APPENDICES

Table - 4 Results of Chemical Analyses of Geochemical Survey Samples in Four Surveyed Areas

1. Emission Spectroanalysis

. Stream Sediment (- 30 mesh)

Area	Nos. of Samples	Ag	Au	Cr	Cu	K	Mg	Mn	Mo	Ni	Pb	Sb	Sn	Ti	Zn
Acandi	(s.s) 091803	-	-	0	2	3	4	3	-	0	-	-	-	1	0
"	(s.s) 091905	-	-	0	2	3	4	3	-	0	-	-	-	1	-
Murindó	(s.s) 092001	-	-	1	3	1	4	3	-	0	-	-	-	2	0
"	(s.s) 092004	-	-	0	3	2	4	3	-	0	-	-	-	1	0
"	(s.s) 092005	-	-	1	3	1	3	3	-	1	-	-	-	2	0
Pantanos	(s.s) 092101	-	-	0	2	3	3	2	-	0	-	-	-	2	0
"	(s.s) 092102	-	-	-	3	2	4	3	-	0	-	-	-	2	0
"	(s.s) 092103	-	-	-	3	3	3	3	-	0	-	-	-	2	0
"	(s.s) 092104	-	-	-	3	3	4	3	-	0	-	-	-	2	-
Puerto Saldaña	(s.s) 100302	-	-	0	1	3	4	3	-	0	-	-	-	4	-
"	(s.s) 100402	-	-	0	1	3	4	3	-	0	-	-	-	2	-
"	(s.s) 100403	-	-	1	1	3	4	3	-	0	-	-	-	4	-
Piedrancha	(s.s) 100703	-	-	1	2	3	4	3	-	1	-	-	-	4	-
"	(s.s) 100704	0	-	1	2	3	4	3	-	0	0	-	-	3	-
"	(s.s) 100903	-	-	2	0	2	4	3	-	0	-	-	-	4	-
"	(s.s) 100904	-	-	2	1	3	4	3	-	0	-	-	-	4	-

. Soil (- 30 mesh)

Area	Nos.of Samples	Ag	Au	Cr	Cu	K	Mg	Mn	Mo	Ni	Pb	Sb	Sn	Ti	Zn
Acandi	(s) 091801	-	-	-	2	1	3	3	-	0	-	-	-	3	0
Murindó	(s) 092001	-	-	0	2	1	3	2	-	0	-	-	-	4	0
Pantanos	(s) 092101	-	-	-	0	3	3	2	-	0	-	-	-	3	0
"	(s) 092103	-	-	0	3	2	3	2	-	0	-	-	-	3	0

Note; - : nil
0 : a few
1 : some few
2 : less
3 : moderate
4 : strong
5 : very strong

2. Atomic Absorption Analysis

. Stream Sediment

Area	Nos.of Samples	Grain Size (mesh)	Au ppm	Ag ppm	Cu ppm	Mo ppm
Acandi	(s.s) 091801	-30			262	
"	(s.s) 091802	"			279	
	(s.s) 091803-a	30 ∿ 50	0.00		268	9
"	-b	50 ∿ 80	0.00		299	10
	-c	-80	0.00		366	10
"	(s.s) 091804	-30			571	
"	(s.s) 091805	"			407	
"	(s.s) 091806	"			231	
"	(s.s) 091901	"			455	
"	(s.s) 091902	"			150	
"	(s.s) 091903	"			71	
"	(s.s) 091904	"			232	
"	(s.s) 091905	"	0.00	0.5	140	
"	(s.s) 091906	"			122	
"	(s.s) 091907	"			364	
	(s.s) 092001-a	30 ∿ 50	0.07		1,065	0
Murindó	-b	50 ∿ 80	0.12		1,861	2
	-c	-80	0.16		3,342	2
"	(s.s) 092002	-30			161	
"	(s.s) 092003	"			1,545	

Area	Nos.of Samples	Grain Size (mesh)	Au ppm	Ag ppm	Cu ppm	Mo ppm
Murindó	(s.s) 092004	-30	0.06	0.3	3,278	
"	(s.s) 092005	"	0.21	0.1	1,544	
"	(s.s) 092006	"			2,970	
"	(s.s) 092007	"			204	
Pantanos	(s.s) 092101	"			441	
"	(s.s) 092102	"	0.00	0.1	897	
"	(s.s) 092103	"			719	
"	(s.s) 092104-a	30 ∿ 50	0.00		729	4
	-b	50 ∿ 80	0.00		732	4
	-c	-80	0.00		800	4
Los Andes	(s.s) 093001	-30			132	
"	(s.s) 093002	"			102	
"	(s.s) 093003	"			340	
"	(s.s) 093004	"			185	
Infierno	(s.s) 092901	"			247	
"	(s.s) 092902	"			241	
"	(s.s) 092903	"			1,332	
"	(s.s) 092904	"			729	
"	(s.s) 092905	"			125	
Puerto Saldaña	(s.s) 100301	"			254	
"	(s.s) 100302-a	30 ∿ 50	0.00		20	0
	-b	50 ∿ 80	0.00		22	0
	-c	-80	0.00		32	0

Area	Nos.of Samples	Grain Size (mesh)	Au ppm	Ag ppm	Cu ppm	Mo ppm
Puerto Saldaña	(s.s) 100401	-30			13	
"	(s.s) 100402	"	0.00	0.0	11	
"	(s.s) 100403	"	0.00		18	0
Piedrancha	(s.s) 100701	"			12	
"	(s.s) 100702	"			62	
"	(s.s) 100703	"			84	
"	(s.s) 100704	"	1.39	5.5	206	
"	(s.s) 100901	"			2	
"	(s.s) 100902	"			2	
"	(s.s) 100903	"			10	
"	(s.s) 100904	"	0.11		20	0
"	(s.s) 100905	"			6	

. Soil

Area	Nos.of Samples	Grain Size (mesh)	Au ppm	Ag ppm	Cu ppm	Mo ppm
Acandi	(s) 091801	-30	0.00		123	12
"	(s) 091802	"			222	
"	(s) 091803	"			155	
"	(s) 091901	"			574	
Murindó	(s) 092001	"	0.50		289	1
Pantanos	(s) 092101	"	0.00		6	0
"	(s) 092102	"			23	
"	(s) 092103	"	0.00	0.0	288	
Piedrancha	(s) 100901	"			7	

Table - 5 Results of Chemical Analyses of Mineralized Rocks in Four Surveyed Areas

Atomic Absorption Analysis

. Rock in Surface

Area	Nos.of Samples	Cu %	Mo ppm	Au ppm	Ag ppm	Pb %	Zn %
Acandi	(R) 091801	0.01	49	< 0.2			
"	(R) 091902	0.42	6	< 0.2			
"	(R) 091904	0.08	< 5	< 0.2			
Murindó	(R) 092001	< 0.01	< 5	< 0.2			
"	(R) 092003	0.36	5	< 0.2			
Pantanos	(R) 092102	1.14	17	< 0.2			
Los Guayabos	(R) 100201	0.04	12	< 0.2			
"	(R) 100202	0.15	< 5	< 0.2			
Puerto Saldaña	(R) 100301	0.09	< 5				
"	(R) 100302	0.16	11				
"	(R) 100305	0.04	< 5	< 0.2			
"	(R) 100307	0.09		< 0.2	2		
Piedrancha	(R) 100902	0.13		0.2	9		
"	(R) 100903	0.05		4.4	21	0.33	1.46
Mina Vieja	(R) 100101	4.58	< 5	0.7			

Table-6 Description of Microscopic Observation

Thin section

No.	Sampling No.	Locality	Macroscopic Observation	Microscopic Observation
CO-02	091802	Acandi area	Greenish gray, coarse grained diorite, with pyrite impregnation.	Coarse grained granular texture. Quartz; original, anhedral 1 to 1.5mm secondary silicification anhedral quartz 0.2 to 0.4mm. Plagioclase; anhedral 1 to 2mm. Orthoclase; anhedral, mostly suffered strong albitization. Moderate sericitization. Mafic mineral are mostly altered to chlorite. Calcite and zeolite (fibrous); in small veinlets. Propylitized quartz diorite. Accessory mineral; apatite, zircon, sphene, rutil.
CO-05	091906	Acandi area	Dark greenish gray to black dioritic rock. Abundant yellowish green mica aggregates after hornblende are visible.	Coarse grained granular texture. Quartz; anhedral 1 to 2mm. Fresh hornblende is rare, and mostly altered to mica and phlogopite showing light yellow to light green pleochroism with parallel cleavage to crystal elongation. The mica has been largely altered to chlorite, with brush-like lamellar structure. Feldspars are subjected to albitization from their margins. small calcite is observed in cracks. Acc. min.; apatite, zircon.
CO-06	AC-Bo. 1-169	Acandi area Borehole sample No. 1-169 ft.	White coarse grained sericitized dioritic rock, with small sulphide (py. cp) impregnation.	Granular, with variation in size. Mafic minerals are not visible owing to strong alteration. Orthoclase and plagioclase; 2 to 4mm, showing dirty surface by medium and strong sericitization. Quartz; 1 to 2mm. Widely occupied among feldspars due to strong silicification. Some calcite; in feldspars. Silicified quartz diorite (or phyllic altered quartz diorite). Acc. min.; sphene, apatite, abundante fine rutil.
CO-07	AC-Bo. 1-433	Acandi area Borehole sample No. 1-433 ft.	White medium grained altered diorite	Coarse grained, anhedral. Feldspar; 1 to 2mm, surface altered intermediately to sericite and chlorite. Chlorite is very abundant among feldspar and quartz. Propylitized quartz diorite. Acc. min.; apatite, zircon, abundante rutil.

No.	Sampling No.	Locality	Macroscopic Observations	Microscopic Observations
CO-08	AC-Bo. 1-678	Acandi area Borehole sample No. 1-678	Dark gray, medium grained diorite	Granular texture. Plagioclase; anhedral, subhedral, abundant. Some plagioclase have zonal structure. Hornblende; 1 to 1.5mm, largely altered to biotite (2 to 3mm) and furthermore to chlorite. Orthoclase is rare. Feldspars are relatively fresh, however marginal parts of some feldspar are suffered albitization. Silicified diorite. Acc. min.; apatite, little sphene.
CO-09	092001	Murindo area	Light gray, silicified diorite	Granular texture. Hornblende; 1 to 2mm, greenish brown. Quartz; 1 to 2mm in size. Plagioclase; subjected to albitization from marginal face. Abundant cracks indicate cataclastic structure, and are filled by sericite and opaque minerals (sulfide). Phyllic altered diorite. Acc. min.; apatite, zircon.
CO-10	092003	Murindo area	Light gray altered diorite with green spot of chlorite associated with pyrite.	Approximately 30% of this specimen is chloritized. Quartz; 1mm± in size, also occupies 30%±. Plagioclase; 1 to 3mm, partly shows zonal structure. Chlorite zone is accompanied with small (sec (secondary) biotite. In general, cataclastic structure. Among feldspar and quartz crystals, sericite, chlorite, and opaque minerals are recognized. Feldspar is suffered weak albitization. Propylitized diorite.
CO-11	092005	Murindo area	Quartz porphyry, with green Cu stained.	Porphyritic texture. Plagioclase; 2 to 3mm, euhedral to subhedral, with zonal structure, marginal parts are altered to albite. Quartz phenocryst; 1 to 8mm. Hornblende; 1 to 3mm, altered to biotite or furthermore to chlorite. Groundmass is composed of small (0.1 to 0.2mm) quartz, plagioclase, and orthoclase. Quartz porphyry.

