

Abbreviations

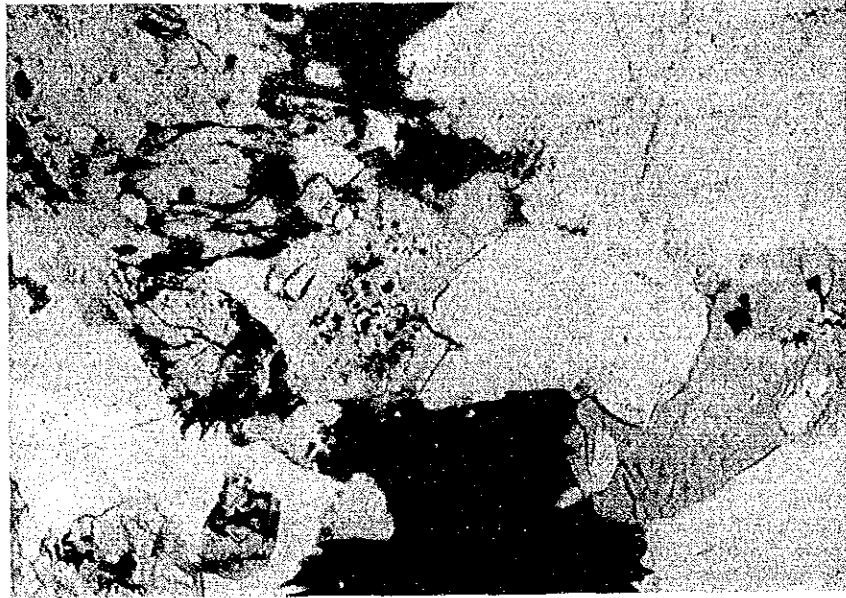
qz :	quartz,	pl :	plagioclase,	kf :	k-feldspar,
bi :	biotite,	hb :	hornblende,	am :	actinolite,
cpx :	clinopyroxene,	sr :	sericite,	ch :	chlorite
cb :	carbonate,	Alm :	altered mafic mineral,		
Mt :	matrix,	Gm :	Groundmass		

