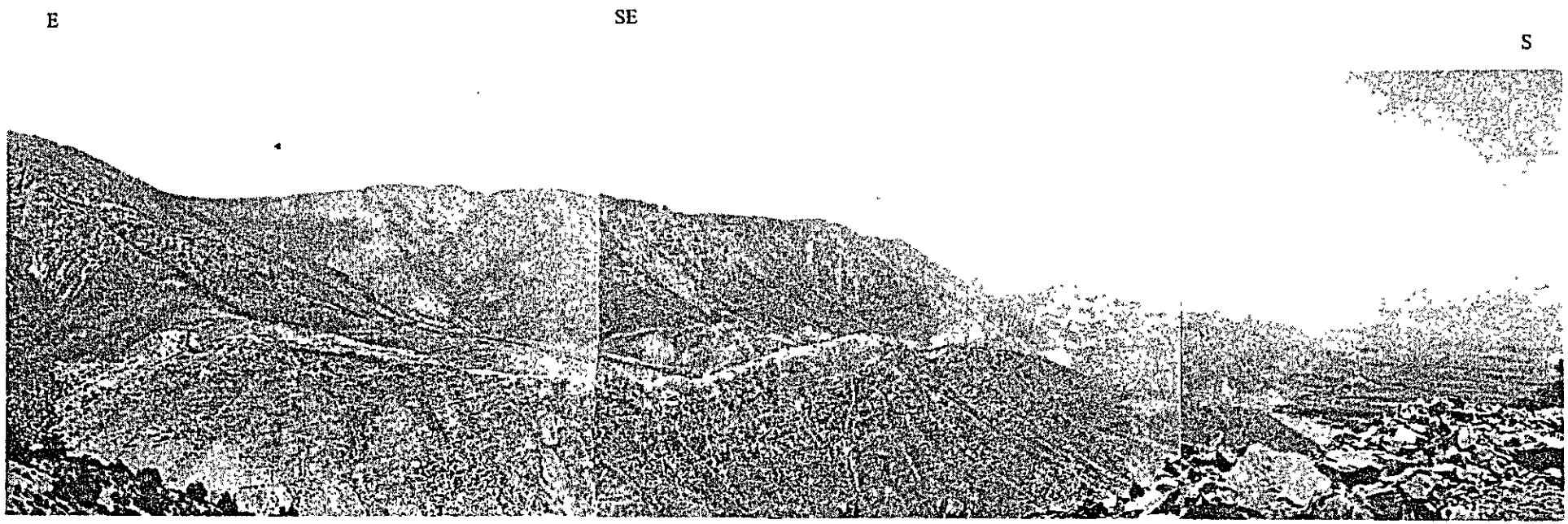
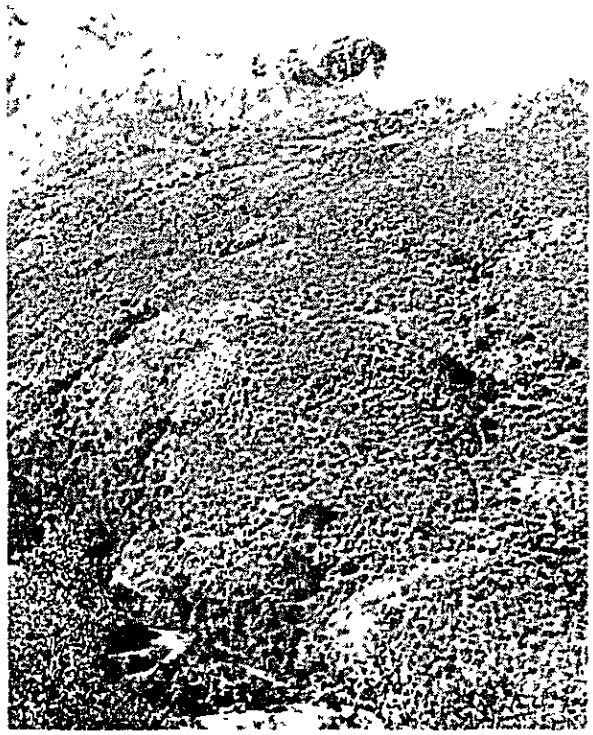
APPENDICES

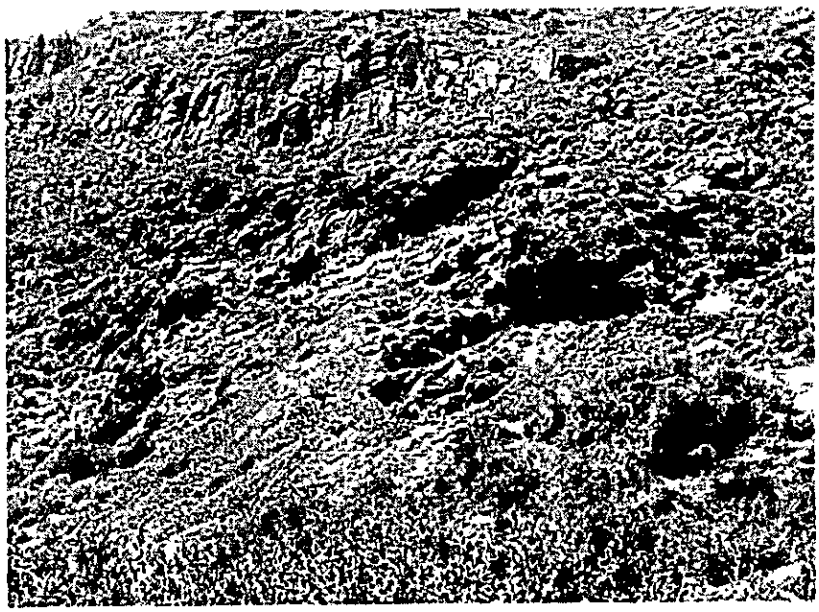
Appendix 1 Photographs



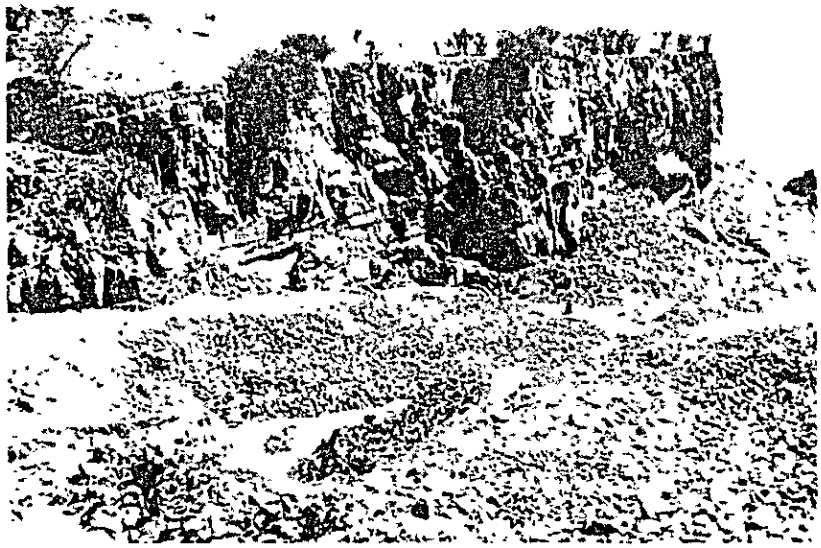
A view from Las Animas Mine. (Cerro Morado Formation)



The view of Guayacan Mine from Fortuna Mine. The upper part belongs to the Veta Negra Formation and the lower, to the Lo Prado. (Northern area)



Farellones Mine (the uppermost of the Lo Prado). The upper part shows andesitic rock belonging to the Veta Negra Formation. (Northern area)

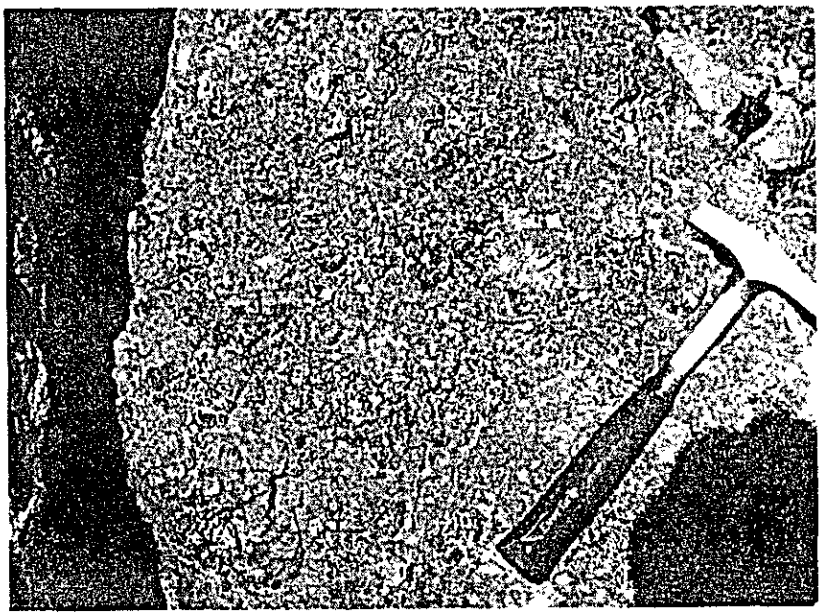


A poor ore horizon, shale-bed (exposed) lies over the copper ore deposits at Blanqueado Mine. (Northern area)

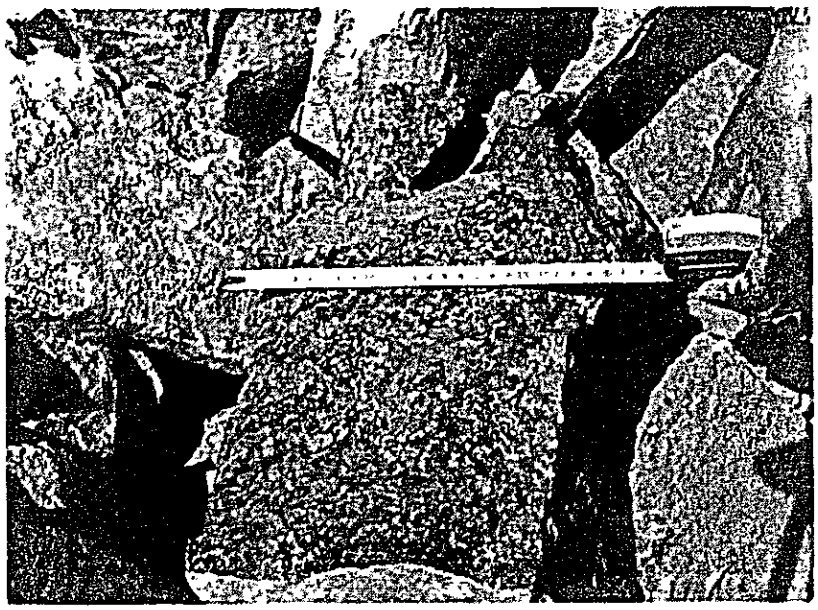
Adit of Ramayana Mine. (Central area)

El Boliviano Mine (open pit and adit)
The copper ore deposits lie in dacitic rock belonging to the Las Chilcas Formation (Central area)

Typical view of the southern area.
The uppermost of the hind mountain may be granitic rock on the Lo Prado Formation.

