Tab.II–1–3 Generalized drilling results

Drill Hole NO	Machine Type	Drilling Period	Drilled Lenght (m)	Core		Number of Drilling Shift			Drilling speed		Remarks
				Length (m)	Recovry (%)	Drilling	Preparation & Removing	Total	m/shift*	m/shift**	
MJJ−2	L−24	July 25, 1992 ~Aug. 2, 1992	151.50	144.50	95.38	18	50	68	2.23	8.42	12hrs/shift
MJJ−3	L−24	Aug. 5, 1992 ~Aug. 23, 1992	150.00	134.40	89.60	38	14	52	2.88	3.95	
MJJ−4	NEPTUNO	Aug. 27, 1992 ~Oct. 15, 1992	148.80	145.09	97.51	100	94	194	0.77	1.49	
MJJ−5	NEPTUNO	Oct. 24, 1992 ~Nov. 30, 1992	300.00	297.00	99.00	76	114	190	1.58	3.95	
MJJ−6	L−24	Sep. 10, 1992 ~Oct. 2, 1992	150.50	148.50	98.67	46	36	82	1.84	3.27	
MJJ−7	NEPTUNO	Nov. 18, 1992 ~Dec. 20, 1992	300.85	297.85	99.00	66	68	134	2.25	4.56	
MJJ−8	NEPTUNO	Aug. 26, 1992 ~Nov. 11, 1992	233.45	231.45	99.14	156	94	250	0.93	1.50	
MJJ−9	L−24	Oct. 6, 1992 ~Oct. 29, 1992	150.00	143.00	95.33	48	170	218	0.69	3.13	

Note * Drilled Length per shift covering total works operated

** Drilled Length per shift covering net drilling operation

(1) Aim and coordination of drill hole

Drilling survey of Phase II aimed to investigate two mineralized zones, the Q.Limonita Mineralized Zone and the Rio Junin Mineralized Zone.

The coordination, altitude, inclination, depth and Aim of each hole were shown on the following table:

Hole	Coordination	Alt.	Inc.	Depth	Aim
MJJ-2	N36.005 E760.251	2123	-90	151.50	To confirm NW-extension of Q.Limonita Mineralized zone
MJJ-3	N36.180 E760.271	2180	-90	150.00	The same aim as MJJ-2
MJJ-4	N35.895 E760.493	1918	-60	148.80	To confirm NE-extension of Q.Limonita Mineralized zone
MJJ-5	N35.890 E760.483	1918	-45	300.00	To confirm SW-extension of Q.Limonita Mineralized zone
MJJ-6	N35.850 E760.631	1860	-90	150.50	To confirm the intensity and the lower limit of mineralization of Q.Limonita mineralized Zone
MJJ-7	N35.480 E760.719	1768	-45	300.85	To confirm W-extension of Rio Junin Mineralized zone
MJJ-8	N35.475 E760.754	1772	-45	233.45	To confirm E-extension of Rio Junin Mineralized zone
MJJ-9	N35.265 E760.773	1730	-90	150.00	To confirm the intensity and the lower limit of mineralization of Rio Junin mineralized Zone

(2) Geology and mineralization of each hole

The geology and mineralization of each hole is as follows:

MJJ-2

0.00- 5.00m	Surface soil (none core)
5.00-151.50m	Granodiorite, pyrite dissemination, strong sericitization

MJJ-3

0.00- 5.00m	Surface soil (none core)
5.00- 56.50m	Granodiorite, weak pyrite dissemination, limonitization and kaolinitization
56.50- 69.80m	Quartz porphyry, weak pyrite dissemination, moderate sericitization
69.80-140.70m	Granodiorite, pyrite dissemination, moderate sericitization
140.70-150.00m	Quartz porphyry, pyrite dissemination, moderate sericitization

MJJ-4

0.00- 2.05m	Surface soil (none core)
2.05- 76.60m	Granodiorite, remarkable fractures, chalcopyrite, pyrite, bornite and molybdenite in fractures
76.60- 86.00m	Quartz porphyry, remarkable fractures, chalcopyrite, pyrite, bornite and molybdenite in fractures
86.00-148.80m	Granodiorite, strong silicification, remarkable fractures, chalcopyrite and pyrite dissemination, chalcopyrite, pyrite, bornite and molybdenite in fractures

MJJ-5

0.00- 5.00m	Surface soil (none core)
5.00- 22.70m	Granodiorite, remarkable fractures, bornite, chalcopyrite and pyrite in fractures
22.70-132.20m	Quartz porphyry, pyrite dissemination
132.20-220.10m	Granodiorite, remarkable fractures, pyrite and chalcopyrite in fractures
220.10-230.00m	Quartz porphyry, pyrite dissemination, chlorite in fractures
230.00-273.90m	Granodiorite, pyrite dissemination, chlorite in fractures
273.90-300.00m	Quartz porphyry, chlorite in fractures

MJJ-6

0.00- 2.00m	Surface soil (none core)
2.00-110.00m	Granodiorite, strong silicification, remarkable fractures, chalcopyrite and pyrite dissemination, chalcopyrite, pyrite, bornite and molybdenite in fractures
110.00-135.00m	Quartz porphyry, pyrite dissemination, pyrite, chalcopyrite and (molybdenite) in fractures
135.00-144.00m	Granodiorite
144.00-150.50m	Quartz porphyry

MJJ-7

0.00- 3.00m	Surface soil (none core)
3.00-131.60m	Granodiorite, pyrite and chalcopyrite dissemination, chlorite film
131.60-142.40m	Melanocratic rock (dike?)
142.40-282.80m	Granodiorite, pyrite dissemination, pyrite, chalcopyrite and (molybdenite) in fractures
282.80-300.85m	Quartz porphyry, moderate chloritization and epidotization

MJJ-8

0.00- 2.00m	Surface soil (none core)
2.00-158.80m	Granodiorite, strong silicification, remarkable fractures, bornite, chalcopyrite and molybdenite in fractures
158.80-176.60m	Quartz porphyry, strong silicification, remarkable fractures, chalcopyrite, molybdenite and (bornite) in fractures
176.60-206.60m	Granodiorite, strong silicification, remarkable fractures, bornite, chalcopyrite and pyrite film and/or dissemination
206.60-233.45m	Quartz porphyry, strong silicification, remarkable fractures, bornite, chalcopyrite and pyrite film and/or dissemination

MJJ-9

0.00- 10.00m	Surface soil (none core)
10.00- 40.50m	Granodiorite, pyrite and chalcopyrite dissemination, bornite, chalcopyrite and molybdenite in fractures
40.50- 43.70m	Quartz porphyry, pyrite and chalcopyrite dissemination
43.70-112.80m	Granodiorite, pyrite and chalcopyrite dissemination, bornite, chalcopyrite and molybdenite in fractures
112.80-119.50m	Quartz porphyry, pyrite and chalcopyrite dissemination, bornite, chalcopyrite and molybdenite in fractures
119.50-126.70m	Granodiorite
126.70-130.40m	Quartz porphyry
130.40-150.00m	Granodiorite, pyrite and chalcopyrite dissemination, bornite, chalcopyrite and molybdenite in fractures

Geological correlation between drill cores and outcrops is figured out in Fig.II-1-4(1) to (4). According to these figures mineralized parts tend to be abundant near and in the vicinity of Quartz Porphyry stocks and/or dikes.

In order to clarify an extension of mineralization of the Q.Limonita mineralized zone, five (5) drill holes were carried out: one for investigating northeastern part (MJJ-4), Next three for western part (MJJ-2,3 and 5), and the rest for the lower limit in the depth (MJJ-6).

(Q.Limonita Mineralized Zone)

As the result of the drilling survey, mineralization tends to dominate in the northeastern part (MJJ-4), toward a direction to the Q.Verde Mineralized Zone. The hole MJJ-4 penetrated through "fracture-zone" in which Chalcopyrite, Bornite, (Chalcocite), Molybdenite and other ore forming minerals were recognized to be abundant or common. Silicification and argillization (sericitization) were predominant in the central part of "fracture-zone" and their vicinity. These fracture zones are considered to have close relation with faults and lineaments. Drill holes MJJ-2 and 3, which locate in the northern part of MJJ-1 (Phase I), were carried out to proceed further investigation in the western part mainly.

Drill hole MJJ-5 was carried out for investigating the southwestern part of the same mineralized zone, especially at the lower level than that of the bottom of MJJ-2 and 3. These holes proved that in the shallow part (upper part of the crest) sulfide minerals had been leached out and argillized zone extended through weathering. Below the leached out level, primary sulfide minerals became common on the drill core, however, predominate Pyrite in stead of Chalcopyrite. Ratio of Chalcopyrite/Pyrite can be expected to increase at lower level. Though MJJ-5 contained a short interval of good mineralization (grade between 0.1 and 3.7 % Cu), this mineralized part was cut by Quartz Porphyry stock which has few fracture.

MJJ-6, which was carried out for investigating the lower limit of mineralization, proved that consistent mineralization and argillization continue from surface to the bottom. This alteration was classified in phyllic alteration zone according to the laboratory analytical data (Appendices 1,2 and 3). Ore assay averages 0.167 % Cu from 4 m through 150 m in depth.

(Rio Junin Mineralized Zone)

As the results of the survey of the Rio Junin Mineralized Zone, three (3) drill holes were carried out: one for investigating eastward (MJJ-8), next for westward (MJJ-7), and the rest for the lower limit in the depth (MJJ-9).

While drill holes had not yet confirmed the eastern limit of mineralized zone, mineralization on the cores tend to predominate to the eastward direction judging from conditions of mineralization and argillization observed near the bottoms. Drill hole MJJ-7 confirmed that mineralized part continued about 200 m interval of core. Near the bottom of the hole this mineralized part was, however, intersected by non-mineralized Quartz porphyry stock. The mineralized part recognized was between 145 m and 169 m in depth with the grade of 0.10 % Cu in average.

Drill hole MJJ-9 proved also that mineralization and alteration continued consistently from the surface to the bottom.Ore assay averages 0.20 % Cu from 10 m through 150 m in depth. Though ore assay tends to fluctuate below 130 m of the hole, Chalcopyrite-Pyrite minerals exist from the surface to the bottom. The mineralization and alteration were classified in Phyllic alteration zone based on laboratory analysis data (Appendices 1,2 and 3).

Therefore, mineralization is expected to extend further to a deeper level than the bottom level of the drill hole MJJ-9.

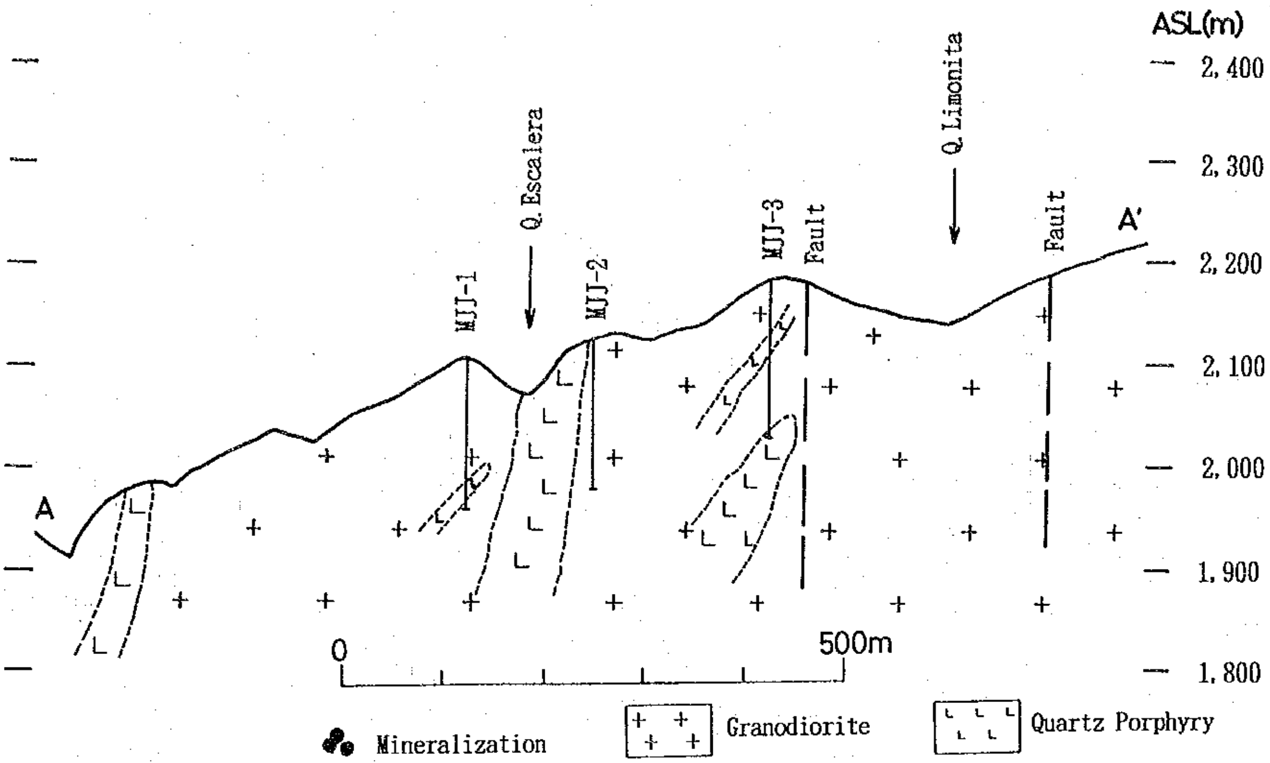


Fig.II–1–4(1) Geologic profile of the drill hole MJJ–2 and MJJ–3

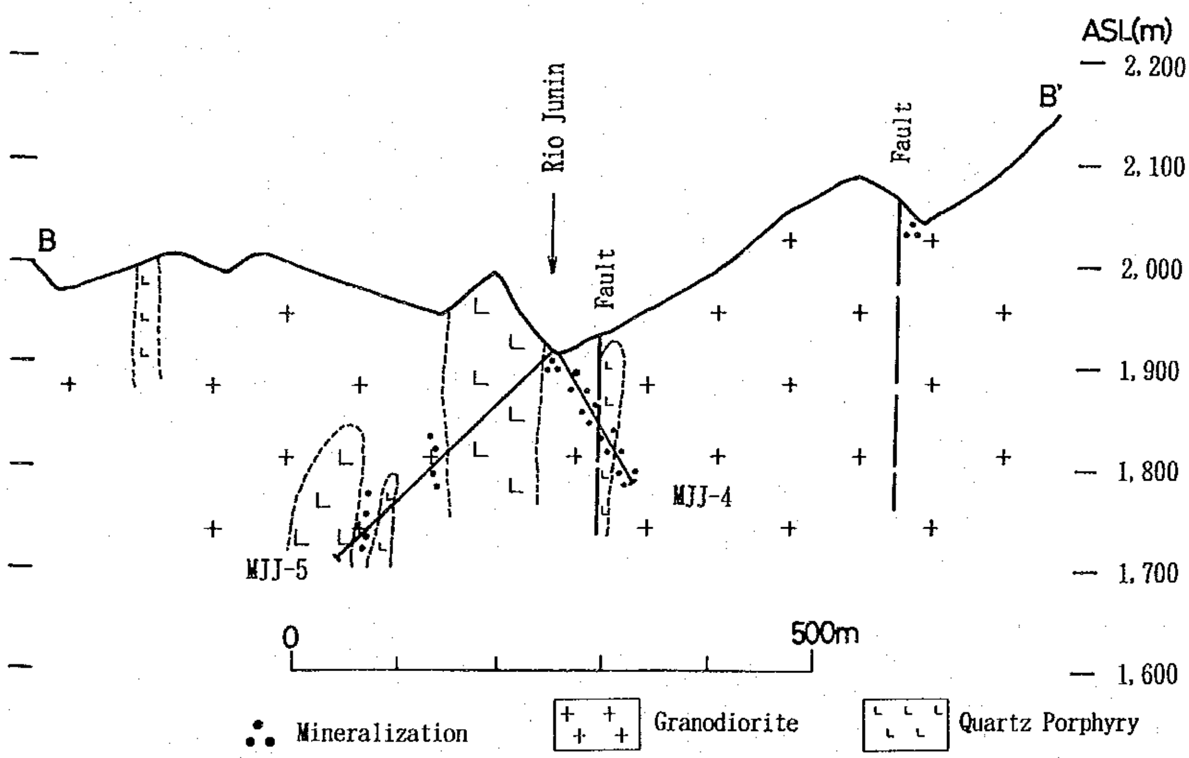


Fig.II–1–4(2) Geologic profile of the drill hole MJJ–4 and MJJ–5

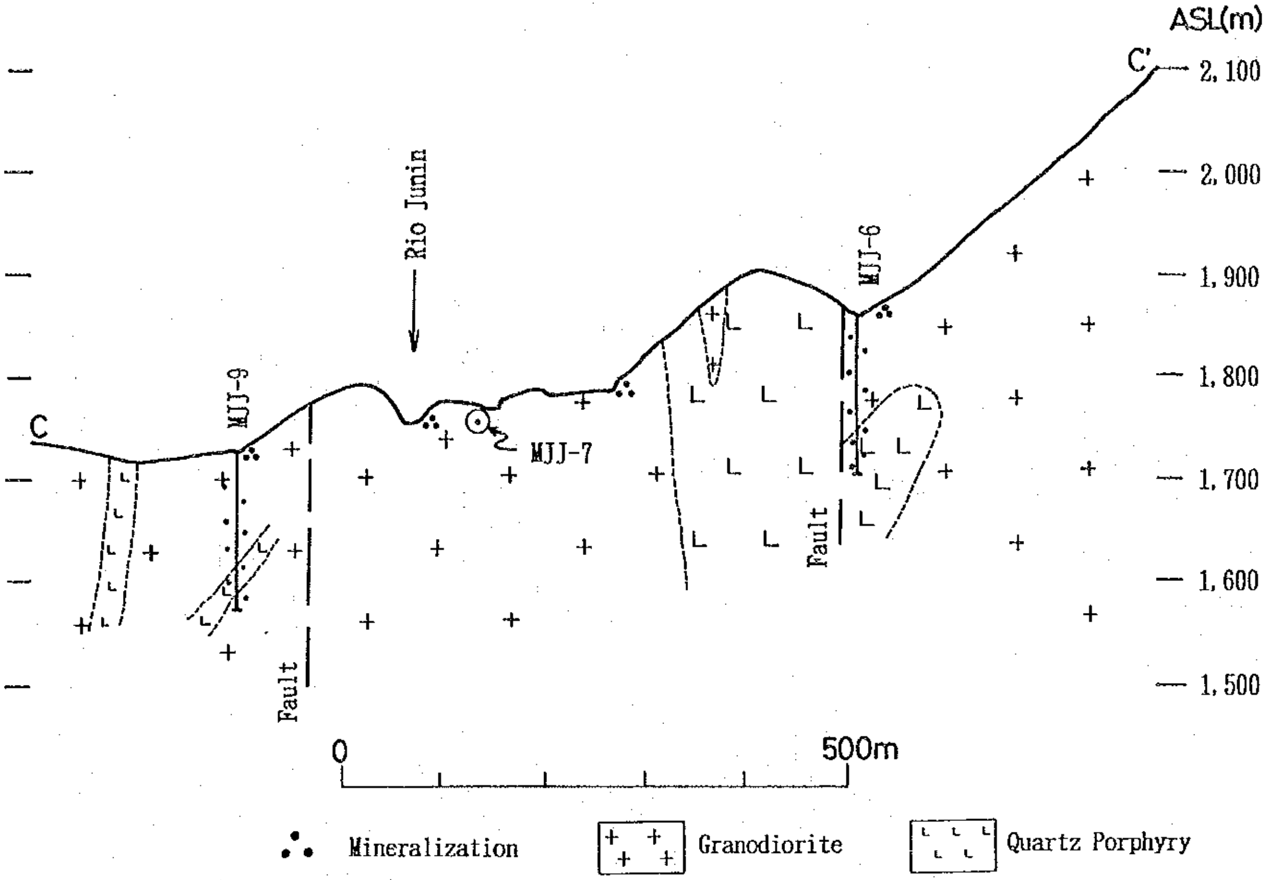


Fig.II–1–4(3) Geologic profile of the drill hole MJJ–6 and MJJ–9

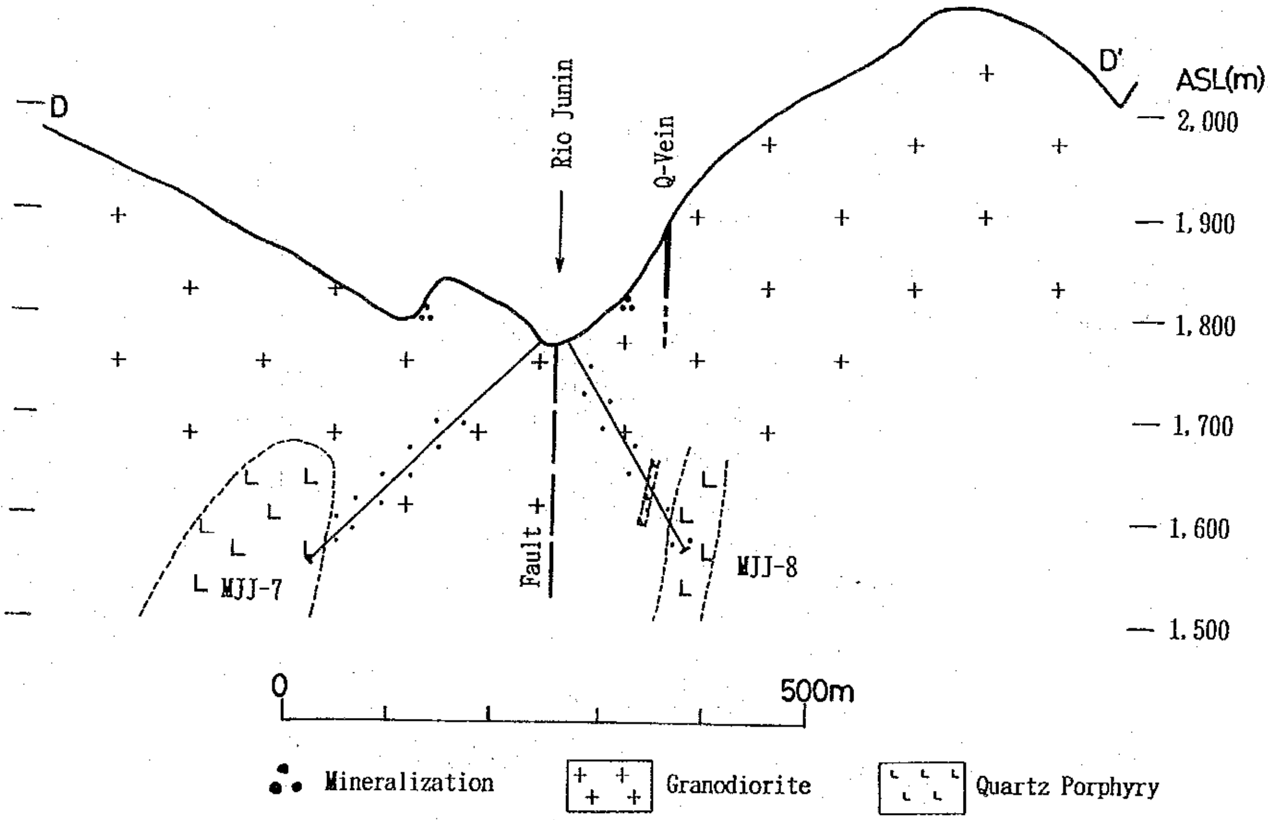


Fig.II–1–4(4) Geologic profile of the drill hole MJJ–7 and MJJ–8

1-3 Consideration

The metallogenetic process of above three mineralized and alteration zones are considered as follows: The trend of granodiorite batholith(Apuela-Nanegal batholith) is the N-S or NNE-SSW directions which is the same of the direction of Andes as a large structure. The distinguished direction of NE-SW and NW-SE of the lineaments is medium scaled structure. They are considered to be conjugate set. And, these three structures are presumed to have existed as a basement structure for quartz diorite magma which rose through the structures and formed stocks.

The Central Zone of Junin area is considered to be a place where these structural and igneous activity concentrated. The radius lineament develops from the area of the juncture of Q.Limonita and Q.Crisocolla. These fractures can be considered to have been the weak structure, and which have been intruded by porphyry accompanied with ore solution. By the mineralization and alteration of Type I together with Type II which occurred in this unique place, each type of ore deposit was formed (Type I and II are considered to be porphyry-copper type).

