CHAPTER 2 RECOMMENDATION FOR THE PHASE Ⅲ SURVEY

The results of the phase Ⅰ and phase Ⅱ surveys verified that the geochemical anomaly from the stream sediments extracted by INGEMMET prove a high probability of mineralized indication. Through the phase Ⅰ survey, a great number of mineralized alteration zones were recognized in the hinterland of geochemically anomalous zones and areas with high potential of existence of gold deposit are detected under the detailed geological survey in phase Ⅱ. The mineralized alteration zones detected in newly surveyed area under the semi-detailed survey in phase Ⅱ are very promising. It is, therefore, recommended that a semi-detailed geological survey be implemented for the Tuna anomalous zone, which is an only area remained pending for survey, to detect the mineralization potential throughout the survey area and to finish the evaluation of the survey area.

The mineralized alteration zones detected in Hualatan West under the semi-detailed survey in phase Ⅱ suggest that a zone with large-scaled quartz veins can exist just above the rise of high resistivity basement, which is confirmed by geophysical survey using the CSAMT method. The distribution of temperature estimated by homogenization of fluid inclusion shows that it is zonal, centering the highest part to the said rise. Moreover, the values of temperature suggest that there can exist a zone in the deep extension beneath the large-scaled quartz veins most adequate for gold and silver mineralization. It is therefore recommended that a drilling survey be implemented for the alteration zone to verify the gold mineralization in the large-scaled quartz veins. Additionally, geophysical survey (gravity prospecting, for example) is recommended to verify the basement structure and the aspects of basement rocks, because the basement structure can play an important role to form the ore shoot during the mineralization.

Drilling survey performed in phase Ⅱ in the Jehuamarca area revealed that silicified zone extracted as high resistivity zone through geophysical survey can be characterized by a mushroomed structure as interpreted through the phase Ⅰ survey. In the silicified zone it can commonly exist not only auri-argentiferous base metal dissemination deposits but also a layered quartz zone with high grade mineralization of gold, silver, copper, lead and zinc, which is concordant to the bedding. Moreover, silicified breccia with gold and silver anomalies, in the oxidized-leached zone near the surface, can contain productive mineralized zone of gold and silver. It is, therefore, recommended that drilling survey be performed to verify the horizontal extension of the mineralized zone to prepare for extraction of productive area. As an available geological map (on the scale of 1/10,000) is insufficient for the analysis of geology of drilling section, more detailed geological survey (with a scale of 1/2,000, for example) is recommended to be performed together with the drilling survey for an interpretation.

Based on these recommendations, evaluating the priority of the surveying areas (Fig. Ⅲ-1) extracted by each survey method, their priority of each area is summarized as Table Ⅲ-1.

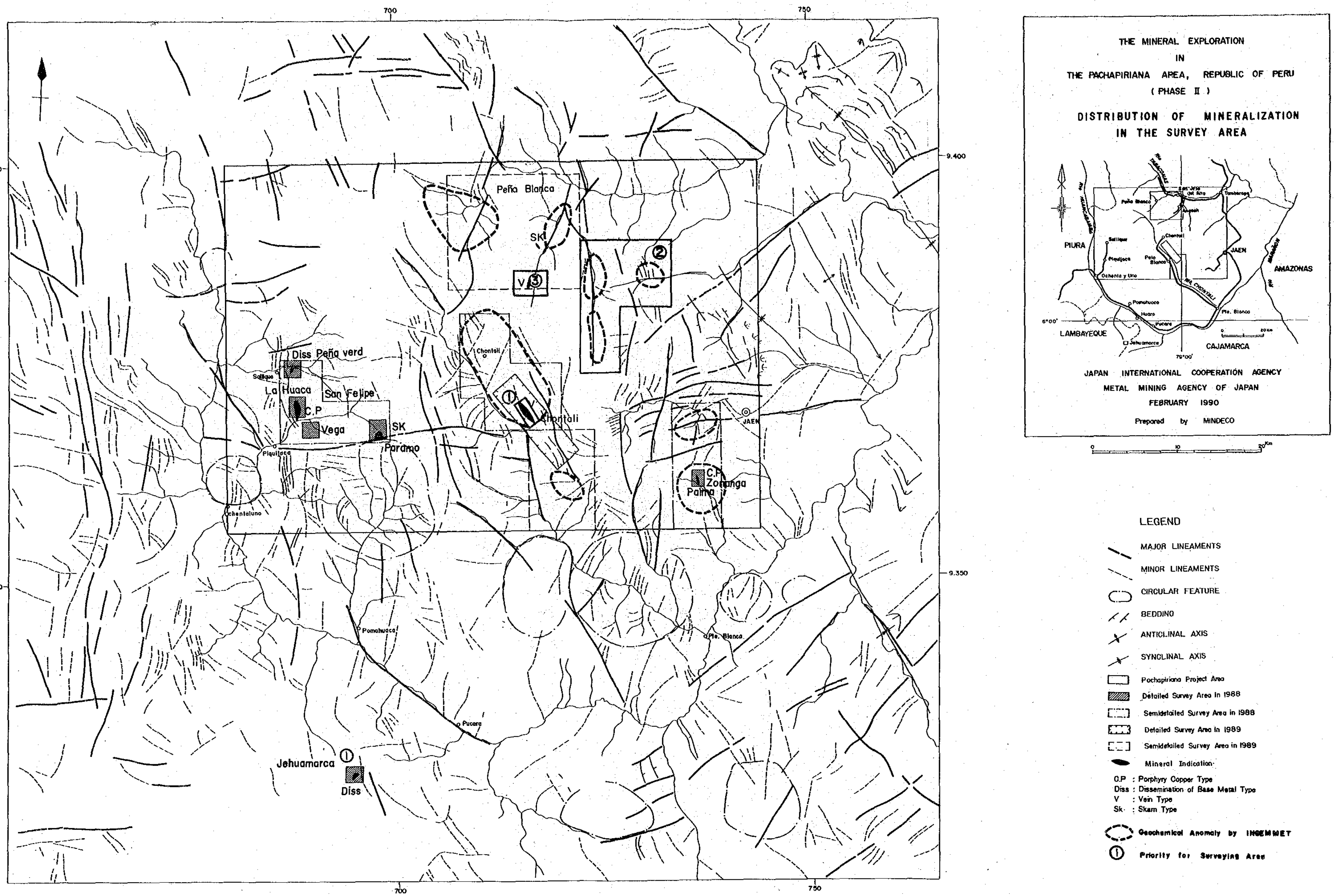

Fig. III-1 Location Map of the Recommended Survey Area for the Future

Table Ⅲ-1 Summarized Recommendation for the Future Survey

Area	Geological Survey			Geophysical Survey		Boring Survey		Priority for Survey Area
	Semi-detailed	Detailed 1/5,000~1/10,000	Ultra-detailed 1/1,000~1/2,000	CSAMT	Gravity	Recon-naissance	Semi-detailed	
Jehuamarca	→	●(4)	◎(1.5)	●(4)		● (816.25)	◎	①
Chontali	●(120)	●(42)	◎(4.5)	●(35)	○(20)	◎		①
Tuna	○(144)							②
Peña Blanca	●(220)	△(12)		△(12)				③

●:Finished →:Omission

():Survey Area in km or Length of Drilling in meter

Priority of the Each Survey Method

◎:the First ○:the Second △:the Third

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APPENDIXES

Apx. 1 Microscopic Observations of Thin Sections

Sample No.	Rock Name	Area	Geol. unit	Texture	Grain / Phenocryst / Main component mineral: Rock fragment	Quartz	Alkali-feldspar	Plagioclase	Biotite	Hornblende	Clinopyroxene	Sericite	Vesuvianite	Scapolite	Carbonate	Al-Chlorite	Opaque mineral
H081804	trachyandesite	C	Oy	porphyritic				◎ 3/0.1			△ 2.7/.06						
Y080304	monzonite	C	Mz	porphyritic				○ 2.9/.15			△ 1.8/.01						
Y082603	meta-andesite	C	Oy	grano-blastic				* 2.5>			* 1.3>						
H072507	altered dacite	CS	Oy	porphyritic		* 1.5/.6	* 1.7/.3	△ 2.6/.25									
H072511	silicified amphibole dacite	CS	Oy	porphyritic		△ .5/.15		○ 3.0/.15	* .5/.06	△ .95/.08							
A082911	rhyolite	CS	Rh	fluidal		○ .2/.01						◎ .18/.01					
MJPJ-1 274.6m	altered andesite	Je	Po	porphyritic intersertal				○ 1.7/.13									
MJPJ-2 35.6m	siltstone	Je	Po	clastic	mudstone * .4	△ .1/.02			○ .3/.01								△ .72/.02
MJPJ-2 258.7m	altered dacite	Je	Po	porphyritic		△ 1/.08		○ 3.6/.16		△ .85/.12							
MJPJ-3 154.25m	dacitic welded tuff	Je	Po	eutaxitic		△ 1.5/.13											
H090805	altered andesite	Pe	Sa	porphyritic				○ 6/.18		△ 1.5/.35							
H091202	granular limestone	Pe	Le	granoblastic											◎ .15/.01		
H091304	brecciated rhyolite	Pe	Rh	brecciated	rhyolite ○ 7.1/.1												
H091508	schistose sandstone	Pe	Sa	clastic		○ .2/.05		△ .2/.07									
H091602	biotite amphibole granodiorite	Pe	Gd	holocrystal equigranular		○ 2.5/.5	* .6/.08	◎ 2.1/.12	△ .85/.04	△ 2.1/.03							
H091910	biotite amphibole granodiorite	Pe	Gd	holocrystal equigranular		△ 2.7/.04	△ 2.8/.05	◎ 3.3/.13	△ 1.45/.05	△ 2.5/.05	* 2.2/.08						
A090406	altered sandstone	Pe	Sa	clastic	siltstone △ .9/.18	○ 1.9/.03	* .4/.1										
A090701	bsltic autobrecciated lava	Pe	Oy	hyalopilitic				○ 3/.07			△ 1.7/.15						
A090904	metadiorite porphyry	Pe	Gd	porphyritic				○ 4.3/.15		△ 4.3/.13							
A092206	diopside vesuvianite scapolite marble	Pe	Le	nemato-blastic				△ .8/.06		△ .2/.05	○ .35/.02		△ 2.1/.05	△ 1.3/.08	◎ 1.7/.03	○ .8/.03	
Y090501	metadacite (marginal facies)	Pe	Mz	porphyritic		* 1.4/.13		△ 3.8/.08		△ 2.8/.05							
Y092010	amphibole granodiorite	Pe	Gd	holocrystal equigranular		△ 1.3/.03	△ 1.3/.06	◎ 2.9/.08		△ 1.7/.11							
Y092220	biotite amphibole adamellite	Pe	Gr	holocrystal equigranular		△ 3.75/.1	○ 4.7/.07	○ 6/.07	△ 1.4/.07	○ 1.2/.07	* 2.9/.14						
Y092311	amphibole granodiorite	Pe	Gd	holocrystal equigranular		△ 1.1/.05	* .4/.02	○ 2.6/.05		△ 3.4/.04							

