3-3 Geochemical Exploration

In this year's survey, a geochemical soil sampling for the survey area was conducted and collected samples were analyzed for 6 indicator elements such as Au, Ag, As, Cu, Pb and Zn.

The statistical data treatment has been made for a combined population of samples in the Pirca Eastern Area and the Pirca Western Area. However, maps and figures have been prepared separately for the two areas.

The Geochemical Interpretation Map each for the Pirca Eastern (Fig. II-13) and the Pirca Western (Fig. II-14) area is prepared by combining anomalies in the principal components and the anomalous zones defined by the univariate analysis.

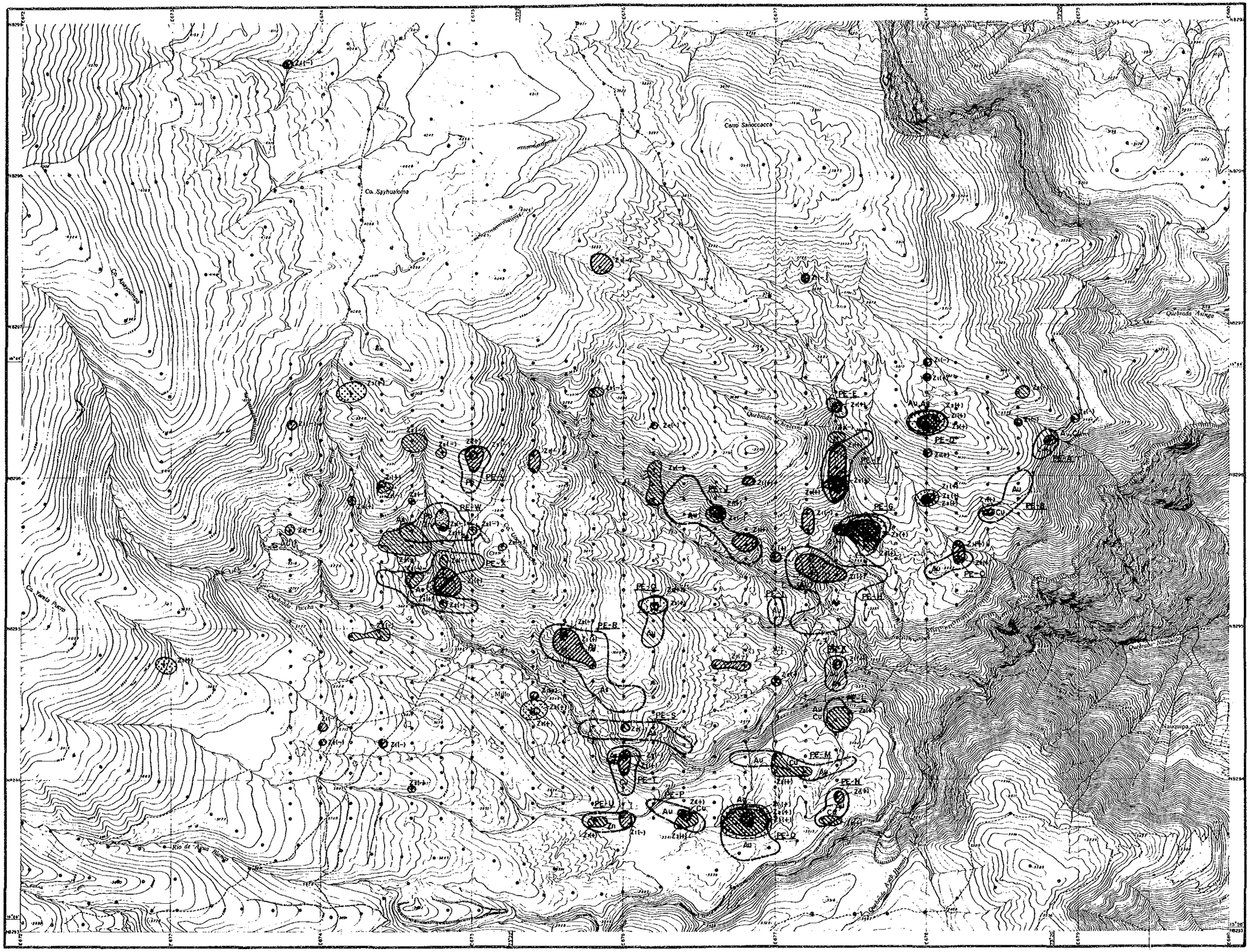
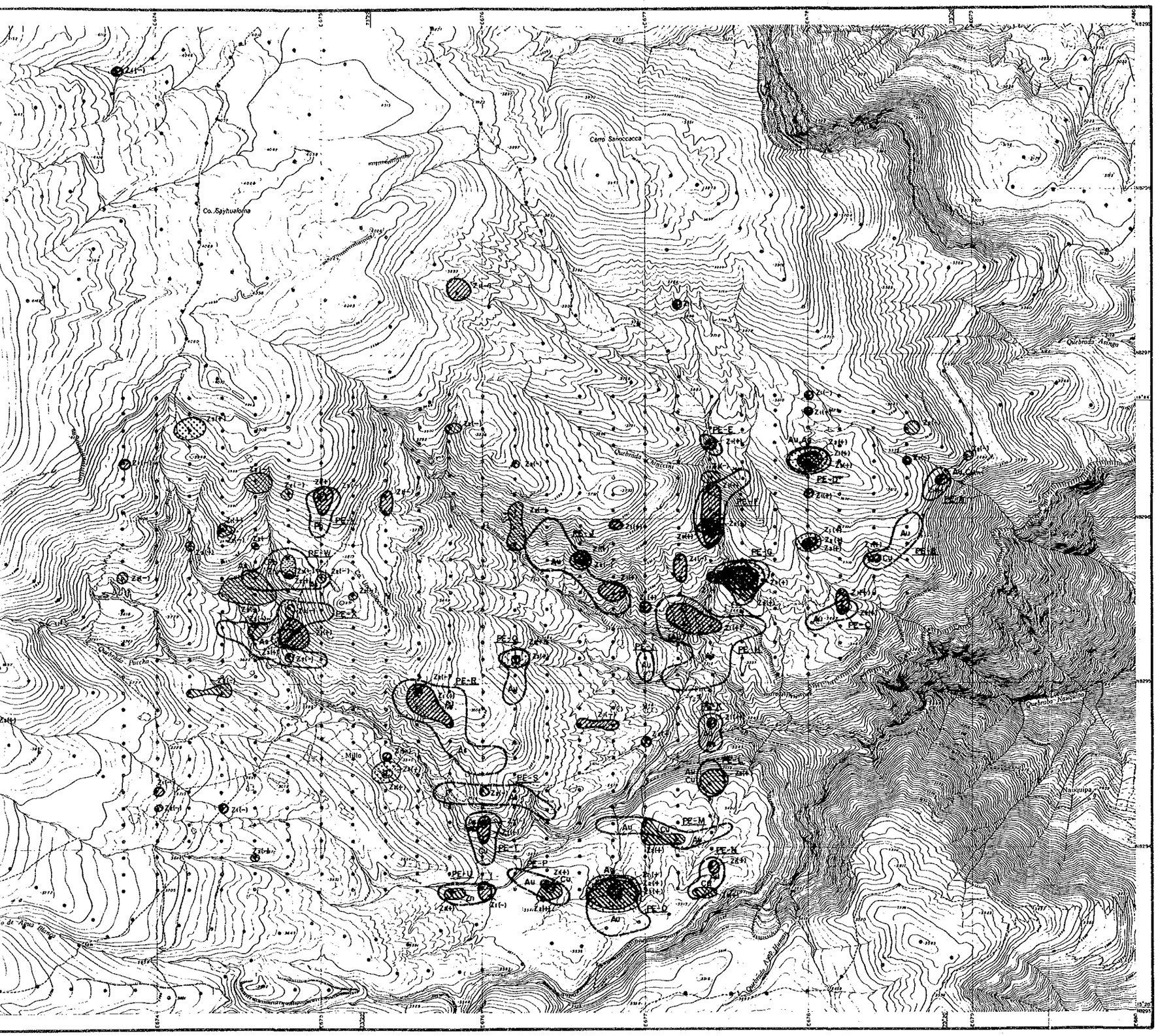
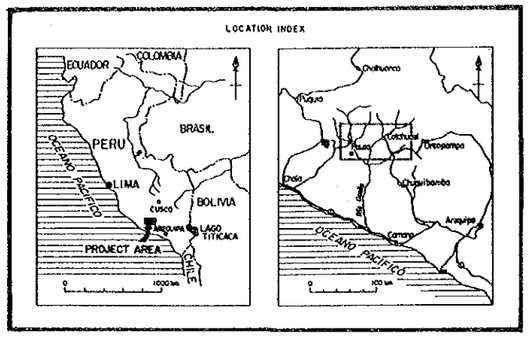


Fig. II-13 Geoch
Pirca





N

0 0.5 km

LEGEND

Geochemical Anomaly
<Univariate Analysis>

(Au,Ag,As / Cu,Pb,Zn) Anomaly Zone and Anomalous Elements

PE-A Name of Anomaly Zone

<Principal Components Analysis>

• 1st Principal Component

Zt(+) + Anomaly

Zt(−) − Anomaly

• 2nd Principal Component

Zs(+) + Anomaly

Zs(−) − Anomaly

• 3rd Principal Component

Zs(+) + Anomaly

Zs(−) − Anomaly

Fig. II-13 Geochemical Interpretation Map of Pirca Eastern Area (Composite Data)

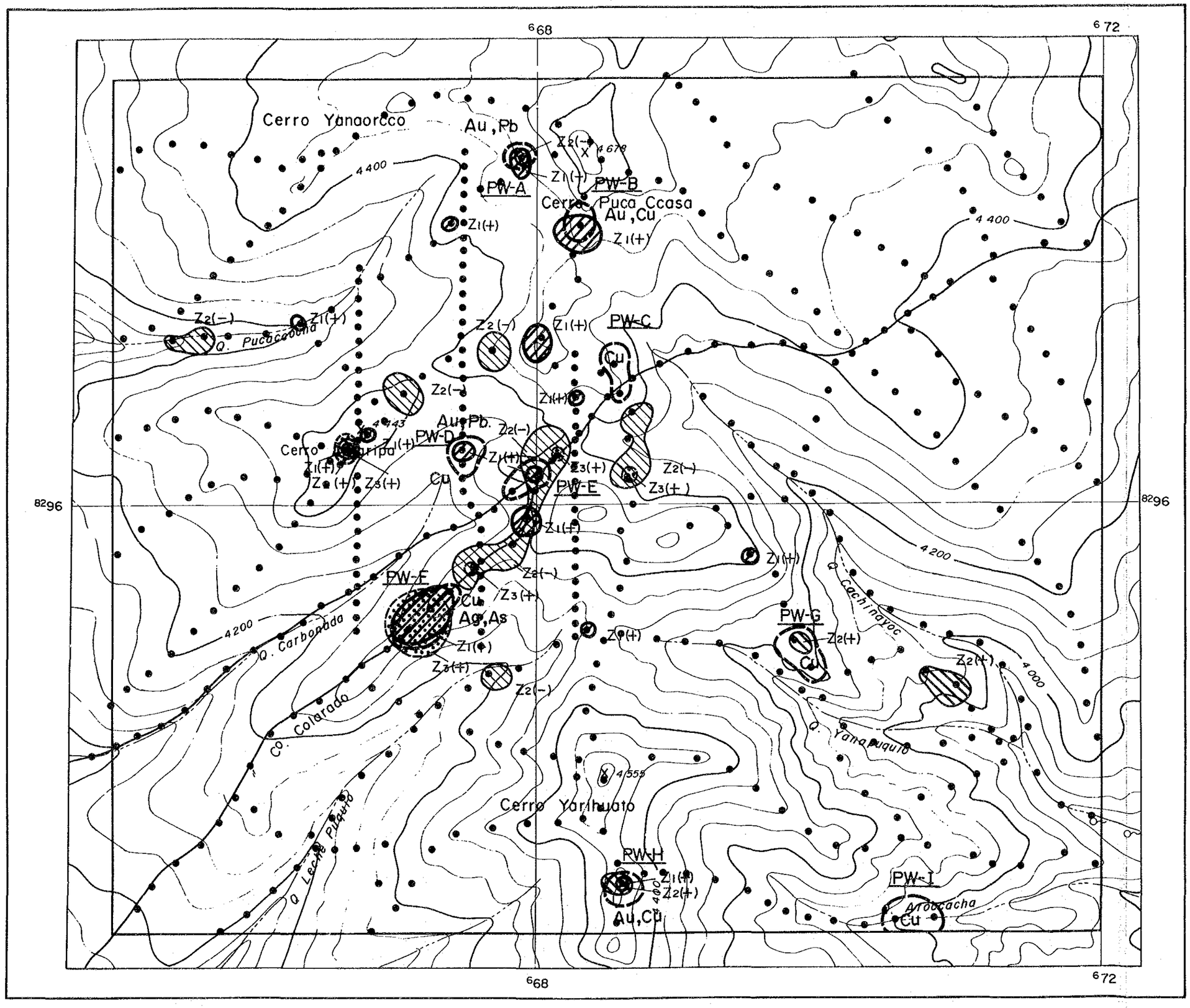
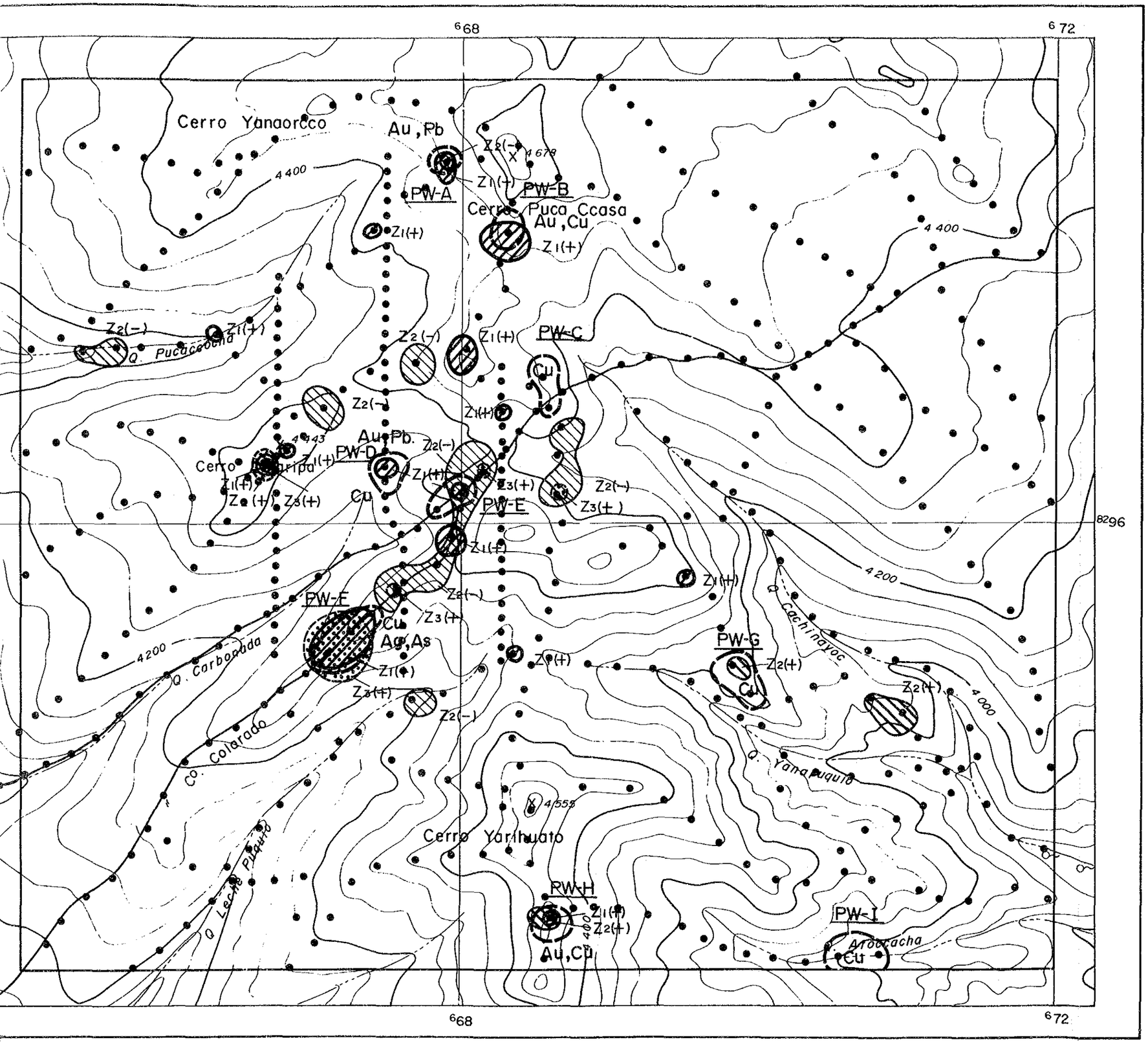