The mineralization was finished by the acidic hydrothermal alteration of Type III in the final stage. After that, the secondary copper minerals are crystallized by the local circulation of ground water, however, oxidation zone or the zone of secondary enrichment are presumed not to be formed, because of extreme shortage of pyrite. (however, the zone of secondary enrichment was formed in Q.Crisocolla mineralized zone, because the leaching progressed along the fault).

By the structural analysis of the fractures Type II and III, the thrust from the deeper part of Q.Verde toward the surface is presumed.

Chapter 2 Surrounding Zone of Junin Area

Detailed geological survey and rock geochemical survey were carried out in an area of 4 km^2 for Phase II survey, which is composed of the following three mineralized zones: Q.Cristal-Branch; Q.Esperanza; Q.Fortuna. These mineralized zones were delineated from the Phase I's survey result.

2-1 Geological Survey

2-1-1 Purpose and Method of Geological Survey

The purpose of the survey is to clarify the size and occurrence of the above-mentioned mineralized zones, and to disclose the source of the geochemical anomalies of stream sediments of the Phase I's survey results.

Before the survey, a map on a scale of 1:5,000 was made by enlargement of the existing topographic map on a scale of 1:10,000 , and route map was also made based on this map. The survey routes were decided with careful examination of the existing data. Aerial photographs were fully used in this survey. During this route survey, rock samples were taken along the routes for geochemical survey.

Geological map is shown in Fig.II-2-1 and Pl.II-2-1, and geological profile is shown in Pl.II-2-2. The generalized columnar section is shown in Fig.II-2-2.

The samples for various analysis and tests were collected after due consideration. The sampling points are shown in Pl.II-1-1. The results of the analysis and the tests are described in this report and also listed up on appendix.

2-1-2 Geology and Geological Structure

Geology of this area mainly consists of granodiorite(Gd) which forms batholith, and diorite porphyry(Dp) and quartz porphyry(Qp) both of which intrude into the batholith as stocks.

(1) Granodiorite(Gd)

Granodiorite forms Apuela-Nanegal batholith which distributes almost through the survey area. This rock shows medium grained, dotted pattern of hornblendes and biotites. The granodiorite batholith includes mafic tuff of Macuchi Formation and its hornfels as xenolith in Q.Esperanza and the upper reaches of Rio Chalguayacu in the western outside part of the area.

(2) Diorite porphyry(Dp)

Diorite porphyry distributes in two places in the Fortuna mineralized zone. The rock intrudes into granodiorite batholith and forms stocks with about 400 m in longitudinal diameter.

(3) Quartz porphyry(Qp)

Quartz porphyry distributes in the Q.Cristal-Branch and Q.Fortuna mineralized zones. The rock intrudes into granodiorite batholith and diorite porphyry stock, and forms dikes of several 10m in width. In the Fortuna mineralized zone, the largest distribution of this rock forms stock with about 1.7 km in longitudinal diameter.

The distributional density of quartz porphyry of the Surrounding Zone is rougher than that of the Central Zone.

These three type of rocks were classified in magnetite series. According to the result of isotope age determination with K-Ar method, the age of granodiorite showed middle Miocene of Tertiary Period, while those of porphyries showed later Miocene of Tertiary (JICA/MMAJ).

(4) Geological Structure

Lineaments develop as the conspicuous geological structure in this survey area. The lineaments were extracted by the analysis of aerial photographs on a scale of one to sixty thousand, and were drawn in geological plan map (Fig,II-2-1 and Pl.II-2-1).

The comparatively long and distinct lineaments in this Zone were developed with the direction of NW-SE, E-W to WNW-ESE, NE-SW and N-S in the Q.Cristal-Branch mineralized zone, and NE-SW and NW-SE in the Esperanza and Fortuna mineralized zones.

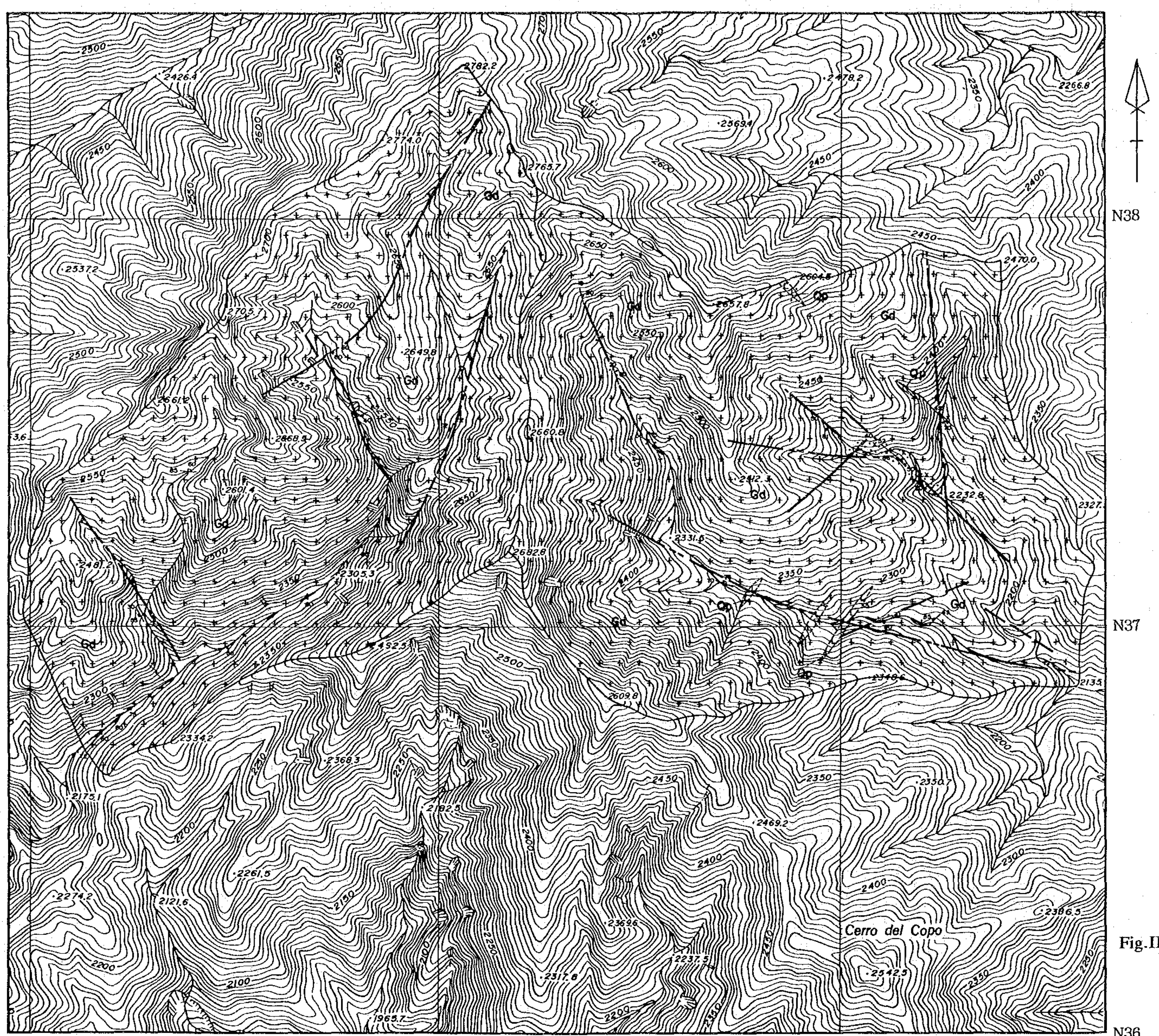
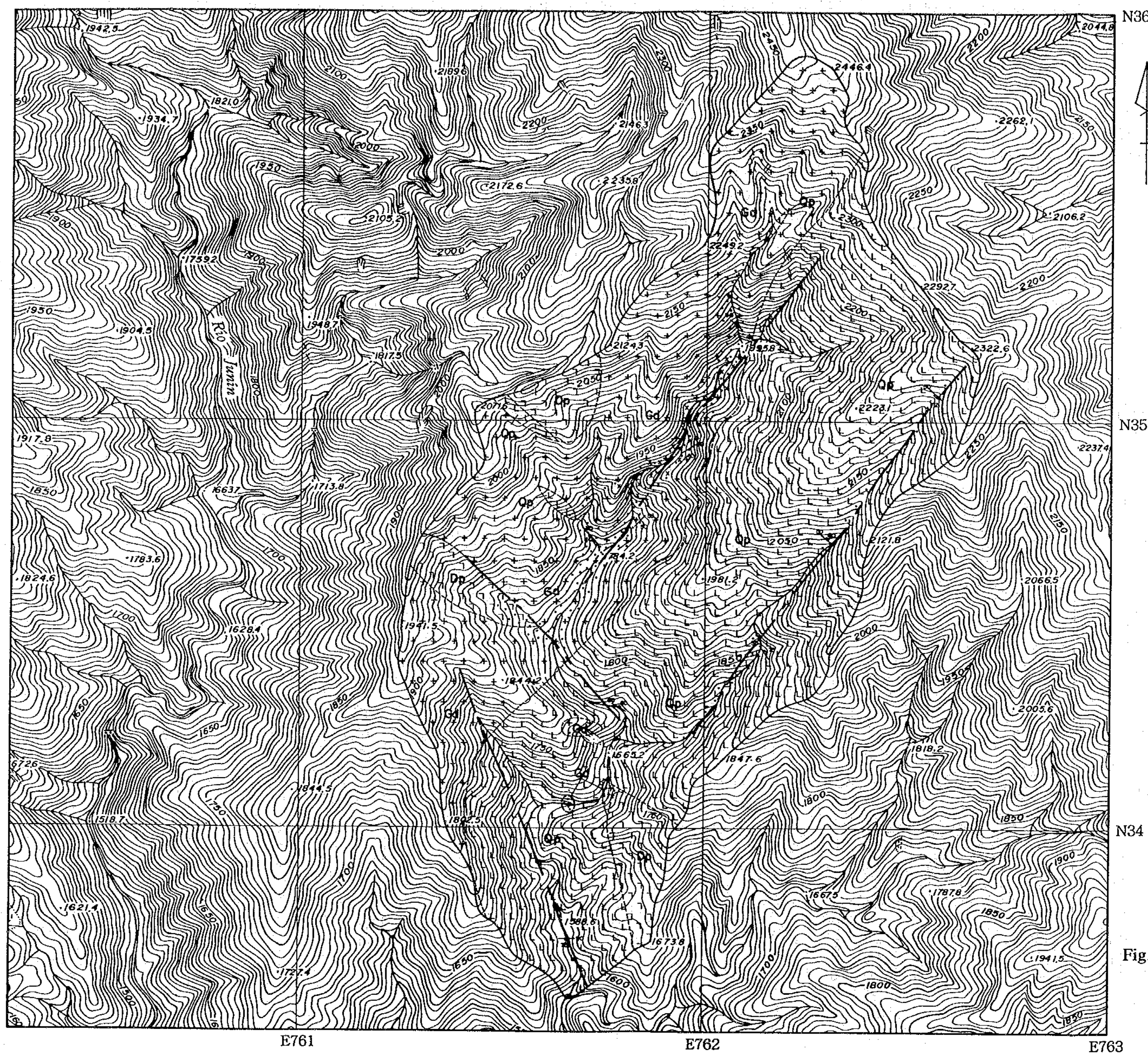
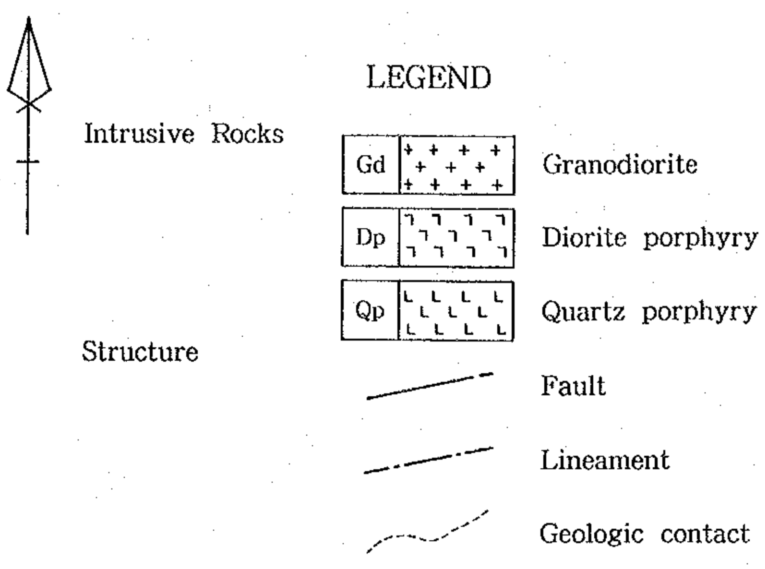


Fig.II–2–1(1) Geologic map of the Q.Cristal–Branch and Q.Esperanza mineralized zones, Surrounding zone,Junin area





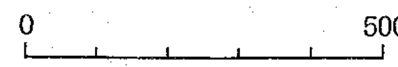


Fig.II–2–1(2) Geologic map of the Q.Fortuna mineralized zone,Surrounding zone,Junin area

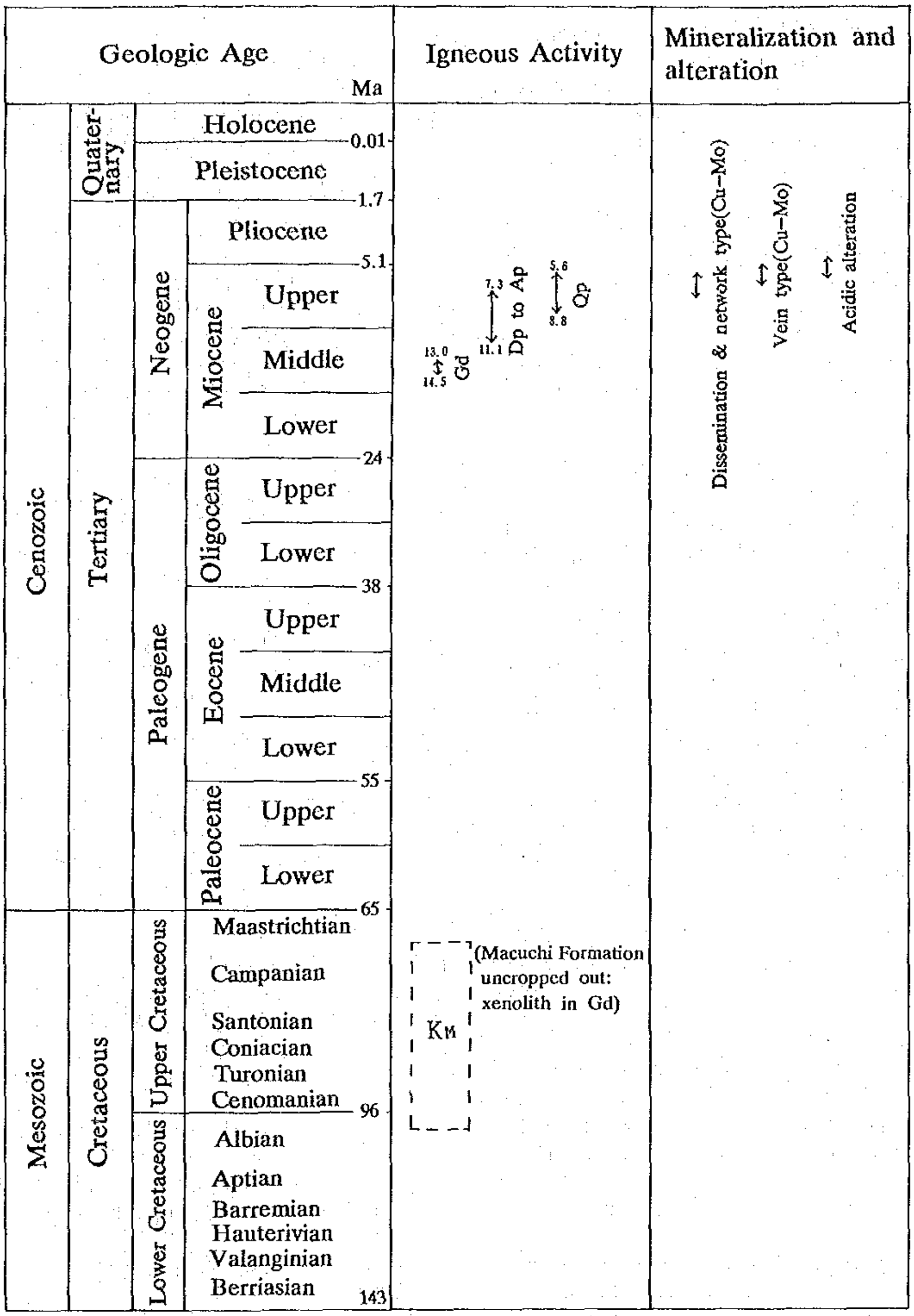


Fig.II–2–2 Generalized columnar section of the Junin and Cuellaje areas

2-1-3 Mineralization and Alteration

Characteristics of each mineralized zone are as follows:

(1) Q.Cristal-Branch mineralized zone (Fig.II-2-3(1))

The geology of the mineralized zone is underlain by granodiorite with some small dikes of quartz porphyry. In this mineralized zone, the Type I, Type IIA and Type IIB are recognized.

The Type I mineralized zones are distributed in the eastern part, and consist of dissemination, network and film of pyrite-chalcopyrite within the silicified and argillized zones along faults and/or dikes of quartz porphyry with direction of NW-SE. The widths of the mineralized zones are narrow and several meters, but the lengths 250 m in maximum. As to the wall rock alteration, the mineral assemblage of quartz-sericite was detected by X-ray diffractive analysis. The assemblage belongs to that of phyllic alteration. According to the ore assay result, sample number D2066 shows 0.78 % Cu and 3.7 g/t Ag.

The type II mineralized zone is distributed in the western part. The characteristic indicates intermediae between the Type IIA and Type IIB on the basis of the following occurrence; large amount of sulfide minerals are observed but quartz outnumbers clay as gangue minerals. The mineralization continues intermittently between 400 m with 30 cm in vein width. The wall rock alteration beside the veins belongs to phyllic alteration. The maximum ore assay results are as follows: 10.53 % Cu obtained from sample number B2096 and 114.5 g/t Ag from sample number B2099.

(2) Q.Esperanza mineralized zone (Fig.II-2-3(1))

The geology of the zone consists of granodiorite. According to the geological data of outside zone, however, dikes of quartz porphyry are supposed to intrude into granodiorite in the deeper part.

The mineralized zone belongs to the Type II, and is recognized on an area of 1 m or more in vein width and 1 km in length along the Q.Esperanza. The strike of vein has NE-SW direction, and dipping to the southeast with 70° in the west, 55° in the center and 85° in the east.

As to the vein characteristics, the Type IIA is recognized at hanging wall and the Type IIB at foot wall from western to central parts, while the opposite occurrence in the east. The vein width of the Type IIA is 1.3 m to 0.6 m, and that of the Type IIB 0.6 m to 0.2 m. Some branch veins with several cm in vein width are found in the west (Fig.II-2-4).

Silicification and argillization belonging to phyllic alteration are marked as wall rock alteration beside the vein.

Ore minerals of the Type IIA consist mainly of pyrite and chalcopyrite with a small amount of tetrahedrite, bornite and chalcocite. According to the ore assay results, ore grade of the west (lower reach) is higher than that of the east (upper reach): 13.98 % to 1.16 % Cu (10 % in average), 4.2 g/t to 0.1 g/t Au, and 43.7 g/t to 3.6 g/t Ag (20 g/t in average).

(3) Q.Fortuna mineralized zone (Fig.II-2-3(2))

The geology of the zone is underlain by granodiorite and stock of quartz porphyry with 1.7 km in length.

The main part of the mineralized zone is distributed on an area of 600 m (length) x 200 m (width) with 200 m in altitude difference in the central part of the zone, and consists mainly of the type I accompanied by the Type IIA and Type IIB.

The Type I contains dissemination and network of chalcopyrite-pyrite-(molybdenite-bornite-chalcocite) in strongly silicified granodiorite. The wall rock alteration belongs to phyllic alteration.

The Type IIA consists of chalcopyrite-pyrite-tetrahedrite-clay vein with 10 cm in vein width distributed in southern limit of the main mineralized zone. The vein strikes N30°W and dips 80° to the west.

The Type IIB is recognized at several places and is composed of quartz veins associated with the same ore minerals as those of the type I. The strike of vein is NE-SW direction and the dipping to the southeast with 40° to 50°.

According to the ore assay results, samples of the Type I show 1.99 % to 0.50 % Cu (0.9 % in average), and 3.4 g/t or less. Cu content of the sample from the type IIA is 2.26 %.

In stock of quartz porphyry, no copper sulfide minerals except pyrite is observed in dissemination and veinlet.

The Type III alteration distributed from the Central Zone is recognized in the northwestern part.

2-2 Geochemical Survey

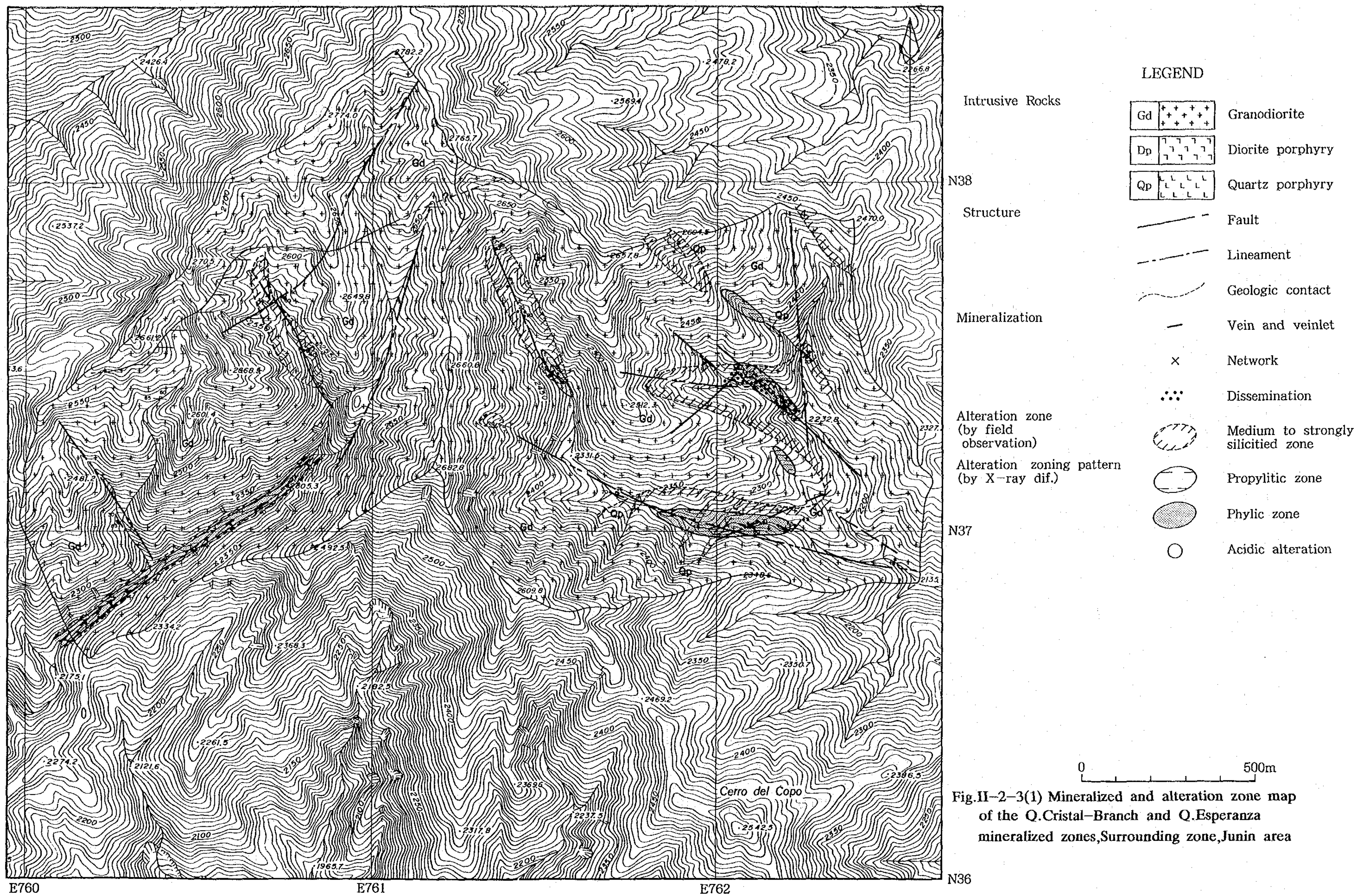


Fig.II–2–3(1) Mineralized and alteration zone map of the Q.Cristal–Branch and Q.Esperanza mineralized zones, Surrounding zone, Junin area

