SH-37	0.1	14	1	29	103	19	2	1	450
SH-38	0.1	27	1	26	125	23	2	1	580
SH-39	0.1	13	1	15	74	15	2	1	310
SH-40	0.1	18	1	22	118	20	1	2	420
SH-41	0.1	16	1	14	140	15	1	1	320
SH-42	0.1	18	1	22	78	39	1	1	460
SH-43	0.1	16	1	18	70	45	3	1	440
SH-44	0.1	17	1	22	88	25	1	2	700
SH-45	0.1	24	2	11	113	2	1	1	250
SH-46	0.1	23	1	12	115	6	1	1	280
SH-47	0.1	3	1	10	58	3	7	1	350
SH-48	0.1	5	1	13	85	4	6	1	480
SH-49	0.1	4	1	16	70	3	4	18	410
SH-50	0.1	3	1	10	47	6	4	1	470
SH-51	0.1	3	1	9	45	3	2	1	510
SH-52	0.1	1	2	11	44	4	1	1	550
SH-53	0.1	2	1	12	63	1	1	1	600
SH-54	0.1	11	1	14	70	11	1	1	510
SH-55	0.1	22	1	18	99	20	1	1	380
SH-56	0.1	10	1	9	49	3	2	1	390
SH-57	0.1	16	1	7	65	4	1	1	550
SH-58	0.1	11	1	5	53	2	2	1	390

Table10 Chemical Analyses of Stream Sediments (6)

Sample No.	Ag ppm	Cu ppm	Mo ppm	Pb ppm	Zn ppm	As ppm	W ppm	Sn ppm	F ppm
SH-59	0.1	7	1	9	46	7	8	1	430
SH-60	0.1	13	1	16	48	2	1	1	250
SH-61	0.1	80	2	18	84	3	1	1	240
SH-62	0.1	130	4	8	66	3	1	1	240
SH-63	0.1	50	2	10	61	1	1	1	190
SH-64	0.1	52	3	18	33	1	1	1	170
SH-65	0.1	250	2	19	60	2	1	1	220
SH-66	0.1	90	6	18	54	1	1	1	170
SK-1	0.6	248	9	113	128	11	2	1	240
SK-2	0.6	48	4	22	34	32	2	1	320
SK-3	0.3	75	2	45	108	63	2	1	310
SK-4	0.3	32	2	23	73	10	1	1	260
SK-5	0.2	113	1	92	282	99	1	1	360
SK-6	0.4	96	3	180	130	45	2	1	560
SK-7	0.3	75	3	34	148	39	2	1	330
SK-8	0.4	95	3	83	113	110	1	1	340
SK-9	0.7	200	2	105	280	55	2	1	270
SK-10	0.2	82	3	138	215	16	2	1	260
SK-11	0.7	328	9	87	205	15	2	1	280
SK-12	0.3	39	5	88	155	17	2	1	270
SK-13	0.3	40	2	31	92	15	1	1	280
SK-14	0.2	153	2	100	650	75	1	1	270
SK-15	0.1	42	2	13	50	55	1	1	320
SK-16	0.2	82	2	96	105	50	1	1	350
SK-17	0.5	128	2	296	343	110	1	1	290
SK-18	0.2	455	5	90	1000	120	1	1	360
SK-19	0.3	108	2	52	470	57	1	1	230
SK-20	0.4	160	2	40	245	100	1	1	270
SK-21	0.1	50	1	18	75	4	1	1	440
SK-22	0.2	42	1	33	130	11	1	1	280
SK-23	0.3	11	2	22	38	19	2	1	230
SK-24	0.2	15	1	19	44	19	2	1	240
SK-25	0.1	47	1	40	82	23	1	1	280
SK-26	0.1	93	1	39	105	15	1	1	310
SK-27	0.2	78	1	80	158	36	1	1	310
SK-28	0.1	82	6	38	117	14	3	1	590
SK-29	0.1	72	6	17	63	16	3	1	890
SK-30	0.1	90	2	69	78	17	1	1	400
