Promising geochemical anomalies are located at Mina Pararapa, Quechualla, Maran, Huayjo, Mina Luicho and Marcabamba. Other anomalies in a single element or multiple elements are located at Cerro Kiura, Hucaccocha (a part of the western alteration zone in Tanisca), Alca and Colta.

2-4 Summary of the Results of the 1st Year's Work

A total of 15 mineralization and alteration zones were identified in the Cotahuasi Area.

The major mineralization and alteration zones are summarized in Table II-3.

Table II-3 Principal Mineralization Zones (Cotahuasi Area)

No.	Name of Mineralized or Alteration Zone	Size of Mineralized or Alteration Zone	Host Rock	Alteration	Mineralization
(1)	Minas Pararapa	1 km x 2.5 km	Andesite (An) dikes and andesitic volcanic rocks (Tc)	Hydrothermal alteration, primarily silicification; browning of ferrous oxide	Gold-silver bearing quartz veins, 0.5 - 1.5 m wide, 1.3 km long
(2)	Mina de Huayllura (East of Tonisca)	1 - 2 km x 10 km	Sandstone (Yu)	Browning by ferrous oxide; hydrothermal alteration with fine quartz vein	Oxidized zones along fracture zones and joints; fine quartz vein with gold and silver
(3)	West of Tonisca	1.5 km x 4 km	Andesitic volcanic rock (Tc)	Hydrothermal alteration accompanied by argillization and silicification	Noticeable mineralization not observed
(4)	Mina Luicho	1 km x 2 km	Sandstone (Yu)	Silicification around fine quartz veins; browning by ferrous oxide	Gold-silver bearing fine quartz veins and browning of ferrous oxide
(5)	Mina Picha	1 km x 2 km	Limestone (Ar)	Skarn zones formed by intrusion of diorite; mainly garnet skarns	Composed of small-scale lense and massive ores, galena black jack and chalcopyrite and bearing gold and silver
(6)	South of Maran	1.5 km x 3.5 km	Andesitic tuff breecia and tuff (Cho)	Silicification around fine quartz veins and browning by ferrous oxide	Gold-silver bearing fine quartz veins and gold-bearing brown contaminated zone by ferrous oxide along fracture zones
(7)	Oyolo	2 km x 8 km	Andesitic to dacitic pyroclastic rock (Tc - Al)	Hydrothermal alteration, primarily argillization; browning by ferrous oxide	Noticeable mineralization not observed
(8)	Pirca	2 km x 5 km	Andesicic volcanic rock (Tc)	Hydrothermal alteration with silicification	Contaminated zone by ferrous oxide

Among the mineralization and alteration zones tabulated here, the largest unit deposit is the gold-silver bearing quartz vein occurring in the mineralized zone of Mina Pararapa. This vein is 0.5 to 1.5 m wide and 1.3 km long. According to the unpublished data of the mine, the highest grade of gold is 40 g/ton and the average grade 4.6 g/ton. According to the results of the present survey, the average grade for 0.8 m of vein width is 4.6 g/ton for gold and 288.0 g/ton for silver.

Analysis of local samples collected from contaminated part by brown ferrous oxides occurring along fissures in the mineralized zones of Mina Luicho, though on a small scale, shows a grade of 26.0 g/ton for gold and 114.1 g/ton for silver.

Massive ores collected from the stockpile of the Mina Richa show a grade of 7.7 g/ton for gold, 777 g/ton for silver, 23.4% for lead, 21.6% for zinc and 1.38% for copper. Such high-grade ores cannot be found in the other mineralized zones surveyed.

Table II-4 Principal Geochemical Anomaly Zones (Cotahuasi Area)

No.	Name of Geochemically Anomalous Zone	Anomaly in Univariate Statistical Analysis (Plural Elements)	Existance of Anomaly in Principal Component Analysis		Size of Anomalous Zone	Area
			1st Principal Component	2nd Principal Component		
1	Mina Pararapa	Au, Ag, (As), (Pb)	Yes	No	7 km x 4 km	28 km^2
2	Quechualla (Tanisca)	Au, Ag, Pb (Zn)(As) (Cu)	Yes	No	13 km x 10 km	130 km^2
3	Huayjo	Au, Cu, Ag (Pb), (Zn)(As)	Yes	Yes	10 km x 2 km	20 km^2
4	Marcabamba	Au, Ag, Pb (Cu)(Zn)	Yes	No	7 km x 3 km	21 km^2
5	Mina Luicho	Au, Ag, Pb (Cu)(Zn)	Yes	No	4 km x 3 km	12 km^2
6	Maran	Au, Cu, Pb, (As), (Zn)(Ag)	Yes	Yes	9 km x 4 km	36 km^2
*	Orcopampa	Zn, Pb, (Au)(Ag)	Yes	No	6 km x 5 km	30 km^2
*	North of Orcopampa	Au, Ag	Yes	No	5 km x 4 km	20 km^2

Mineralized/Alteration zones, such as Mina Pararapa composed mainly of gold bearing quartz veins, Minas de Huayllura (east of Tanisca) composed of gold bearing fine quartz veins and oxidized zones, Mina Luicho and southern Maran, substantially overlap geochemically anomalous zones consisting mainly of Au and Ag. Mina Picha displaying contact metasomatic mineralization overlap geochemically anomalous zones of Au, Ag, Pb, (Zn) and (As) in a conspicuous manner.

Interesting alteration zones which are close to known mineralized zones and which overlap weak geochemically anomalous zones include the alteration zone in the west Tanisca overlapping an anomalous zone of Au and the alteration zone of Pirca overlapping anomalous zones of Zn and Ag.

Of the geochemically anomalous zones, those of Vellinga along the Cotahuasi River and of northern Huayjo reflect brown altered zones of ferrous oxide bearing small-scale gold deposits. The anomalous zones, including those of Alca in the northeast of the survey area, Quepacc and southern Huayjo in the south, and Marcabamba in the northwest, overlap intrusive bodies of diorite and reflect a weak pyritization caused by the intrusion.

The following tabulation gives the suggested survey areas and methods of survey for the second and succeeding survey years which are based on the results of the first-year survey.

Table II-5 Recommendation for Follor-up Survey (Cotahuasi Area)

Area	Method of Survey
1. Mina Pararapa	Detailed geological survey Geochemical exploration Geophysical prospecting Diamong Drilling
2. West of Tanisca Alteration Zone	Detailed geological survey Geochemical exploration Geophysical prospecting
3. Mina Luicho	Detailed geological survey Geochemical exploration
4. Pirca Alteration Zone	Detailed geological survey Geochemical exploration Geophysical prospecting

However, it is necessary to examine the circumstances of the establishment of mining concessions in the selection of survey areas for the second and succeeding years.

CHAPTER 3 PIRCA AREA

3-1 Geology and Geological Structures

The Pirca Area in the southwest part of the first year's survey area, extends westwards from the Pirca village approximately 15 km south of the Pausa, and covers on area of 90 km^2 (Fig. I-1). This area was divided into two subareas, the Pirca Eastern Area (48 km^2) and the Pirca Western Area (42 km^2), with an intention to carry out surveys more in details in the eastern area than in the western area.