Sample No.	Quartz	Alkali-feldspar	Plagioclase	Hornblende	Clinopyroxene	Biotite	Matrix / Groundmass / Accessory mineral: Apatite	Sphene	Anatase	Zircon	Glass	Carbonate	Carbonic material	Sericite	Chl
H081804		△ .2>	○ .15>								△ .05>				
Y080304			○ .1>		△ .15>		* .2>	* .1>							
Y082603			△ .07>							* .2>					
H072507	○ .8>	○ .15>						* .05>		* .13>					
H072511							* .1>			* .12>	○				
A082911						△ .12>							* .05>		
MJPJ-1 274.6m			○ .13>				* .75>								
MJPJ-2 35.6m															
MJPJ-2 258.7m	○ .03>		○ .16>	* .12>			* .15>				○				
MJPJ-3 154.25m	△ .13>								* .1>						
H090805			○ .2>								○				
H091202	△ 1.5/.03											△ .35/.02			
H091304	◎ .02>														
H091508	○ .2>					△ .2>							△ .06>	○ .15>	△ .1
H091602								△ .2>							
H091910							* .02>	* .67>							
A090406															
A090701			○ .15>								○				
A090904	○ .1>		△ .05>	△ .18>			* .45>								
A092206							* .06>	△ .2/.04							△ .1
Y090501	* .13>		△ .08>	* .05>			* .18>				○				
Y092010							* .25>	* .6>							
Y092220							* .35>	* .18>		* .14>					
Y092311								△ .3>							

◎:abundant ○:common △:few *:rare

Grain size : maximum/minimum (mm)

Abbreviations C:Chontali, CS:Chontali South, Je:Jehuamarca, Pe:Pena Blanca
Gd:Granodiorite, Gr:Granite, Le:Leche formation, Mz:monzonite, Oy:Oyotun formation, Po:Porculla formation, Rh:Rhyolite, Sa:Salas gr

...t mineral					Matrix / Groundmass / Accessory mineral																			Secondary mineral												
Vesuvianite	Scapolite	Carbonate	Al-Chlorite	Opaque mineral	Quartz	Alkali-feldspar	Plagioclase	Hornblende	Clinopyroxene	Biotite	Apatite	Sphene	Anatase	Zircon	Glass	Carbonate	Carbonic material	Sericite	Chlorite	Clay mineral	Sphalerite	Opaque mineral	Fossil	Quartz	Albite	Biotite	Hornblende	Actinolite	Chlorite	Sericite	Epidote	Clay mineral	Cristobalite	Carbonate	Sphalerite	Opaque mineral
						△ .2>	○ .15>								△ .05>							△ .2>							△ .03>					△ .25>		
							○ .1>		△ .15>		* .2>	* .1>										△ .7>		* .15>	○ 2.9>				○ .15>	* .1>						
							△ .07>							* .2>								* .25>		◎ .1>	△ .07>	△ .04>				◎ .3>						
					○ .8>	○ .15>						* .05>		* .13>								* 1.1/.06		△ .1>	○				△ 1.2>	△ .05>	△ .3>					
											* .1>			* .12>	○							△ .2>		◎ .2>	△ 3>				△ .02>	◎ .1>				○ .25>		
										△ .12>							* .05>					△ .3>														
							○ .13>				* .75>											△ .25>			○ .15>				△ .2>	* .07>				△ .07>		
				△ .72/.02																◎			* .1>													
					○ .03>		○ .16>	* .12>			* .15>				○							* .3>			○ 3.6>				* .12>	△ .1>	△ .6>			△ .3>	* .2>	
					△ .13>								* .1>									△ .4>		△ .06>						○ .1>		* .2>				
							○ .2>								○							△ .07>		△ .15>	△ 4.6>				△ .1>	◎ .15>				○ .2>		
		◎ .15/.01			△ 1.5/.03											△ .35/.02						△ .4>														
					◎ .02>																	○ .02>		○ 12.5/.03										△ .2>		
					○ .2>					△ .2>							△ .06>	○ .15>	△ .14>			* .07>		○ .2>		△ .2>			△ .14>	○ .15>						* .07>
												△ .2>										△ .25>							△ .8>		△ .5>					
											* .02>	* .67>										* .7>							△ 2.5>	△ .25>	△ .7>					
																								○ .1>		* .1>			* .08>	△ .25>						○ .2>
							○ .15>								○										○ 3>				○ .03>		△ .5>		△ .03>	△ .12>		
					○ .1>		△ .05>	△ .18>			* .45>											△ .4>		○ .25>		△ .15>										
△ 2.1/.05	△ 1.3/.08	◎ 1.7/.03	○ .8/.03								* .06>	△ .2/.04							△ .1>		* .3/.02	△ .3/.02														
					* .13>		△ .08>	* .05>			* .18>				○							* .2>		○ .2>		△ .25>	△ .4>		△ .3>							
											* .25>	* .6>																* .7>	* .65							
											* .35>	* .18>		* .14>								* .5>							* .15>	△ .2>	* .1>					
												△ .3>										* .92>			○ 2.6>				△ 1.4>	○ .25	△ .5>					

◎:abundant ○:common △:few *:rare Grain size : maximum/minimum (mm)

Abbreviations C:Chontali, CS:Chontali South, Je:Jehuamarca, Pe:Pena Blanca
Gd:Granodiorite, Gr:Granite, Le:Leche formation, Mz:monzonite, Oy:Oyotun formation, Po:Porculla formation, Rh:Rhyolite, Sa:Salas group

Result of microscopic observation (thin section)

H081804 (Chontali) Trachyandesite

It is porphyritic with abundant phenocrysts of prismatic and euhedral plagioclase and a few pyroxene. The latter tends to perfectly be replaced by chlorite. The groundmass is pilotaxitic and composed of plagioclase laths embedded in K-feldspar and a few glass. Constituent minerals of phenocrysts and groundmass are replaced by chlorite and calcite.

Y080304 (Chontali) Monzonite porphyry

It is porphyritic with abundant phenocrysts of short- prismatic and euhedral plagioclase and pyroxene. The latter tends to perfectly be replaced by clay minerals. The groundmass is composed of prismatic plagioclase, euhedral pyroxene, pale brownish apatite, pale brownish sphene and opaque minerals. Plagioclase is replaced by albite, and mafic minerals by chlorite, quartz and sericite.

Y082603 (Chontali) Meta-andesite

It is porphyritic but partly changed to be granoblastic with phenocrysts of sericitized plagioclase and short- prismatic mafic minerals. The groundmass is composed of albitized plagioclase, zircon and opaque minerals. As secondary minerals occur albite replacing plagioclase, granoblastic aggregate of quartz and biotite and sericite replacing mafic minerals.

H072507 (Chontali South) Altered dacite

It is porphyritic with essential phenocrysts of plagioclase, K-feldspar and quartz. The former two almost tend to be replaced by albite, quartz, chlorite, epidote and sericite. The groundmass is holocrystalline and intergranular texture, in which wedge-shaped areas between albitized plagioclase prisms are filled with granular quartz. Such accessory minerals as sphene and zircon are embedded in a groundmass.

H072511 (Chontali South) Silicified hornblende dacite

It is porphyritic with essential phenocrysts of plagioclase, quartz, biotite and hornblende. The phenocrysts except for quartz tends to be replaced by albite, chlorite, sericite, calcite and quartz. The groundmass is composed essentially of glass, which is almost replaced by sericite and quartz. Such accessory minerals as sphene and zircon are embedded in a groundmass.

A082911 (Chondali South) Rhyolite

It is microcrystalline and equigranular, showing a flow structure. Main constituents are sericite and quartz. The former is granular and/or lepidoblastic and/or vein-filling and are arranged parallel to the flow structure. The latter is anhedral and granular and/or fragmental. As accessory minerals occur biotite, opaque minerals and carbonaceous materials. Biotite is intercalated with sericite and mixed with vermiculite.

MJPJ-1 274.6m (Jehuamarca) Altered andesite

It is porphyritic and intersertal but intensely altered. Phenocryst is composed only by short-prismatic plagioclase with euhedral shape of 0.13-1.70 mm in length. The groundmass is composed of euhedral short-prismatic plagioclase, very subordinate opaque minerals and accessory apatite with acicular and/or prismatic shape. As secondary minerals occur lepidoblastic sericite replacing plagioclase, irregularly shaped albite and fine grained and radial arranged aggregate of chlorite and carbonates.

MJPJ-2 35.6m (Jehuamarca) Siltstone

It is a clastic rock with microfossils. A few of brecciated mudstone of 0.4 mm in diameter are included as rock fragment. The silt grains consist of hydromica with a diameter ranging from 0.03 to 0.30 mm as well as of quartz and opaque minerals ranging from 0.02 to 0.10 mm. Matrix is constituted by aphanitic and/or cryptocrystalline clay minerals. Microfossils are less than 0.1 mm in diameter with ellipsoidal and/or spheroidal shape.

MJPJ-2 258.7m (Jehuamarca)   Altered dacite

It is porphyritic with a cryptocrystalline groundmass. Phenocryst is intensely replaced by secondary minerals and is composed of prismatic and short-prismatic pseudomorph of plagioclase, very subordinate quartz and hornblende. Hornblende is perfectly replaced by secondary minerals. The groundmass is composed of plagioclase and quartz which are embedded in glass and a few amounts of hornblende, apatite and opaque minerals. As secondary minerals occur sericite and albite replacing plagioclase, chlorite replacing mafic minerals and vein filling carbonates. Very fine grained sphalerite is associated by opaque minerals, which is inferred to be pyrite, in carbonate veins.

MJPJ-3 154.25m (Jehuamarca)   Altered dacitic welded tuff

It is porphyritic and eutaxitic but intense alteration makes an original texture unclear. Phenocryst is composed only of subhedral to anhedral quartz of 0.13-1.50 mm in length. It is granular, corroded and fragmental. Matrix is composed of subhedral to anhedral quartz less than 0.13 mm, opaque minerals and accessory anatase and sphalerite. As secondary minerals occur anhedral sericite less than 0.1 mm, very subordinate quartz and accessory clay minerals.

H090805 (Peña Blanca)   Altered andesite

It is porphyritic with essential phenocrysts of plagioclase and subordinate mafic minerals. Plagioclase tends to be replaced almost by sericite and calcite, and sometimes by albite. Mafic minerals are altered to be mantled by iron-oxides and replaced perfectly by the aggregate of chlorite, calcite and sericite. The groundmass is composed of plagioclase with prismatic to lath shapes, glass and subordinate opaque minerals. Sericitization and calcitization are intense in a groundmass.

H091202 (Peña Blanca) Granular limestone

It is recrystallized limestone with granoblastic texture. Main constituent is anhedral calcite as equigranular aggregate and sometimes as a porphyroblast of 1 mm in diameter. Quartz veinlets traverse associating ankerite and opaque minerals.