No.	Sampling No.	Locality	Macroscopic Observation	Microscopic Observation
CO-12	092102	Pantanos area	Silicified quartz porphyry with green Cu.	Porphyritic texture. Quartz; 2mm in size. Plagioclase; 1 to 2mm in size, corroded. Plagioclase is suffered sericitization. Groundmass; strongly kaolinized. Limonite is observed in druse. Acc. min.; apatite, zircon, abundante fine rutil.
CO-13	092102	Pantanos area	Silicified quartz porphyry with quartz veinlets and pyrite-chalcopyrite.	Porphyritic texture. Quartz; 2mm as phenocryst, 0.1 to 0.2mm small anhedral crystals in matrix. Plagioclase is almost altered to saussurite, and strongly sericitized along fractures. Opaque minerals are recognized in fractures. And also, limonite stained. Acc. min.; abundante rutil.
CO-14	P-Bo. 3-564	Pantanos area Borehole sample No. 3-56.4 ft.	White quartz porphyry. (Dacitic)	Porphyritic texture. Quartz; 1 to 2mm. Feldspar up to 5mm in size. Moderate sericitization, chloritization, and weak carbonitization are recognized in this specimen. Groundmass is completely altered to saussurite. Altered quartz porphyry.
CO-15	P-Bo. 5-129	Pantanos area Borehole sample No. 5-129 ft.	White quartz porphyry. (Dacitic) with Cu vein.	Porphyritic texture. Quartz; 1 to 2mm. Plagioclase; up to 4mm in size. Feldspar is completely altered to sericite and kaolinite. Small crystals in the groundmass are identified as quartz, feldpar 0.05mm± in size.
CO-16	P-Bo. 5-233	Pantanos area Borehole sample No. 5-233 ft.	Gray quartz porphyry.	Porphyritic texture. Quartz; 1 to 2mm. Feldspar; 1 to 3mm. Corroded quartz is observed obviously. Groundmass is strongly kaolinized. Strong carbonitization is widely recognized in this specimen.

No.	Sampling No.	Locality	Macroscopic Observations	Microscopic Observations
CO-17	P-Bo. 9-140	Pantanos area Borehole sample No. 5-140 ft.	Gray quartz diorite	Granular, cataclastic texture. Quartz phenocrysts of 1 to 5mm in size are divided into many small parts which show wave extinction each other. Hornblende; 1 to 5mm, mainly altered to chlorite, sphene and sericite. Feldspar with fine pericline-albite twinning is weakly sericitized. Altered quartz diorite. Acc. min.; zircon, apatite.
CO-18	P-Bo. 9-160	Pantanos area Borehole sample No. 9-160 ft.	Gray quartz diorite	Granular, cataclastic texture. Divided quartz grains are arranged in the same direction roughly, with elongated form of 5:1 ratio up to 0.2mm in width. Feldspars are completely altered to sericite, so their forms are not distinct. The same rock as the former, but more advanced alteration is suffered.
CO-19	P-Bo. 11-143	Pantanos area Borehole sample No. 11-143 ft.	Coarse grained, chloritized quartz diorite	Granular, cataclastic texture. Quartz; 1 to 4mm, broken, fractured, and wave extinction. Feldspar, strongly altered; 1 to 2mm, moderate sericitization along cleavages and cracks, and albitization is undergone from crystal margin. Groundmass; chloritization strongly. Altered quartz diorite. Acc. min.; apatite, sphene.
CO-20	P-Bo. 11-290	Pantanos area Borehole sample No. 11-290 ft.	Pinkish gray, porphyritic altered rock.	Slightly porphyritic, cataclastic texture highly potassic altered. Quartz; 1 to 3mm, divided into fine grains 0.2 to 0.5mm in size with irregular shape showing wave extinction. Feldspar; 1 to 3mm, consists of original and secondary potassic feldspars and albite. As an intense alteration is widely observed, the twinning pattern is indistinctly recognized except very fine pericline twinnings of plagioclase. Groundmass is composed of small (0.1 to 0.2mm) euhedral and subhedral of potassic feldspar, and anhedral quartz, which may have been secondarily crystallized while potassic-alteration. Margin of feldspar is altered, due to moderate kaolinization, weak sericitization and chloritization. Sericite aggregates with opaque (sulfide) minerals are visible.

No.	Sampling No.	Locality	Macroscopic Observations	Microscopic Observations
CO-23	092902	Infierno area	Yellowish gray coarse grained strongly silicified, sericitized dioritic rock, with disseminated chalcopyrite and pyrite.	Granular texture. Feldspar; anhedral, 3 to 5mm, with fine albite twinning, 5° to 10° of extinction angle and nearly 90° of cleavage to crystal's elongation. Pseudomorphic potassic feldspar after plagioclase, and moderately silicified. Quartz; in aggregates of anhedral crystals of 1 to 3mm, among feldspars. No mafic minerals are observed, due to alterations. Calcite is observed in cracks. Acc. min.; abundante sphene is scattered as an alteration product.
CO-24	092905	Infierno area	Gray silicified and chloritized diorite, with a few pyritization.	Porphyritic texture. Phenocryst feldspar: idiomorphic plagioclase 2mm in size, some parts show zonal structure. In general, the surface is dirty due to kaolinization. Phenocryst qyartz is very rare and small up 1mm in size. Alteration; sericitization and chloritization are so strong that the original forms of mafic minerals are not able to be observed. Silicification quartz is in the form of veinlet and impregnation in groundmass. Fairly limonitized. Altered quartz diorite.
CO-25	PI-Bo. 1-22.5	Infierno area Borehole sample No. 1-22.5m	Dark gray, chloritized and silicified diorite with disseminated chalcopyrite and pyrite.	Slightly porphyritic texture. Phenocryst plagioclase; subhedral to euhedral, 1 to 2mm, having zonal structure and medium albitization. Phenocryst quartz; rare, anhedral, 1mm in size. Mafic minerals are completely altered to chlorite. Quartz and plagioclase in groundmass are 0.5mm in size. Strong silicification and biotitization are observed in veinlet and impregnated form. Medium sericitization on feldspar and many clacite with chlorite are observed.

No.	Sampling No.	Locality	Macroscopic Observations	Microscopic Observations
CO-26	PI-Ba. 1-173	Infierno area Borehole sampling No. 1-173m	Gray medium grained quartz diorite.	Porphyritic texture. Phenocryst plagioclase; subhedral to euhedral, 2 to 5mm in size, with zoning structure partly, and altered from margin to inner part by albitization. Phenocryst quartz; rare, 1 to 1.5mm in size, irregular rimmed form. Quartz and plagioclase with biotite in the groundmass are 0.2 to 0.5mm in size. Quartz and biotite are in veinlets and spotted-form due to strong silicification and biotitization. Biotite is mostly changed to chlorite. Acc. min.; apatite, sphene.
CO-27	PI-Bo. 3-100	Infierno area Borehole sample No. 3-100 ft.	Light gray, phyllic altered diorite with pyrite impregnation.	Porphyritic texture. Phenocryst plagioclase; strongly altered to sericite. Phenocryst quartz; 2mm, anhedral. Groundmass; small crystals of quartz and plagioclase, 1mm, with small (1mm) pyrite. Fibrous zeolite in druses, fan shaped. Phyllic altered quartz diorite.
CO-28	PI-Bo. 3-519	Infierno area Borehole sample No. 3-519 ft.	Phyllic altered porphyritic quartz diorite, with light brown part.	Porphyritic texture. Phenocryst of quartz; 2mm in size, plagioclase; strongly altered to sericite, having abundant very small (2μ) crystals of reddish rutile which make light brown color to the rock. Groundmass crystals are 0.1 to 0.3mm in size, with sericite and quartz due to silicification.
CO-29	093001	Los Andes area Breccia dike	Dark gray porphyritic altered quartz diorite.	Porphyritic texture. Phenocryst plagioclase; 1 to 2mm in size. Quartz; 1 to 2mm, with chloritized biotite, and have been undergone carbonization. Sphene is abundantly observed as secondary alteration product. Other acc. min.; apatite. Groundmass; quartz, sericite and chlorite, 0.1 to 0.2mm in size, and strong carbonization is observed.

No.	Sampling No.	Locality	Macroscopic Observations	Microscopic Observations
CO-30	093003	Los Andes area	Silicified quartz diorite	Porphyritic texture. Plagioclase of phenocryst; 1 to 2mm in size, euhedral to anhedral, with zoning structure, albitization, and potassic alteration, in breccia structure. Groundmass; 0.2 to 0.4mm in size, of quartz and plagioclase, with sericitization and silicification. A few zeolite is observed.
CO-31	LA-Bo. 1-59	Los Andes area Borehole sample No. 1-59m	Light gray strongly silicified quartz diorite, with chlorite aggregates.	Granular texture. Phenocryst quartz; anhedral 1 to 2mm. Plagioclase; strongly sericitized. Chlorite aggregates which are thought to be changed from biotite are observed in druses and around silicification quartz. Calcite is recognized in cracks as a final product.
CO-32	LA-Bo. 1-127	Los Andes area Borehole sample No. 1-127m	Dark gray dioritic rock with impregnation of chalcopyrite and pyrite, and partly altered to pinkish brown minerals.	Granular texture. Plagioclase; 2 to 3mm in size, anhedral, sericitized. Hornblende up to 2mm in size is altered to biotite and chlorite. A few calcite is observed.
CO-33	LA-Bo. 2-105	Los Andes area Borehole sample No. 2-10.5m	Light gray strongly silicified quartz diorite with brown or green chloritized part.	Porphyritic structure. Phenocryst plagioclase; 2 to 4mm in size, with zonal structure. Quartz; 1 to 1.5mm in size. Groundmass; plagioclase, quartz and biotite 0.2 to 0.5mm in size. This rock have been undergone strong biotitization anc chloritization. Acc. min.; apatite, little sphene.
CO-34	LA-Bo. 2-128.2	Los Andes area Borehole sample No. 2-128.2m	Gneiss with black biotite and light brown feldspar.	Banded structure. Bands of quartz and biotite, 1mm in width. Quartz; 0.05 to 0.3mm in size. Biotite; 0.05 to 0.2mm, they are arranged in the same direction roughly. The bigger feldspar crystals of more or less 4mm in size, are intruded by fine-grained quartz veinlet, with biotite. Fine crystals of rutile (1μ) are observed in feldspar, and their color effect feldspar light brown.

No.	Sampling No.	Locality	Macroscopic Observations	Microscopic Observations
CO-35	100201	Guayabos area	Greenish and yellowish brown compact garnet skarn with pyrite, and limonite stained.	Andradite with small epidote, quartz veinlets of 0.1 tp 0.5mm in width, sulfides and limonite.
CO-36	100202	Guayabos area	Brownish gray and yellowish green skarn.	Andradite and sulfide minerals, with small grains of epidote.
CO-37	100301	Puerto Saldaña area	Slightly porphyritic granodiorite.	Granular texture. Phenocryst plagioclase; anhedral 2 to 3mm in size, with zonal structure. Quartz; 2 to 5mm in size. Groundmass; silicification quartz (0.2 to 0.5mm) and biotite (0.1 tp 0.5mm). Relatively fresh.
CO-38	100302	Puerto Saldaña area	Silicified granodiorite.	Slightly porphyritic texture. Plagioclase; 2 to 3mm in size. Quartz; 0.5 to 1mm in size. The half numbers of biotite crystals have been undergone chloritization. Apatite is observed as main accessory mineral.
CO-39	100303	Puerto Saldaña area	Gray strongly silicified granodioritic rock (porphyritic)	Porphyritic texture. Plagioclase and orthoclase; 2 to 3mm in size, anhedral. Quartz; 1 to 3mm in size. Some biotite crystals are remained in fresh, 0.05 to 0.2mm in size. Quartz and sericite are formed in veinlets.
CO-41	100306	Puerto-Saldaña area	Gray dacitic porphyry; silicified, impregnation of pyrite, yellow brown iron oxide stained. (Py:Cp = 5:1)	Porphyritic texture. Phenocryst; plagioclase 1 to 2mm, euhedral, subhedral with zonal structure. Quartz; 1 to 1.5mm in size, corroded. Biotite; 1 to 1.5mm in size, almostly chloritized. Groundmass; microcryptocrystalline, plagioclase and quartz 0.05mm in size. Fine quartz veinlets and weak sericitization are observed.
CO-42	100307	Puerto Saldaña area	Dark gray, silicified and chloritized dacitic porphyry, Py-Cp impregnated. (Py:Cp = 3:1)	Porphyritic texture. Phenocryst; plagioclase with zonal structure 1 to 4mm in size. Quartz, 1 to 2mm. Phenocrysts are relatively fresh. Groundmass; coarse grained plagioclase and quartz 0.1 to 0.5mm in size. Weak sericitization, muscovite accumulation with sulphide and a little zeolite are observed.