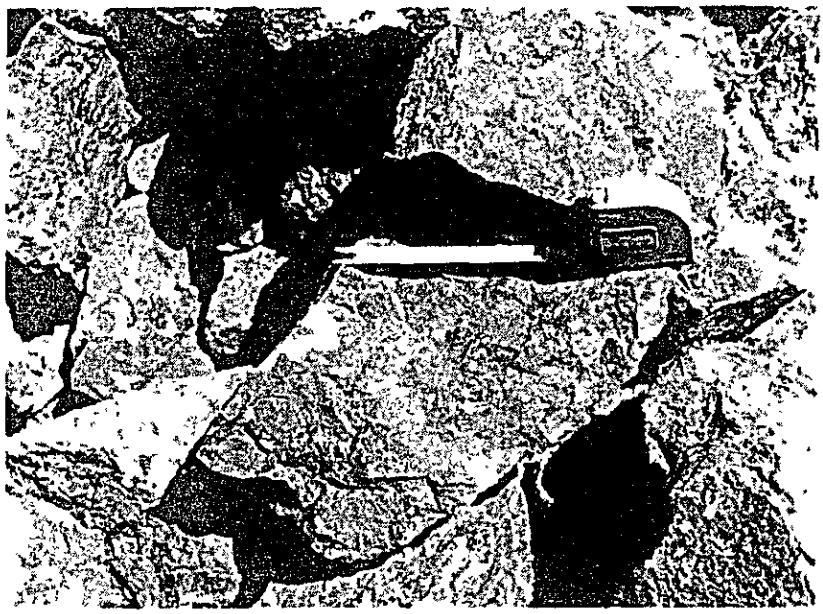


Andesite breccia, Las Chilcas Formation
(6km south of Tiltil)



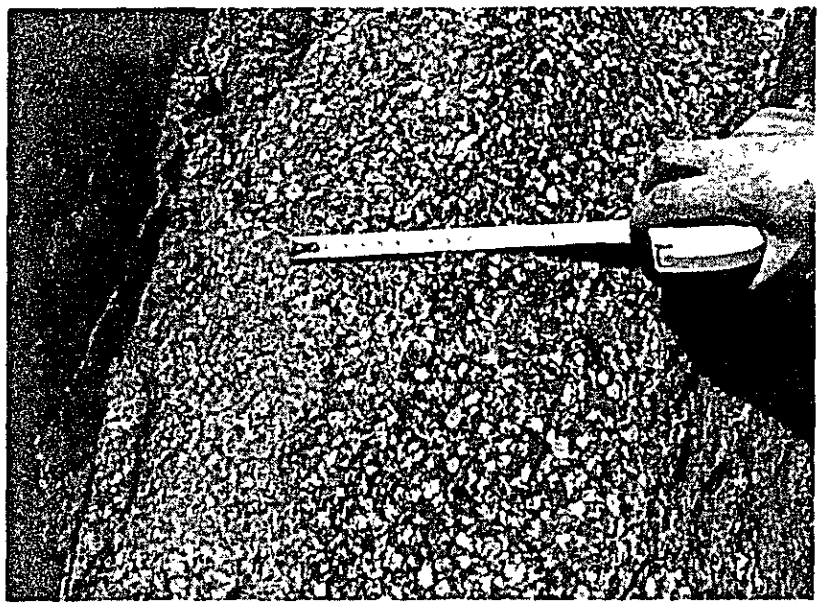
Peperite with chalcopyrite mineralization, Cerro Morado Formation

(Romero Mine)



Peperite, Cerro Morado Formation

(Blanqueado Mine)

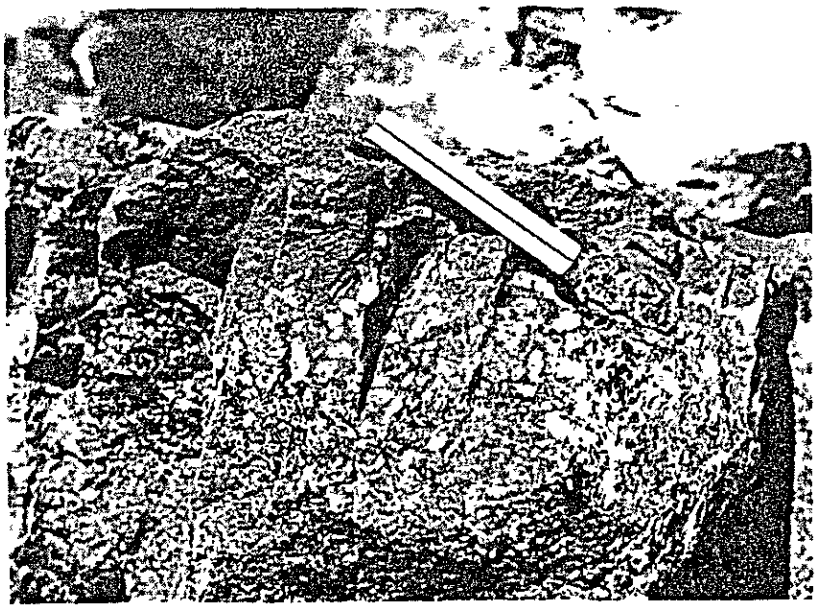


Ocoite, Veta Negra Formation

(6km east of Ocoa)

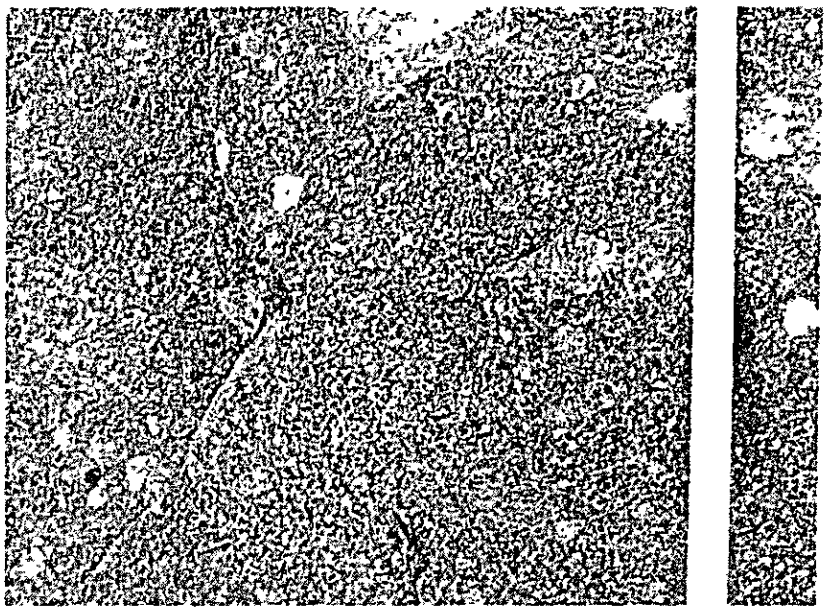
Shale, overlain ore horizon, Lo Prado Formation.

(Guayacan Mine)



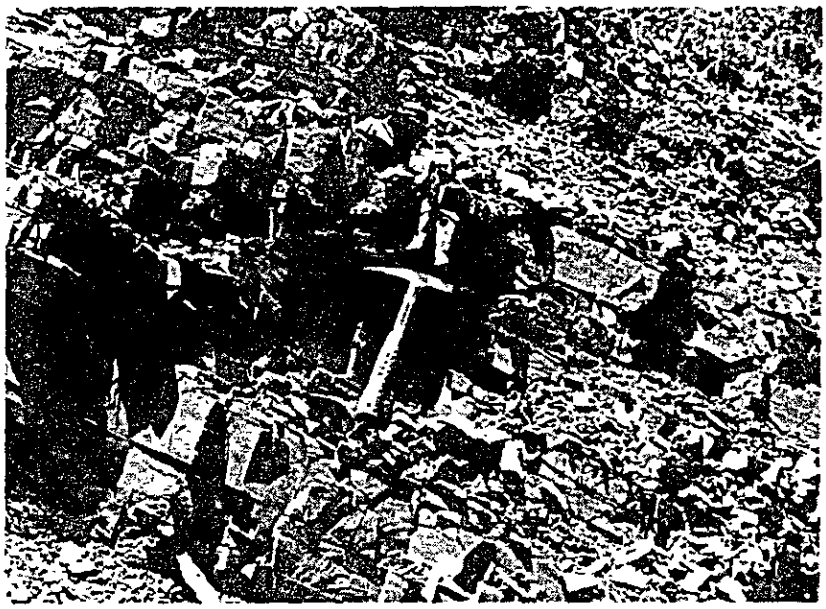
Peperite ~ Andesite Breccia, Lo Prado Formation.