SK-31	0.1	95	1	170	193	100	1	1	230
SK-32	0.2	92	1	62	252	65	1	1	240
SK-33	0.2	555	1	35	218	24	3	1	280
SK-34	0.1	40	1	22	130	9	1	1	290
SK-35	0.1	58	2	80	145	11	2	1	370
SK-36	0.3	37	1	140	98	46	1	1	300
SK-37	0.6	116	1	143	193	14	1	1	360
SK-38	0.5	110	2	71	350	77	4	1	510
SK-39	0.6	138	2	165	290	35	3	1	390
SK-40	0.3	22	1	42	145	30	3	1	330
SK-41	0.3	34	3	144	285	57	1	1	490
SK-42	0.7	87	1	266	460	63	3	1	440
SK-43	0.2	50	2	133	295	45	4	1	620
SK-44	0.5	65	1	368	250	41	2	1	310
SK-45	0.2	28	1	30	45	14	9	2	590
SK-46	0.2	14	1	18	42	12	3	1	350
SK-47	0.2	6	1	4	31	7	2	1	550

Sample No.	Ag ppm	Cu ppm	Mo ppm	Pb ppm	Zn ppm	As ppm	W ppm	Sn ppm	F ppm
SK-48	0.1	13	1	22	53	6	1	1	420
SK-49	0.6	123	1	320	435	57	2	1	450
SK-50	0.1	21	2	32	87	10	3	1	370
SK-51	0.5	235	17	82	150	10	7	1	360
SK-52	1.4	780	10	222	635	17	8	1	420
SK-53	0.6	182	8	82	600	12	12	5	340
SK-54	0.5	323	20	34	115	11	13	1	320
SK-55	0.4	253	5	42	293	19	3	1	460
SK-56	0.1	10	1	29	130	7	1	1	350
SK-57	0.1	15	1	23	155	9	1	1	220
SK-58	0.1	5	1	8	59	4	1	1	210
SK-59	0.2	34	1	198	223	11	1	1	290
SK-60	0.3	33	3	40	130	19	1	1	350
SK-61	0.3	34	1	25	92	113	1	1	550
SK-62	0.1	27	1	40	95	23	8	1	640
SK-63	0.1	58	1	32	83	63	1	1	600
SK-64	1.3	30	1	1050	448	67	1	1	370
SK-65	0.1	15	1	53	115	12	1	1	480
SK-66	0.2	33	1	82	105	25	9	1	440
SK-67	0.3	26	1	45	108	23	1	1	530
SK-68	0.3	24	1	60	203	14	1	2	580
SK-69	0.1	36	2	20	106	6	1	1	290
SK-70	0.1	52	1	17	160	11	1	1	320
SK-71	0.1	24	1	13	142	9	1	1	290
SK-72	0.1	21	1	19	107	6	1	1	320
SK-73	0.1	21	4	17	45	90	1	1	230
SK-74	0.1	45	3	43	152	32	1	1	240
0	0.0	0	0	0	0	0	0	0	0
SK-75	0.1	56	4	34	76	25	1	1	280
SK-76	0.1	48	2	24	134	51	1	1	250
SK-77	0.1	32	1	54	230	1	1	1	290
SK-78	0.1	9	1	24	46	4	1	1	130
SK-79	0.1	95	1	87	162	51	1	1	370
SK-80	0.1	38	1	50	75	14	1	1	240
SK-81	0.1	35	1	48	198	32	1	1	290
SK-82	0.1	48	1	140	162	19	1	1	190
SK-83	0.4	250	1	2300	1560	29	1	1	270
SK-84	0.1	1	1	20	38	1	1	1	120
SK-85	0.1	1	1	11	31	2	1	1	130
SM-1	0.1	1	1	10	57	4	1	2	460
SM-2	0.1	5	1	21	54	3	8	1	490
SM-3	0.1	1	1	20	60	3	1	1	420
SM-4	0.1	1	1	18	58	4	1	1	370
SM-5	0.1	2	2	23	60	3	1	1	480
SM-6	0.1	1	1	30	51	2	1	1	450