The geology of the both areas are shown in Fig. II-9 and II-10.

The stratigraphic sequences of the area are composed in stratigraphically ascending order of the Jurassic Chocolate volcanics at the bottom, the Tertiary Tacaza Formation (Tc), the Quaternary system comprising the Pirca sediments (PS), the Upper and Lower Barroso Formations (Vbu, Vbl), Moraine (Mo) of the Pleistocene and the Pausa volcanic sediments (Vsp) and alluvium (al) of the Holocene. There are also distributed by minor hornblende andesite dikes.

No prominent tectonic element has been recognized in the Pirca Area.

In the Pirca Eastern Area, the Tacaza Formation appears to have been deformed subject to the Andean Orogeny (at the waning stage of the orogeny?). The beddings of the formation strike in the direction of E-W and dip 10° to 15° to N.

Faults have been recognized at three localities, one trending NW-SE along the Paccha creek in the vicinity of Millo, another trending NE-SW on the slope to the northeast of Millo and the third also trending NE-SW on the slope approximately 1 km southeast of Millo. Magnitudes of dislocation by these faults appear to be small, possibility within ranges of several tens of meters.

No Notable structural features has been recognized in the Pirca Western Area.

3-2 Mineralization and Alteration

A number of alteration zones of variable sizes have been observed in the Pirca Area (Fig. II-11, II-12).

However, the mineralization of this area is generally weak and no mineralized zone has ever been exploited though several localities have been explored by means of trenching.

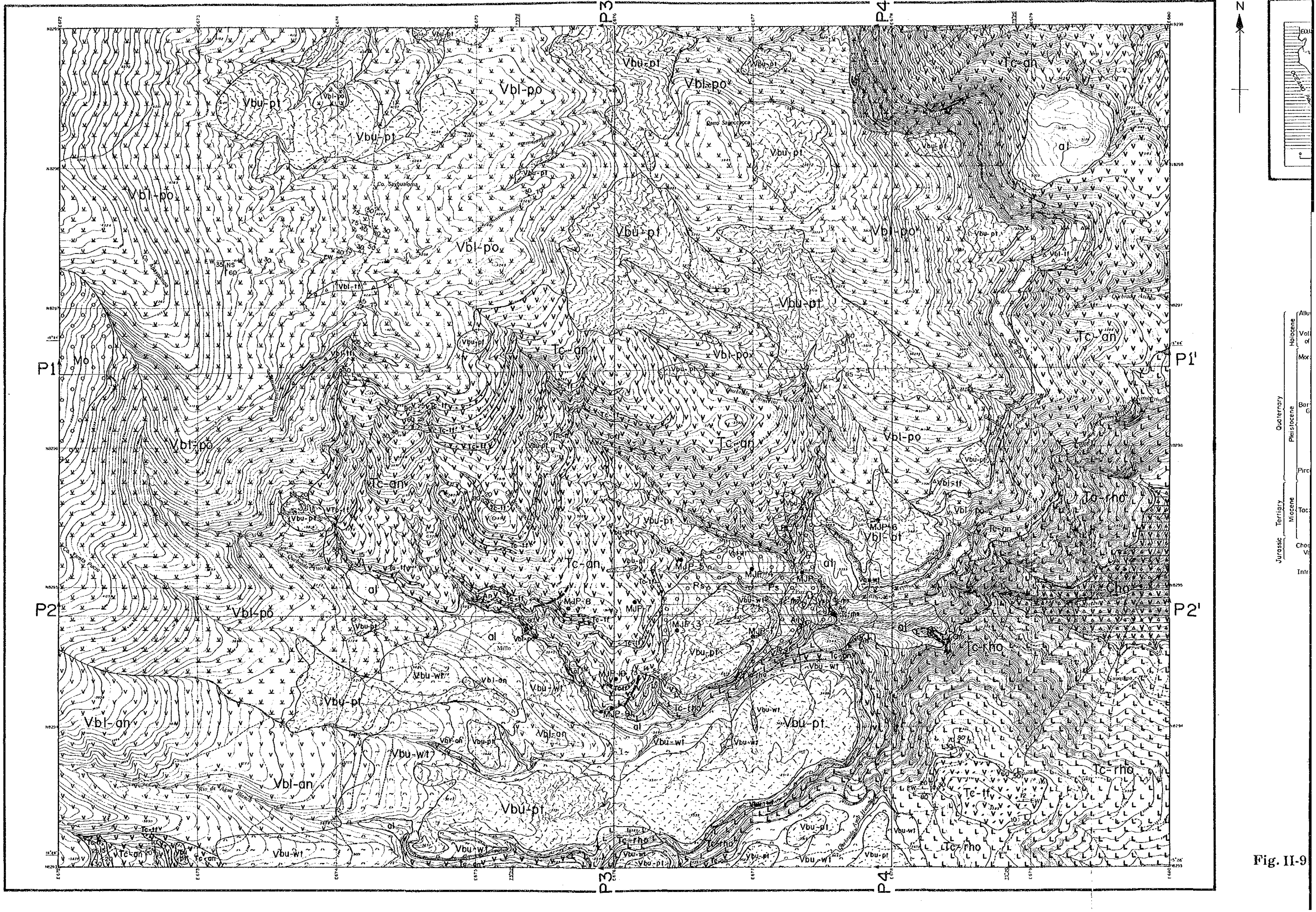
Most of the alteration zones are located in areas distributed by the andesitic lavas (Tc-an) and the andesite tuffs (Tc-an) of the Tacaza Formation (Tc), and a few in areas distributed by the rhyolitic tuffs (Tc-rho) of the same formation.

No primary alteration or mineralization has been recognized in the Quaternary system, though fragments of altered or silicified rocks are contained in the Pirca sediments, the lowermost formation of the Quaternary.

Distributions, sizes and modes of occurrences of the major alteration and mineralization zones are summarized in Table II-6. Seven major alteration zones, PE-1 through PE-7 are recognized in the Pirca Eastern Area, and three, PW-1 through PW-3, in the Pirca Western Area.

