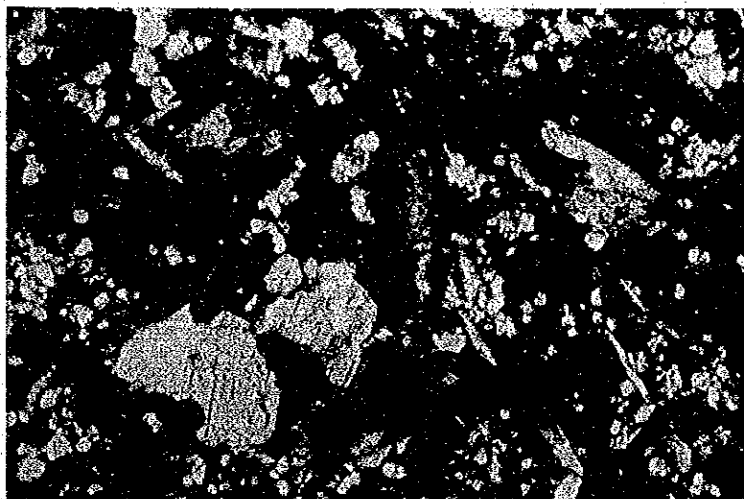
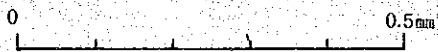


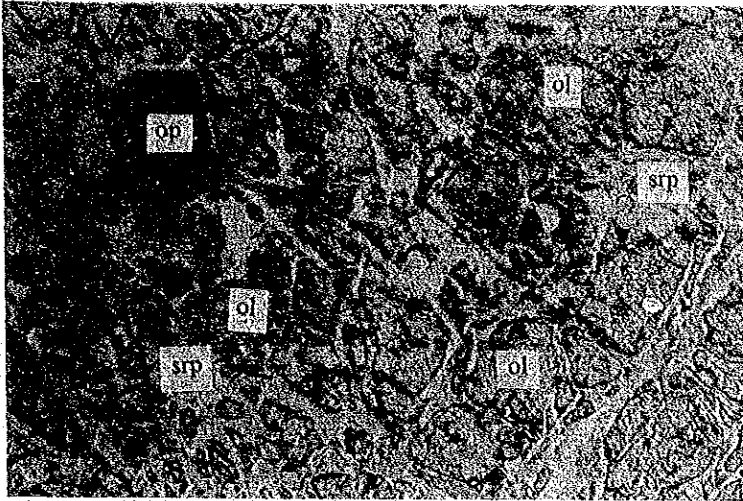
Only lower polar



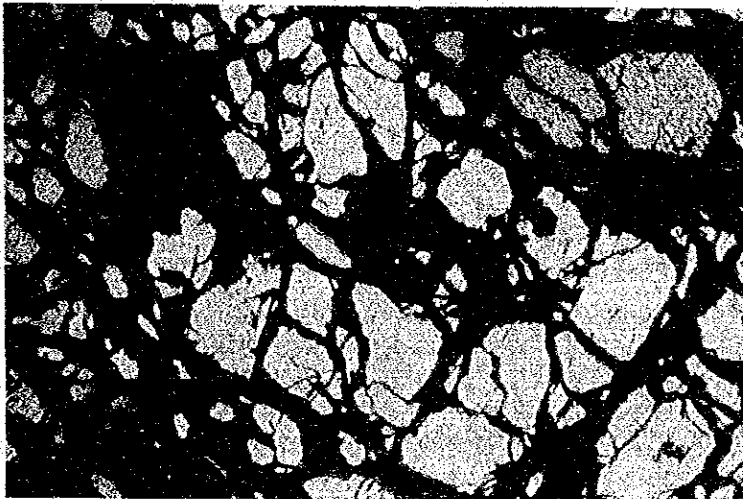
Crossed polars



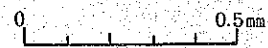
Sample No. : KR2-014
Location : Lumintao River
Rock name : Basalt
Group name : Lumintao formation



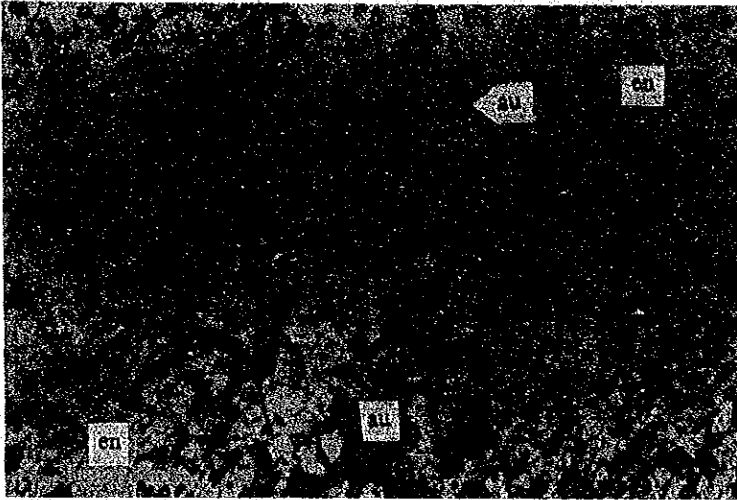
Only lower polar



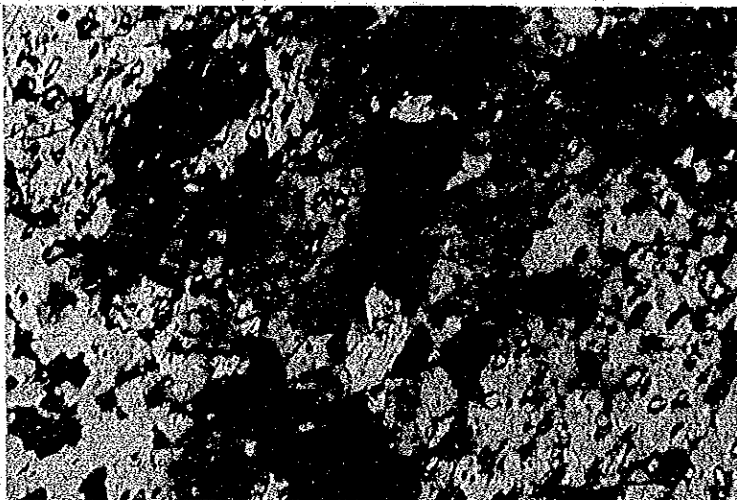
Crossed polars



Sample No. : KR2-100
Location : Ogos River
Rock name : Dunite
Group name : Ultramafic complex