SM-7	0.1	1	1	16	49	2	1	1	460
SM-8	0.1	2	1	12	46	4	4	1	450
SM-9	0.2	5	1	21	72	6	1	2	420
SM-10	0.2	3	2	30	62	3	3	1	620
SM-11	0.2	4	1	11	55	4	1	1	540
SM-12	0.2	10	2	29	54	5	1	1	530
SM-13	0.2	7	2	17	46	6	1	1	520
SM-14	0.1	2	1	7	47	3	1	1	460
SM-15	0.1	155	3	53	46	46	1	1	300
SM-16	0.1	67	1	145	400	50	4	1	430

Table10 Chemical Analyses of Stream Sediments (7)

Sample No.	ppm Ag	ppm Cu	ppm Mo	ppm Pb	ppm Zn	ppm As	ppm W	ppm Sn	ppm F
SM-17	0.1	75	1	78	250	50	2	1	520
SM-18	0.1	43	1	128	280	39	1	1	540
SM-19	0.1	19	1	145	105	55	1	1	370
SM-20	0.1	45	1	30	112	83	1	1	230
SM-21	0.2	38	1	129	118	48	1	1	390
SM-22	0.1	43	1	150	195	11	1	1	380
SM-23	0.1	9	1	19	100	15	1	1	300
SM-24	0.1	25	1	64	135	19	1	1	290
SM-25	0.3	41	1	165	455	36	1	1	480
SM-26	0.2	10	10	35	98	10	4	2	430
SM-27	0.1	32	6	62	105	9	1	1	450
SM-28	0.1	24	28	86	570	10	3	1	350
SM-29	0.1	38	3	51	118	6	1	1	410
SM-30	0.1	9	1	21	34	6	1	1	590
SM-31	0.2	53	1	110	260	53	1	1	350
SM-32	0.1	27	5	24	46	6	1	1	480
SM-33	0.3	56	4	93	70	11	1	1	640
SM-34	2.4	36	5	54	48	15	1	1	500
SM-35	0.1	28	2	19	44	11	1	1	440
SM-36	0.1	43	1	19	41	11	1	1	540
SM-37	0.2	65	1	320	263	41	1	1	320
SM-38	1.8	515	1	510	265	180	1	1	460
SM-39	0.2	22	1	25	102	15	1	1	250
SM-40	0.1	24	1	55	105	29	1	1	320
SM-41	0.1	17	1	33	46	39	1	1	370
SM-42	0.1	25	1	41	75	50	1	1	380
SM-43	0.2	45	1	60	125	180	1	1	650
SM-44	2.4	130	1	1880	840	100	3	1	410
SM-45	0.1	34	1	53	160	17	1	1	520
SM-46	2.2	62	1	740	355	77	1	1	460
SM-47	0.1	1	1	11	15	1	1	1	100
SS-1	0.1	35	2	18	40	14	2	1	560
SS-2	0.1	40	1	21	36	20	1	1	570
SS-3	0.1	58	1	27	57	12	3	1	740
SS-4	2.0	420	1	3250	1450	97	1	1	770
SS-5	0.2	61	2	89	330	43	1	1	270
SS-6	0.1	67	2	105	435	53	1	1	330
SS-7	0.1	40	1	10	123	6	1	1	140
SS-8	0.5	100	1	330	385	36	3	1	250
SS-9	0.1	55	2	335	110	14	1	1	280
SS-10	0.1	43	1	12	73	5	1	1	190
SS-11	0.2	37	1	20	84	16	1	1	250
SS-12	0.1	20	1	22	57	10	1	1	280
SS-13	0.1	13	1	70	53	3	1	1	350
SS-14	0.1	33	1	10	50	12	1	1	410
SS-15	0.1	15	1	5	48	5	1	1	270
SS-16	0.1	22	1	7	42	4	1	1	320
SS-17	0.1	29	1	10	45	9	3	1	360
SS-18	0.1	22	1	6	48	5	1	1	260
SS-19	0.1	12	1	13	45	5	1	1	300