No.	Sampling No.	Locality	Macroscopic Observations	Microscopic Observations
CO-43	100401	Puerto Saldaña area	Black biotite schist, with pyrite veinlet.	The rock consists of 60 to 80% biotite and 25 to 15% feldspar (plagioclase and lesser orthoclase). Biotite; 0.1 to 2mm in size, occupies among anhedral or broken crystals of feldspar. Quartz is little quantity; 5% approximately. Relatively fresh. Only small quartz-chlorite-biotite veinlet is observed.
CO-44	100901	Piedrancha area	Black, altered andesite, weakly metamorphosed. (Hornfels)	Porphyritic texture. Phenocryst feldspar; idiomorphic plagioclase 1mm in size is altered strongly to sericite, chlorite, and saussurite. Groundmass is mostly altered to chlorite and small quartz. Chloritized and silicified andesite.
CO-46	100903	Piedrancha area	Gray silicified acidic rock with chalcopyrite dissemination.	Granular texture. The rock consists of 65% quartz, 30% muscovite and 5% plagioclase. Quartz is mostly clean and secondary mineral, 0.5 to 3mm in size. Muscovite is secondary mineral too, and 0.1 to 4mm in size. Plgioclase is partly altered to sericite, remaining its idiomorphic form. That suggests this rock may be originally a dacite-like porphyry.
CO-47	100101	Mina Vieja	Brownish green Cu skarn ore	Andradite; euhedral to subhedral, 1 to 2 mm in size. Needle-like hematite 1 to 2 mm in size is recog nized in calcite. Calcite and quartz are crystallized after andradite.

Table-7 Description of Microscopic Observation

Polished section

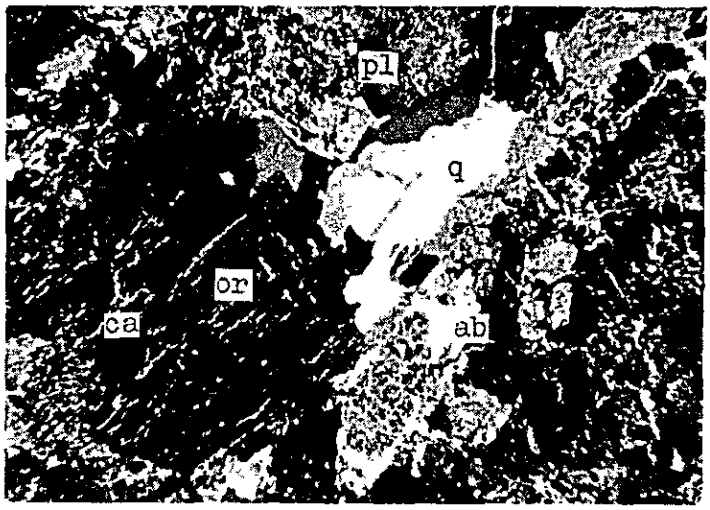
No.	Sampling No.	Locality	Macroscopic Observations	Microscopic Observations
CO-13	092102	Pantanos area	Silicified quartz porphyry with small pyrite and chalcopyrite	A small piece of chalcopyrite is visible.
CO-15	P-Bo. 5-129	Pantanos area Borehole sample No. 5-129 ft.	Chalcopyrite-pyrite veinlet with quartz, in porphyritic rock. Chalcopyrite is in the center, otherwise, pyrite crystallized near vein-limit.	Euhedral chalcopyrite is always associated with pyrite. In the cracks of chalcopyrite, chalcocite is recognized as the former's alteration. Veinlet of cp-py is 4mm in width. Intimate association of cp-py, is same to disseminated spots out of the veinlet also.
CO-21	P-Bo. 11-257.5	Pantanos area Borehole sample No. 1 -257.5 ft.	cp-py fine impregnation in chloritized rock.	Irregularly shaped small spots of chalcopyrite, pyrite, and sphalerite are observed as, 0.01 to 0.5mm grains. These minerals are occured in separate or in contact. They are mostly accompanied with chlorite aggregates. py:cp = 1:1
CO-22	P-Bo. 11-296	Pantanos area Borehole sample2 No. 11-296 ft.	Cu rich impregnation with chloritized in potassic altered dioritic rock.	Small chalcopyrite and pyrite are distributed in hair-like cracks and spots. Cu rich, cp:py = 3:1. Both minerals are associated with chlorite aggregates.
CO-27	PI-Bo. 3-100	Infierno area	Gray silicified intrusive rock with disseminated pyrite	Quartz veinlet with anhedral pyrite (0.2-0.4cm) including small chalcopyrite (0.3mm).
CO-36	100202	Guayabos area	Chalcopyrite and magnetite associated with garnet and epidote skarn	Anhedral pyrite 0.2-1.0cm, lesser amount of chalcopyrite 0.2-0.4mm, associated with magnetite and hematite in needle like crystal form.
CO-39	100303	Puerto Saldaña area	Silicified gneiss with pyritization	Anhedral pyrite 1-2mm as impregnation and veinlet. In pyrite, very small crystal (0.05-0.05mm) of chalcopyrite are included.
CO-45	100902	Piedrancha area	Quartz vein, with pyrite and chlorite.	Small chalcopyrite (0.2mm) is recognized in the pyrite-quartz veinlet. Gold is not observed in this specimen.

No.	Sampling No.	Locality	Macroscopic Observations	Microscopic Observations
CO-46	100903	Piedrancha area	Breccia ore of sphalerite, galena, chalcopyrite, and pyrite with quartz.	Subhedral pyrite, the bigger (0.2~0.5mm) anhedral sphalerite, and small anhedral chalcopyrite among the gangue minerals are identified and very small inclusions in sphalerite are observed. Little galena is associated with sphalerite.
CO-47	100101	Mina Vieja	Chalcopyrite-garnet skarn ore	Chalcopyrite; massive and fine veinlets (0.01mm, width) in gangue minerals, associated with magnetite in irregular form.

Fig-52 Photomicrographs of Thin sections

Abbreviation

q	Quartz	ch	Chlorite
pl	Plagioclase	ca	Calcite
or	Orthoclase	ap	Apatite
ab	Albite	spn	Sphene
hb	Hornblende	ka	Kaoline
bi	Biotite	an	Andradite
mv	Muscovite	ze	Zeolite
se	Sericite		



CO-02
No.091802
Acandi area

Crossed Nicols

0 1 mm

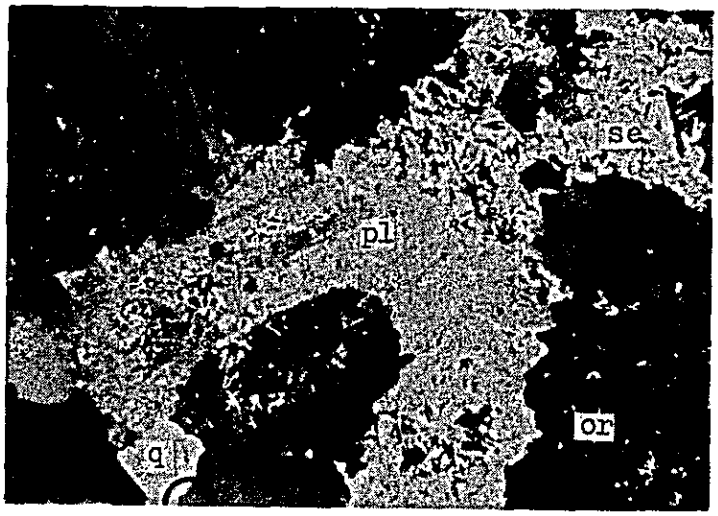
Propilitized quartz diorite
Albitization of plagioclase is apparent.

CO-05
No.091906
Acandi area

Crossed Nicols

0 1 mm

Propylitized quartz diorite
Fresh hornblende is rare,and mostly altered to biotite and chlorite.

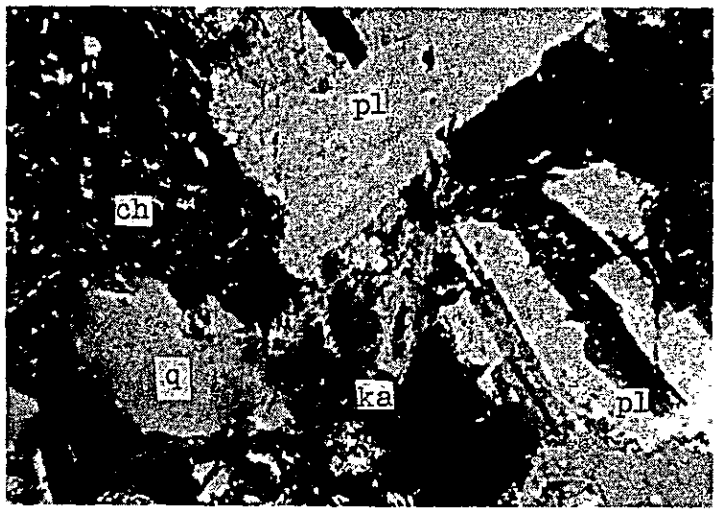


CO-06
No.AC-Bo.1-169
Acandi area

Crossed Nicols

0 1 mm

Altered quartz diorite
Plagioclase highly altered to sericite and saussurite.

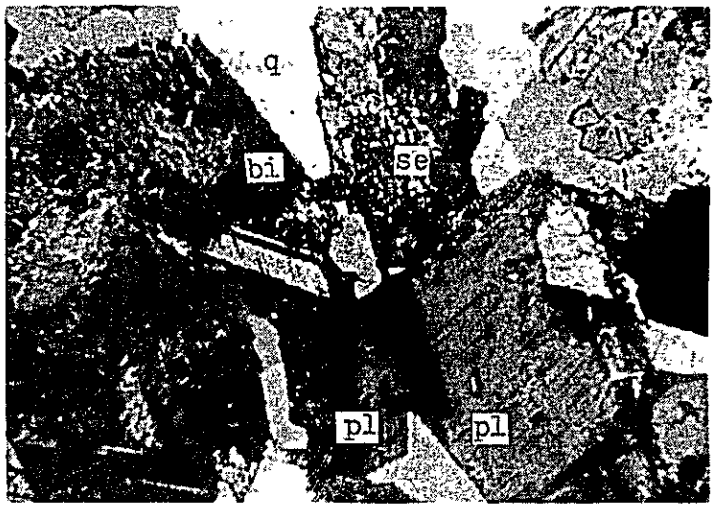


CO-07
No.AC-1-433
Acandi area

Crossed Nicols

0 1 mm

Altered quartz diorite
Strong chloritization is observed.



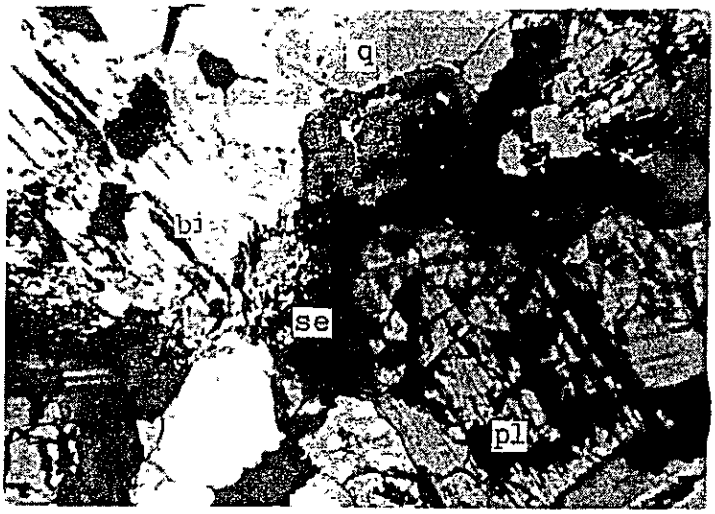
CO-08
No.AC-Bo.1-678
Acandi area

Crossed Nicols

0 1 mm

Silicihied diorite

Feldspars are relatively fresh, but hornblends are mostly changed to biotite.