H091304 (Peña Blanca) Brecciated rhyolite

It is brecciated and composed of rhyolitic fragments and felsic matrix. The fragments are in the range from 0.1 to 7.1 mm in diameter and shows cryptocrystalline texture composed by clay minerals and recrystallized felsic minerals. Veinlets of quartz traverse in a matrix with an aggregate of fine felsic and clay minerals. Siderite occurs as secondary mineral. Intense silicification makes an original texture unclear.

H091508 (Peña Blanca) Schistose sandstone

It is a clastic rock with grains of plagioclase and quartz embedded in a fine grained matrix. Plagioclase is prismatic to fragmental and are albitized as a whole. Quartz is fragmental and frequently recrystallized. Main constituents of matrix are granular to metasomatic quartz, aggregate of fibrous to granular biotite, granular to foliated chlorite with pale greenish tint, and parallel arranged lepidoblastic sericite, opaque minerals and carbonaceous materials.

H091602 (Peña Blanca) Biotite hornblende granodiorite

It is holocrystalline and equigranular. Main constituent is prismatic to granular plagioclase and anhedral granular quartz, next in abundance is platy to foliated biotite and subhedral hornblende of grayish green to pale yellow tint, then K-feldspar. Mafic minerals are associated with accessory sphene and opaque minerals and are partly replaced by chlorite and epidote.

H091910 (Peña Blanca) Biotite hornblende granodiorite

It is holocrystalline and equigranular. Main constituent is prismatic euhedral plagioclase, next in abundance is anhedral K-feldspar, anhedral quartz filling the interstices between the plagioclase, platy to foliated biotite and anhedral prismatic hornblende, then clinopyroxene. Mafic minerals are associated with accessory sphene, apatite and opaque minerals. Mafic minerals, Plagioclase and K-feldspar are partly replaced by chlorite, epidote and sericite.

A090406 (Peña Blanca) Altered sandstone

It is a clastic rock with silty rock fragments, and grains of plagioclase and quartz embedded in a fine grained matrix. The rock fragments are subangular to rounded in size of 0.18-0.9 mm. K-feldspar is anhedral and granular, partly replaced by fine grained secondary minerals. Quartz is anhedral and well-rounded. Main constituents of matrix are granular quartz, granular to platy biotite with pale yellow to pale brownish tint, chlorite, sericite and opaque minerals.

A090701 (Peña Blanca) Autobrecciated basaltic lava

It is porphyritic, porous and autobrecciated. Phenocryst is albitized plagioclase with euhedral and prismatic habit and perfectly altered pyroxene with euhedral to subhedral habit. Groundmass is porous and hyalopilitic with albitized plagioclase laths and chloritized glass. Interstices are filled with such secondary minerals as albite, chlorite, epidote, calcite and cristobalite.

A090904 (Peña Blanca) Altered diorite porphyry

It is holocrystalline and porphyritic with phenocrysts of long-prismatic to prismatic plagioclase and prismatic mafic minerals. The former tends to be replaced by sericite and biotite and the latter by biotite, sericite and iron oxides. The groundmass is composed of short-prismatic plagioclase replaced by sericite, granular quartz, biotitized mafic minerals, apatite and opaque minerals.

A092206 (Peña Blanca) Diopside-vesuvianite-scapolite marble

It is nematoblastic constituted by such three zones with different mineral assemblages as scapolite-diopside-calcite, diopside-scapolite-opaque minerals-calcite and chlorite- diopside-anorthite-vesuvianite-scapolite-calcite-sphene. Main constituent is irregularly shaped platy calcite associated with subordinate diopside and scapolite, short-prismatic colorless diopside, prismatic vesuvianite, prismatic colorless amphiboles, scapolite, anorthitic plagioclase and colorless Al-chlorite. Accessory minerals are vesuvianite, pale greenish chlorite replacing Al-chlorite, pale brownish sphene, apatite, opaque minerals and sphalerite.

Y090501 (Peña Blanca) Meta-dacite

It is porphyritic with glassy groundmass converted into quartz, biotite and amphiboles due to the thermal metamorphism. The phenocrysts are of prismatic plagioclase, quartz and euhedral hornblende perfectly replaced by secondary minerals. Groundmass are of plagioclase, quartz, mafic minerals, apatite, devitrified glass and opaque minerals. As secondary minerals occur quartz, biotite replacing hornblende, chlorite and amphiboles.

Y092010 (Peña Blanca) Hornblende granodiorite

It is holocrystalline and equigranular. Main constituent is prismatic euhedral plagioclase, subhedral to anhedral hornblende and irregularly-shaped granular K-feldspar and quartz. Accessory minerals are apatite and pale brownish sphene. Secondary minerals are actinolite and chlorite, replacing hornblende.

Y092220 (Peña Blanca) Biotite hornblende adamellite

It is holocrystalline and equigranular. Main constituent is perthitic K-feldspar, subhedral prismatic hornblende, plagioclase, quartz, biotite and corroded clinopyroxene preserved in a core part of hornblende. Accessory minerals are zircon, apatite, sphene and opaque minerals. Secondary minerals are chlorite replacing biotite, and epidote and sericite replacing plagioclase.

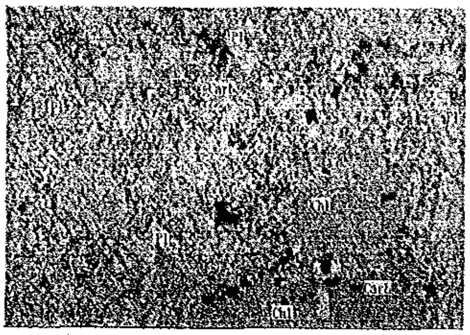
Y092311 (Peña Blanca) Hornblende granodiorite

It is holocrystalline and equigranular. Main constituent is plagioclase, quartz, prismatic hornblende and K-feldspar. Accessory minerals are pale brownish sphene and opaque minerals. Secondary minerals are albite, sericite and epidote replacing plagioclase, and chlorite replacing hornblende.

Apx. 2 Microscopic Photographs of Thin Sections

Abbreviations

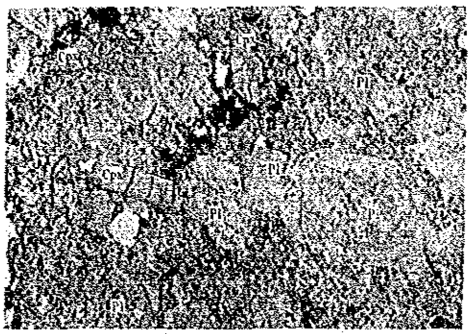
Act : actinolite	Hb : hornblende
Ank : ankerite	Kf : alkali feldspar
Bi : biotite	Opq : opaque minerals
Cal : calcite	Pl : plagio clase
Carb : carbonate	Qz : quartz
Chl : chlorite	Rf : rock fragments
Clay : clay minerals	Ves : vesuvianite
Cpx : clinopyroxene	Sc : scapolite
Ep : epidote	Ser : sericite
Fs : microfossils	Sph : sphene



Plain polarized light　　0　1.0mm

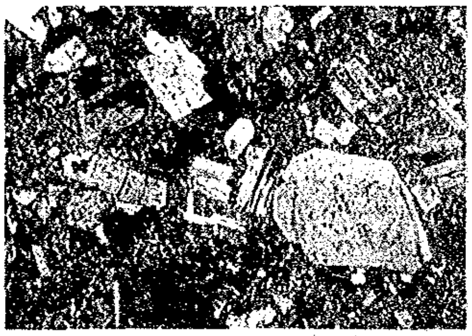
Sample No. : H081804
Area: Chontali
Rock Name : Trachyandesite

Crossed polarized light　　0　1.0mm



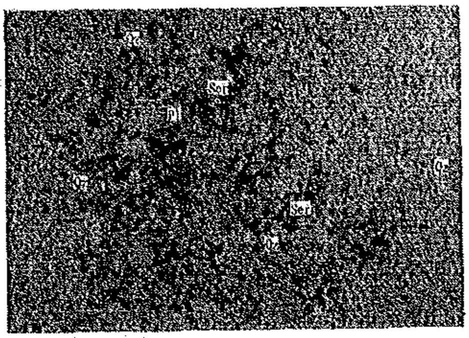
Plain polarized light　　0　1.0mm

Sample No. : Y080304
Area: Chontali
Rock Name : Monzonite porphyry

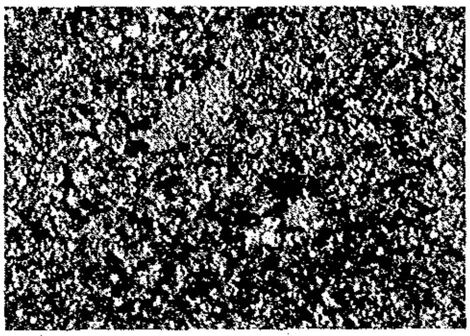


Crossed polarized light　　0　1.0mm

Sample No. : Y082603
Area: Chontali
Rock Name : Meta-andesite

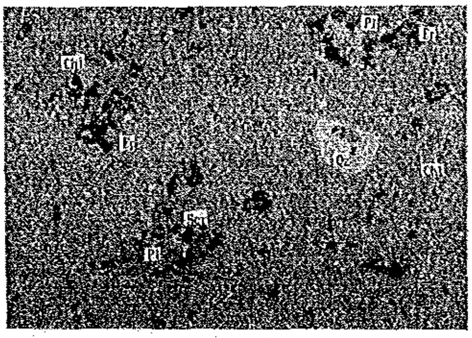


Plain polarized light 0 0.5mm

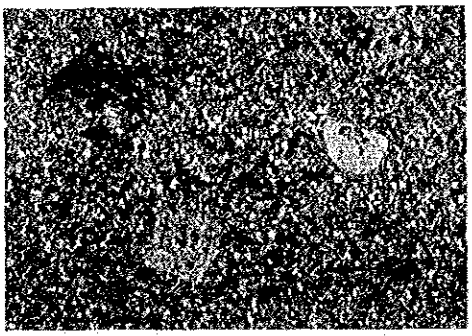


Crossed polarized light 0 0.5mm

Sample No. : H072507
Area: Chontali South
Rock Name : Altered dacite

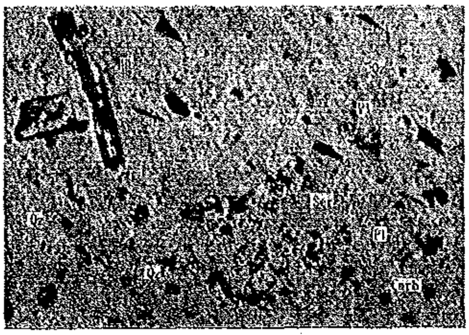


Plain polarized light 0 1.0mm



Crossed polarized light 0 1.0mm

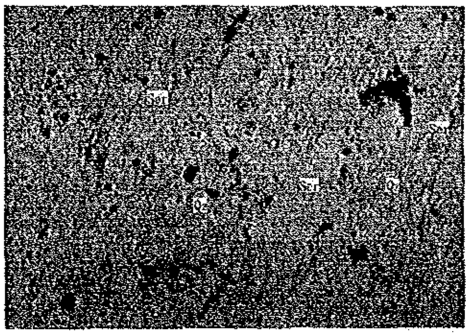
Sample No. : H072511
Area: Chontali South
Rock Name : Silicified amphibole dacite