SS-20	0.1	15	1	19	60	14	2	1	390
SS-21	0.1	7	1	18	47	4	2	1	300
SS-22	0.1	12	1	15	64	5	9	1	280
SS-23	0.1	15	1	18	61	25	1	1	360
SS-24	0.1	15	1	17	60	11	21	4	300

Sample No.	ppm Ag	ppm Cu	ppm Mo	ppm Pb	ppm Zn	ppm As	ppm W	ppm Sn	ppm F
SS-25	0.1	23	1	19	100	23	1	1	360
SS-26	0.2	19	1	18	85	19	1	1	230
SS-27	0.1	60	4	19	67	6	1	1	400
SS-28	0.1	43	3	18	40	11	1	1	390
SS-29	0.1	21	2	8	21	3	1	1	290
SS-30	0.1	170	12	20	18	4	2	1	720
SS-31	0.1	26	4	10	21	4	1	1	540
SS-32	0.1	50	2	23	38	6	1	1	480
SS-33	0.1	13	1	50	94	14	1	1	140
SS-34	0.1	26	1	30	75	4	1	1	170
SS-35	0.1	12	1	20	56	6	1	1	140
SS-38	0.1	17	3	53	84	2	1	1	130
ST-1	0.1	10	1	9	40	4	1	1	250
ST-2	0.1	20	1	12	85	5	1	2	190
ST-3	0.1	3	1	13	31	3	1	1	210
ST-4	0.1	9	1	20	47	5	1	1	340
ST-5	0.1	21	1	15	83	10	1	1	270
ST-6	0.1	26	1	21	96	16	1	1	270
ST-7	0.1	17	1	11	155	5	1	1	260
ST-8	0.1	22	1	26	128	19	4	3	280
ST-9	0.1	22	1	10	145	5	1	1	240
ST-10	0.1	25	1	18	190	4	1	1	230
ST-11	0.1	27	1	15	243	9	1	1	210
ST-12	0.2	22	1	19	110	14	1	1	280
ST-13	0.2	28	1	9	120	4	1	1	210
ST-14	0.1	27	1	31	70	20	1	1	310
ST-15	0.1	7	1	16	59	5	1	2	320
ST-16	0.1	14	1	9	44	10	1	1	240
ST-17	0.1	9	1	13	52	6	1	2	300
ST-18	0.1	13	1	10	46	11	1	1	230
ST-19	0.1	10	1	17	54	5	1	1	330
ST-20	0.1	6	1	19	58	5	5	2	320
ST-21	0.1	17	1	49	68	23	1	1	330
ST-22	0.1	17	1	18	50	14	1	1	240
ST-23	0.1	46	1	4	48	4	1	1	280
ST-24	0.1	50	1	11	57	6	1	1	270
ST-25	0.1	75	1	80	225	10	1	1	310
ST-26	0.1	62	2	63	128	15	1	1	330
ST-27	0.1	76	2	52	94	14	1	1	280
ST-28	0.1	74	4	33	98	5	1	1	280
ST-29	0.1	52	3	1	38	3	1	1	270
ST-30	0.1	25	1	13	30	2	1	1	210
ST-31	0.1	35	1	15	72	10	1	1	220
ST-32	0.1	50	1	48	133	45	1	1	260
ST-33	0.1	31	1	40	73	39	1	1	240
ST-34	0.1	210	9	36	73	5	1	1	180
ST-35	0.1	35	1	85	130	19	1	1	230
ST-36	0.1	30	2	37	92	15	1	1	220
ST-37	0.1	40	3	48	114	11	1	1	180
ST-38	0.1	120	6	55	115	12	1	1	200
ST-39	0.1	26	2	44	84	12	1	1	180
ST-40	0.1	48	3	135	193	6	1	1	210
ST-41	0.1	60	1	110	142	30	1	1	190
ST-42	0.1	265	7	21	78	3	1	1	190
ST-43	0.1	350	13	21	54	3	1	1	190

Table10 Chemical Analyses of Stream Sediments (8)

Sample No.	Ag ppm	Cu ppm	Mo ppm	Pb ppm	Zn ppm	As ppm	W ppm	Sn ppm	F ppm