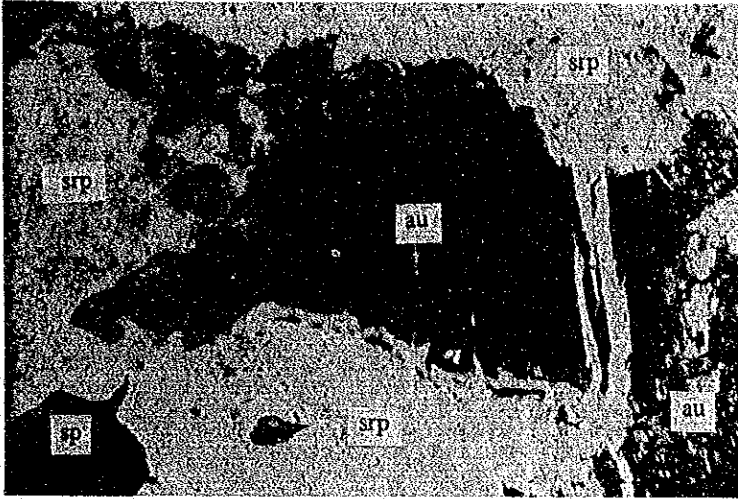


Only lower polar

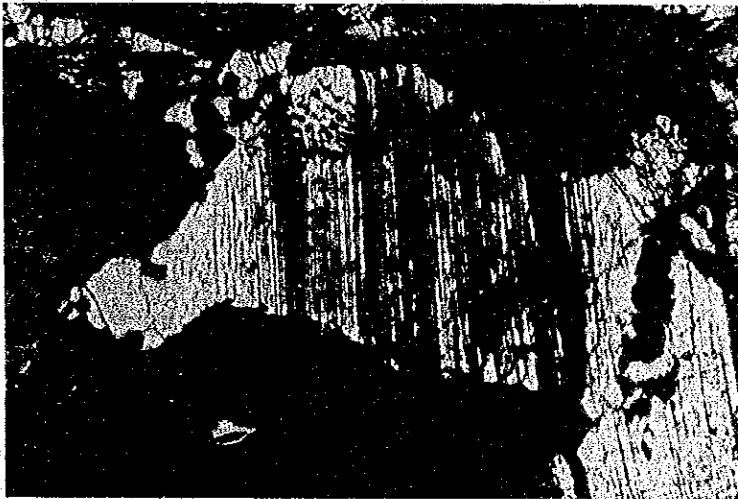


Crossed polars

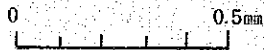
Sample No. : KR2-094
Location : Baléte River
Rock name : Harzburgite
Group name : Ultramafic complex



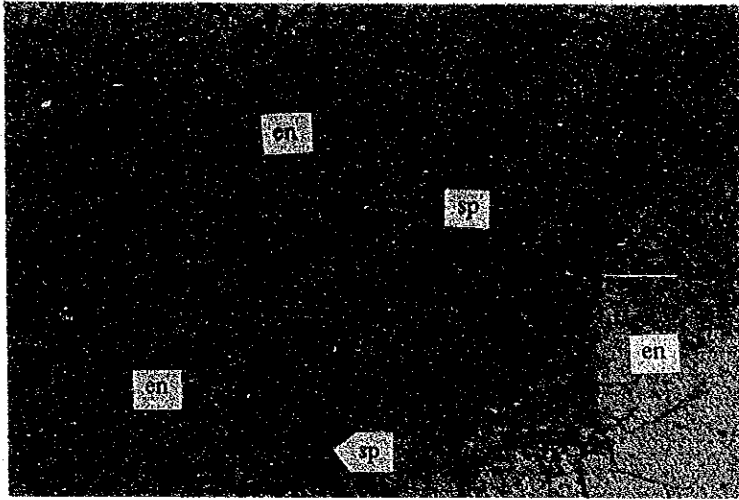
Only lower polar



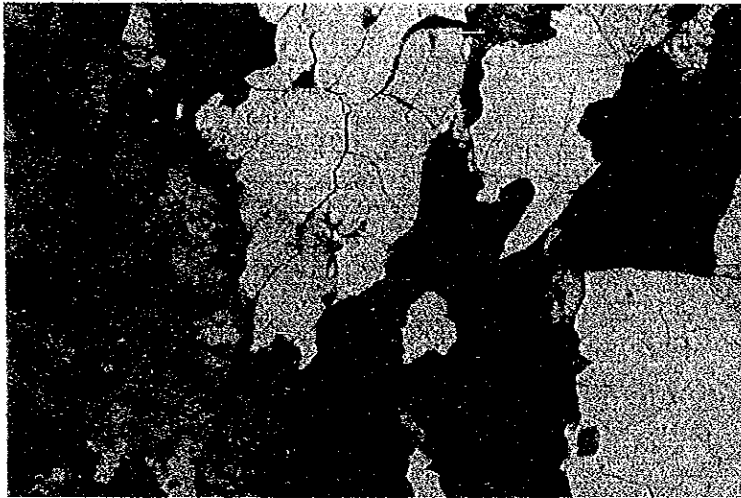
Crossed polars



Sample No. : KR2-095
Location : Balet River
Rock name : Lherzolite
Group name : Ultramafic complex



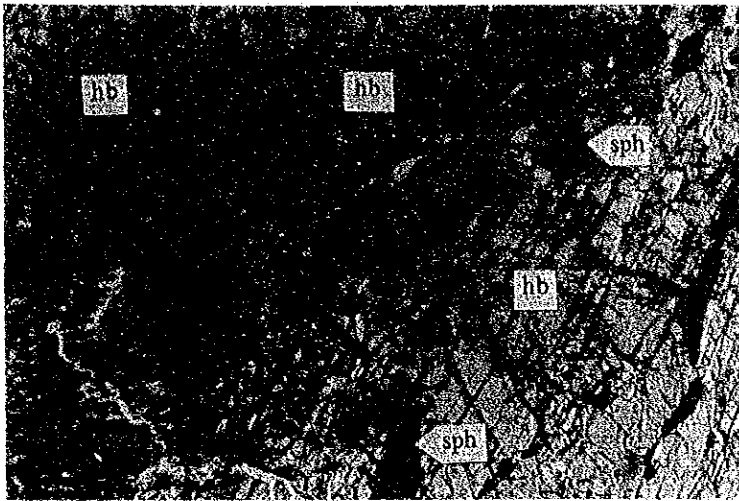
Only lower polar



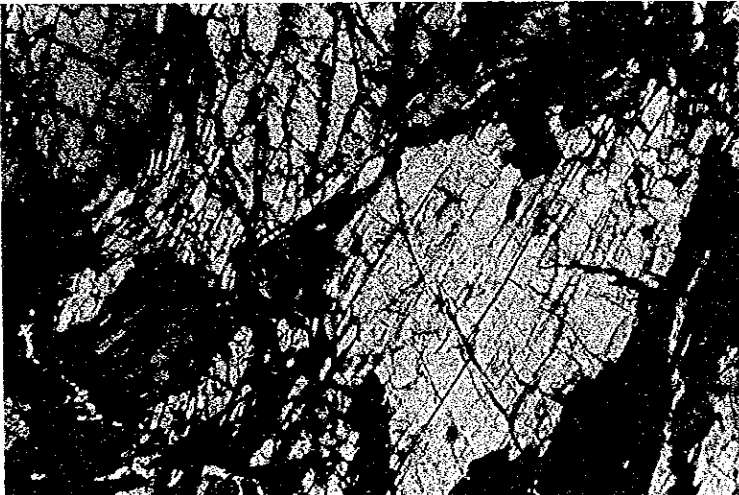
Crossed polars

0 0.5mm

Sample No. : KR2-026
Location : Pintin River
Rock name : Orthopyroxenite
Group name : Ultramafic complex