Sample No. : K12309

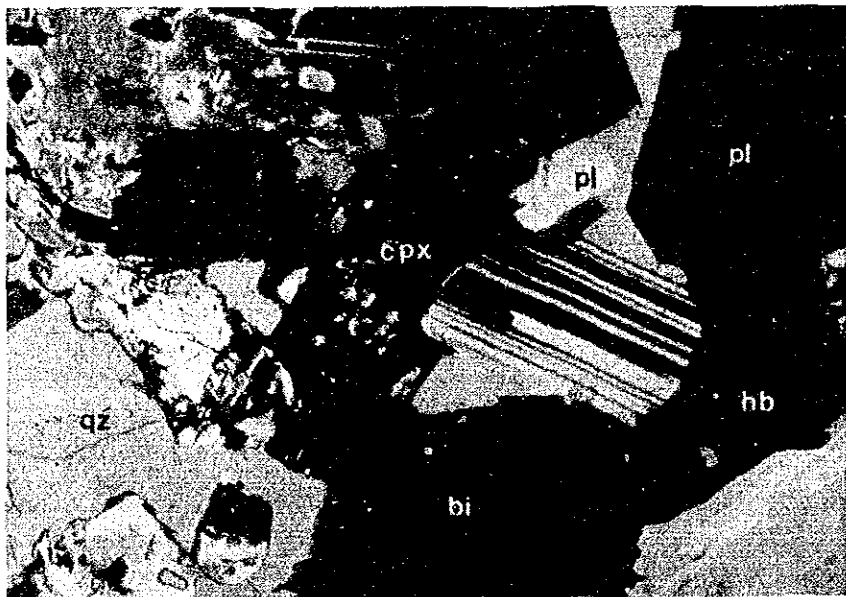
Locality : Chontali


Rock Name : Quartz diorite

PPL



XPL



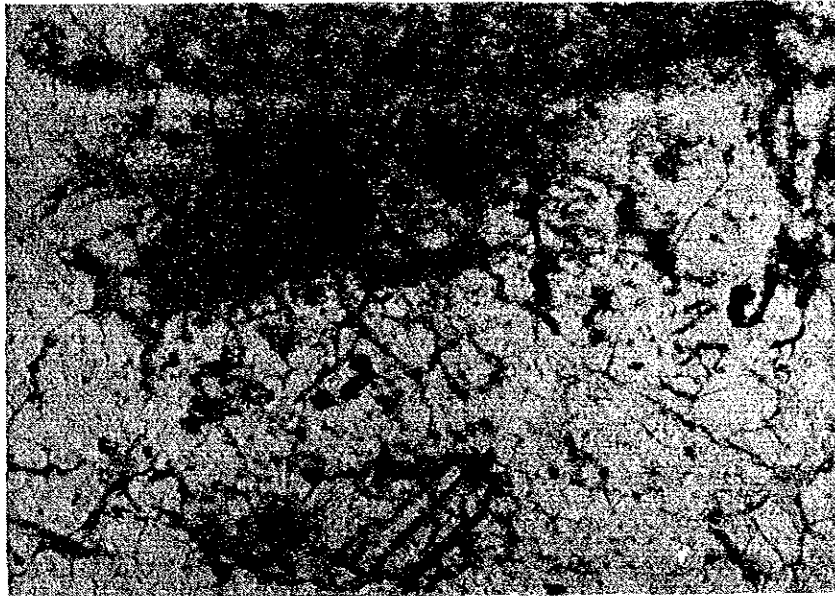
Scale 1 mm 

Sample No. : K02505

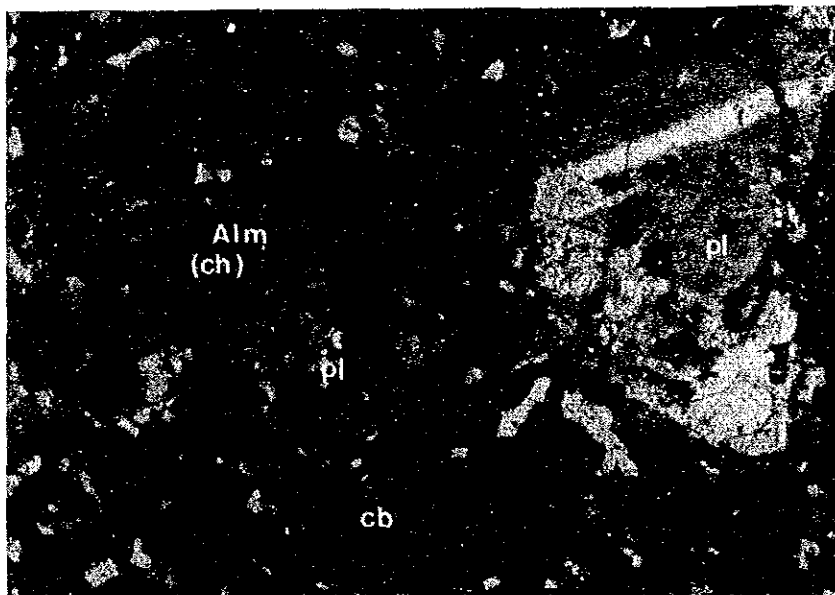
Locality : San Felipe


Rock Name : Diorite porphyry

PPL



XPL



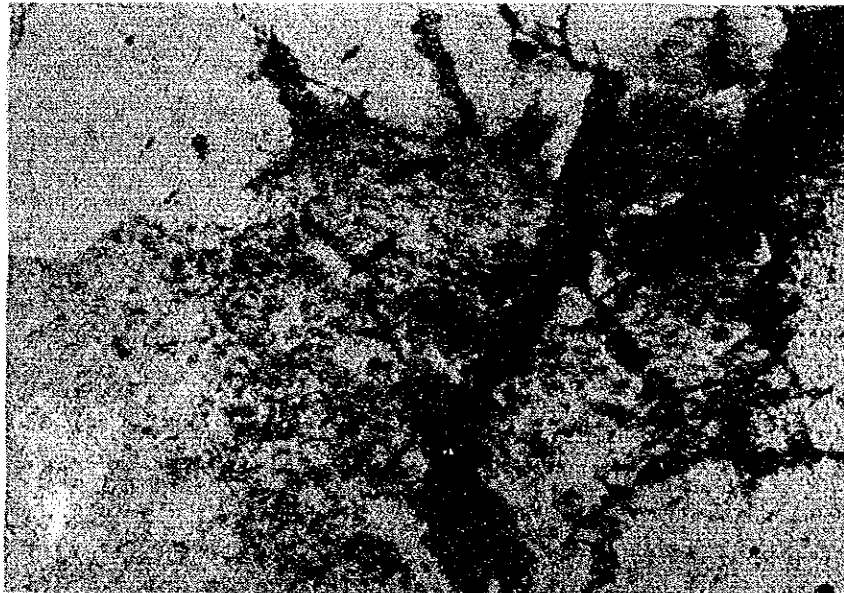
Scale 1 mm 

Sample No. : H12405B

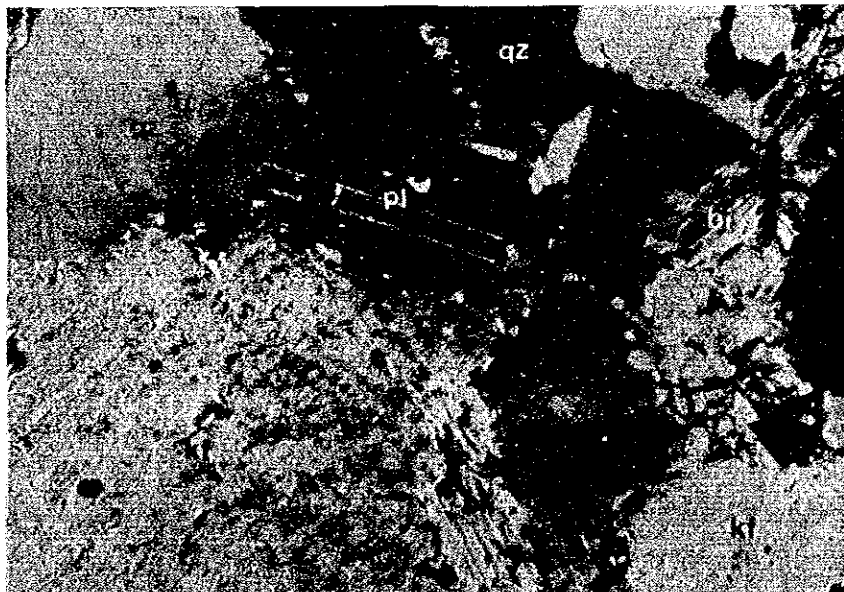
Locality : Chontali


Rock Name : Granodiorite

PPL



XPL



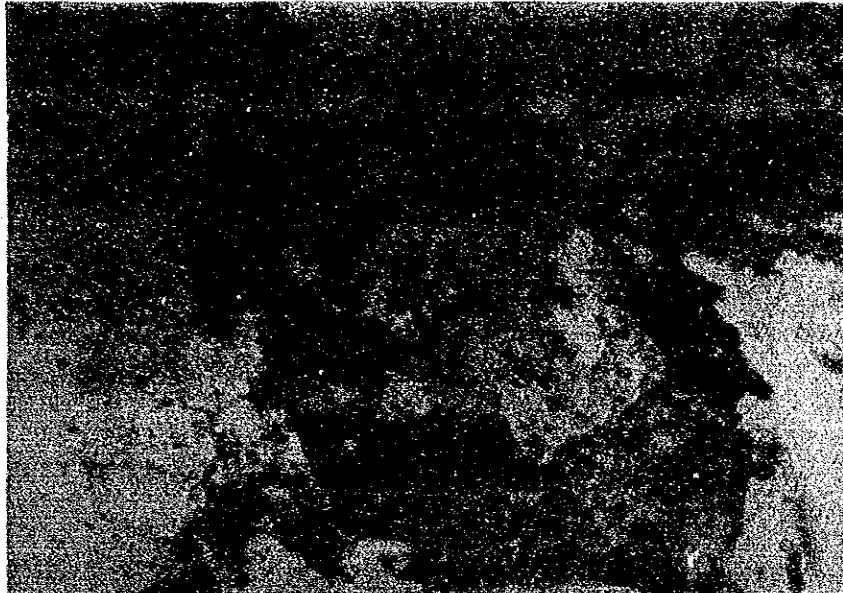
Scale 1mm 

Sample No. : H20303

Locality : Palma


Rock Name : Syenite

PPL



XPL



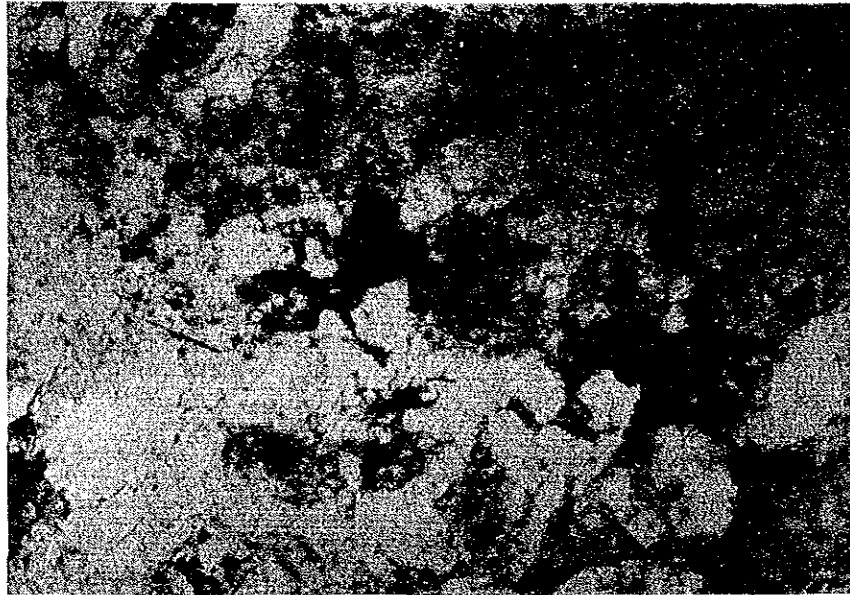
Scale 1mm 

Sample No. : H11005

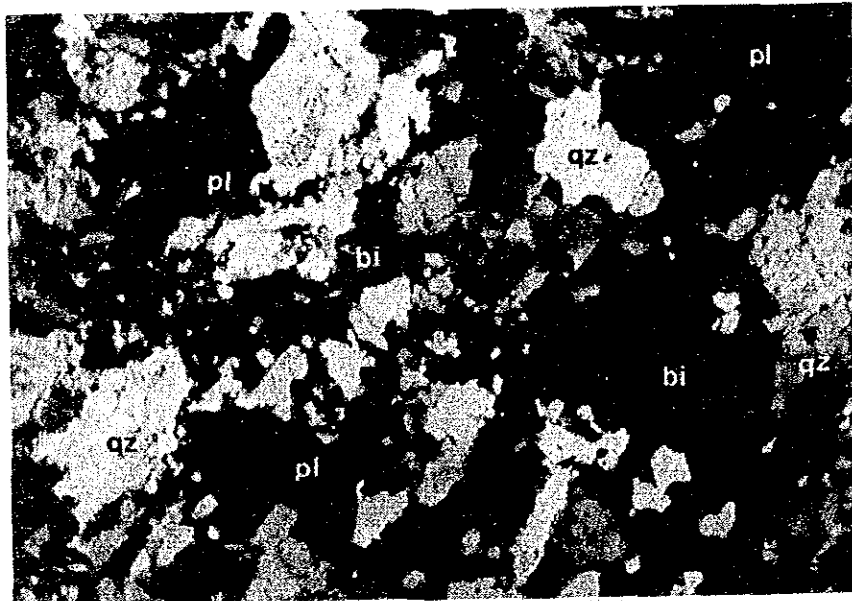
Locality : San Felipe


Rock Name : Granodiorite

PPL



XPL



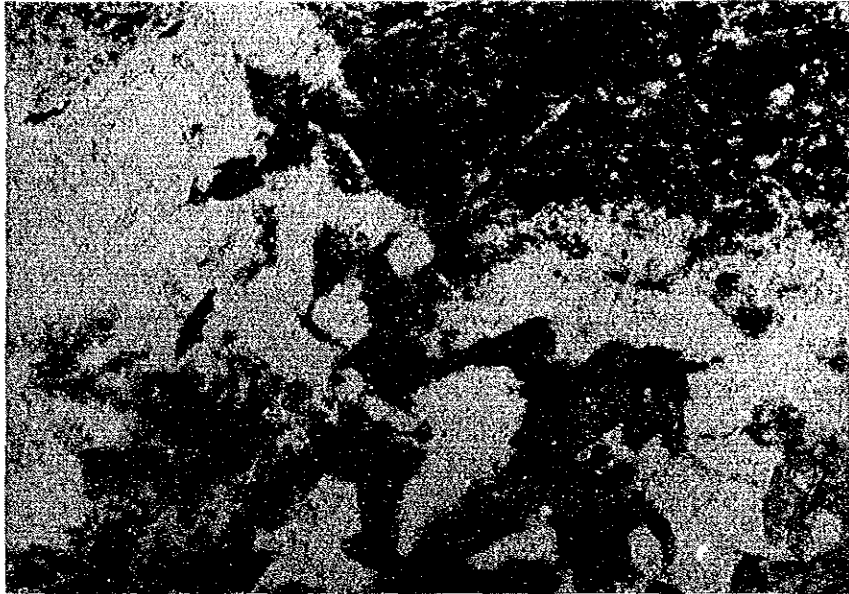
Scale 1 mm 

Sample No. : M02603

Locality : Palma


Rock Name : Granite (Adamelite)