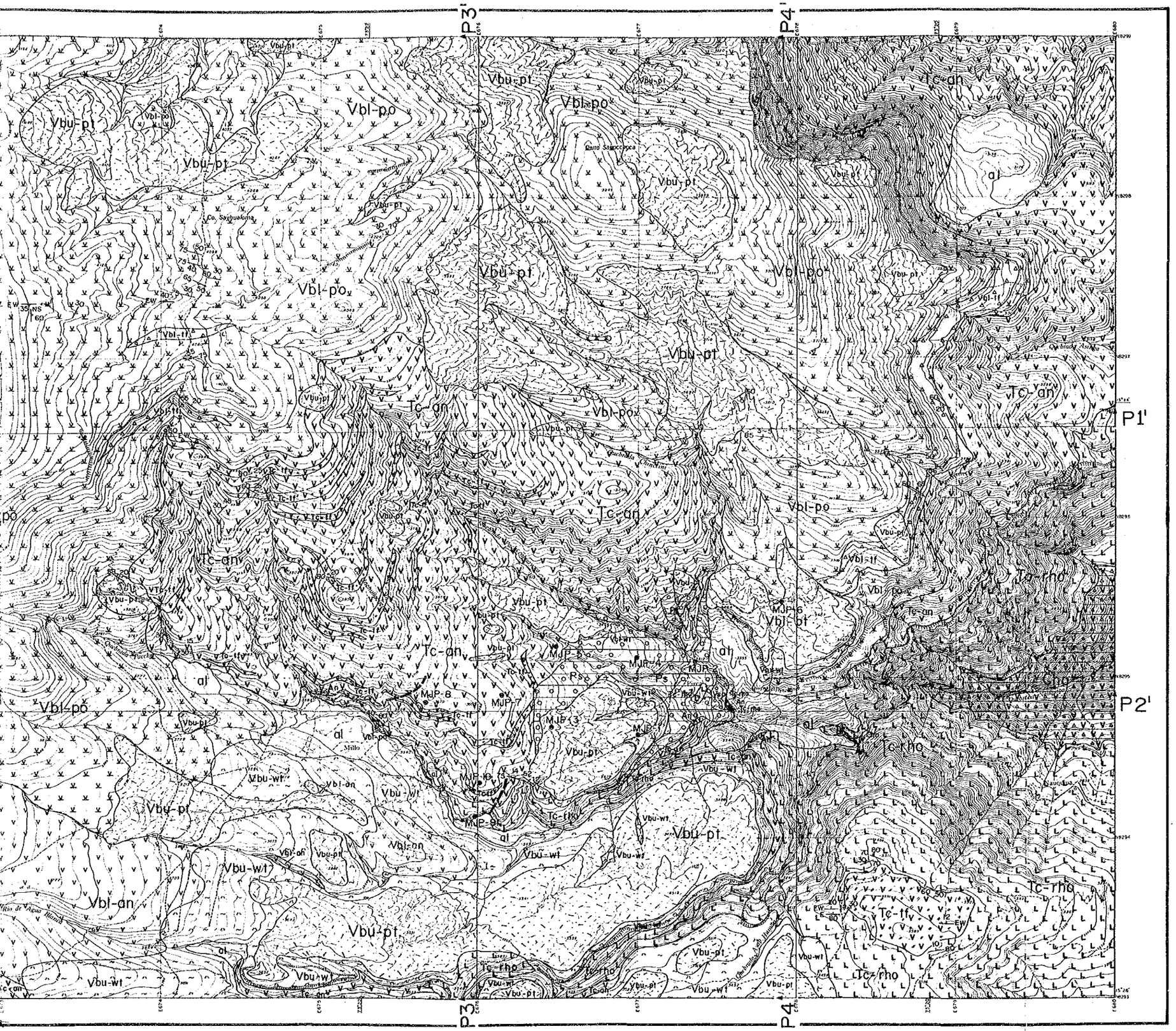
The zones PW-1 and PW-3 in the Pirca Western Area include the Au-Ag mineralization associated with the alteration dominated by silicification and the accompanying quartz veinlets.

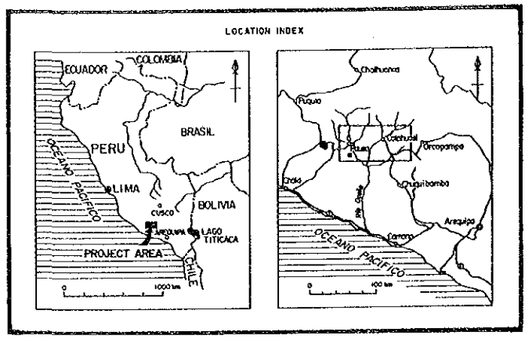
No or very little evidences of the Au-Ag mineralization have been recognized in the Pirca Eastern Area. There is none at all in respect to the Cu-Pb-Zn mineralization. Pyritization is the only megascopically identified mineralization in the Pirca Eastern Area (Table II-7).



P3'
P4'
N
P1
P1'
P2
P2'
P3
P4
Vbl-po
Vbu-pt
Vbl-an
Vbu-wt
Tc-an
Tc-rho
Tc-tf
al
Mo
Cho
MJP-6
MJP-5
MJP-4
MJP-8
MJP-7
MJP-3
MJP-10
MJP-9
Holocene
Pleistocene
Quaternary
Miocene
Tertiary
Jurassic

Fig. II-9





N

0 0.5 1 km

LEGEND

Quaternary	Holocene	Alluvium and Talus	al	Gravel, sand, silt and clay
		Volcanic Sediments of Pausa	Vs p	Volcanic ash and gravel
		Moraine Sediments	Mo	Gravel, sand and mud
	Pleistocene	Barroso Group, Upper Formation	Vbu-pt	Pumice fall and tuffaceous sand
			Vbu-wt	Dacite lava, docitic tuff and welded tuff
		Barroso Group, Lower Formation	Vbl-an	Pyroxene andesite lavas
			Vbl-tf	Andesitic tuff, lapilli tuff and tuff breccia
			Vbl-po	Hornblende andesite lava
		Pirca Sediments	Ps	Gravel, sand, silt and clay
Tertiary	Miocene		Tc-tf	Andesitic tuff, lapilli tuff and tuff breccia
		Tacaza Formation	Tc-an	Andesite lava with thin bedded tuff, lapilli tuff and tuff breccia
			Tc-rho	Rhyolite lava, tuff and lapilli tuff
Jurassic		Chocolate Volcanic Rocks	Tc-cho	Andesite lava, andesitic tuff and tuff breccia (partly green semischist)
		Intrusive rock, Dike	An	Hornblende andesite