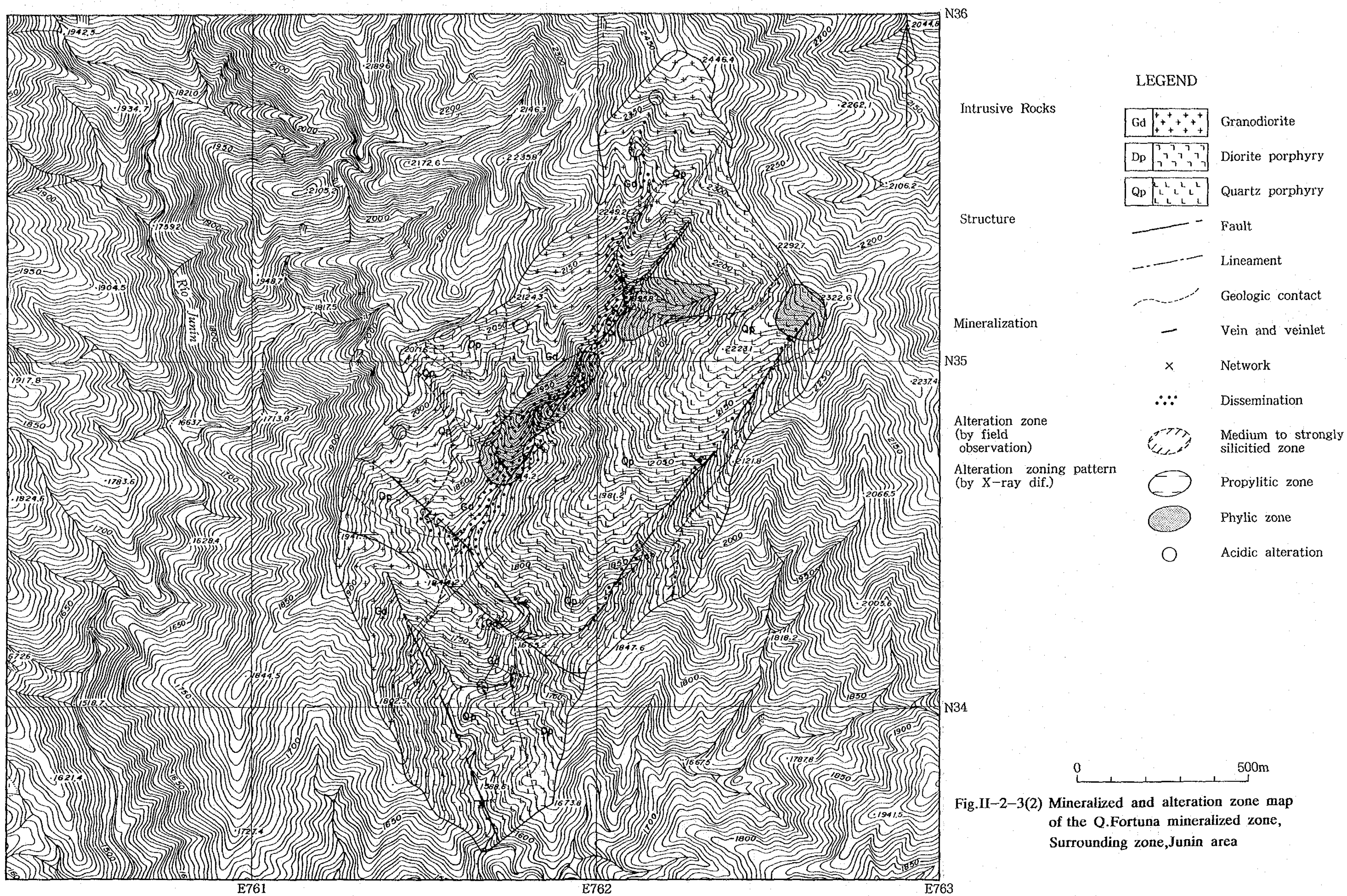


Fig.II-2-3(2) Mineralized and alteration zone map of the Q.Fortuna mineralized zone, Surrounding zone, Junin area

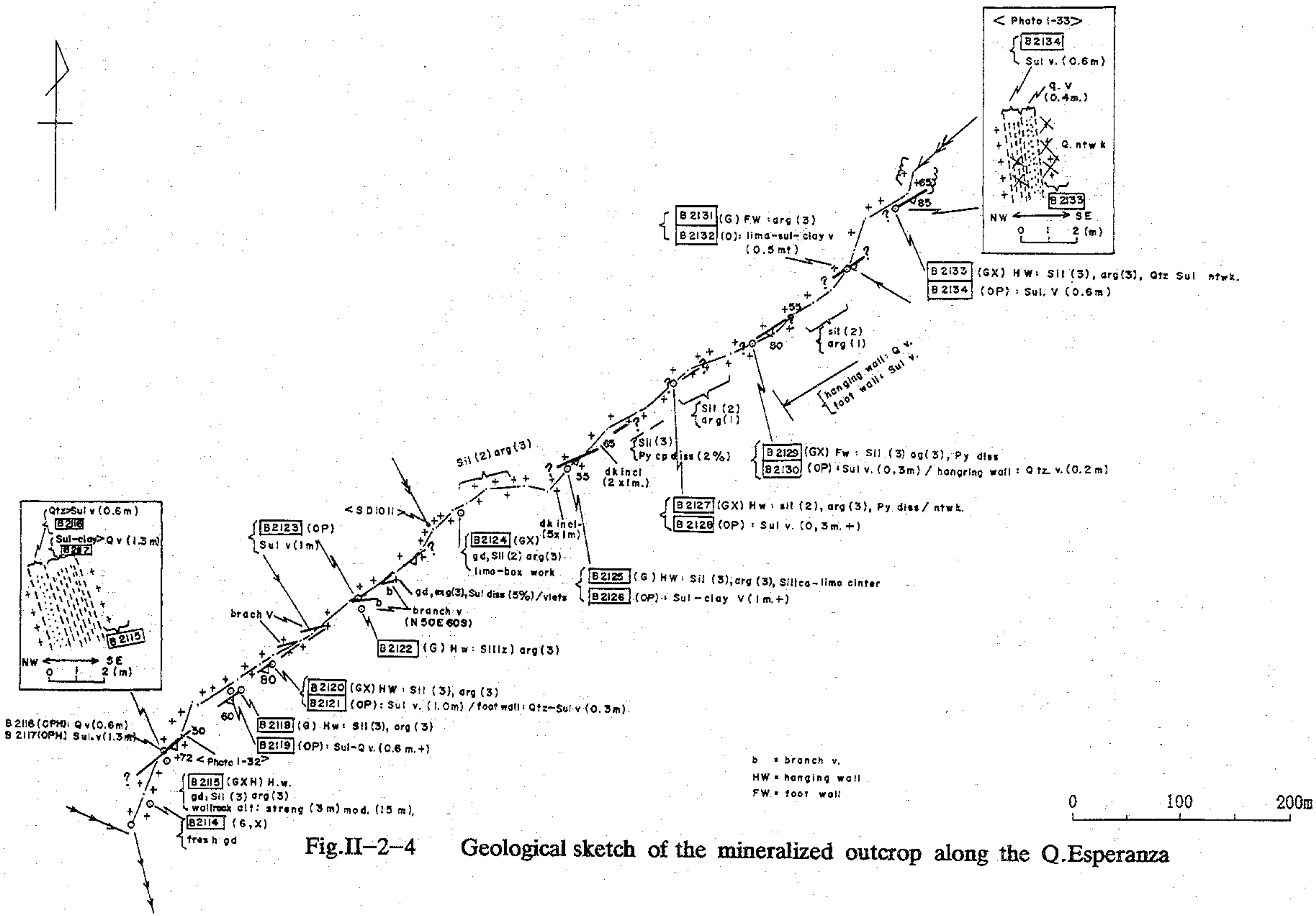


Fig.II–2–4 Geological sketch of the mineralized outcrop along the Q.Esperanza

2-2-1 Purpose of Geochemical Survey

The purpose of the geochemical survey is to clarify the dispersion of elements related with mineralization and alteration of rocks in this area, and to delineate any promising mineralized zone.

2-2-2 Method of Geochemical Survey

(1) Sampling and preparation of samples

The amount of 215 rock samples were evenly collected at the outcrops in the valleys in general and on the ridges in local over the whole area during the geological survey (Pl.II-1-1). The average intervals between the sampling points is about 100m.

Several small pieces of rocks were collected within the area of about 1 to 2 square meters of each sampling outcrop, and total weight of rock sample was over 500 grams each. Geology, type of alteration and hardness, etc. were recorded in each sampling point.

The secondary minerals were eliminated from the samples to make sample be weighed 300 g approximately. After crushing and preparing them individually, 50 g of sample was gathered each by the one fourth method to analyze them chemically, and another 50 g was also kept each for spare.

(2) Chemical analysis

Chemical analysis was carried out in Geotechnical Laboratory of BEC. The target elements were six (6) such as Cu, Pb, Zn, Au, Ag and Mo.

The method of chemical analysis and the detection limit for each element are shown on Tab.II-2-1. The results of chemical analysis are listed up on Appendix 5.

(3) Data processing

(i) Univariate analysis

Statistic processing of chemical analysis data was carried out with computer. The data less than detection limit assumed to be a half value of the detection limit. Since samples associated with the Type II mineralized zone of this Zone outnumbered those of the Central Zone, samples from only the Surrounding Zone except those of the Central Zone were processed in a lump. The statistical analysis are shown on Tab.II-2-2. In comparison with the results of the Central Zone, those of this Zone are as follows: mean value of Zn and Ag slightly high, mean value of Mo slightly low, and maximum value of Zn, Au, Ag and Mo high.

Correlation coefficient was calculated in order to clarify the relationship among each element (Tab.II-2-3, and Fig.II-2-5). According to the calculation result, the correlation of Au-Ag, Cu-Ag and Ag-Mo was proved to be good and those correlation was more than 0.5.

Exploratory data analysis(EDA) method, which was proposed by Kurzul,H. (1988), was adopted in order to decide the threshold value to detect the geochemical anomalies. Histogram and boxplot were made on the data processed for each component (Fig.II-2-6). According to these data processing, the threshold value was decided to be the value of upper fence and supplemental threshold to be that of upper wisker (Tab.II-2-4). The threshold value of Cu, Zn, Au and Ag of this Zone was slightly higher than that of the Central Zone, while the threshold value of Mo slightly lower.

(ii) Multivariate analysis

Factor analysis method was applied for examination of the relationship among the elements and mineralization or characteristics of country rock by the chemical analysis data of the samples.

Data was processed with computer by Varimax rotation method. As the result, such two factors as 1) Cu-Mo-Au-Ag and 2) Pb-Zn were extracted. According to the result of the Central Zone, the following three factors were proved: 1) Cu-Mo-(Ag), 2) Pb-Zn-(Mo), and 3) Au-Ag. The difference of factor seems to be that of the amounts of samples associated with the Type II mineralized zone. Factor loading, communality and factor score are all shown on Tab.II-2-5.

Factor score, which would indicate how high relationship between mineralization and target elements would each sample obtain, were allocated on samples individually. The samples, absolute value of factor score more than 1, were extracted and examined which relationship could be expected between the factor score and the geology and/or mineralization in this report.

Tab.II-2-1 Method and detection limits of chemical analyses

Sample media	Elements	Method	Detection limits
Rock	Cu	Inductively coupled plasma emission spectrometry	1 ppm
	Pb	ditto	1 ppm
	Zn	ditto	1 ppm
	Au	Atomic absorption spectroscopy	1 ppb
	Ag	ditto	0.2 ppm
	Mo	Inductively coupled plasma emission spectrometry	1 ppm
	Fe	ditto	0.01 %
	S	ditto	0.001 %

Tab.II-2-2 Summary of statistical analysis of rock geochemical data, Surrounding zone,Junin area

Geologic units	Elements	Mean	Variance	Standard deviation	Min.	Max.	Mean+2S.D
Gd, Qp & Dp. (N=215)	Cu (ppm)	132.5	0.563	0.751	4.0	18,060.0	4,202.1
	Pb (ppm)	3.9	0.211	0.459	0.5	120.0	31.9
	Zn (ppm)	29.4	0.329	0.573	2.0	2,627.0	411.9
	Au (ppb)	1.5	0.429	0.655	0.5	474.0	30.7
	Ag (ppm)	0.34	0.352	0.593	0.10	37.00	5.27
	Mo (ppm)	0.9	0.316	0.562	0.5	430.0	12.3

Tab.II–2–3 Correlation of six elements of rock geochemical data, Surrounding zone,Junin area

	Cu	Pb	Zn	Au	Ag	Mo
Cu	1.000					
Pb	0.316	1.000				
Zn	0.090	0.399	1.000			
Au	0.422	0.359	-0.209	1.000		
Ag	0.617	0.428	-0.028	0.633	1.000	
Mo	0.469	0.045	-0.204	0.478	0.520	1.000

Tab.II–2–4 Results of the EDA analysis of rock geochemical data, Surrounding zone,Junin area

Elements	Median	L. fence	L. wisker	L. hinge	U. hinge	U. wisker	U. fence
Cu(ppm)	124.0	-395.0	25.0	34.0	320.0	519.0	749.0
Pb(ppm)	3.0	-5.5	2.0	2.0	7.0	10.0	14.5
Zn(ppm)	30.0	-76.5	7.0	12.0	71.0	87.0	159.5
Au(ppb)	0.5	-4.8	0.5	0.5	4.0	6.0	9.3
Ag(ppm)	0.20	-0.80	0.10	0.10	0.70	1.20	1.60
Mo(ppm)	0.5	0.5	0.5	0.5	0.5	2.0	0.5

Tab.II–2–5 Results of factor analysis of rock geochemical data, Surrounding zone,Junin area

Elements	Factor		Communality
	1	2	
Cu	0.691	0.234	0.5322
Pb	0.346	0.608	0.4891
Zn	-0.150	0.653	0.4491
Au	0.765	-0.022	0.5856
Ag	0.811	0.177	0.6898
Mo	0.674	-0.214	0.5003
Contribution	71.40%	28.60%	

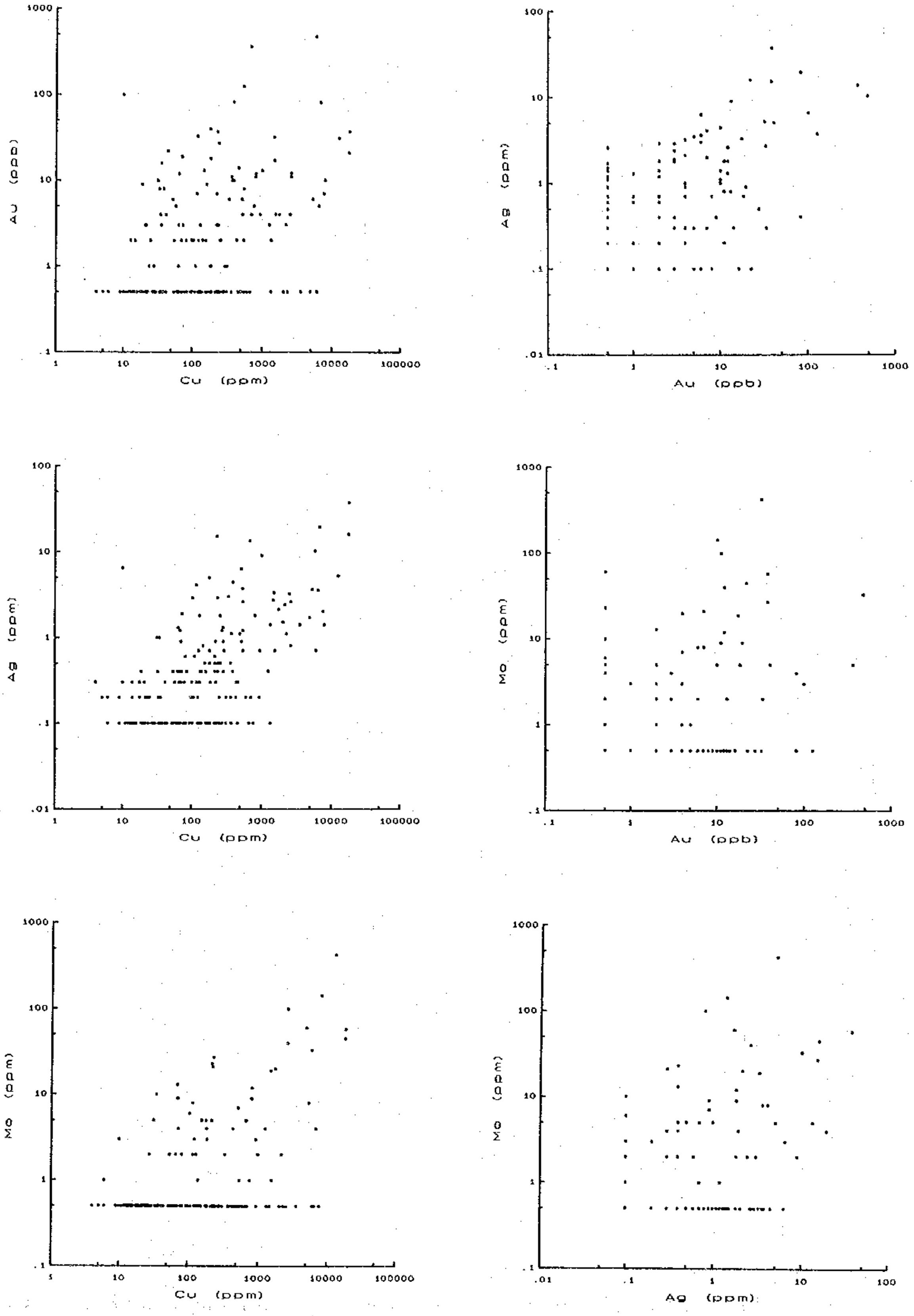


Fig.II–2–5 Correlation diagram between each element,Surrounding zone,Junin area

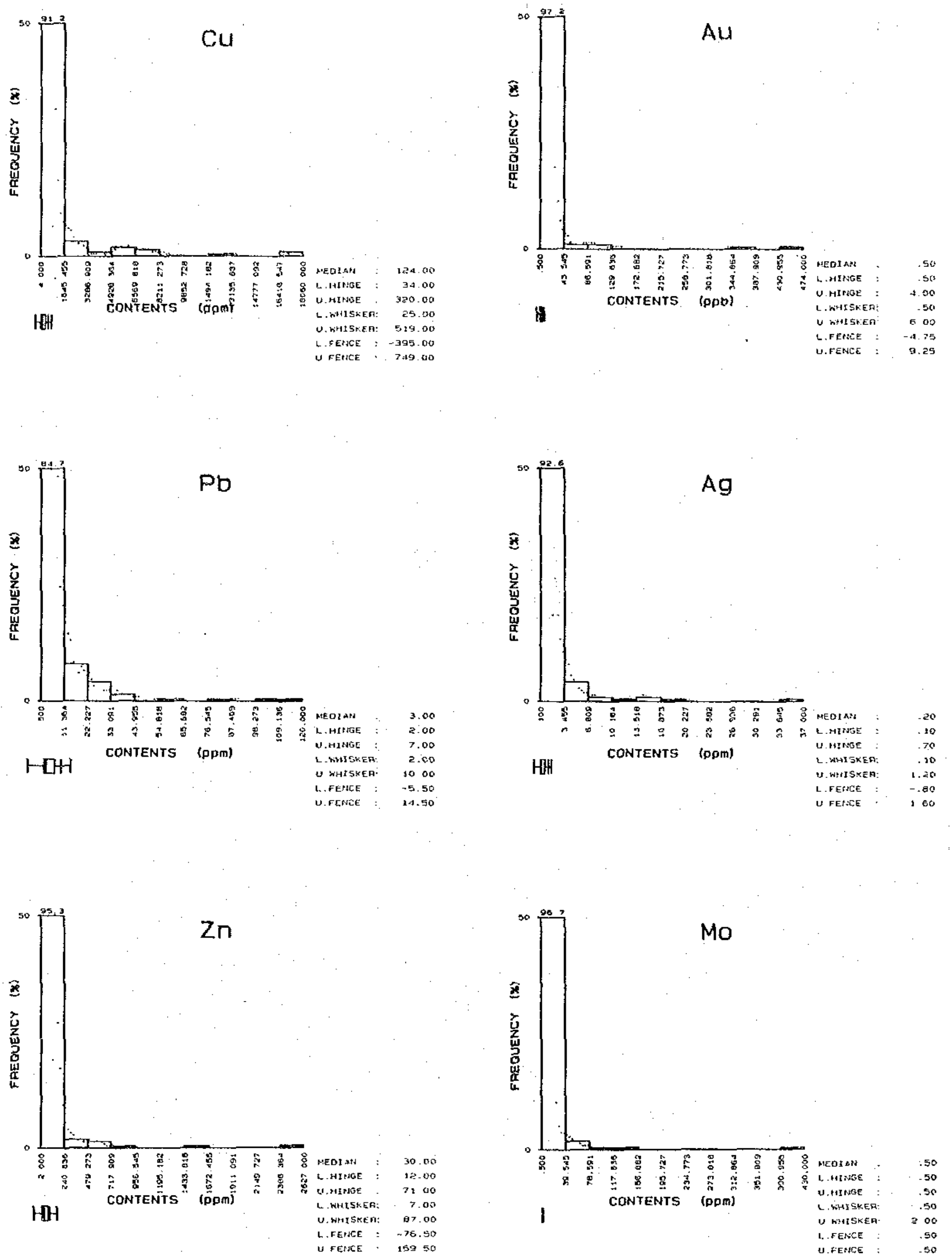


Fig.II–2–6 Histograms and boxplots of six elements,Surrounding zone,Junin area

2-2-3 Results of Geochemical Survey

(1) Geochemical anomaly in each element

Geochemical anomaly maps (Fig.II-2-7) were made by examining of distributions of such concentration as Cu, Pb, Zn, Au, Ag and Mo with EDA method of univariate analysis.

Copper(Cu): Concentration of copper showed a variation from the minimum value of 4 ppm to the maximum value of 18,060 ppm. The distribution map of high concentration was made as shown in Fig.II-2-7(1) based on the upper fence value (749.0 ppm) and upper wisker value (519.0 ppm).

Anomalous zones over the threshold of upper fence were delineated on some parts corresponding with the following mineralized zones: the Type I of eastern part of the Q.Cristal-Branch; the Type II of western part of the Q.Cristal-Branch; the Q.Esperanza; main part of the Q.Fortuna.

The anomalous zones of the Q.Cristal-Branch mineralized zone consist of 10 sampling points including seven sampling points between 1,321 ppm and 7,739 ppm with 18,060 ppm as maximum.

The anomalous zone of the Q.Esperanza mineralized zone contains six sampling points including four sampling points between 2,150 ppm and 6,323 ppm.

The anomalous zone of the Q.Fortuna mineralized zone is composed of 15 sampling points including 13 sampling points between 1,247 ppm and 17,877 ppm.

Lead(Pb): Concentration of copper showed a variation from the minimum value of 1 ppm to the maximum value of 120 ppm. The distribution map of high concentration was made as shown in Fig.II-2-7(2) based on the upper fence value (14.5 ppm) and upper wisker value (10.0 ppm).

Anomalous zones over the threshold of upper fence were delineated on some parts corresponding with the following mineralized zones: eastern and western sides of the Type I of eastern part of the Q.Cristal-Branch; the Type II of western part of the Q.Cristal-Branch; eastern half of the Q.Esperanza; outside of main part of Q.Fortuna.

The anomalous zones of the Q.Cristal-Branch mineralized zone consist of 12 sampling points including 106 ppm as maximum.

The anomalous zone of the Q.Esperanza mineralized zone contains three sampling points including 58 ppm as maximum.

The anomalous zone of the Q.Fortuna mineralized zone is composed of 11 sampling points including 120 ppm as maximum.

Zinc(Zn): Concentration of copper showed a variation from the minimum value of 2 ppm to the maximum value of 2,627 ppm. The distribution map of high concentration was made as shown in Fig.II-2-7(3) based on the upper fence value (159.5 ppm) and upper wisker value (87.0 ppm).

Anomalous zones over the threshold of upper fence were delineated on the same parts as those of Pb in the Q.Fortuna mineralized zone. However, anomalous zone in the Q.Cristal-Branch mineralized zone was limited, and no anomalous zone in the Q.Esperanza mineralized zone.

The anomalous zone of the Q.Fortuna mineralized zone is composed of 11 sampling points including 2,627 ppm as maximum.

The anomalous zone of the Q.Cristal-Branch mineralized zone contains five sampling points.