PPL



XPL



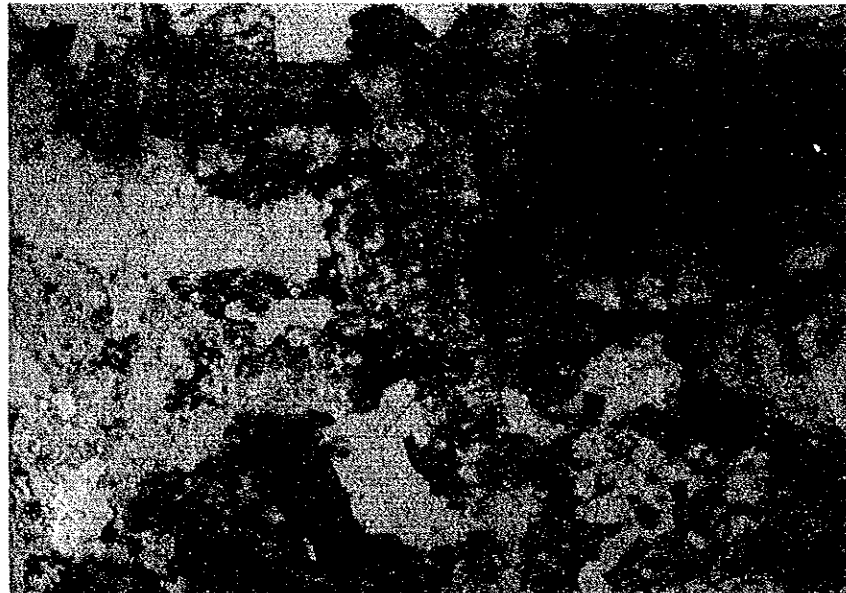
Scale 1 mm 

Sample No. : H03008

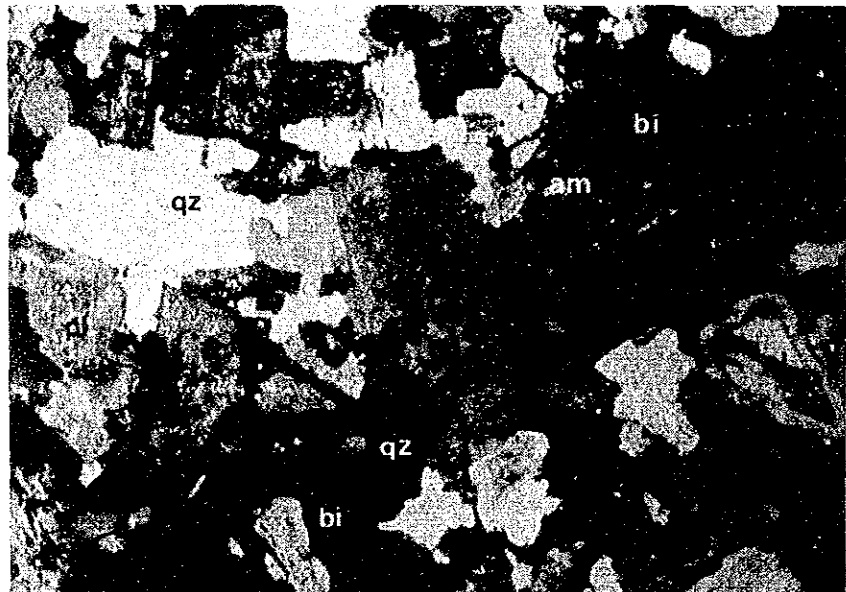
Locality : San Felipe

Rock Name : Tonalite

PPL



XPL



Scale 1mm 

Sample No. : H12418

Locality : Chontali

Rock Name : Quartz monzonite

PPL



XPL



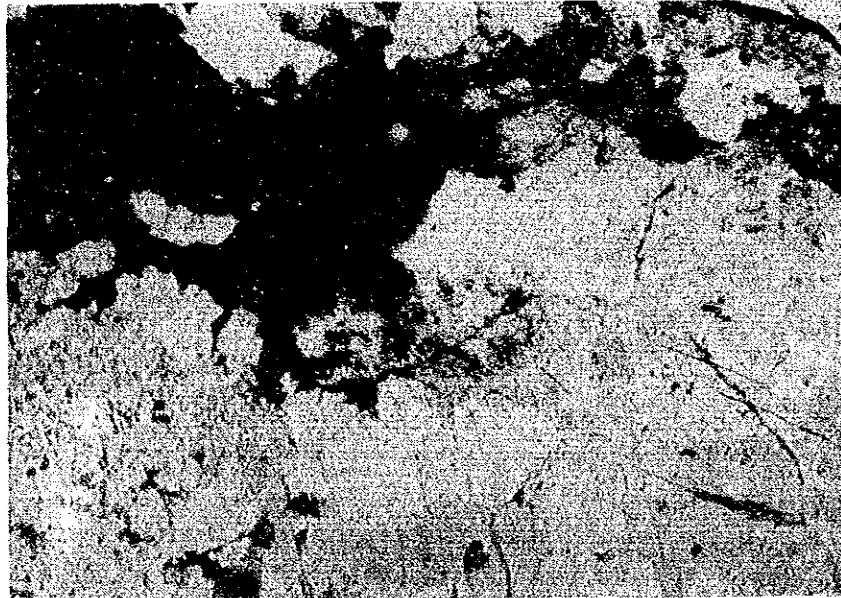
Scale 1mm 

Sample No. : K21201

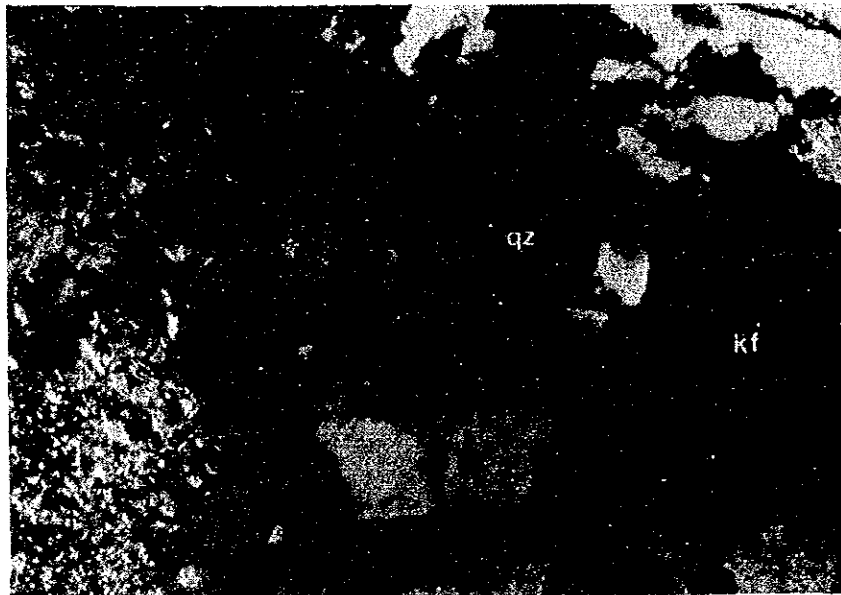
Locality : Palma

Rock Name : Granite (Adamelite)

