

Appendix 1. Microscopic observations of thin sections

Sample No.: 1203

Rock Name: Dacite tuff

Loc. Name: Chual

Coordinate: 9118720 N, 768110 E

This specimen is pale greenish gray, compact, massive dacite tuff. It contains a large amount of crystal fragment (ca 50 vol. %) and a small amount of lithic fragment (altered aphyric andesite : max. 4mm across) and pumice fragment within the fine-grained matrix. The crystal fragments are, in a decreasing order, plagioclase (max. 3mm across), quartz (max. 3mm), biotite (max. 1mm) and hornblende (max. 2mm). They are mostly subhedral to anhedral. Especially, quartz fragments often show an angular broken form as shown in photo, suggesting a pyroclastic origin. Pumice fragments are dark green, lenticular (max. 1-2cm in length) and make a weakly foliated structure. The matrix is heterogeneous both in composition and crystallinity, and is made up of microcrystalline to cryptocrystalline aggregate of quartz, plagioclase, K-feldspar and clay minerals. Mafic minerals such as biotite and hornblende can be recognized only as pseudomorph, and they are wholly altered to chlorite, smectite (or mixed-layer minerals) and carbonate minerals. On the other hand, plagioclase is partly replaced by sericite and carbonate minerals.

Based upon above features, this specimen is thought to be a welded(?) pumice tuff of pyroclastic flow origin, although the welding structure of the matrix does not remain due to the alteration.

Sample No.: A1402

Rock Name: Altered hornblende andesite

Loc. Name: Cerro Purimaca

Coordinate: 9095860 N, 821440 E

This specimen is very pale yellow, porous, altered andesite. It contains a large amount of euhedral phenocryst of hornblende (max. length:2mm) and plagioclase (max. length:1mm) and a small amount of hypersthene and opaque mineral. The groundmass shows the fluidal and hyalopilitic texture, and is composed of fine-grained lath-shaped plagioclase, hornblende, hypersthene, opaque minerals and devitrified glass.

Due to the intense alteration, plagioclase, hornblende and hypersthene can be recognized only as pseudomorphs, and are perfectly altered to aggregate of very fine-grained kaolinite and smectite. Opaque minerals are altered to aggregate of very fine-grained rutile and goethite. Within the groundmass, irregular-shaped pores are sporadically formed, probably due to the leaching after the alteration.

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Sample No.: A1701

Rock Name: Altered quartz porphyry

Loc. Name: Quillish Pampa

Coordinate: 9155200 N, 807400 E

This specimen is whitish gray, massive quartz porphyry with abundant brownish hematite veins. It shows a marked porphyritic texture. Phenocryst minerals are, in a decreasing order, plagioclase (max. length: 5mm), quartz (max. 1.5mm across), biotite (max. 2mm across) and hornblende (max. length: 1.5mm). Quartz phenocrysts show a nearly euhedral but considerably corroded form. The groundmass is holocrystalline, and is composed of fine-grained quartz, plagioclase, K-feldspar and leucoxene.

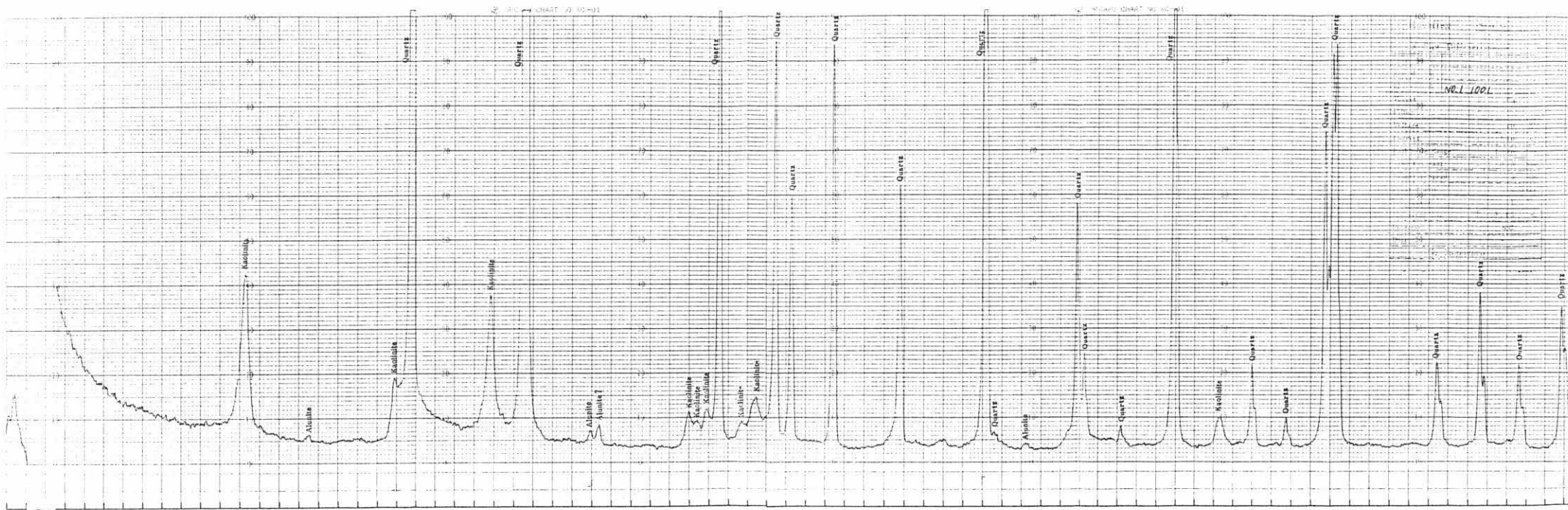
Due to the intense alteration, plagioclase is perfectly kaolinized, whereas biotite and hornblende are altered to aggregate of chlorite, smectite and leucoxene.