Gold(Au): Concentration of copper showed a variation from the minimum value of 1 ppb or less (detection limit) to the maximum value of 474 ppb. The distribution map of high concentration was made as shown in Fig.II-2-7(4) based on the upper fence value (9.3 ppb) and upper wisker value (6.0 ppm).

Anomalous zones over the threshold of upper fence were delineated on the following zones: zone including the Type I of eastern part of the Q.Cristal-Branch; zones including the Type II of western part of the Q.Cristal-Branch, and extending to the southwestern and southern parts; the central and northern parts of the Q.Esperanza; main part of the Q.Fortuna.

The anomalous zones of the Q.Cristal-Branch mineralized zone consist of 16 sampling points including 474 ppb as maximum.

The anomalous zone of the Q.Esperanza mineralized zone contains three sampling points, and 13 sampling points in the Q.Fortuna mineralized zone.

Silver(Ag): Concentration of copper showed a variation from the minimum value of 0.2 ppm or less (detection limit) to the maximum value of 37.0 ppm. The distribution map of high concentration was made as shown in Fig.II-2-7(5) based on the upper fence value (1.60 ppm) and upper wisker value (1.20 ppm).

Anomalous zones over the threshold of upper fence were delineated on some parts corresponding with those of Au.

The anomalous zones of the Q.Cristal-Branch mineralized zone consist of eight sampling points including 37 ppm as maximum.

The anomalous zone of the Q.Esperanza mineralized zone contains six sampling points, and 20 sampling points in the Q.Fortuna mineralized zone.

Molybdenum(Mo): Concentration of copper showed a variation from the minimum value of 1 ppm (detection limit) to the maximum value of 430 ppm. The distribution map of high concentration was made as shown in Fig.II-2-7(6) based on the upper wisker value (2.0 ppm).

Anomalous zones over the threshold of upper wisker were delineated on some zones of the following mineralized zones: the similar zones to those of Cu in the Q.Cristal-Branch and the Q.Fortuna; the limited zone in the Q.Esperanza.

The anomalous zones of the Q.Cristal-Branch mineralized zone consist of 15 sampling points including 58 ppm as maximum.

The anomalous zone of the Q.Esperanza mineralized zone contains five sampling points.

The anomalous zone of the Q.Fortuna mineralized zone is composed of 26 sampling points including 430 ppm as maximum.

(2) The results of factor analysis

The following two factors were proved by factor analysis of Varimax rotation method in multivariate analysis.

The first factor : Cu-Mo-Au-Ag

The second factor: Pb-Zn

(i) The first factor: Cu-Mo-Au-Ag

The distribution map of high factor score more than 1.000 is shown in Fig.II-2-8(1). The distribution zones of high factor score are delineated in the center of the Q.Cristal-Branch, Q.Esperanza and Q.Fortuna mineralized zones.

(ii) The second factor: Pb-Zn

The distribution map of high factor score more than 1.000 is shown in Fig.II-2-8(2). The distribution zones of high factor score are recognized to be scattered outside of each mineralized zone.

2-3 Consideration

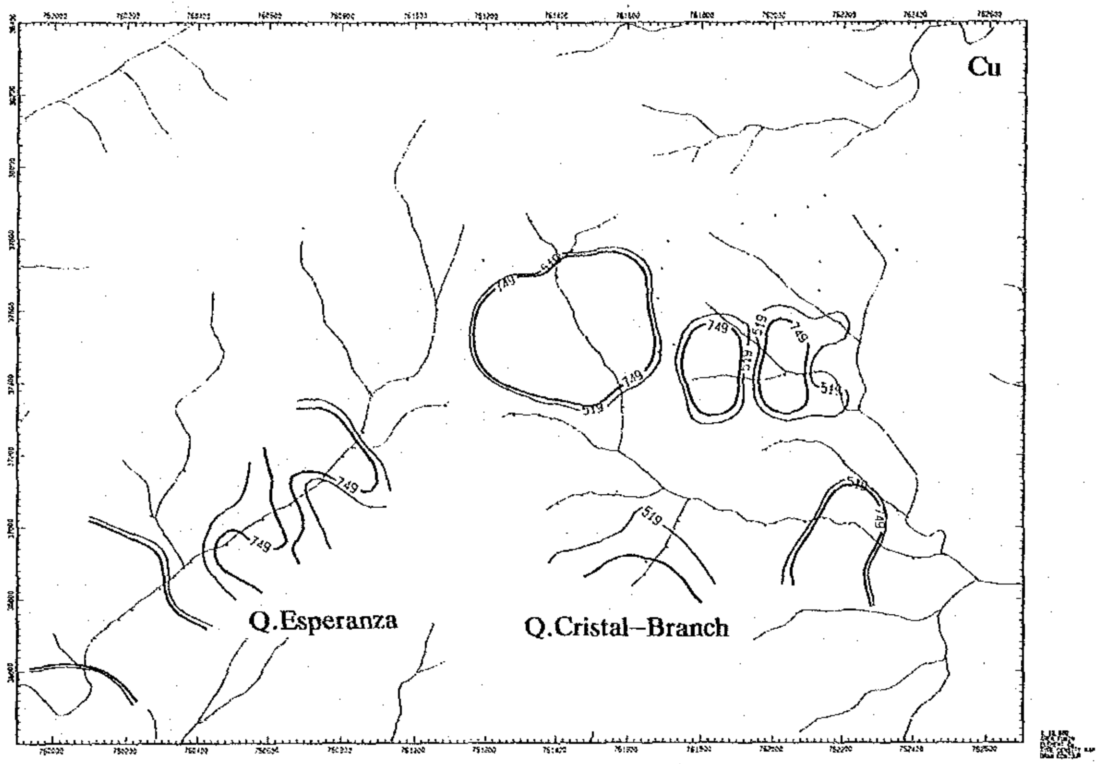
The Q.Cristal-Branch, Q.Esperanza and Q.Fortuna mineralized zones are distributed in the Surrounding Zone of Junin area.

The Q.Cristal-Branch mineralized zone is divided into east and west mineralized zones. The former consists mainly of type I, the latter type II.

Q.Esperanza mineralizes zone contains vein deposit belonging to type II. The mineralization is observed on an area of 1 m in vein width, 1 km in length and 120 m in altitude difference, in the Q.Esperanza. Average ore assay result is 10 % of Cu and 20 g/t of Ag.

Q.Fortuna mineralized zone consists mainly of type I and a few type II which is distributed on an area of 600 m in length, 200 m in width and 200 m in vertical difference. Average ore assay result is 1 % of Cu.

The distribution pattern of geochemical anomalous zones limited extent of mineralization, and were corresponded with those of mineralization and/or alteration. For instance, Cu-Mo geochemical anomalous zones were delineated over obvious mineralized zones, while Pb-Zn geochemical anomalous zone were scattered around the mineralized zone. Stream sediment geochemical anomalies of the Phase I survey and rock geochemical anomalies of the Phase II survey resulted from each mineralization.



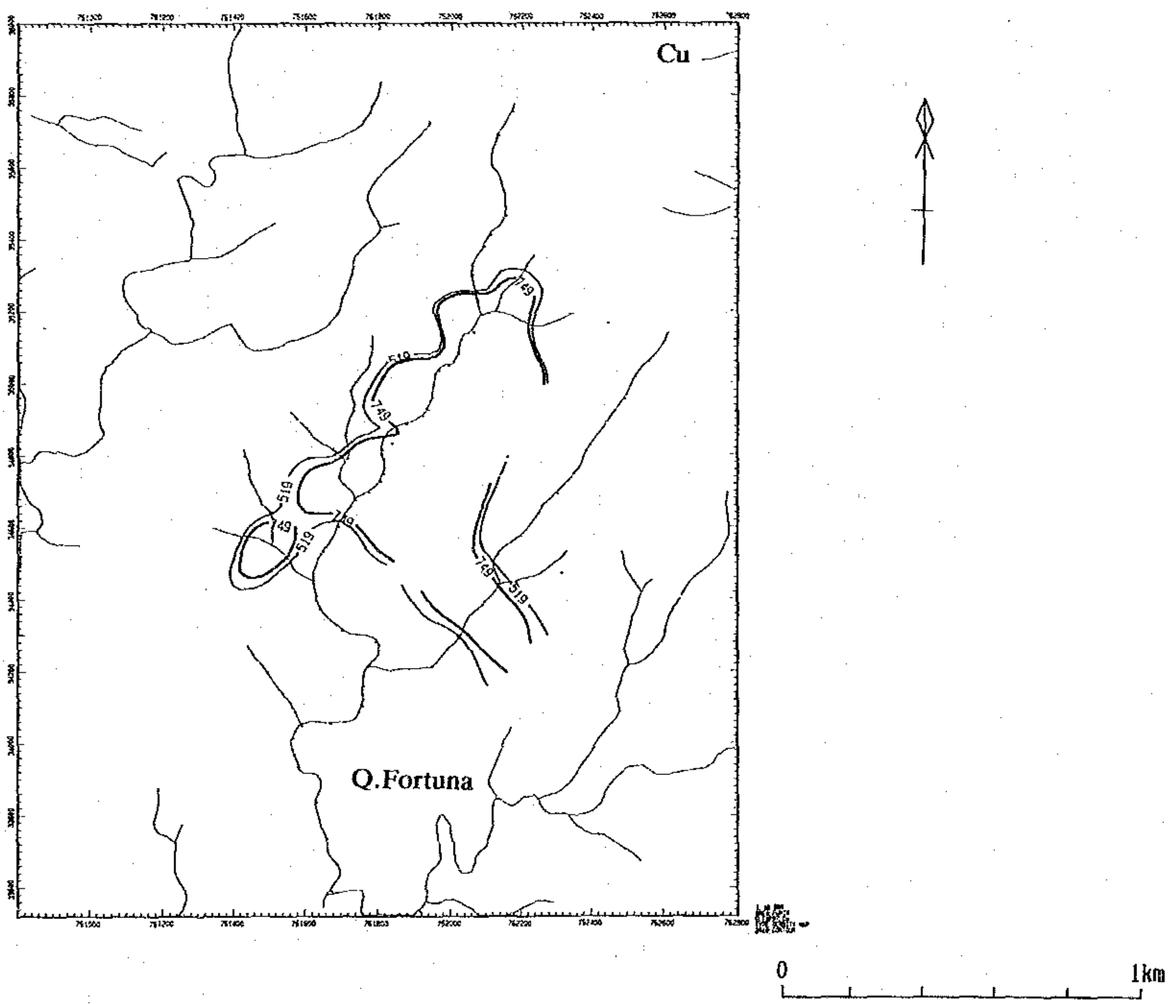


Fig.II-2-7(1) Geochemical anomalies of rock samples(Cu),Surrounding zone,Junin area

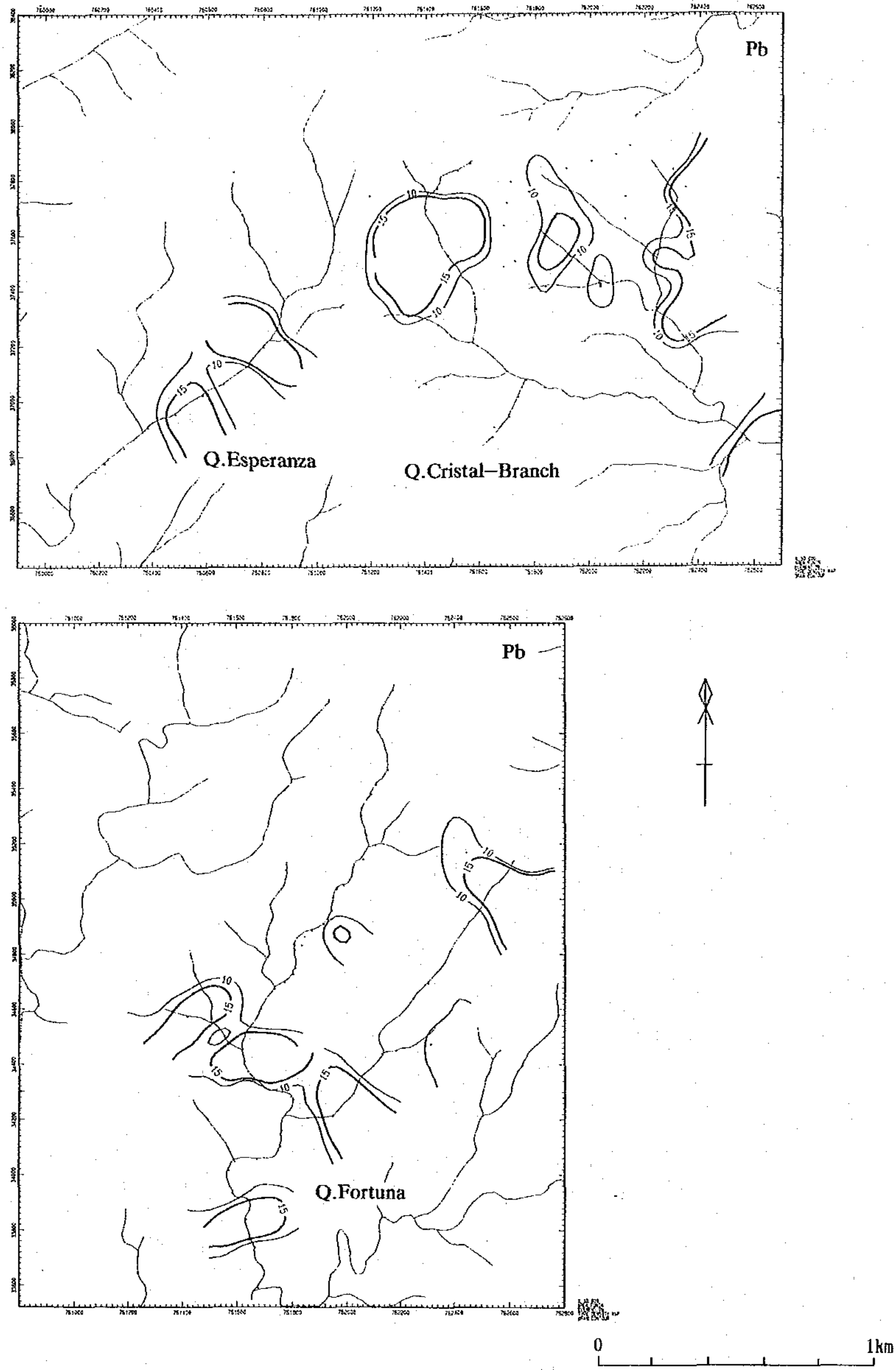


Fig.II–2–7(2) Geochemical anomalies of rock samples(Pb),Surrounding zone,Junin area

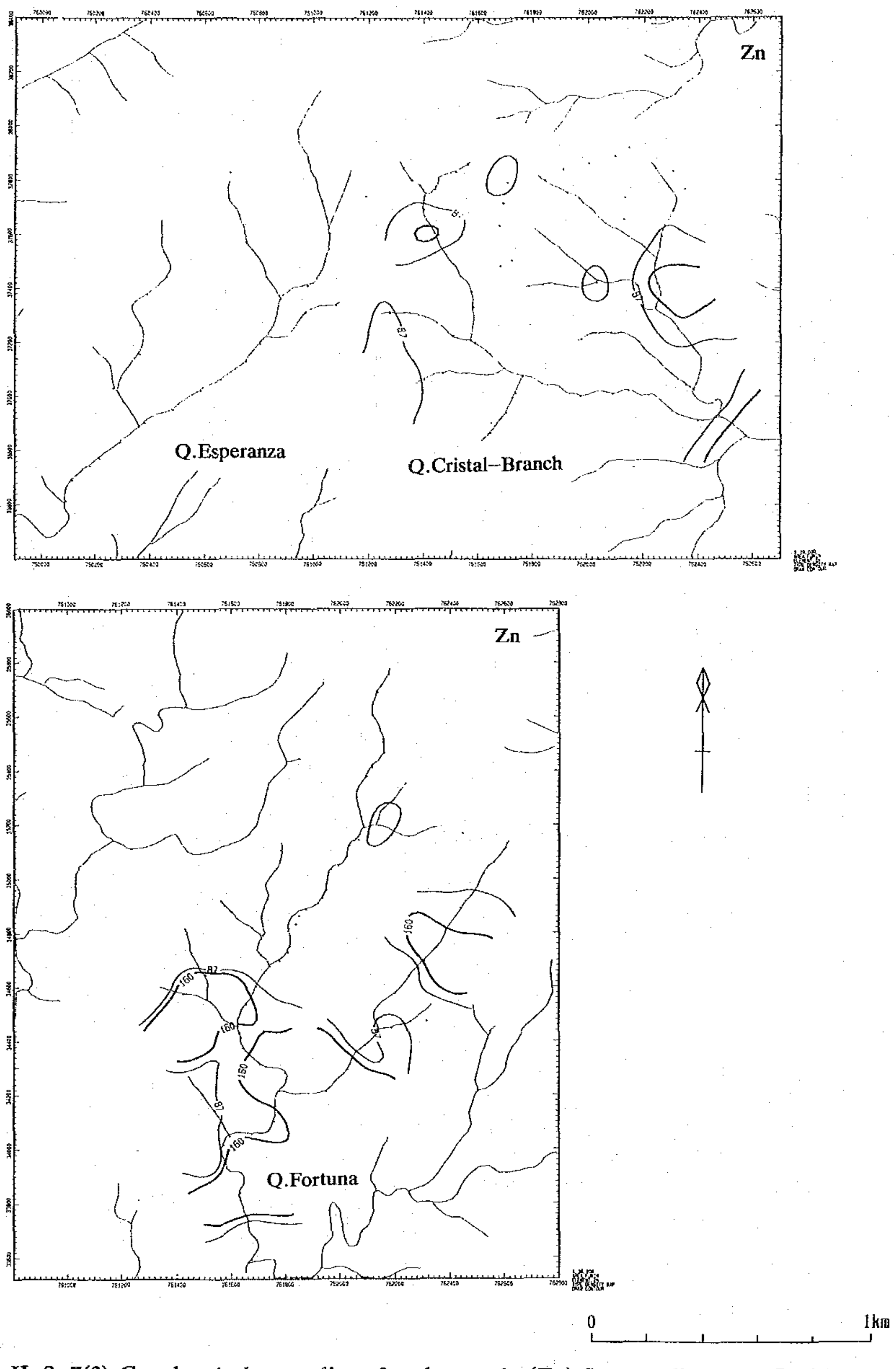
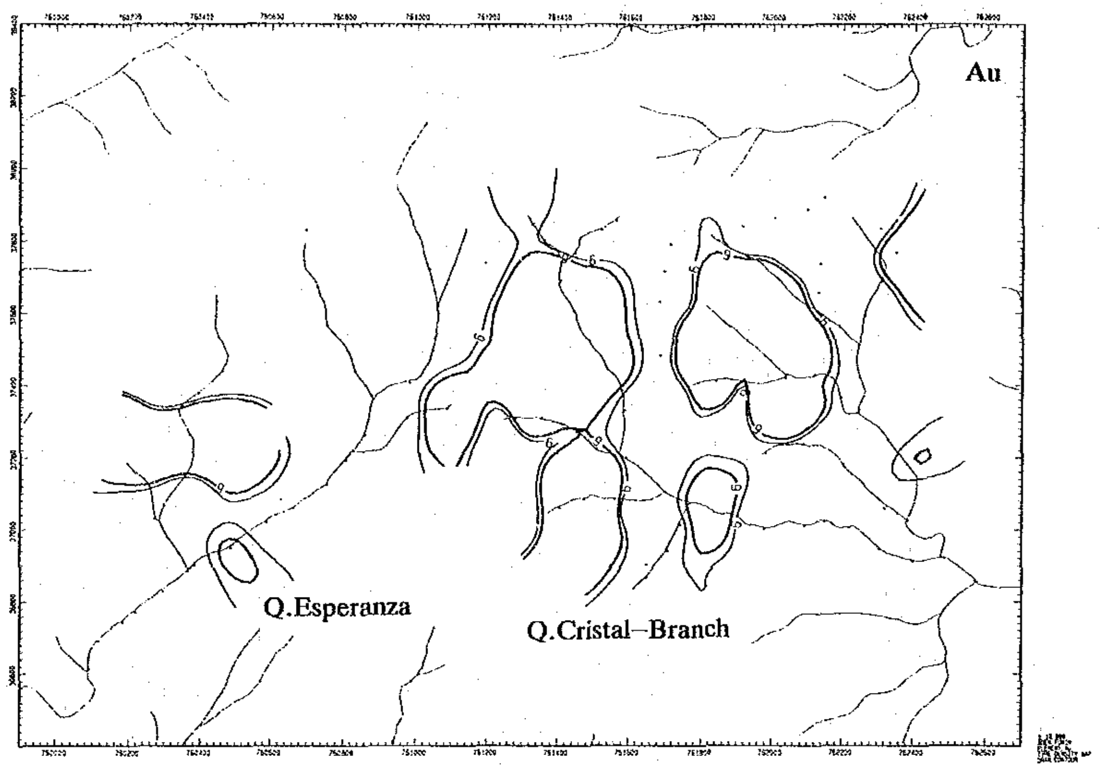


Fig.II–2–7(3) Geochemical anomalies of rock samples(Zn),Surrounding zone,Junin area



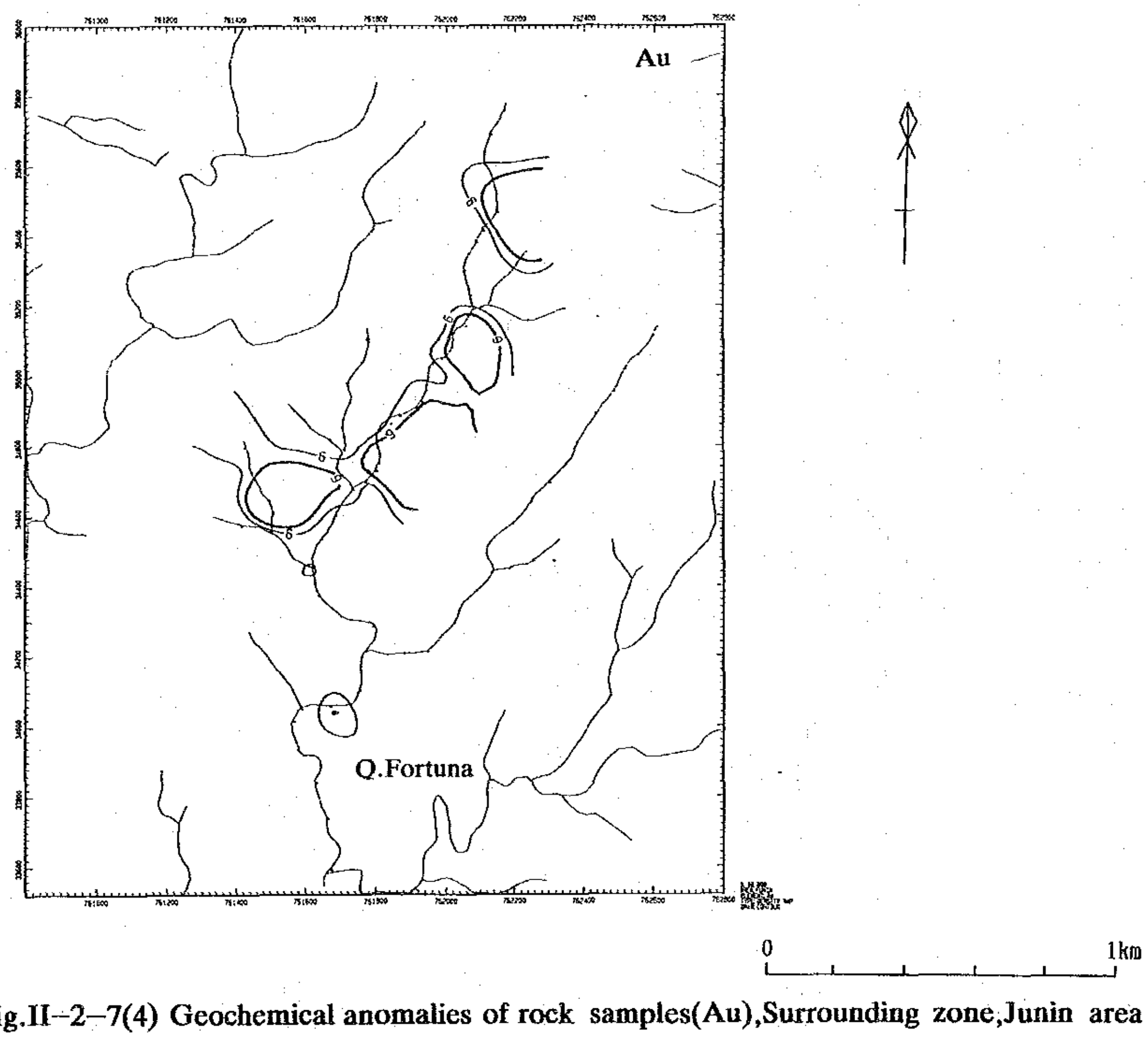


Fig.II–2–7(4) Geochemical anomalies of rock samples(Au),Surrounding zone,Junin area