PPL



XPL



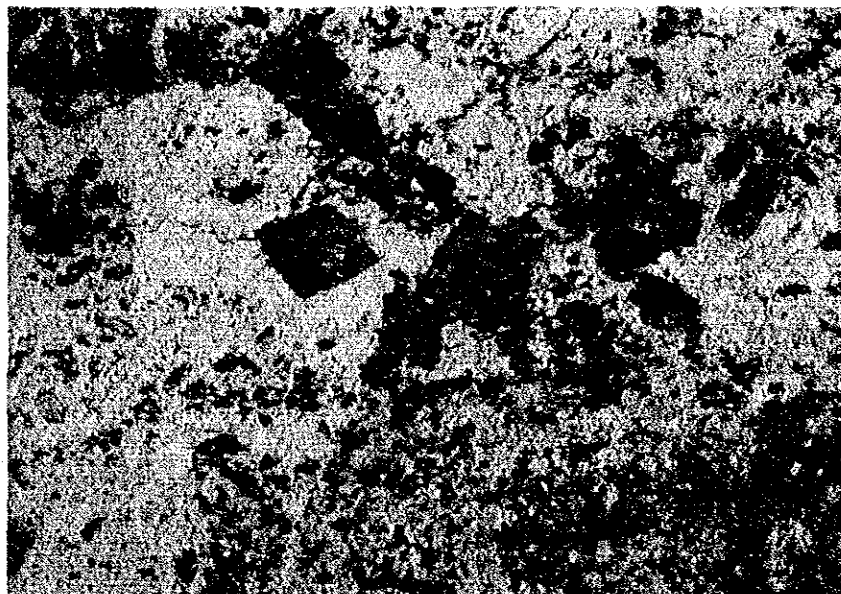
Scale 1mm 

Sample No. : H02503

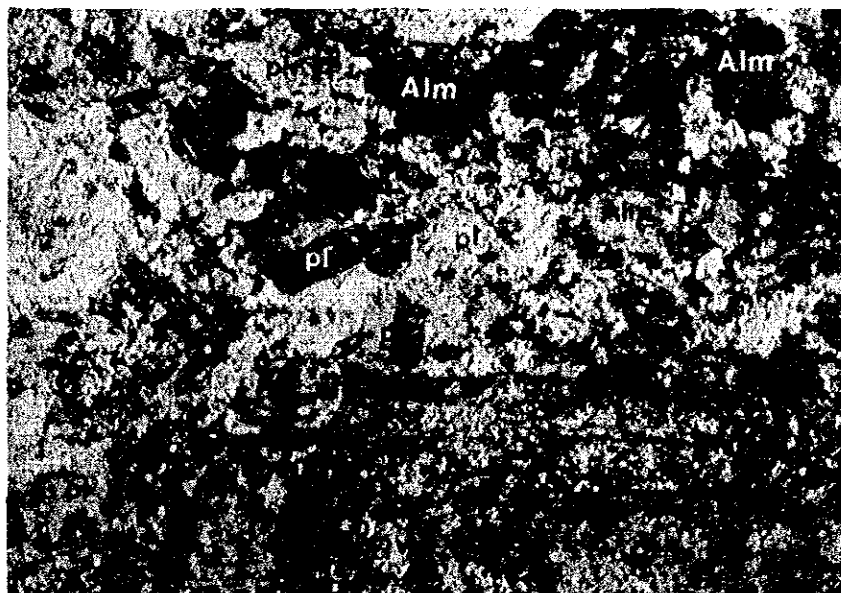
Locality : San Felipe


Rock Name : Monzonisyenite

PPL



XPL



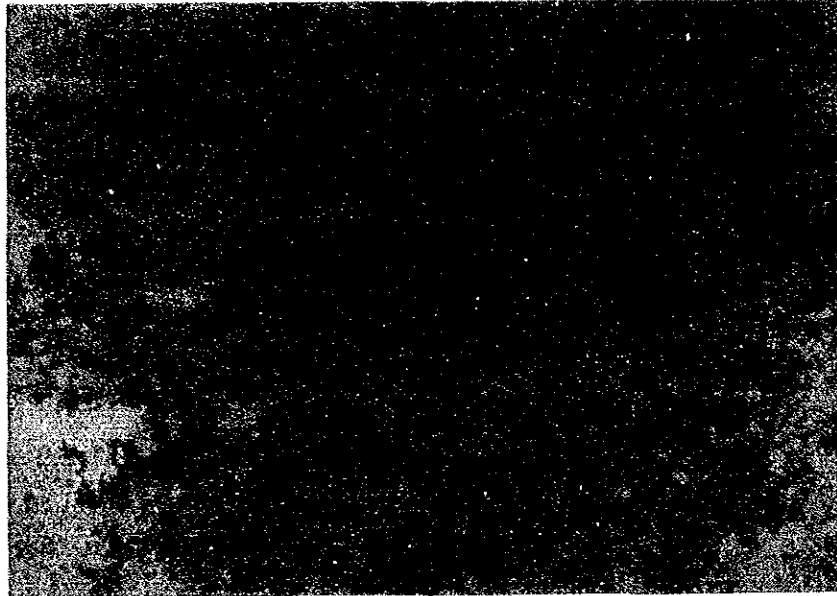
Scale 1mm 

Sample No. : K12501

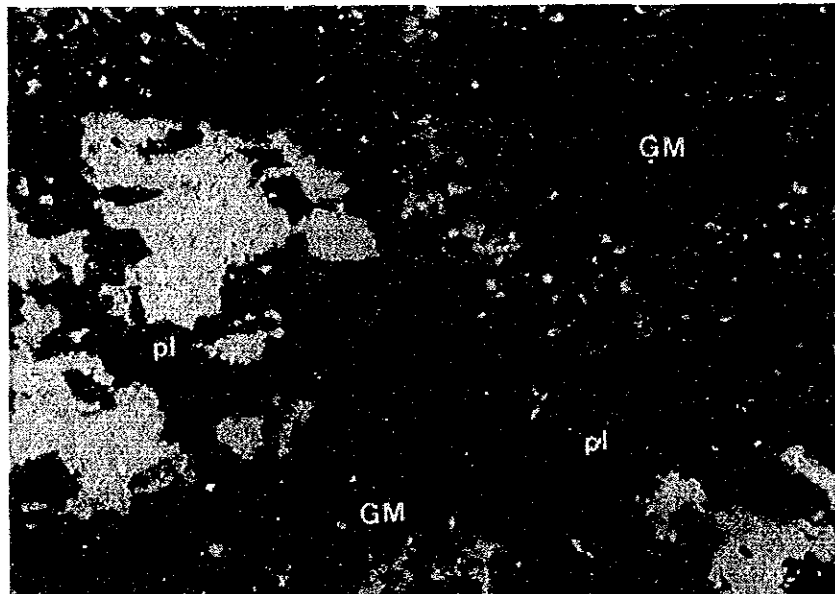
Locality : Chontali


Rock Name : Monzonite porphyry

PPL



XPL



Scale 1 mm 

Sample No. : H12405A

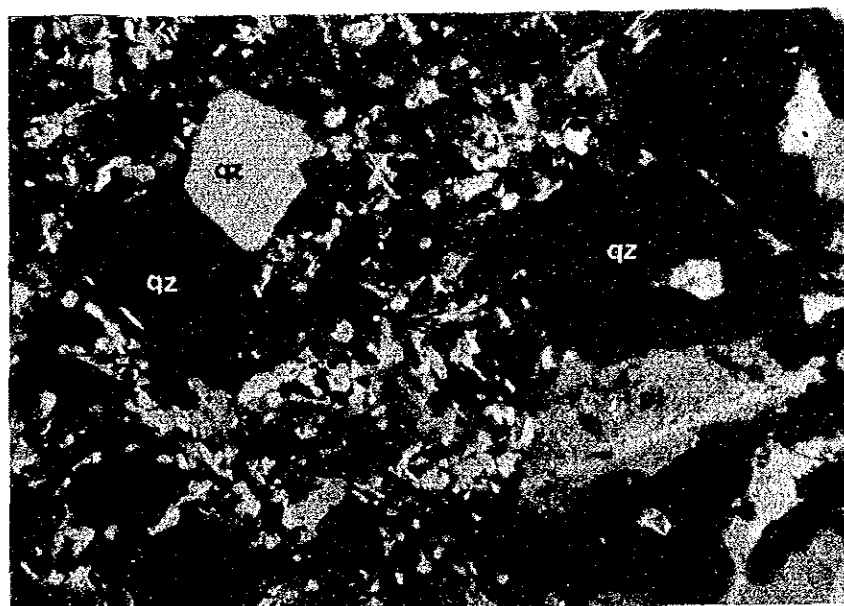
Locality : Chontali

Rock Name : Granite porphyry

PPL



XPL



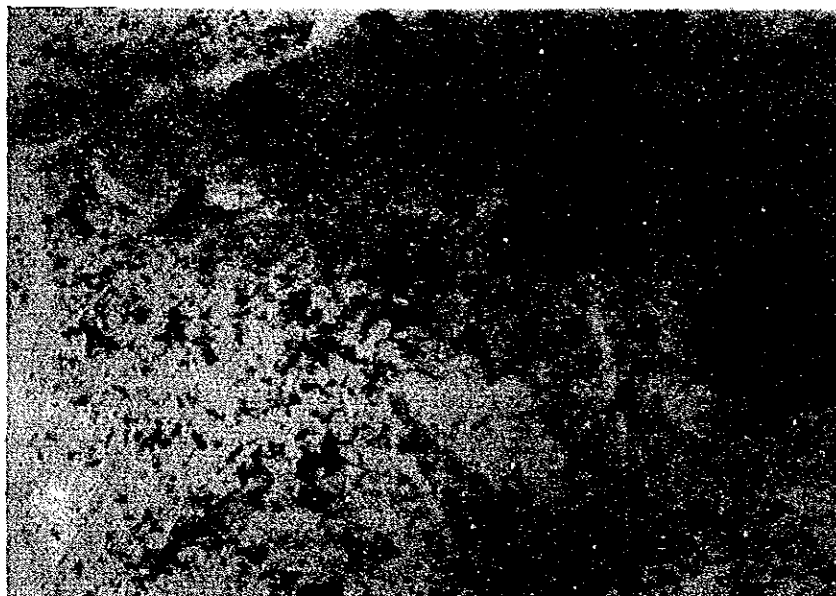
Scale 1mm 

Sample No. : H12404

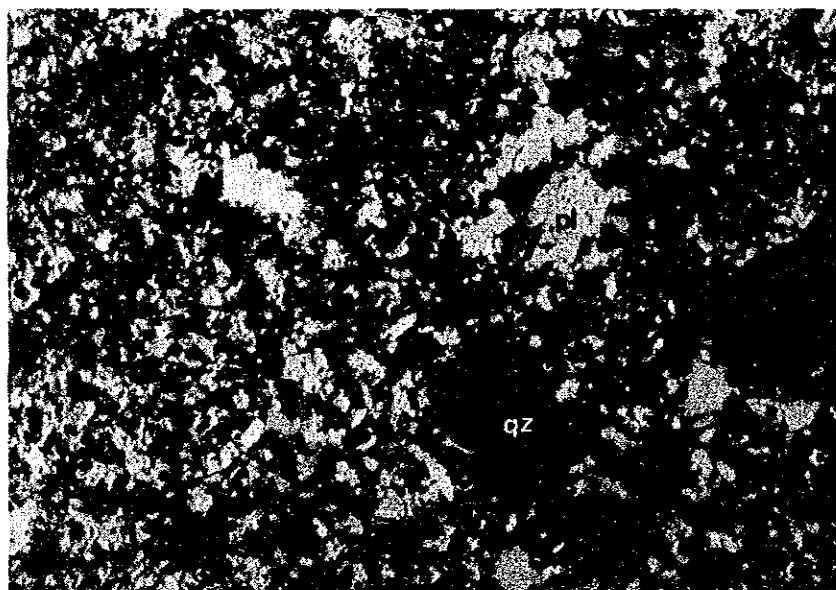
Locality : Chontali