Plain polarized light 0 1.0mm

Crossed polarized light 0 1.0mm

Sample No. : A082911
Area: Chontali South
Rock Name : Rhyolite



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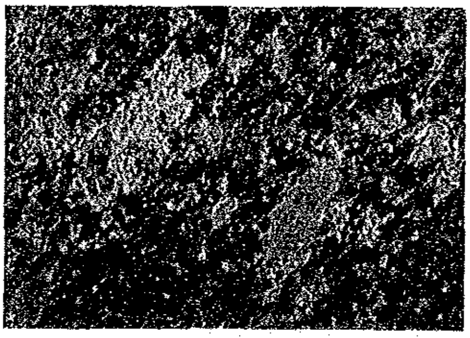
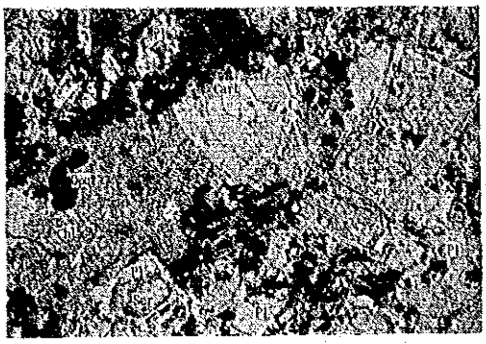
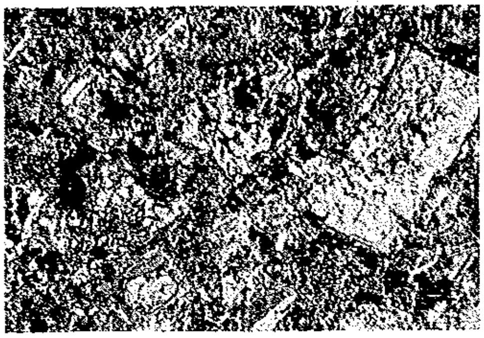


Crossed polarized light 0 1.0mm

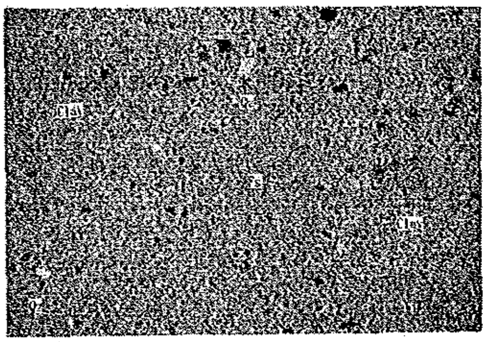


Plain polarized light 0 0.5mm

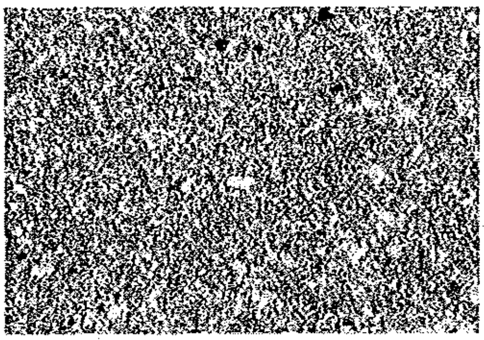


Crossed polarized light 0 0.5mm

Sample No. : MJPJ-1 247.6m
Area: Jehuamarca
Rock Name : Altered andesite



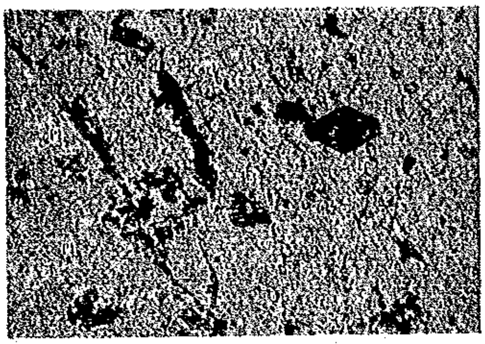
Plain polarized light 0 0.5mm



Crossed polarized light 0 0.5mm

Sample No. : MJPJ-2 35.6m
Area: Jehuamarca
Rock Name : Siltstone

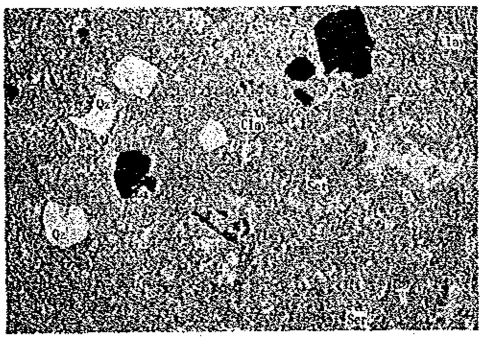
Sample No. : MJPJ-2 258.7m
Area: Jehuamarca
Rock Name : Altered dacite



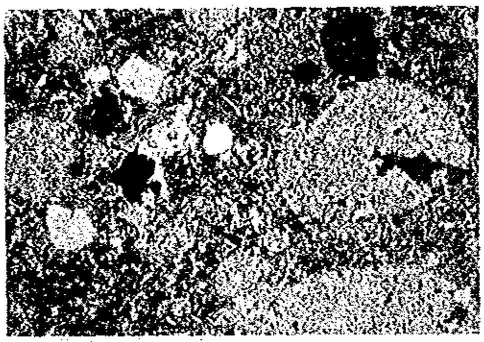
Plain polarized light 0 0.5mm

Crossed polarized light 0 0.5mm

Sample No. : MJPJ-3 154.25m
Area: Jehuamarca
Rock Name : Dacitic welded tuff



Plain polarized light 0 0.5mm

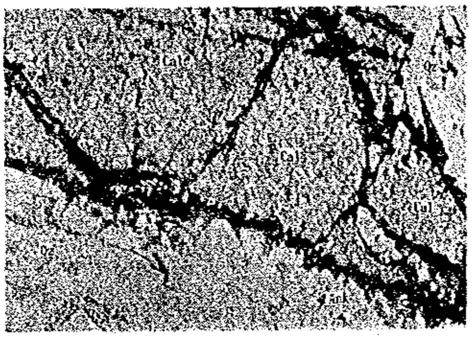


Crossed polarized light 0 0.5mm

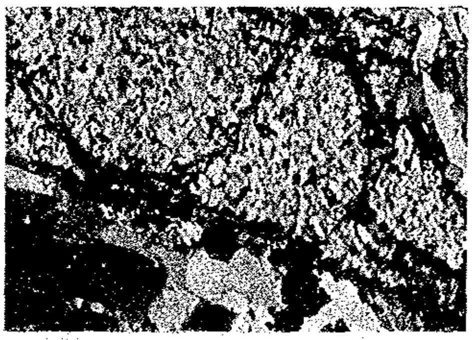
Plain polarized light 0 1.0mm

Crossed polarized light 0 1.0mm

Sample No. : H090805
Area: Peña Blanca
Rock Name : Altered andesite

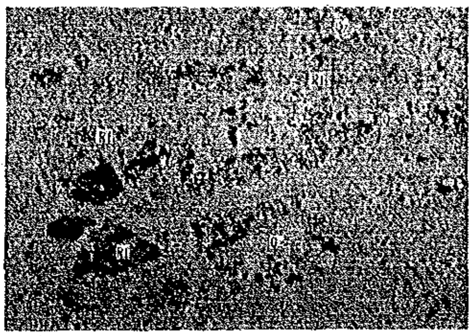


Plain polarized light 0 1.0mm



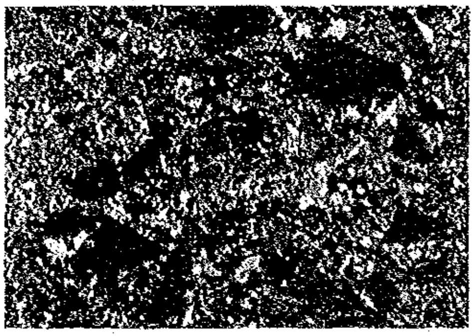
Crossed polarized light 0 1.0mm

Sample No. : H091202
Area: Peña Blanca
Rock Name : Granular limestone

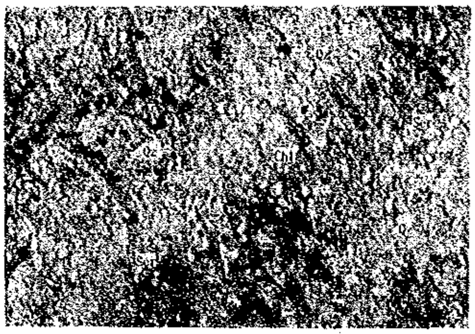


Plain polarized light 0 1.0mm

Sample No. : H091304
Area: Peña Blanca
Rock Name : Brecciated rhyolite

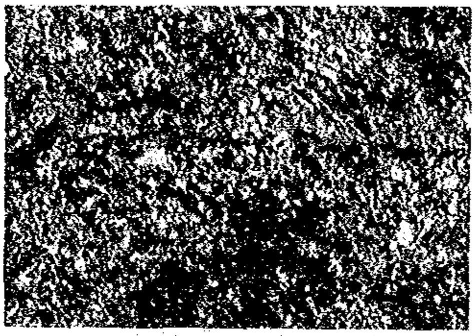


Crossed polarized light 0 1.0mm



Plain polarized light 0 1.0mm

Sample No. : H091508
Area: Peña Blanca
Rock Name : Schistose sandstone

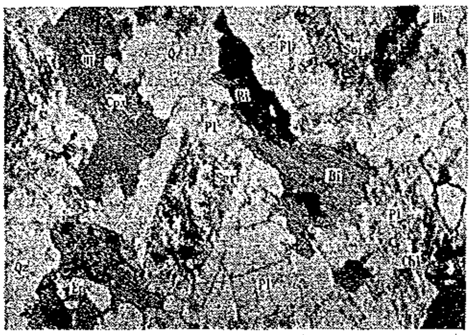


Crossed polarized light 0 1.0mm

Plain polarized light 0 1.0mm

Sample No. : H091602
Area: Peña Blanca
Rock Name : Biotite amphibole granodiorite