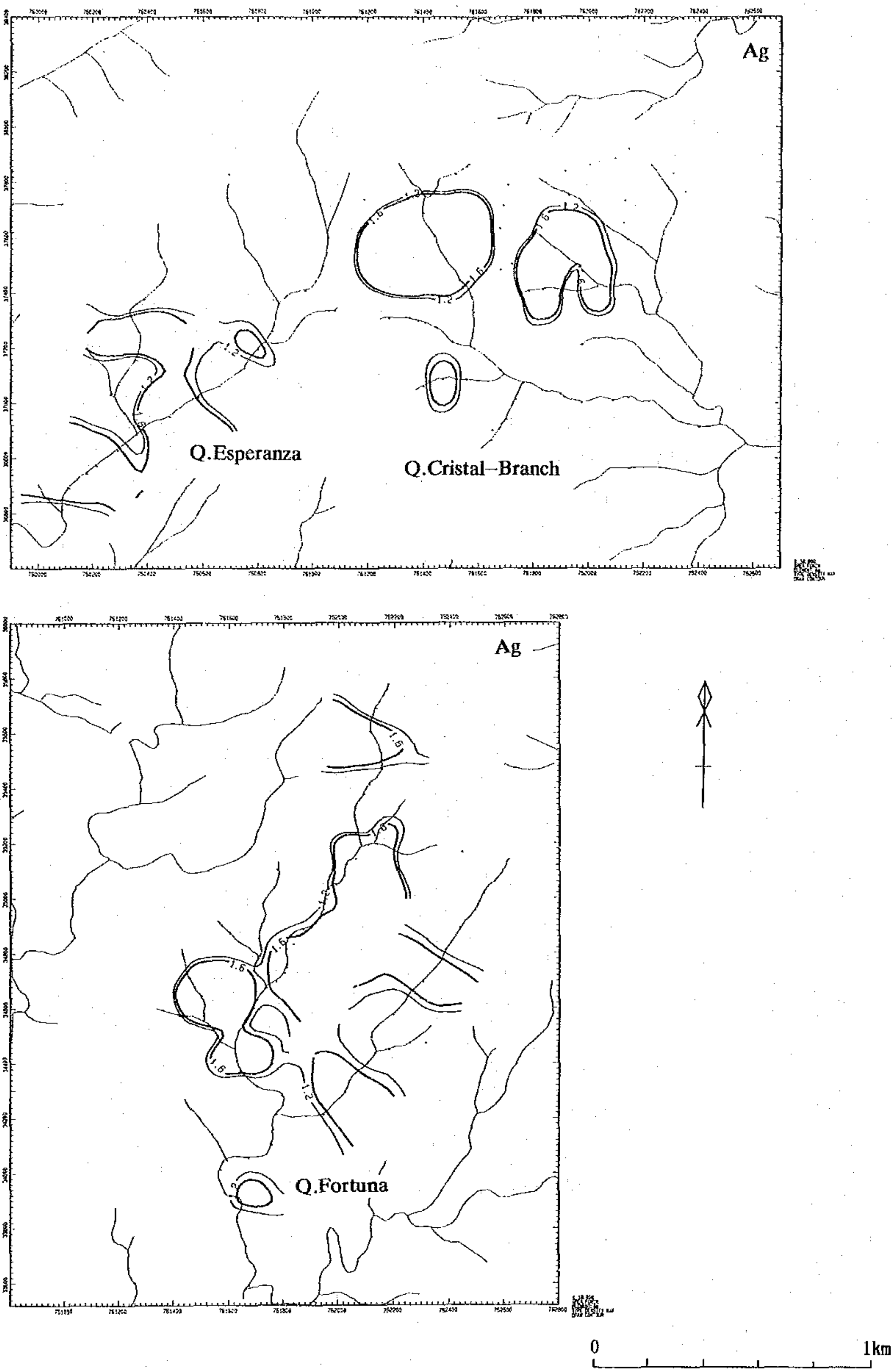


Fig.II-2-7(5) Geochemical anomalies of rock samples(Ag),Surrounding zone,Junin area

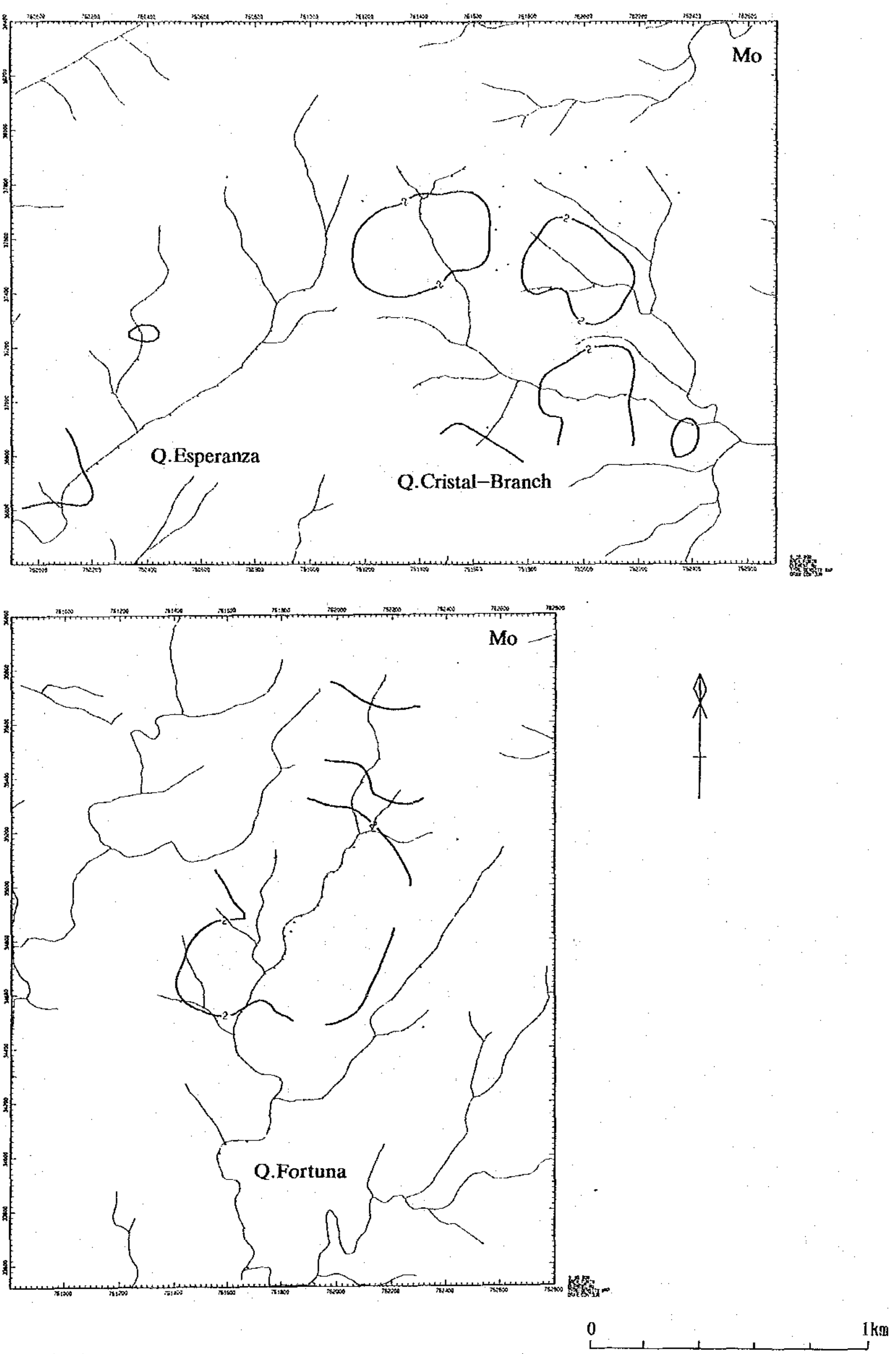
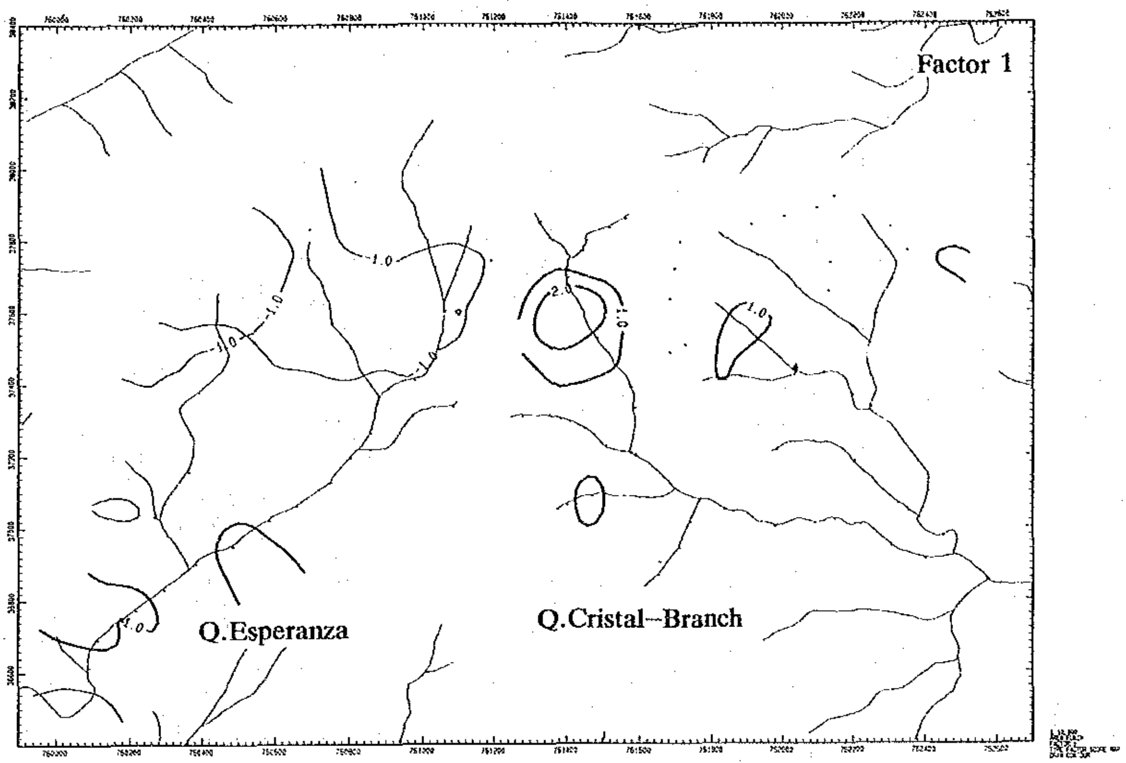


Fig.II-2-7(6) Geochemical anomalies of rock samples(Mo),Surrounding zone,Junin area



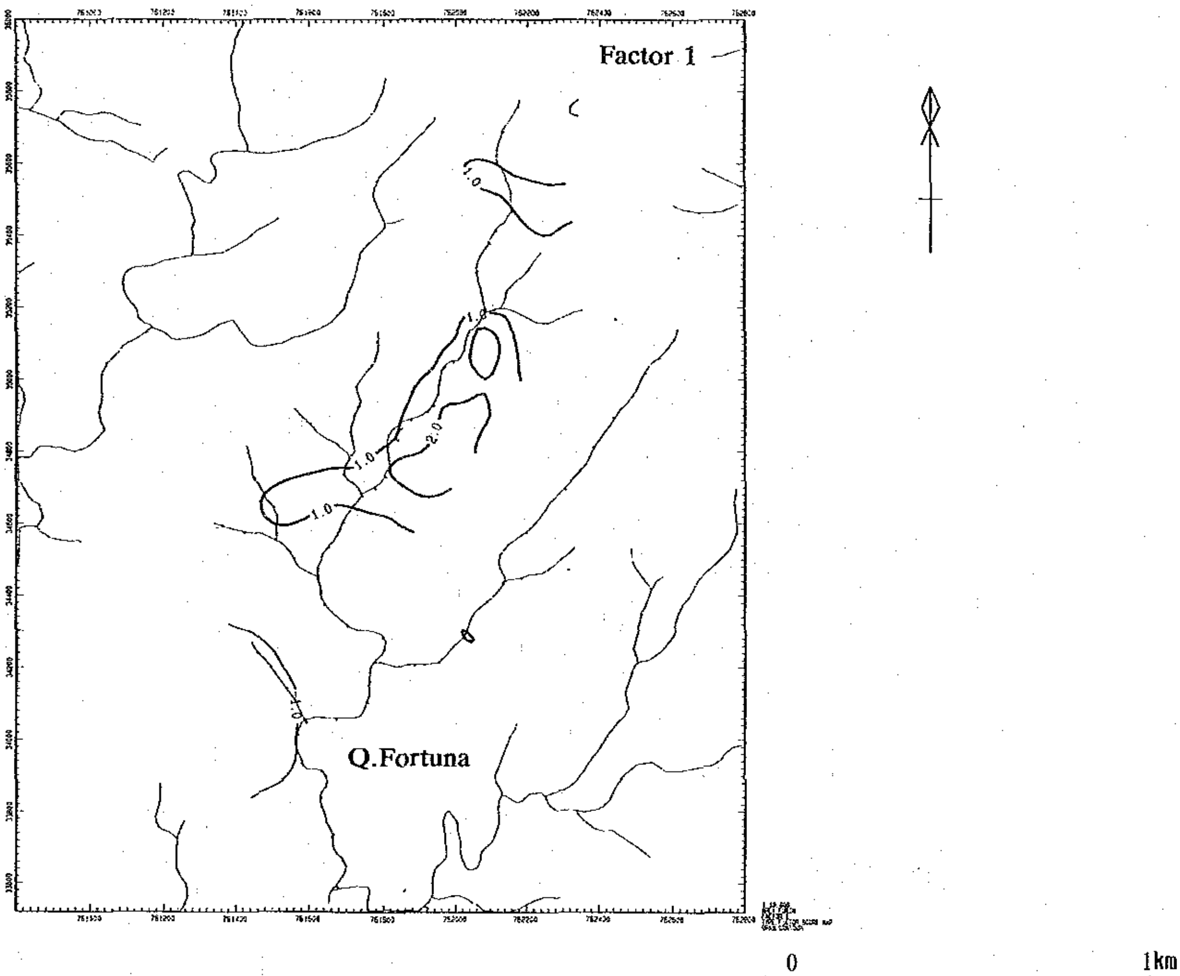


Fig.II–2–8(1) High factor scores from factor analysis of rock samples:Factor 1;Cu–Mo–Au–Ag

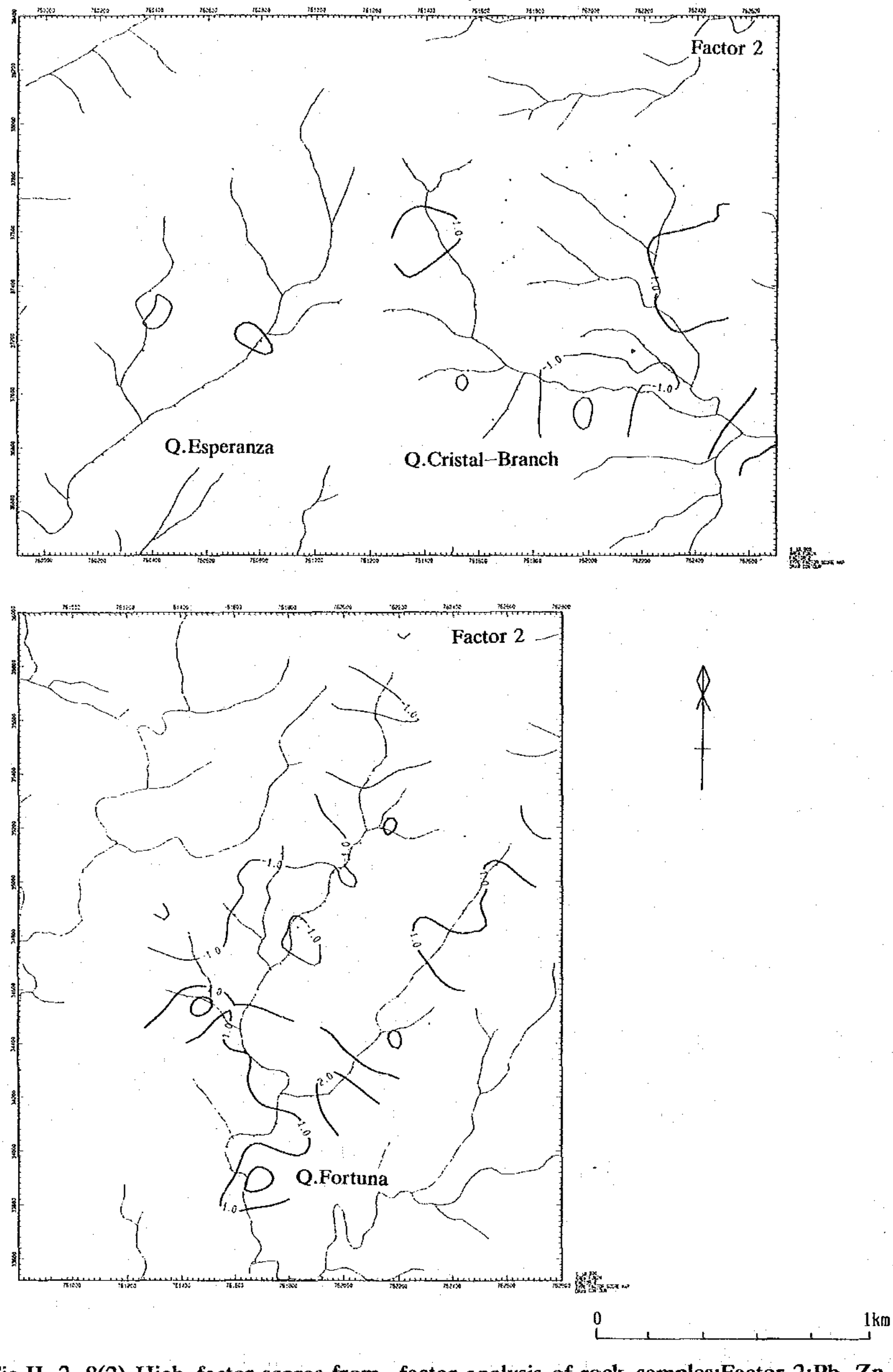


Fig.II-2-8(2) High factor scores from factor analysis of rock samples:Factor 2;Pb-Zn

Chapter 3 Rio Magdalena Zone of Cuellaje Area

Detailed geological survey and rock geochemical survey were carried out in an area of 4 km^2 for Phase II survey, which includes new porphyry copper mineralized zones delineated by the Phase I's survey.

3-1 Geological Survey

3-1-1 Purpose and Method of Geological Survey

The purpose of survey is to clarify the size and occurrence of the above-mentioned mineralized zones.

Before the survey, a map on a scale of 1:5,000 was made by enlargement of the existing topographical map on a scale of 1:25,000, and route map was also made based on this map. The survey routes were decided with careful examination of the existing data. Aerial photographs were fully used in this survey. During this route survey, rock samples were taken along the routes for geochemical survey.

Geological map is shown in Fig.II-3-1 and Pl.II-3-1, and geological profile is shown in Pl.II-2-2. The generalized columnar section in Fig.II-2-2.

The samples for various analysis and tests were collected after due consideration. The sampling points are shown in Pl.II-3-3. The results of the analysis and the tests are described in this report and also listed up on appendix.

3-1-2 Geology and Geological Structure

The geology of this area consists of granodiorite mainly which forms batholith as the same one distributed in Junin area, stock to dike of andesite porphyry(Ap), and dike of quartz porphyry(Qp) and diorite porphyry(Dp) which intrude into granodiorite.

(1) Granodiorite(Gd)

The Granodiorite shows grayish color and is medium grained, and includes biotite > hornblende as mafic minerals. The rock is generally the same as that of Junin area, though some rock body is observed to contain few hornblende partly.

The microscopic observation of typical rock is the following (Appendix 1);

Granodiorite(B2024)

Location: central part

Texture : holocrystalline

Main and accessory minerals : plagioclase > quartz > biotite > K-feldspar > apatite, allanite, sphene, opaque minerals

Alteration minerals: chlorite, epidote, albite,sericite

Plagioclase is partially albitized and epidotized, and biotite is slightly altered to chlorite and epidote.

(2) Andesite porphyry(Ap)

Andesite porphyry distributes in the branch of Rio Magdalena of the central part as stock, and in the southeastern and northwestern parts as dikes. In the former, the elliptical distribution of approximately 120 x 60m is located the eastern limit of the Rio Magdalena-Branch mineralized zone mentioned bellow. The rock shows felsic and includes plagioclase phenocrysts. In the latter, the rock includes plagioclase phenocrysts of several millimeters in greenish glassy groundmass.

The microscopic observation of typical rock is as follows (Appendix 1);

Andesite porphyry(C2006)

Location: southeastern part

Texture : porphyritic

Phenocryst: plagioclase > hornblende > quartz, (biotite) > opaque minerals

Groundmass: glass > plagioclase > quartz

Alteration minerals: chlorite, epidote > quartz, sericite

Biotite is completely altered to chlorite. Plagioclase of phenocryst and groundmass is replaced by albite and epidote.

(3) Diorite porphyry(Dp)

Diorite porphyry is observed as several dikes in the Zone. Outside of the Zone, however, the rock is distributed comparatively wide in the eastern part of 400 x 250 m along Rio Cristopamba, and also distributes as small dikes with the ENE to NNE direction along the Q.San Joaquin of the southern part and the southeastern part of Cuellaje village. The lithology is similar to andesite porphyry, but its groundmass is much holocrystalline and coarser. Some part gradually changes to granodiorite in the northeastern part outside the survey area.

(4) Quartz porphyry(Qp)

Quartz porphyry occurs as several small dikes within the Zone, while as large dike with the scale of 300 m x 20 m and the direction of NE-SW at the juncture of Rio Cristopamba and Rio Magdalena of the eastern outside. The rock is grayish white color and compact, and includes quartz phenocrysts of 1 to 2 mm in diameter in glassy groundmass.

These four kinds of rocks are classified in granodiorite, I-Type and magnetite series. According to the result of isotope age determination with K-Ar method, the following results were obtained; 13.0 + 0.6 Ma for granodiorite, 11.1 + 0.6 to 10.4 + 0.5 Ma for andesite porphyry and 8.8 + 0.4 Ma for quartz porphyry (JICA/MMAJ,1992). These ages shows middle to later Miocene of Tertiary Period.

(5) Geological structure

The lineaments with the directions of NNE-SSW and NW-SE are conspicuous, and outside the Zone, lineaments with N-S and E-W as the second order are also developed.

3-1-3 Mineralization and Alteration

In Cuellaje area, in addition to the vein deposit (Type II in Junin area) along Rio Cristopamba near Cuellaje village known as a potential area of ore deposit, two mineralized zones, which were composed of dissemination deposit (Type I in Junin area), were confirmed by the Phase I's survey: one in the upper reaches of Rio Magdalena in the northwestern area and the other along Q.San Miguel in the southeastern area. Among them, mineralized zone in the upper reaches of Rio Magdalena was surveyed in detail in this year (Fig.II-3-2).

(1) Rio Magdalena-Branch mineralized zone (mineralized zone A)

The mineralized zone A belongs to the Type I. Dissemination to film deposit of chalcopyrite, pyrite and chrysocolla with small amount of bornite and chalcocite are observed within an area of 500 m x 400 m, which is included into strong to medium silicified and argillized zones with a radius of 600 m of just west side of andesite porphyry stock in the central part. Molybdenite stockwork is observed in the central part of the mineralized zone.

By X-ray diffraction method, the zonal arrangement which consists of the mineral assemblages of quartz-sericite-chlorite in the center, and chlorite-calcite around the center, is identified.

Samples for ore analysis were taken in order to average mineralized outcrops. The ore assay results are as follows :1.40 % to 0.20 % Cu (0.5 % in average), 7.3 g/t to 0.1 g/t or less Ag and 0.16 % to 0.01 % or less Mo (Appendix 4). The scale of the mineralized zone A and Cu content are comparable to those of the Q.Limonita to the Q.Verde mineralized zones of the Central Zone of Junin area and the Q.Fortuna mineralized zone of the Surrounding Zone of Junin area.