Rock Name : Granophyre

PPL



XPL



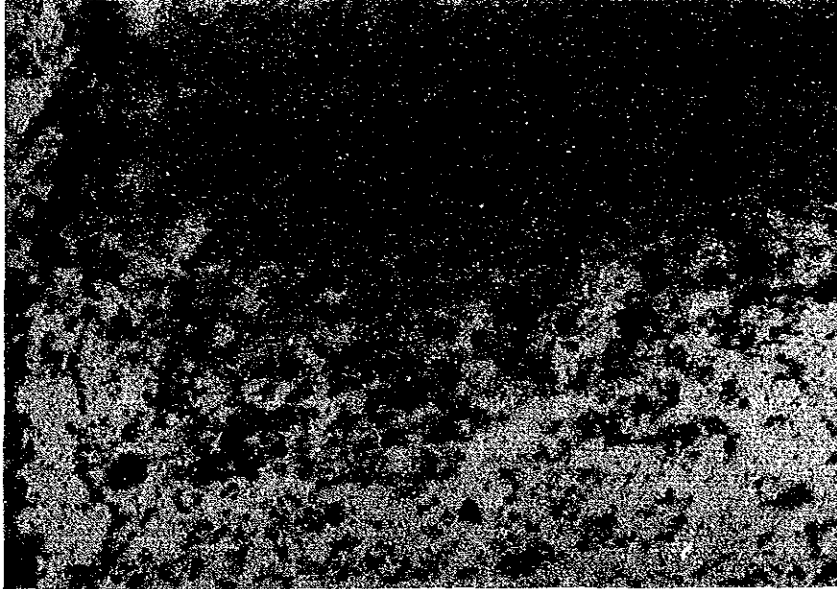
Scale 1mm 

Sample No. : H11703

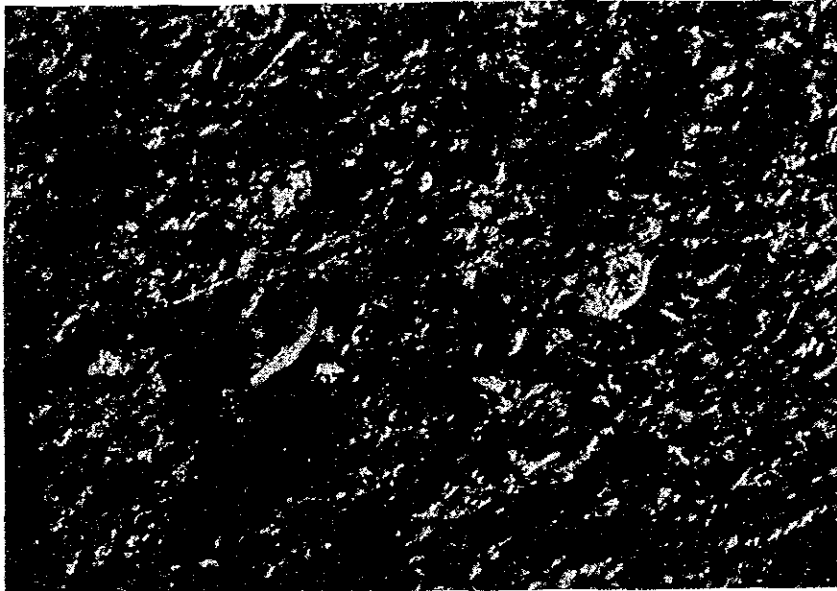
Locality : Jehuamarca


Rock Name : Rhyorite

PPL



XPL



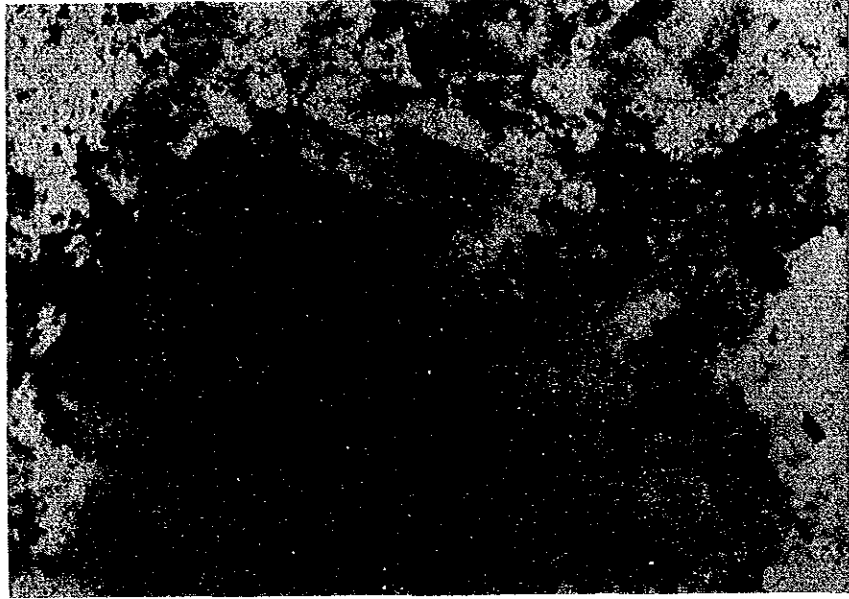
Scale 1mm 

Sample No.: M02503

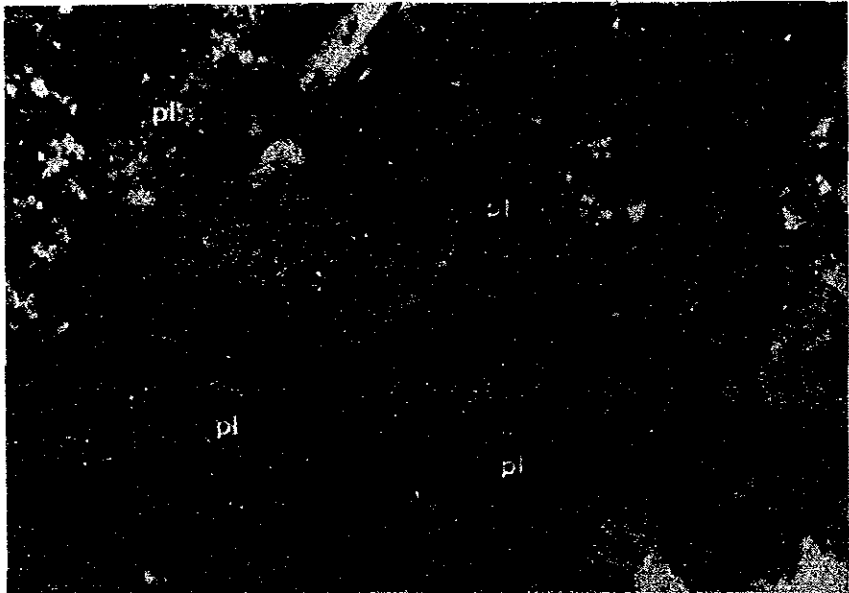
Locality: San Felipe


Rock Name: Andesite

PPL



XPL



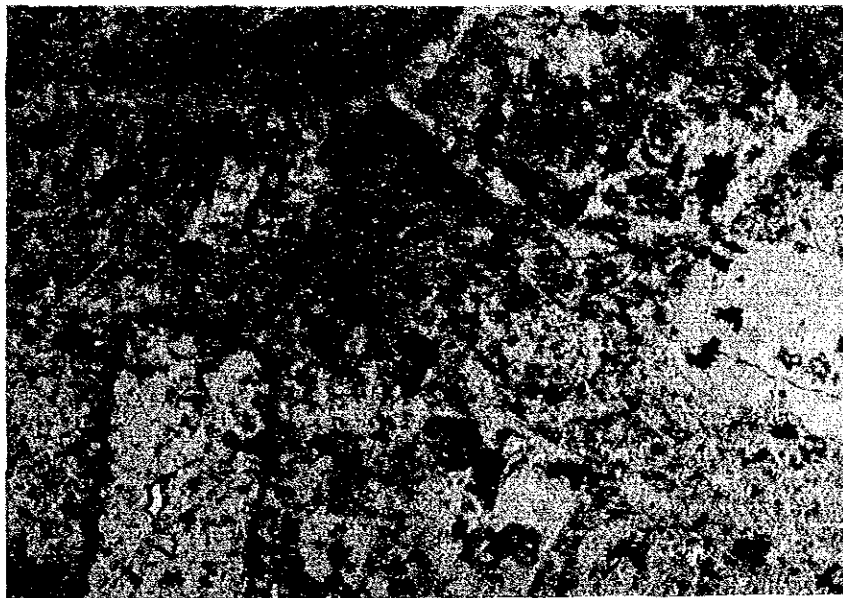
Scale 1 mm 

Sample No.: K12307

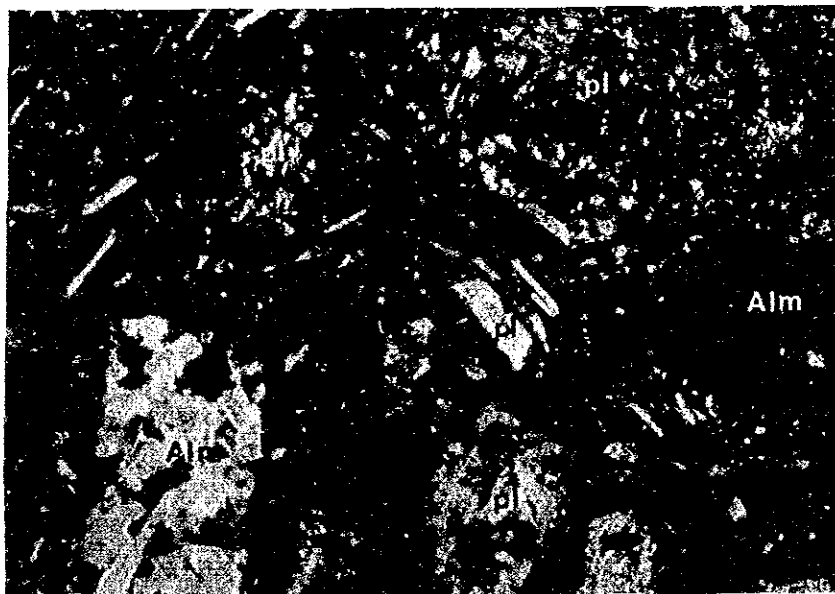
Locality: Chontali

Rock Name: Andesite

PPL



XPL



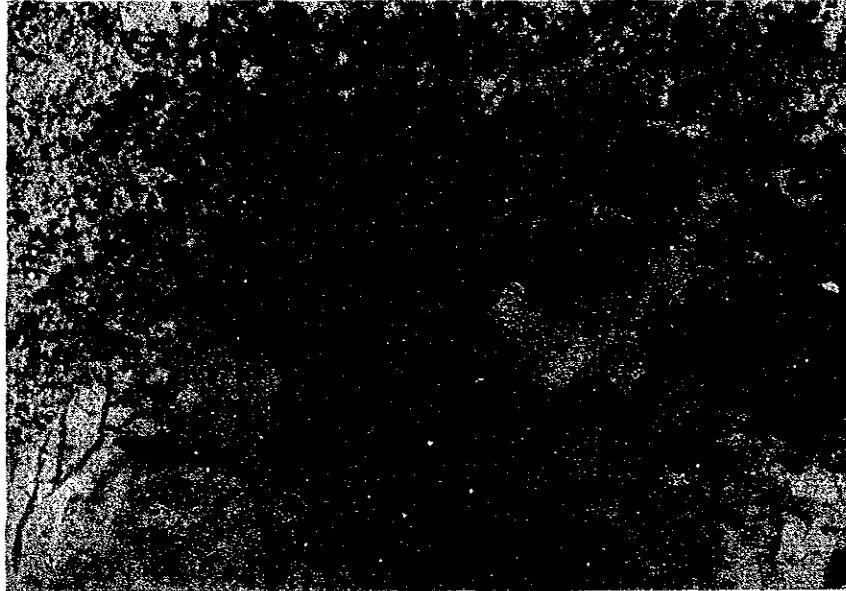
Scale 1 mm 

Sample No. : M02403

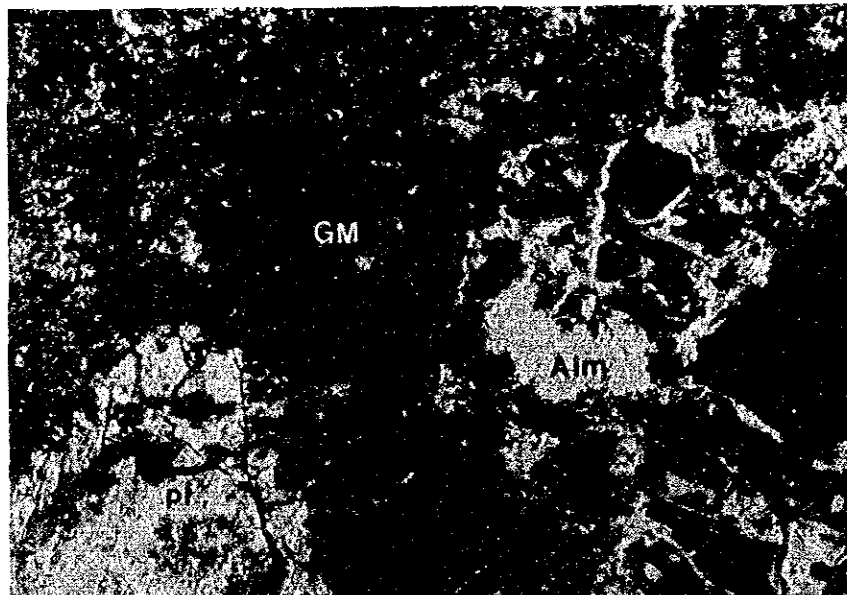