(Guayacan Mine)



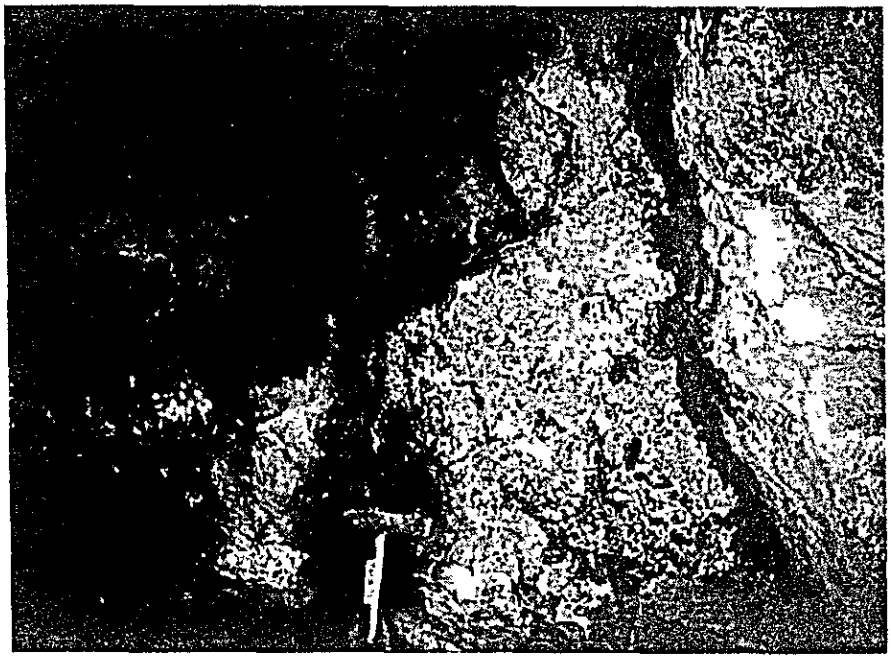
Volcanic Breccia, Lo Prado Formation.

(Cholqui)



Shale, Lo Prado Formation.

(3km southeast of Cholqui)



Disseminated Ore (Chalcopyrite >> Bornite)

(La Verde Mine)

Whitish Dacite with bornite mineralization

(El Salado Mine)

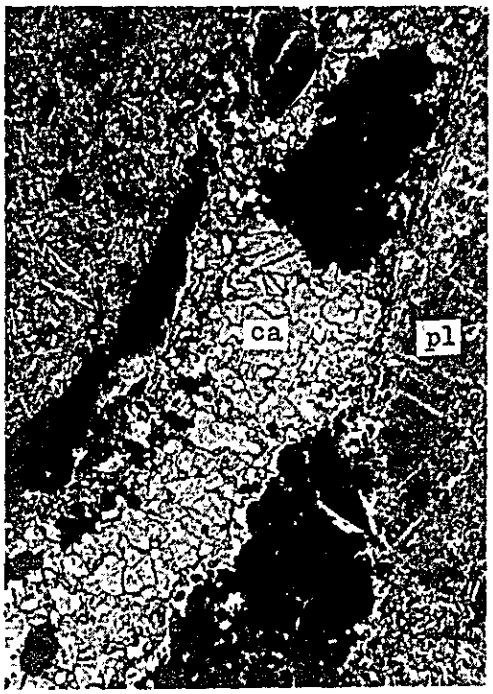
Appendix 2 Photomicrographs and microscopic observations of thin sections

Abbreviations

olivine	ol
plagioclase	pl
hematite	hm
hornblende	hb
sericite	ser
chlorite	chl
quartz	q
sulphide mineral	sm
calcite	ca
opacite	op
chalcopyrite	cp
epidote	ep
augite	ag
amygdale	am
sphalerite	sph
pyrite	py
rutile	rt
clay mineral	cm
sand stone block	ssb
shale block	shb

DO 021201 Olivine basalt-basic andesite (Venus Mine, Lo Prado Formation).

17-4 Open nicol.



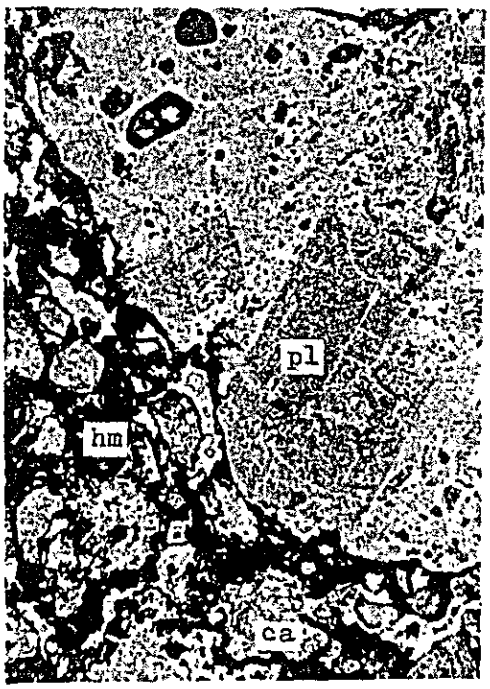
17-5 Crossed nicols.

Veins of carbonates and sulfides with some amount of chlorite cut through the hollocrystalline intergranular groundmass together with phenocrysts of plagioclase and olivine which is mostly carbonatized

0.5mm

DO 020202 Volcanic conglomerate of opacitized andesite (Venus Mine, Lo Prado Formation)

17-6 Open nicol.



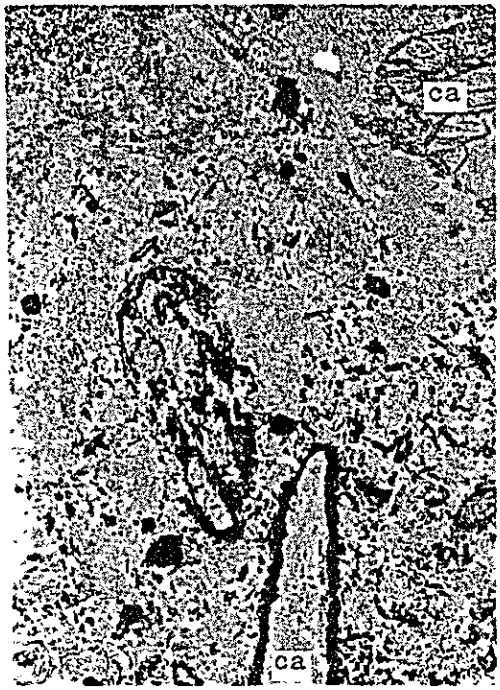
17-7 Crossed nicols.

Many fine grained crystals of hematite occur in the groundmass with phenocrysts of opacitized hornblende and plagioclase.

0.5mm

DO 020301 Oxydized and carbonatized andesite. (Las Chilcas Formation)

17-8 Open nicol.



17-9 Crossed nicols.

Phenocrysts of plagioclase and opacitized mafic minerals occur in the groundmass of hyalopilitic groundmass with many hematite small crystals.

0.25mm

MI 0308 Altered andesite and dacite lapilli tuff (Prehue member of Veta Negra Formation)

17-10 Open nicol.

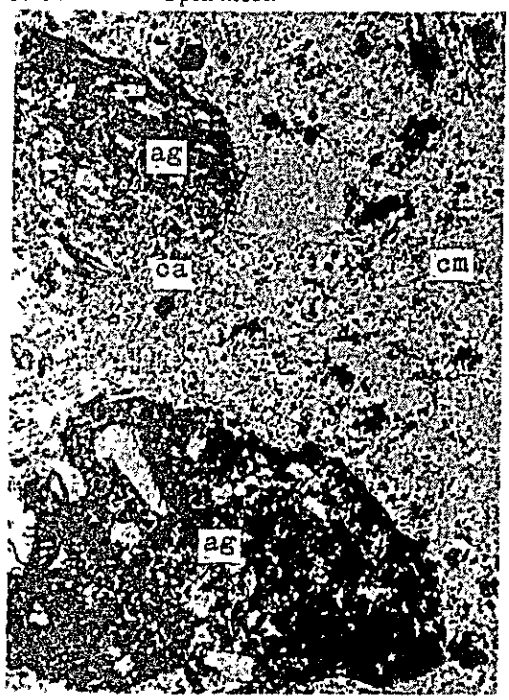
17-11 Crossed nicols.

0.25mm

Both blocks and matrix are affected sericization and chloritization

DO 020302 Altered coarse andesitic tuff (Las Chilcas Formation)

17-12 Open nicol.

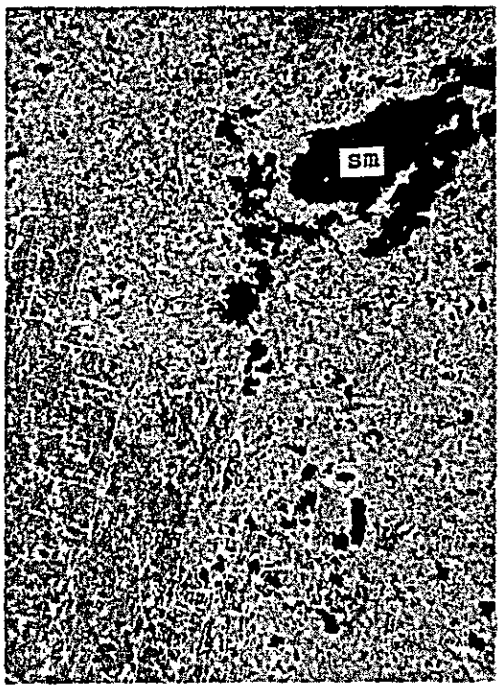


0.25mm

Carbonate minerals and hematite occur throughout the matrix.

TA 0612 Trachytic dacite. (El Salado Mine, veta Negra Formation)

17-15 Open nicol.



17-16 Crossed nicols.

Amygdales being filled by quartz, carbonates and sulfides occur in the groundmass of hollocrystalline feldspar lath with plagioclase phenocrysts.

0.5mm

TA 0613 Altered dacite (El Salado Mine, Veta Negra Formation)

17-17 Open nicol.

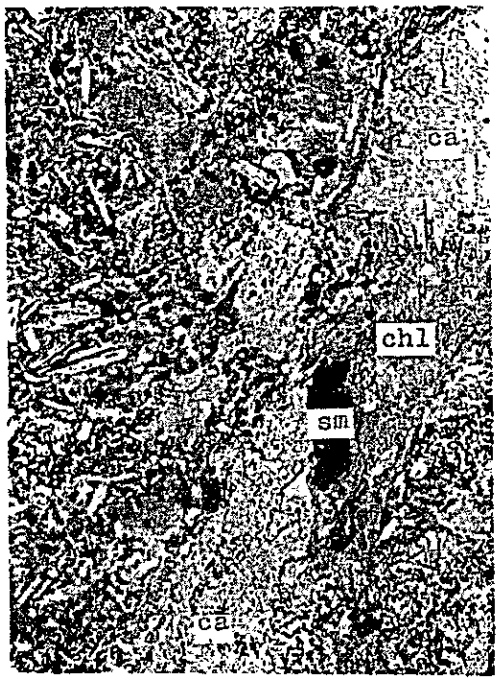
17-18 Crossed nicols.