(2) Rio Magdalena mineralized zones (mineralized zone B to E)

Four mineralized zones are recognized along the lineament with NW-SE direction in the Rio Magdalena. Each size of those zones is 100 m to 400 m along the river.

The mineralized zones B, C and E consist of dissemination to film of pyrite, chalcopyrite and chrysocolla in the partially silicified and argillized granodiorite. Ore assay results show 0.37 % to 0.06 % Cu and 4.3 g/t to 0.1 g/t or less Ag (Appendix 4).

The mineralized zone D is composed of chrysocolla-quartz network veins within the silicified zone (acidic alteration) same as the Type III distributed from southeastern part of the Central Zone of Junin area to the Q.Fortuna mineralized zone of the Surrounding Zone of Junin area. Au-Ag geochemical anomaly is delineated in the mineralized zone D same as Junin area as mentioned below.

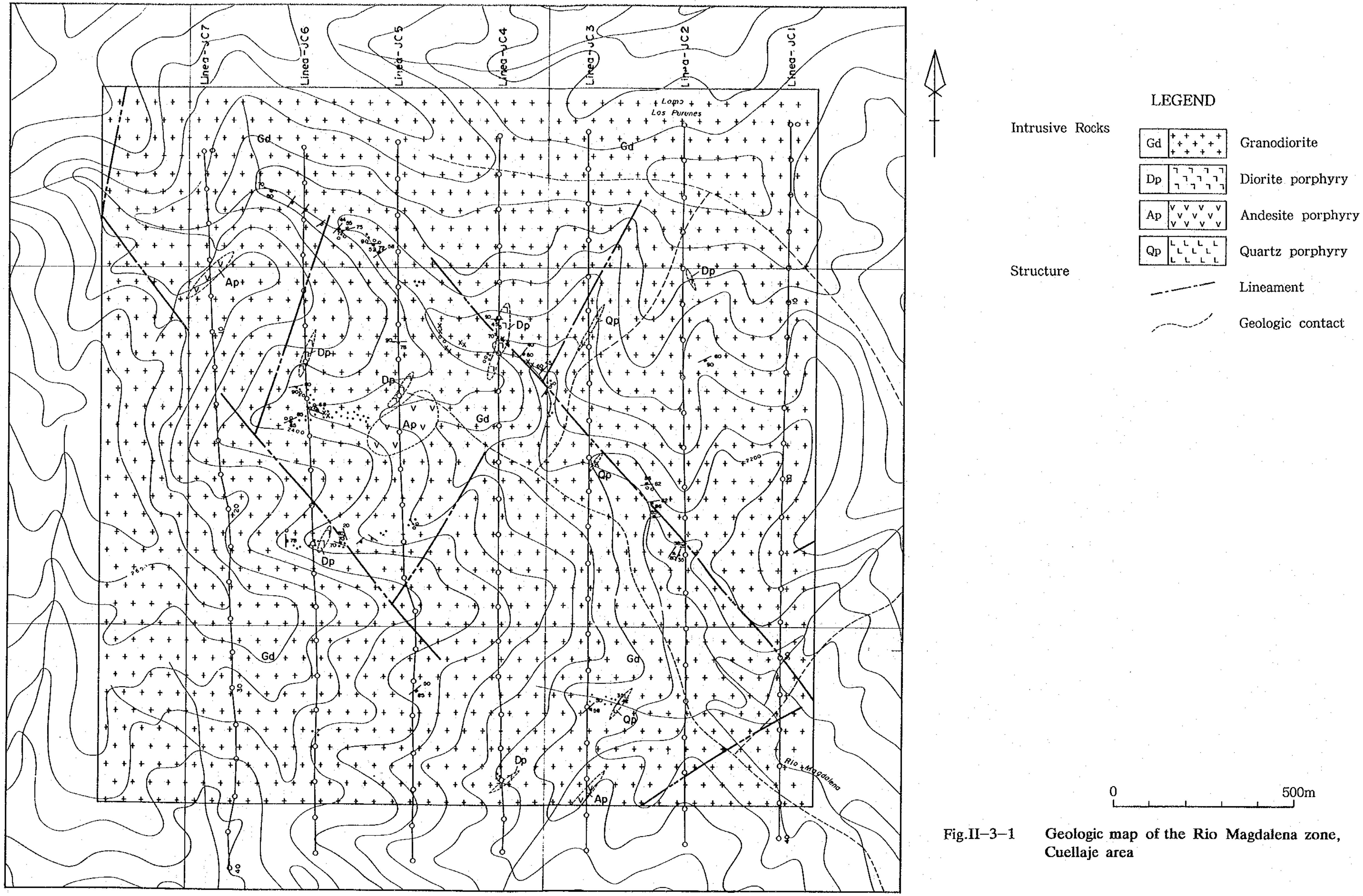


Fig.II-3-1 **Geologic map of the Rio Magdalena zone, Cuellaje area**

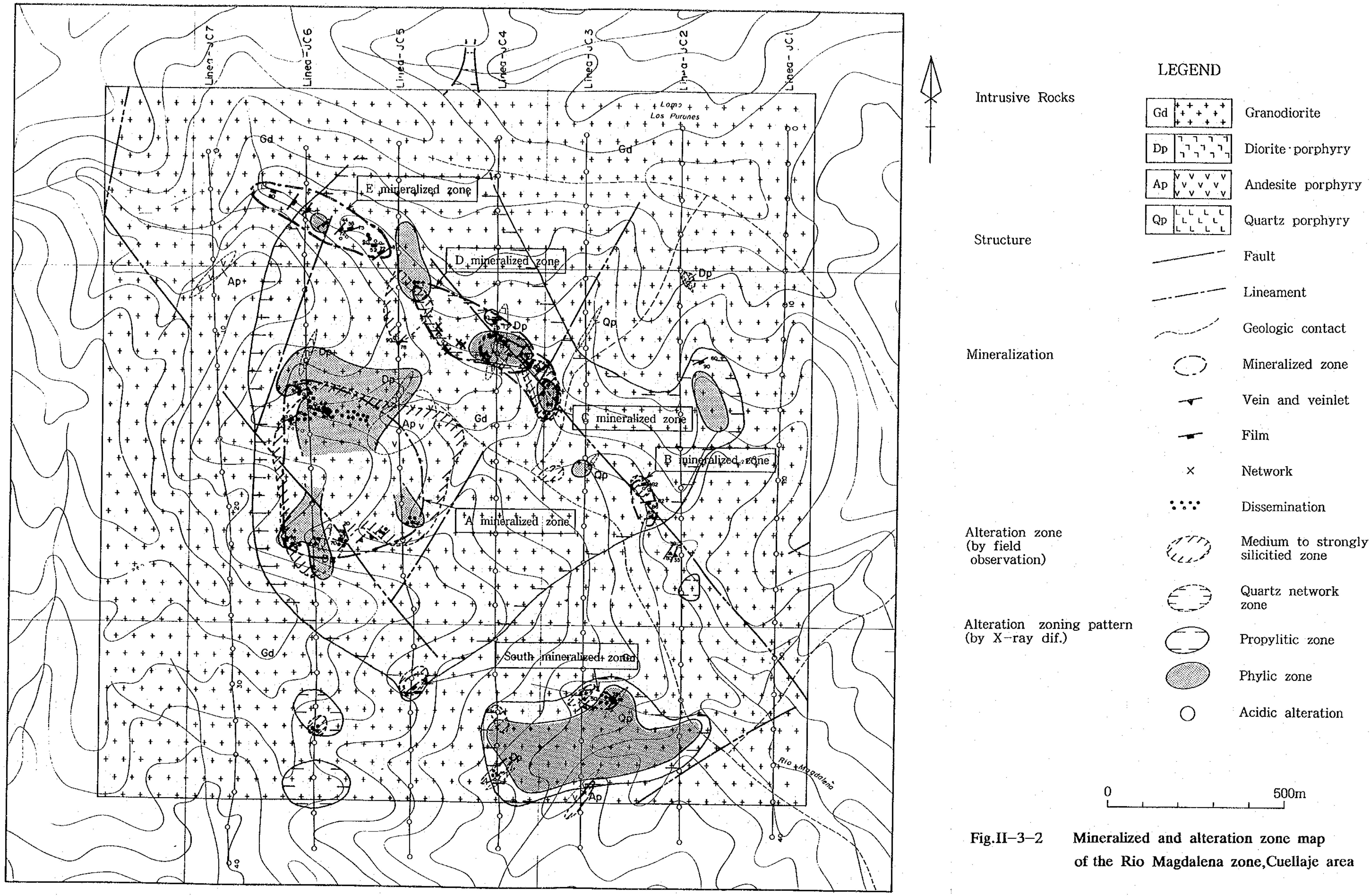


Fig.II-3-2 Mineralized and alteration zone map of the Rio Magdalena zone, Cuellaje area

(3) South mineralized zones

Two mineralized zones belonging to the Type IIA are observed in the south. The mineralized zones consist of pyrite-chalcopyrite-quartz veins with NE-SW direction and 10 cm to 80 cm in vein width.

According to X-ray diffractive analysis for wall rock alteration beside vein, the mineral assemblage of quartz-sericite-chlorite is detected along the veins, and that of chlorite-calcite apart from veins.

Ore assay results are as follows: 0.49 % to 0.34 % Cu, 4.0 g/t to 2.4 g/t Ag and 0.15 % to 0.03 % Mo.

3-2 Geochemical Survey

3-2-1 Purpose of Geochemical Survey

The purpose of the geochemical survey is to clarify the dispersion of elements related with mineralization and alteration of rocks in this area, and to delineate any promising mineralized zone.

3-2-2 Method of Geochemical Survey

(1) Sampling and preparation of samples

The amount of 206 rock samples were collected at the outcrops in the valleys and on the ridges over the whole Zone during the geological survey (Pl.II-3-3). It was difficult to take samples evenly from entire area because of highly weathering on the ridges. Therefore, the average intervals between the sampling points along the valleys is about 50m, those on the ridges very roughly. Amounts of samples from the valleys are 155, those from ridges 51.

Several small pieces of rocks were collected within the area of about 1 to 2 square meters of each sampling outcrop, and total weight of rock sample was over 500 grams each. Geology, type of alteration and hardness, etc. were recorded in each sampling point.

The secondary minerals were eliminated from the samples to make sample be weighed 300 g approximately. After crushing and preparing them individually, 50 g of sample was gathered each by the one fourth method to analyze them chemically, and another 50 g was also kept each for spare.

(2) Chemical analysis

Chemical analysis was carried out in Geotechnical Laboratory of BEC. The target elements were eight (8) such as Cu, Pb, Zn, Au, Ag, Mo, Fe and S. The latter two elements were added in order to quantitatively consider below-mentioned geophysical anomalies.

The method of chemical analysis and the detection limit for each element are shown on Tab.II-2-1. The results of chemical analysis are listed up on Appendix 5.

(3) Data processing

(i) Univariate analysis

Statistic processing of chemical analysis data was carried out with computer. The data less than detection limit assumed to be a half value of the detection limit. Since samples associated with the Type I mineralized zone of this Zone were abundant same as the Central Zone of Junin area, samples from only the Rio Magdalena Zone were processed in a lump because of 20 km of distance between the Rio Magdalena Zone and the Central Zone of Junin area. The statistical analysis are shown on Tab.II-3-1. In comparison with the results of the Central Zone of Junin area, those of this Zone are as follows: mean value of Cu double, mean value of Ag two times and half, mean value of Zn and Au slightly high, mean value of Pb and Mo slightly low; and maximum value of Cu, Au and Mo high, maximum value of Pb, Zn and Ag low.

Correlation coefficient was calculated in order to clarify the relationship among each element (Tab.II-3-2, and Fig.II-3-3). According to the calculation result, the correlation of Cu-Au, Cu-Ag, Au-Ag, Ag-Mo and Zn-Fe was proved to be good and those correlation was more than 0.5.

The above-mentioned EDA method was adopted in order to decide the threshold value to detect the geochemical anomalies. Histogram and boxplot were made on the data processed for each component (Fig.II-3-4). According to these data processing, the threshold value was decided to be the value of upper fence and supplemental threshold to be that of upper wisker (Tab.II-3-3). In comparison with the threshold value of the Central Zone of Junin area, that of this Zone is the following: twice for Cu, three times for Au, five times for Ag, one third for Pb and Zn, and half for Mo.

Tab.II-3-1 Summary of statistical analysis of rock geochemical data, Rio Magdalena zone,Cuellaje area

Geologic units	Elements	Mean	Variance	Standard deviation	Min.	Max.	Mean+2S.D
Gd. Qp.	Cu (ppm)	256.0	0.298	0.546	5.0	18,842.0	3,162.7
Dp & Ap	Pb (ppm)	1.7	0.099	0.314	0.5	108.0	7.3
(N=206)	Zn (ppm)	21.1	0.067	0.258	2.0	155.0	69.2
	Au (ppb)	2.1	0.446	0.668	0.5	136.0	45.1
	Ag (ppm)	0.23	0.197	0.443	0.10	5.70	1.80
	Mo (ppm)	1.1	0.408	0.639	0.5	1,688.0	20.2
	Fe (%)	1.93	0.024	0.154	0.32	4.27	3.91
	S (%)	0.033	0.110	0.332	0.012	1.557	0.154

Tab.II-3-2 Correlation of eight elements of rock geochemical data, Rio Magdalena zone,Cuellaje area

	Cu	Pb	Zn	Au	Ag	Mo	Fe	S
Cu	1.000							
Pb	0.328	1.000						
Zn	-0.052	0.053	1.000					
Au	0.559	0.217	-0.383	1.000				
Ag	0.575	0.474	-0.225	0.645	1.000			
Mo	0.472	0.520	-0.113	0.420	0.597	1.000		
Fe	-0.169	-0.159	0.567	-0.361	-0.390	-0.241	1.000	
S	0.455	0.223	0.134	0.183	0.395	0.467	0.035	1.000

Tab.II-3-3 Results of the EDA analysis of rock geochemical data, Rio Magdalena zone,Cuellaje area

Elements	Median	L.fence	L.wisker	L.hinge	U.hinge	U.wisker	U.fence
Cu(ppm)	268.5	-562.0	99.0	119.0	573.0	726.0	1,254.0
Pb(ppm)	2.0	-0.5	1.0	1.0	2.0	2.0	3.5
Zn(ppm)	22.0	-3.5	14.0	16.0	29.0	32.0	48.5
Au(ppb)	1.5	-7.8	0.5	0.5	6.0	11.0	14.3
Ag(ppm)	0.20	-0.50	0.10	0.10	0.50	0.60	1.10
Mo(ppm)	0.5	-1.8	0.5	0.5	2.0	3.0	4.3
Fe(%)	2.13	0.55	1.54	1.66	2.40	2.48	3.51
S (%)	0.027	0.012	0.023	0.024	0.032	0.035	0.044

Tab.II-3-4 Results of factor analysis of rock geochemical data, Rio Magdalena zone,Cuellaje area

Elements	Factor			Communality
	1	2	3	
Cu	0.729	-0.079	0.235	0.5924
Pb	0.196	-0.027	0.695	0.5220
Zn	-0.041	0.758	0.070	0.5810
Au	0.641	-0.479	0.094	0.6494
Ag	0.615	-0.333	0.453	0.6943
Mo	0.480	-0.129	0.600	0.6064
Fe	-0.071	0.722	-0.199	0.5654
S	0.542	0.218	0.284	0.4222
Contribution	40.76%	32.53%	26.71%	

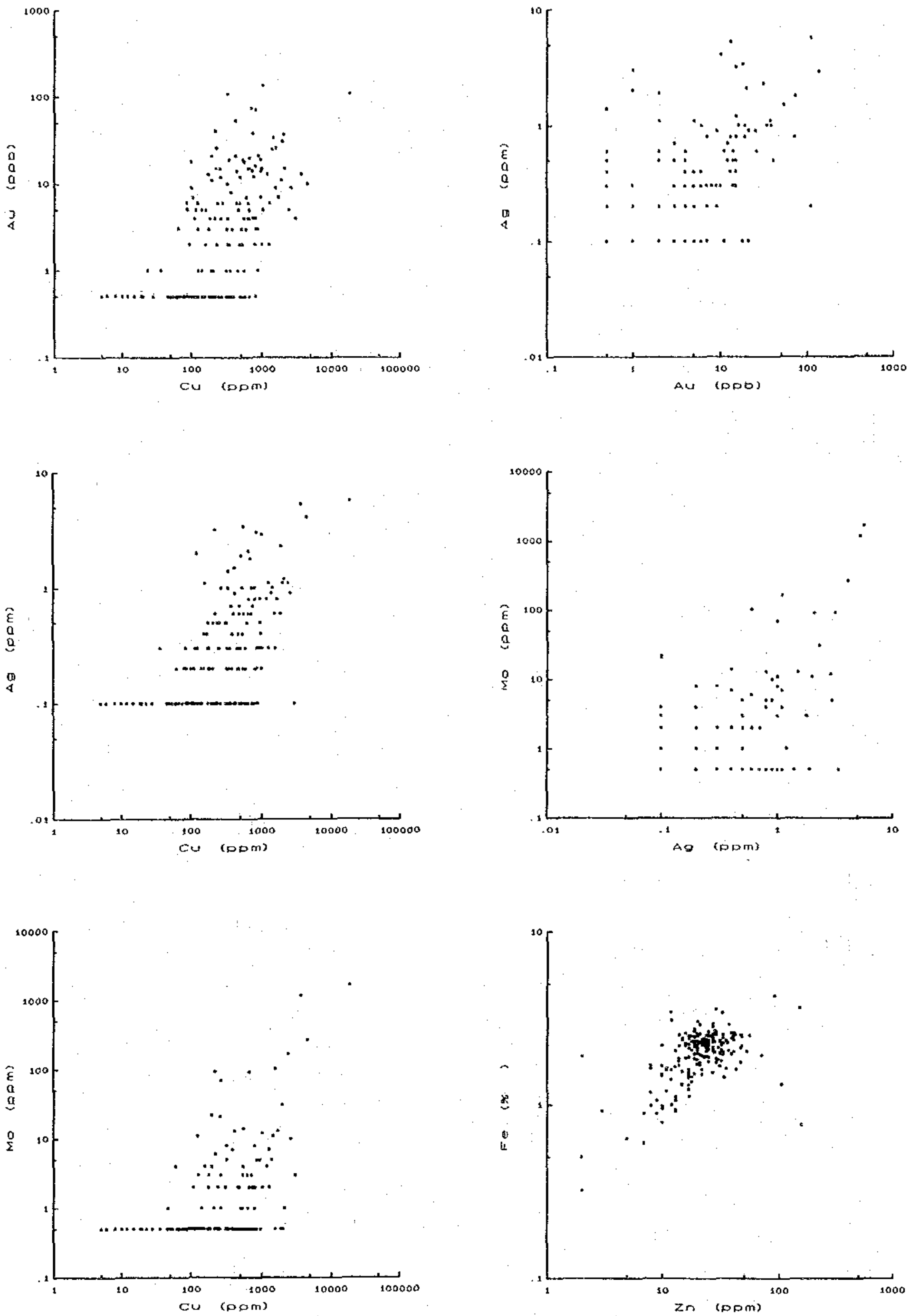


Fig.II–3–3 Correlation diagram between each element,Rio Magdalena zone,Cuellaje area

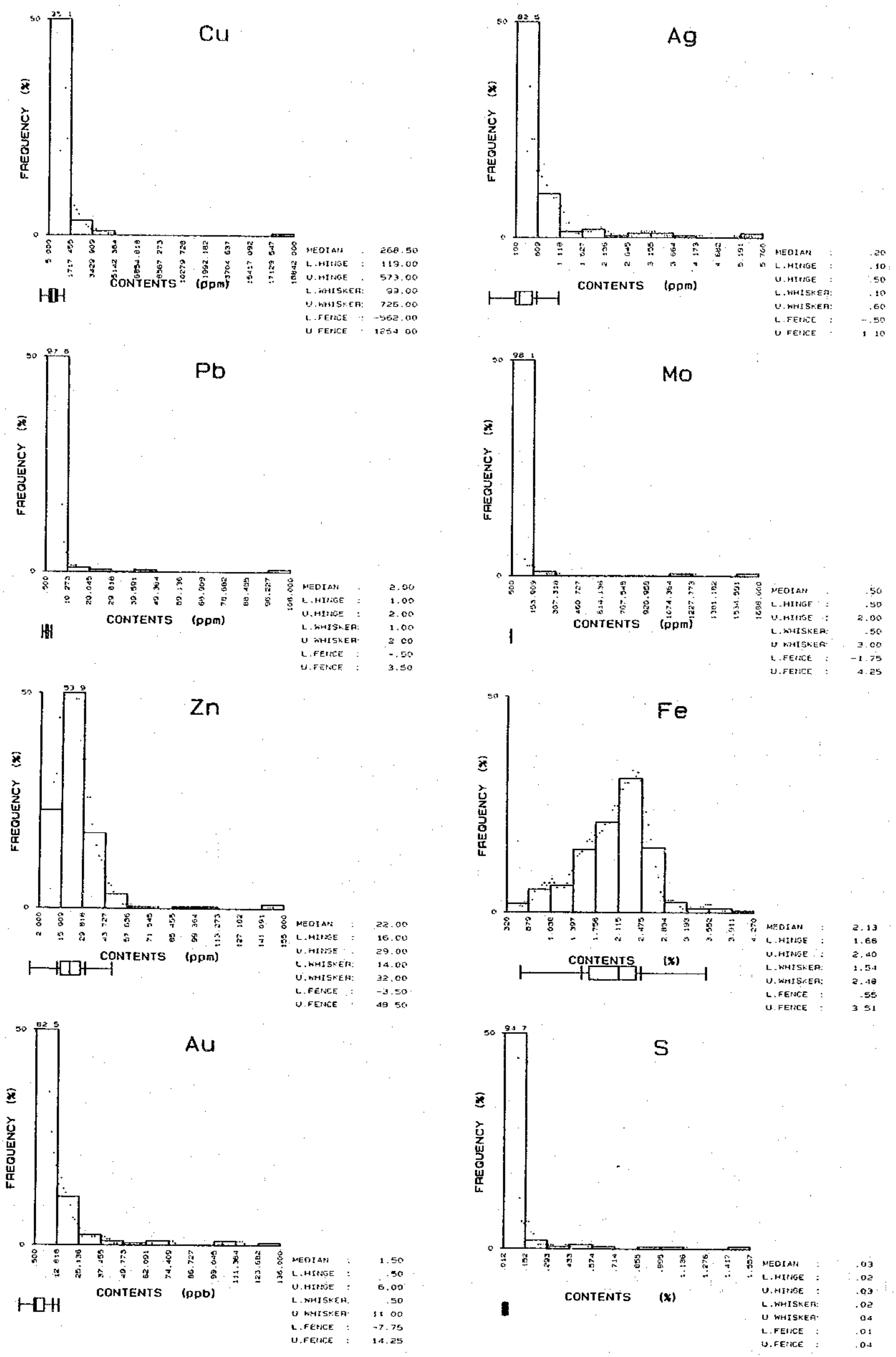


Fig.II–3–4 Histograms and boxplots of eight elements, Rio Magdalena zone, Cuellaje area

(ii) Multivariate analysis

Factor analysis method was applied for examination in a similar way to Junin area.

Data was processed with computer by Varimax rotation method. As the result, such three factors as 1) Cu-Mo-Au-Ag, 2) Au-Ag, and 3) Pb-Mo-Ag were proved. Factor loading, communality and factor score are all shown on Tab.II-3-4.

The samples, absolute value of factor score more than 1, were extracted and examined which relationship could be expected between the factor score and the geology and/or mineralization in this report.

3-2-3 Results of Geochemical Survey

(1) Geochemical anomaly in each element

Geochemical anomaly maps (Fig.II-3-5) were made by examining of distributions of such concentration as Cu, Pb, Zn, Au, Ag, Mo, Fe and S with EDA method of univariate analysis.

Copper(Cu): Concentration of copper showed a variation from the minimum value of 5 ppm to the maximum value of 18,842 ppm. The distribution map of high concentration was made as shown in Fig.II-3-5(1) based on the upper fence value (1,254.0 ppm) and upper wisker value (726.0 ppm).

Anomalous zones over the threshold of upper fence were delineated on some parts corresponding with the mineralized zones A, C and E, and south mineralized zone.

The anomalous zone of the mineralized zone A consists of 7 sampling points with 18,842 ppm as maximum.

The anomalous zones of the mineralized zone C and south mineralized zone contain two sampling points, respectively.

The anomalous zone of the mineralized zone E is composed of four sampling points.