Fig. II-14

Geochemical Interpre
the Pirca Western A



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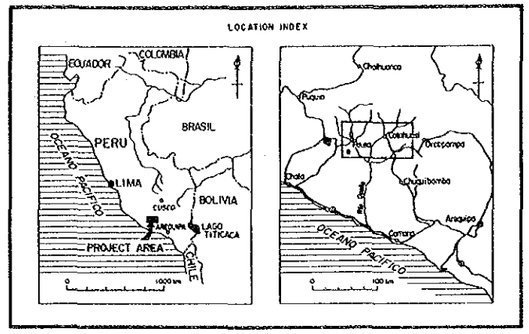


0 1 2 km

LEGEND

Geochemical Anomaly

<Univariate Analysis>

(Au,Ag,As / Cu,Pb,Zn) Anomaly Zone and Anomalous Elements

PW-A Name of Anomaly Zone

<Principal Components Analysis>

• 1st Principal Component

Z1(+) + Anomaly

Z1(−) − Anomaly

• 2nd Principal Component

Z2(+) + Anomaly

Z2(−) − Anomaly

• 3rd Principal Component

Z3(+) + Anomaly

Z3(−) − Anomaly

Fig. II-14

Geochemical Interpretation Map of the Pirca Western Area (Composite Data)

Table II-8 List of Geochemical Anomaly Zones in the Pirca Area

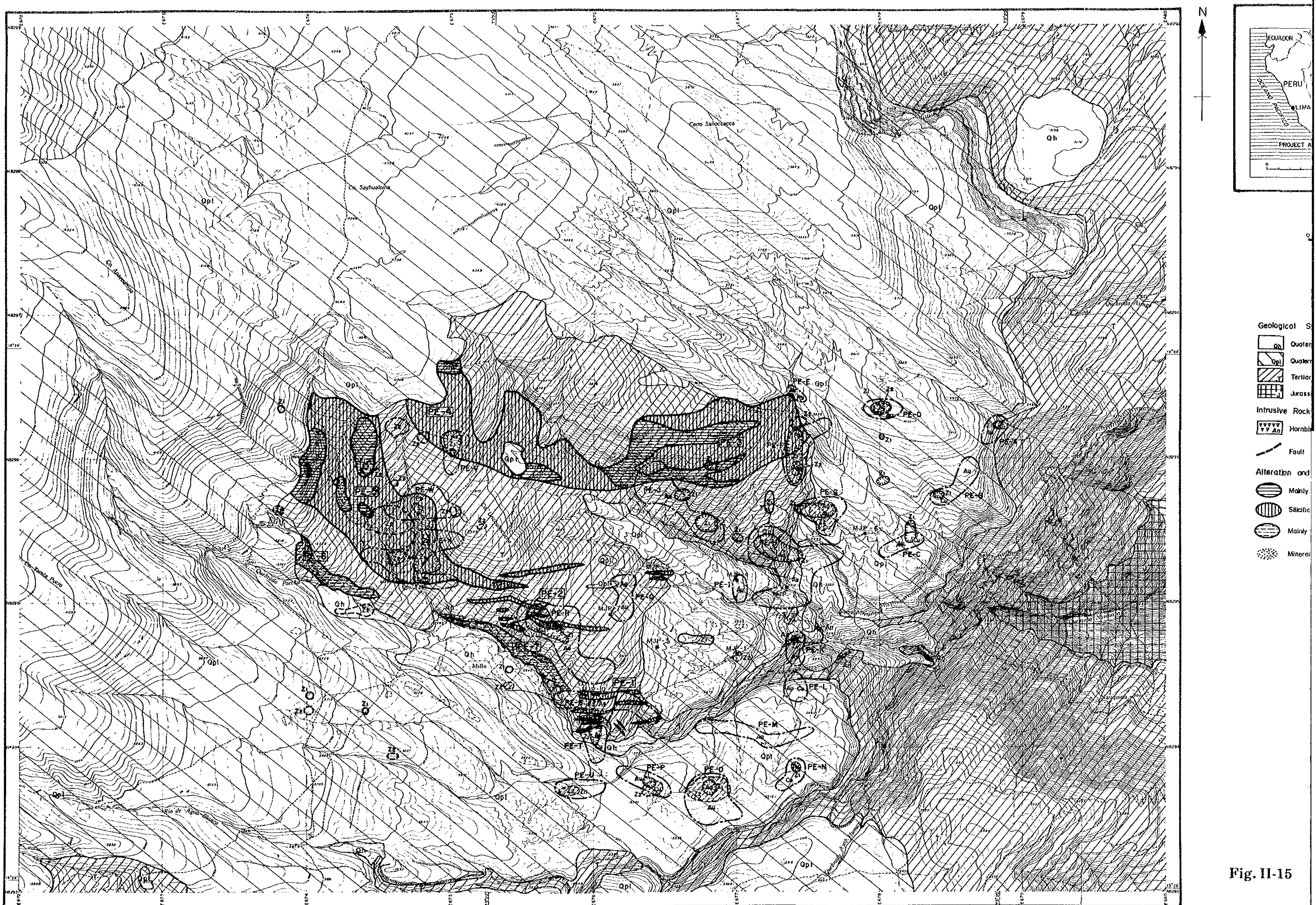
Area	Name of anomaly zone	Location	Scale (km)	Remarks (mineralization)
Pirca Eastern Area	PE-A	2.0 km NE of Pirca	0.1 x 0.2	Au
	PE-B	1.5 Km NE of Pirca	0.1 x 0.4	Au (+Cu)
	PE-C	1.0 km NE of Pirca	0.1 x 0.3	Au-Cu
	PE-D	1.6 km NNE of Pirca	0.15 x 0.25	Au-Ag, Cu-Zn
	PE-E	1.5 km N of Pirca	0.07 x 0.15	Au-Pb
	PE-F	1.2 km N of Pirca	0.2 x 0.5	Au-Ag-Cu-Pb
	PE-G	0.8 km NNE of Pirca	0.25 x 0.3	Au-Ag, Cu (+Pb)
	PE-H	0.3 km N of Pirca	0.5 x 0.7	Au-As
	PE-I	0.3 km WNW of Pirca	0.1 x 0.2	(Au)
	PE-J	1.0 km NW of Pirca	0.2 x 0.75	Au
	PE-K	0.2 km S of Pirca	0.15 x 0.25	(Au)
	PE-L	0.5 km S of Pirca	0.15 x 0.2	Au-Cu
	PE-M	0.8 km SSW of Pirca	0.1 x 0.8	Au-Cu
	PE-N	1.0 km S of Pirca	0.1 x 0.3	Au-Cu
	PE-O	1.3 km SSW of Pirca	0.3 x 0.4	Au-Ag, (Cu-Zn)
	PE-P	1.5 km SW of Pirca	0.1 x 0.4	Au-Cu (+Ag)
	PE-Q	1.1 km W of Pirca	0.1 x 0.3	Ag, Cu
	PE-R	1.5 km W of Pirca	0.25 x 0.8	Au-As
	PE-S	1.3 km WSW of Pirca	0.1 x 0.75	As
	PE-T	1.5 km WSW of Pirca	0.15 x 0.3	Au-As-Cu
	PE-U	1.8 km SW of Pirca	0.1 x 0.35	Zn
	PE-V	2.5 km WNW of Pirca	0.15 x 0.3	Pb-As
	PE-W	2.5 km WNW of Pirca	0.2 x 0.55	Pb-As, Zn
	PE-X	2.5 km W of Pirca	0.3 x 0.7	As, Ag
Pirca Western Area	PW-A	W of C°. Puca Ccasa	0.15 x 0.2	Au-Pb
	PW-B	S of C°. Puca Ccasa	0.2 x 0.25	Au-Cu
	PW-C	S of C°. Puca Ccasa	0.15 x 0.4	Cu
	PW-D	E of C°. Antaripa	0.25 x 0.25	Au-Cu-Pb
	PW-E	S of C°. Puca Ccasa	0.15 x 0.35	Pb (+Au)
	PW-F	C°. Colarado	0.25 x 0.6	Ag-Cu (+As)
	PW-G	NE of C°. Yarihuato	0.25 x 0.4	Cu
	PW-H	S of C°. Yarihuato	0.2 x 0.2	Au-Cu
	PW-I	Q. Atoccacha	0.25 x 0.4	Cu

The interpretation Map of the Pirca Eastern Area (Fig. II-15) and of the Pirca Western Area (Fig. II-16) are prepared by combining the anomalous zones and the anomalies in soil geochemistry with the alteration-mineralization zones located by the geological survey.

Characters of the presumable mineralization for the selected geochemically anomalous zones are compared with those of existing mineralization and/or alteration zones as summarized in Table II-9. The numbers of the anomalous zones selected for this study are 13 in the Pirca Eastern Area and 4 in the Pirca Western Area.

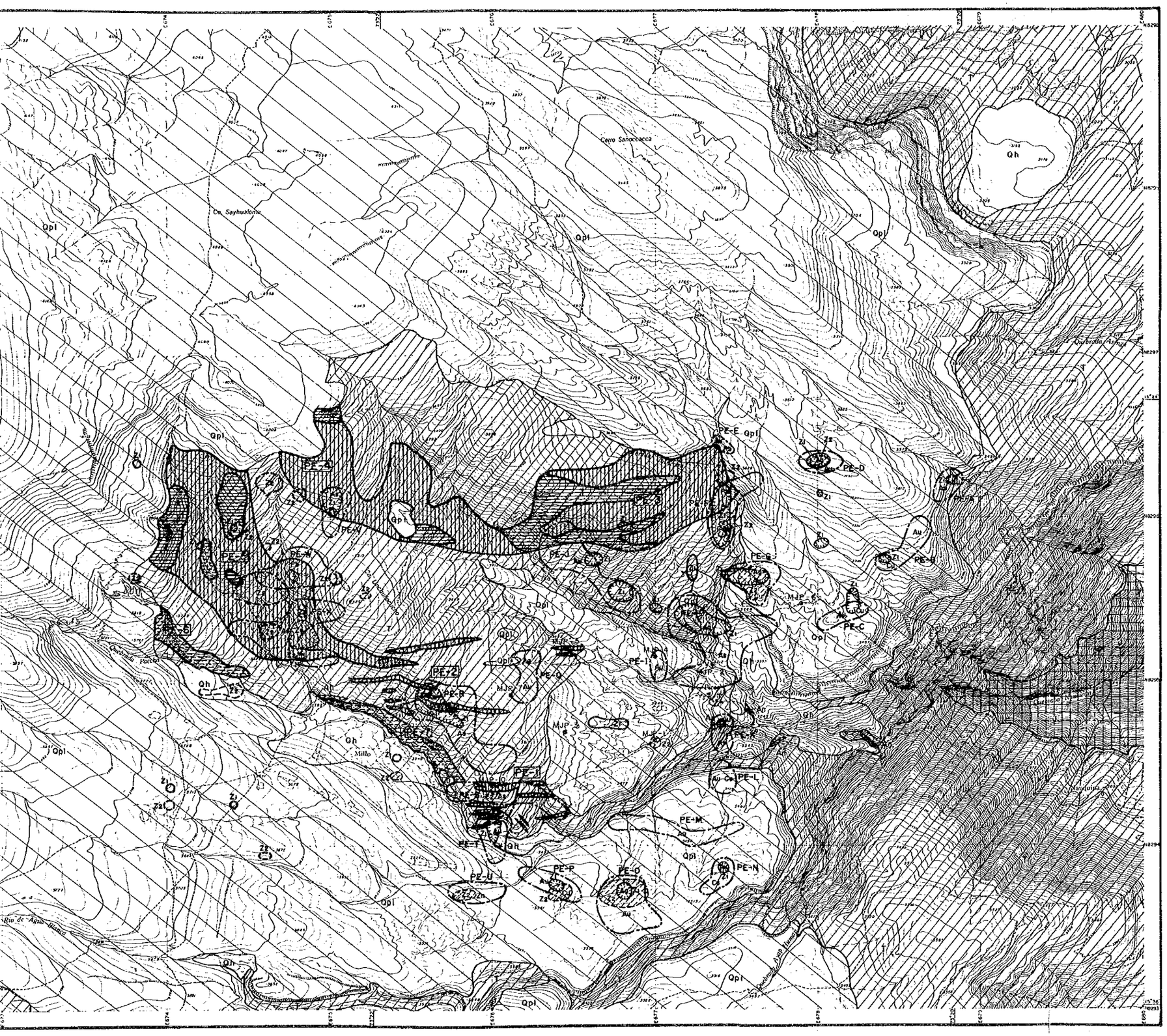
As the results of this study, there are some discrepancies between the mineralization presumed for the geochemically anomalous zones and the existing mineralization and alteration zones; they are 1) geochemically anomalous zones without signs of alteration or mineralization (PE-D, PE-G, PE-H, PE-O, PW-H), 2) weak Ag mineralization zones without notable geochemical signatures (PE-R, PE-V, PE-W), 3) geochemically anomalous zones for Au without recognition of Au mineralization by the geological survey (PE-A, PE-O, PW-D, PW-H), 4) weak mineralization zone without geochemically anomalous values, 5) the significant Au-Ag mineralization zone PW-1 (6.65 g/t Au, 10.0 g/t Ag) only with minimal geochemical values. The reasons for these discrepancies would be that soil sections are incomplete at most of sample localities due to poor development of soils, and that mineralization itself is weak in the whole area and very much localized.