ST-44	0.1	95	5	70	120	10	1	1	230
ST-45	0.1	320	26	24	58	2	1	1	290
SY-1	0.4	46	1	200	145	29	1	1	240
SY-2	0.1	18	1	13	48	7	1	1	280
SY-3	0.1	27	1	67	80	17	1	1	280
SY-4	0.1	25	2	26	73	30	1	1	310
SY-5	0.5	41	2	50	93	190	1	1	340
SY-6	0.4	35	1	35	50	69	1	1	390
SY-7	0.1	34	1	12	55	24	1	1	250
SY-8	0.1	39	1	24	43	71	1	1	250
SY-9	0.1	15	1	12	32	11	1	1	350
SY-10	0.1	8	1	8	35	17	8	1	300
SY-11	0.1	12	1	12	58	11	1	1	290
SY-12	0.1	11	1	12	40	10	1	1	330
SY-13	0.1	8	1	9	48	4	1	1	430
SY-14	0.1	14	1	14	45	15	1	7	290
SY-15	0.1	14	1	41	65	14	1	1	310
SY-16	0.1	16	1	9	47	10	14	1	380
SY-17	0.1	9	1	10	35	6	1	1	360
SY-18	0.1	28	1	26	75	29	1	1	340
SY-19	0.1	9	1	8	45	5	3	2	280
SY-20	0.4	33	1	22	70	23	1	1	300
SY-21	0.1	30	1	45	110	30	1	1	320
SY-22	0.1	28	1	20	72	35	1	1	250
SY-23	0.1	8	1	11	45	3	7	1	310
SY-24	0.1	19	1	26	68	30	1	1	450
SY-25	0.1	9	1	20	70	9	1	1	400
SY-26	0.1	20	1	22	68	9	1	1	380
SY-27	0.1	21	1	35	61	15	1	1	320
SY-28	0.1	16	1	15	77	7	1	1	340
SY-29	0.1	16	1	14	64	9	1	1	270
SY-30	0.1	15	1	8	55	4	1	1	340
SY-31	0.1	19	1	30	65	12	1	1	330
SY-32	0.1	37	1	17	88	19	1	1	330
SY-33	0.2	54	1	24	110	24	1	1	320
SY-34	0.1	17	1	14	98	10	1	1	240
SY-35	0.2	24	1	74	165	17	1	1	320
SY-36	0.1	13	1	19	78	9	1	1	280
SY-37	0.4	26	1	135	273	29	1	1	300
SY-38	0.1	30	1	75	228	17	3	1	280
SY-39	0.5	24	2	114	155	43	3	1	290
SY-40	0.6	31	2	336	400	63	2	1	450
SY-41	0.1	17	1	15	58	10	1	1	350
SY-42	0.1	16	1	18	48	15	2	1	440
SY-43	0.1	10	1	15	55	5	1	7	420
SY-44	0.1	21	1	23	78	5	1	1	350
SY-45	0.8	16	1	23	73	10	1	1	320
SY-46	0.1	13	1	31	95	25	1	1	510
SY-47	0.1	16	1	28	110	23	1	1	470
SY-48	0.1	15	1	22	102	16	1	1	440
SY-49	0.1	12	1	30	104	19	1	1	480
SY-50	0.1	72	1	46	90	15	1	1	150
SY-51	0.1	122	2	20	77	11	1	1	240
SY-52	0.1	42	2	11	50	16	1	1	330
SY-53	0.1	33	1	28	76	29	1	1	440
SY-54	0.1	13	1	12	31	11	1	1	160
SY-55	0.1	21	1	11	37	38	1	1	180
SY-56	0.1	25	1	42	51	14	1	1	300
SY-57	0.1	17	1	50	76	30	1	1	260
SY-58	0.1	22	1	38	90	9	1	1	210
SY-59	0.1	20	1	30	61	5	1	1	260
SY-60	0.1	12	1	6	38	1	1	1	160
SY-61	0.1	11	1	7	34	1	1	1	210
SY-62	0.1	19	2	5	25	1	2	1	180
SY-63	0.1	28	1	32	63	6	1	1	190