Amygdales being filled by quartz, sericite and sulfide minerals are abundant in the groundmass of holocrystalline feldspar lath.

0.5mm

DO 020605 Altered and carbonatized andesitic lapilli tuff. (Animas Mine, Cerro Morado Formation)

17-19 Open nicol.



17-20 Crossed nicols.

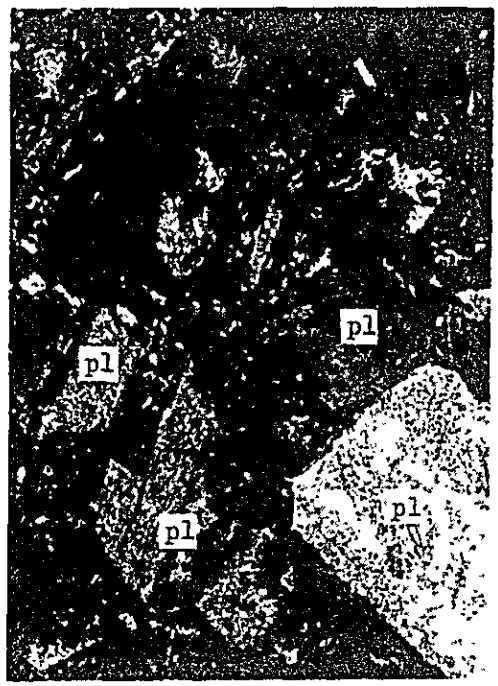
Carbonates with some sulfide minerals fill the veinlets and replace the rock mainly a part of matrix.

0.25mm

TA 0401 Altered opacite andesite (Las Chilcas Formation)

17-21 Open nicol.

17-22 Crossed nicols.



Carbonates and epidote replace the opacite after hornblende.

0.25mm

DO 020206 Altered glassy andesite. (Lo Prado Formation)

17-23 Open nicol.

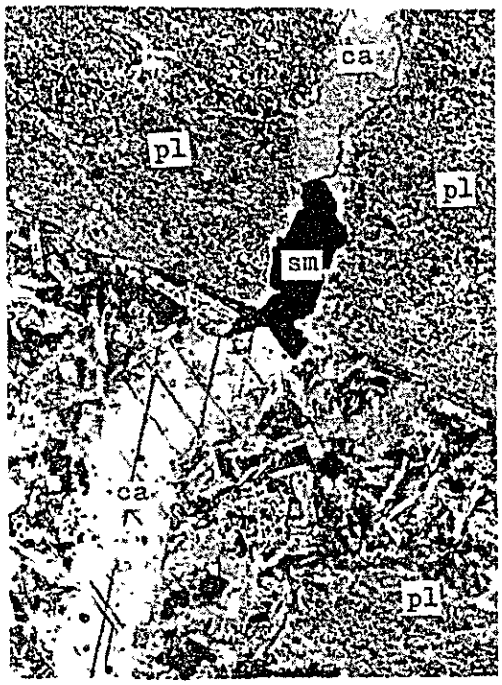
17-24 Crossed nicols.

Glassy groundmass with distinct flowage has recrystallized keeping its original texture. Hornblende has altered to chlorite, and a part of plagioclase phenocrysts has altered to sericite.

0.25mm

TA 1203 Altered coarse grained dacite with chalcopyrite dissemination (Venus Mine, Lo Prado Formation)

17-25 Open nicol



17-26 Crossed nicols.

0.25mm

DO 020602 Augite andesite with calcite and chalcopyrite veinlet. (Animas Mine, Cerro Morado Formation)

17-27 Open nicol.

17-28 Crossed nicols

0.25mm

Glass part of hyalopilitic groundmass has altered to clay minerals and carbonates.

DO 020312 Altered augite andesite. (Prehue member of Veta Negra Formation)

17-29 Open nicol.

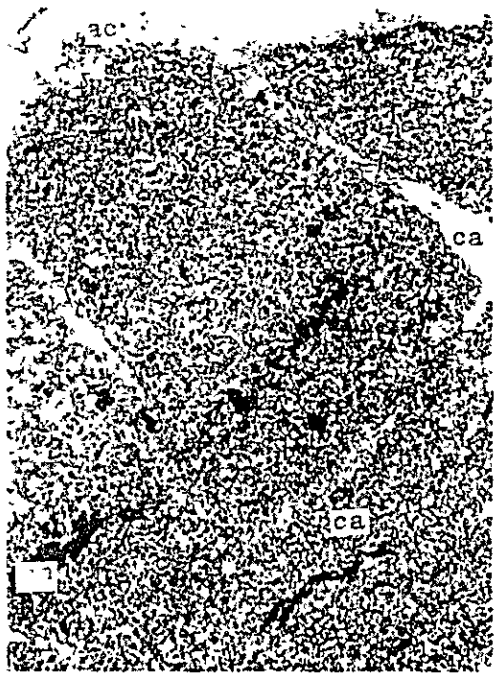
17-30 Crossed nicols.

A part of plagioclase phenocrysts has altered to sericite. Phenocrysts of hornblende has altered to opacite and chlorite. Augite phenocrysts remain fresh.

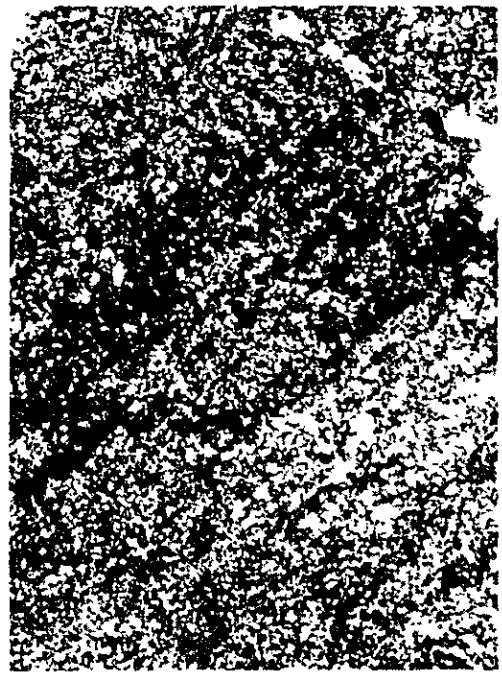
0.25mm

TA 0603 Fine grained impure limestone. (Animas Mine, Cerro Morado Formation)

17-31 Open nicol.



17-32 Crossed nicols.

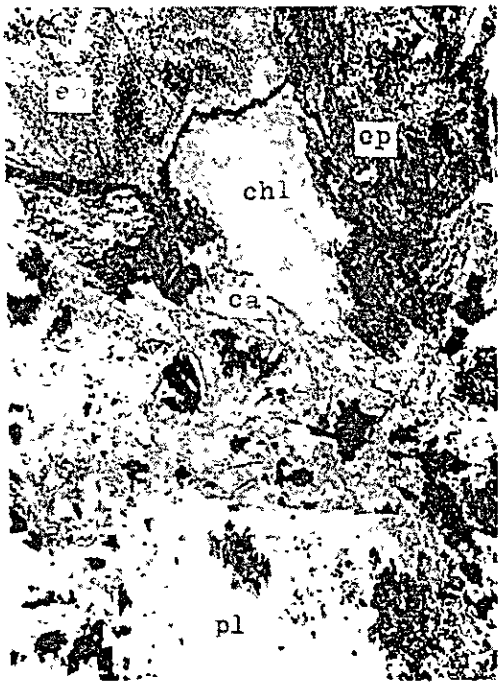


A thin layer of sulfide minerals occurs occasionally along the bedding plane. Calcite veinlets as segregation product cut casually.

0.25mm

TA 1201 Altered dacite. (Venus Mine, Lo Prado Formation)

17-33 Open nicol



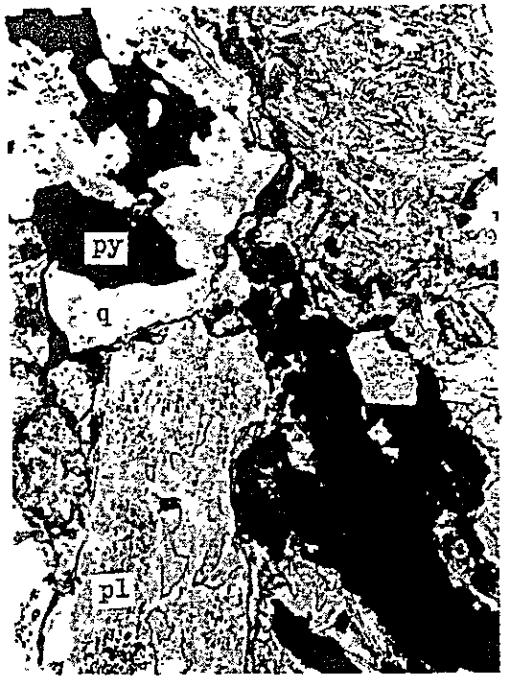
17-34 Crossed nicols.

Epidote veinlet with calcite and quartz crossed heavily. Amygdales are also filled by gangue minerals.

0.25mm

DO 020704 Altered olivine basalt lapilli tuff. (Guayacan Mine, Lo Prado Formation)

17-35 Open nicol.



17-36 Crossed nicols.

Carbonates replace the rock mainly at the matrix part.

0.25mm

TA 0704 Porphyritic altered dacite. (Guayacan Mine, Lo Prado Formation)

18-1 Open nicol.