Locality : Palma


Rock Name : Dacite

PPL



XPL



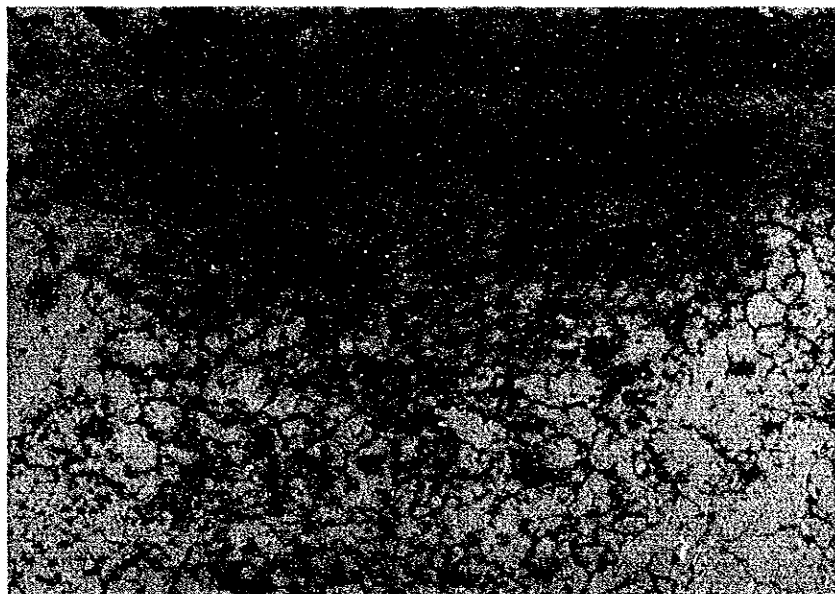
Scale 1 mm 

Sample No. : K11803

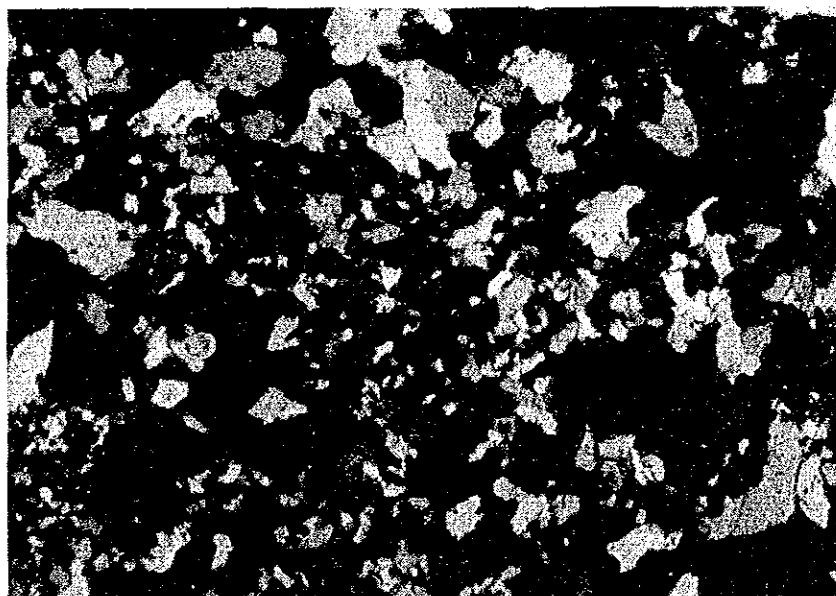
Locality : Jehuamarca


Rock Name : Siliceous Rock

PPL



XPL



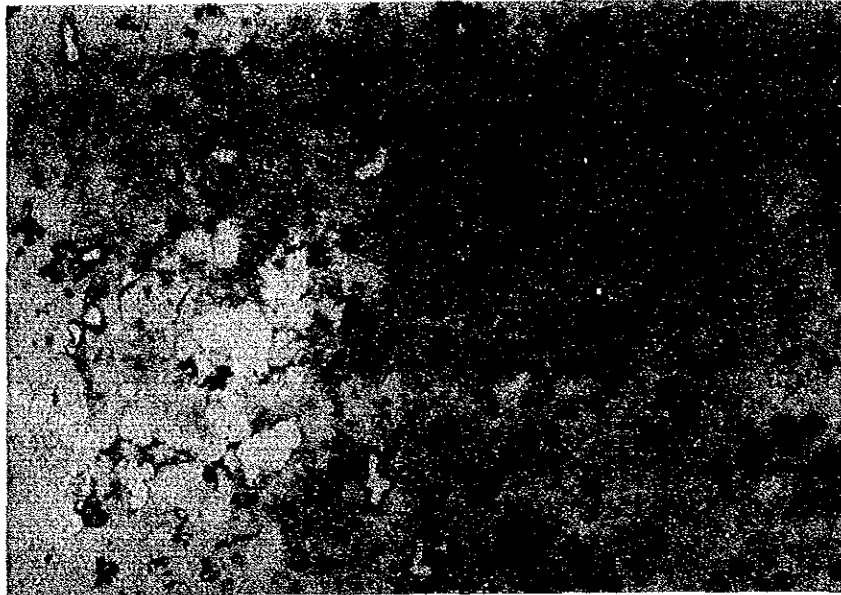
Scale 1 mm 

Sample No. : H11902

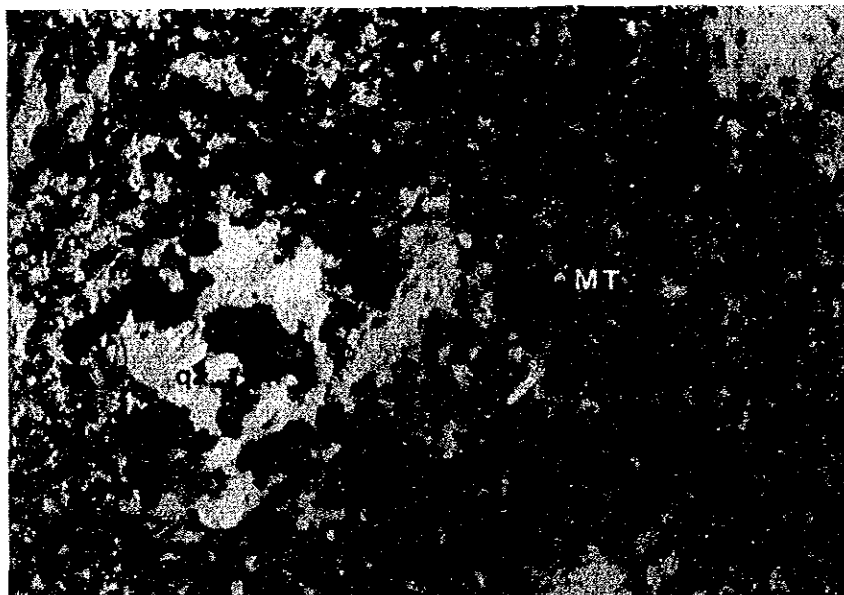
Locality : Jehuamarca


Rock Name : Welded tuff

PPL



XPL



Scale 1mm 

Sample No. : K11906

Locality : Jehuamarca

Rock Name : Tuff

PPL



XPL



Scale 1mm 

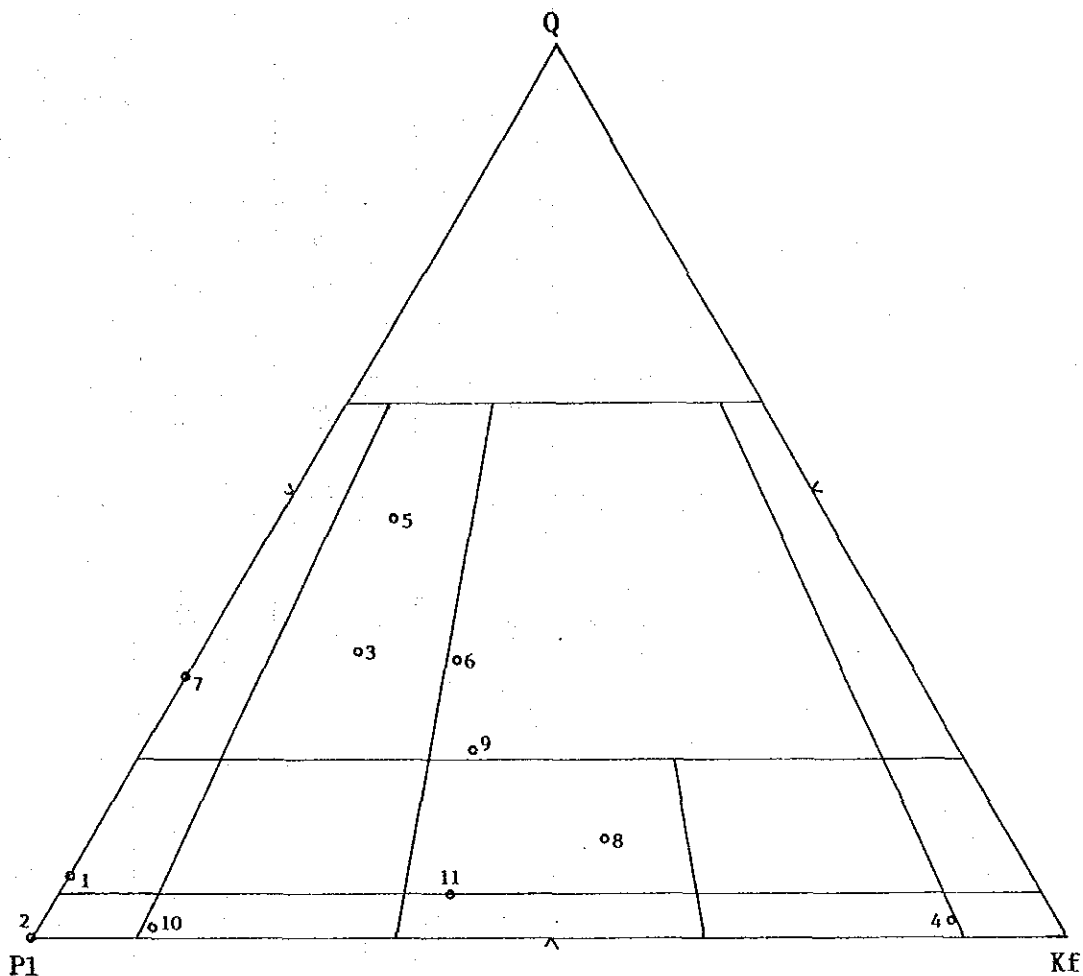
Apx.3

Results of Whole-Rock Chemical Analysis

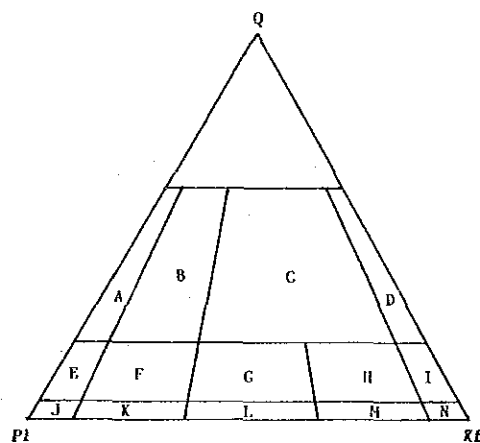
(1)