Fault

Strike and dip of bedding

Strike and dip of flow structure

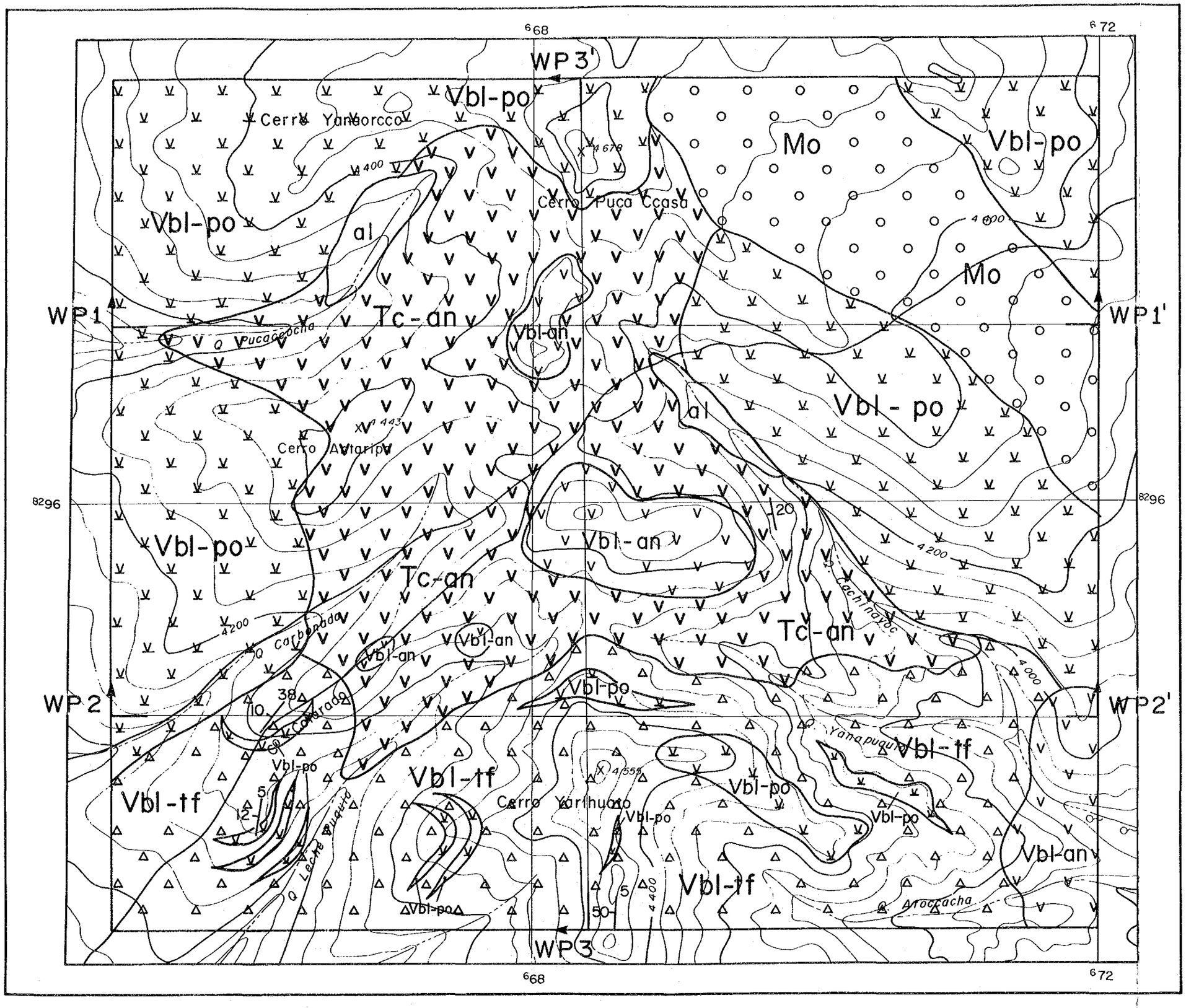
Strike and dip of joint

Strike and dip of contact plane

MJP-1 Location of drilling

P1 — P1' Geological Profile line

Fig. II-9 Geological Map of the Pirca Eastern Area



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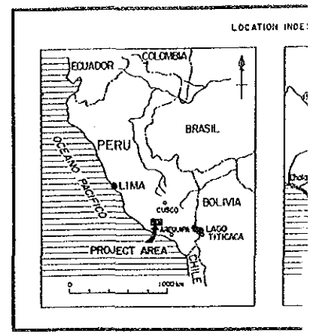

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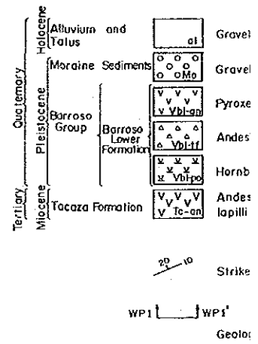
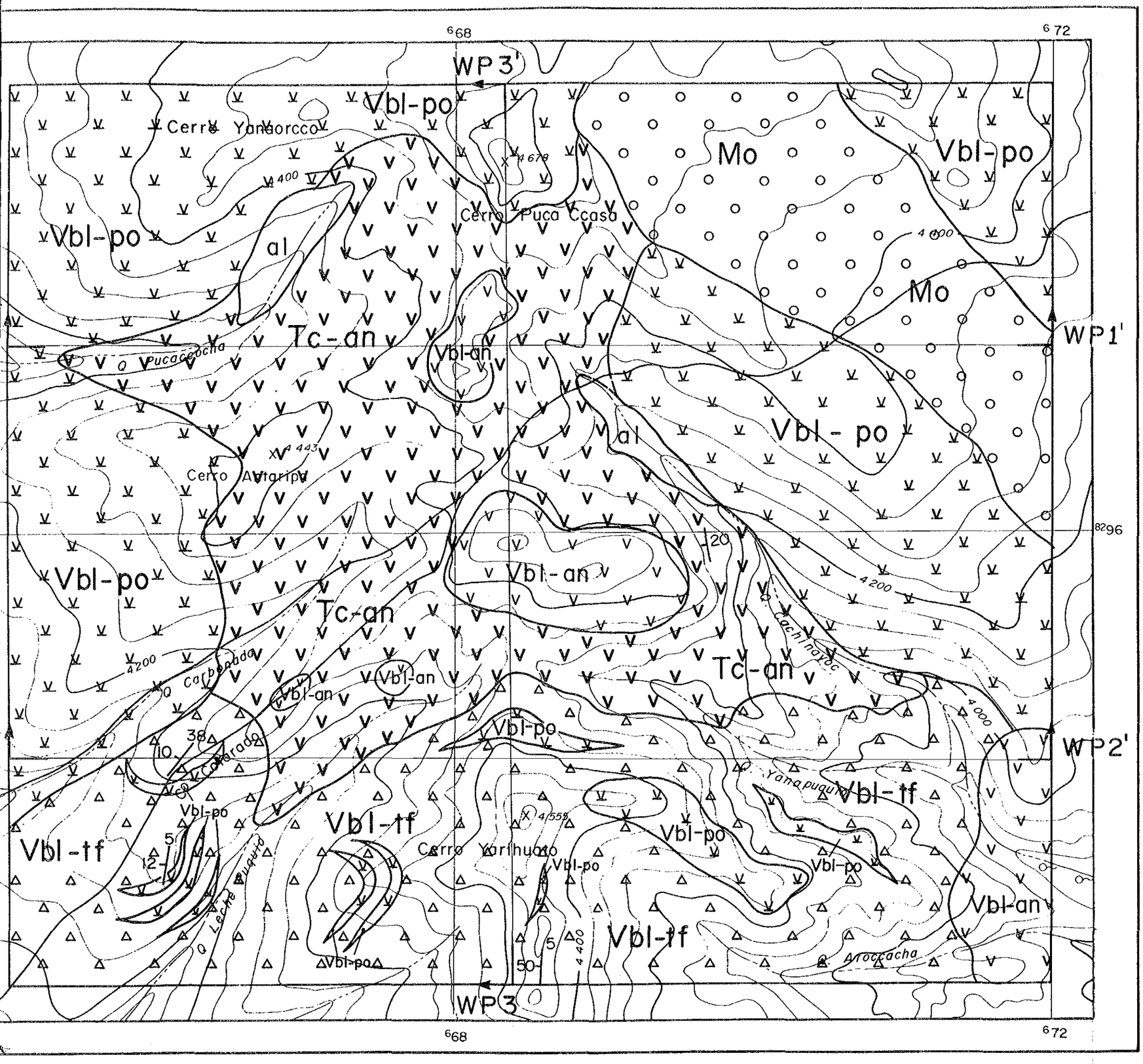