Hematite (max. 0.5mm across) occurs as veinlet, network or disseminated minerals. Around hematite crystals, aggregate of fine-grained goethite are formed due to the alteration.

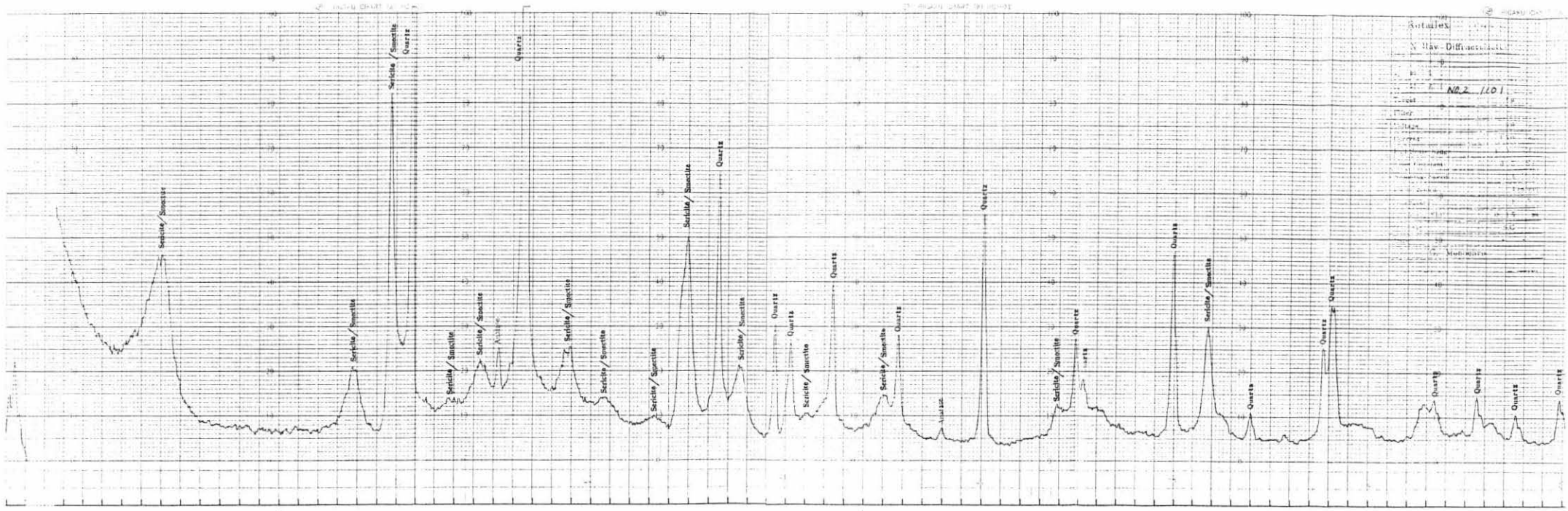
Appendix 2. X-ray diffraction analysis

Number	Northing	Easting	Location	Rock type	Quartz	Kaolinite	Sericite	Sericite/S mectite	Alunite	Anatase	Rutile	Hematite	Goethite
1001	9,099,610	759,390	Mina Machacala	rhyolite	A	M	-	-	R	-	-	-	-
1101	9,112,020	777,920	Julcan	tuff	A	-	-	A	-	F	-	-	-
A1701	9,155,200	807,400	Quillish pampa	quartz porphyry	A	A	-	F	-	-	-	-	-
I2001	9,222,220	795,720	Michiquillay	granodiorite	A	F	A	-	-	-	F	F	F
A2101	9,214,470	769,540	Huanbo cancha	sandstone	A	M	F	-	-	R	-	-	-