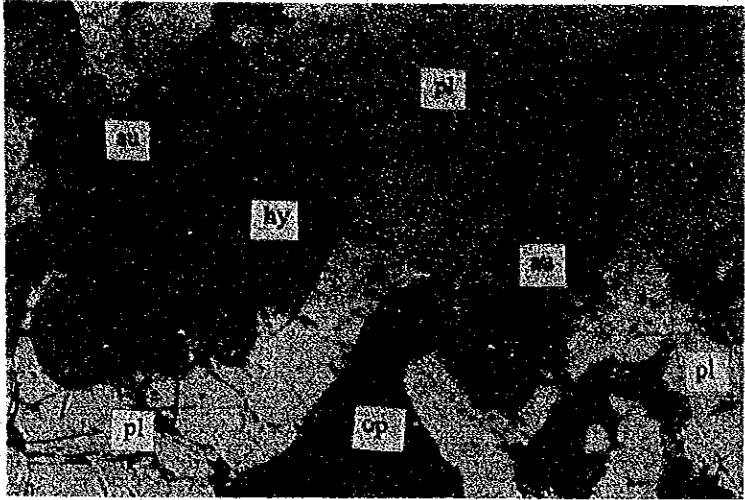
Only lower polar



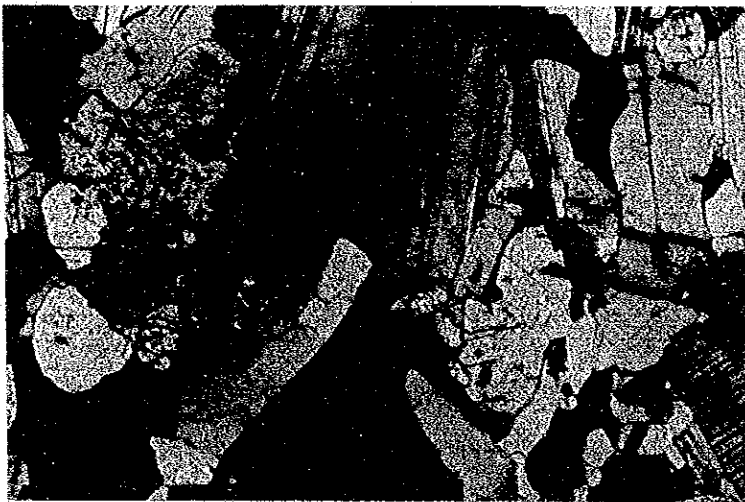
Crossed polars

0 0.5mm

Sample No. : KR2-025
Location : Pintin River
Rock name : Hornblendite
Group name : Ultramafic complex

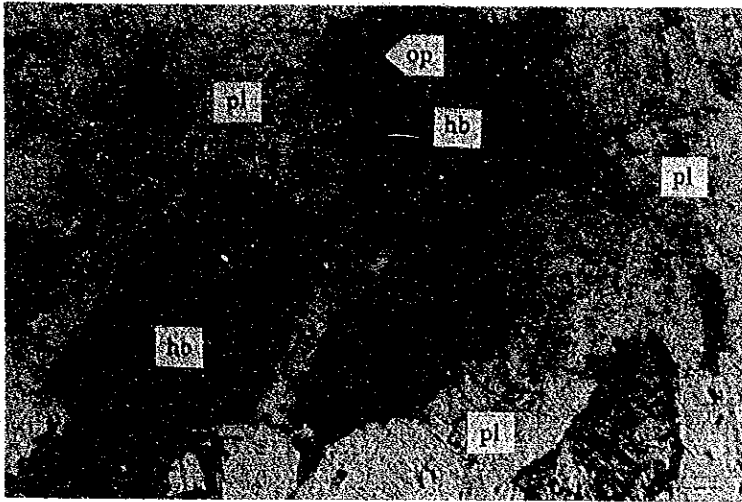


Only lower polar

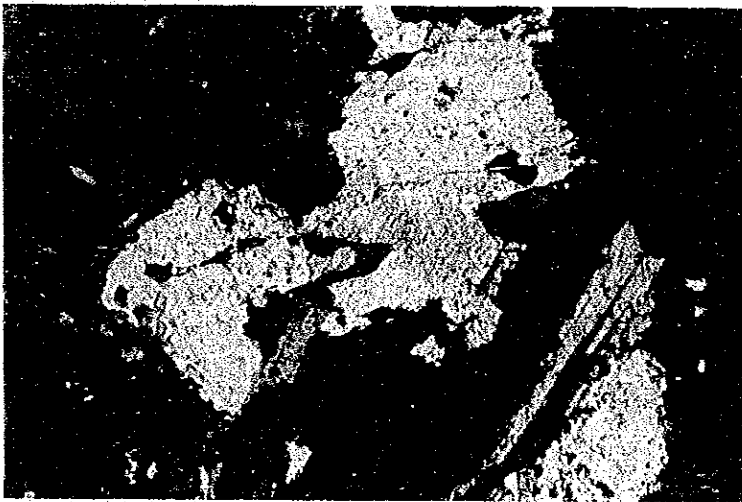


Crossed polars

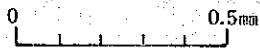
Sample No. : KR2-030
Location : Pintin River
Rock name : au-hy gabbro
Group name : Ultramafic complex



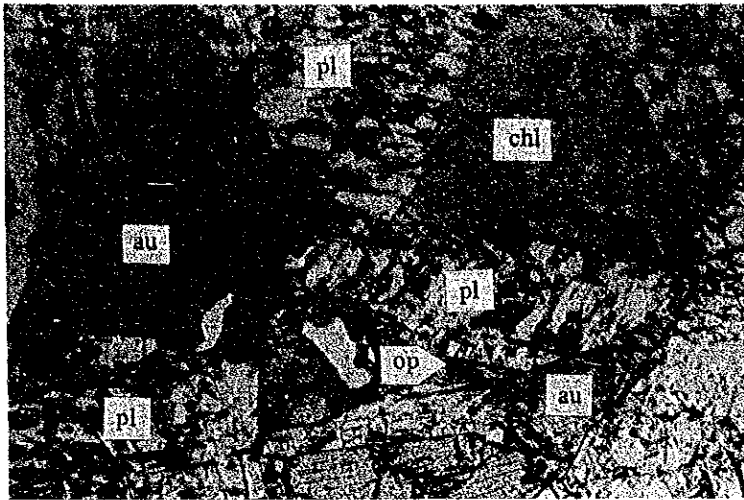
Only lower polar



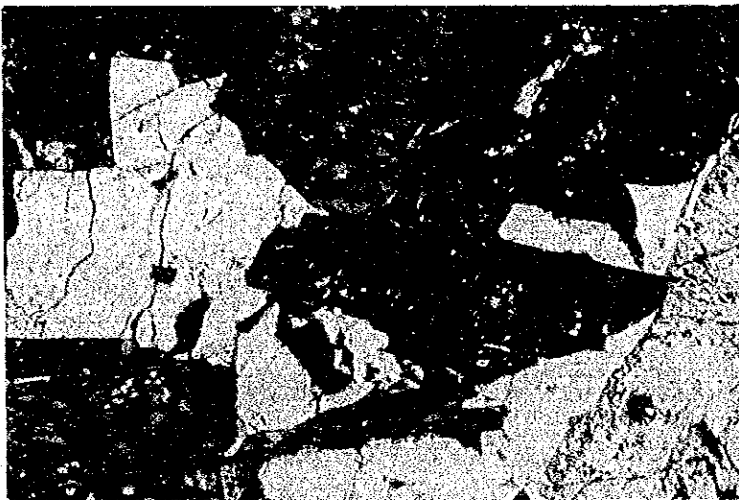
Crossed polars



Sample No. : KR2-063
Location : Igsoso
Rock name : hb gabbro
Group name : Ultramafic complex



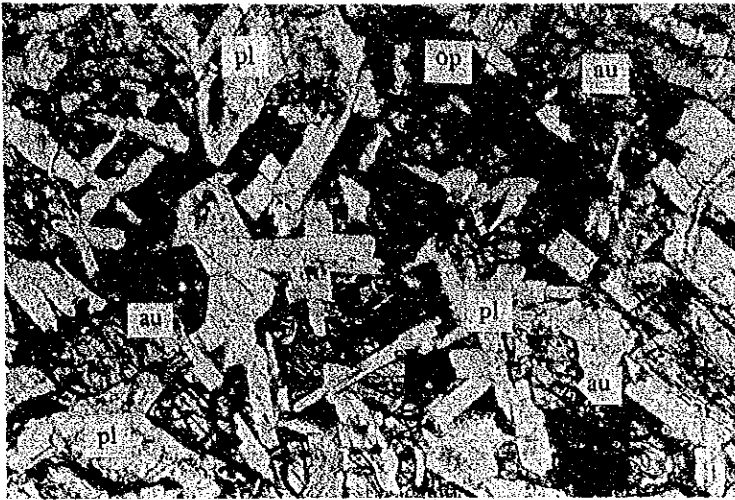
Only lower polar



Crossed polars



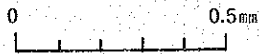
Sample No. : KR2-015
Location : Lumintao River
Rock name : au gabbro