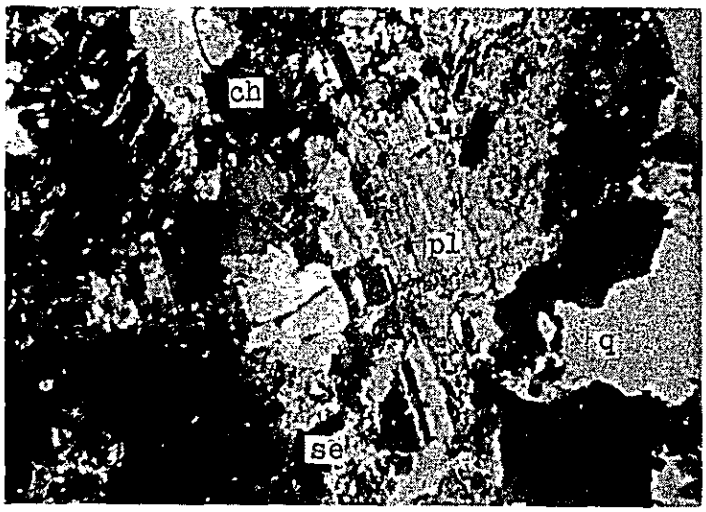
CO-09
No.092001
Muriondo area

Crossed Nicols

0 1 mm

Phyllic altered quartz diorite

Cataclastic structure and albitization are recognized.



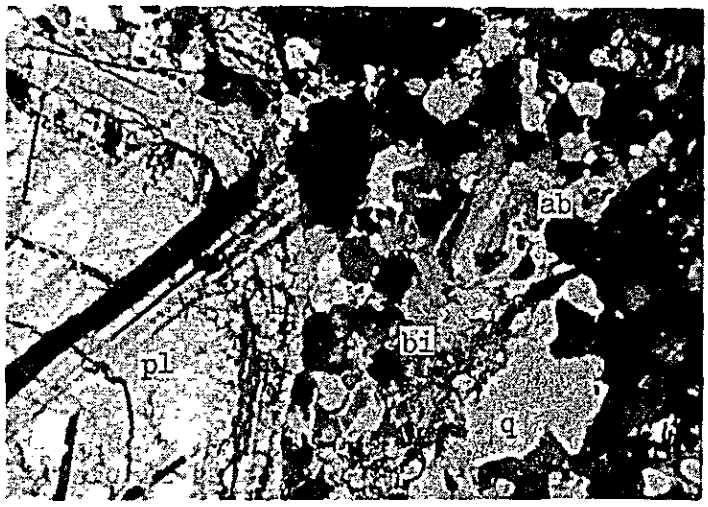
CO-10
NO.092003
Murindo area

Crossed Nicols

0 1 mm

Propylitized quartz diorite

Cataclastic structure, sericitization and chloritization are visible.



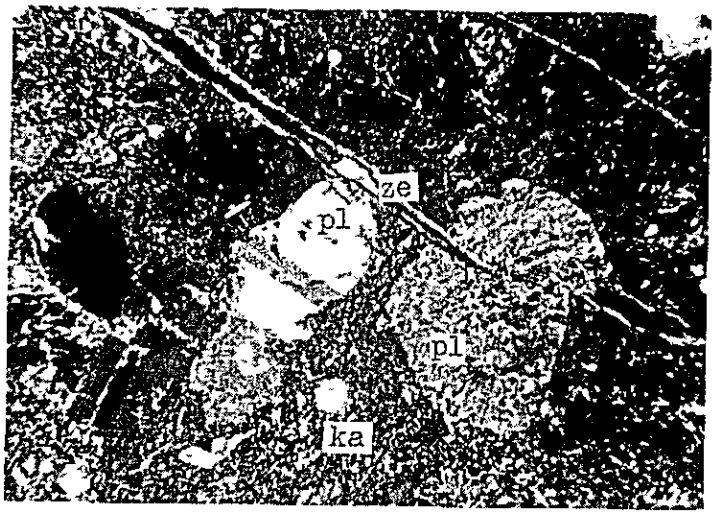
CO-11
No.092005
Murindo area

Crossed Nicols

0 1 mm

Quartz porphyry

Large phenocrysts of quartz and plagioclase showing zonal structure are 1 to 8 mm in side, cemented by small (0.1-0.2mm) crystals of quartz and feldspars of groundmass. Hornblende has been altered to biotite and chlorite.



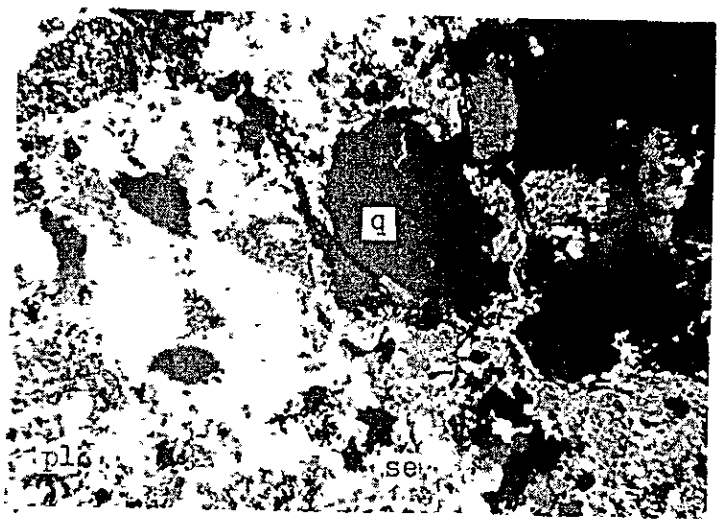
CO-12
No.092102
Pantanos area

Crossed Nicols

0 1 mm

Silicified quartz porphyry

The rock is suffered sericitization, and groundmass is strongly kaolinized. Zeolite is observed in the latest fractures.



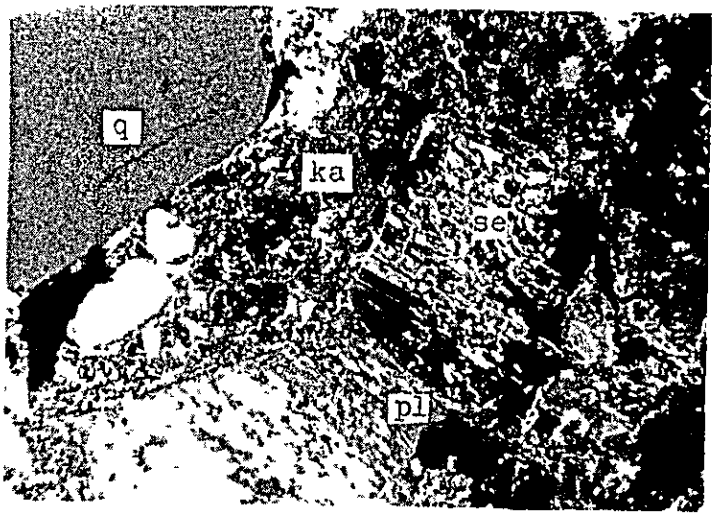
CO-13
No.092102
Pantanos area

Crossed Nicols

0 1 mm

Silicified quartz porphyry

Intense sericitization is observed in groundmass and on the phenocryst plagioclase.



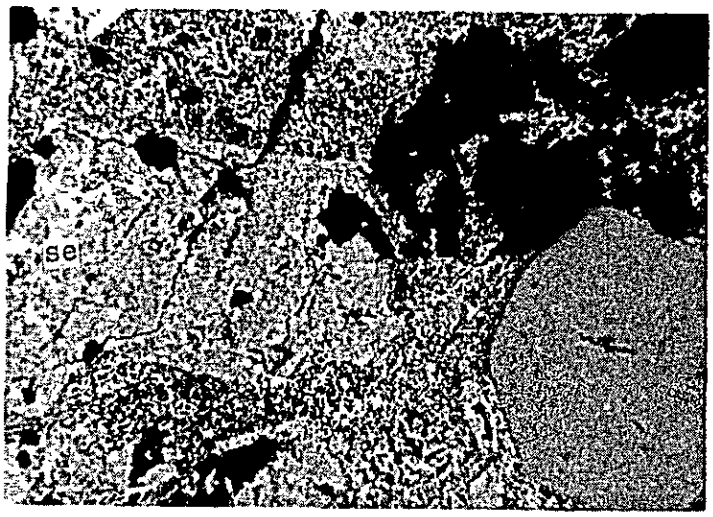
CQ-14
No.P-Bo.3-564
Pantanos area

Crossed Nicols

0 1 mm

Altered quartz porphyry

The rock is moderately altered by sericitization and chloritization.



CO-15
No.P-Bo.5-129
Pantanos area

Crossed Nicols

0 1 mm

Quartz porphyry

Plagioclases are altered to sericite and kaolinite. Opaque minerals are abundant.

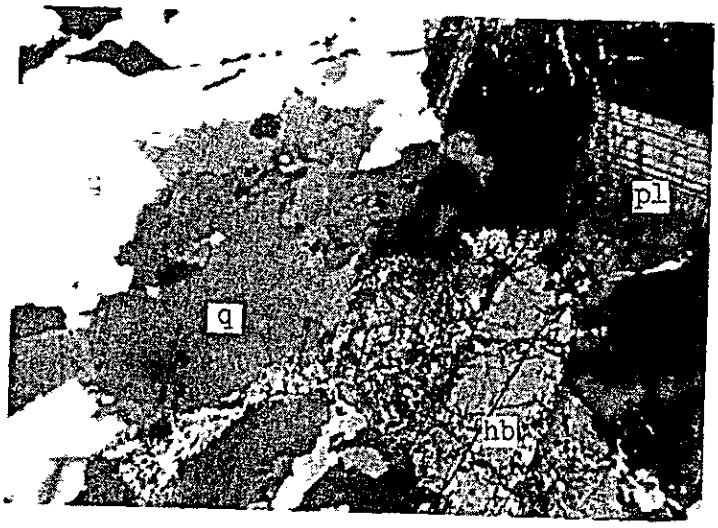
CO-16
No.P-Bo.5-233
Pantanos area

Crossed Nicols

0 1 mm

Quartz porphyry

Corroded quartz,albitized plagioclase and strongly carbonitized groundmass are apparent.



CO-17
No.P-Bo.9-140
Pantanos area

Crossed Nicols

0 1 mm

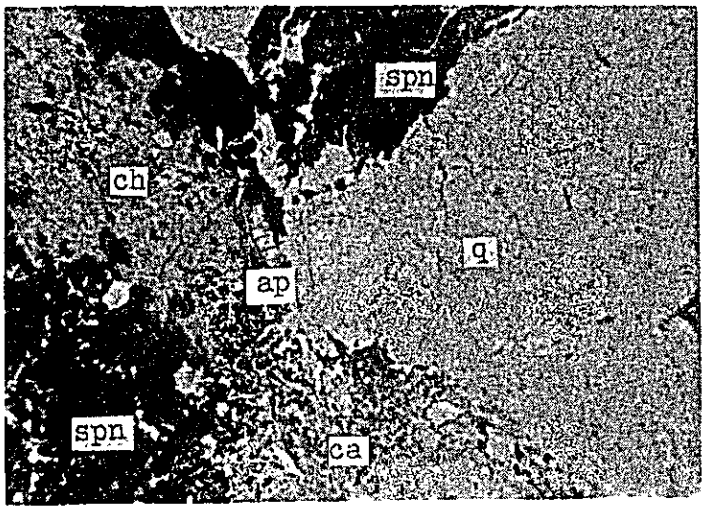
Quartz diorite

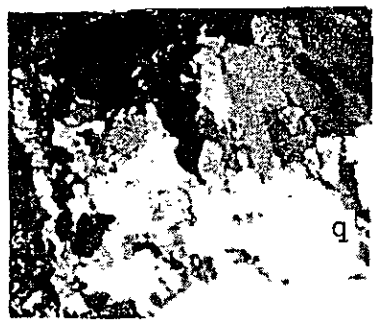
Divided quartz shows wave-extinction,i.e.cataclastic structure. Chloritization and sericitization are moderately. Hornblende has changed mostly to chlorite and sphene.