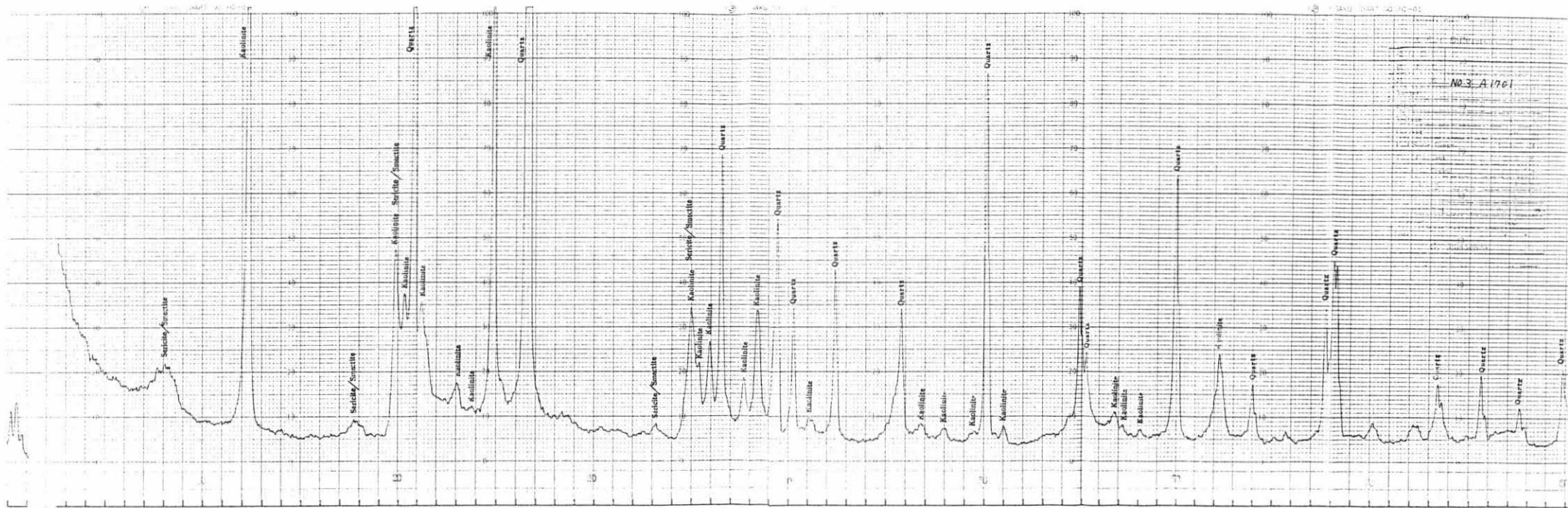
A: abundant, M: many, F: few, R: rare, -: none