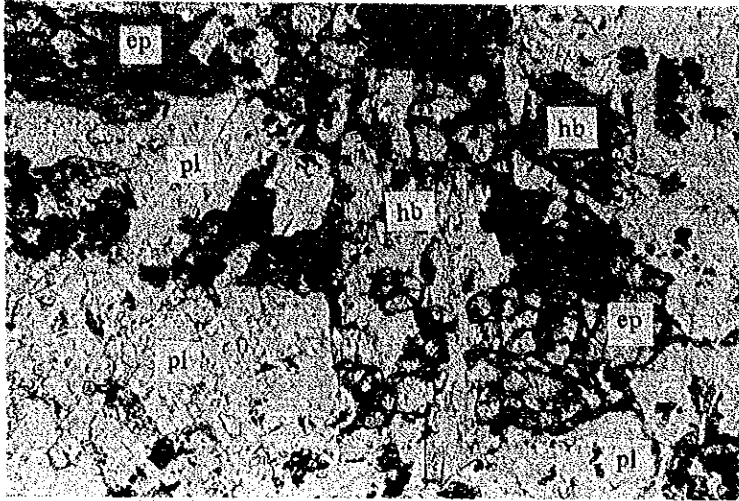
Only lower polar



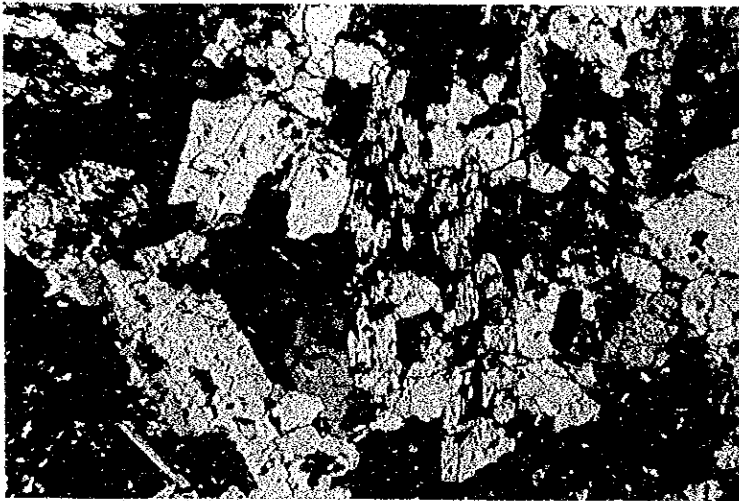
Crossed polars



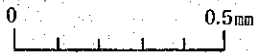
Sample No. : KR2-011
Location : Lumintao River
Rock name : Dolerite



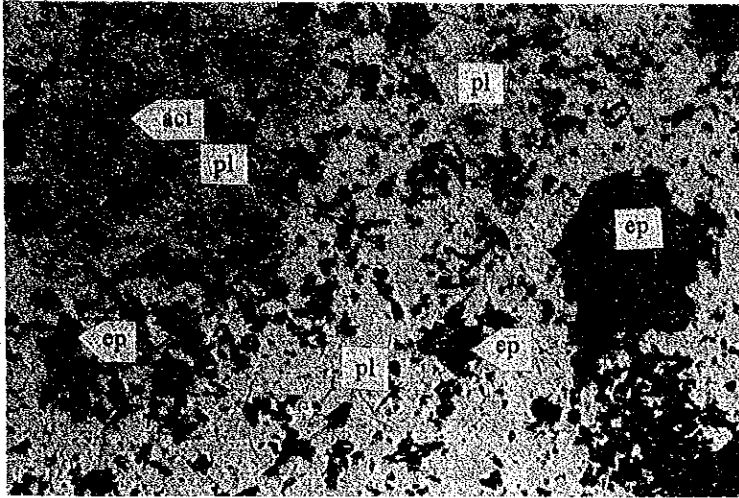
Only lower polar



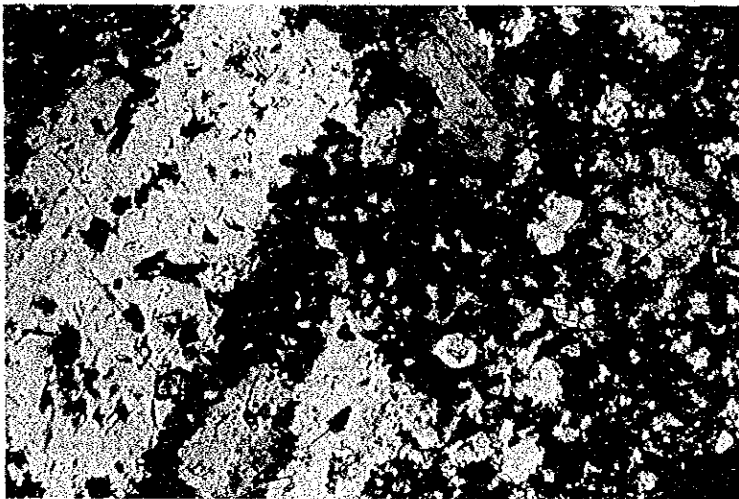
Crossed polars



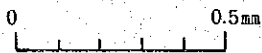
Sample No. : TR2-80
Location : Mamburao River
Rock name : hb diorite



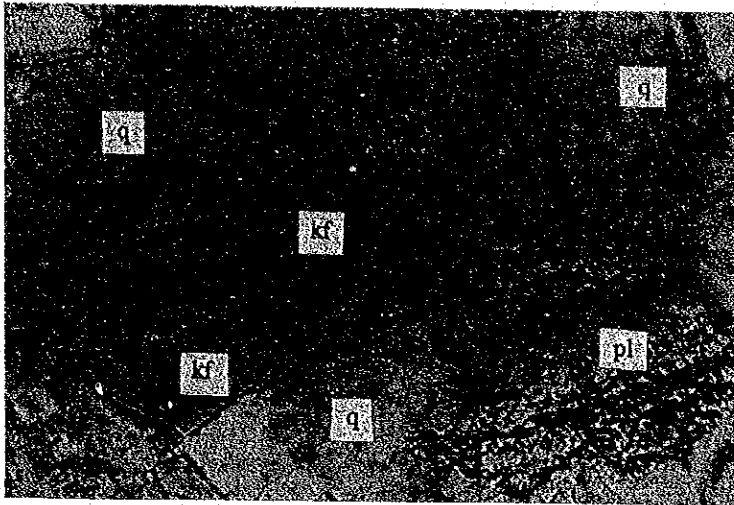
Only lower polar



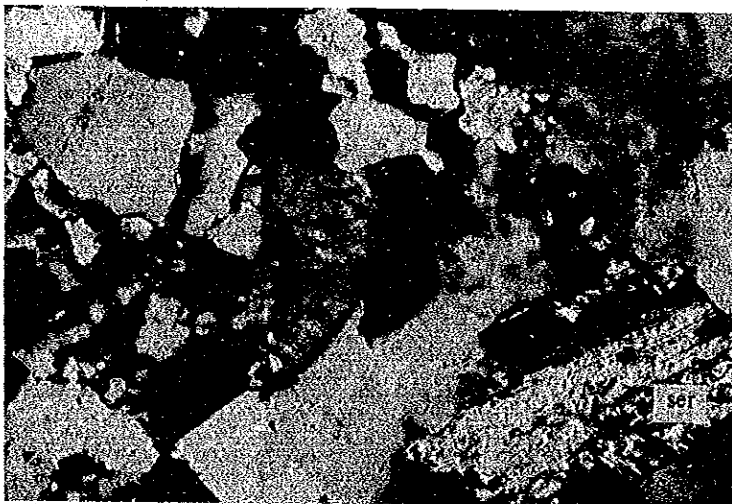
Crossed polars



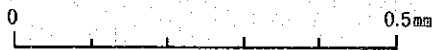
Sample No. : TR2-83
Location : Mamburao River
Rock name : Diorite porphyry