Fig. II-10 Geological M
Pirca Weste



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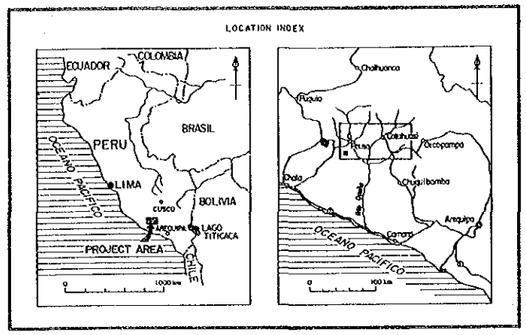


0 1 2km

LEGEND

Quaternary	Holocene	Alluvium and Talus	al	Gravel, sand, silt and clay
		Moraine Sediments	Mo	Gravel, sand and mud
	Pleistocene	Borroso Group, Barroso Lower Formation	Vbl-an	Pyroxene andesite lava
			Vbl-tf	Andesitic tuff, lapilli tuff and tuff breccia
			Vbl-po	Hornblende andesite lava
Tertiary	Miocene	Tacaza Formation	Tc-an	Andesite lava with thin bedded tuff, lapilli tuff and tuff breccia

20/10 Strike and dip of bedding

WP1 — WP1' Geological profile line

Fig. II-10 Geological Map of the Pirca Western Area

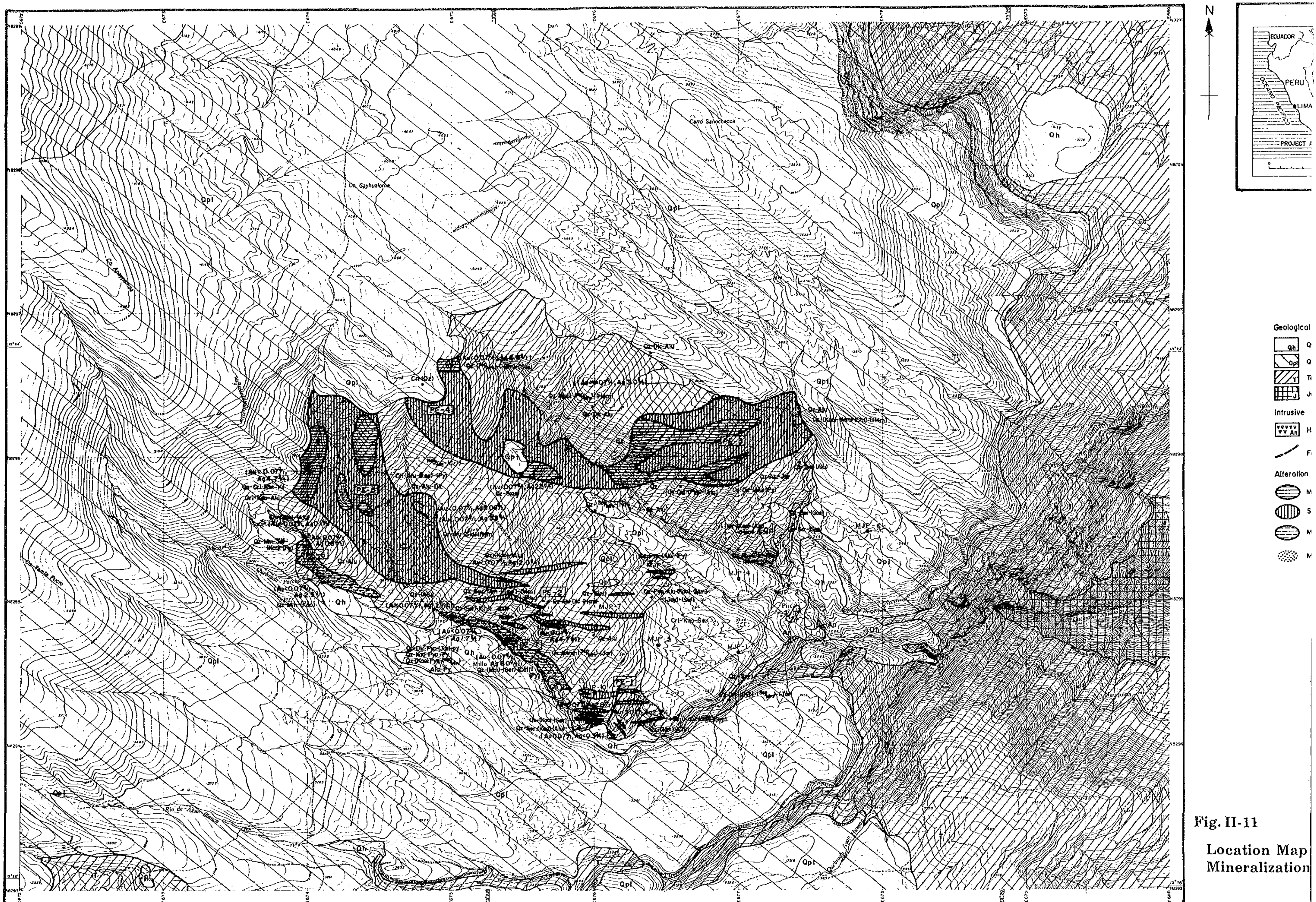
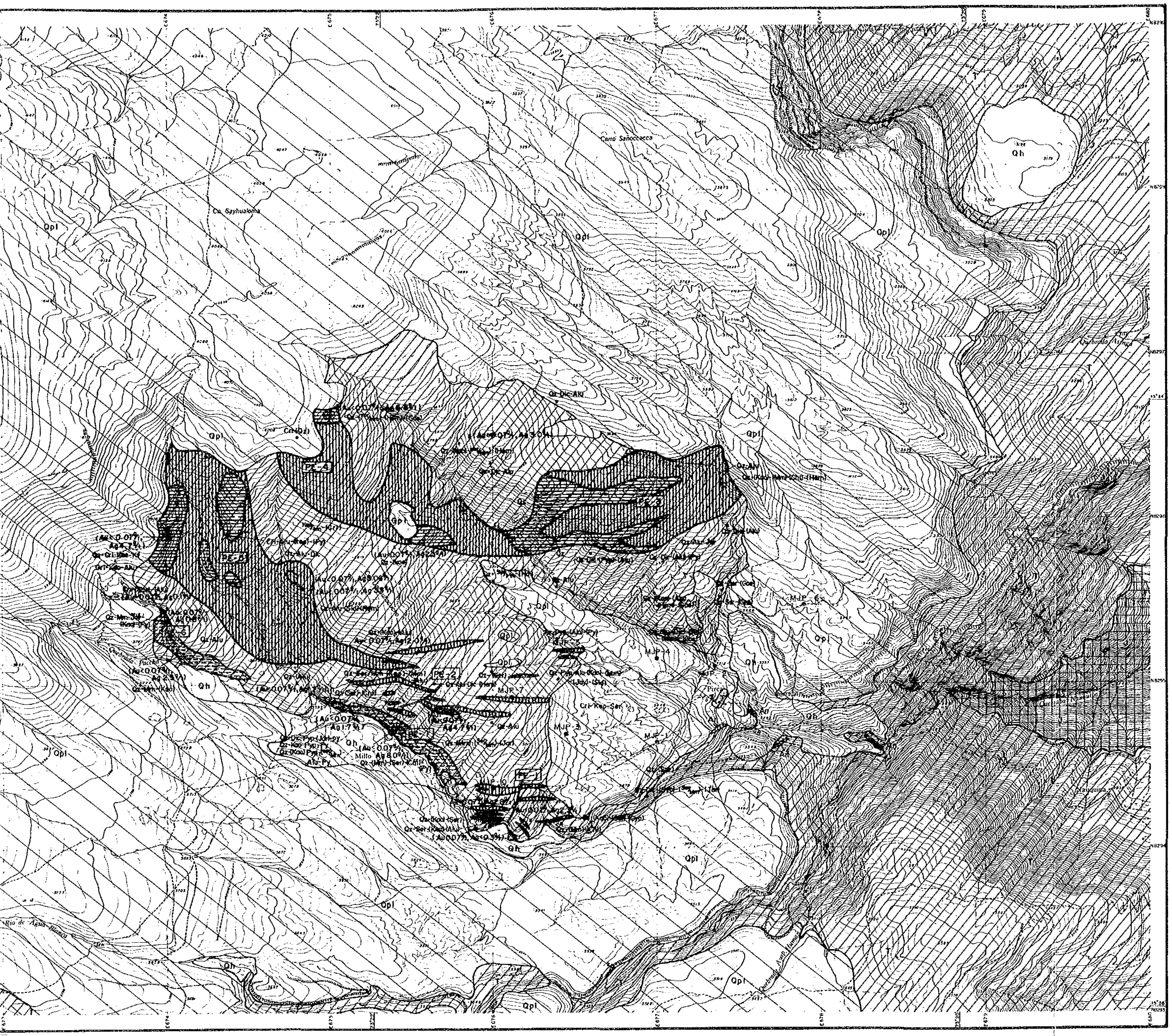