In the Pirca Area, relatively promising targets of geochemically anomalous zones are PE-F, PE-G, PE-J, PE-Q, PE-R, PE-T and PW-F. Of these, PE-Q, PE-R and PE-T, with higher priority than the other anomalous zones, were examined by drilling with a length of approximately 100 m for each hole. However, the drilling results failed to indicate any signs of promising ore deposits or mineralization in association with these anomalous zones. Accordingly, no significant mineralization may be expected in association with the other anomalous zones of lower priority.



N
ECUADOR
PERU
LIMA
Cerro Sañoccacca
Co. Sayhualoma
Qh
Qpl
Millo
Rio de Agua Blanca
PE-A
PE-B
PE-C
PE-D
PE-E
PE-L
PE-M
PE-N
PE-O
PE-P
PE-T
PE-U
Intrusive Rock
Fault
Alteration and

Fig. II-15



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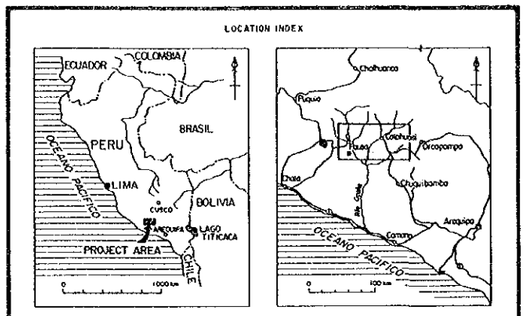
LOCATION INDEX



0 0.5 1 km

LEGEND

Geological System

- Qh — Quaternary (Holocene) System
- Qpl — Quaternary (Pleistocene) System
- Tertiary System
- Jurassic System

Intrusive Rock

- Hornblende andesite

Fault

Alteration and Mineralization Zones

- Mainly silicification
- Silicification and argillization
- Mainly argillization
- Mineralization

Geochemical Anomaly

(Univariate Analysis)

- Au, Ag, As / Cu, Pb, Zn — Anomaly zone and anomalous elements

(Principal Components Analysis)

- 1st Principal Component
  - Zi — + Anomaly
  - Zi — − Anomaly
- 2nd Principal Component
  - Zs — + Anomaly
  - Zs — − Anomaly

Fig. II-15 Interpretation Map of the Pirca Eastern Area

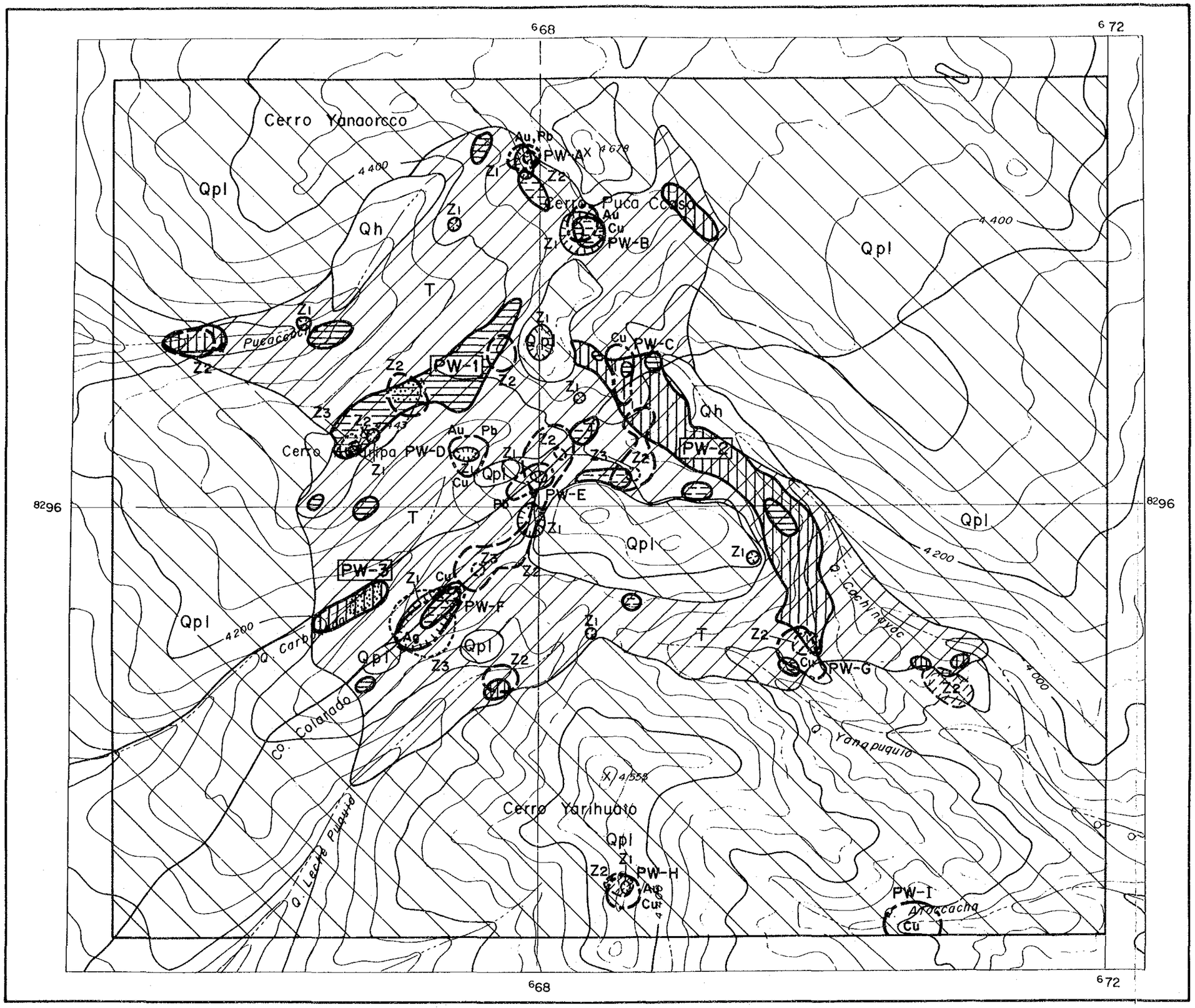
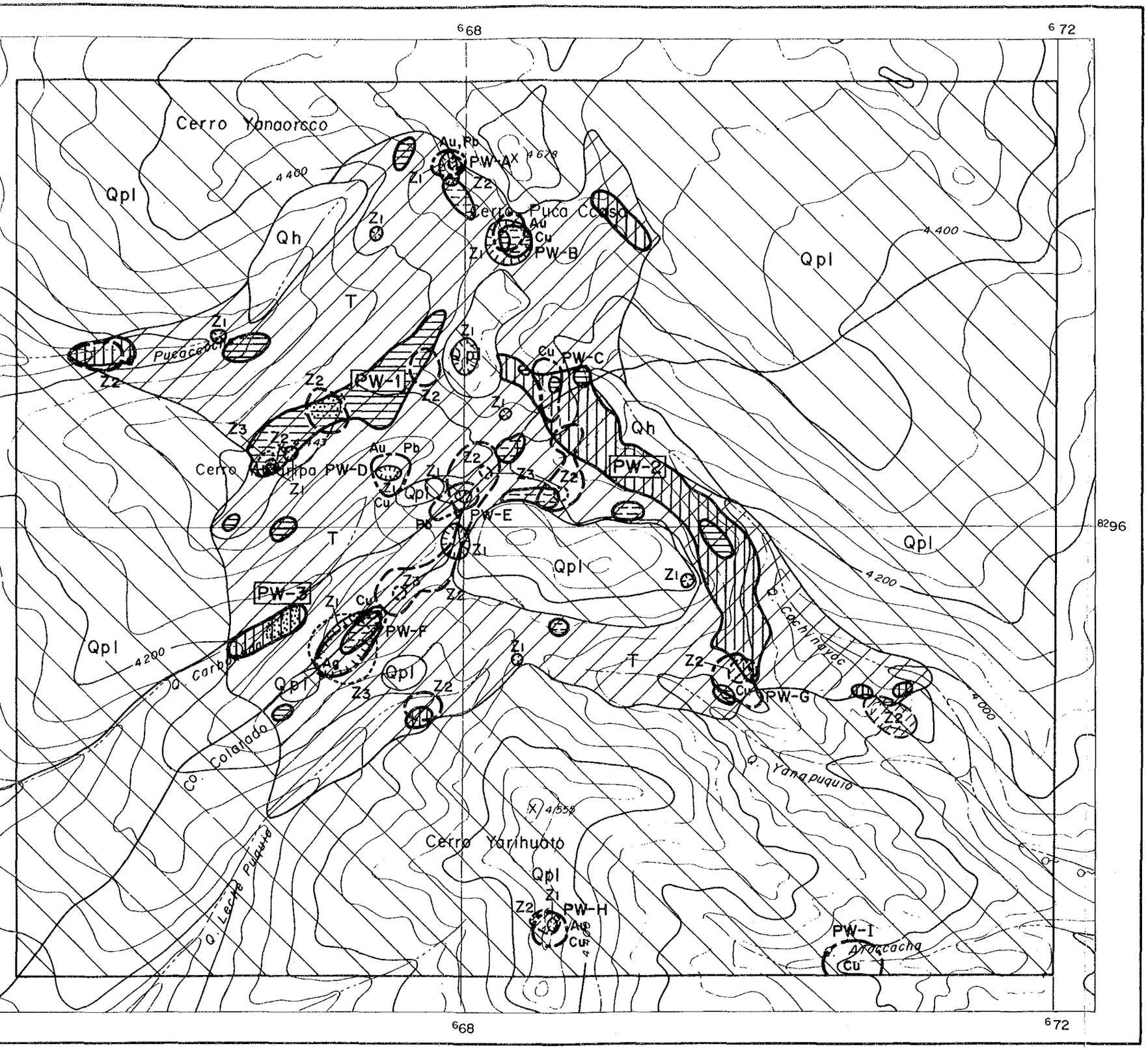


Fig. II-16 Interpretati
Pirca West



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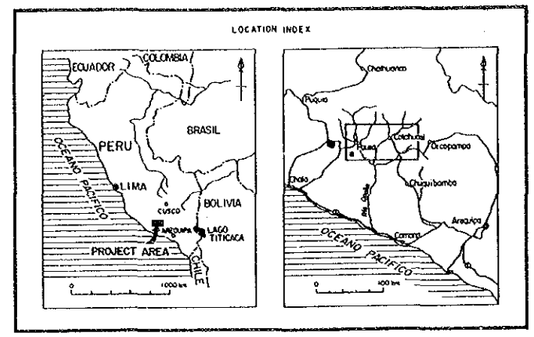


0 1 2km

LEGEND

Geological System

- Qh — Quaternary (Holocene) System
- Qpl — Quaternary (Pleistocene) System
- T — Tertiary System

Alteration and Mineralization Zones

- Mainly silicification
- Silicification and argillization
- Mainly argillization
- Mineralization

Geochemical Anomaly
< Univariate Analysis >

- Au Ag As / Cu, Pb, Zn — Anomaly zone and anomalous elements

< Principal Components Analysis >

- 1st Principal Component
  - Z1 — + Anomaly
- 2nd Principal Component
  - Z2 — + Anomaly
  - Z2 — − Anomaly
- 3rd Principal Component
  - Z3 — + Anomaly

Fig. II-16 Interpretation Map of the Pirca Western Area

Table II-9 Comparison of Geochemical Anomaly Zones with Mineralization Zones in the Pirca Area

Area	*Geochemical anomaly zone*		*Results of geological survey*	
	Name of anomaly zone	Mineralization, assumed by geochemical anomaly	Characteristics of mineralization	Characteristics of alteration
Pirca Eastern Area	PE-D	Au-Ag, Cu-Zn	Not observed	Not observed
	PE-F	Au-Ag, Cu-Pb	"	Partly PE-3 Alteration zone: Hydrothermal alteration (silicification + argillization) Qz + Alu + (Mn) + (Ser).
	PE-G	Au-Ag, Cu (+Pb)	"	Not observed
	PE-H	Au-As	"	Weak argillization
	PE-J	Au	"	Partly, PE-3 alteration zone: Hydrothermal alteration (silicification + argillization) Qz + Alu + (Mn) + (Ser)
	PE-O	Au-Ag, (Cu-Zn)	"	Not observed
	PE-Q	Ag, Cu	"	"
	PE-R	Au-As	(Ag: 4.7 g/t, As: 0.003%)	PE-2 alteration zone: Hydrothermal alteration (silicification + argillization Qz + Alu + (Mn) + (Ser)
	PE-S	As	Not observed	PE-1 alteration zone: Hydrothermal alteration Qz + Ser + (Kao) + (Alu)
	PE-T	Au, As, Cu	(Ag: 7.8 g/t, As: 0.002% Pb: 0.01%, Zn: 0.01%)	PE-1 alteration zone: Hydrothermal alteration Qz + Ser + (Kao) + (Alu)
	PE-V	Pb-As	Au: < 0.07 g/t, Ag: 6.8 g/t	PE-4 alteration zone } Hydrothermal alteration Qz, Qz + Kao, Qz + Cri + Kao Qz + Alu, Qz + Alu + Jar
	PE-W	Pb-As, Zn	Au: 0.07 g/t, Ag: 3.3 g/t, As: 0.022%	PE-5 alteration zone }
	PE-X	As, Ag	Not observed	PE-5 alteration zone }
Pirca Western Area	PW-B	Au-Cu	Not observed	Argillization
	PW-D	Au-Cu-Pb	Lack of outcrops	
	PW-F	Ag-Cu (+As)	Not observed	Argillization (Cri + Kao + Alu)
	PW-H	Au-Cu	"	Not observed