CO-18

No.P-Bo.9-160

Pantanos area





↑Crossed Nicols

←Open Nicol

0 1 mm

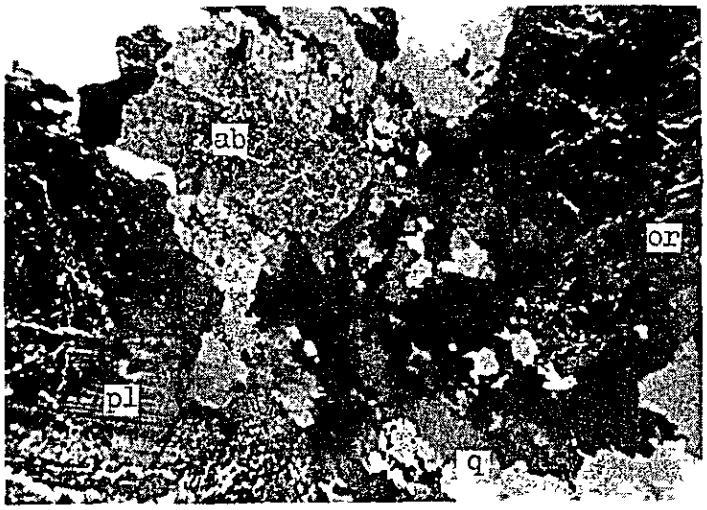
Altered quartz diorite

Feldspars have changed mainly to sericite. mafic minerals altered to mostly chlorite and sphene. The quartz shows wave-extinction on the divided parts.

CO-19

No.P-Bo.11-143

Pantanos area

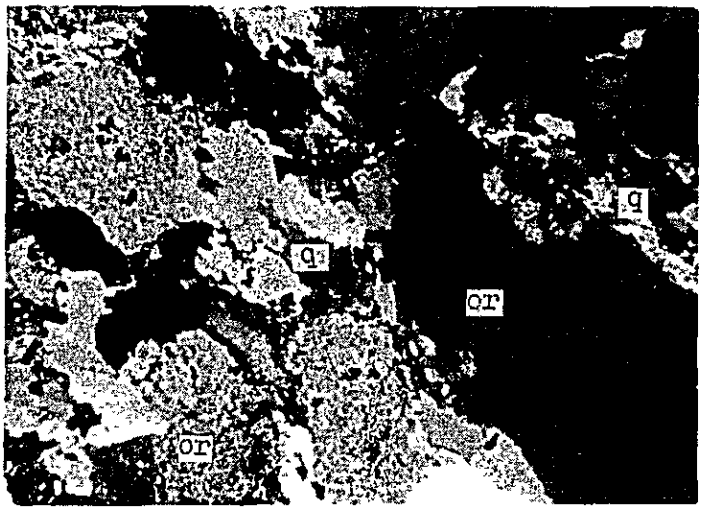


Crossed Nicols

0 1 mm

Altered quartz diorite

Moderate sericitization, strong chloritization are apparent.



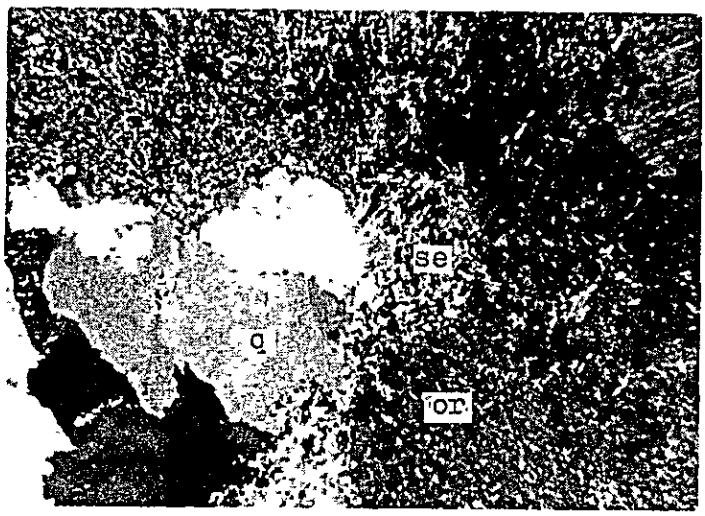
CO-20
No.P-Bo.11-290
Pantanos area

Crossed Nicols

0 1 mm

Porphyritic altered rock

Potassic alteration is intense,and silicification is moderate.



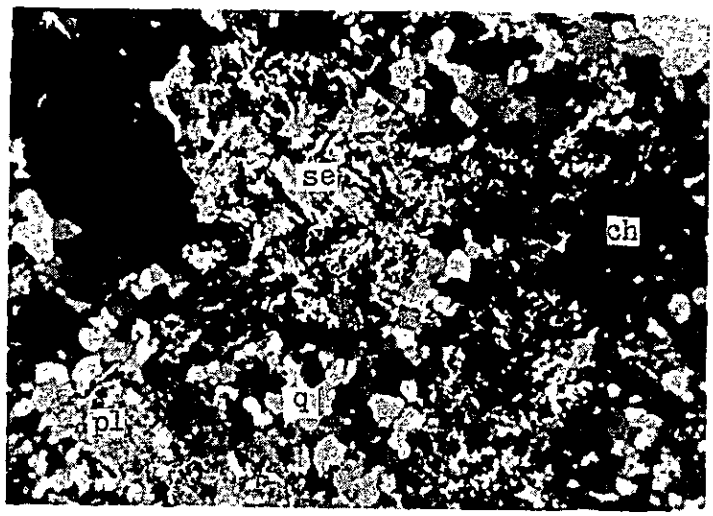
CO-23
No.092902
Infierno area

Crossed Nicols

0 1 mm

Altered quartz diorite

Potassic alteration, silicification and sericitization are very intense. Mafic minerals are not remained by these alterations.



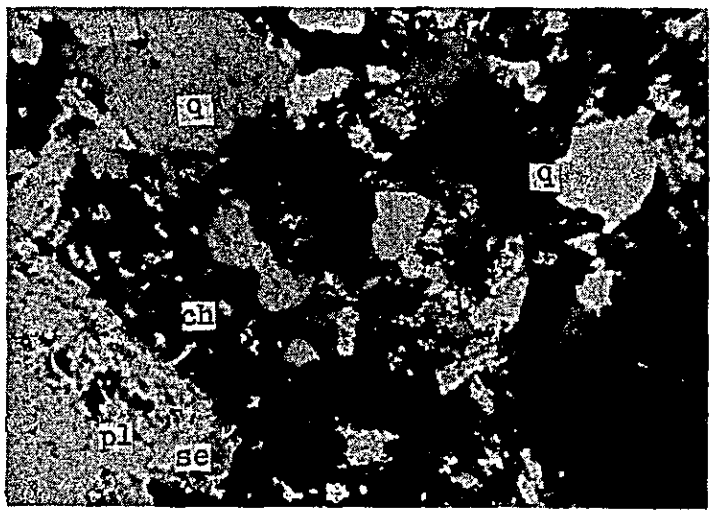
CO-24
No.092905
Infierno area

Crossed Nicols

0 1 mm

Porphyritic quartz diorite

Sericitization, chloritization and silicification are so strong that original structure could not be observed.



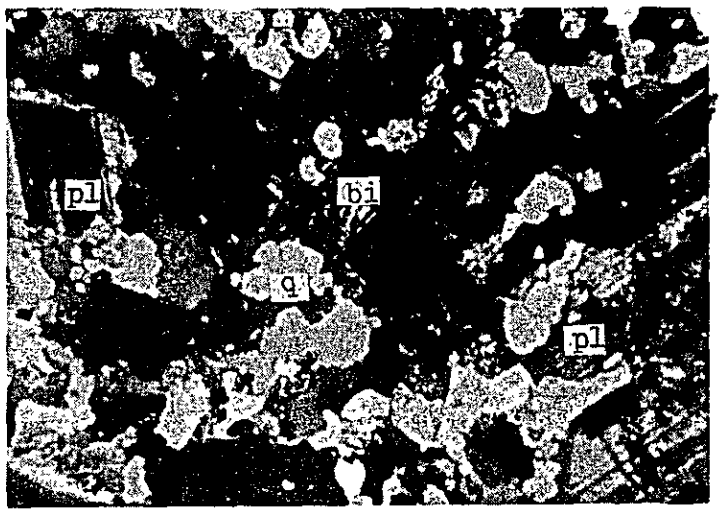
CO-25
No.PI-Bo.1-22.5
Infierno area

Crossed Nicols

0 1 mm

Porphyritic quartz diorite

Plagiocalse suffered sericitization and albitization, and hornblende has changed to chlorite. Also biotitization with quartz is obvious in veinlets.



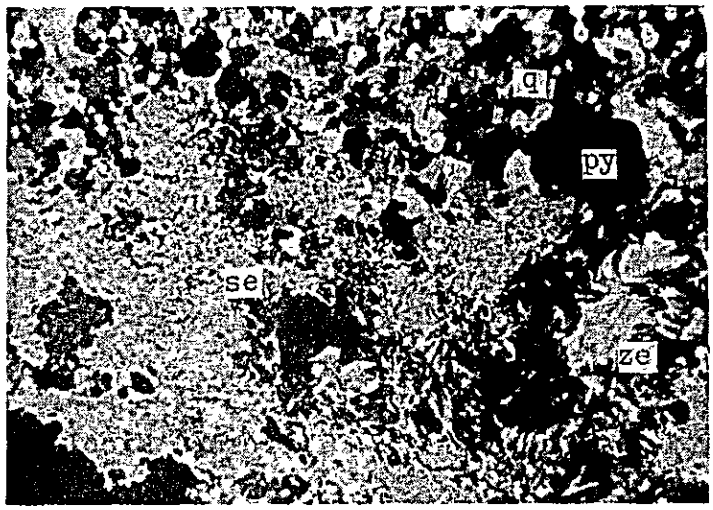
CO-26
No.PI-Bo-1-173
Infierno area

Crossed Nicols

Quartz diorite

0 ——— 1 mm

Plagiocalse suffered albitization. In groundmass, secondary biotite is observed among quartz and plagiocalse.



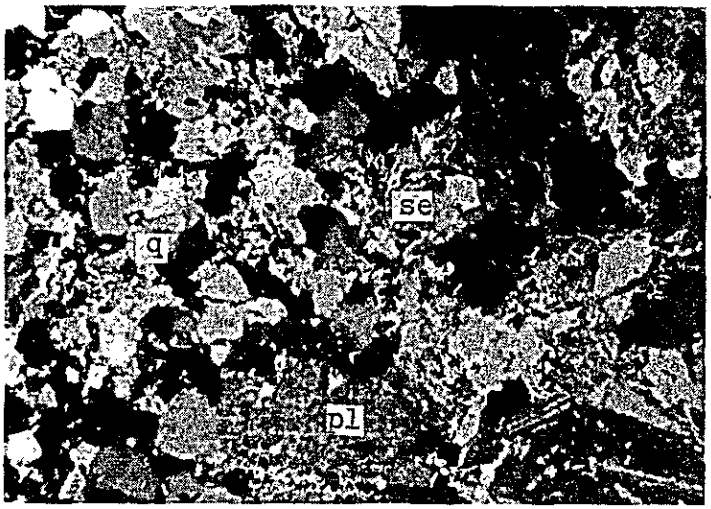
CO-27
No.PI-Bo.3-100
Infierno area

Crossed Nicols

0 ——— 1 mm

Phyllic altered diorite

Strong sericitization, and zeolite in druses are observed.



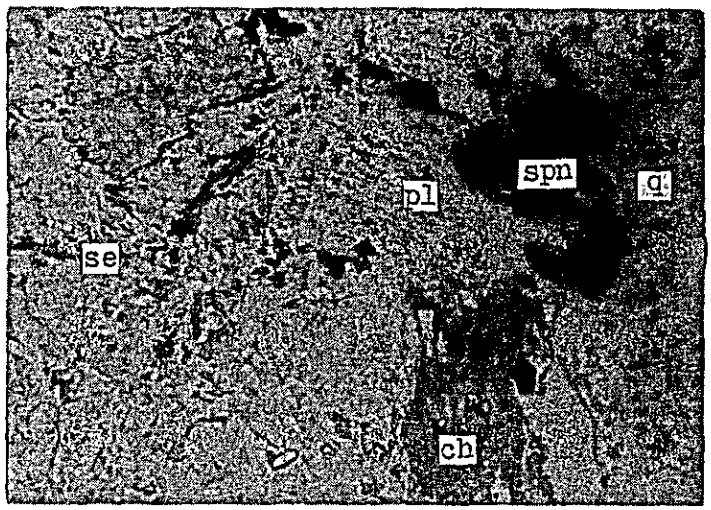
CO-28
No.PI-Bo.3-519
Infierno area

Crossed Nicols

0 1 mm

Porphyritic quartz diorite

Silicification and sericitization are moderately. Fine and abundant rutils give the rock light brown color.