Crossed polarized light 0 1.0mm

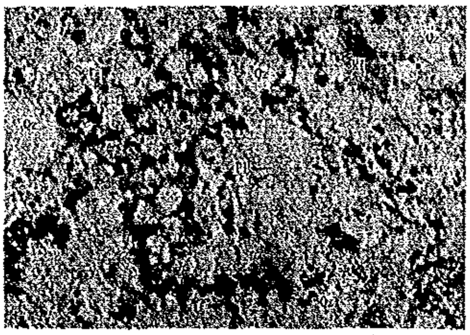


Plain polarized light 0 1.0mm

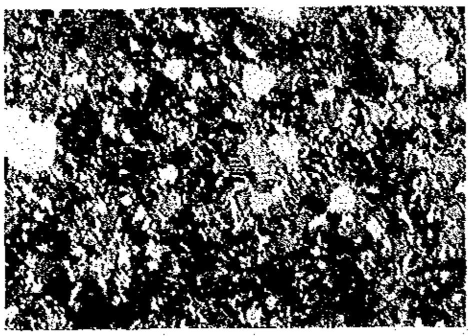
Sample No. : H091910
Area: Peña Blanca
Rock Name : Biotite amphibole granodiorite

Crossed polarized light 0 1.0mm

Sample No. : A090406
Area: Peña Blanca
Rock Name : Altered sandstone

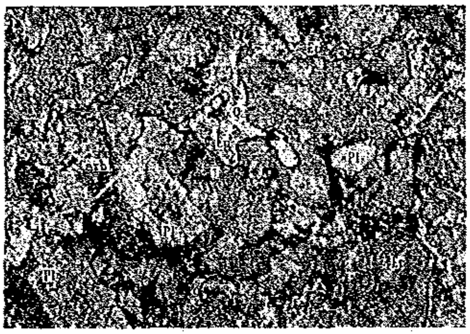


Crossed polarized light 0

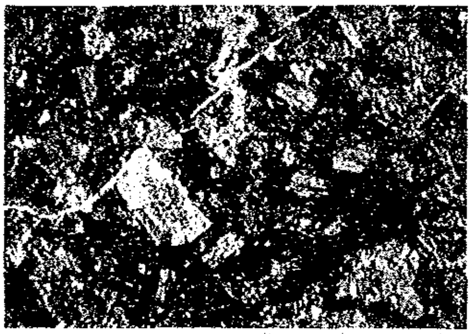


Plain polarized light 0

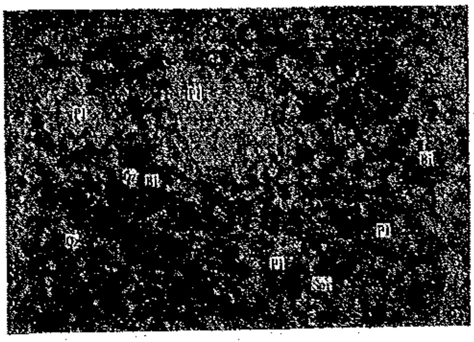
Sample No. : A090701
Area: Peña Blanca
Rock Name : Basaltic autobrecciated lava



Plain polarized light 0 1.0mm

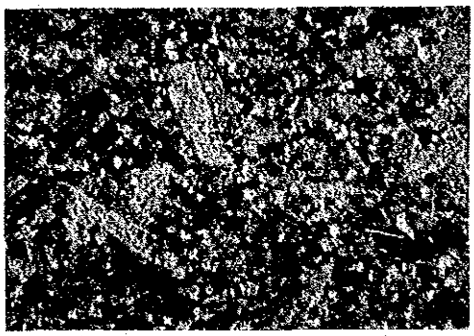


Crossed polarized light 0 1.0mm

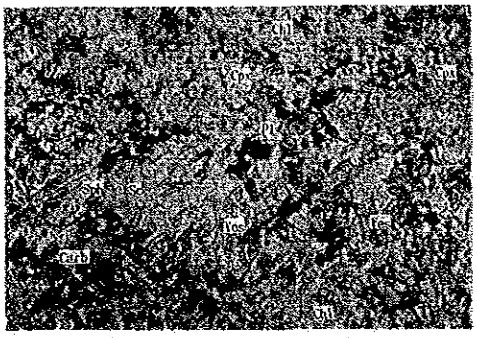


Plain polarized light 0 1.0mm

Sample No. : A090904
Area: Peña Blanca
Rock Name : Metadiorite porphyry

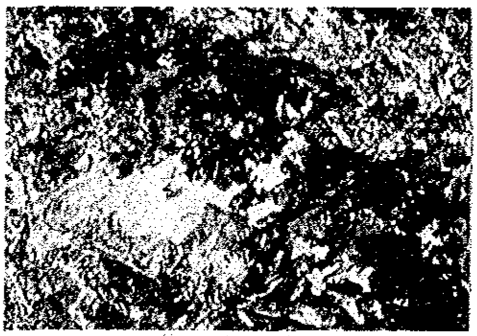


Crossed polarized light 0 1.0mm



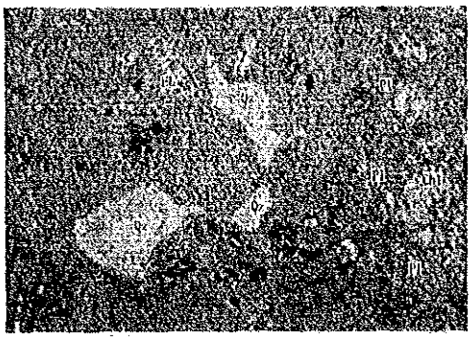
Plain polarized light 0 0.5mm

Sample No. : A092206
Area: Peña Blanca
Rock Name : Diopside vesuvianite scapolite marble



Crossed polarized light 0 0.5mm

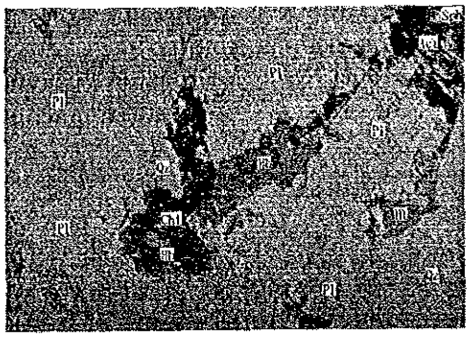
Sample No. : Y090501
Area: Peña Blanca
Rock Name : Metadacite



Plain polarized light　0　1.0mm

Crossed polarized light　0　1.0mm

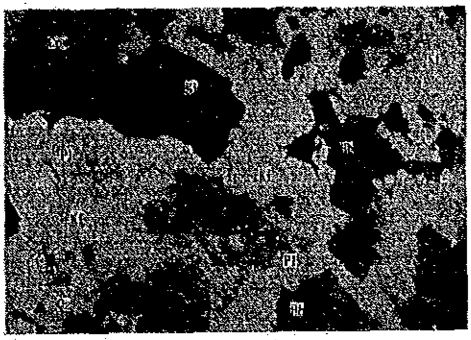
Sample No. : Y092010
Area: Peña Blanca
Rock Name : Amphibole granodiorite



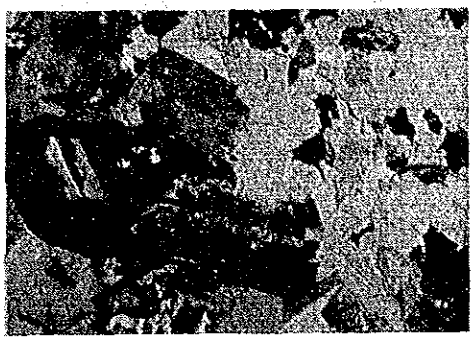
Plain polarized light　0　1.0mm

Crossed polarized light　0　1.0mm

Sample No. : Y092220
Area: Peña Blanca
Rock Name : Biotite amphibole adamellite

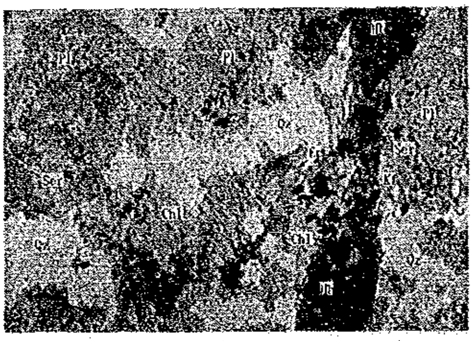


Plain polarized light 0 1.0mm

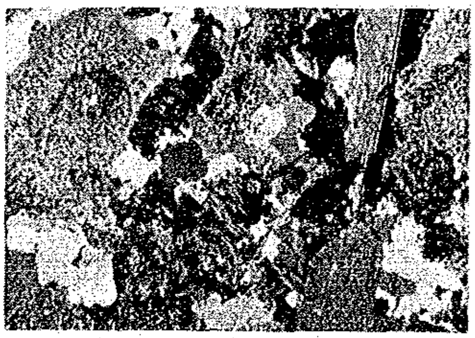


Crossed polarized light 0 1.0mm

Sample No. : Y092311
Area: Peña Blanca
Rock Name : Amphibole granodiorite



Plain polarized light 0 1.0mm



Crossed polarized light 0 1.0mm

Apx. 3 Results of Whole Rock Chemical Analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Sample No.	Y080304	Y082603	A082911	H081804	H091304	H091910	Y090501	Y092010	Y092220	Y092311
SiO2	57.49	76.03	67.65	52.39	95.41	59.98	62.45	65.25	60.78	64.54
TiO2	0.68	0.08	0.49	0.72	0.03	0.72	0.50	0.55	0.74	0.62
Al2O3	19.17	14.25	21.16	19.35	0.64	16.76	17.53	17.37	15.66	16.11
Fe2O3	5.10	0.50	2.61	3.50	0.73	2.76	0.79	0.63	2.36	1.07
FeO	2.12	0.35	0.12	4.20	0.19	3.60	3.69	1.58	3.81	3.30
MnO	0.12	0.01	0.04	0.18	0.01	0.14	0.11	0.07	0.11	0.07
MgO	3.09	0.16	0.09	2.67	0.08	3.00	1.69	1.80	2.90	1.87
CaO	0.58	0.30	0.28	9.38	0.31	6.51	4.98	6.50	5.25	4.40
Na2O	7.41	4.66	0.39	2.63	0.16	3.31	3.46	3.69	3.05	4.58
K2O	0.35	2.73	4.08	0.22	0.08	2.28	2.86	1.98	4.06	1.64
P2O5	0.25	0.17	0.16	0.30	0.07	0.31	0.28	0.27	0.27	0.21
BaO	0.03	0.12	0.08	0.06	0.01	0.14	0.12	0.12	0.09	0.05
LOI	4.12	1.53	3.44	4.35	0.25	1.12	2.33	0.60	1.06	1.70
Total	100.51	100.89	100.59	99.95	97.97	100.63	100.79	100.41	100.14	100.16
FeO*	6.71	0.80	2.47	7.35	0.85	6.08	4.40	2.15	5.93	4.26
FeO*/MgO	2.17	5.00	27.43	2.75	10.59	2.03	2.60	1.19	2.05	2.28
S.I.	17.60	1.92	1.28	20.75	6.86	20.45	13.62	18.72	18.19	15.14
C.I.P.W. norm										
Q	7.88	37.92	49.52	12.10	93.65	14.17	16.37	20.77	12.38	18.44
C	6.12	3.41	16.10	0.00	0.00	0.00	0.27	0.00	0.00	0.00
or	2.07	16.13	24.11	1.30	0.47	13.47	16.90	11.70	23.99	9.69
ab	62.70	39.43	3.30	22.25	1.35	28.01	29.28	31.22	25.81	38.75
an	1.31	0.61	0.00	40.34	0.79	24.14	23.11	24.98	17.05	18.55
lc	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ne	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
kp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ac	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
wo	0.00	0.00	0.00	1.82	0.13	2.68	0.00	2.39	3.10	0.84
en	7.70	0.40	0.22	6.65	0.20	7.47	4.21	4.48	7.22	4.66
fs	0.00	0.12	0.00	3.97	0.00	3.40	5.50	1.60	4.03	4.28
fo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
fa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
cs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
mt	5.25	0.72	0.00	5.07	0.54	4.00	1.15	0.91	3.42	1.55
hm	1.48	0.00	2.61	0.00	0.36	0.00	0.00	0.00	0.00	0.00
il	1.29	0.15	0.34	1.37	0.06	1.37	0.95	1.04	1.41	1.18
ru	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ap	0.59	0.40	0.38	0.71	0.17	0.73	0.66	0.64	0.64	0.50
Σ femic	16.31	1.79	3.72	19.59	1.45	19.65	12.47	11.08	19.82	13.00