Abbreviations: Qz: quartz, Alu: alunite, Mn: mantmorillonite, Ser: sericite, Kao: Kaolinite, Cri: cristobalite, Jar: jarosite

Table II-10 Principal Alteration and Mineralization Zones of the Pirca Area

Area	No.	Name	Scale (km)	Wall Rock	Alteration	Mineralization
Eastern Area	1	PE-1	0.3×0.5	Rhyolite type tuff (Tc-rho)	Brown alteration zone composed of dissemination of pyrite and contamination of iron oxide. Hydrothermal alteration composed of silicification and argillization with quartz veinlets (width 0.1 m ~ 1.0 m) [Qz + Ser + (Kao) + (Alu)]	No prominent mineralization is observed.
	2	PE-2	0.1×0.3	Andesite lava (Tc-an)	Brown alteration zone contaminated by iron oxide. Hydrothermal alteration composed of silicification and argillization [Qz + Alu + (Mu) + (Ser)]	No prominent mineralization is recognized. Massive iron oxide is observed in MJP-8. Assay results of a sample taken from silicified outcrop indicate Au<0.07 g/t and Ag 4.7 g/t.
	3 4 5	PE-3 PE-4 PE-5	0.6×1.4 0.4×1.4 0.5×1.5	Andesite lava (Tc-an) and andesitic volcanic breccia (Tc-tf)	Brown to yellow-brown alteration zone contaminated by iron oxide, partially accompanying white argillization zone and strongly silicified zone. Hydrothermal alteration composed of silicification and argillization. Silicified part: [Qz, Qz + Kao, Qz + Cri + Kao] Argillization part: [Qz + Alu, Qz + Alu + Jar]	No prominent mineralization is recognized. PE-4; silicified rock --- Au<0.07 g/t, Ag 6.8 g/t PE-5; argillized rock --- Au<0.07 g/t, Ag 12.0 g/t PE-5; silicified rock --- Au<0.07 g/t, Ag 4.7 g/t
	6 7	PE-6 PE-7	0.1×0.6 0.1×0.8	Andesite lava (Tc-an)	Brown to yellow-brown alteration zone contaminated by iron oxide. Hydrothermal alteration composed of mainly argillization. Silicified part: [Qz + Mu + (Kao), Qz + (Mu) + (Ser)] Argillization part: [Qz + Kao + Pyp]	No prominent mineralization is observed. PE-6; argillized rock --- Au<0.07 g/t, Ag 2.5 g/t PE-7; silicified rock --- Au<0.07 g/t, Ag 8.0 g/t
Western Area	8	PW-1	0.3×1.5	Andesite lava (Tc-an)	Grey to light grey alteration zone with strong silicification being accompanied with quartz veinlets and dissemination of pyrite. Hydrothermal alteration composed of mainly silicification. [Qz, partly Qz + (Cri) + (Alu)]	Mineralization of gold and silver occurs locally. Veinlets in silicified rocks --- Au 6.65 g/t, Ag 10.0 g/t Other silicified parts are in low grade.
	9	PW-2	0.3×2.5	Andesite lava (Tc-an), partly including andesitic volcanic breccia (Tc-tf)	Brown to light brown alteration zone contaminated by iron oxide. Hydrothermal alteration composed of silicification and argillization. [Qz + Cri + Alu, Kf + (Kal) + (Mu) + (Alu)]	No prominent mineralization is observed.
	10	PW-3	0.15×0.5	Andesite lava (Tc-an)	Light brown to greyish white alteration zone accompanying strongly silicified part. Hydrothermal alteration composed of silicification and argillization. [Qz, Qz + (Kal)]	No prominent mineralization is recognized. A local sample taken from silicified zone --- Au 0.89 g/t, Ag 7.0 g/t

Among these alteration zones, a sample of a quartz-vein network is strongly silicified part in the PW-1 alteration zone in the Pirca Western Area has the highest analytical values of Au 6.65 g/t and Ag 10.0 g/t. However, all other samples taken from silicified outcrops of the same zone are in low grade, and for this reason, mineralization in the whole of the PW-1 alteration zone may be insignificant. Mineralization observed in other alteration zones is poor in all cases.

Results of the geochemical survey show that the geochemical anomalies in this area are small in scale and low in intensity compared with those in the Marcabamba Area. Comparatively large-scaled geochemical anomalies in this area are summarized in the following Table II-11.

Table II-11 Relation with Geochemical Anomaly Zones and Alteration Zones in the Pirca Area

Area	No.	Name of geochemically anomalous area	Scale of anomalous area (km)	Relation with alteration zone
Eastern Area	1	PE-F	0.2×0.5	Partly PE-3 alteration zone
	2	PE-G	0.25×0.3	None
	3	PE-H	0.5×0.7	Weakly argillized alteration zone
	4	PE-J	0.2×0.75	Partly PE-3 alteration zone
	5	PE-O	0.3×0.4	None
	6	PE-Q	0.1×0.3	None
	7	PE-R	0.25 0.8	PE-2 alteration zone
	8	PE-S	0.1×0.75	PE-1 alteration zone
	9	PE-T	0.15×0.3	PE-1 alteration zone
	10	PE-V	0.15 0.3	PE-4 alteration zone
	11	PE-W	0.2×0.55	PE-5 alteration zone
	12	PE-X	0.3×0.7	PE-5 alteration zone
Western Area	13	PW-B	0.2×0.25	Small scale argillized alteration zone
	14	PW-D	0.25×0.25	None
	15	PW-F	0.25×0.6	Small scale argillized alteration zone
	16	PW-H	0.2×0.2	None

In the Pirca Eastern Area, the places where an alteration zone and geochemically anomalous zone overlap prominently are the PE-1 alteration zone overlapping PE-S and PE-T anomalous zones, and PE-2 alteration zone overlapping PE-R anomalous zone. Also, PE-W and PE-X anomalous zones overlap with the PE-5 alteration zone in its southeastern part.

In the Pirca Western Area, sizes of geochemical anomalies are limited in comparison with those of alteration zones, besides, there is no geochemical anomaly which overlap alteration zones prominently.

3-4 Drilling Result

The drilling survey of this year aimed at making clear of the geological condition and grasping of the occurrence of ore deposit in the Cotahuasi area of Peru and the vertical drilling of ten holes (MJP-1 - 10) were operated (Fig. II-17 and Table II-13, II-14).

The ten vertical holes drilled in the Pirca Area were aimed to make clear the mineralization of the area through clarifying mainly of the geology and the geological structure in the six holes MJP-1 to MJP-6 and the states of the geochemically anomalous zones and the alteration zones in the four holes MJP-7 to MJP-10.

As the result of drilling survey in the Pirca Eastern Area, the Pirca Sediment (Ps), which had not been recognized in the past, and its stratigraphy were confirmed in MJP-1 to MJP-4 holes. In these four holes, alteration zones and quartz veins in the lower part of the Pirca Sediment (Ps) were confirmed in MJP-3 and MJP-4. In MJP-5, a quartz vein having a core length of 2.45 m was interseeted in the lower part of the hole. In MJP-6, rock facies and thickness of the Lower Barroso Formation were confirmed. In four holes of MJP-7 to MJP-10, prominent alteration of mainly argillization was recognized in each of them, and in addition, alteration zones having strong silicification zones and quartz veins were recognized in MJP-8 and MJP-9.

Alternation and Mineralization of Drilling cores are summerized in Table II-14.

The results of chemical analysis on the drill core samples of the alteration zones seen indicate that they are low in grade, for the sizes of these alteration zones. The parts where mineralization are recognized, though very weak, are mainly alteration zones of quartz veinlets, of strongly silicified rocks, of concentrated zones by iron oxide and of disseminated zone of pyrite. These are summarized in the Table II-12.

Table II-12 Chemical Analyses of Altered Rocks and Quartz Vein of Drilling Cores

Drilling No.	Sample No.	Depth (m) ~ (m)	Alteration	Au g/t	Ag g/t	As %	Cu %	Pb %	Zn %
MJP-3	P3M-1	84.50 ~ 85.65	Argillized andesite accompanying dissemination of pyrite	<0.07	0.5	0.025	0.04	<0.01	<0.01
MJP-4	P4M-2	55.80 ~ 56.10	Quartz-goethite veins	<0.07	1.9	0.028	0.05	<0.01	<0.01
MJP-8	P8M-1	1.90 ~ 2.55	Strongly silicified rocks	0.17	<0.3	0.008	<0.01	<0.01	<0.01
	P8M-3	7.55 ~ 8.75	Massive reddish brown iron oxide	<0.07	1.7	0.021	0.01	<0.01	<0.01
	P8M-5	46.85 ~ 46.95	Quartz veins	<0.07	1.0	0.012	<0.01	<0.01	<0.01
MJP-9	P9M-4	74.65 ~ 76.00	Strongly silicified rocks	<0.07	1.0	0.006	0.01	0.01	0.06
	P9M-5	76.70 ~ 77.00	Greyish quartz veins	<0.07	2.8	0.006	0.02	0.01	0.07
	P9M-6	88.80 ~ 89.00	Rhyolitic tuff accompanying quartz veinlets	<0.07	1.0	0.008	<0.01	0.01	0.08

Taking all these survey results into consideration, possibility of existence of high potential mineralization are considered to be low in the Pirca Area.

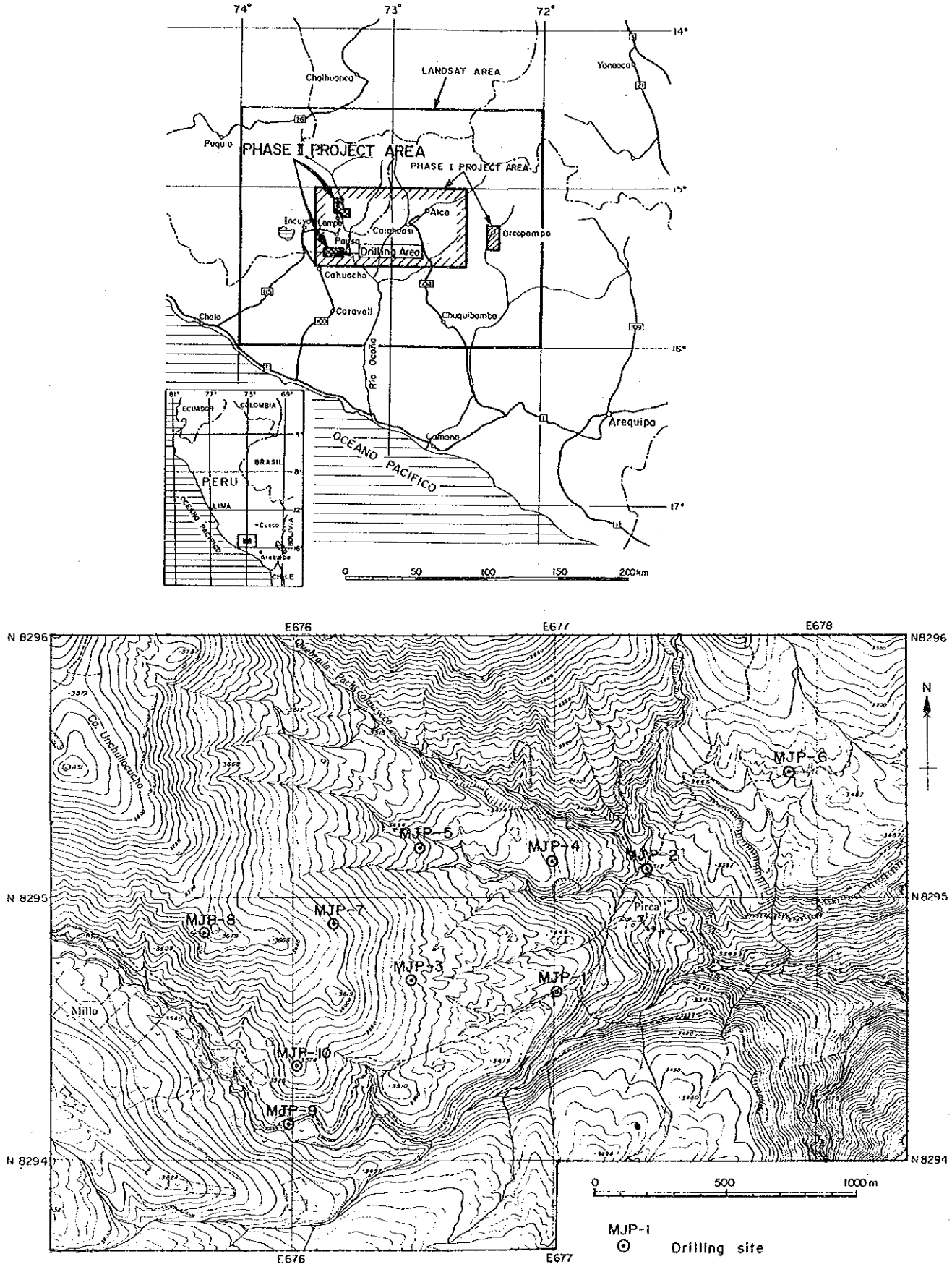
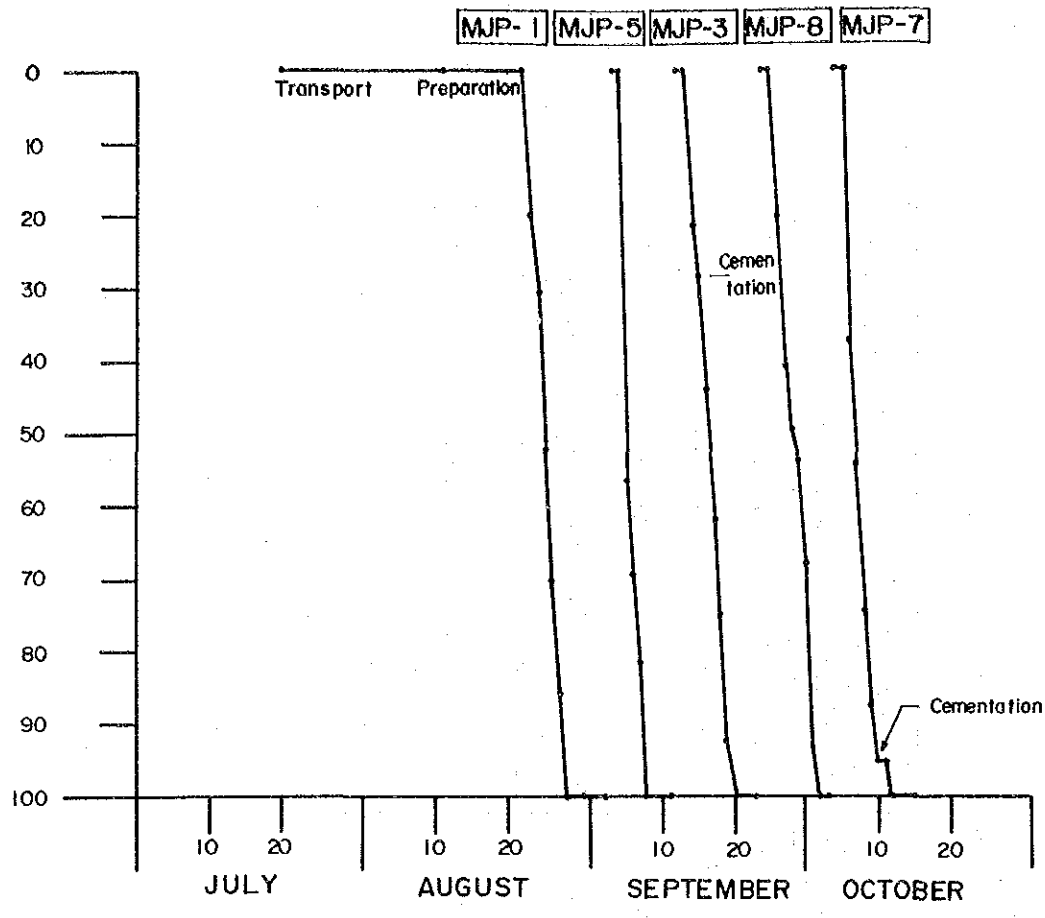