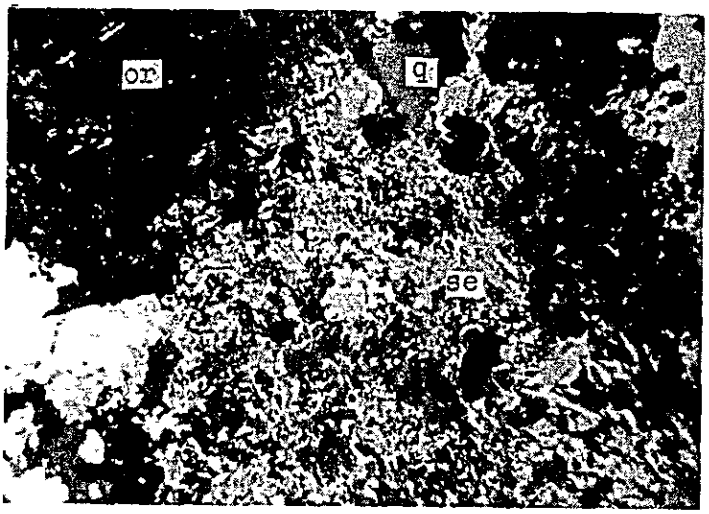
CO-29
No.093001
Los Andes area

Open Nicol

0 1 mm

Porphyritic quartz diorite

Chloritization and carbonitization are strongly, and so, shene is observed frequently as an alteration product.



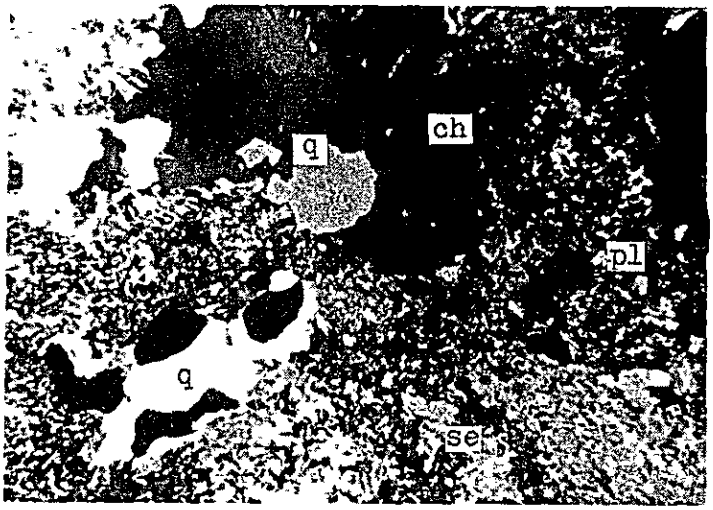
CO-30
No.093003
Los Andes area

Crossed Nicols

0 1 mm

Silicified quartz diorite

Porphyritic and brecciated structures are recognized, and potassic alteration and albitization are apparent.



CO-31
No.LA-Bo.1-59
Los Andes area

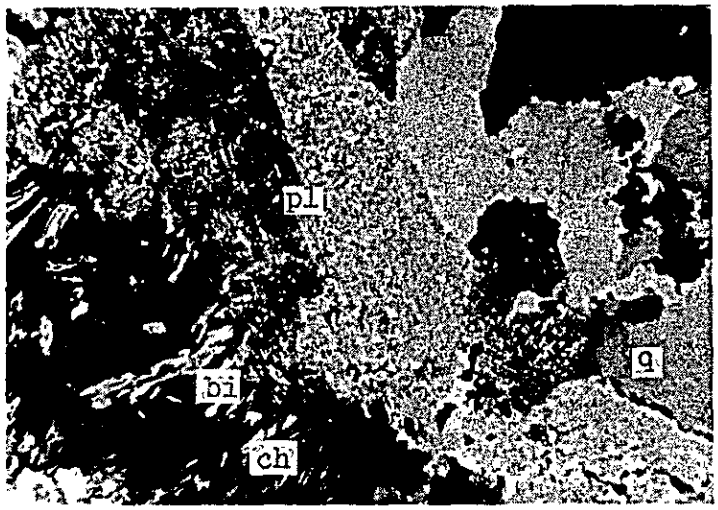
Crossed Nicols

0 1 mm

Quartz diorite

Strong sericitization, silicification and chloritization are observed. Opaque minerals (sulphides) have occured with quartz and chlorite.

CO-32
No.LA-Bo.1-127
Los Andes area



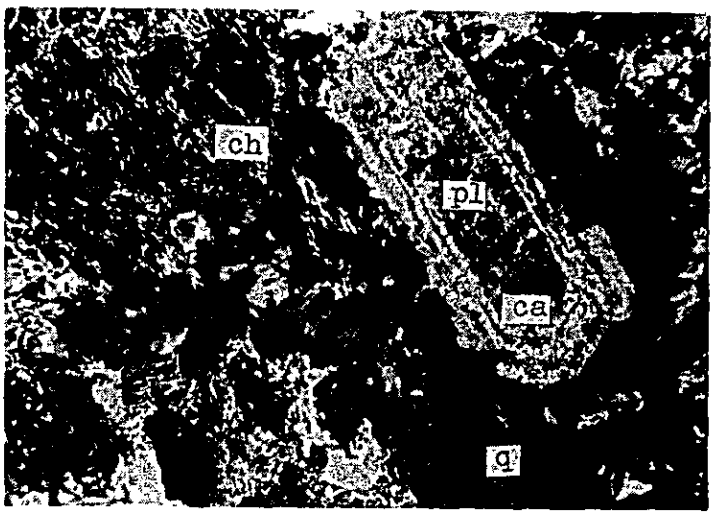
Crossed Nicols

0 1 mm

Altered diorite

Hornblende has changed to biotite and chlorite where alteration more advanced.

CO-33
No.LA-Bo.2-105
Los Andes

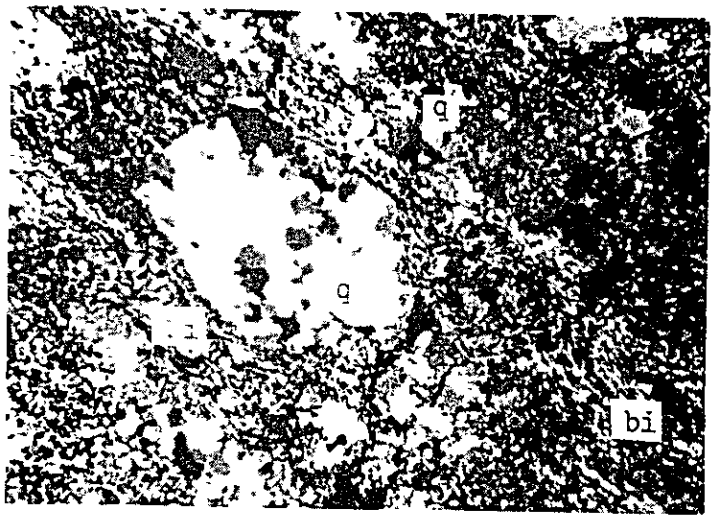


Crossed Nicols

0 1 mm

Quartz diorite

The rock generally altered by biotitization and chloritization, and plagioclase with zonal structure is suffered carbonitization.



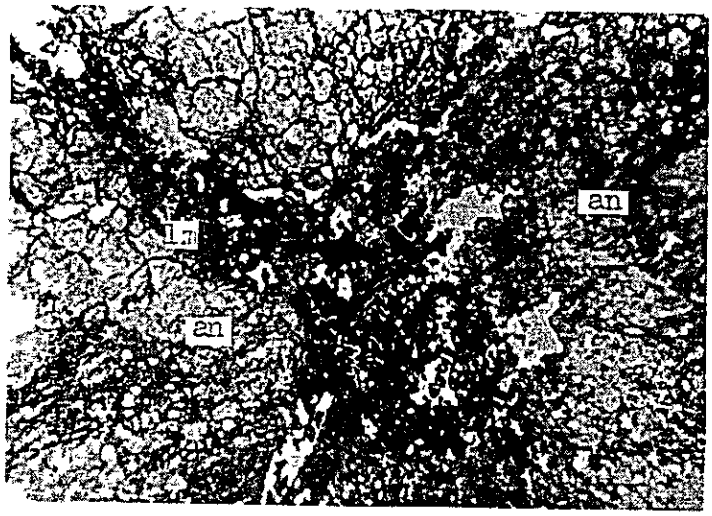
CO-34
No.LA-Bo.2-128.2
Los Andes area

Crossed Nicols

0 1 mm

Gneiss

Feldspars and quartz distribute in eye-like spots, cementing by roughly parallel arranged biotite.



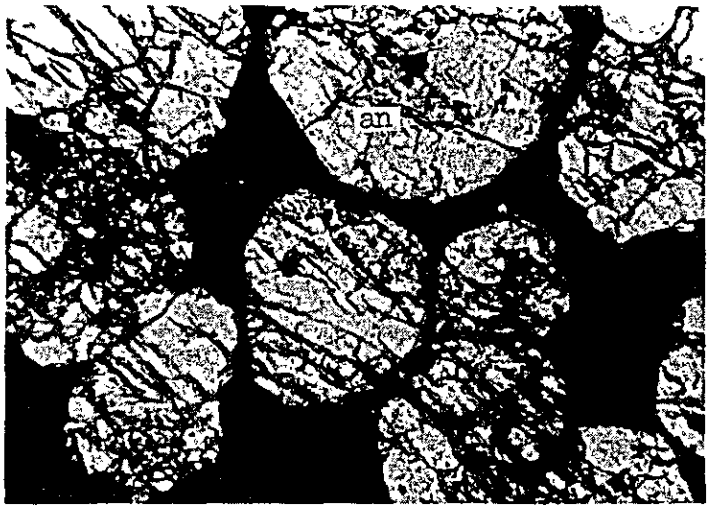
CO-35
No.100201
Guayabos area

Open Nicol

0 1 mm

Skarn ore

Andradite is seen with iron-oxide in its cracks.

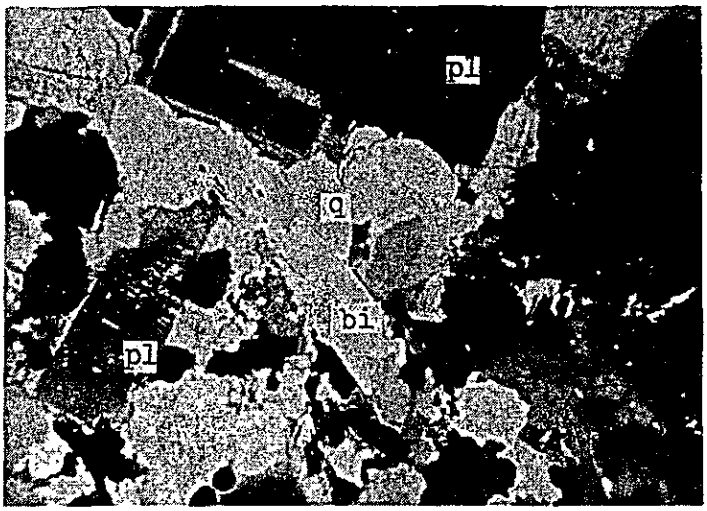


CO-36
No.100202
Guayabos

Open Nicol

0 1 mm

Andradite crystals are cemented by sulphide.