	(15)	(11)	(8)	(10)	(3)	(20)	(2)	(9)	(17)	(1)	(16)
	K12309	K02505	H12405B	H20303	H11005	M20603	H03008	H12418	K21201	H02503	K12501
SiO2	56.03	62.91	75.33	75.05	73.37	68.88	63.50	62.66	71.46	62.43	55.02
TiO2	0.69	0.35	0.17	0.14	0.22	0.37	0.44	0.66	0.20	0.44	0.42
Al2O3	16.94	16.31	13.30	13.09	13.60	14.40	17.24	15.56	14.76	16.52	16.59
Fe2O3	2.27	1.98	1.24	1.20	1.44	1.13	1.68	1.52	0.95	1.35	0.87
FeO	4.94	1.63	0.53	0.68	0.99	2.60	2.35	3.34	1.56	2.24	0.93
MnO	0.14	0.05	0.03	0.06	0.04	0.09	0.05	0.08	0.05	0.06	0.06
MgO	3.96	2.02	0.74	0.35	0.86	1.45	2.40	2.48	0.60	2.76	1.12
CaO	7.90	3.47	0.71	1.43	1.58	3.82	3.82	4.50	2.80	4.97	8.60
Na2O	3.02	5.35	6.28	3.77	5.63	3.17	4.78	3.01	4.28	5.01	7.91
K2O	2.67	2.51	1.78	4.74	2.45	3.58	2.30	4.57	3.46	2.16	1.65
P2O5	0.05	0.11	0.12	0.14	0.10	0.13	0.11	0.13	0.14	0.11	0.01
H2O+	0.18	2.80	0.73	0.28	0.68	1.14	1.63	0.43	0.93	2.80	7.35
H2O-	0.06	0.55	0.34	0.14	0.11	0.12	0.20	0.12	0.17	0.13	0.33
BaO	0.06	0.03	0.01	0.08	0.07	0.07	0.03	0.20	0.07	0.02	0.01
Total	98.91	100.07	101.31	101.15	101.14	100.95	100.53	99.26	101.43	101.00	100.97
Q	5.70	12.38	29.69	31.99	27.24	25.96	14.37	14.12	26.42	11.14	0.00
C	0.00	0.00	0.03	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00
or	15.78	14.83	10.52	28.01	14.48	21.16	13.59	27.01	20.45	12.76	9.75
ab	25.55	45.27	53.14	31.90	47.64	26.82	40.45	25.47	36.22	42.39	46.25
an	24.78	13.07	2.76	4.79	4.60	14.49	18.29	15.45	10.84	16.21	5.16
lc	0.00	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	11.20
kp	0.00	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	0.00
wo	5.93	1.45	0.00	0.64	1.13	1.57	0.00	2.67	0.95	3.25	15.64
en	9.86	5.03	1.84	0.87	2.14	3.61	5.98	6.18	1.49	6.87	2.79
fs	6.32	0.87	0.00	0.14	0.34	3.40	2.29	3.94	1.84	2.38	0.41
fo	0.00	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	0.00
cs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
mt	3.29	2.87	1.31	1.74	2.09	1.64	2.44	2.20	1.38	1.96	1.26
hm	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
il	1.31	0.66	0.32	0.27	0.42	0.70	0.84	1.25	0.38	0.84	0.80
ru	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ap	0.12	0.26	0.28	0.33	0.24	0.31	0.26	0.31	0.33	0.26	0.02
FeO*/MgO	1.76	1.69	2.22	5.03	2.66	2.49	1.61	1.90	4.02	1.25	1.53
SI	23.81	15.20	7.08	3.30	7.66	12.27	17.99	16.79	5.58	20.62	9.04
D.I.	47.03	72.48	93.35	91.90	89.35	73.94	68.41	66.59	83.08	66.30	67.20

	(6)	(7)	(4)	(18)	(14)	(19)	(12)	(5)	(13)
	H12404	H12405A	H11703	M02503	K12307	M20403	K11803	H11902	K11906
SiO2	75.66	76.26	84.48	64.01	56.28	57.23	87.21	77.21	75.34
TiO2	0.16	0.16	0.19	0.60	0.60	0.71	0.08	0.20	0.37
Al2O3	13.07	13.28	9.17	16.00	16.32	16.97	3.37	13.28	13.36
Fe2O3	0.87	0.98	0.61	2.59	2.41	4.88	4.29	2.36	1.71
FeO	0.91	0.56	0.17	2.91	4.97	0.89	0.58	0.10	1.00
MnO	0.03	0.02	0.02	0.14	0.17	0.11	0.01	0.01	0.06
MgO	0.53	0.59	0.37	1.60	4.64	1.76	0.17	0.20	0.64
CaO	1.86	0.76	0.62	4.60	5.57	4.31	0.57	0.61	0.68
Na2O	4.47	5.91	0.22	4.70	3.29	3.80	0.21	0.18	0.19
K2O	2.70	1.96	3.04	2.31	2.32	3.76	1.82	3.78	4.33
P2O5	0.12	0.14	0.20	0.22	0.12	0.22	0.19	0.15	0.14
H2O+	0.98	0.74	1.76	1.25	3.64	4.58	2.87	2.24	2.68
H2O-	0.07	0.16	0.50	0.10	0.36	0.60	0.17	0.42	0.49
BaO	0.11	0.02	0.03	0.06	0.05	0.07	0.01	0.01	0.03
Total	101.54	101.54	101.38	101.09	100.74	99.89	101.55	100.75	101.02
Q	34.68	32.25	70.22	16.28	7.64	9.86	78.07	60.56	55.62
C	0.00	0.37	4.84	0.00	0.00	0.00	0.46	8.23	7.44
or	15.96	11.58	17.97	13.65	13.71	22.22	10.76	22.34	25.59
ab	37.82	50.01	1.86	39.77	27.84	32.15	1.78	1.52	1.61
an	7.62	2.90	1.84	15.74	22.91	18.14	1.62	1.80	2.52
lc	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
kp	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
wo	0.43	0.00	0.00	2.41	1.69	0.81	0.00	0.00	0.00
en	1.32	1.47	0.92	3.99	11.56	4.38	0.42	0.50	1.59
fs	0.74	0.00	0.00	2.47	6.46	0.00	0.00	0.00	0.00
fo	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
cs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
mt	1.26	1.41	0.06	3.76	3.49	1.17	1.67	0.00	2.35
hm	0.00	0.01	0.57	0.00	0.00	4.07	3.14	2.36	0.09
il	0.30	0.30	0.36	1.14	1.14	1.35	0.15	0.23	0.70
ru	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ap	0.28	0.33	0.47	0.52	0.28	0.52	0.45	0.36	0.33
FeO*/MgO	3.19	2.44	1.94	3.28	1.54	3.00	26.12	11.12	3.97
SI	5.64	5.96	8.51	11.55	26.68	12.05	2.56	3.13	8.31
D.I.	88.46	93.84	90.05	69.70	49.19	64.23	90.60	84.42	82.82



Field Name	Sample No.
Diorite Granodiorite	1 K12309
	2 K02505
	3 H12405B
Granite	4 H20303
	5 H11005
	6 M20603
	7 H03008
	8 H12418
Monzonite	9 K21201
	10 H02503
	11 K12501



A tonalite	H quartz syenite
B granodiorite	I quartz alkaline syenite
C granite	J diorite
D alkaline granite	K monzoni-diorite
E quartz diorite	L monzonite
F quartz monzoni-diorite	M syenite
G quartz monzonite	N alkaline-syenite
	after IUGS (1973)

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

Sample No	Locality	Rock Name	Material Analyzed	Isotopic Age (Ma)	⁴⁰ Ar * (scc/gm x 10 ⁻⁵)	% ⁴⁰ Ar *	% K	Notes
H11005	San Felipe	Granodiorite	Whole Rock	82.5 ± 4.1	.417 .430	81.8 80.3	1.30 1.28	
H02503	San Felipe	Monzoni Syenite	Whole Rock	78.0 ± 3.9	.221 .219	70.8 62.2	.71 .71	
K12309	Chontali	Quartz Diorite	Whole Rock	119. ± 6.	.644 .643	73.5 80.3	1.35 1.35	
H12418	Chontali	Quartz Monzonite	Whole Rock	106. ± 5.	1.56 1.54	93.8 92.1	3.64 3.66	
M20603	Palma	Adamelite	Whole Rock	47.6 ± 2.4	.463 .441	78.6 84.2	2.42 2.40	

ApX.6

Microscopic Observations of Polished Section

Sample No.	Rock Name	Locality	Geological Unit	Primary Mineral			Secondary Mineral		Remarks
				Mt	Py	Cu	He	Ge	
H10307	Skarn	San Felipe	Oy	⊙ 2.8/0.5	○ 0.8/0.3	△ 0.5	• 0.01	• 0.01	Apx. 7 Apx. 8
K10602	Silicified Monzonite	"	Mz		• 0.02			• 0.02	Apx. 8
H10103	Magnetite Skarn	"	Oy	⊙ 0.8/0.4					Apx. 8
H11701	Argillized Tuff	Jhuamarca	Po	△ 0.2	○ 0.4/0.2		• Mt→ 0.1	• 0.1	
H11801	Silicified Rock	"	Po		△ 0.1				Apx. 7 Apx. 8
H12301	Chloritized Andesite	Chontali	Oy		• 0.1			△ 0.05	
H12304	Andesite with Pyrite	"	"		• 1.0			• 0.02	Apx. 8
K12808	Silicified Rock(Vein)	"	"		• 0.2		△ Mt→ 0.2	• 0.01	Apx. 7 Apx. 8
V12419	Andesite with Pyrite	"	"		△ 0.2			• 0.01	Apx. 8
K20303	Silicified Rock with Py.Gr.Cu	Palma	"		△ 0.1			• 0.003	
K20802	Lapilli Tuff with Pyrite	"	"		△ 0.1			• 0.2	
H20504	Skarn with Pyrite	"	"	○ 0.4/0.2			△ Mt→ 0.05	• 0.01	
M20703	Epidote Skarn with Pyrite	"	"		• 0.02		• Mt→	• He→ 0.02	Apx. 7 Apx. 8
V20802	Andesite with Pyrite	"	"		○ 0.5/0.2			• 0.05	Apx. 7
J20302	Silicified Diorite with Pyrite	"	Di		△ 0.2			• 0.02	Apx. 8

Mt : magnetite
Py : pyrite
Cu : cubanite
He : hematite
Ge : geothite

Comparative Quantity
⊙ most abundant
○ abundant
△ common
• rare

Grain Size
2.8/0.5 : max/mean
0.5 : mean

Mt→ : changed from Mt.