Only lower polar



Crossed polars

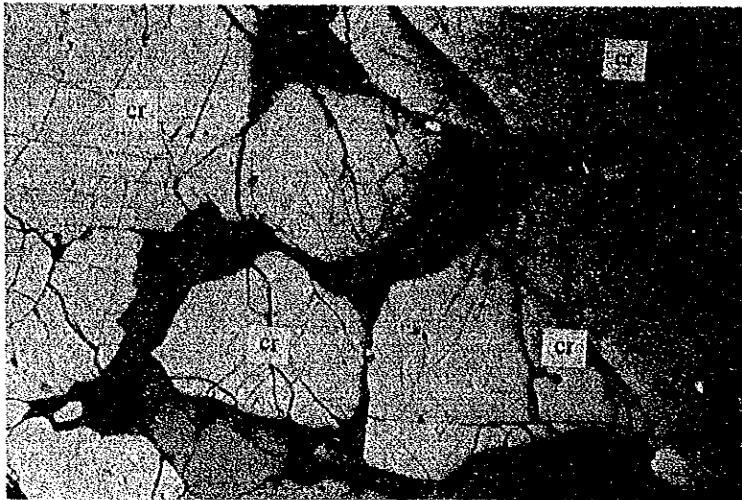


Sample No. : TR2-110
Location : Mamburao River
Rock name : q diorite

Fig. A-2 Microphotograph of Polished Section

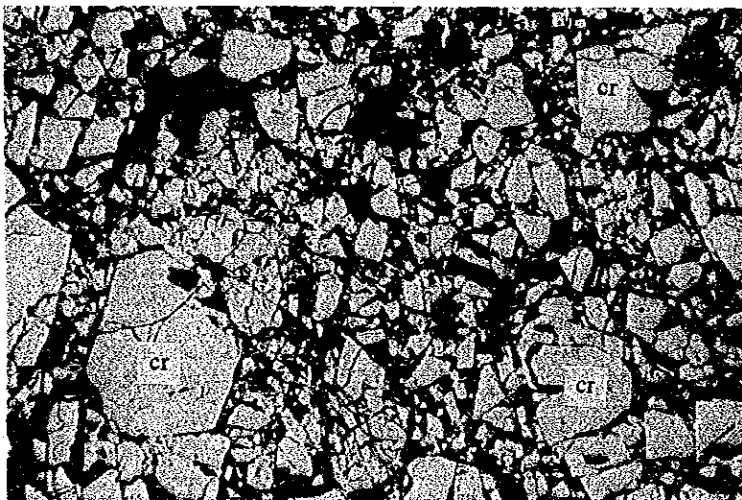
Abbreviation

cr	:	chromite
mg	:	magnetite
he	:	hematite
pyr	:	pyrrhotite
cp	:	chalcopyrite
sph	:	sphalerite
py	:	pyrite



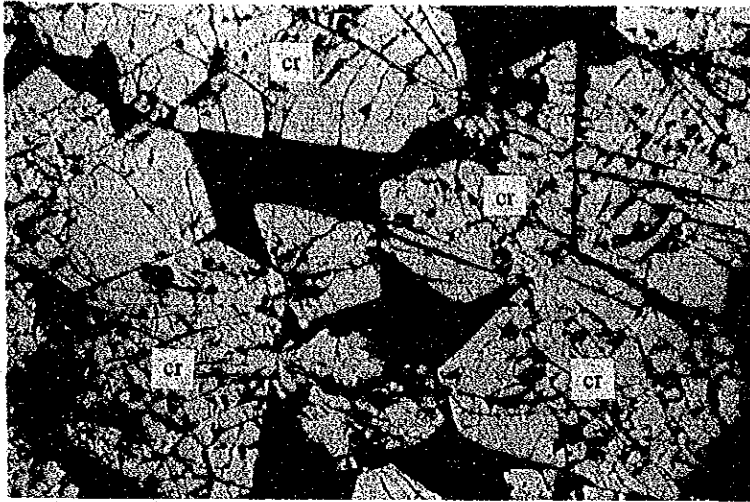
Sample No. : KR2-105a
Location : Ogos deposit
Ore name : chromite ore

Reflected light
Only lower polar



Sample No. : TR2-130a
Location : Banus deposit
Ore name : chromite ore

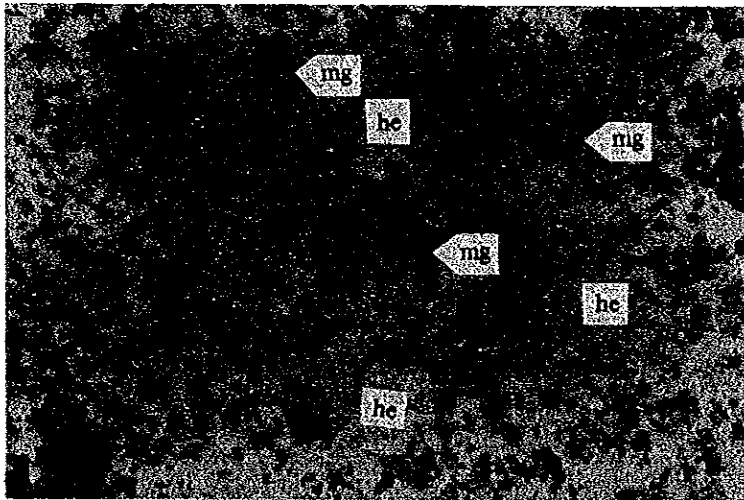
Reflected light
Only lower polar



0 0.5mm

Sample No. : KR2-050a
Location : Pintin deposit
Ore name : chromite ore

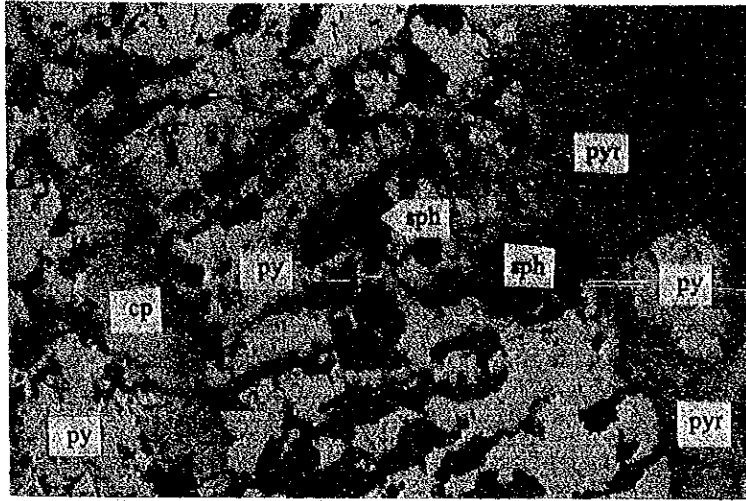
Reflected light
Only lower polar



0 0.2mm

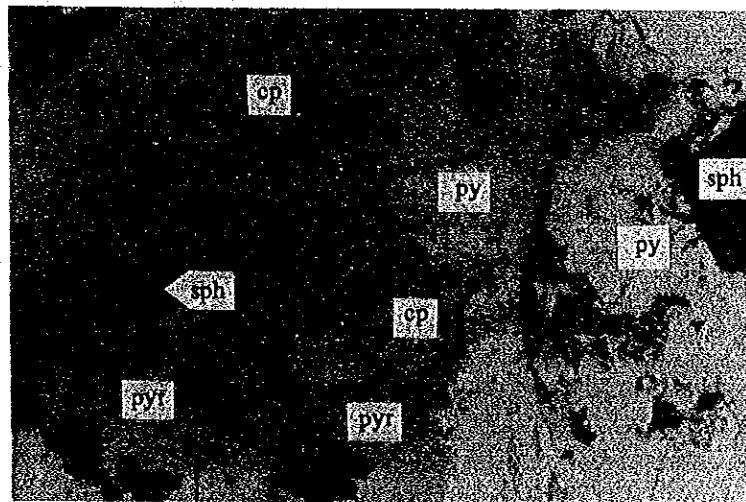
Sample No. : TR2-093
Location : Lasala deposit
Ore name : hematite-magnetite ore