Fig. II-11

Location Map
Mineralization



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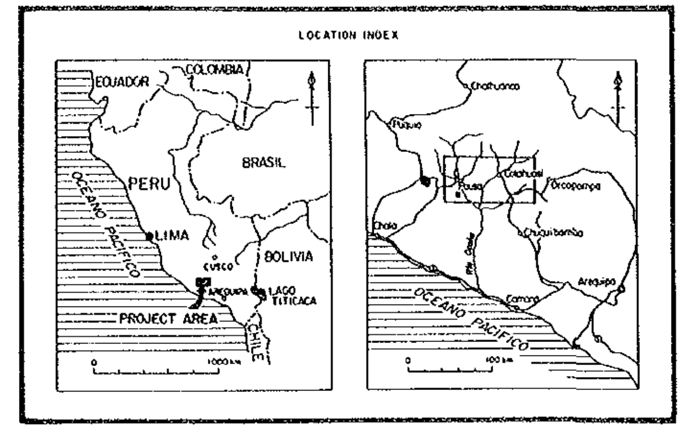


0 0.5 1 km

LEGEND

Geological System

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

Intrusive Rock

- An — Hornblende andesite
- Fault

Alteration and Mineralization Zones

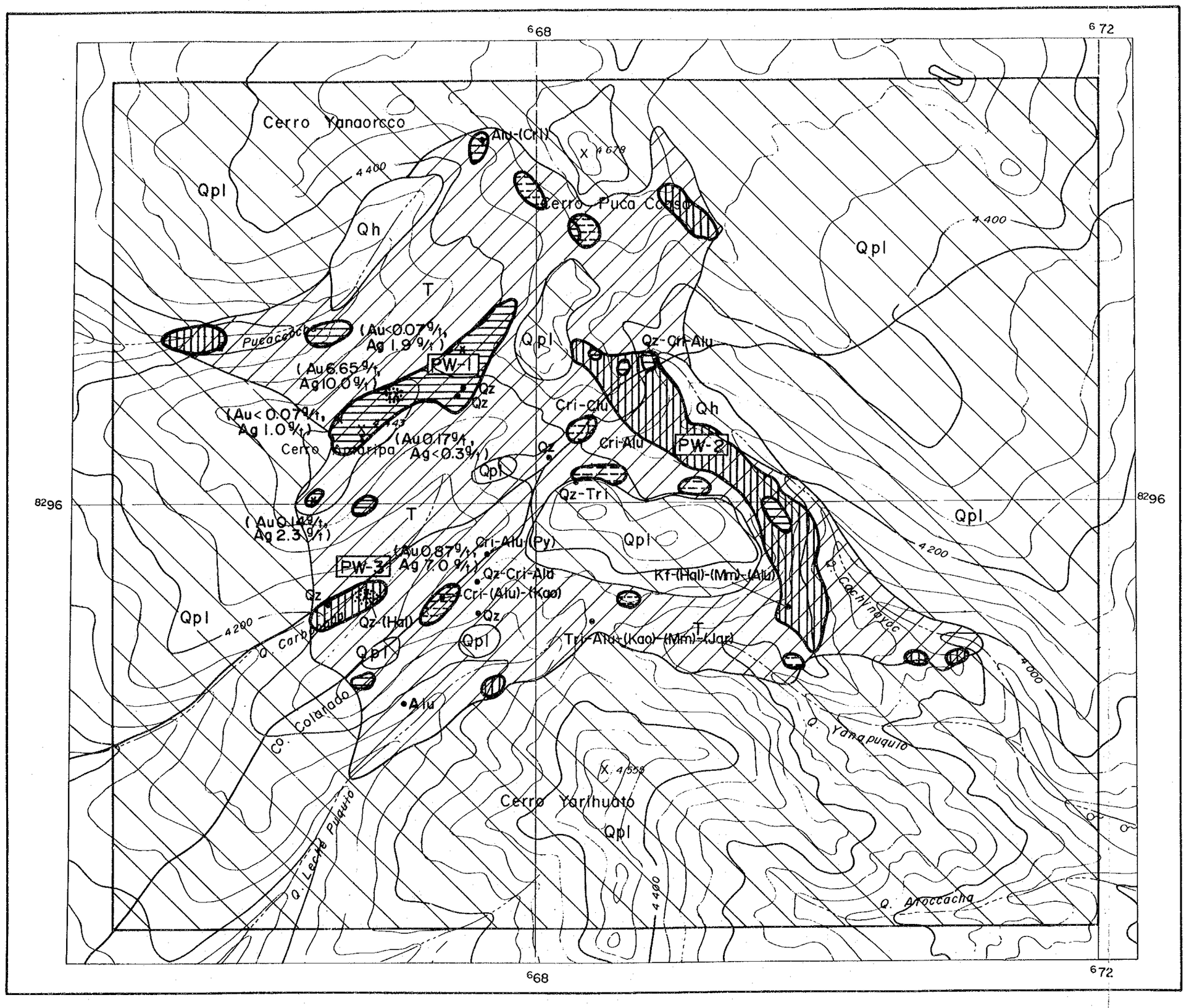
- Mainly silisification
- Silicification and argilization
- Mainly argillization
- Mineralization

Abbriviatiom

- Qz : quartz
- Kf : potasium feldsper
- Cri : α-cristbalite
- Hal : halloysite
- Kao : kaolinite
- Dic : dickite
- Pyp : pyrophyllite
- Mm : montmorillonite
- Ser : sericite
- Chl : chlorite
- Kao/Mm : kaolinite-montmorillonite mixed layer
- Ser/Mm : sericite-montmorillonite mixed layer
- Alu : alunite
- Jar : jarosite
- Gyp : gypsum
- Py : pyrite
- Hem : hematite
- Goe : goethite