Fig. II-17 Location Map of the Drilling Sites

Table II-13 Drilling Results

Drill Hole No.	Type of Machine	Drilling Period	Length (m)	Core Recovery (%)	Location of Drill Hole		Elevation (m)
					Longitude	Latitude	
MJP-1	Acker	22th∿28th Aug. '86	100.80	98.3	N8'294,638.2	E677,006.7	3,441.1
MJP-2	BBS-1	10th∿21th Aug. '86	100.00	98.0	N8'295,108.1	E677,352.5	3,309.0
MJP-3	Acker	13th∿20th Sep. '86	100.00	99.4	N8'294,686.8	E676,456.1	3,512.5
MJP-4	BBS-1	17th∿23th Sep. '86	100.00	99.1	N8'295,133.7	E676,988.3	3,416.0
MJP-5	Acker	4th ∿ 8th Sep. '86	100.10	98.6	N8'295,191.2	E676,479.9	3,480.4
MJP-6	BBS-1	27th Aug. ∿ 12th Sep. '86	100.80	73.0	N8'295,480.0	E677,892.0	3,452.0
MJP-7	Acker	5th ∿ 12th Oct. '86	100.00	99.4	N8'294,901.1	E676,151.7	3,598.5
MJP-8	Acker	25th Sep. ∿ 2th Oct. '86	100.20	98.8	N8'294.865.9	E675,655.6	3,673.4
MJP-9	BBS-1	7th ∿ 13th Oct. '86	100.00	99.7	N8'294,132.0	E675.986.5	3,491.3
MJP-10	BBS-1	27th Sep. ∿ 4th Oct. '86	100.00	98.3	N8'294,354.5	E676,013.2	3,572.0



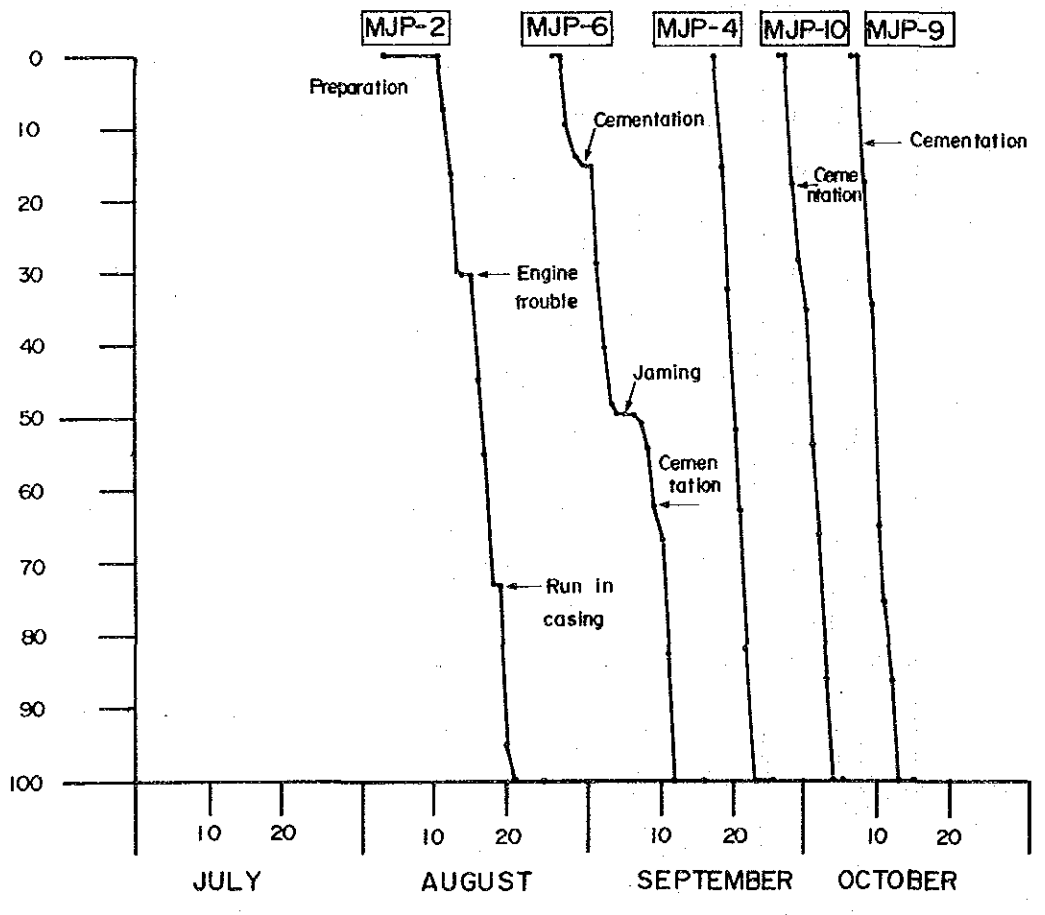


Fig. II – 18 Drilling Progress of the Pirca Eastern Area (MJP-1 ~ 10)

Table II-14 List of Alteration and Mineralization of Drilling Cores in Pirca Eastern Area

Drilling No.	Geological Unit		Argillization (m) ∿ (m)	Silicification (m) ∿ (m)	Quartz Vein (m) ∿ (m)	Pyritization (m) ∿ (m)	Mineral Assemblage of Altered Zone	Main Results of Chemical Analysis of Altered Rock					
	Depth (m) ∿ (m)	Formation						Depth (m)	Au g/t	Ag g/t	As%	Cu%	Pb%	Zn%
MJP-1	0.00∿ 24.00 24.00∿ 43.55 43.55∿100.80	Barroso Upper (Vbu-pt) Barroso Upper (Vbu-wt) Pirca Sediments (Ps)	-	-	-	-	no examination		no-assey				
MJP-2	0.00∿ 3.90 3.90∿ 18.40 18.40∿100.00	Alluvium (al) Pirca Sediments (Ps) Tacaza F. (Tc-rho)	weak argillization	weak silicification	-	18.40-100.00 (dissemination)	Main [Qz+Ser] Others (Al),(Hal), (Kao),(Kf)		-				
MJP-3	0.00∿ 3.90 3.90∿ 16.40 16.40∿ 92.10 92.10∿100.00	Barroso Upper (Vbu-pt) Pirca Sedimens (Ps) Tacaza F. (Tc-an) Tacaza F. (Tc-tf)	33.50∿ 42.45 67.60∿ 68.00 81.80∿ 85.65 94.95∿ 96.30 96.60∿100.00	(98.80∿99.20)	96.30∿96.60	92.10∿100.0	Main [Qz+Ser] Others (Mn),(Hal)(Py)	[P3M-1] 84.50∿ 85.64	<0.07	0.5	0.025	0.04	<0.01	<0.01
MJP-4	0.00∿ 34.55 34.55∿100.00	Pirca Sediments (Ps) Tacaza F.(Tc-an)	34.55∿ 45.00 50.30∿ 51.15 76.60∿ 83.00	85.70∿ 86.85	55.00∿55.30 55.80∿56.10 79.50∿79.70 85.70∿86.85 (network)	30.70∿43.75 76.60∿83.00 (dissemination vein let)	Main [Qz+Ser+Py] Others (Chl),(Kao) (Pyp),(Mn)	[P4M-2] 55.80∿ 56.10	<0.07	1.9	0.028	0.05	<0.01	<0.01
MJP-5	0.00∿ 1.90 1.90∿100.10	Talus (al) Tacaza F.(Tc-an)	1.90∿ 13.30 22.70∿ 27.0 49.80∿ 54.40 61.90∿ 63.70	83.30∿95.35	95.35∿97.80 (2.45 m)	44.85∿49.80 61.90∿63.70 97.80∿100.10	Main [Qz+Al+Kao+ Py] Others (Pyp),(Ser), (Mn)		-				
MJP-6	0.00∿ 7.05 7.05∿ 23.60 49.80∿ 54.40 23.60∿ 96.35 96.35∿100.80	Talus (al) Borroso Lower (Vbl-po) " Tacaza F. (Tc-an)	-	-	-	-	Tacaza F. [Qz+Ser+Mm]		no-assey				
MJP-7	0.00∿ 57.90 57.90∿100.00	Tacaza F. (Tc-an) " (Tc-tf)	0.00∿22.40 57.90∿60.10 22.40∿34.70 45.00∿49.50 56.55∿67.25 73.30∿76.40	-	-	-	Main [Qz+Mm+(Hal)] Others (Ser)(Ser/Mm)		-				
MJP-8	0.00∿ 22.20 22.20∿ 36.20 36.20∿ 55.20 55.20∿ 89.70 89.70∿100.20	Tacaza F. (Tc-an) " (Tc-tf) " (Tc-an) " (Tc-tf) " (Tc-an)	0.00∿ 1.90 3.65∿ 7.55 8.75∿ 9.10 10.45∿ 15.80 66.95∿ 79.55 94.85∿100.20	1.90∿ 3.65 9.10∿ 9.90	46.85∿46.95 quartz vein let	7.55∿ 8.75 (iron oxides) 9.90∿10.45 (iron oxides) 69.95∿79.55 86.60∿89.70	Main [Qz+Alu+Kao] Others (Mm), (hem) (Hal)	[P8M-1] 1.90∿ 2.55 [P8M-3] 7.55∿ 8.75 [P8M-5] 46.85∿ 46.95	0.17 <0.07 0.07	<0.3 1.7 1.0	0.08 0.021 0.012	<0.01 0.01 <0.01	0.01 <0.01 <0.01	<0.01 <0.01 <0.01
MJP-9	0.00∿ 3.80 3.80∿100.00	Alluvium (al) Tacaza F.(Tc-rho)	14.90∿ 21.25	3.80∿14.90 74.65∿76.00 90.75∿91.55	49.00∿49.80 (w=4 cm) 76.70∿77.00 (w=30 cm)	38.60∿39.80 61.65∿64.70	Main [Qz+Kao] Others (Ser),(Py) (Ser/Mm), (Kf)	[P9M-4] 74.65∿ 76.00 [P9M-5] 76.70∿ 77.00 [P9M-6] 88.80∿ 89.00	<0.07 <0.07 <0.07	1.0 2.8 1.0	0.006 0.006 0.08	0.01 0.02 <0.01	0.01 0.01 0.01	0.06 0.07 0.08
MJP-10	0.00∿ 26.70 26.70∿ 53.15 53.15∿ 81.10 81.10∿100.00	Tacaza F. (Tc-an) " (Tc-tf) " (Tc-an) " (Tc-rho)	0.00∿ 13.00 18.20∿ 21.75 24.55∿ 25.35 58.40∿ 59.70 81.00∿ 86.85	-	-	81.10∿86.85	Main [Qz+Mm] Others (Kao), (Chl), (Ser), (Alu), (Kf)		-				

Abbreviation Qz: Quartz, Ser: Sericite, Kao: Kaolinite, Hal: Halloysite, Al: Alunite, Mm: Montmorillonite, Chl: Chlorite, Pyp: Pyrophyllite, Py: Pyrite, Kf: Potasium feldspar, Ser/Mm: Sericite-Montmorillonite mixed layer

3-5 Summary of the Results in the Pirca Area

Most of the alteration zones are distributed in the Tertiary andesitic volcanic rocks, and some are in rhyolitic tuff. The alteration can be broadly classified into three types; one dominated by silicification, another characterized by both silicification and argillization in similar degrees and the third dominated by argillization.

There are number of alteration zone with variable extention. Seven alteration zones in the Pirca Eastern Area and three zones in the Pirca Western Area are relatively extensive. Of the samples collected in these alteration zones, a sample collected from a quartz vein network in strongly silicified rocks of the PW-1 alteration zone in the Pirca Western Area yielded the highest values of 6.65 g/t Au and 10.0 g/t Ag. However, other samples of strongly silicified rocks in the continuous outcrops gave low values. The alteration zone as a whole does not seem to be intensively mineralized. Mineralization observed in other alteration zones is weak and the analytical results indicated only low values of up to 0.89 g/t Au and up to 12.0 g/t Ag.

The geochemical anomalies in this area are smaller in sizes and weaker in intensity than those of the Marcabamba Area.

The places where geochemical anomalies superimpose alteration zones in the Pirca Eastern Area are anomalous in As, Cu and (Au) values in the PE-1 alteration zone and anomalous in either As or Au values in the PE-2 alteration zone. Also, anomalies of As, Pb, or Zn superimposes the southeastern part of PE-5 alteration zone. No other geochemical anomalies are located in association with any alteration zones. There is a geochemical anomaly extending from north to northwest of the Pirca village. Weak alteration is associated in its vicinity but neither prominent silicification nor quartz vein has been observed.

In the Pirca Western Area, sizes of geochemical anomalies are small in comparison with extent of the alteration zones, and no superimposition of alteration zones and geochemical anomalies has been recognized.