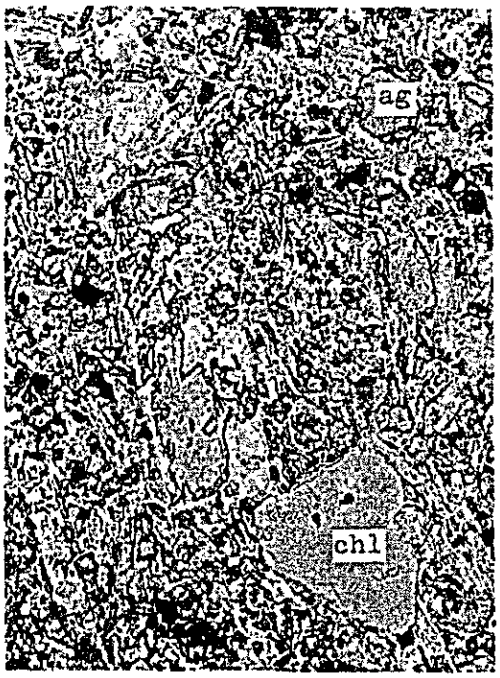
18-2 Crossed nicols.

Sulfide mindrals of chalcopyrite, sphalerite or pyrite replace a part of plagioclase phenocrysts and fill veinlets together with mainly calcite and quartz.

0.25mm

TA 0703 Porphyritic pyroxene olivine basalt. (Guayacan Mine, Lo Prado Formation)

18-3 Open nicol.



18-4 Crossed nicols.

Plagioclase phenocrysts of large size occur in the groundmass of intergranular texture together with phenocrysts of augite and pseudomorphs after olivine.

0.25mm

TA 1202 Coarse grained altered andesite. (Venus Mine, Lo Prado Formation)

18-5 Open nicol.)

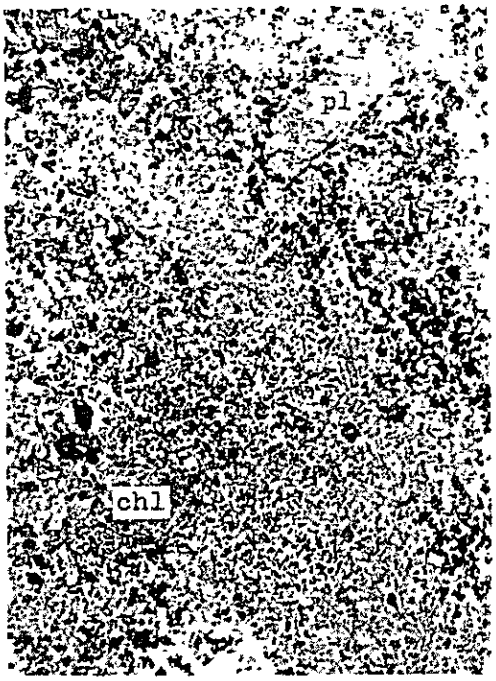
18-6 Crossed nicols

Plagioclase phenocrysts occur in the groundmass of intersertal texture. Veinlets of calcite, quartz and epidote cross around

0.25mm

DO 020307 Altered agglomerate. (Lo Prado Formation)

18-7 Open nicol



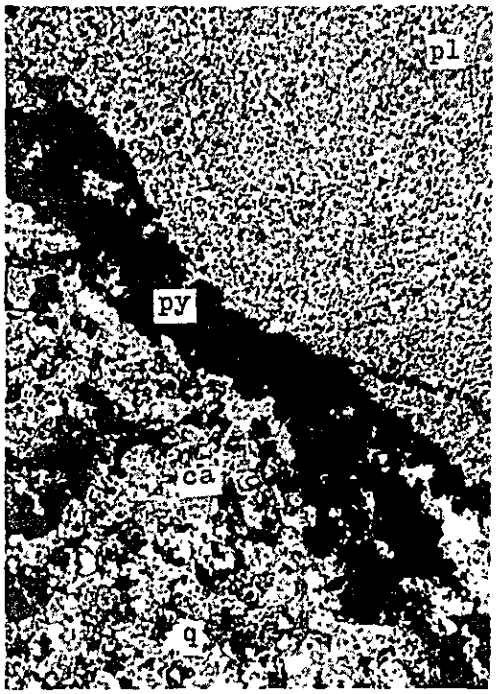
18-8 Crossed nicols

Blocks of fine grained ophitic olivine basalt are predominated. Matrix has been affected by sericitization and silicification.

0.25mm

DO 020801 A contact part of dacite and sandstone. (La Verde Mine, Lo Prado Formation)

18-9 Open nicol.

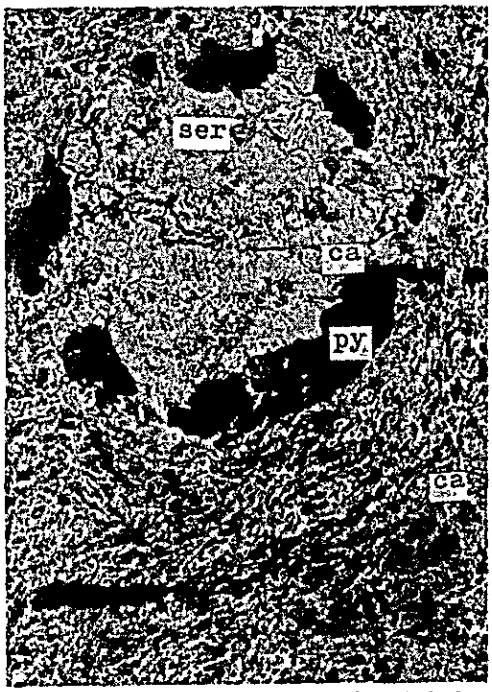


18-10 Crossed nicols.

0.25mm

DO 020801 Dacite. (La Verde Mine, Lo Prado Formation)

18-11 Open nicol.



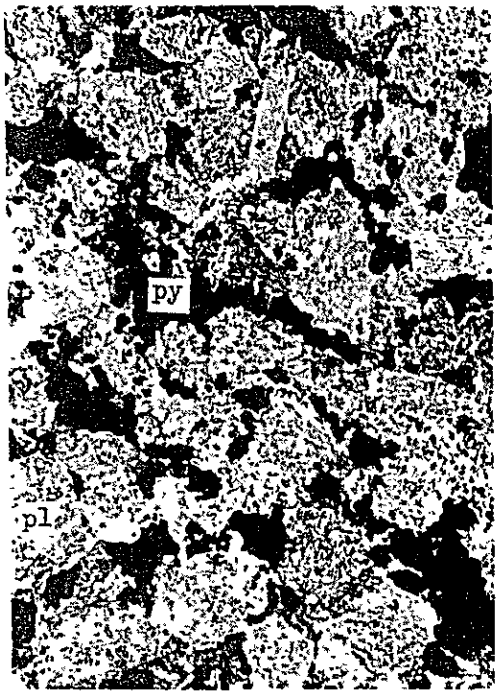
18-12 Crossed nicols.

Flowage of the dacite is cut diagonally by the boundary indicating the dacite is a block. Amygdales are abundant in the dacite part being filled mostly by sericite, calcite, sulfide minerals and occasionally rutile. Sandstone has impregnation of sulfides and carbonates along its cleavage plane.

0.25mm

DO 020801 Sandstone. (La verde Mine, Lo Prado Formation)

18-13 Open nicol.

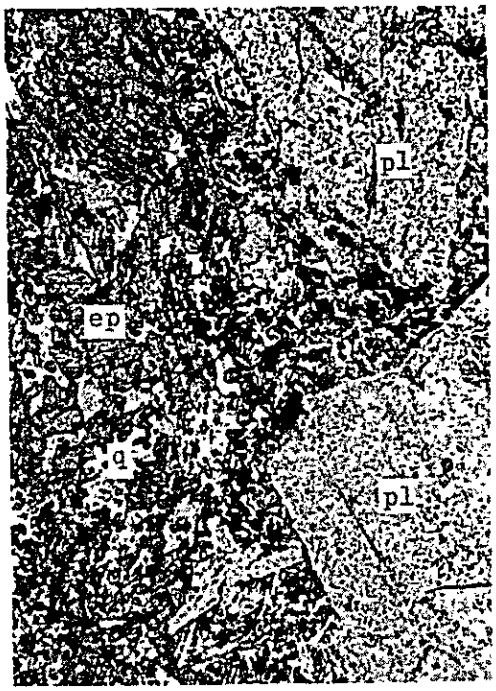


18-14 Crossed nicols.

0.25mm

MI 0301 Porphyritic basic andesite (so called "Ocoite", Ocoa member of Veta Negra Formation)

18-15 Open nicol.



18-16 Crossed nicols.

Plagioclase phenocrysts of large sizes occur abundantly in the groundmass of ophitic texture. Epidote, quartz and calcite are filling the veinlets as well as replacing a part of the rock.

0.5mm

DO 021302 Banded limestone. (Fortuna Mine, Las Chilcas Formation)

18-17 Open nicol

18-18 Crossed nicols

It contains small amounts of sand and clay materials.

0.25mm

DO 020703 Graywacke sandstone (Guayacan Mine, Lo Prado Formation)

18-19 Open nicol.

18-20 Crossed nicols.

Grains of detrital quartz and feldspars as well as materials of clays are predominant. Carbonate mineral replaces partly throughout the matrix.

0.25mm

TA 0610 Altered fine grained porphyritic andesite. (El Salado Mine, Veta Negra Formation)

18-21 Open nicol.

18-22 Crossed nicols.

Plagioclase phenocrysts of large size occur abundantly in the fine grained groundmass of hyalopilitic texture.

0 25mm

DO 021202 Porphyritic dacite (Venus Mine, Lo Prado Formation)

18-23 Open nicol.

18-24 Crossed nicols.