CO-37
No.100301
Puerto Saldana area

Crossed Nicols

0 1 mm

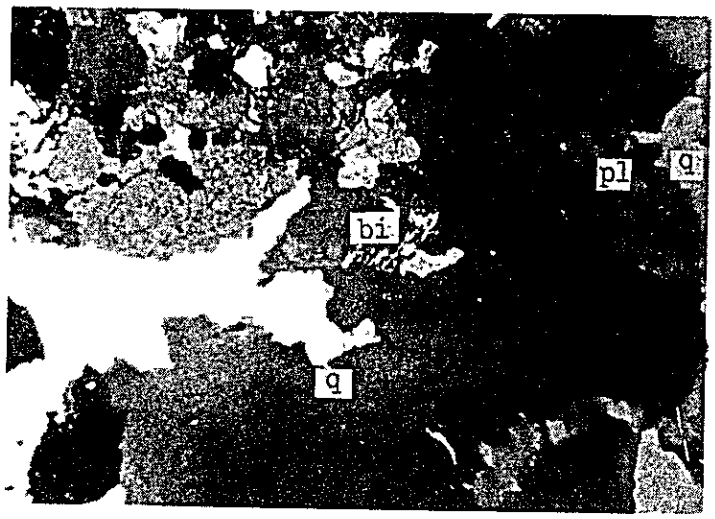
Granodiorite

This is porphyritic and relatively fresh, however silicification quartz and biotite flakes are seen as secondary crystallization.

CO-38

No.100302

Puerto Saldana area



Crossed Nicols

0 1 mm

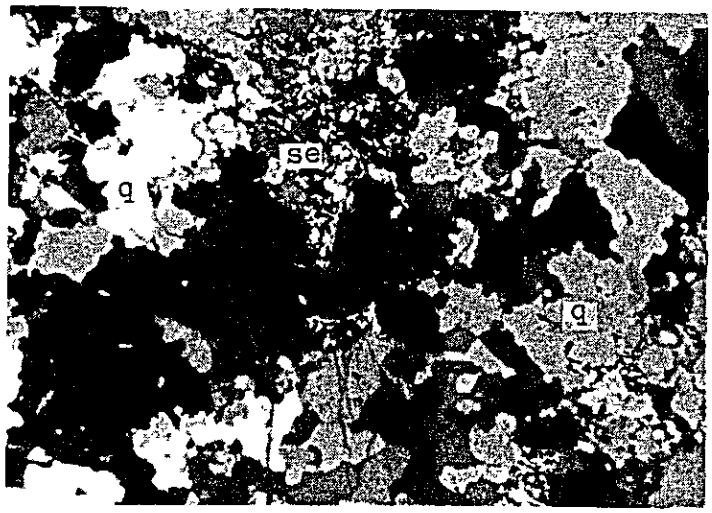
Granodiorite

This is slightly porphyritic, and moderate silicification and chloritization are observed.

CO-39

No.100303

Puerto Saldana area



Crossed Nicols

0 1 mm

Porphyritic granodiorite

The rock is generally fresh. Small biotite (0.05-0.2mm) and quartz-sericite veinlets are observed.

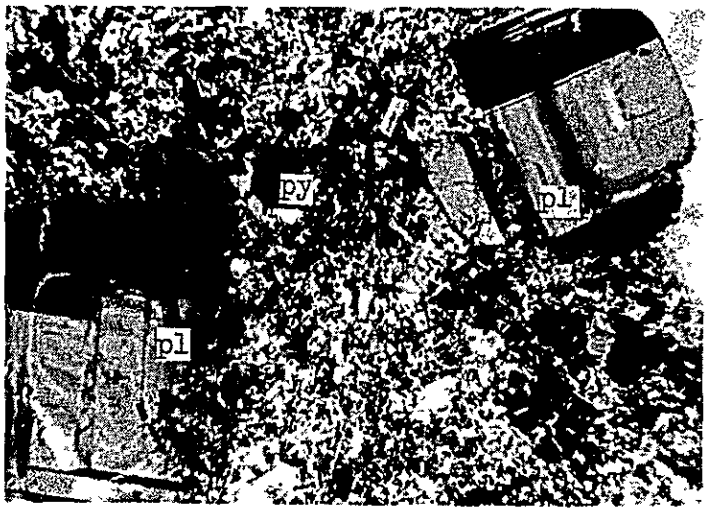
CO-41
No.100306
Puerto Saldana area

Crossed Nicols

0 1 mm

Dacitic porphyry

Phenocrysts of plagioclase, quartz, and biotite; 1-1.5 mm in size, are observed in cryptocrystalline groudmass with weak sericitization.

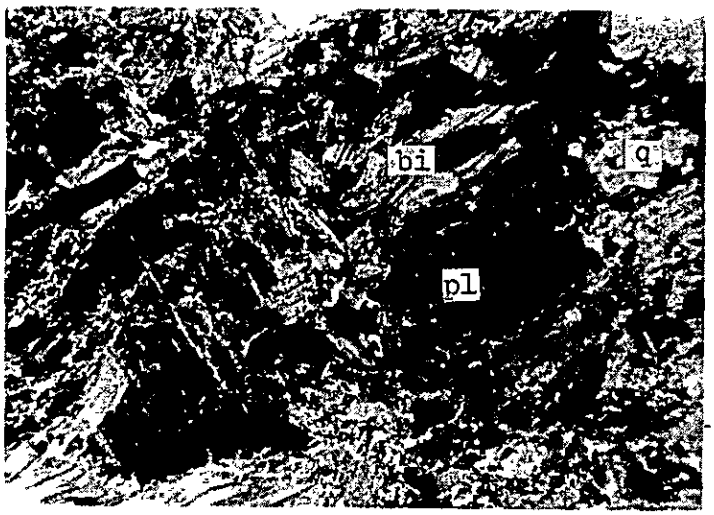


CO-42
No.100307
Puerto Saldaña area

Crossed Nicols

0 1 mm

Dacitic porphyry
Phenocryst plagioclase showing carlsbad twin and zonal structure is relatively fresh, although ground mass has suffered weak sericitization.

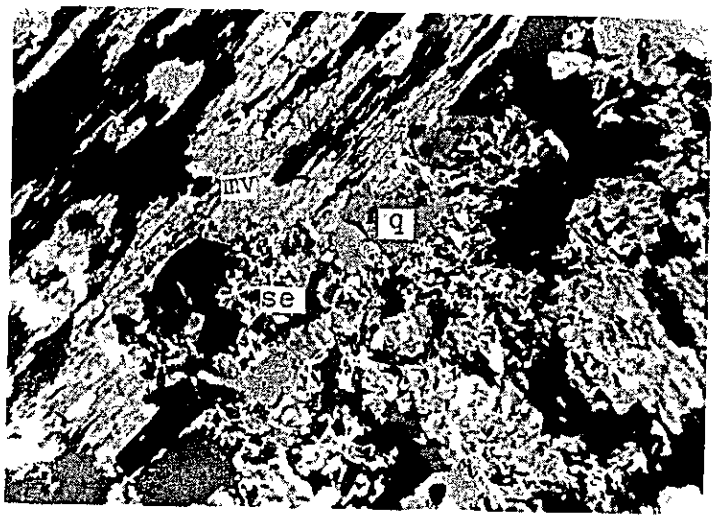


CO-43
No.100401
Puerto Saldaña area

Crossed Nicols

0 1 mm

Biotite schist
The rock consists of 60-80% biotite, 25-15% feldspar, and small amount of quartz.

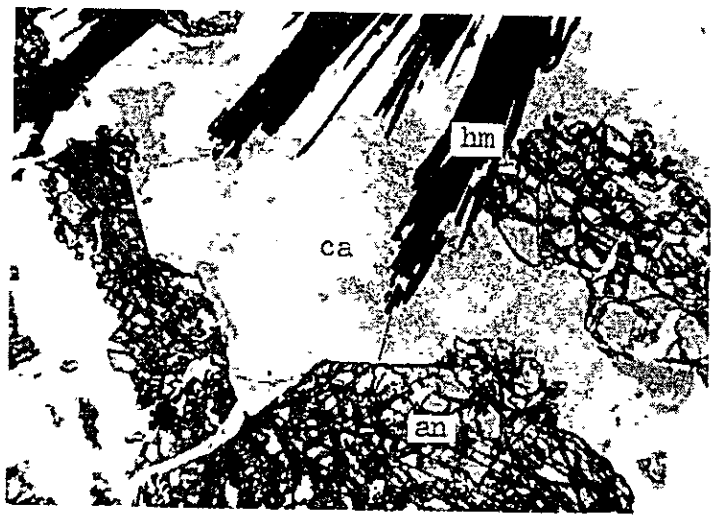


CO-46
No.100903
Piedrancha area

Crossed Nicols

0 1 mm

Acidic intrusive rock
Secondary muscovite is abundantly observed. Some sericitized plagioclase are recognized,however strongly altered.



CO-47
No.100101
Mina Vieja

Open Nicol

0 1 mm

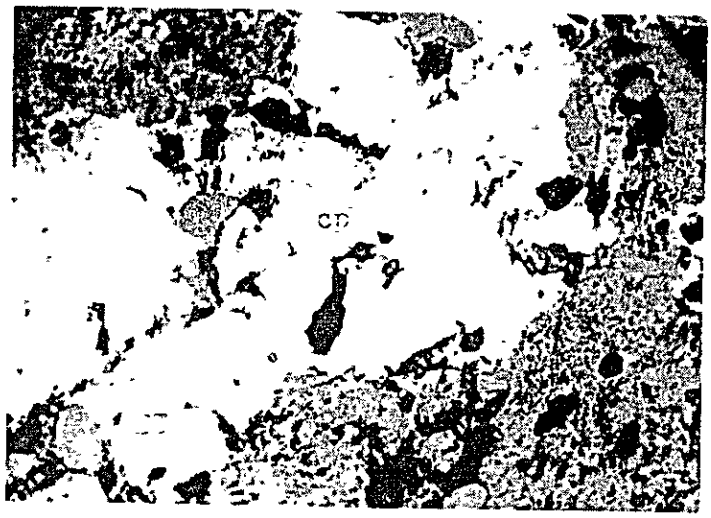
Cu skarn ore

This consists of andradite, calcite and needle-like hematite are observed.

Fig-53 Photomicrographs of Polished sections

Abbreviation

py	Pyrite	ga	Galena
cp	Chalcopyrite	lm	Limonite
hm	Hematite	gg	Gangue minerals
sp	Sphalerite	mg	Magnetite
cc	Chalcocite		

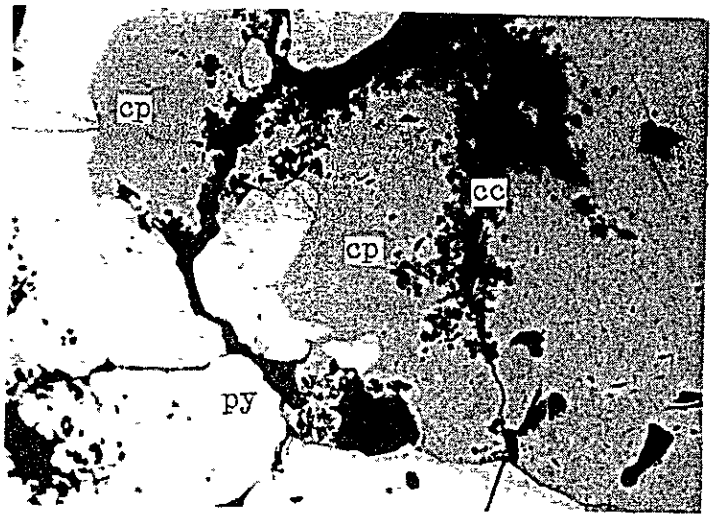


CO-13
No.092102
Pantanos area

Polished section

0.5 mm

Small piece of chalcopyrite is remained in oxidated porphyritic rock.

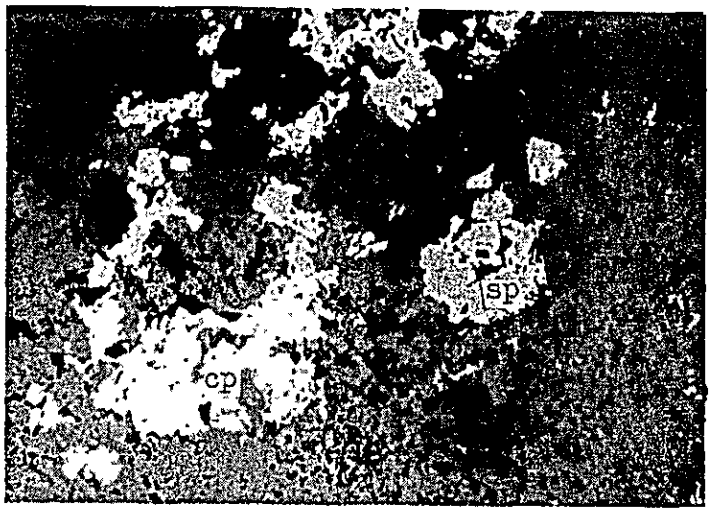


CO-15
No.P-Bo.5-129
Pantanos area

Polished section

0.5 mm

Pyrite and chalcopyrite with chalcocite rim in the quartz veinlets.