Drilling operation performed 10 holes in the Pirca Eastern Area. Some of these holes intersected a gravel bed (Pirca sediments) of the lower most member of the Quaternary formation and confirmed its stratigraphic position, which had not been recognized in the holes of MJP-1, through MJP-4. The hole MJP-6 revealed facies changes of the Quaternary volcanic rocks and also established their stratigraphy.

A number of alteration zones were recognized; for example, an alteration zone with quartz veins at the bottom of the gravel bed in the holes of MJP-3 and MJP-4, a quartz vein having a core length of 2.45 m in the hole of MJP-5, a prominent alteration zone of mainly argillization in the four holes of MJP-7 through MJP-10, and an alteration zone accompanying strong silicification and quartz veins in the holes of MJP-8 and MJP-9. The alteration mineral assamblages indicate that the alteration is of the hydrothermal. The chemical analysis of the drill core samples collected in these alteration zones yielded generally low values up to 0.07 g/t Au and 2.8 g/t Ag.

Taking all these survey results into consideration, possibility of existence of high potential mineralization are considered to be low in the Pirca Area.

CHAPTER 4 MARCABAMBA AREA

4-1 Geology and Geological Structures

The Marcabamba Area, being located in the northwest of the first-year survey area, covers an area of 80 km^2 and extends from the vicinity of the village of Marcabamba, about 14 km north of the Pausa village, to the north and east-southeast (Fig. I-1, II-2, II-19).

Jurassic and Cretaceous sedimentary rocks, being distributed in the southeast of the Marcabamba Area, unconformably overlain by Tertiary volcanic rocks which are widely distributed in the northern and the northeastern parts of the area. The Quaternary formations are mostly developed in belts along major rivers. The only major intrusive rocks in the area are the Accha stocks which are regionally arranged in the direction of NW-SE. Minor andesite dikes are also observed in limited parts of the area.

The Hualhuani (Yu), Murco (Mu) and Arcurquina Formations of early to middle Cretaceous form the lowermost group in the area and are overlain by the Tacaza (Tc) and the Alpabamba (Al) Formations of Miocene age of the Tertiary.

The Quaternary formations in the Marcabamba Area include the andesites of Lampa (Vla), the volcanic sediments (Vsp) of Pausa and alluvial layers (al). The intrusive rocks, intruding the Tacaza Group (Tc) and underlying formations, include quartz diorite (Di) and porphyritic andesite (An-p) of the Accha stocks, and andesite dikes (An) intruding the quartz diorite (Fig. II-19).

The geological structure of the Marcabamba Area is characterized by folding and faulting. An anticlinal structure is presumed to form in and around the Colta village in the southeastern part of the area. However, the axial area, being covered by alluvials, is not well defined. This anticline have been assumed from strikes and dips of beddings of the Hualhuani, the Murco and the Arcurquina Formations of the Cretaceous. Its axis appears to run through the Colta village with a direction of NE-SW. Although quartz

diorite stocks are distributed in the vicinity of Colta where the axis can be assumed, it is not certain if the Cretaceous formations have been folded due to the intrusion of these stocks.

The faults are observed in a zone stretching from Concugnia in the central Marcabamba Area to Hamocpampa in the south, with general strikes ranging from N15° to 20° W. These faults cut across the Cretaceous formations, the Tacaza Formation of the Tertiary and the quartz diorite stocks. Displacement by these faults has not been determined precisely but appears to be relatively larger in the Cretaceous and the Tertiary formations and smaller in the quartz diorite stocks.

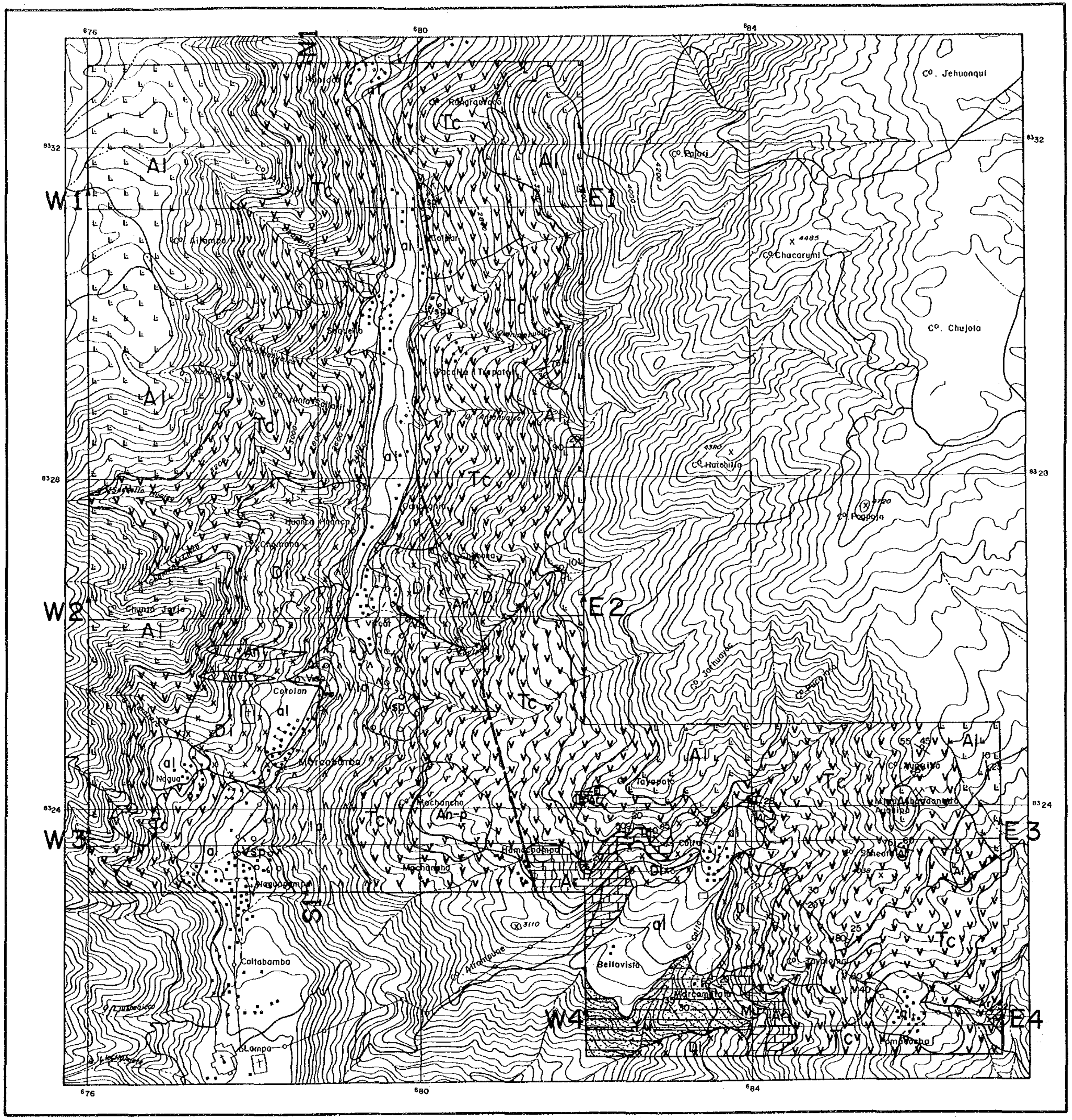
4-2 Mineralization and Alteration

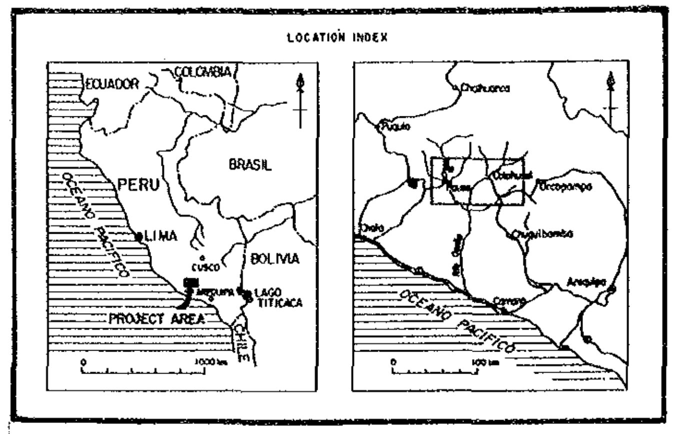
Numerous alteration and mineralization zones, though limited in their extents, have been located in the Marcabamba Area (Fig. II-20).

In the Marcabamba Area, the alteration and mineralization zones have been identified in parts of, the Hualhuani, the Murco and the Arcurquina Formations composed of sedimentary rocks of the Cretaceous, the Tacaza Formation consisting of andesitic volcanic rocks of the Tertiary unconformably overlying these formations, and the quartz diorite stocks of the Accha. In the Alpabamba Formation overlying the Tacaza Formation, weak argillic alteration is locally observed in and around the lowermost part, but no alteration or mineralization zones are found in the upper parts of the formation.

The major alteration and mineralization zones are shown in Table II-15. Of greater importance among these zones area a) Colpar, b) Soncota, c) Pomacocha, d) Marcamalata and f) Sequello.

Each alteration-mineralization zone is hereinafter described in detail. The chemical analysis results of the samples collected from each alteration mineralization zone are shown in Table II-16.





0 1 2 3 km

LEGEND

Quaternary	Holocene	Alluvium and Talus	al	Gravel, sand, silt and clay
		Volcanic Sediments of Pausa	Vsp	Volcanic ash, sand and gravel
		Lampa Volcanic Rocks	Vlo	Basaltic andesite lava and volcanic breccia
Tertiary	Miocene	Alpabamba Formation	Al	Rhyolite lava, lapilli tuff and tuff breccia
		Tacaza Formation	Tc	Andesite lava, tuff, lapilli tuff and tuff breccia
Cretaceous		Arcurquina Formation	Ar	Limestone with chert nodule
		Murco Formation	Mu	Alternation of shale, siltstone and sandstone
		Yura Group	Yu	Quartzite and siliceous sandstone

Intrusive Rocks

Dike	An	Andesite
Stock	Amp	Porphyritic andesite
Accha Stock	Di	Diorite~quartz diorite

Fault

Strike and dip of bedding

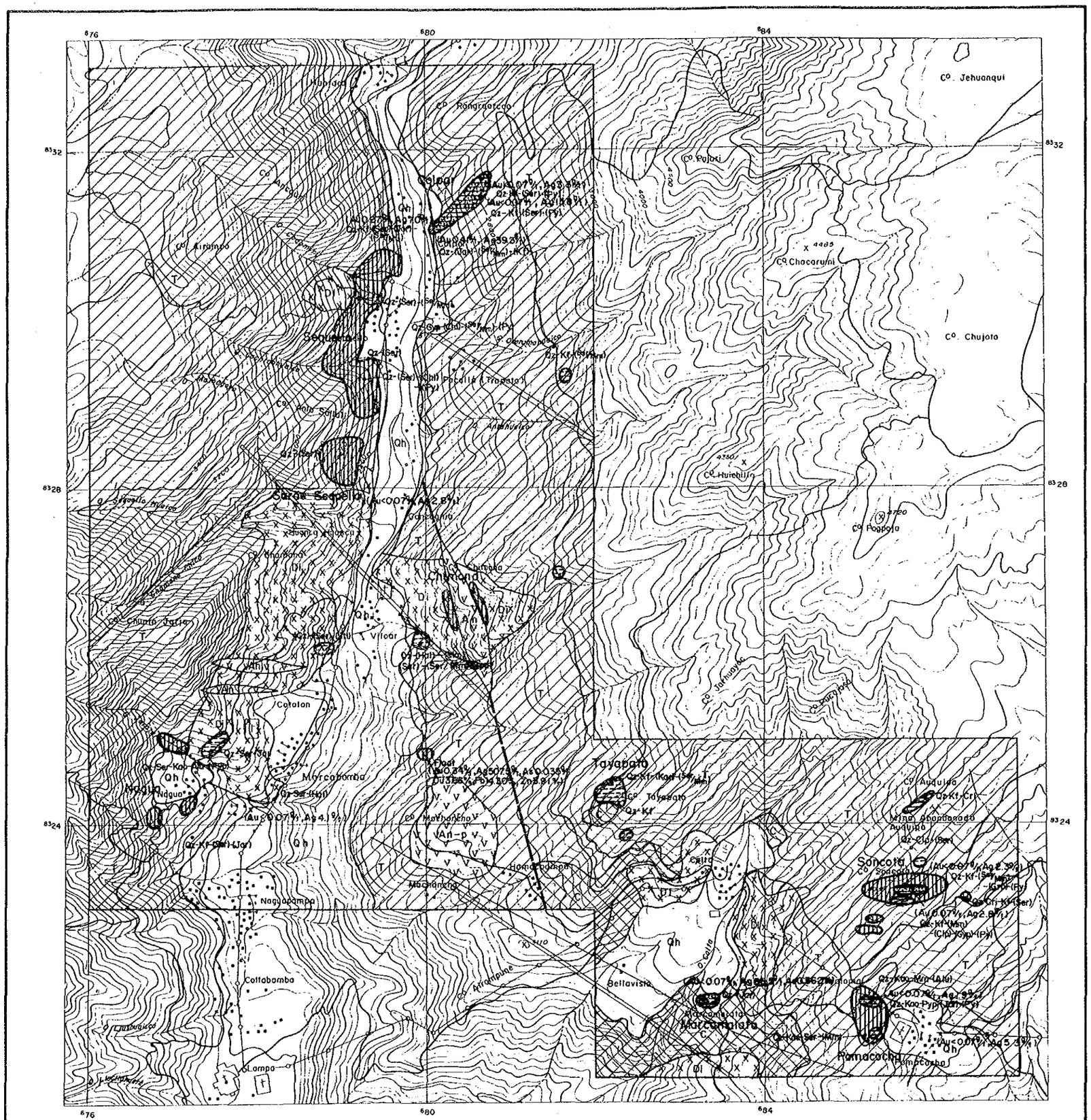
Strike and dip of flow structure

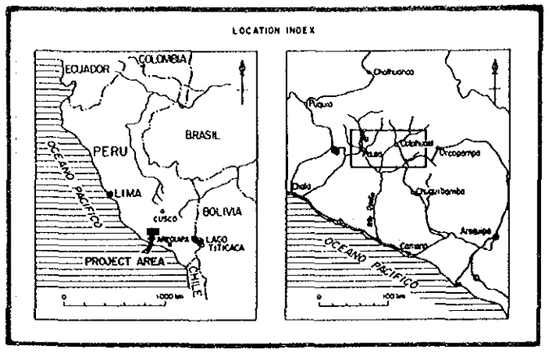
Strike and dip of joint

W1 E1 Geological profile line

Fig. II-19

Geological Map of the Marcabamba Area





LEGEND

Geological System

- Qh — Quaternary (Holocene) System
- T — Tertiary System
- C — Cretaceous System