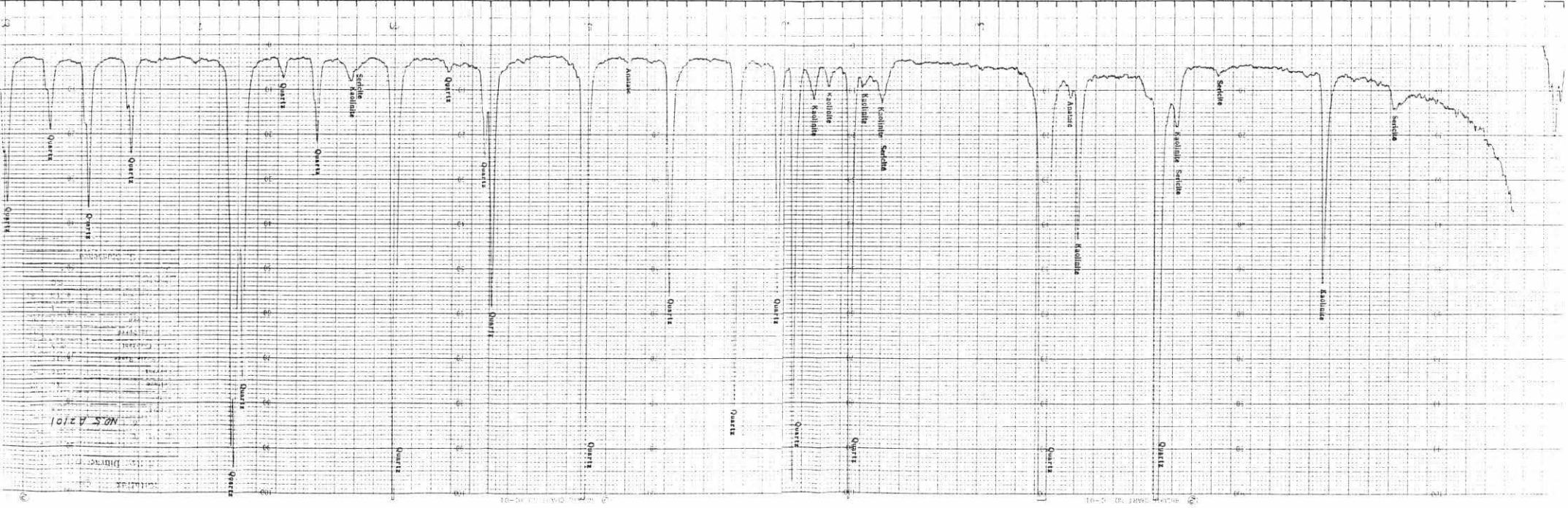
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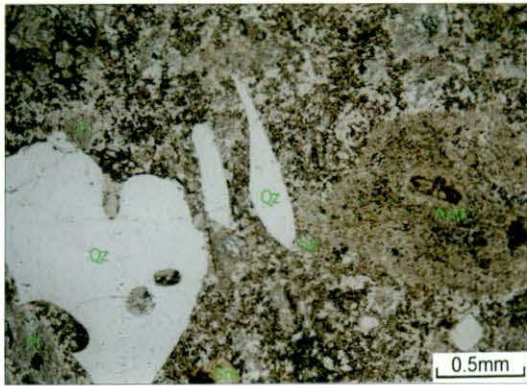
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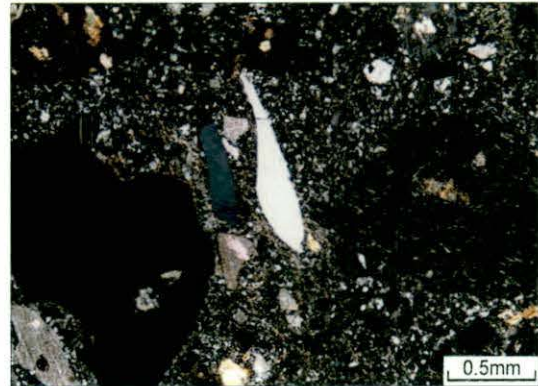
Appendix 3. Geochemical analysis

	Number	Au (ppb)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	As (ppm)	Sb (ppm)	Te (ppm)	Hg (ppm)
1	0901	<1	<1	16	9	30	13	<5	<20	80
2	1001	193	37	40	156	40	7	<5	<20	<20
3	1103	<1	<1	7	6	25	10	<5	<20	<20
4	1202	<1	<1	18	9	40	17	5	<20	<20
5	A1402	<1	<1	17	5	<5	101	6	<20	140
6	A1604	<1	<1	<5	13	33	18	7	<20	<20
7	A1605	2	<1	47	28	292	14	<5	<20	<20
8	A1701	32	<1	14	27	46	33	12	<20	460
9	A1801	<1	<1	<5	13	405	42	<5	<20	20
10	A1901	<1	<1	20	45	404	49	<5	<20	30
11	A1903	<1	<1	51	10	39	7	<5	<20	<20
12	I2001	10	<1	172	9	5	13	<5	<20	<20
13	A2101	<1	<1	12	7	7	12	<5	<20	<20
14	I2301	<1	<1	33	9	52	22	<5	<20	<20