*:total Fe as FeO   S.I.:Solidification Index

Apx. 4 Results of Isotopic (K-Ar) Datings

Sample No.	Locality	Rock Name	Analyzed Material	Isotopic Age (Ma)	40Ar(scc /gmx10-5)	% 40Ar	% K	Notes
H091910	PB	granodio	Whole Rock	88.8±4.4	0.691	81.9	1.91	
					0.661	89.6	1.91	
Y072504	CS	granodio	Whole Rock	64.0±3.2	0.282	73.3	1.10	
					0.270	78.2	1.08	
Y092010	PB	granodio	Whole Rock	16.4±0.8	0.101	64.1	1.61	
					0.107	64.6	1.63	
Y092220	PB	adamel	Whole Rock	102. ±5	1.230	85.3	3.08	
					1.290	90.7	3.08	
Y092311	PB	granodio	Whole Rock	122. ±6	0.659	77.0	1.36	
					0.668	83.3	1.35	

abbreviations adamel:adamellite, CS:Chontali South,
granodio:granodiorite, PE:Peña Blanca

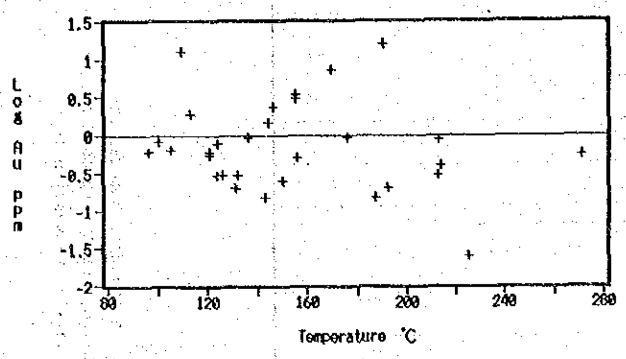
Apx. 5 Results of Fluid Inclusion Homogenization Temperature Analysis(1)

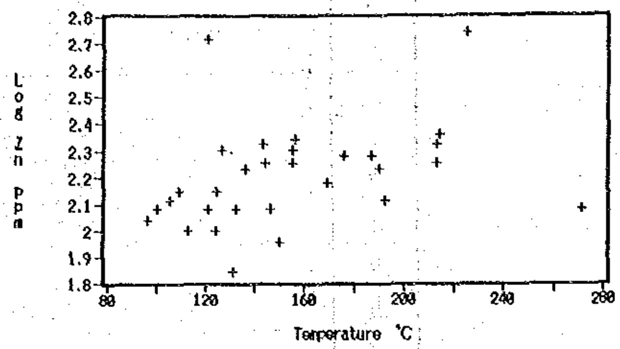
No.	Sample No.	NM	Min. (℃)	Max. (℃)	Mean (℃)	Assay					
						Au(g/t)	Ag(g/t)	Pb(ppm)	Zn(ppm)	Cu(ppm)	Mo(ppm)
1	Y080808	5	61	152	96	0.60	tr	100	110	30	10
2	A080411	9	80	164	100	0.85	6	300	120	20	8
3	A081305	8	82	151	105	0.65	25	200	130	50	16
4	H080904	4	106	112	109	12.95	18	600	140	150	8
5	Y080401	7	95	133	113	1.95	8	200	100	20	1
6	A081505	3	90	142	121	0.55	5	200	120	10	7
7	A080412	3	106	136	121	0.60	7	600	520	30	8
8	Y081604	3	104	155	124	0.30	2	500	100	40	12
9	H082302	6	104	151	124	0.80	7	100	140	80	3
10	Y081902	7	92	162	126	0.30	8	400	200	50	15
11	A080413	11	83	158	131	0.20	2	3,500	70	20	8
12	A080415	12	111	166	132	0.30	2	200	120	10	7
13	H080805	1	136	136	136	0.95	tr	600	170	370	18
14	A082413	8	116	192	143	0.15	45	500	210	340	4
15	A080203	12	109	195	144	1.50	11	300	180	60	6
16	A080410	13	130	189	146	2.35	6	400	120	150	4
17	A082405	9	106	184	150	0.25	9	200	90	10	13
18	A082408	5	108	232	155	3.50	97	1,300	200	20	526
19	H080902	3	105	206	155	3.15	12	400	180	250	12
20	H080708	13	100	223	156	0.50	20	1,400	220	180	23
21	H080803	18	110	256	169	7.45	4	400	150	240	6
22	H081004	4	124	224	176	0.95	18	1,800	190	330	7
23	V082104	2	177	196	187	0.15	15	12,100	190	920	7
24	A081707	10	138	308	190	16.15	11	300	170	50	8
25	H081702	14	99	291	192	0.20	tr	100	130	10	10
26	H080712	7	114	298	213	0.30	3	700	180	180	27
27	H072503	17	105	291	213	0.90	2	500	210	270	31
28	H080710	17	153	281	214	0.40	30	500	230	200	4
29	H080704	10	118	303	225	tr	2	500	550	3,440	6
30	A081601	9	226	294	271	0.55	3	tr	120	40	6
31	A080809	ab				0.65	4	100	140	10	10
32	A081702	ab				0.15	2	100	110	10	3
33	A082410	ab				0.45	21	200	150	260	8
34	A082411	ab				0.5	8	200	180	90	10
35	H082404	ab				0.1	4	100	120	90	8
36	H082505	ab				1.3	37	1500	170	210	8
37	Y080502	ab				1.7	23	200	140	60	2
38	Y080503	ab				2.85	23	200	90	30	5
39	Y080505	ab				2.85	10	200	140	50	10
40	Y080509	ab				2.6	5	200	230	80	35
41	Y080808	ab				0.6	tr	100	100	30	10
42	Y081004	ab				0.8	3	600	170	30	7
43	Y081413	ab				0.25	4	100	120	40	146

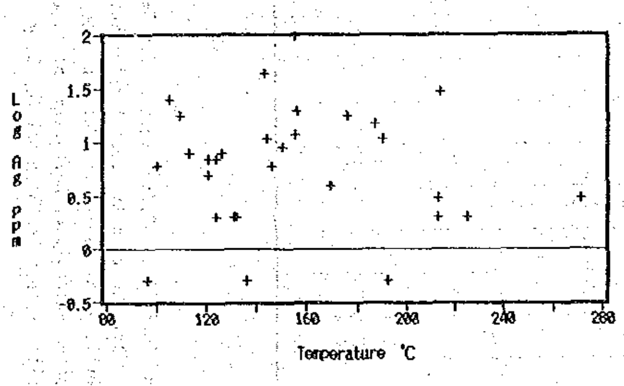
NM : number of fluid inclusions for measurement
ab : unavailable because of the absence of fluid inclusion
Min. : minimum of measured temperature (℃)
Max. : maximum of measured temperature (℃)

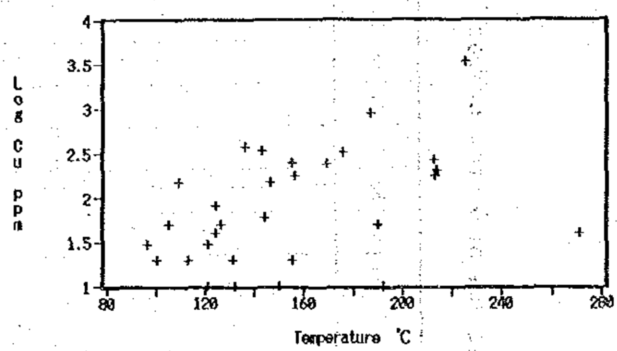
Analyzed material is quartz in all sample.

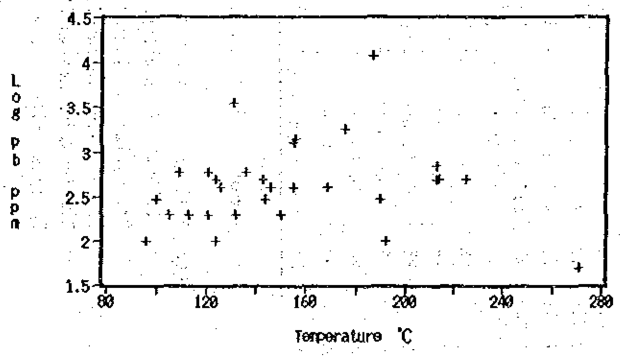
Apx. 5 Results of Fluid Inclusion Homogenization Temperature Analysis 2)