Reflected light
Only lower polar



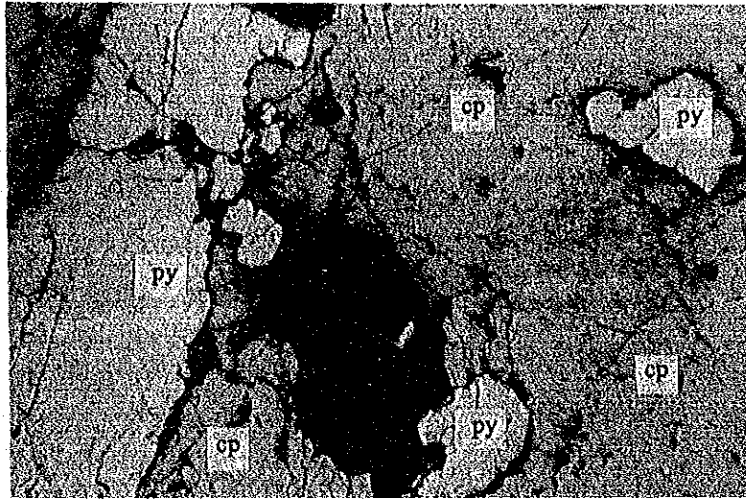
Sample No. : SR2-127a
 Location : Masnon deposit
 Ore name : chalcopyrite-pyrite
 -pyrrhotite-sphalerite ore

Reflected light
 Only lower polar



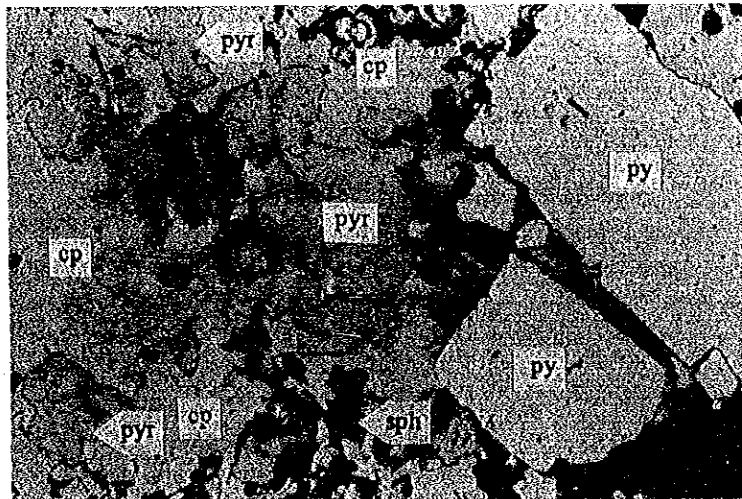
Sample No. : SR2-127b
 Location : Masnon deposit
 Ore name : pyrrhotite-pyrite
 -sphalerite-chalcopyrite ore

Reflected light
 Only lower polar



Sample No. : SR2-136
Location : Manamburao deposit
Ore name : chalcopyrite-pyrite ore

Reflected light
Only lower polar



Sample No. : FR2-024
Location : Sibakoi River
Ore name : pyrite-chalcopyrite-pyrrhotite ore

Reflected light
Only lower polar

Table A-1-1 List of Lager Foraminifera

Species of Lager Foraminifera	Group Name		Sablayan Group																			
	Sample No.	Location	Geologic Age																			
Acerulina inhaerens Schulze	do.	Tributary of Balingan R.	TR2 - 005																			
A. sp.	do.	Tributary of Caguray R.	YR2 - 024a																			
Amphistegina radiata (Fichtel and Moll)	do.	Tributary of Aramay R.	YR2 - 034 (float)																			
Asterocyclina sp.	do.	Epaz Point	YR2 - 036 (float)																			
Biplanospira mirabilis (Umbgrove)	do.	Tributary of Mongpong R.	TR2 - 029																			
Cycloclypeus sp.	do.	do.	TR2 - 039																			
Discocyclina cf. dispersa (Sowerby)	do.	Banus R.	TR2 - 127																			
D. sp.	do.	do.	TR2 - 137																			
Gypsina globulus (Reuss)	do.	Caguray R.	YR2 - 002																			
G. vesicularis (Parker and Jones)	do.	?																				
Halkarcia minima (Liebus)	do.	do.																				
Heterostegina cf. borneensis Van der Vlerk	do.	do.																				
H. sp.	do.	do.																				
Homotrema rubrum (Lamerck)	do.	do.																				
Lepidocyclina (Eulepidina) cf. monstrosa Yabe	do.	do.																				
L. (E.) planata (Oppenoorth)	do.	do.																				
L. (E.) sp.	do.	do.																				
(Multilepidina) luxurians (Tobler)	do.	do.																				
(Nephrolepidina) angulosa Provale	do.	do.																				
(N.) ferretoi Provale	do.	do.																				
(N.) cf. isolepidinoides Van der Vlerk	do.	do.																				
(N.) japonica (Yabe)	do.	do.																				
(N.) sumatrensis (Brady)	do.	do.																				
Miniacina miniacea (Falias)	do.	do.																				
Miogypsina (Lepidosemicyclina) thecidaeformis Rutilen	do.	do.																				
M. (Miogypsinoidea) complanata (Schlumberger)	do.	do.																				
Nummulites cf. fabianii (Früer)	do.	do.																				
N. fichteli (Michellotti)	do.	do.																				
Operculina cf. complanata (Defrans)	do.	do.																				
O. venosa (Fichtel and Moll)	do.	do.																				
O. sp.	do.	do.																				
Panorbulinella larvata (Parker and Jones)	do.	do.																				
Rotalia sp.	do.	do.																				
Rupertina? sp.	do.	do.																				
Spiroclypeus leupoldi Van der Vlerk	do.	do.																				
S. vermicularis Tan	do.	do.																				

Table A-1-2 List of Smaller Foraminifera

Species of Smaller Foraminifera	Group Name		Sablayan Group		Bongabong Group		
	Sample No.	Location	Geologic Age				
Bolivina robusta	do.	Caguray R.	YR2 - 006				
Bolivina quadrilatera	do.	do.	YR2 - 007				
Bulimina cf. buchiana	do.	do.	YR2 - 015				
B. marginata	do.	do.					
B. striata	do.	do.					
Cassidulina subglobosa	do.	do.					
Cellanthus craticulatum	do.	do.					
Chilostomella oolina	do.	do.					
Cibicides dorsopustulosus	do.	do.					
C. praecinctus	do.	do.					
Clavulinoides sp.	do.	do.					
Cymbaloporeta squamosa	do.	do.					
Dorothis sp.	do.	do.					
Florilus boueanum	do.	do.					
Gyroldina soldanii	do.	do.					
Hemicristellaria gemmata	do.	do.					
Hoglundina elegans	do.	do.					
Hyalinea haitiaca	do.	do.					
Karreriella bradyi	do.	do.					
Lagenodosaria hirsuta	do.	do.					
Margulinopsis bradyi	do.	do.					
Nodosaria longicata	do.	do.					
Planulina ariminensis	do.	do.					
Pseudorotalia schroeteriana	do.	do.					
Rectobolivina bifrons	do.	do.					
Rotalia calcar	do.	do.					
Signolopsis schlumbergeri	do.	do.					
Siphonogenina striata	do.	do.					
Uvigerina ampullacea	do.	do.					
U. canariensis	do.	do.					
U. cushmani	do.	do.					
U. peregrina	do.	do.					
Planktonic Foraminifera							
Catapsydrax distimilis							
C. unicus							
Cyclamina cancellata							
Globigerina bulloides Blow							
Globigerinoides conglobatus							
G. obliquus							
G. quadrilobatus group							
G. rubra (d'Orbigny)							
Globobulimina sp.							
Globorotalia crassaformis							
G. menardii (d'Orbigny)							
G. pseudopina							
G. tosaensis							
G. tumida							
Haplophragmoides compressa							
Neoglobobulimina duteirei							
Orbulina universa d'Orbigny							
Pulleniatina obliquoculata							
P. pyramis							
Sphaeroidinella dehiscens							