Fig. II-11

Location Map of Alteration and Mineralization Zone of the Pirca Eastern Area



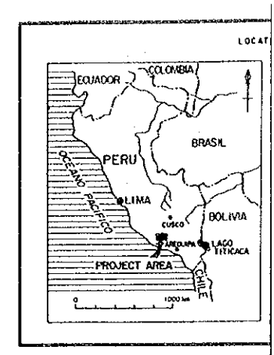
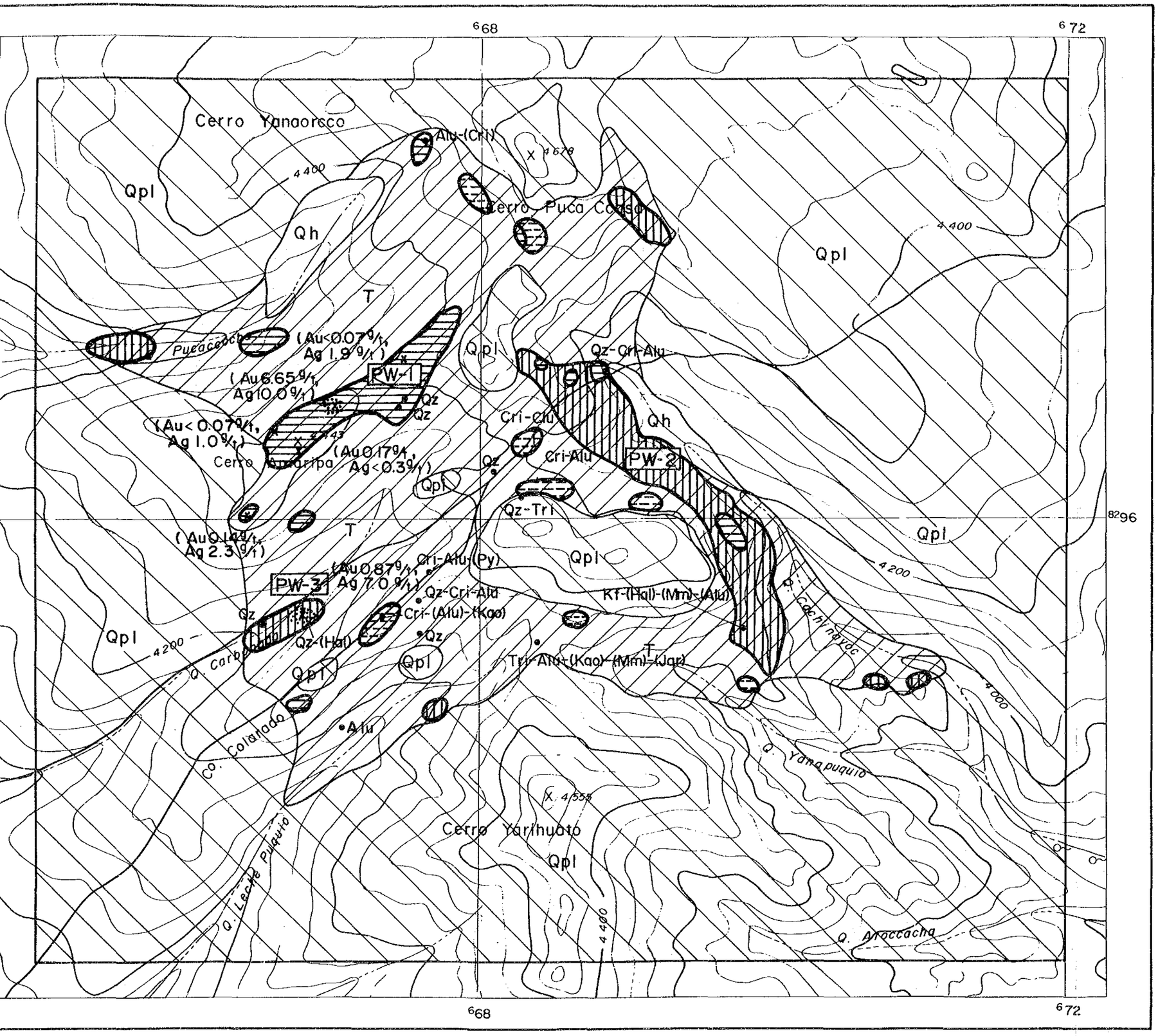
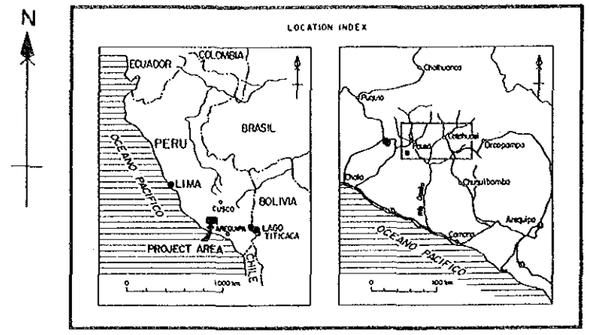


Fig. II-12 Location M
Alteration
Zone of th





N

0 1 2km

LEGEND

Geological System

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

Alteration and Mineralization Zones

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

Abbreviation

Qz : quartz
Tri : tridymite
Cri : α-cristobalite
Alu : alunite
Jar : jarosite
Hal : halloysite
Kao : kaolinite
Mm : montmorillonite

Fig. II-12 Location Map of Alteration and Mineralization Zone of the Pirca Western Area