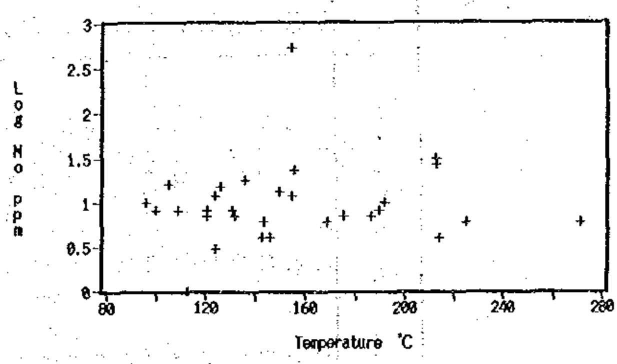












Apx. 6 Results of X-ray diffractive Analysis

Sample No.	Area	Rock Name	Qz	Pl	KF	Ca	Do	Rh	An	Sm	Se	Ch	Ph	Ka	Ta	Ja	Na	Ap	Di	Am	Dp	An	Ru	Ba	Gr	Ve	Sp	Ga	Ce	Py	He	Ge
H080712	CD	sil v	4								2					1						1										
H080803	CD	sil v	4								2					1																
H082404	CD	sil tf	4								3					2	1															
A080411	CD	Qz v	4								1																					
A080502	CD	lap tf	4	1						1	2			2								1										2
A080812	CD	sil Ba v	4								1													4								
A082401	CD	arg sil lap tf	4								3			1																		
Y080505	CD	Qz v	4											1																		
Y080707	CD	Qz v	4								1																					
Y081908	CD	sil tf	4								2											1										
Y082603	CD	silty tf	4	4	2						2																					
V082105	CD	Pb beared Qz v	4																					2				4	4			
A072704	CS	arg tf bre	4								2												1								2	
MJPJ-1 309.00m	JE	sil arg lap tf	4								2		2	2							2	1								2		
MJPJ-2 93.90m	JE	sil arg lap tf	4		2			3			2	3															2					
MJPJ-2 131.10m	JE	sil arg Ch tf	4								2											1								2		
MJPJ-2 155.80m	JE	sil arg tf	4								3											1					4			2		
MJPJ-3 70.35m	JE	sil arg Ch br	4								2											1								2		
MJPJ-3 104.75m	JE	sil arg Ch br	4								2											1								3		
MJPJ-3 154.25m	JE	sil arg Ch tf	4								3											1								3		
MJPJ-3 183.60m	JE	sil Ch tf	4		2			4			2											2								2		
H091202	PB	sil ls	3			4			4																							
H091206	PB	dolomite				4	4							1																		
A092204	PB	Cu-Fe ore	2												2				3	1										3		
A092206	PB	Ch skarn		1		4						4							4											1		
A092208	PB	Cu-Fe ore				2						2																		4		
A092210	PB	sil ls				2												2							4	2						
Y090904	PB	iron oxide ore																													2	3

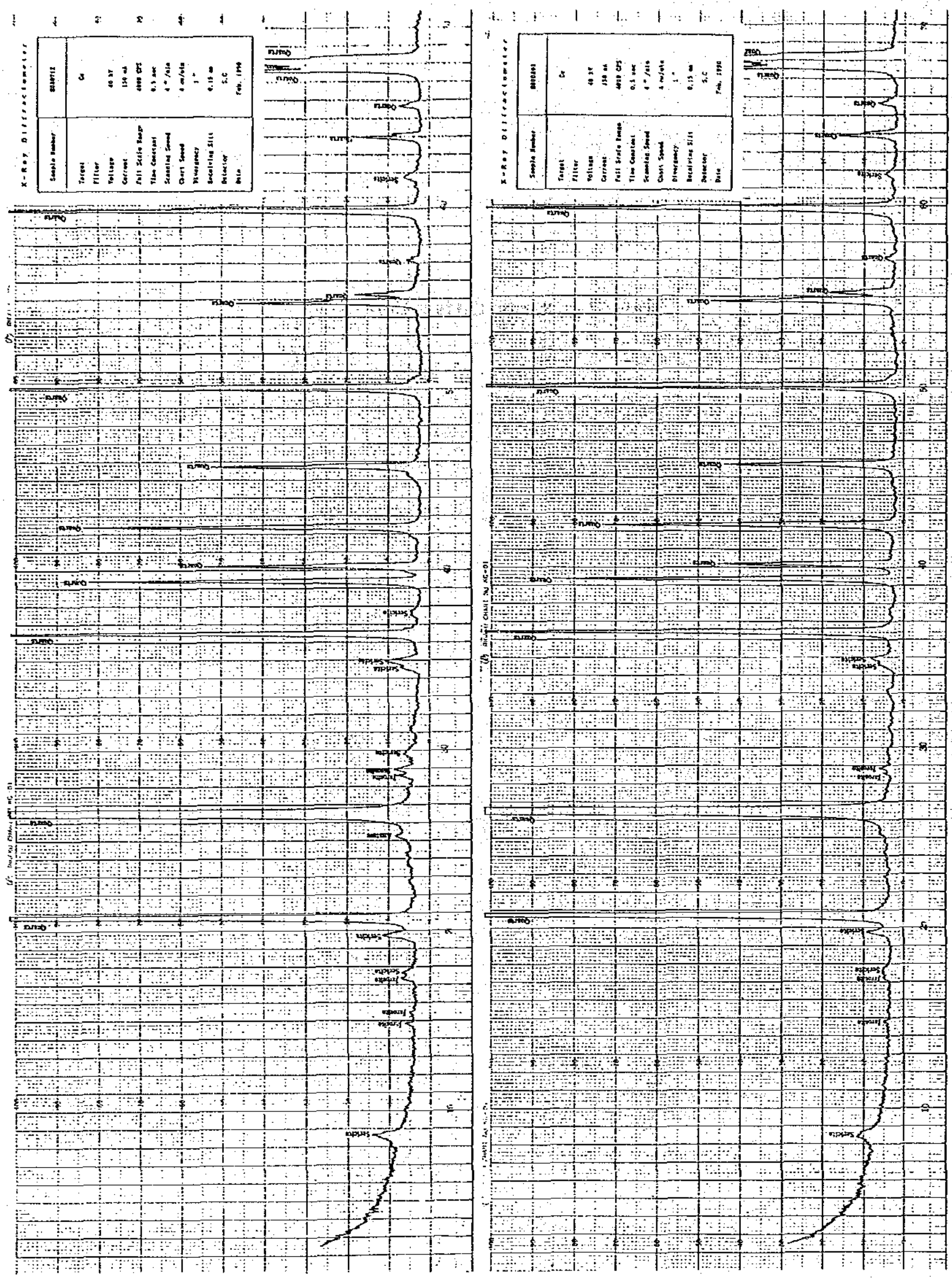
4:many 3:intermediate 2:few 1:rare

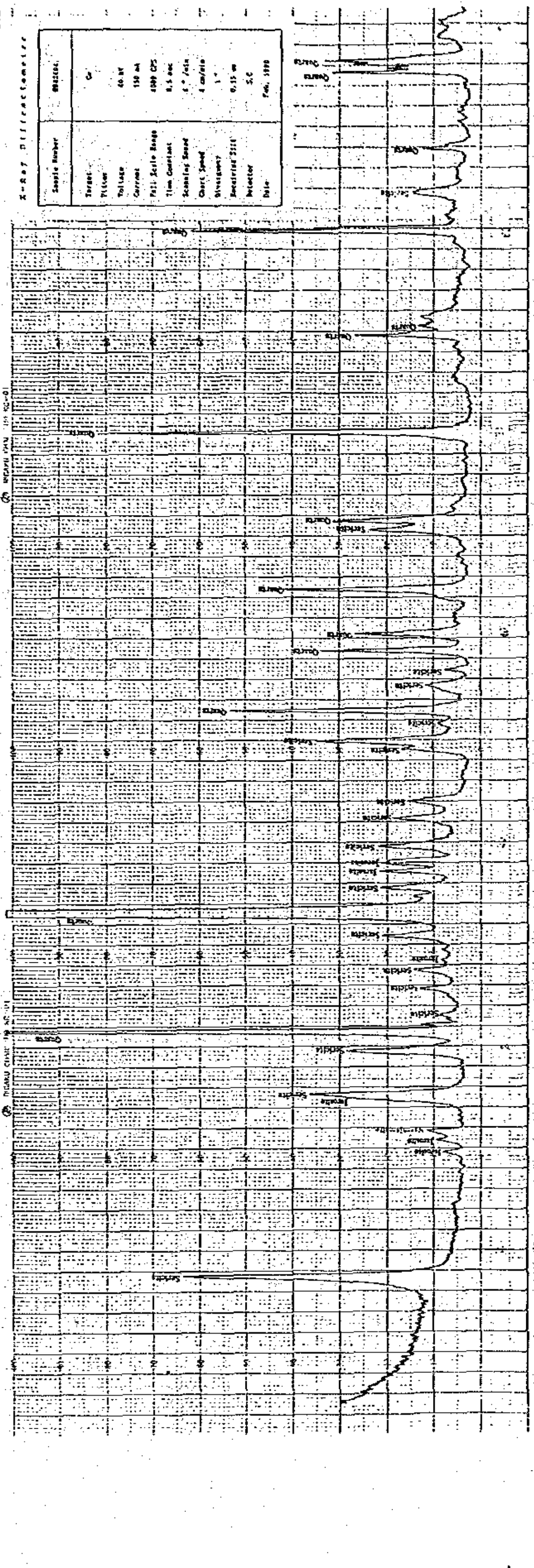
Abbriviations

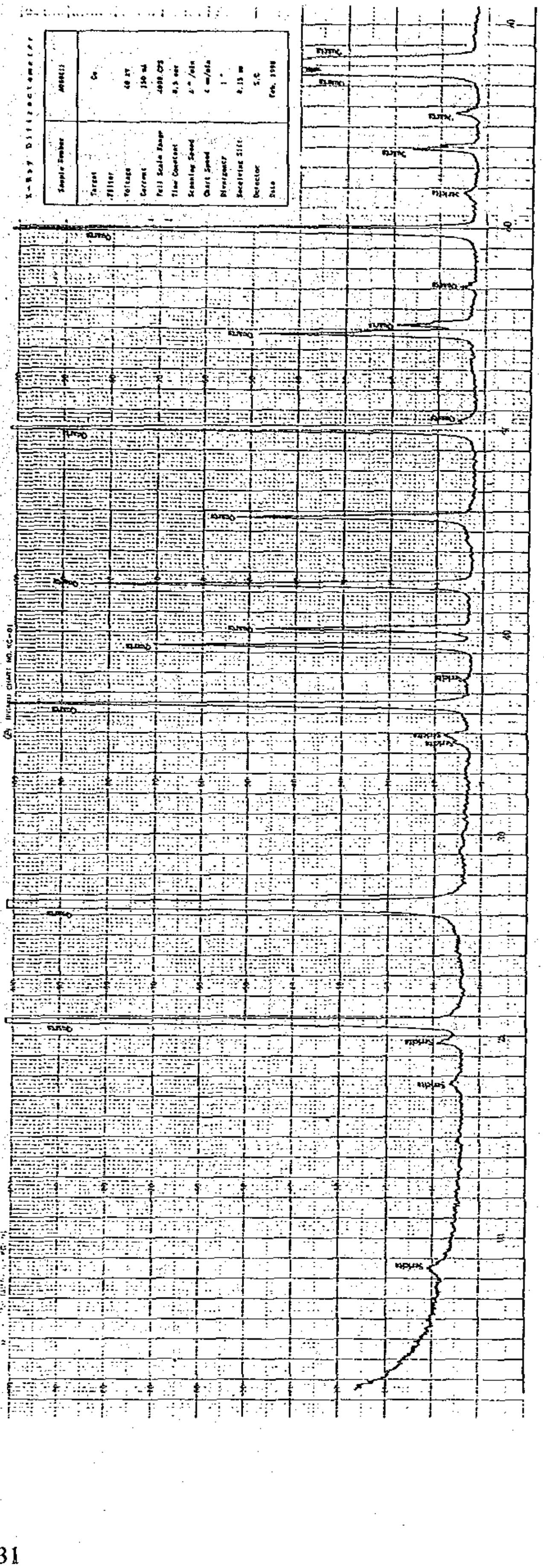
CD:Chontali detailed, CS:Chontali semidetailed, JE:Jehuamarca, PE:Peña Blanca