Table A-2-1 List of Microscopic Observations(Thin Section)

Abbreviation;

Mineral

q	:	quartz
kf	:	potash feldspar
pl	:	plagioclase
bt	:	biotite
mus	:	muscovite
hb	:	hornblende
au	:	augite
hy	:	hypersthene
en	:	enstatite
ol	:	olivine
act	:	actinolite
tor	:	tourmaline
cpx	:	clinopyroxene
opx	:	orthopyroxene
ap	:	apatite
ga	:	garnet
sph	:	sphene
op	:	opaque minerals
gl	:	glass
ep	:	epidote
ser	:	sericite
chl	:	chlorite
cal	:	calcite
srp	:	serpentine
sap	:	saponite
mon	:	montmorillonite
zeo	:	zeolite
prh	:	prehnite
ru	:	rutile
cr	:	chromite
pic	:	picotite
tr	:	tremolite

Table A-2-2 List of Microscopic Observations(Polished Section)

(1)

No.	Sample No.	Location	Name of Ore and Formation	Microscopic Observation	Remarks
1	FR2-024	Sibakoi R.	Pyrite-Chalcopyrite Ore (Mansalay F.)	Ore minerals consist of pyrite \gg chalcopyrite $>$ pyrrhotite $>$ sphalerite. Earlier stage pyrite, chalcopyrite and pyrrhotite have a colloform banding, which are cut by later stage pyrite veinlets (0.1 ~ 1 cm in width).	see photograph float
2	FR2-036	Nagsabongan Dep.	Magnetite Ore (Sablayan G.)	A small amount of hematite with acicular or dendritic form, replace magnetite along cracks. Very fine grains (0.02 mm in size) of pyrite and chalcopyrite are sometimes visible in magnetite.	
3	FR2-037	do	Magnetite Ore (do)	Same as FR2-36	
4	FR2-039	Tiraca R.	Hematite Ore (do)	The section consists mainly of hypidiomorphic hematite grain aggregate (0.05 ~ 0.5 mm in size). A small amount of limonite and silicate minerals fill intergranular spaces. Hematite crystals show lattice structure.	
5	KR2-050a	Pintin R.	Chromite Ore (Ultramafic C.)	Idiomorphic chromite crystals (0.2 ~ 1.0 mm in size) compose the ore. The crystals have irregular cracks (0.02 ~ 0.5 mm in width) and are partly changed into fine fragments (0.05 ~ 0.2 mm in size) by shearing.	see photograph massive ore
6	KR2-050b	do	Chromite Ore (do)	Same as KR2-050a	massive ore
7	KR2-055a	Liw liw area	Chromite Ore (do)	Xenomorphic granular chromite crystals (0.01 ~ 0.1 mm in size), contain many irregular cracks, show a cataclastic texture. Two systems of shear fracture (0.5 ~ 1.0 mm in width) are found and the crystals are broken into fine fragments (0.01 ~ 0.02 mm in size)	dense spotted ore stockpile
8	KR2-055b	do	Chromite Ore (do)	Same as KR2-055a	massive ore stock pile
9	KR2-060	Igsoso	Chromite Ore (do)	Xenomorphic chromite crystals (0.03 ~ 1.0 mm in size) with many irregular cracks (0.01 ~ 0.3 mm in width) are abundant. A small amount of idiomorphic chromite crystals have sometimes a zonal arrangement of olivine inclusions (0.01 ~ 0.03 mm in size). Prismatic or acicular magnetite crystals (0.01 ~ 0.1 mm in width, 0.1 ~ 1 mm in length) are rarely found, some of which are replaced by hematite. The chromite crystals are fairly crushed by shearing.	banded ore
10	KR2-062	do	Chromite Ore (do)	Same as KR2-060	

(2)

No.	Sample No.	Location	Name of Ore and Formation	Microscopic Observation	Remarks
11	KR2-065	Igoso	Chromite Ore (Ultramafic C.)	Xenomorphic chromite crystals (0.04 ~ 2.0 mm in size) with many irregular cracks (0.02 ~ 1 mm in width) are abundant. The section shows a cataclastic texture and the chromite crystals are crushed into fragments (<0.2 mm in size). A few coarse idiomorphic crystals are rotated and crystal rims are crushed by shearing. Slightly hematitized magnetite (<0.05 mm in size) and silicate mineral (<0.1 mm in size), with zonal arrangement, are rarely found.	massive ore stock pile
12	KR2-069a	Maril area	Chromite Ore (do)	Abundant chromite fragments (0.02 ~ 1.0 mm in size) with many cracks (0.01 ~ 0.3 mm in width) show a cataclastic texture. Two directions of shear fracture (0.3 ~ 0.5 mm in width) intersecting at an angle of 60° are developed and crush the chromite into fine fragments under 0.05 mm in size.	dense spotted ore, stock pile
13	KR2-069b	do	Chromite Ore (do)	Same as KR2-069a	dense spotted ore, stock pile
14	KR2-070	do	Chromite Ore (do)	Coarse, idiomorphic chromite crystals (0.5 ~ 1 mm in size) with many cracks (0.05 ~ 0.3 mm in width) occupy the most part. Uvarovite veinlets (<0.2 mm in width) are found along cracks. Irregular shear fractures (0.2 ~ 0.5 mm in width) are developed and the crystals are crushed into fragments (0.03 ~ 0.1 mm) along fractures.	massive ore float
15	KR2-072	San Vicente Dep.	Chromite Ore (do)	Main ore mineral is coarse, idiomorphic magnetite (0.5 ~ 3 mm in size), replaced by hematite along the rim. Chromite crystals (0.02 ~ 0.05 mm in size) are fine grained, idiomorphic and very few.	disseminated ore float
16	KR2-105a	Ogos River	Chromite Ore (do)	Chromite crystals (0.3 ~ 1.5 mm in size) are idiomorphic but somewhat rounded. Many cracks are developed. A few idiomorphic pyrite crystals (0.03 ~ 0.06 mm in size) are included in chromite.	see photograph dense spotted ore
17	KR2-105b	do	Chromite Ore (do)	Almost same as KR2-105a, but the grain size is coarser (0.3 ~ 2 mm in size).	dense spotted ore
18	KR2-105c	do	Chromite Ore (do)	Same as KR2-105b	dense spotted ore
19	KR2-106	do	Chromite Ore (do)	Chromite grains (0.03 ~ 0.3 mm in size) are sand-like particles decomposed by weathering.	disseminated ore sandy by weathering
20	SR2-124	Mason Dep.	Pyrrhotite-Pyrite Ore (do)	Ore minerals are pyrrhotite > pyrite > chalcopyrite, sphalerite. Brecciation is partly recognized. The later stage of sphalerite has filled many fractures (0.02 ~ 0.6 mm in width) with quartz, and replaced partially pyrrhotite.	