Lead(Pb): Concentration of copper showed a variation from the minimum value of 1 ppm or less (detection limit) to the maximum value of 108 ppm. The distribution map of high concentration was made as shown in Fig.II-3-5(2) based on the upper fence value (3.5 ppm) and upper wisker value (2.0 ppm).

Anomalous zones over the threshold of upper fence were delineated on relatively sizable zone in the south mineralized zone, and on scattered places including the mineralized zone A and marginal part of the Zone.

The anomalous zone of the south mineralized zone contains six sampling points including 108 ppm as maximum.

The anomalous zone of the mineralized zone A is composed of five sampling points, and seven sampling points are scattered.

Zinc(Zn): Concentration of copper showed a variation from the minimum value of 2 ppm to the maximum value of 155 ppm. The distribution map of high concentration was made as shown in Fig.II-3-5(3) based on the upper fence value (48.5 ppm) and upper wisker value (32.0 ppm).

Anomalous zones over the threshold of upper fence were delineated on the south mineralized zone and southwestern part.

The anomalous zone of the south mineralized zone is composed of three sampling points including 155 ppm as maximum.

The anomalous zone of the southwestern part contains two sampling points including 151 ppm as maximum.

Gold(Au): Concentration of copper showed a variation from the minimum value of 1 ppb or less (detection limit) to the maximum value of 136 ppb. The distribution map of high concentration was made as shown in Fig.II-3-5(4) based on the upper fence value (14.3 ppb) and upper wisker value (11.0 ppm).

Anomalous zones over the threshold of upper fence were delineated on the zones including the mineralized zones A, C, D and E, and on the limited zones of the mineralized zone B and the northern end of the Zone.

The anomalous zones of the mineralized zones A, C, D and E consist of 21 sampling points including 136 ppb as maximum.

The anomalous zone of the mineralized zone B contains five sampling points, and three sampling points in the northern end.

Silver(Ag): Concentration of copper showed a variation from the minimum value of 0.2 ppm or less (detection limit) to the maximum value of 5.7 ppm. The distribution map of high concentration was made as shown in

Fig.II-3-5(5) based on the upper fence value (1.10 ppm) and upper wisker value (0.60 ppm).

Anomalous zones over the threshold of upper fence were delineated on some zones corresponding with the mineralized zone A and E, and the south mineralized zone, in addition to the mineralized zone D and its eastern part.

The anomalous zone of the mineralized zone A consists of five sampling points including 5.7 ppm as maximum.

The anomalous zones of the mineralized zone E and the south mineralized zone contain three sampling points, respectively.

The anomalous zone of the mineralized zone D with its eastern part includes four sampling points.

Molybdenum(Mo): Concentration of copper showed a variation from the minimum value of 1 ppm (detection limit) to the maximum value of 1,688 ppm. The distribution map of high concentration was made as shown in Fig.II-3-5(6) based on the upper fence value (4.3 ppm) and the upper wisker value (3.0 ppm).

Anomalous zones over the threshold of upper fence were delineated on the similar zones to those Cu.

The anomalous zone of the mineralized zone A consists of 10 sampling points including 1,688 ppm as maximum.

The anomalous zone of the south mineralized zone contains four sampling points including 1,178 ppm as maximum.

The anomalous zone of the mineralized zone E is composed of five sampling points.

Iron(Fe): Concentration of copper showed a variation from the minimum value of 0.32 % the maximum value of 4.27 %. The distribution map of high concentration was made as shown in Fig.II-3-5(7) based on the upper fence value (3.51 %) and upper wisker value (2.48 ppm).

Anomalous zones over the threshold of upper wisker were delineated on some zones including the mineralized zones A, B and E, and the south mineralized zone, in addition to the northern end and the southwestern part.

The anomalous zone of the mineralized zones A and B consist of 12 and five sampling points including 3.40 % and 3.57 % as maximum, respectively.

The anomalous zone of the mineralized zone E includes three sampling points.

The anomalous zones of the south mineralized zone and the southwestern part contain nine and three sampling points including 4.27 % and 3.64 %, respectively.

The anomalous zone of the northern end includes eight sampling points.

Sulfur(S): Concentration of copper showed a variation from the minimum value of 0.012 % to the maximum value of 1.557 %. The distribution map of high concentration was made as shown in Fig.II-3-5(8) based on the upper fence value (0.044 %) and the upper wisker value (0.035 %).

Anomalous zones over the threshold of upper fence were delineated on the similar zones to those Cu.

The anomalous zone of the mineralized zone A consists of 13 sampling points including 1.557 % as maximum.

The anomalous zone of the south mineralized zone contains five sampling points including 1.094 % as maximum.

The anomalous zones of the mineralized zones C and E are composed of three and nine sampling points, respectively.

(2) The results of factor analysis

The following three factors were proved by factor analysis of Varimax rotation method in multivariate analysis.

The first factor : Cu-Mo-Au-Ag
The second factor: Au-Ag
The third factor : Pb-Mo-Ag

(i) The first factor: Cu-Mo-Au-Ag

The distribution map of high factor score more than 1.000 is shown in Fig.II-3-6(1). The distribution zones of high factor score are delineated on the mineralized zone A, the mineralized zone E, south mineralized zone and northeastern part.

(ii) The second factor: Au-Ag

The distribution map of high factor score less than -1.000 is shown in Fig.II-3-6(2). The distribution zone of high factor score is delineated on the mineralized zone D.

(iii) The third factor: Pb-Mo-Ag

The distribution map of high factor score more than 1.000 is shown in Fig.II-3-6(3). The distribution zones of high factor score are delineated on the mineralized zone A, the mineralized zone E, south mineralized zone and northeastern part.

(3) Normative chalcopyrite-pyrite

Geochemical anomaly maps of all elements were considered to evaluate below-mentioned IP anomalies. The distributions of the geochemical anomaly zones of sulfur were coincident with those of the IP anomalies.

Normative chalcopyrite and pyrite values were calculated on the basis of the chemical composition of each rock (Tab.II-3-5). In practice, Fe contents of both minerals were substituted for normative chalcopyrite and pyrite values owing to various restraints of factor, that is, the evaluation of IP anomaly was done by normative pyrite value and normative chalcopyrite-pyrite ratio because normative chalcopyrite value was decided by Cu content (Fig.II-3-7).

Before calculation, the following two prerequisites were taken into consideration:

1) The ratio between Cu contents in sulfide minerals and total Cu contents indicated about 30 % in the mineralized zones of the Central Zone of Junin area according to the result of the Phase I survey. Since oxide copper minerals in this Zone were not so many as those in the Central Zone of Junin area, the ratio was estimated as 50 %.

2) Sulfide copper minerals were supposed to be consisted mainly of chalcopyrite without bornite and chalcocite.

As to calculation flow, Cu, Fe and S in chalcopyrite were calculated from total contents of Cu, Fe and S, and the rests were allocated for pyrite. The normative chalcopyrite-pyrite ratio was calculated finally. Minus value of Fe and S in pyrite, and that of normative chalcopyrite-pyrite value indicate that sulfur is not enough and oxide minerals are so many as sulfide minerals.

The proved results are as follows:

1) IP anomaly is proportion to total amounts of sulfide minerals. 2) It seems that IP anomalies on the mineralized zone A and E are caused by same amount of chalcopyrite and pyrite, IP anomaly on the south mineralized zone pyrite > chalcopyrite, and IP anomaly on the northeastern part pyrite.

3) It is difficult for normative chalcoyrite-pyrite ratio to evaluate IP anomaly.

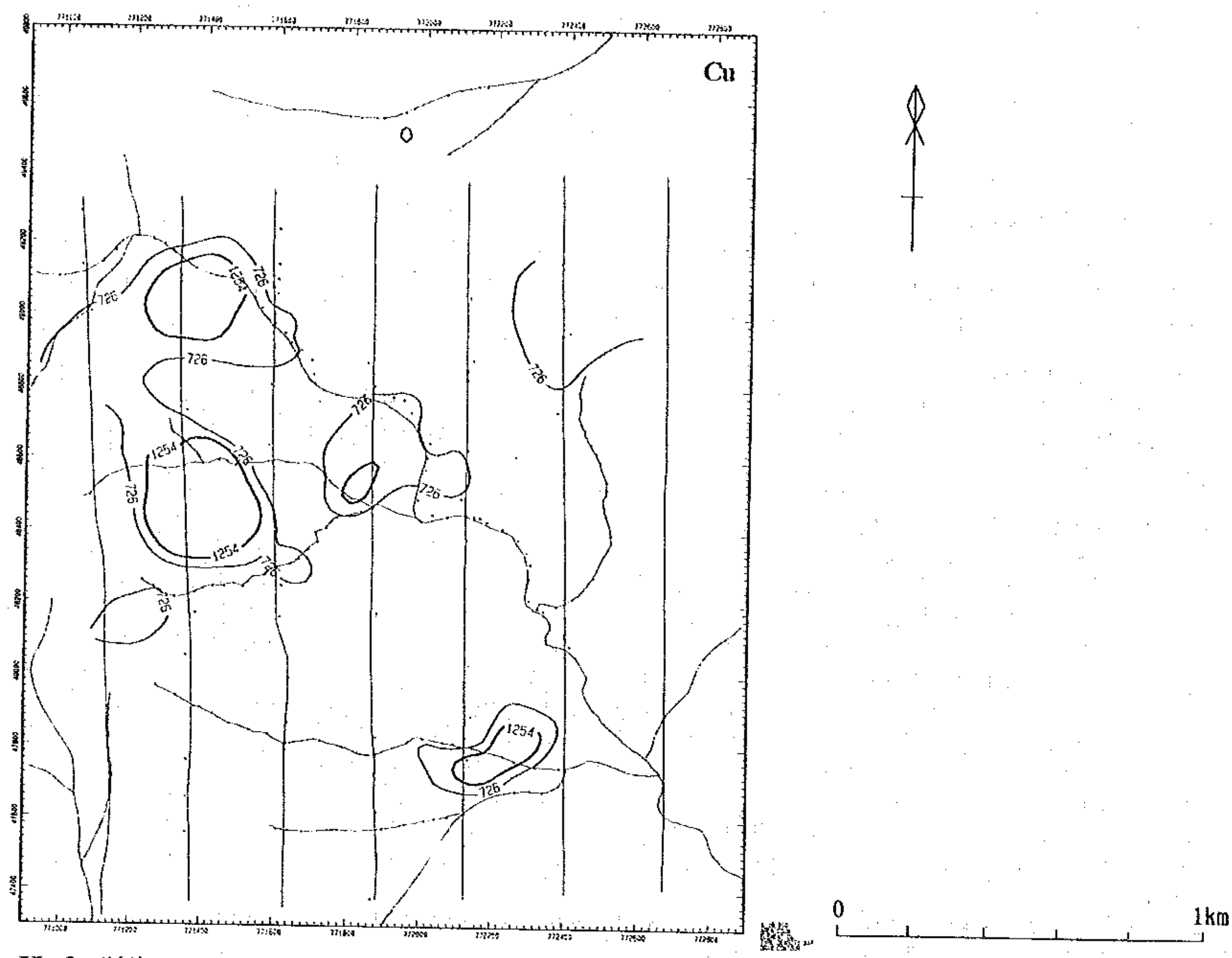


Fig.II–3–5(1) Geochemical anomalies of rock samples(Cu),Rio Magdalena zone,Cuellaje area

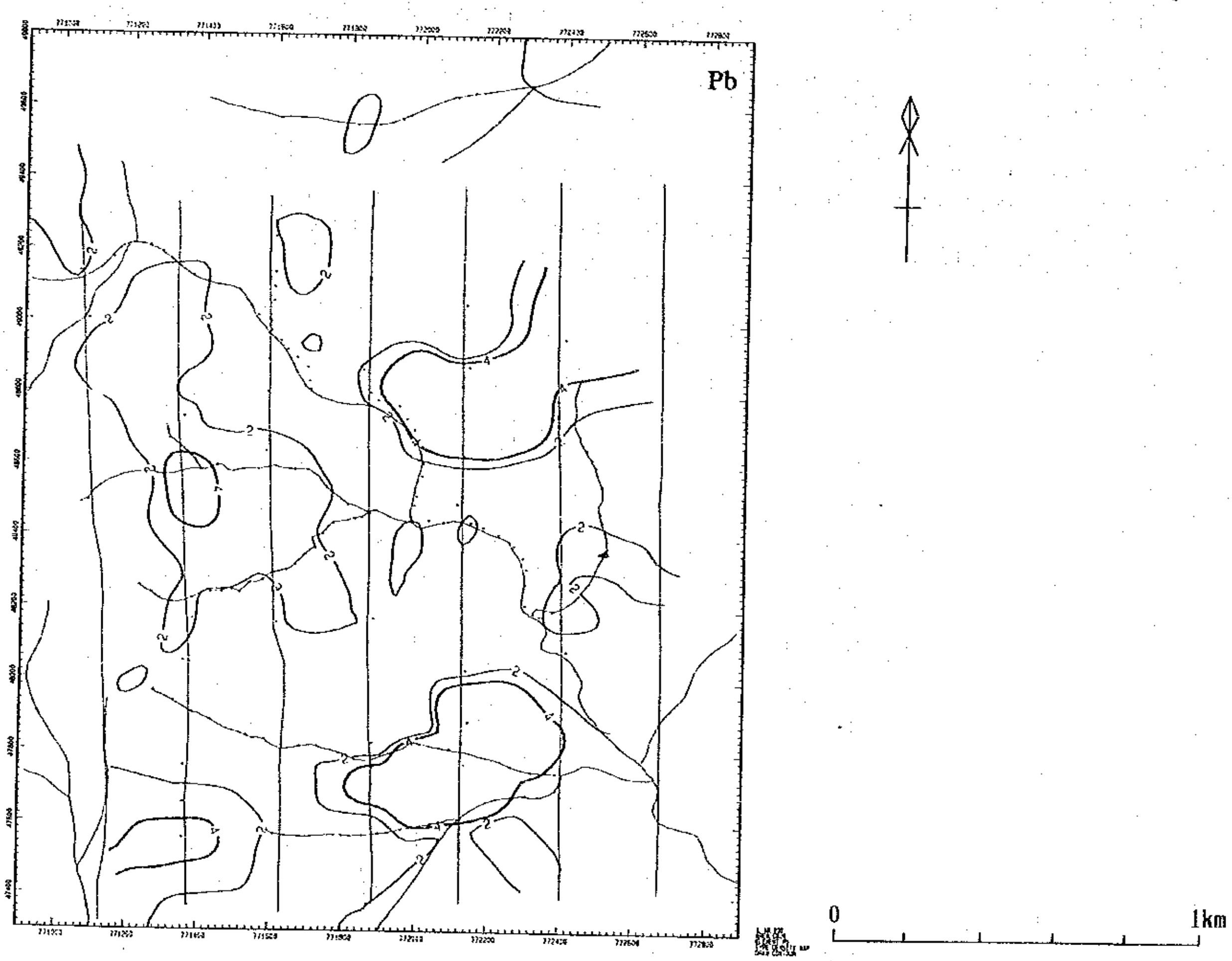


Fig.II–3–5(2) Geochemical anomalies of rock samples(Pb),Rio Magdalena zone,Cuellaje area

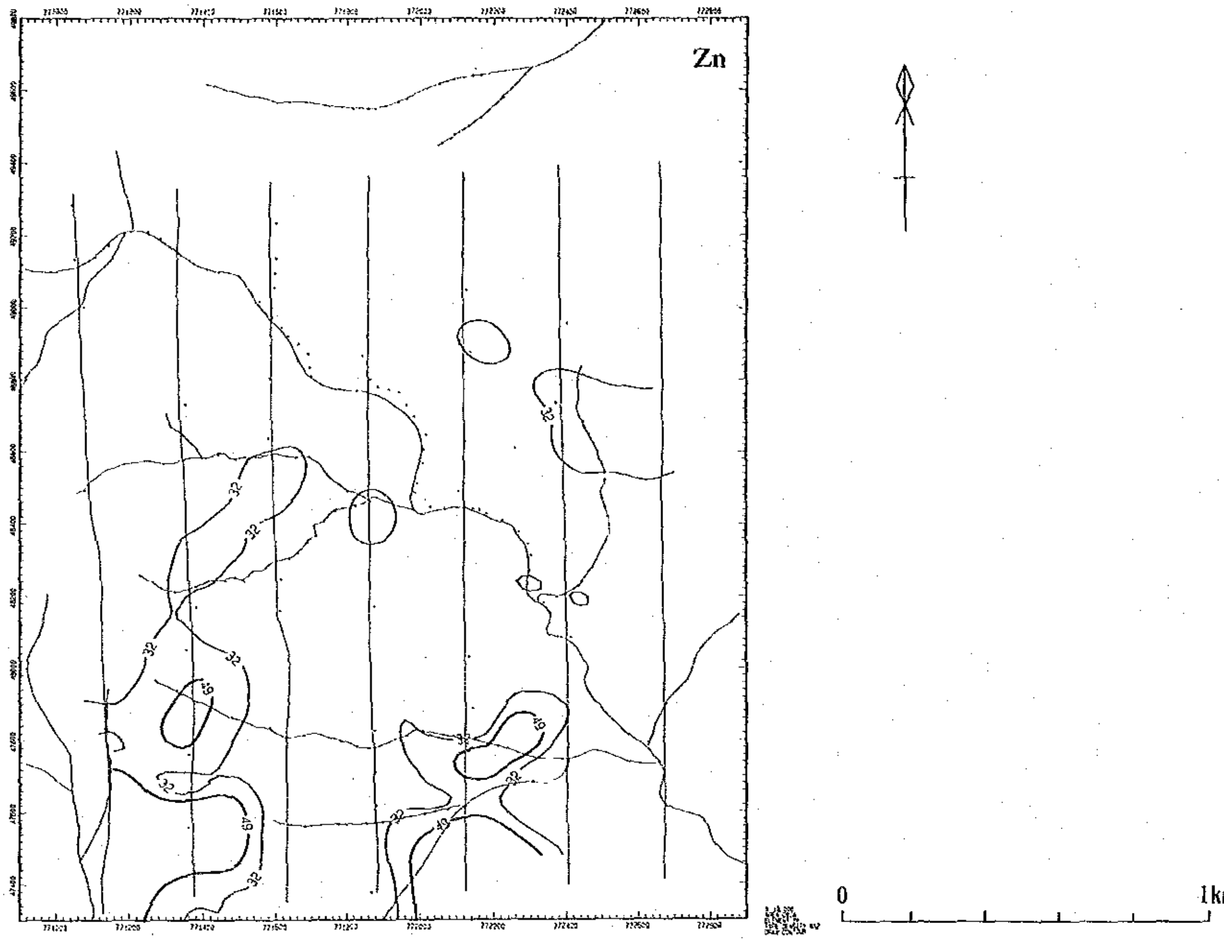


Fig.II–3–5(3) Geochemical anomalies of rock samples(Zn),Rio Magdalena zone,Cuellaje area

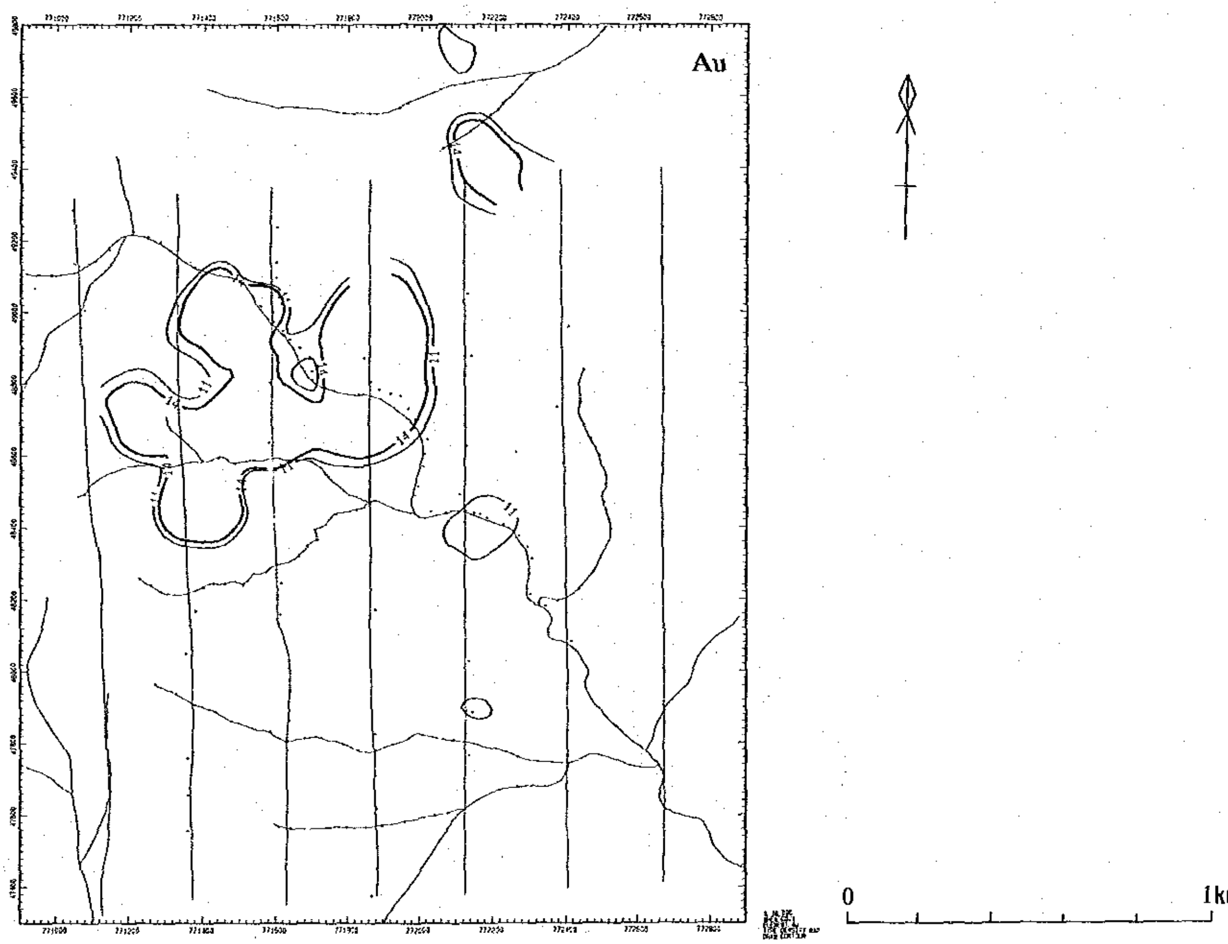


Fig.II–3–5(4) Geochemical anomalies of rock samples(Au),Rio Magdalena zone,Cuellaje area

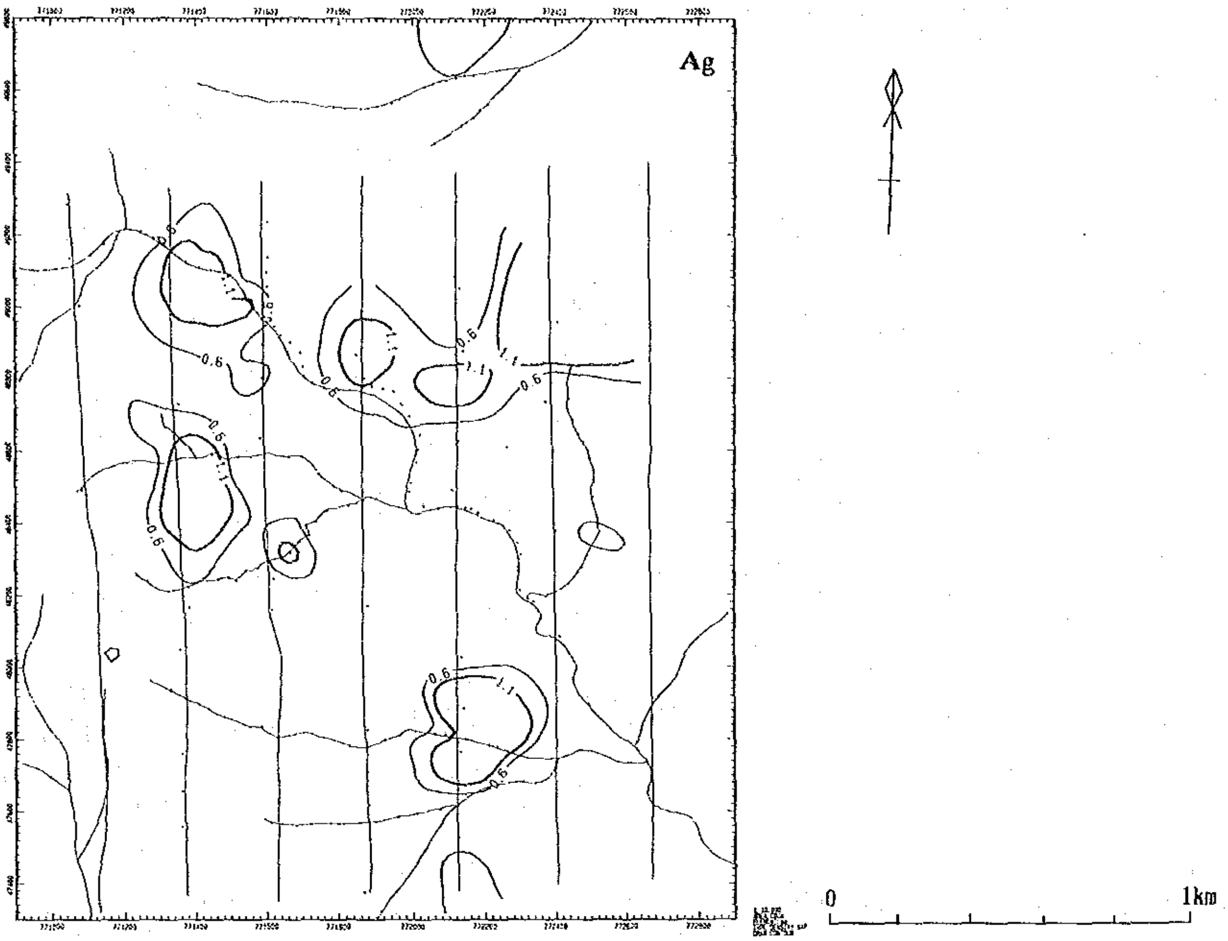


Fig.II–3–5(5) Geochemical anomalies of rock samples(Ag),Rio Magdalena zone,Cuellaje area