Table II-6 List of Alteration and Mineralization Zones of the Pirca Area

Area	No.	Name	Location: Direction	Location: Distance (km)	Scale (km)	Alteration	Mineralization
Pirca Eastern Area	1	PE-1	SE (from Millo)	0.8	0.3 × 0.5	·Brown to light brown altered rhyolitic toff with pyrite dissemination and iron oxides. ·Hydrothermal alteration (silicification and argillization) ·Quartz vain (wideness: 0.1 1.0 m) [Qz + Ser + (Kao) + (Alu)]	·No significant mineralization observed
	2	PE-2	NE (from Millo)	0.5	0.1 × 0.3	·Brown altered zone contaminated by iron oxides. ·Hydrothermal alteration (silicification and argillization) [Qz + Alu + (Mm) + (Ser)]	·No significant mineralization observed ·Reddish brown massive iron oxides (hematite, limonite) are observed in drill cores of the hole MJP-8 ·Analysis of samples showed the maximum grade of Au < 0.07 g/t, Ag 4.7 g/t
	3	PE-3	N NW (from Pirca)	1.3∿1.6	0.6 × 1.4	·Brown, light brown and white grey altered zone ·Hydrothermal alteration (silicification and argillization) [Qz, Qz + Alu, Qz + Dic + (Alu), Qz + (Kao) + (Mn)]	·No significant mineralization observed
	4	PE-4	NW (from Pirca)	1.6∿3.0	0.4 × 1.4	·Brown to yellowish brown altered zone with white strongly siliceous rock. ·Hydrothermal alteration (silicification and argillization) [Qz + (Kao), Qz - (Ser/Mm)]	·No significant mineralization observed ·Analysis of samples showed the maximum grade of Au < 0.07 g/t, Ag 6.8 g/t.
	5	PE-5	NNW (from Millo)	0.7∿2.2	0.5 × 1.5	·Brown, yellowish brown and white altered zone ·Hydrothermal alteration (silicification and argillization) [Cri + Kao + Alu, Qz + Kf + Cri + KaO, Qz + Alu + Dic]	·No significant mineralization observed ·Two of analysed samples showed the grades of Au < 0.07 g/t, Ag 12.0 g/t and Au < 0.07 g/t, Ag 4.7 g/t
	6	PE-6	NW (from Millo)	0.9∿1.5	0.1 × 0.6	·Brown to light brown strongly argillaceous alteration zone with iron oxides. ·Hydrothermal alteration (Mainly argillization) [Qz + Mm + (Kao), Qz + Mm + Jar + (KaO)]	·No significant mineralization observed ·Analysis of samples showed the maximum grade of Au < 0.07 g/t, Ag 2.5 g/t
	7	PE-7	N E (Along the Q. Pacchs near by Millo)	0.3∿0.6	0.1 × 0.8	·Brown and yellowish brown strongly argillaceous alteration zone with iron oxides ·Hydrothermal alteration (Mainly argillization) [Qz + Kao + Pyp, Qz + (Mm) + (Ser) + (Chl)]	·No significant mineralization observed ·Analysis of a strongly argillaceous rock sample showed the grade of Au < 0.07 g/t, Ag 8.0 g/t
Pirca Western Area	8	PW-1	Ridge of Co. Antaripa		0.3 × 1.5	·Grey to light grey strongly silicified zone with quartz veinlets, partly pyrite dissemination [Mainly Qz, partly Qz + (Cri) + (Alu)]	·Weak mineralization of Au and Ag is observed ·One of spot samples from quartz veinlets in outcrop of siliceous rock showed the grade of Au 6.65 g/t, Ag 10.0 g/t
	9	PW-2	Along the right bank of the upper stream of Q. Cachinayoc		0.3 × 2.5	·Brown to light brown altered zone contaminated by iron oxides. ·Hydrothermal alteration (argillization and silicification) [Qz + Cri + Alu, Kf + (Hal) + (Mm) + (Alu)]	·No significant mineralization observed
	10	PW-3	Along the left bank of the upper stream of Q. Carbonada		0.15 × 0.5	·Light brown to greyish white altered zone with strongly siliceous parts. ·Hydrothermal alteration (silicification and argillization) [Qz, Qz + (Hal)]	·No significant mineralization observed ·A spot sample of siliceous rock showed the grade of Au 0.89 g/t, Ag 7.0 g/t

Abbreviations of alteration mineral .... Qz: quartz, Alu: Alunite, Kao: Kaolinite, Mm: Montmorillonite, Ser: Sericite, Jar: Jarosite, Dic: Dickite, Pyp: Pyrophyllite, Kao/Mm: Kaolinite-Montmorillonite mixed layer, Ser/Mm: Sericite-Montmorillonite mixed layer, Cri: Cristobalite

Table II-7 Chemical Analyses of Altered Rocks and Ore Samples of the Pirca Area

Name of Alteration Zone		Sample No.	Co-ordinates		Au g/t	Ag g/t	As %	Cu %	Pb %	Zn %	Remarks
			E (km)	N (km)							
Pirca Eastern Area	PE-1	PMV-2	676.2	8294.2	<0.07	2.3	0.004	<0.01	<0.01	<0.01	quartz vein (w = 0.80 m)
		PK-6	676.0	8294.2	<0.07	2.8	0.002	<0.01	0.01	0.01	strong siliceous rock
		PK-39	675.9	8294.1	0.07	<0.3	0.005	<0.01	<0.01	<0.01	strong siliceous rock (quartz vein?)
		PK-42	676.3	8294.2	<0.07	<0.3	<0.001	<0.01	<0.01	<0.01	quartz vein (w : 0.45 m)
	PE-2	PV-16	675.5	8294.8	<0.07	4.7	0.003	<0.01	<0.01	<0.01	siliceous rock
	PE-4	PK-30	675.0	8296.6	<0.07	6.8	0.005	<0.01	0.01	0.01	siliceous rock
		Pm-25	675.4	8295.8	<0.07	2.5	0.002	<0.01	<0.01	<0.01	"
	PE-5	Pm-13	674.0	8295.9	<0.07	4.7	0.004	<0.01	<0.01	<0.01	argillaceous rock with pyrite
		Pm-24	675.4	8295.2	<0.07	12.0	0.001	<0.01	0.01	0.01	"
		PZ-14	674.8	8295.6	0.07	3.3	0.022	<0.01	<0.01	<0.01	siliceous rock with limonite stains
		PZ-15	674.8	8295.6	<0.07	0.3	0.006	<0.01	<0.01	<0.01	"
	PE-6	Pm-9	674.1	8295.2	<0.07	2.5	0.022	<0.01	<0.01	<0.01	white argillaceous rock
		Pm-10	674.0	8295.4	<0.07	0.8	0.040	<0.01	<0.01	<0.01	"
		Pm-11	674.0	8295.5	<0.07	1.0	0.002	<0.01	<0.01	<0.01	siliceous rock
	PE-7	PK-25	675.1	8294.8	<0.07	1.7	0.011	0.01	<0.01	0.01	siliceous rock (quartz vein?)
		Pm-20	675.4	8294.7	<0.07	8.0	0.028	<0.01	0.01	0.02	argillaceous rock with pyrite
	Others	Pm-2	673.8	8294.1	<0.07	0.8	0.002	<0.01	<0.01	<0.01	massive quartz (float)
		PZ-6	675.8	8296.5	<0.07	3.0	0.008	<0.01	<0.01	<0.01	altered rock with iron oxides
		PZ-12	674.8	8295.0	<0.07	1.7	0.001	<0.01	<0.01	<0.01	calcedonic quartz (float)
Pirca Western Area	PW-1	PN-31	667.5	8297.1	<0.07	1.9	0.002	<0.01	<0.01	<0.01	siliceous rock
		PV-21	666.6	8296.6	<0.07	1.0	0.002	<0.01	<0.01	<0.01	"
		WG-2	667.0	8296.8	6.65	10.0	0.006	<0.01	0.02	0.01	grey quartz vein
		WPK-1	666.8	8296.5	0.17	<0.3	<0.001	<0.01	<0.01	<0.01	strong siliceous rock
		WPZ-6	666.4	8296.0	0.14	2.3	0.007	<0.01	<0.01	<0.01	white siliceous rock
	PW-3	WG-1	666.8	8295.3	0.89	7.0	0.009	<0.01	0.04	0.01	siliceous rock
		WPZ-10	666.5	8295.3	<0.07	<0.3	0.001	<0.01	<0.01	<0.01	strong siliceous rock
	Others	PN-24	667.7	8295.7	<0.07	<0.3	0.008	<0.01	<0.01	<0.01	siliceous rock