(3)

No.	Sample No.	Location	Name of Ore and Formation	Microscopic Observation	Remarks
21	SR2-125	Mason Dep.	Chalcopyrite-Pyrite Ore (Ultramafic C.)	The section consists mainly of chalcopyrite enclosing a small amount of pyrite \geq sphalerite grains (< 0.4 mm in size), and shows a brecciated texture in part. Sphalerite is included in pyrite as hydriomorphic grains ($0.02 \sim 0.3$ mm in size) or veinlets (< 0.05 mm in width).	
22	SR2-127a	do	Chalcopyrite-Pyrite-Pyrrhotite Ore (do)	Chalcopyrite, pyrite and pyrrhotite occupy almost same amount associating lesser amount of sphalerite. Large pyrite grains (> 2 mm in size) enclosing hydriomorphic sphalerite ($0.02 \sim 0.2$ mm in size) have been crushed intensely and replaced by chalcopyrite and pyrrhotite along fractures. Chalcopyrite and pyrrhotite are cut by veinlets ($0.01 \sim 0.2$ mm in width) of other ore minerals. Twinning lamellae has developed in pyrrhotite.	see photograph
23	SR2-127b	do	Pyrrhotite-Pyrite Ore (do)	Ore minerals are pyrrhotite \geq pyrite $>$ sphalerite \geq chalcopyrite. Many micro-fractures filled by chalcopyrite and pyrrhotite are developed in pyrite. The sequence of crystallization is pyrite \rightarrow sphalerite \rightarrow pyrrhotite \rightarrow chalcopyrite.	see photograph
24	SR2-136	Manamburao Dep.	Chalcopyrite-Pyrite-Quartz Vein (Lumintao F.)	String-like or tabular shaped chalcopyrite encloses granular pyrite (2 mm in size), some of which have been replaced by chalcopyrite. A small amount of sphalerite are visible as partial rim of other minerals or as veinlets.	see photograph
25	SR2-148	Mason Dep.	Chalcopyrite-Pyrrhotite Ore (Ultramafic C.)	Component minerals: chalcopyrite = pyrrhotite \geq sphalerite $>$ pyrite, are brecciated into smaller grains ($0.01 \sim 2.0$ mm in size). Pyrite in pyrrhotite-rich part is fractured intensely and replaced by pyrrhotite and sphalerite. Pyrite veinlets ($0.03 \sim 0.2$ mm in width) cut chalcopyrite.	brecciated ore
26	SR2-151	Chialawood Dep.	Pyrrhotite Ore (Lumintao F.)	Most of the field consist of pyrrhotite and gangue mineral. Pyrrhotite encloses irregular shaped chalcopyrite ($0.01 \sim 0.3$ mm in size) and less sphalerite (< 0.1 mm in size). Very thin sphalerite veinlets (< 0.01 mm in width) can be seen in the gangue.	
27	SR2-154	Banbanon Dep.	Pyrite Ore (Lumintao F.)	Fine grained pyrite aggregates ($0.01 \sim 0.1$ mm in size), showing a mosaic texture, occupy most of the section. Sphalerite and some copper minerals (chalcopyrite, bornite, chalcocite, covellite) fill intergranular spaces of pyrite. Covellite has replaced copper minerals.	
28	TR2-044	Amnay R.	Pyrite-Sphalerite Ore (?)	Ore minerals consist of pyrite \geq sphalerite $>$ chalcopyrite. Pyrite grains ($0.02 \sim 0.6$ mm in size) have an idiomorphic \sim hydriomorphic form showing a mosaic texture. Irregular shaped sphalerite, chalcopyrite and quartz fill intergranular spaces of pyrite grains.	float
29	TR2-060	San Vicente Dep.	Chromite Ore (Ultramafic C.)	Chromite crystals are idiomorphic ($1 \sim 2$ mm in size) and have many cracks ($0.1 \sim 0.5$ mm in width). A very few acicular crystals (< 0.01 mm in width) of magnetite, replaced by hematite mostly, are included in chromite. Two directions of shear fractures ($0.01 \sim 0.03$ mm in width) intersecting at an angle of 30° are developed.	massive ore

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No.	Sample No.	Location	Name of Ore and Formation	Microscopic Observation	Remarks
30	TR2-090	Lasala Dep.	Hematite-Magnetite Ore (Sablayan G.)	Ore minerals consist of hematite > magnetite ≧ limonite. Hematite grains (0.1 ~ 0.6 mm in size) show pseudomorph of hypidiomorphic magnetite. Small grains of relict magnetite (< 0.05 mm in size) are scattered in Hematite.	banded ore
31	TR2-093	Lasala Dep.	Magnetite Ore (do)	Magnetite and hematite occur in almost the same amount. Magnetite has been replaced by hematite. Magnetite grains (0.005 ~ 0.05 mm in size) are also found in hematite.	see photograph massive ore float
32	TR2-096	Lapa-Ao Dep.	Magnetite Ore (Mansalay F.)	Ore minerals consist of magnetite ≧ hematite ≧ limonite. Magnetite grains (0.05 ~ 0.5 mm in size) are xenomorphic and rich in cracks. Acicular or dendritic hematite has replaced magnetite along cracks.	
33	TR2-097	do	Magnetite Ore (do)	Magnetite grains (0.1 ~ 0.5 mm in size) are composed of xenomorphic crystals showing a mosaic texture partly. Acicular hematite crystals replacing magnetite are rarely found.	
34	TR2-109	Cobanga-on Dep.	Magnetite Ore (do)	Magnetite ≧ hematite ≧ limonite are component ore minerals. Hematite occurs in magnetite in the form of dot or needle, and also in silicate mineral as idiomorphic blade-like crystal (< 0.1 mm in length). Many fractures are formed by shearing.	massive ore
35	TR2-130a	Banus R.	Chromite Ore (Ultramafic C.)	The section consists mainly of xenomorphic chromite crystals (0.05 ~ 1.0 mm in size) with a cataclastic texture. A few coarse idiomorphic chromites have been rotated and crushed at crystal rim by shearing. Many shear fractures are developed and have broken crystals into aggregate of many fragments (< 0.12 mm in size). Very fine grains of pyrite and magnetite (< 0.02 mm in size) are rarely included.	see photograph massive ore
36	TR2-130b	do	Chromite Ore (do)	Chromite crystals (0.1 ~ 2.0 mm in size) are rounded and idiomorphic, and rich in fractures or cracks (0.01 ~ 0.05 mm in width) with a cataclastic texture. Aggregates of fine grained fragmental chromite (< 0.05 mm in size) are arranged parallel to the foliation of host rock.	spotted ore
37	TR2-152	Dulangan R.	Pyrite-Chalcopyrite Ore (Halcon M.)	Irregular shaped pyrite (0.02 ~ 0.4 mm in size) ≧ chalcopyrite (0.02 ~ 0.25 mm in size) grains are arranged almost parallel to the foliation of host rock. Many open spaces rimmed by pyrite suggest the mineralization after brecciation.	float
38	TR2-157	do	Pyrite-Quartz (do)	Pyrite ≧ sphalerite, chalcopyrite are in quartz separatedly. Smaller grains of pyrite (< 0.1 mm in size) are idiomorphic while larger ones (0.1 ~ 0.5 mm in size) are xenomorphic. A few grains of sphalerite (< 0.1 mm in size) and chalcopyrite (0.03 mm) are visible.	float

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No.	Sample No.	Location	Name of Ore and Formation	Microscopic Observation	Remarks
39	YR2-037a	Manini	Chromite Ore (Ultramafic C.)	The ore consists of xenomorphic chromite crystals with a weakly sheared texture. Many fractures or cracks (<0.1 mm in width) are developed and have broken chromite crystals into fine grained aggregate.	massive ore
40	YR2-037b	do	Chromite Ore (do)	Almost same as YR2-37b, but parallel fractures are more developed.	massive ore