0.5mm

71°15'
71°00'
70°45'
32°15'
30'
-45'
33°
1759
1172
1052
CABILDO
LA LIGUA
(62)
(63)
(64)
1945
(1)
2333
(2)
(3)
(4)
(5)
(6)
(7)
(8)
(9)
(10)
2342
862
(11)
2185
(12)
2215
(65)
(66)
(67)
(13)
(14)
(15)
(68)
(69)
(16)
(17)
CERRILLO
(18)
2192
(19)
2036
1802
(21)
(20)
(22)
(23)
(24)
LA CALERA
(25)
(26)
(70)
(27)
(71)
(28)
(72)
RIO ACONCAGUA
784
LLAILLAY
(29)
QUILLOTA
(30)
1580
1157
SAN FRANCISCO
DE LIMACHE
805
1360
1871
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1608
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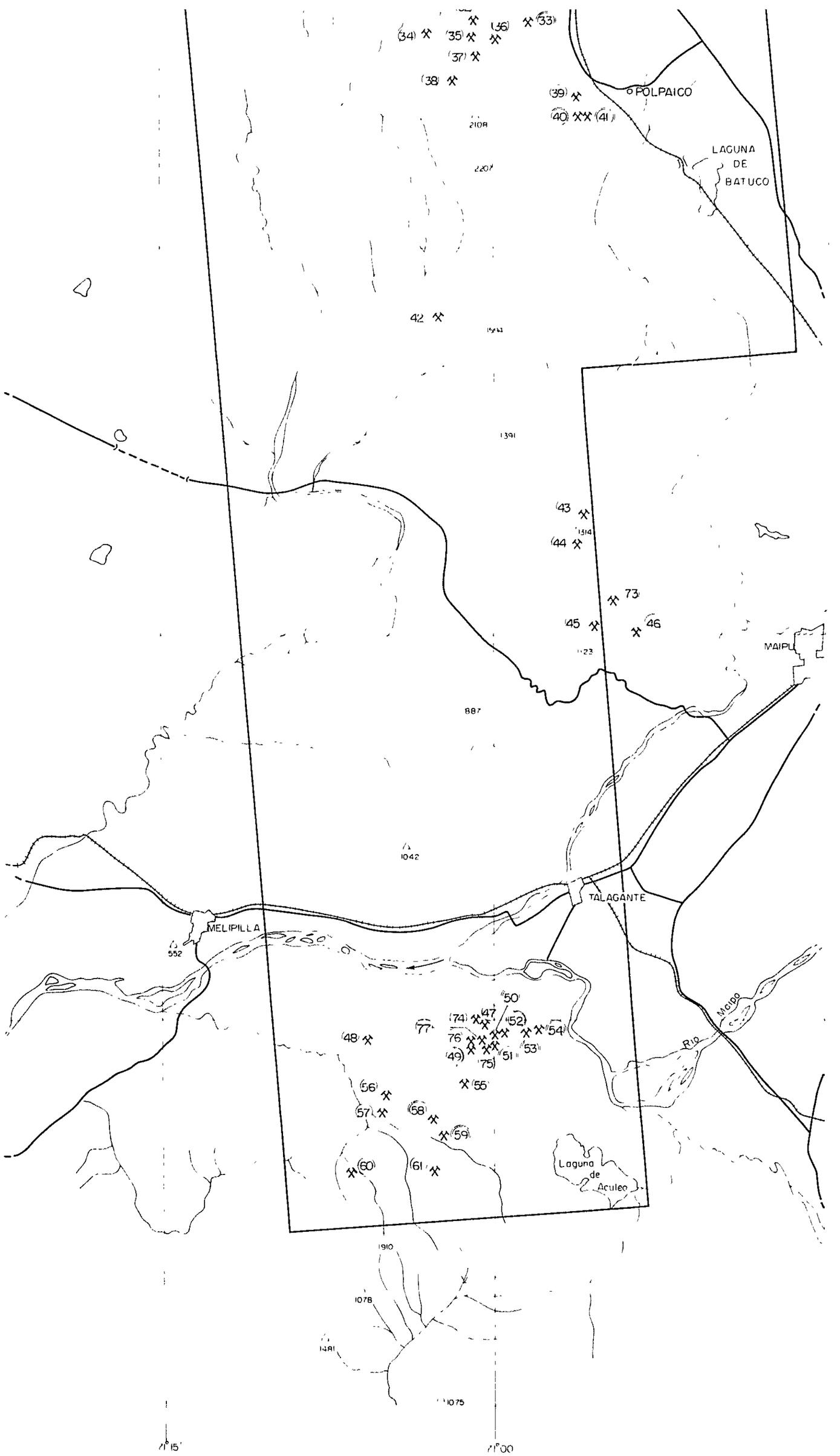
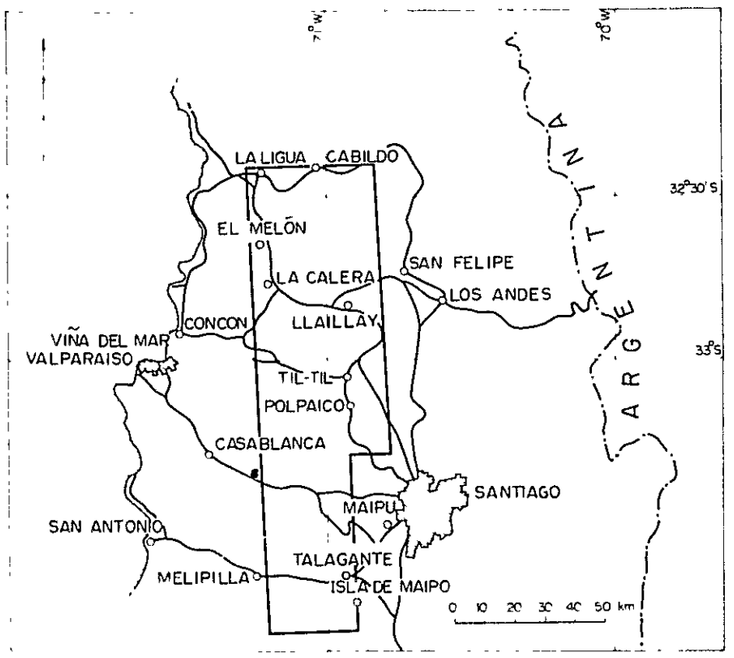

POLPAICO
LAGUNA DE BATUCO
MAIPU
MELIPILLA
TALAGANTE
Maipo
Rio
Laguna de Aculeo
2108
2207
1391
1314
887
1042
552
1910
1078
1481
1075
15
30
45'
34°
71°15'
71°00'