	Number	Map	Zone	East. (km)	North. (km)	Location name	Rock type	Alteration	Formation
1	0901	16-f	17	762.35	9,127.09	Pachin Bajo	tuff breccia ?	st.sil.+ wht.argi.	Calipuy
2	1001	17-f	17	759.39	9,099.61	Machacala mine	rhyolite	st.sil.	Calipuy
3	1103	16-f	17	770.39	9,130.26	Carnihual Bajo	lapilli tuff	st.sil.+ wht.argi.	Calipuy
4	1202	16-f	17	749.82	9,134.64	Alcachas	quartz porphyry	st.sil.+ part.argi.	Calipuy
5	A1402	17-g	17	821.44	9,095.86	Cerro Purimaca	lapilli tuff ?	st.sil.+ py.	Calipuy
6	A1604	16-h	18	169.10	9,145.74	Chiquilbamba	calc. shale	limonite network	Inca, Chulec, Pariatambo
7	A1605	16-h	18	173.62	9,130.63	Calvario	arkosic ss.	wk.sil.+py. ?	Inca, Chulec, Pariatambo
8	A1701	16-g	17	807.40	9,155.20	Quillish Pampa	granodiorite	st.wht.argi.+sil.	Tertiary intrusive rock
9	A1801	15-g	17	821.31	9,183.68	Cerro Quinua	ark.ss./calc.sh.	Fe oxide (gossan)	Inca
10	A1901	15-g	17	821.19	9,182.76	Cerro Quinua 2	ark.ss./sh./ls.	Fe oxide (gossan)	Inca
11	A1903	15-g	17	795.44	9,201.40	Rosa Pampa	sh./ss.	Fe oxide + wk.sil.	Farrat
12	I2001	15-g	17	795.72	9,222.22	Michiquillay	granodiorite	wht.argi.+ sil.	Tertiary intrusive rock
13	A2101	15-f	17	769.54	9,214.47	Huambo Cancha	arkosic ss.	wk.sil.+ argi.	Farrat
14	I2301	16-g	17	726.16	9,156.84	Huaca	sandstone	wk.sil.	Chicama

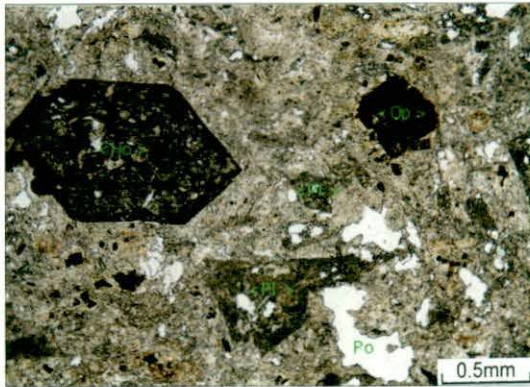


lower polar

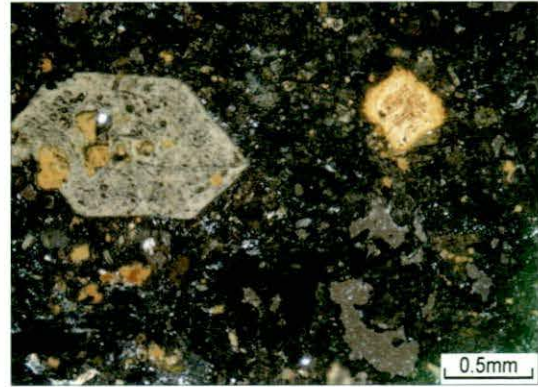


crossed polar

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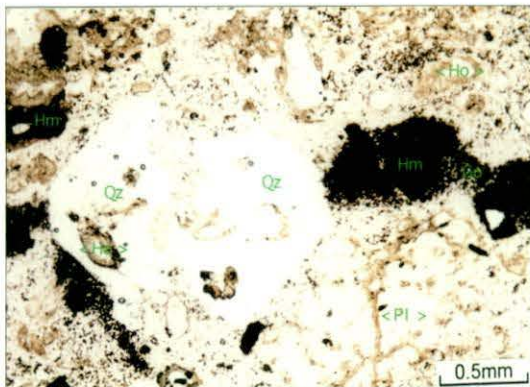


lower polar



crossed polar

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 Rock Name: Altered hornblende andesite
 Loc. Name: Cerro Purimaca
 Coordinate: 9095860 N, 821440 E



lower polar



crossed polar

Sample No.: A1402
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 Loc. Name: Cerro Purimaca
 Coordinate: 9095860 N, 821440 E

And: Andesite Go: Goethite Hm: Hematite Ho: Hornblende Op: Opaque mineral
 Pl: Plagioclase Po: Pore Qz: Quartz Se: Sericite Sm: Smectite < >: Pseudomorph