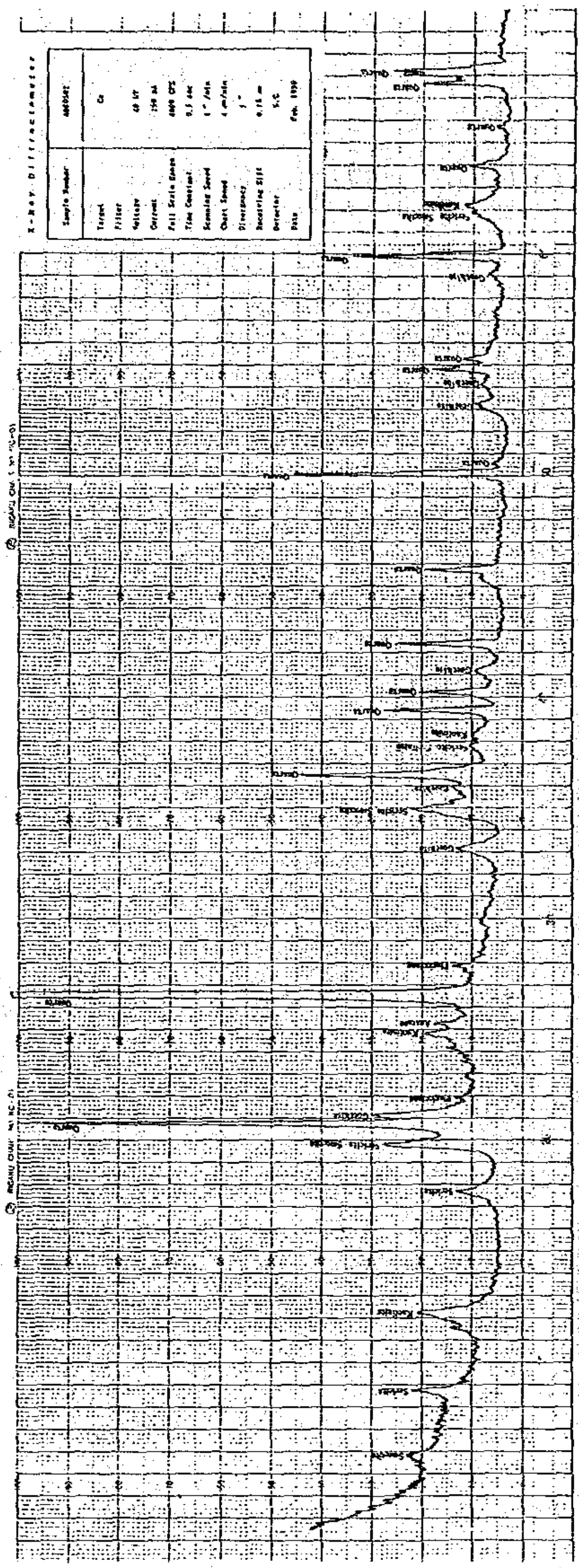
Qz:quartz, Pl:plagioclase, KF:K-feldspar, Ca:calcite, Do:dolomite, Rh:rhodocrosite, An:anatase, Sm:smectite, Se:sericite, Ch:chrolite, Ph:pyrophyllite, Ka:kaolinite, Ta:talc, Ja:jarosite, Na:natrojarosite, Ap:apatite, Di:diopside, Am:amphibole, Dp:diaspore, An:anatase, Ru:rutile, Ba:barite, Gr:Grossularite, Ve:vesvianite, Sp:sphalerite, Ga:galena, Ce:cerussite, Py:pyrite, He:hematite, Go:goethite

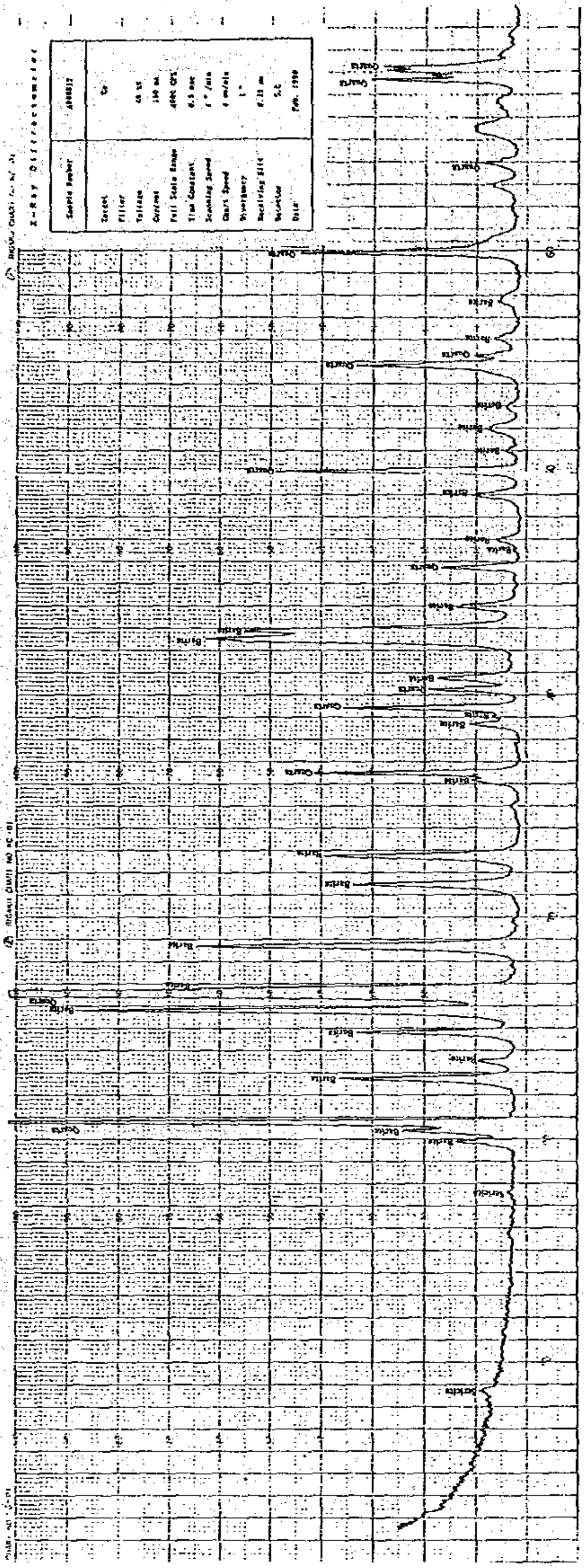
Apx. 7 X-ray Diffraction Chart

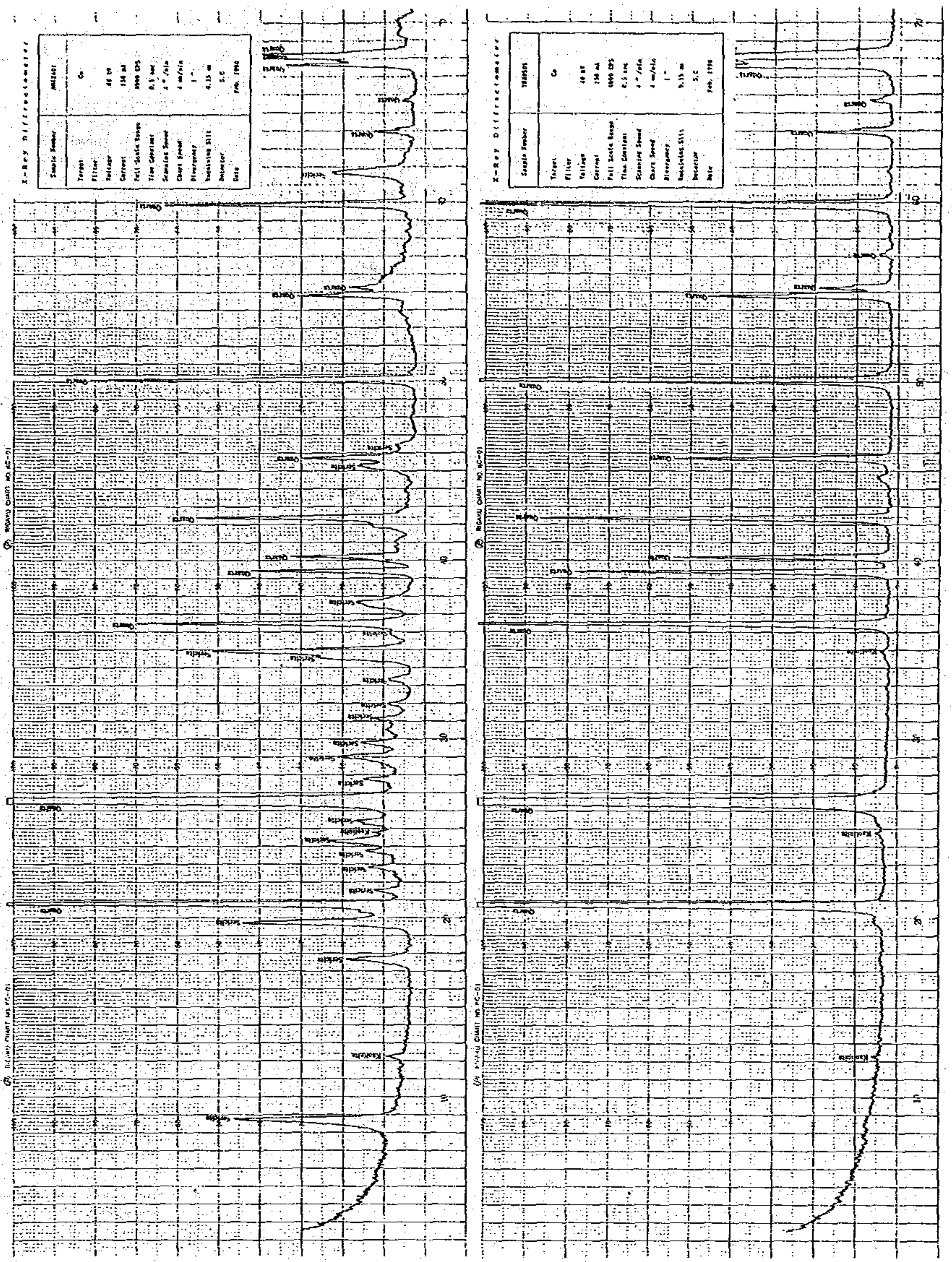











X-Ray Diffractometer
Quartz
Sericite
Kaolinite