MINERAL RESOURCES DEVELOPMENT IN THE REPUBLIC OF CHILE

LOCATION MAP OF MINES



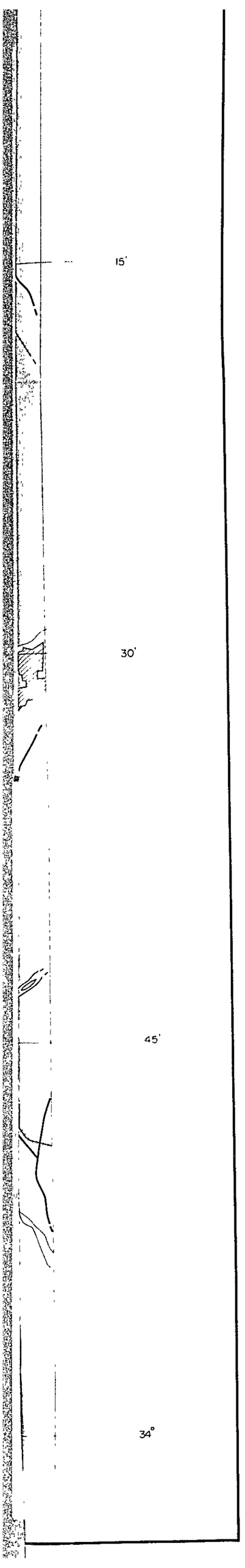
JAPAN INTERNATIONAL COOPERATION AGENCY
GOVERNMENT OF JAPAN

MARCH 1980
prepared by DOWA ENGINEERING CO, LTD

SCALE 1 250,000

0 5 10 15 20 25 km

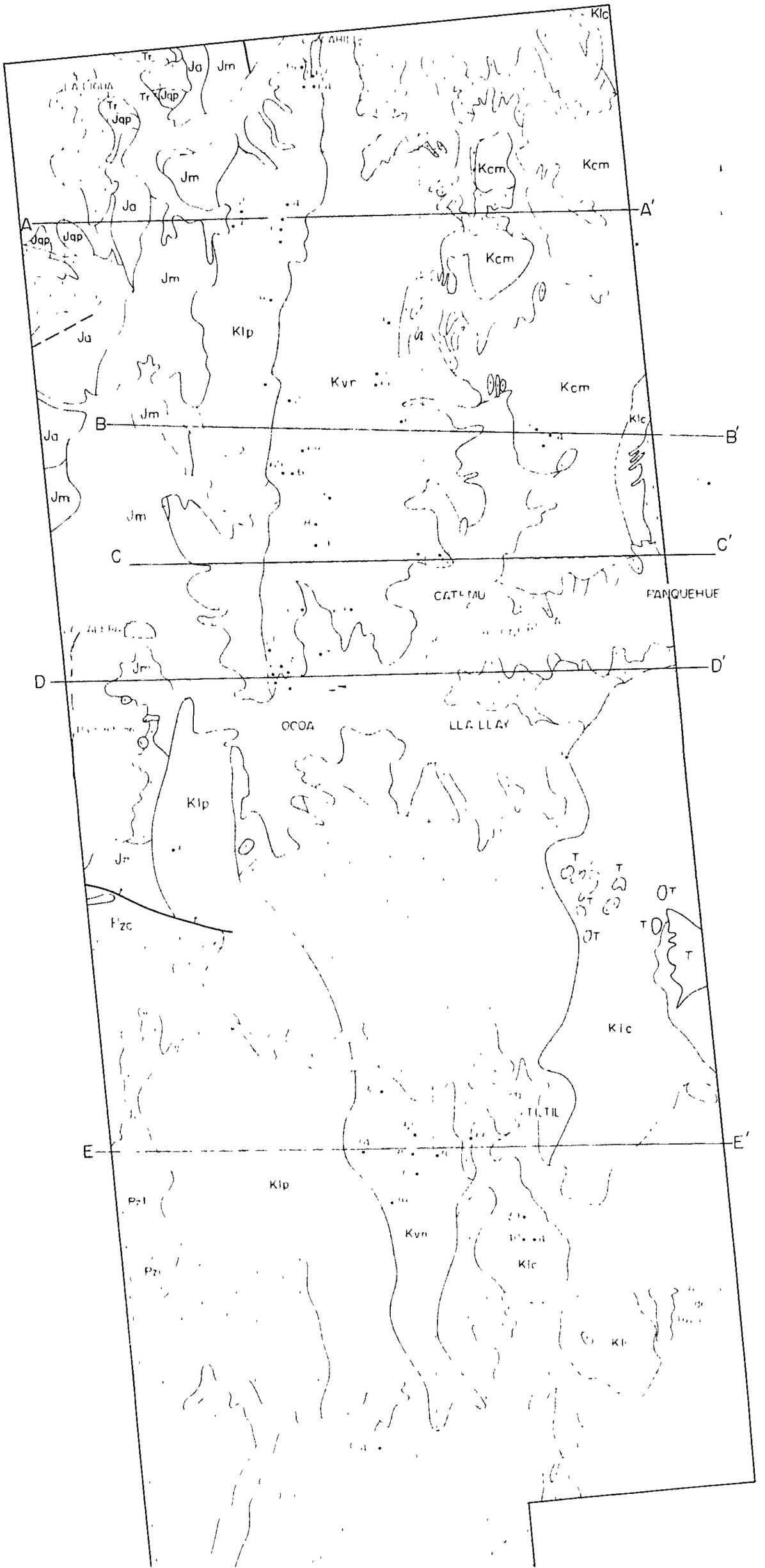
(1) LOS MANTOS	2 LA PATAGUA	3 CENTINELA	4 LA HERMITA	5 PEUMO
(6) GUAYACAN	7 FARELLON DELIRIO	8 LA COMUNA	9 EL CERRADO	10 CO NEGRO
(11) EL SOLDADO	(12) VETA NEGRA	(13) BLANQUEADO	(14) ANIMAS	15 ROMERO
16 LA MERCED	17 COLIHUE	(18) LA BANDERA	19 CAQUI	20 MANZANA
(21) EL SALADO	22 BELLAVISTA	23 ZOILA ROSA	24 LA FILOMENA	25 INFIERNILLO
(26) NENITA	(27) LA VERDE	28 SANTA GENOVEVA	29 EL SAUCE	30 SANTA TERESITA
(31) RAMAYANA	32 BRILLANTE	33 BOLIVIANO	34 CERRO NEGRO	35 VERDEONES
36 ALETAS COLORADA ESCONDIDA	37 EL MANZANO	(38) MANTO	39 EL ALAMO	40 FORTUNA ALTO
(41) FORTUNA BAJO	(42) DURAZNO	(43) SAN ANTONIO	44 LO AGUIRRE	45 MANTO SANDOVAL
(46) LA VIRTUD	47 LAS VACAS	48 LO HERMANOS	(49) MASCOTA	50 PEUMO
(51) CONSUELO	52 VENUS	(53) BUITRE	54 TRINCHERA	(55) LA DURA
(56) EMA	57 AN DACOLLO	(58) MANTOS NEGROS	59 ABUELITA	60 LAS GUIAS
61 SAN ENRIQUE y VIRGEN DEL CARMEN			MOSTAZA	(PALIOCABE)
(62) EL SAUCE	63 LOS MAQUIS NORTE	64 LOS MAQUIS SUR	65 CORRAL DEL ROMERO	66 LA REINA
(67) MANTO BRON	68 DABÚ	69 BRONCEADA	(70) LA LIBERTAD	71 CARMELITA
72 NEGRITA	73 FUENTES	74 LAS GUÍAS (NALTAGUA)	75 BRILLANTE	76 EL GATO
(77) LA HECHICERA				

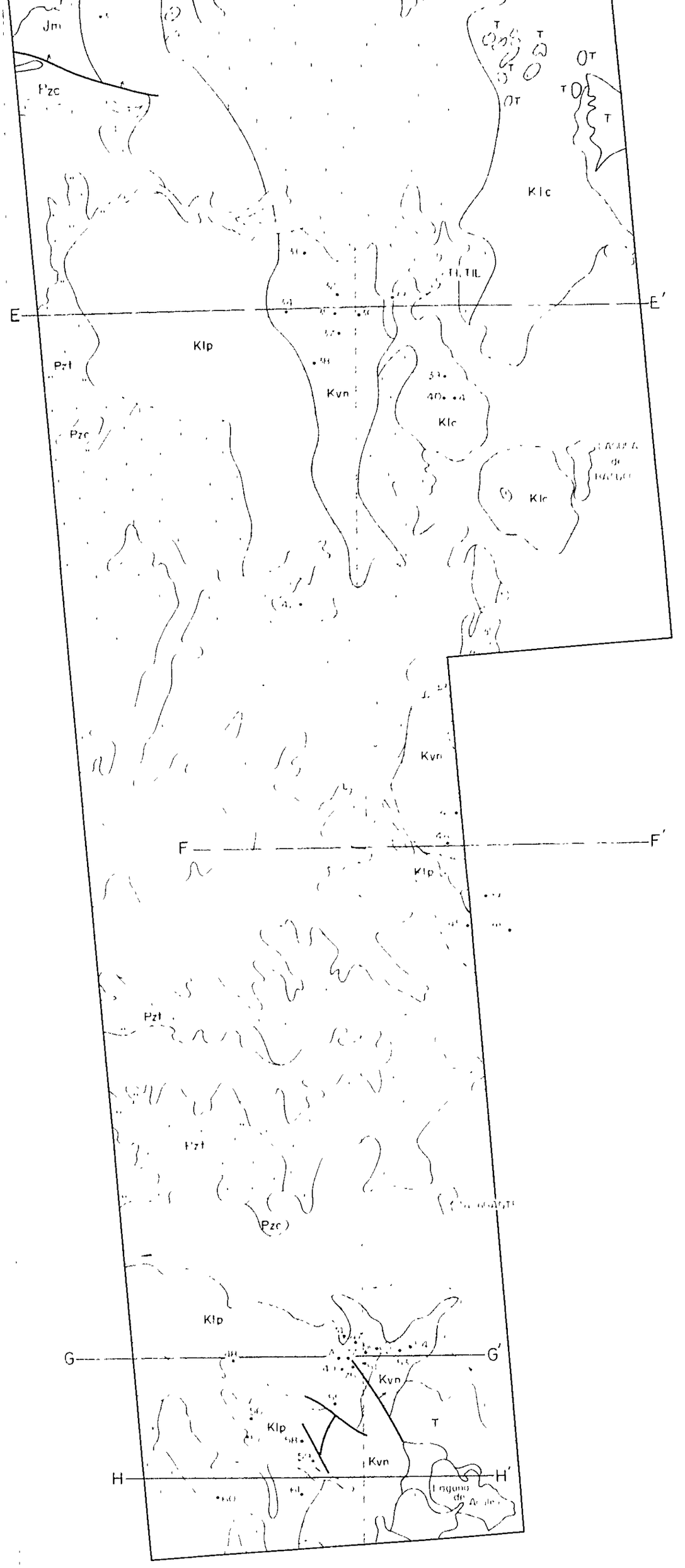


	NORTE	SUR	ROMERO	
(67) MANTO BRON	(68) DABÚ	(69) BRONCEADA	(70) LA LIBERTAD	(71) CARMELITA
(72) NEGRITA	(73) FUENTES	(74) LAS GUÍAS (NALTAGUA)	(75) BRILLANTE	(76) EL GATO
(77) LA HECHICERA				

(1) not investigated

(5) investigated in 1980 (CHILEAN - JAPANESE MISSION)


Klc
Tr
Ja
Jm
Tr
Jqp
Tr
Jqp
Kcm
Kcm
A
A'
Jm
Ja
Jqp
Jqp
Kcm
Jm
Ja
Klp
Kvr
Kcm
B
B'
Jm
Klc
Ja
Jm
Jm
C
C'
CATAMU
PANQUEHUE
D
D'
Jm
OCOA
LLA LLAY
Klp
Jm
Pzc
T
T
T
T
T
T
Klc
TILTIL
E
E'
Klp
Pzl
Kvn
Klc
Pzl
Klp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Pzc
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OT
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Klc
TL, TIL
E
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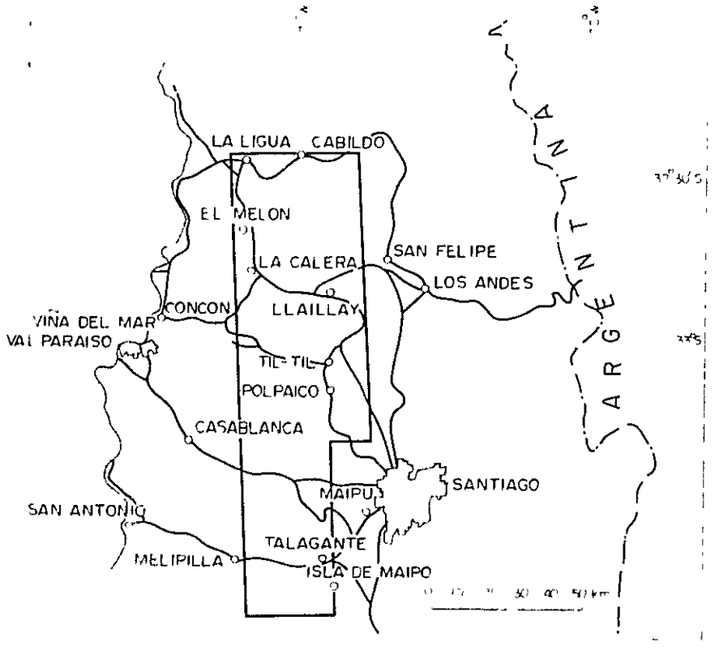
Pzt
Kvn
Klc
Pzc
Klc
Kvn
F
F'
Klp
Pzt
Pzt
Pzc
Klp
G
G'
Kvn
Klp
T
Kvn
H
H'

MINERAL RESOURCES DEVELOPMENT
IN
THE REPUBLIC OF CHILE

GEOLOGICAL MAP
OF
THE INVESTIGATED AREA



JAPAN INTERNATIONAL COOPERATION AGENCY
GOVERNMENT OF JAPAN

MARCH 1980
prepared by DOWA ENGINEERING CO., LTD

SCALE 1 250,000

0 5 10 15 20 25 km

LEGEND

	QUATERNARY	
T	TERTIARY	
Klc	LAS CHILCAS FOR	CRETACEOUS
Kcm	CERRO MORADO FOR	CRETACEOUS
Kvn	VETA NEGRA FOR	CRETACEOUS
Klp	LO PRADO FOR	CRETACEOUS
Jm	MELÓN FOR	JURASSIC
J	AJIAL FOR	JURASSIC
Jl	QUEBRADA EL POBRE FOR	JURASSIC
Tr	TRIASSIC	