Oy : Oyojun Formation

Po : Porculla Formation

Mz : Intrusive rock. monzonite

Di : Intrusive rock. Diorite

Abbreviations

Py : Pyrite,

Cu : Cubanite,

Mt : Magnetite

He : Hematite,

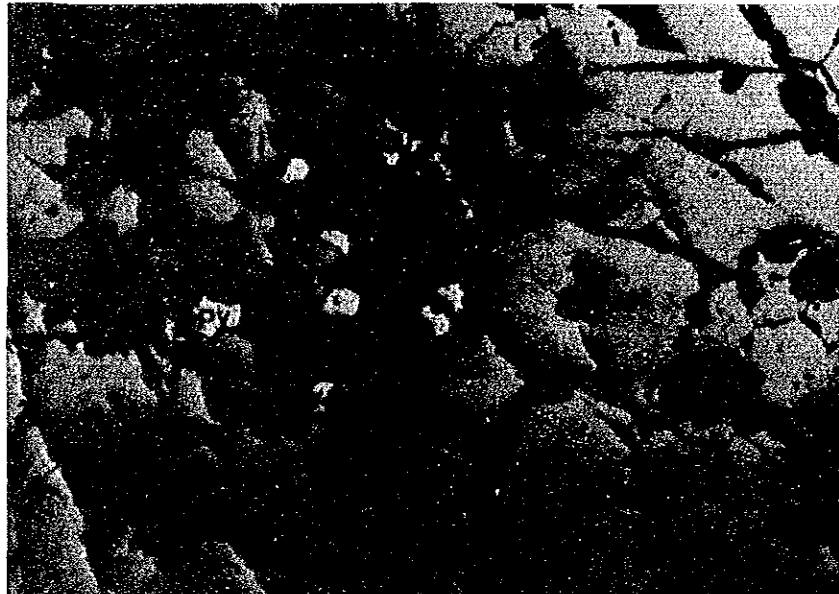
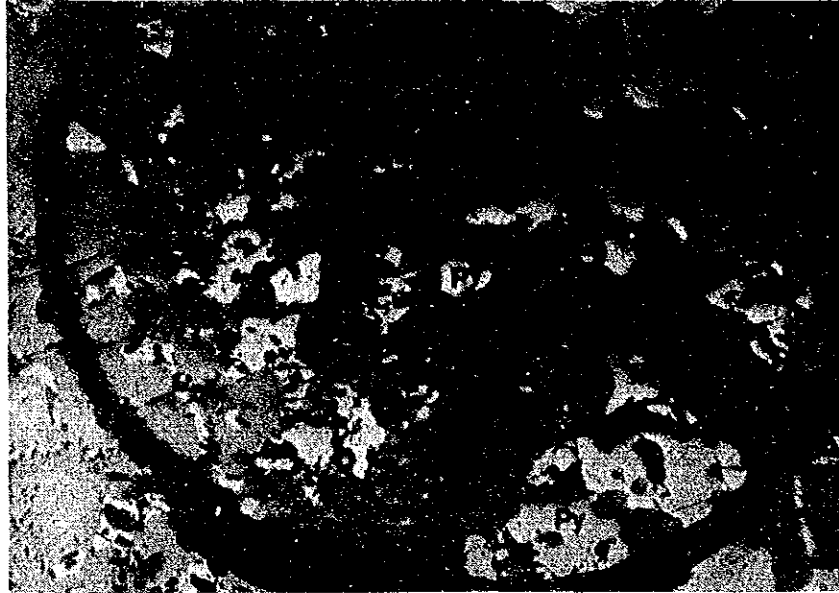
Ge : Geothite

Sample No.: H10307

Locality: San Felipe

Rock Name: Skarn

PPL



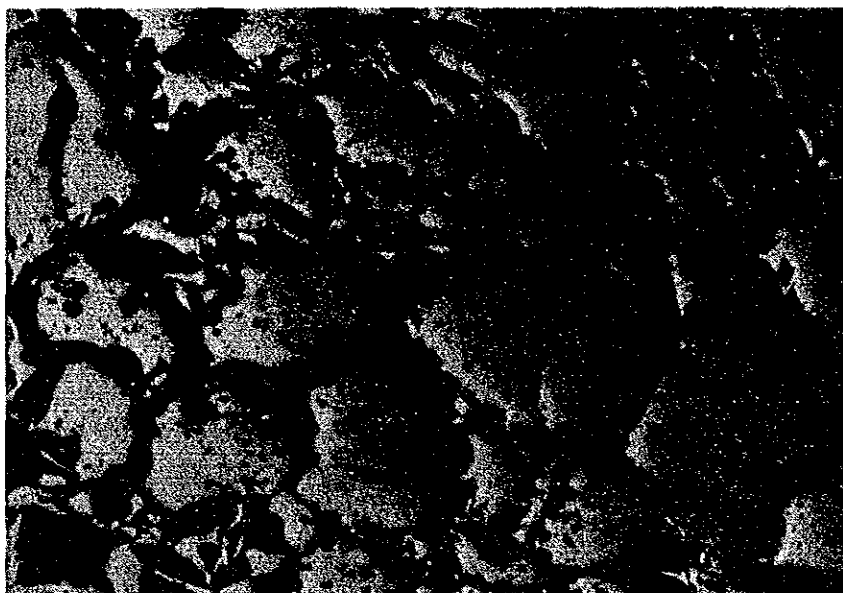
Scale 1mm 


Sample No. : M10103

Locality : San Felipe

Rock Name : Magnetite Skarn

PPL



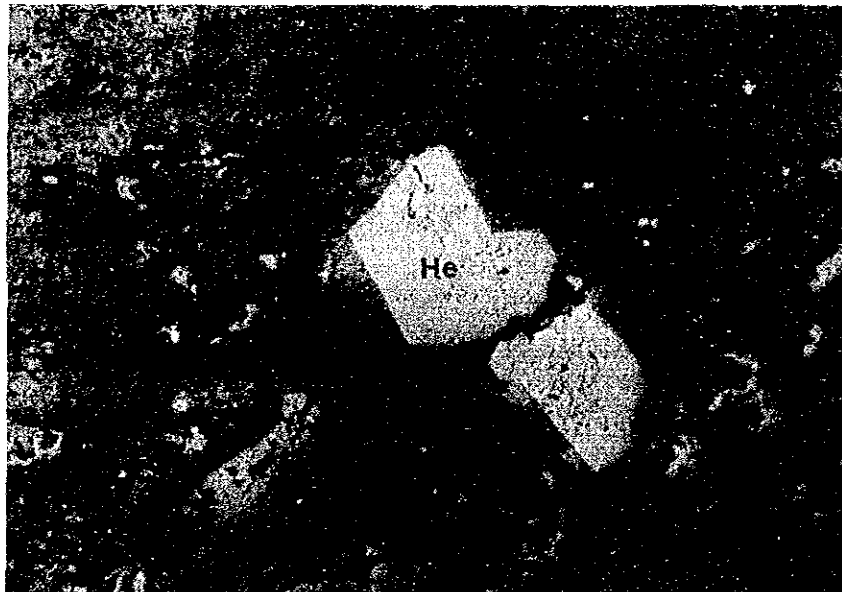
Scale 1mm 


Sample No. : K12808

Locality : Jehuamarca

Rock Name : Silicified rock

FPL



Scale 1mm 


Sample No.: M11801

Locality: Jehuamarca

Rock Name: Silicified rock

PPL



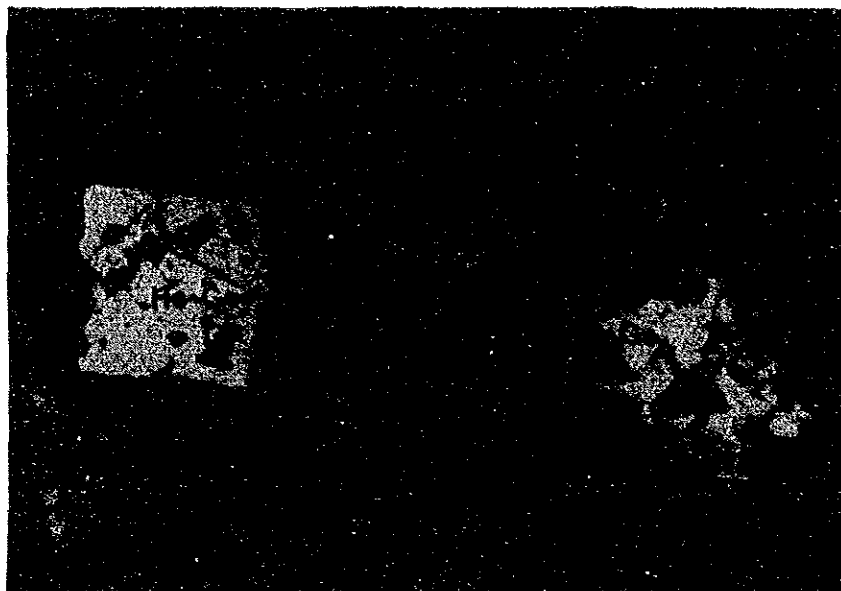
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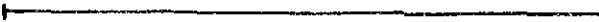
Sample No. : M20703

Locality : Palma

Rock Name : Epidote Skarn

PPL



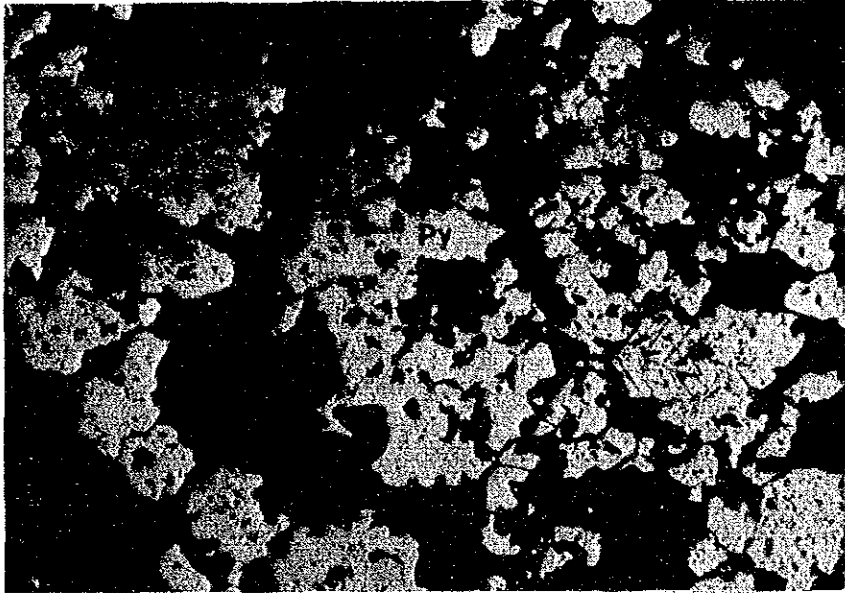
Scale 1mm 

Sample No. : V20802

Locality : Palma

Rock Name : Andesite

PPL



Scale 1mm 