CO-21

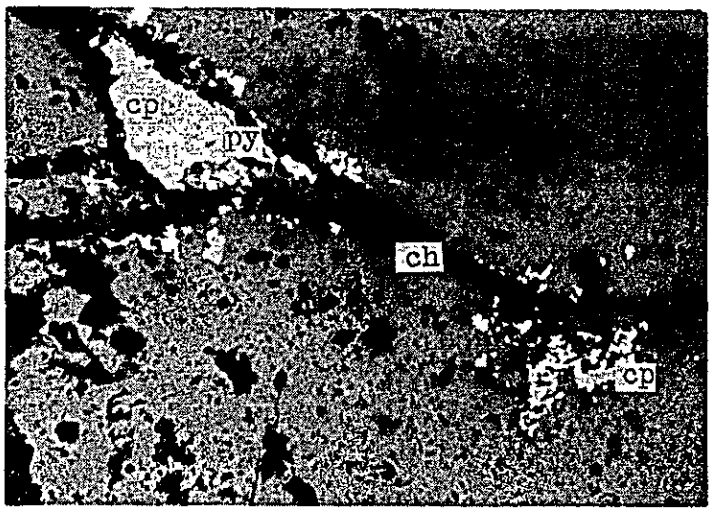
No.P-Bo.11-257.5

Pantanos area

Polished section

0.5 mm

Irregular shaped small spots of chalcopyrite, pyrite and sphalerite are observed associating and separating in particles.



CO-22

No.P-Bo.11-296

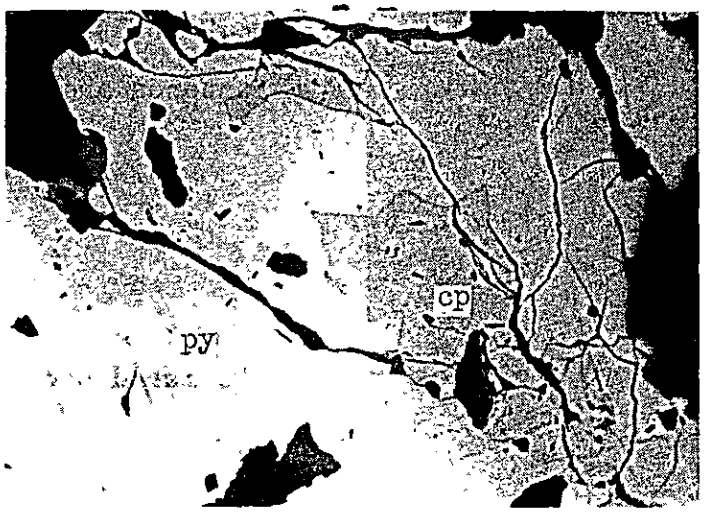
Pantanos area

Polished section

0 0.5 mm

Chalcopyrite-pyrite mineralization in the fine hair-like cracks and spots is seen,associating with chlorite in dioritic rock.

CO-27
No.PI-Bo.3-100
Infierno area



Polished section

0.5 mm

Pyrite in quartz vein encludes small chalcopyrite.

CO-36
No.100202
Guayabos area

Polished section

0.5 mm

Chalcopyrite occures associating with pyrite and magnetite, in the form of massive irregular aggregate or veinlets.

CO-39
No.100303
Puerto Saldaña area

Polished section

0.5 mm

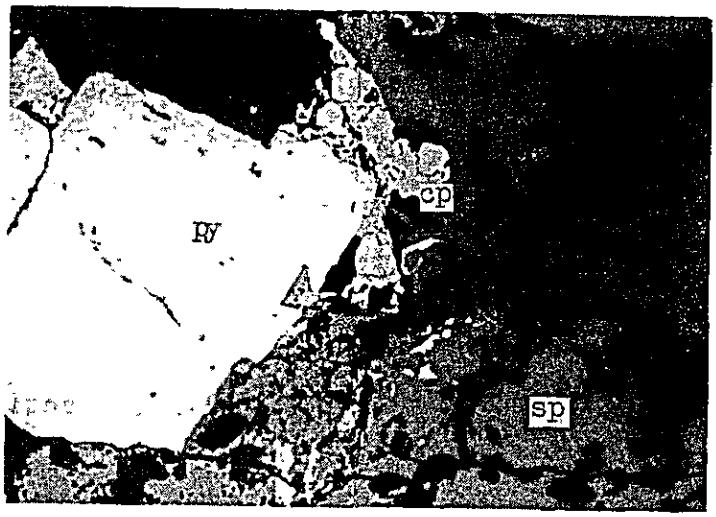
Pyrite with irregular form encloses small chalcopyrite.

CO-45
No.100902
Piedrancha area

Polished section

0 0.5 mm

Chalcopyrite associated with pyrite in quartz vein.

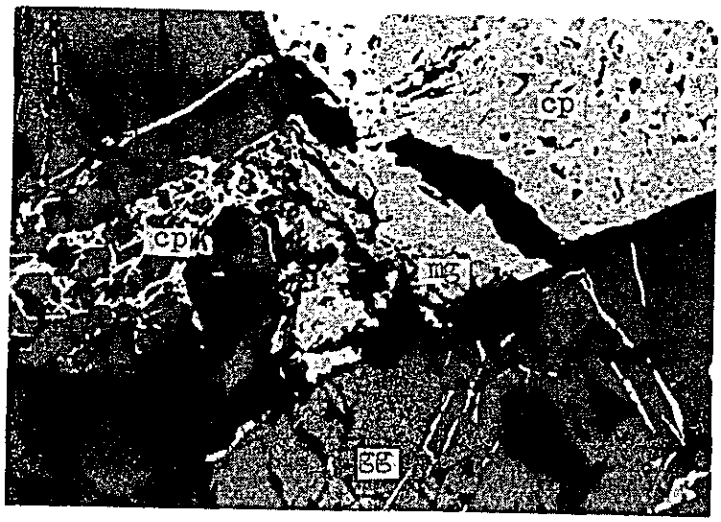


CO-46
No.100903
Piedrancha area

Polished section

0 0.5 mm

The ore consists of pyrite, sphalerite, chalcopyrite, and pyrite. Small chalcopyrite are observed in sphalerite crystals.



CO-47
No.100101
Mina Vieja

Polished section

0.5 mm

Big massive chalcopyrite and lesser amount of magnetite have crystallized among the garnet skarn, and chalcopyrite is observed in fine cracks of gangue minerals too.

MEMORANDUM OF VERBAL INFORMATION

Mr. Michel Hermelin

Director of INGEOMINAS

Bogotá, Rep. of Colombia

October, 15th, 1979, Bogotá

MEMORANDUM OF VERBAL INFORMATION

Introduction

Japanese mission surveyed four areas of Acandi, Pantanos, Rovira - Chaparral and Piedrancha where have been proposed by the government of Colombia for the cooperative basic survey of mineral resources between Colombia and Japan, from 9th September to 15th October, 1979.

In the above-mentioned areas, ground checking, collection of samples of country rocks, soils and stream sediments have been done. And, the mission have received some new information regarding those areas.

As it is necessary to require more time for examination of those data, the final technical evaluation report will be written later.

Meanwhile, the mission presents verbally herewith a tentative technical opinion.

The mission expresses its profound gratitude to the staffs of head quarter office, regional offices of Medellín, Ibagué and Popayán of INGEOMINAS, for their kind cooperation.

Tentative technical opinions on respective area

1. Acandi area;

   Porphyry copper type alterations were recognized widely, but potassic alteration was very vague.

Cu-Mo mineralization was mainly observed near the boundary between phyllic and propylitic zone, however generally very weak.

It maybe approved that drilling exploration in 2nd phase of U.N.D.P. has been done in the central part of alteration and mineralization, therefore it will be very difficult to obtain new high grade mineralized zone in this adjacent area.

2. Pantanos area (including Murindo area);

In Pantanos area, being recognized porphyry copper type alterations, in generally it is predominant in phyllic or propylitic alteration. And potassic alteration zone will appear in deeper level.

Cu-Mo mineralization may be accompanied with quartz porphyry dykes intruded in NW-SE and E-W directions, and it is possible to concentrate the mineralization near the boundary of quartz porphyry and quartzdiorite.

Strong copper mineralization was observed on the No. 11 drilling cores.

The mission concluded that area is a very promising one for porphyry copper deposit.

However, by the reason of the relatively intensive structural control to the mineralization, it is strongly recommended to be done more basic investigations.

In the Murindo area, there are some large porphyry copper type geochemical and geophysical anomaly zones. It is expected to be promising mineralized area similar to Pantanos area.

3. Rovira - Chaparral area;

The mission inspected the four areas of Infierno, Los Andes, Guayabos and Puerto Saldaña, and the Vieja Mine for reference.

In the Infierno and Los Andes, porphyry copper type alteration with weak Cu mineralization was only observed along some fractured zones in quartz diorite.

The drilling exploration, it is acceptable, has been done in the most interesting part in this area. Consequently, around this part, it could not be found any other interesting part.

The Guayabos Cu mineralized indication is occurred in a fractured zone of calcareous beds of Post-Payande formation, and is associated with garnet-magnetite skarn.

It is possible to expect some ore bodies like as Vieja Mine's ore body based on future exploration. And also around the area, the similar mineralization should be expected.

In the Puerto Saldaña area, on the road of aproximately 3 kms. it was observed relatively intensed biotitization, silicification and sericitization and weak Cu-Mo mineralization in some places of quartzdiorite, quartzporphyry and metamorphic rocks.

According to some skarnized floats in the rivers, it is presumed that some skarn type mineralization may exist in the area.

4. Piedrancha area;

The mission could not approach to the main geochemical anomaly area of U.N.D.P. 1st phase exploration results, because of bad weather. Therefore, the mission investigated only eastern and southern part, and studied geological data, mineral samples of "Zona Minera de Pasto", samples from a person of Piedrancha, and geological circumstance with geochemical anomaly of U.N.D.P.'s works. By the results of above-mentioned studies, Cu-Mo (plus Zu, Au) mineralized zones may exist in this area.

Conclusión

The mission presents verbally herewith tentative technical conclusions which are based on the results of only geological reconnaissances in this time.

The final technical evaluation report will be written after completing analysis of samples and examination of geological data.

It is advisable to carry out geological investigations in the following order based on the above mentioned technical opinions, for technical cooperation works between Colombia and Japan.

1. Pantanos area;

   At first, geological and structural investigations in detail, systematic geochemical (soil) and geophysical (I.P.) investigations are favorable to select target areas. At second, information drillings must be done in the target areas.

2. Murindo area;

   Geological and structural investigations, and more systematic geochemical and geophysical surveys where they are required, should be necessary to pick up the most promising zone. And finally, information drillings shall be done in the target area.

3. Puerto Saldaña area (Southwestern area of Chaparral);

   It is required to make topographic map at first, and regional geological and structural investigation must be followed. For the hopeful area by those investigation works, information drillings shall be carried out.

   Because of expecting to be similar mineralized areas around this project by the result of U.N.D.P. 1st phase survey, a regional geological investigation may be effective.

4. Piedrancha area;

The mission recommends a regional geological survery and geochemical prospecting with topographic survey by handy teodolite, and it should be followed by detailed geological survey, geological and geochemical investigations, and information drillings.

5. Guayabos area (Northern area of Chaparral);

It is recommended to effect a regional geological survey and study of skarn copper mineralized zone in detail. After those works, geophysical investigation (magnetic survey, and/or I.P.) and information drillings.

Japanese survey team for mineral resources
on Republic of Colombia.