T

E'

LAGUNA
de
BATUCO

F'

4°

70°45

LEGEND

	QUATERNARY	
T	TERTIARY	
Klc	LAS CHILCAS FOR	CRETACEOUS
Kcm	CERRO MORADO FOR	CRETACEOUS
Kvn	VETA NEGRA FOR	CRETACEOUS
Klp	LO PRADO FOR	CRETACEOUS
Jm	MELÓN FOR	JURASSIC
Ja	AJIAL FOR	JURASSIC
[illegible]	QUEBRADA EL POBRE FOR	JURASSIC
Tr	TRIASSIC	
[illegible]	PALEOZOIC	
	CENTRAL BATHOLITH [GRANODIORITE etc] (CRETACEOUS ~ TERTIARY?)	
	COAST BATHOLITH [TONALITE, ADAMELITE etc] (PALEOZOIC)	
	FAULT	

0m

Cerro Negros

Klp

Kmo

Boliviano

Kmp

2,000m

0m

E

2,000m

0m

F

Lo Agguire

Klp

Kmp

Kmo

Peumo,
Venus

Buitre

Lo Hermanos

Consuelo

Kmp

2 000m

0m

G

Klp

Las Guias

Mantos Negros

Kmp

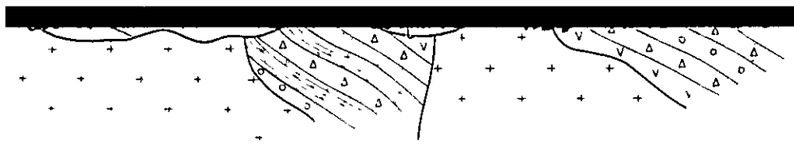
2000m

0m

2,000m

H

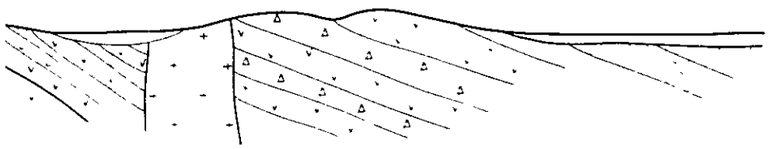
Klp



ano

Klc

E'



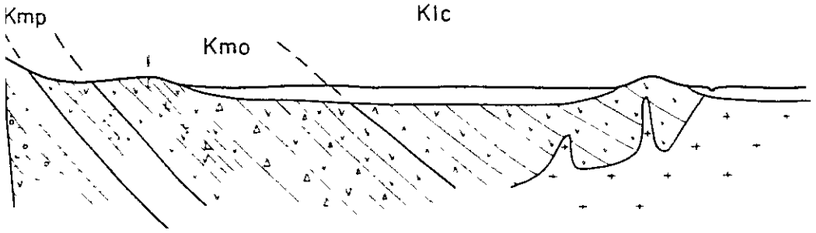
Lo Agguire

Kmp

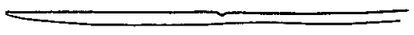
Klc

Kmo

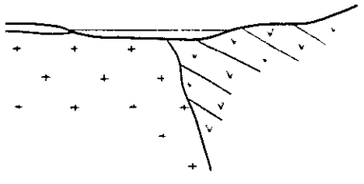
F'



G'

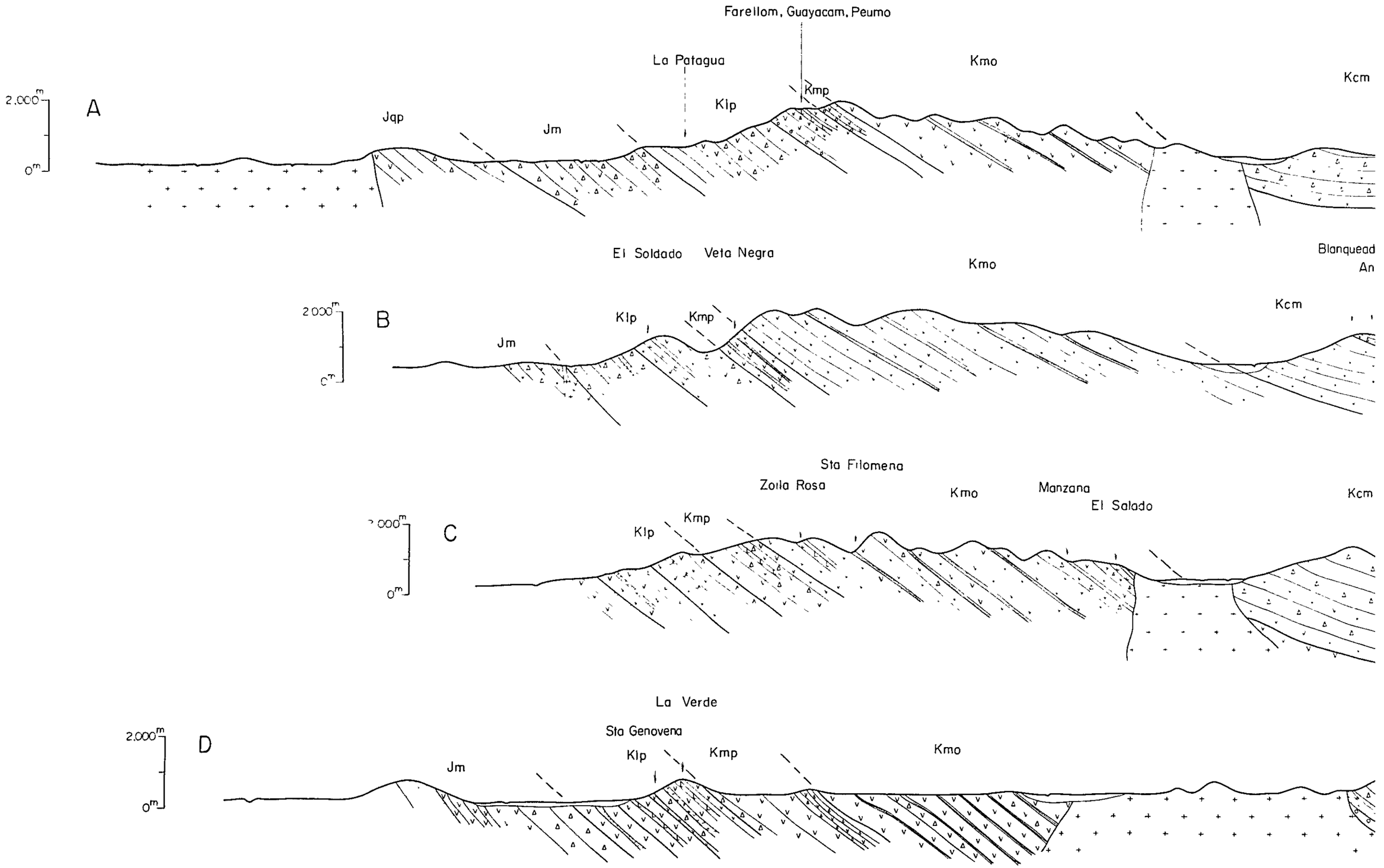


H'



LEGEND

- Shale
- Sandstone
- Conglomerate
- Limestone
- Tuff
- Volcanic breccia
- Ignimbrite
- Dacitic rock
- Andesite
- Autobrecciated andesite
- Trachite
- Granodiorite etc
- Tonalite etc
- Marginal facies of intrusive rocks


Farellom, Guayacam, Peumo
La Patagua
Kmo
Kcm
2.000m
0m
A
Jqp
Jm
Klp
Kmp
El Soldado
Veta Negra
Kmo
Blanquead
An
2000m
0m
B
Jm
Klp
Kmp
Kcm
Sta Filomena
Zoila Rosa
Kmo
Manzana
El Salado
Kcm
2.000m
0m
C
Klp
Kmp
La Verde
Sta Genovena
2.000m
0m
D
Jm
Klp
Kmp
Kmo

Kcm

A'

Blanqueado

Animas, Romero

Klc

:m

B'

Kcm

C'

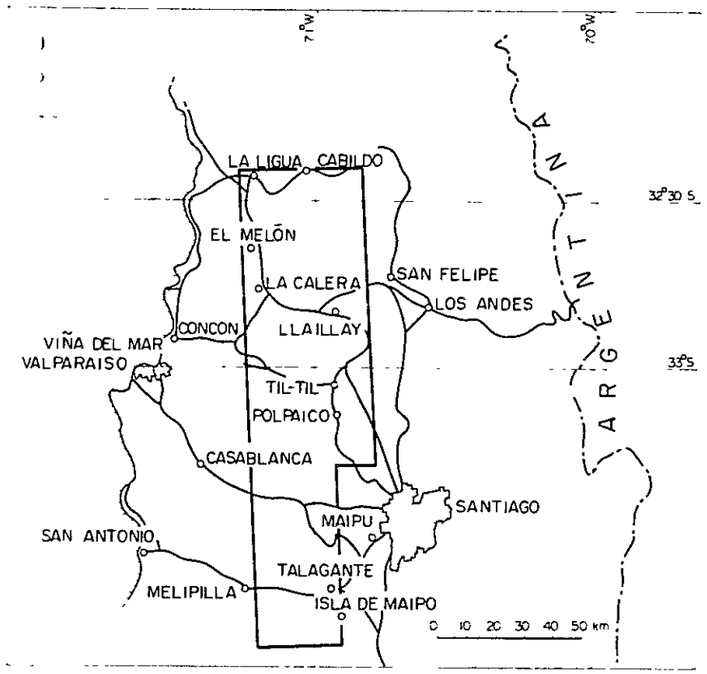
Kcm

Klc

D'

MINERAL RESOURCES DEVELOPMENT
IN
THE REPUBLIC OF CHILE

GEOLOGICAL PROFILE
OF
INVESTIGATED AREA



JAPAN INTERNATIONAL COOPERATION AGENCY
GOVERNMENT OF JAPAN

MARCH 1980
prepared by DOWA ENGINEERING CO, LTD

SCALE 1 100,000

0 2 4 6 8 10 km