Intrusive Rocks

- An — Andesite
- An-p — Porphyritic andesite
- Di — Diorite-quartz diorite
- Fault
- Lineament (Landsat)
- Lineament (Aerial photograph)

Abbriviation

- Qz : quartz
- Kf : potassium feldspar
- Cri : α - cristbalite
- Hal : halloysite
- Kao : kaolinite
- Dic : dickite
- Pyp : pyrophyllite
- Mm : montmorillonite
- Ser : sericite
- Chl : chlorite
- Ser/Mm : sericite-montmorillonite mixed layer
- Alu : alunite
- Jar : jarosite
- Gyp : gypsum
- Clp : clinoptilolite

Alteration and Mineralization Zones

- Mainly silicification
- Silicification and argillization
- Mainly argillization
- Mineralization

Fig. II-20 Location Map of Alteration and Mineralization Zone of the Marcabamba Area

Table II-15 List of Alteration and Mineralization Zones of the Marcabamba Area

No.	Name	Location	Scale	Host Rock	Alteration	Mineralization
1	Colpar	Northeast of Colpar	0.18 km × 1.0 km	Andesitic volcanic rocks (Tacaza Formation)	·Brown to light brown altered zone contaminated by iron oxides. ·Hydrothermal alteration (mainly silicification) [Qz + Kf + (Ser), Qz + (Ser) + (Jar)]	·Mineralization of gold and silver in N40°E and 70°NW siliceous zone with quartz veinlets ·Analysis of samples showed the maximum grades of Au 0.41 g/t, Ag 39.3 g/t.
2	Soncota	Approx. 4.2 km east of Colta	0.35 km × 1.0 km	Andesitic volcanic breccia (Tacaza Formation)	·Hydrothermal alteration (argillization and silicification) [Qz + Kf + (Gyp) + (Mn)]	·Mineralization of gold and silver in siliceous zone with dissemination of pyrite ·Analysis of sample showed the grades of Au 0.07 g/t, Ag 2.8 g/t.
3	Pomacocha	Approx. 0.8 km west-northwest of Pomacocha	0.4 km × 0.6 km	Andesitic volcanic breccia (Tacaza Formation)	·Brown altered zone contaminated by iron oxides (silicification and argillization) [Qz + Kao + Mm + (Alu), Qz + Kao + Pyp + (Jar) Qz + Kao + Ser + Mm]	·Mineralization of silver in siliceous rock. ·Analysis of a sample showed the grades (Au < 0.007 g/t, Ag 1.9 g/t.
4	Marcamalata	Approx. 1.5 km south of Colta	0.15 km × 0.3 km	Sandstone (Hualhuani Formation)	·Brown alteration zone contaminated by iron oxides ·Hydrothermal alteration (mainly silicification) [Qz - (Jar)]	·Mineralization of silver in siliceous rock ·Analysis of sample showed the grade of Au < 0.07 g/t, Ag 96,6 g/t.
5	Sequello	Western to south-western part of Sequello	0.8 km × 2.0 km	Andeside lava (Tacaza Formation)	·Brown alteration zone with dissemination of pyrite and contamination of iron oxides. ·Hydrothermal alteration (silicification and artillization) [Qz + (Ser), Qz + (Ser) + (Chl)]	·No significant mineralization observed
6	South of Sequello	Approx. 2 km South-southwest of Sequello	0.5 km × 0.5 km	Andesite lava (Tacaza Formation)	·Brown alteration zone with dissemination of pyrite ·Hydrothermal alteration (silicification and argillization) [Qz + (Ser)]	·No significant mineralization observed
7	Nagua	Approx. 1.5 km west of Marcabamba	0.15 km × 0.2 km × 2 0.15 km × 0.4 km × 2	Andesite lava (Tacaza Formation) Quartz diorite (Accha stock)	·Brown alteration zone contaminated by iron oxides in adesite lava. (Qz + Mm + Ser) ·White argilliferous alteration zone [Qz + Ser + Alu + (Pyp), Qz + Ser + Jar]	·No significant mineralization observed
8	Toyapata	Approx. 1.5 km Northwest of Colta	0.3 km × 0.3 km	Andesitic volcanic breccia (Tacaza Formation)	·White artgilliferous alteration zone [Qz - (Kao) - (Ser/Mm), Qz - Kf]	·No significant mineralization observed
9	Chimona	Approx. 1.0 km East of Vilcar	0.1 km × 0.5 km × 2	Quartz diorite (Accha stock)	·Brown alteration zone contaminated by iron oxides. (argillization and silicification) [Qz + (Hal) + (Mm) + (Ser) + (Gyp) + (Ser/Mm)]	·No significant mineralization observed

Table II-16 Chemical Analyses of Altered Rocks and Ore Samples of the Marcabamba Area

Name of Alteration zone	Sample No.	Co-ordinates		Au g/t	Ag g/t	As %	Cu %	Pb %	Zn %	Remarks
		E (km)	N (km)							
Colpar	MN-10	680.2	8331.1	0.27	7.0	0.014	<0.01	<0.01	<0.01	siliceous rock
	MN-11	680.1	8331.0	0.41	39.3	0.006	0.01	0.23	0.01	"
	MN-16	680.7	8331.6	<0.07	15.8	0.024	<0.01	<0.01	0.01	"
	MN-17	680.6	8331.6	<0.07	3.3	0.019	<0.01	<0.01	<0.01	"
Soncota	MN-23	685.6	8323.3	<0.07	2.3	0.006	<0.01	<0.01	<0.01	siliceous rock
	MN-24	685.7	8323.3	0.07	2.8	0.006	<0.01	<0.01	<0.01	"
Pomacocha	Mm-7	685.2	8321.9	<0.07	1.9	0.003	<0.01	0.03	0.01	white argillaceous rock
Marcamalata	MmV-6	683.3	8321.9	<0.07	86.5	0.362	<0.01	0.08	<0.01	siliceous rock
Nagua	MZ-10	676.8	8325.1	<0.07	<0.3	0.001	<0.01	<0.01	0.01	siliceous rock
Others	MK-1	679.3	8327.8	<0.07	2.8	0.003	<0.01	0.03	0.04	hematite dissemination ore
	MZ-5	677.9	8324.2	<0.07	4.1	0.001	<0.01	0.06	<0.01	argillaceous sheared rock
	MG-15	686.6	8321.5	<0.07	5.3	0.004	0.04	0.13	0.04	quartz vein
Float	M-1	680.1	8324.8	0.34	507.5	0.035	3.66	14.30	3.91	massive ore

4-3 Geochemical Exploration

In this year's survey, a geochemical soil sampling for the survey area was conducted and collected samples were analyzed for 6 indicator elements such as Au, Ag, As, Cu, Pb and Zn.

The Geochemical Interpretation Map (Fig. II-21) is prepared by combining anomalies in the principal components and the anomalous zones defined by the univariate analysis. The principal component anomalies appear to coinside broadly with the anomalous zones of the univariate analysis.

The anomalous zones, which superimpose the positive anomaly in the first principal components having the largest contribution ratio of the three principal components. are Colpar-A, -B, -C, Huanca Huanca-A, -B, -C, Machancha, Marcamalata, Tayaloma and Soncota. Of these 9 anomalous zones, five anomalous zones, Colpar-A, -B, Machancha, Marcamalata and Soncota has higher potentials in Au-Ag mineralization, taking account of sizes of the anomalous zones and strength of anomalous values (Table II-17).

The interpretation Map of the Marcabamba Area (Fig. II-22) is prepared by combining the anomalous zones and anomalies in soil geochemistry with the alteration-mineralization zones located by the geological survey. Of the 5 major geochemically anomalous zones, the Colpar-A, the Marcabamba and the Soncota zones superimpose the alteration-mineralization zones.

Characters of the presumable mineralization zones for the geochemically anomalous zones are compared with those of the existing alteration-mineralization zones as presented in Table II-18.

Colpar-A Anomalous Zones: Au-Ag-Pb mineralization may be expected in association with Cu-Zn mineralization.

High values detected in some soil samples range from 1.4 to 2.4 g/t Au, from 72 to over 100 g/t Ag, from 0.02 to 0.05% Cu, from 0.2 to 0.5% Pb and from 0.05 to 0.1% Zn, while mineralized rock samples indicated 0.3 to 0.4 g/t Au, 7 to 39 g/t Ag, upto 0.01% Cu, upto 0.2% Pb and upto 0.01% Zn.

Since the soil sample with high Au-Ag values were collected at the bottoms of steep slopes, the expected source of the Au-Ag mineralization may be located somewhat at higher elevation on the slopes. Although, Pb values are slightly anomalous, Cu-Pb-Zn mineralization is regarded generally of secondary importance.

Colpar-B Anomalous Zone: As in the Colpar-A zone, Au-Ag-Pb mineralization may be expected in association with Cu-Zn mineralization. Though only in one soil sample, very high values are detected such as more than 10 g/t Au, 72 g/t Ag, 0.02% Cu, 0.6% Pb and 0.3% Zn. No mineralized outcrops are observed at the locality of this particular sample but it may be expected that Au-Ag mineralization be hidden by soil cover in the vicinity.

Machancha Anomalous Zone: Au-Ag mineralization may be expected according to the results of the soil geochemistry. Values in Au and Ag in soil samples range from 0.4 to 0.5 g/t and from 4 to 6 g/t respectively, which are lower than those in the soil samples of the Colpar-A and -B zones. Though no mineralized outcrops have been located in this anomalous zones, Au-Ag mineralization trending in the E-W direction may be expected.

Marcamalata Anomalous Zone: Au-Ag-Pb and Cu mineralization may be expected according to the results of the soil geochemistry. Values of the indicator elements in soil samples range from 0.1 to 3.3 g/t Au, from 7 to more than 100 g/t Ag, from less than 0.01% to 0.02% Cu and from 0.1 to 1% Pb, while a mineralized rock sample yielded values of less than 0.07 g/t Au, 86.5 g/t Ag, less than 0.01% Cu and 0.08% Pb. This anomalous zones appear to be relatively broad in its extent and mineralization hidden by soil cover may be presumed in part of the zone.

Table II-17 List of Geochemical Anomaly Zones in the Marcabamba Area

Name of anomaly zone	Location	Scale (km)	Remarks (Mineralization)
Colpar A	Colpar, in the north of the Marcabamba area	0.6 x 0.7	Au - Ag, Pb - Cu, Zn mainly Au - Ag
B	Approx. 0.8 km SE of Colpar	0.4 x 0.9	
C	Approx. 1 km NE of Colpar	0.15 x 0.3	Au - Ag
Huanca Huanca A	Aprox. 1 km north of Huanca Huanca	0.15 x 0.25	Pb > Cu, Zn
B	Aprox. 0.8 km north of Huanca Huanca	0.15 x 0.2	Ag - Zn
C	Approx. 0.6 km NNW of Huanca Huanca	0.15 x 0.2	Pb > Cu, Zn
Vilcar	Approx. 1 km SE of Vilcar	0.2 x 0.2	Cu
Machancha	Approx. 0.5 km north of Co. Machancha	0.2 x 0.8	Au - Ag
Colta	Approx. 1 km WSW of Colta	0.2 x 0.4	Au
Marcamalata	Marcamalata, in the SE of the Marcabamba area	0.5 x 1.1	Au - Ag, Pb - Cu
Tayaloma	Approx. 0.8 km E of Marcamalata	0.15 x 0.4	Ag, Pb - Zn
Soncota	Co. Soncota	0.4 x 0.9	Au - Ag

Soncota Anomalous Zone: Au-Ag mineralization may be expected according to the results of the soil geochemistry. Higher values in Au and Ag in soil samples range from 1.2 to 4.9 g/t and from 4 to 6 g/t respectively, while two mineralized rock samples yielded values as low as 0.7 g/t Au and 2 to 3 g/t Ag. Mineralization with higher grades in Au and Ag may be expected though its size would be insignificant judging from indistinctive occurrences of the mineralized outcrops.

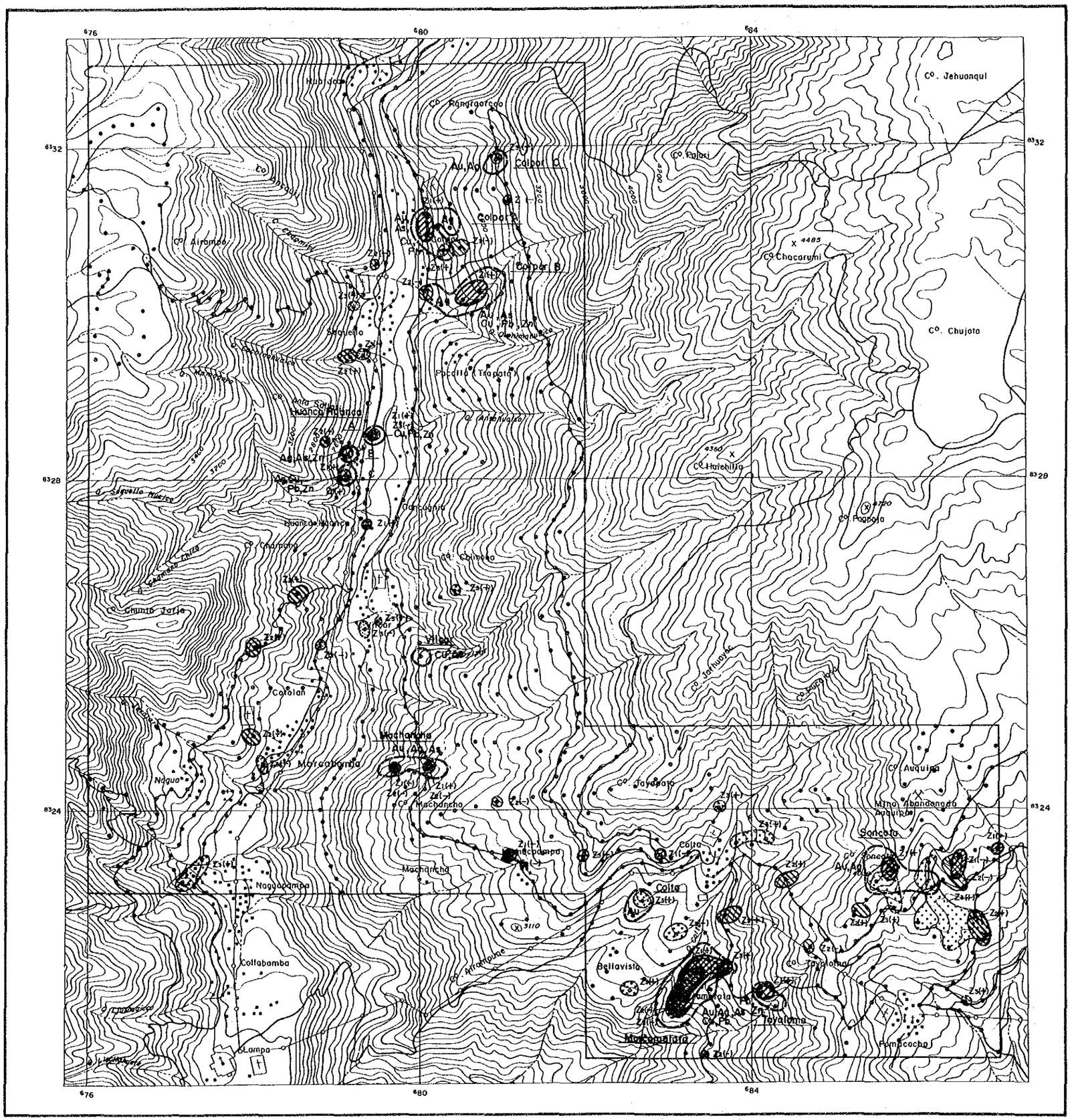
Promising geochemical anomalies are summarized in Table II-18.