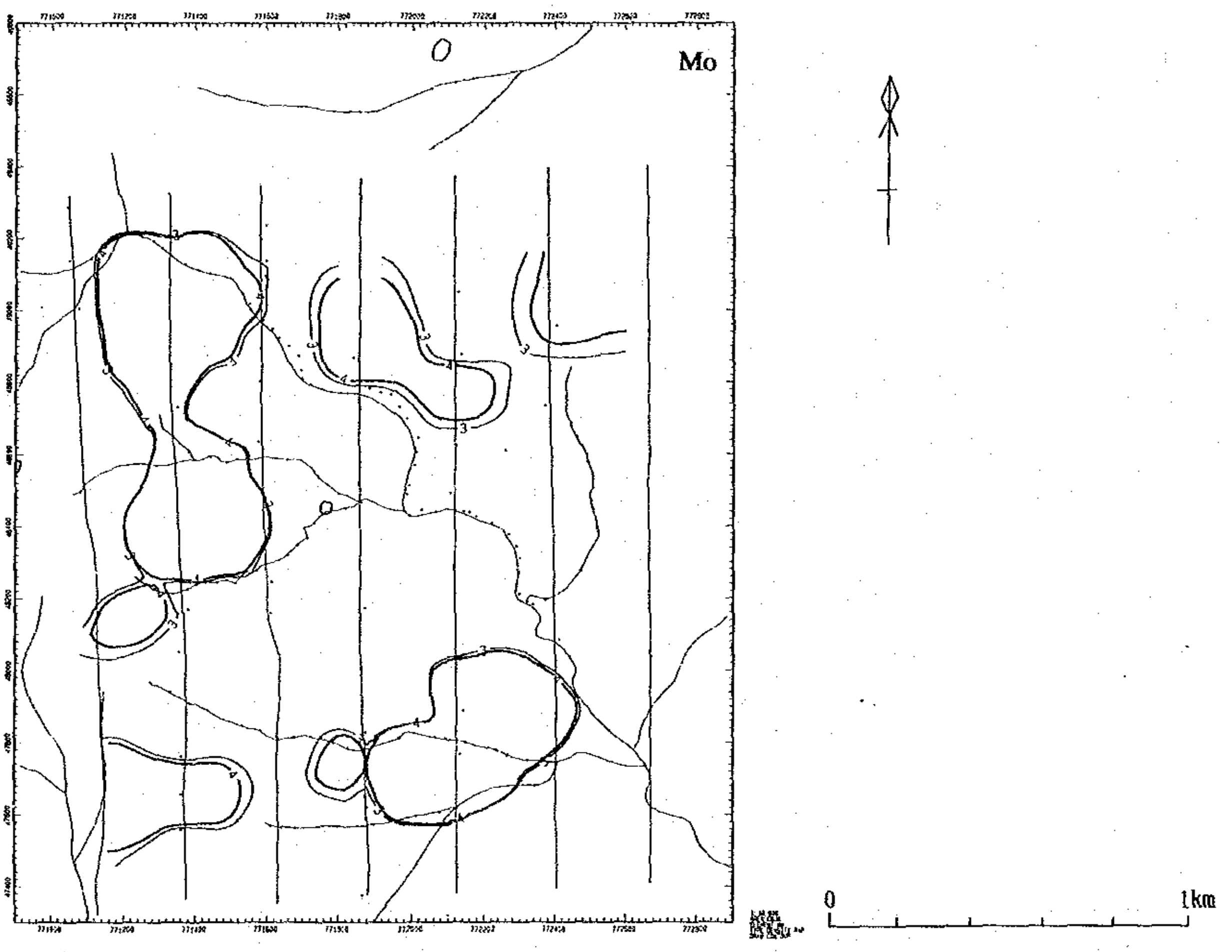


Fig.II–3–5(6) Geochemical anomalies of rock samples(Mo),Rio Magdalena zone,Cuellaje area

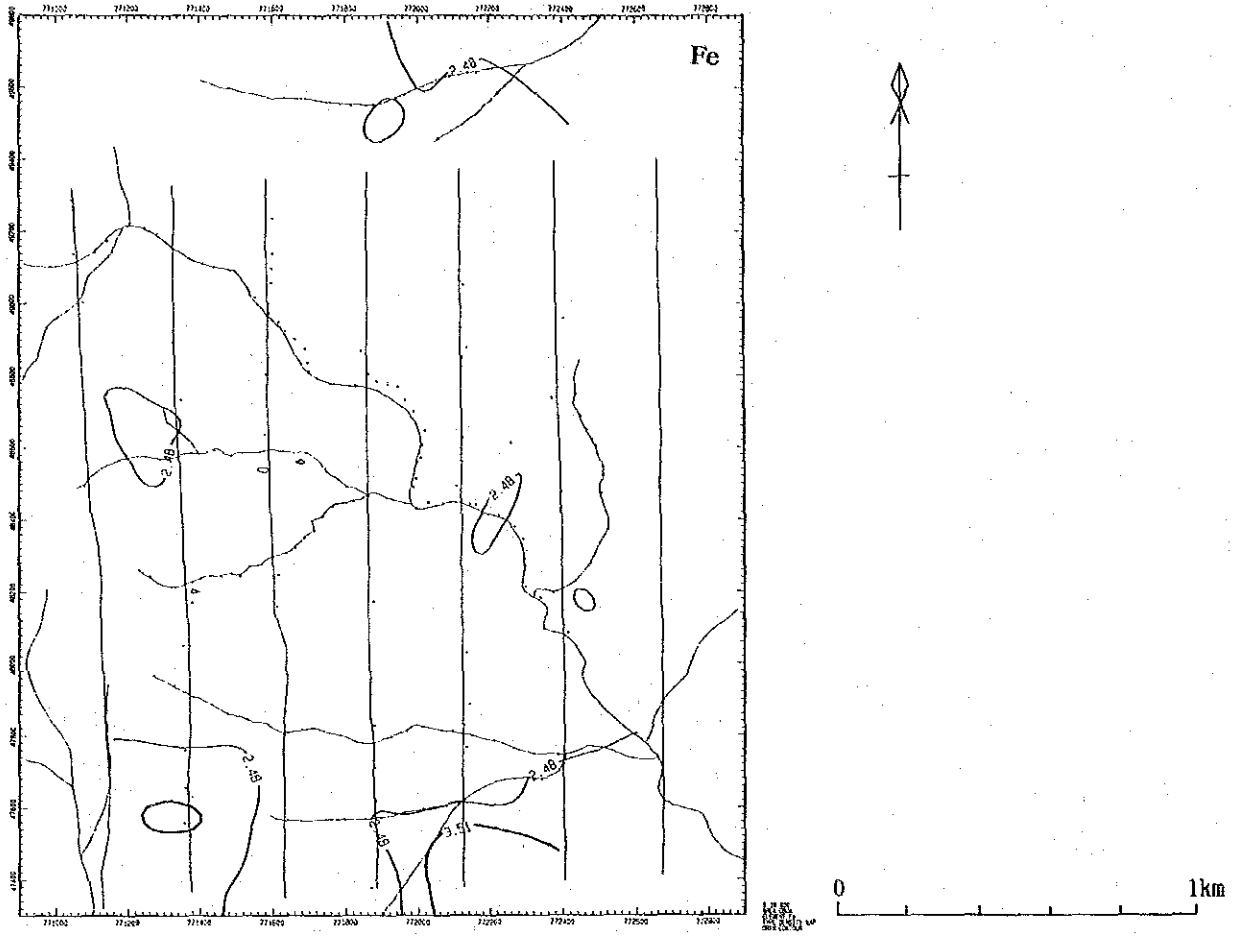


Fig.II-3-5(7) Geochemical anomalies of rock samples(Fe),Rio Magdalena zone,Cuellaje area

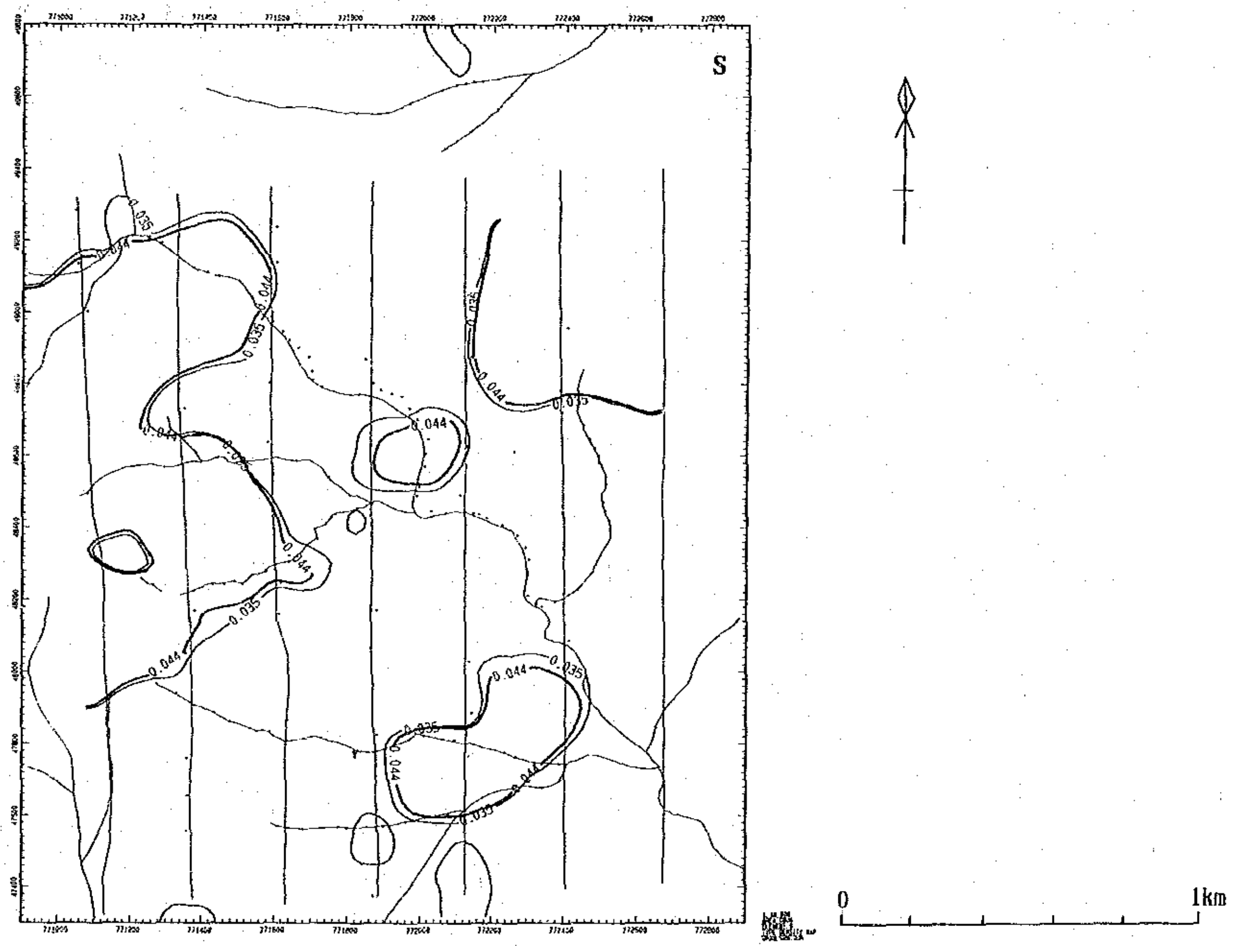


Fig.II-3-5(8) Geochemical anomalies of rock samples(S),Rio Magdalena zone,Cuellaje area

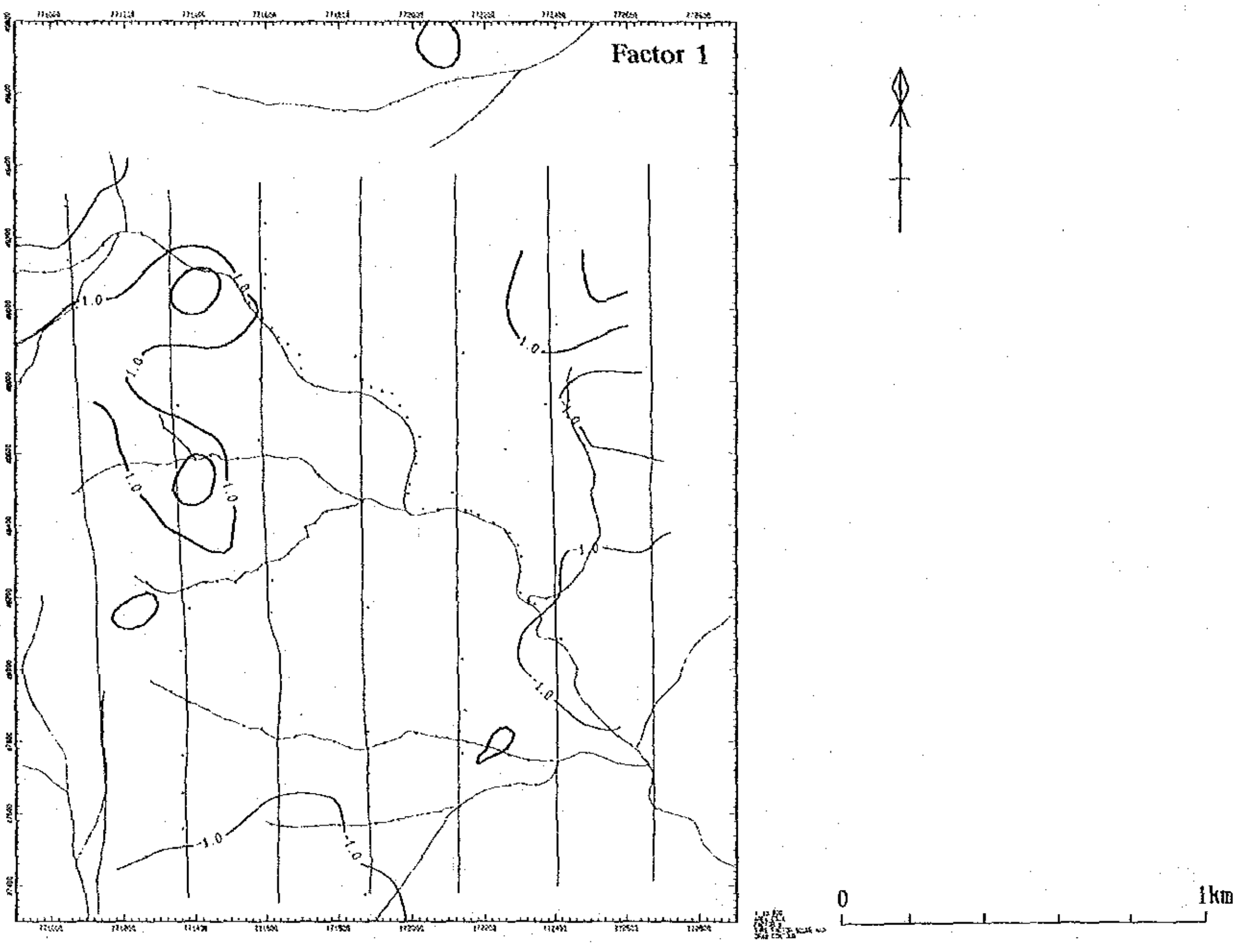


Fig.II–3–6(1) High factor scores from factor analysis of rock samples:
Factor 1;Cu–(Mo)–Au–Ag–S

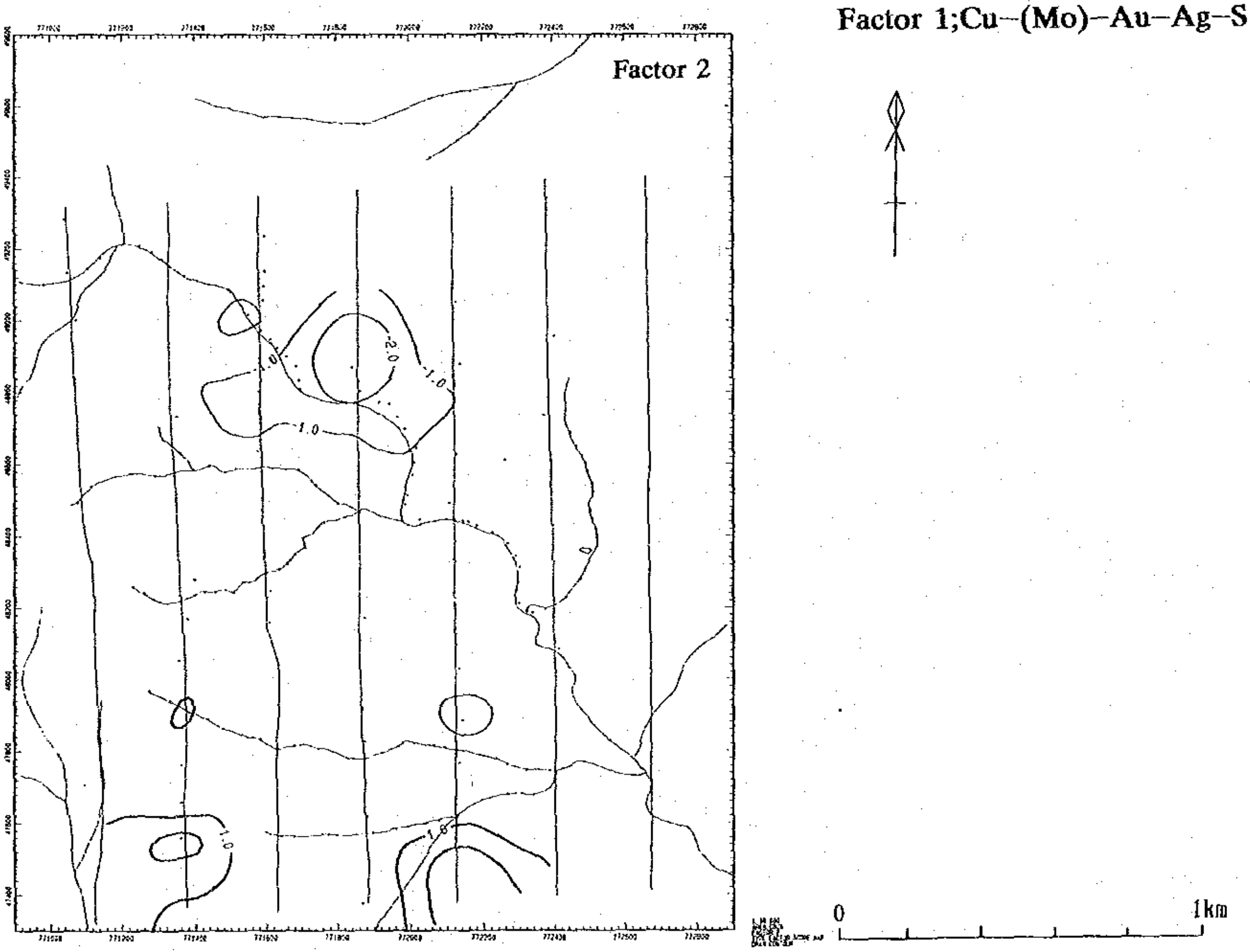


Fig.II–3–6(2) High factor scores from factor analysis of rock samples:Factor 2;Au–Ag

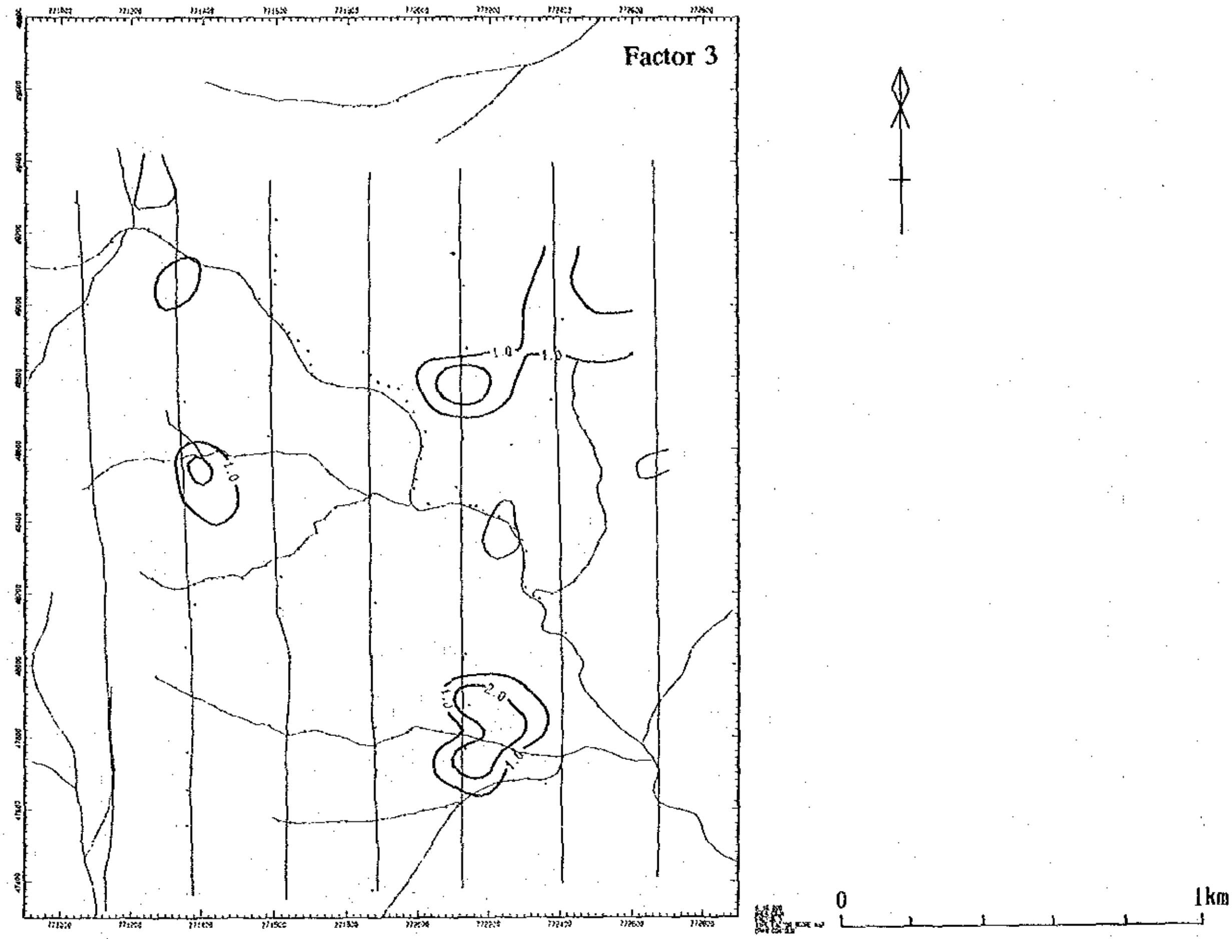


Fig.II–3–6(3) High factor scores from factor analysis of rock samples:Factor 3;Pb–Mo–(Ag)