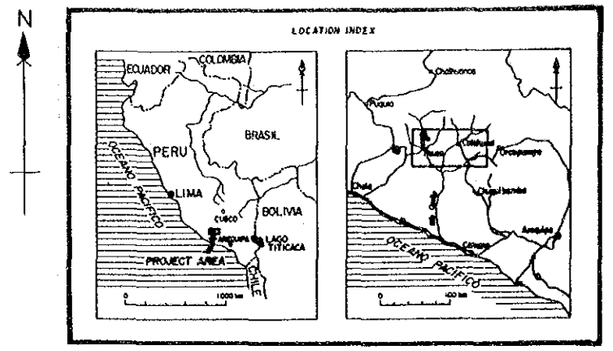
Table II-18 Comparison of Geochemical Anomaly Zones with Mineralization Zones in the Marcabamba Area

Geochemical anomaly zone		Results of geological survey	
Name	Mineralization, assumed by geochemical anomaly	Characteristic of mineralization	Characteristic of alteration
Colpar A	Au−Ag, Pb−Cu, Zn	Au−Ag in silicified zone with quartz veinlets (Au : 0.41g/t, Ag : 39.3g/t)	Hydrothermal alteration (mainly silicification), Qz+Kf+ (Ser) (contamination of oxides)
Colpar B	Au−Ag, Pb−Cu, Zn	Lack of outcrops	
Machancha	Au−Ag	Lack of outcrops	
Marcamalaca	Au−Ag, Pb−Cu	Ag in silicified rock (Au : 0.07g/t, Ag : 86.5g/t)	Hydrothermal alteration (mainly silicification), Qz+ (Jar) (contamination of ironoxides)
soncota	Au−Ag	Au−Ag in silicified zone with dissemination of pyrite (Au : 0.07g/t, Ag : 2.8g/t)	Hydrochemal alteration (argillization and silicification) Qz+Kf+ (Gyp) + (Mn)

Abbreviations :
Qz : quartz, Kf : K−feldsper
Ser : sericite, Jar : Jarosice
Gyp : gypsum, Mn : montmorillonite

The statistical parameters of the geochemical results such as average, threshold and maximum values are shown in Table II-19 to compare the geochemical significance of the Marcabamba Area to that of the Pirca Area.





N

0 1 2km

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Geochemical Anomaly
<Univariate Analysis>

(Au,Ag,As / Cu,Pb,Zn) Anomaly Zone and Anomalous Elements

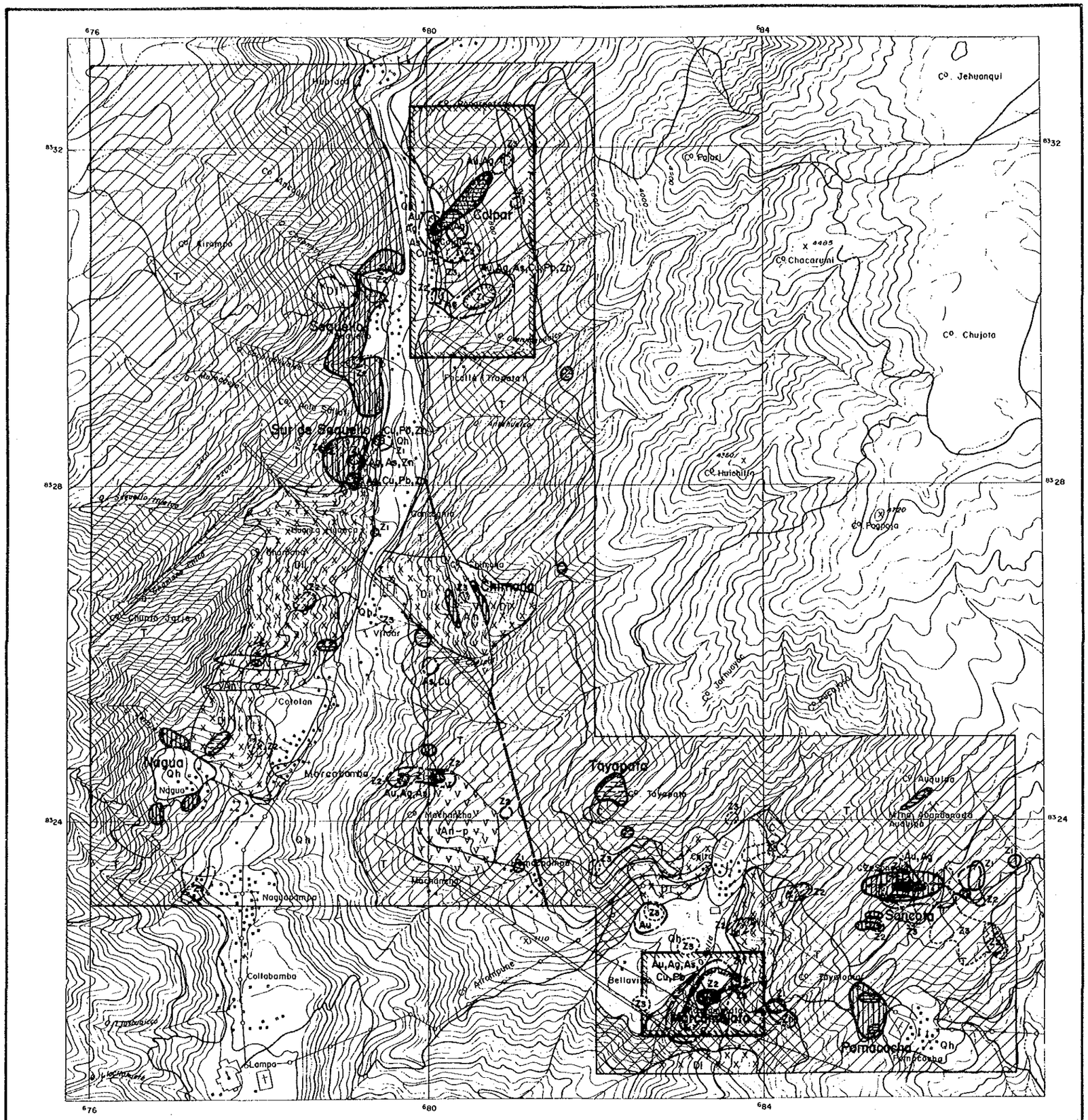
Colpar A Name of Anomaly Zone

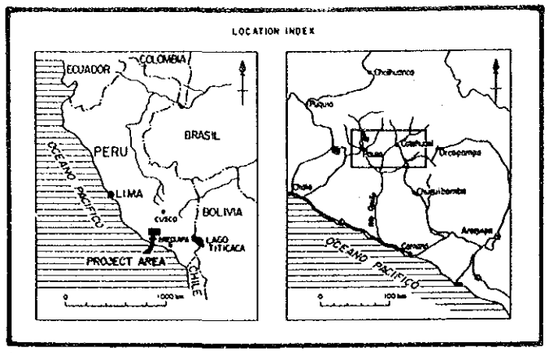
<Principal Components Analysis>

- 1st Principal Component
  - Z1(+) + Anomaly
  - Z1(−) − Anomaly
- 2nd Principal Component
  - Zs(+) + Anomaly
  - Zs(−) − Anomaly
- 3rd Principal Component
  - Zs(+) + Anomaly
  - Zs(−) − Anomaly

Fig. II-21

Geochemical Interpretation Map of the Marcabamba Area (Composite Data)





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Geological System

- Qh — Quaternary (Holocene) System
- T — Tertiary System
- Cretaceous System

Intrusive Rocks

- Andesite
- Porphyritic andesite
- Diorite ~ quartz diorite

Fault

Lineament (Landsat)

Lineament (Aerial photograph)

Alteration and Mineralization Zones

- Mainly silicification
- Silicification and argillization
- Mainly argillization
- Mineralization

Geochemical Anomaly
(Univariate Analysis)

- Au, Ag / As, Cu / Pb, Zn — Anomaly zone and anomalous element

(Principal Components Analysis)

•1st Principal Component
- Z1 — + Anomaly
- Z1 — − Anomaly

•2nd Principal Component
- Z2 — + Anomaly
- Z2 — − Anomaly

•3rd Principal Component
- Z3 — + Anomaly

Recomended Area

Fig. II-22 Interpretation Map of the Marcabamba Area

Table II-19 Comparison of the Pirca Area with the Marcabamba Area on Geochemical Statistic Parameteres

Area		Au (ppb)	Ag (ppm)	As (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)
Pirca	Mean	1.7	0.10	5.6	43.9	43.9	59.8
	Threshold	7.8	0.12	41.7	89.8	21.1	146.1
	Maximum	79	0.5	780	218	137	600
Marcababa	Mean	4.6	0.15	7.8	28.0	13.4	68.7
	Threshold	73.0	1.15	72.9	72.5	83.9	174.6
	Maximum	>10,000	>100	>10,000	570	>10,000	2,750

4-4 Summary of the Results in the Marcabamba Area

Alteration and mineralization zones are observed in the Tacaza Formation of the Tertiary and the underlying formations. Alteration zones can be classified into three types; an alteration zone mainly consisting of silicification, of silicification and argillization and of argillization, and mineralization is somewhat dominant in the first two alteration zones.

Mineralization in the area is mainly classified into several types; mineralization of gold and silver associated with intensive silicification or quartz veinlets in silicified zones, mineralization of gold and silver in fracture zones and joints stained by iron oxide, and disseminated pyrite mineralization in alteration zones of silicification and argillization. The major alteration and mineralization zones in the area are summarized in the Table II-20. The former two types are of major interest in the survey area.

Table II-20 Principal Alteration and Mineralization Zones of the Marcabamba Area

No.	Name	Scale (km)	Wall Rock	Alteration	Mineralization
(1)	Colpar	0.18 × 1.0	Andesitic volcanic rocks (Tc)	Brown to light brown alteration zone stained by iron oxide. Hydrothermal alteration of mainly silicification [Qz + Kf + (Ser), Qz + (Ser) + (Jar)]	Mineralization of gold and silver in the silicified zone of N45°E-70°NW accompanying quartz veinlets. Assay results indicate max. Au: 0.41 g/t, Ag: 39.3 g/t
(2)	Soncota	0.35 × 1.0	Andesitic volcanic breccia (Tc)	Hydrothermal alteration being composed of silicification and argillization [Qz + Kf + (Gyp) + (Mn)]	Mineralization of gold and silver in a silicified zone of pyrite dissemination. Assay results indicate Au 0.07 g/t, Ag 2.8 g/t
(3)	Pomacocha	0.4 × 0.5	Andesitic volcanic breccia (Tc)	Brown alteration zone stained by iron oxide. Hydrothermal alteration being composed of silicification and argillization [Qz + Kao + Mn + (Alu), Qz + Kao + Pyp + (Jar), Qz + Kao + Ser + Mn]	Mineralization of silver in a silicified zone. Assay results indicate Au < 0.07 g/t, Ag 1.9 g/t
(4)	Marcamalata	0.15 × 0.3	Sandstone (Yu)	Brown alteration zone stained by iron oxide. Hydrothermal alteration of mainly silicification [Qz + (Jar)]	Mineralization of silver in silicified rocks. Assay results indicate Au < 0.07 g/t, Ag 86.5 g/t
(5)	Sequello	0.8 × 2.0	Andesite lava (Tc)	Brown alteration zone being accompanied with dissemination of pyrite and contamination of iron oxide. [Qz + (Ser), Qz + (Ser) + (Chl)]	No prominent mineralization is observed

Abbreviation:
Qz: quartz, Kf: potasium feldspar, Ser: sericite, Jar: jarosite, Gyp: gypsum, Mn: montmorillonite, Alu: alunite, Kao: Kaolinite, Pyp: pyrophyllite, Chl: chlorite, Cri: α-cristobalite, Hal: Halloysite

Among these alteration and mineralization zones, the Colpar mineralization zone is prominent in gold and silver and the Marcamalata zone prominent in silver.

Based on the results of geochemical survey, the major geochemically anomalous areas are summarized in the Table II-21.

Table II-21 Relation with Geochemical Anomaly Zones and Alteration Zones in the Marcabamba Area

No.	Name of geochemically anomalous area	Scale of anomalous area (km)	Relation with alteration zone
1	Colpar A	0.6×0.7	Colpar alteration zone
2	Colpar B	0.4×0.9	Alteration zone is unclear
3	Machancha	0.2×0.8	Contact part between porphyritic andesite stocks and andesitic volcanic breccia Alteration zone is unclear
4	Soncota	0.4×0.9	Soncota alteration zone
5	Marcamalata	0.5×1.1	Marcamalata alteration zone

Among these geochemically anomalous zones, the Colpar-A, the Colpar-B and the Marcamalata anomalous zones are prominent. The Colpar-A and the Marcamalata anomalous zones overlap the Colpar and the Marcamalata alteration zones respectively. On the other hand, the Colpar-B anomalous zone located to the south of the Colpar alteration zone has no surface expression of mineralization-alteration, but assay results of one soil sample shows Au > 10 g/t and Ag: 72 g/t, indicating a possibility of existance of a concealed mineralization zone.

Considering these results, the Colpar area including Colpar-A and Colpar-B geochemically anomalous zones and the Marcamalata area including the Marcamalata anomalous zones are considered to have potential mineralization.