

Sample No.	Sector	Rock name	Microscopic observation
6Y046R	Mongolwe	Nepheline syenite	<p>nepheline syenite medium-grained texture main constituents: orthoclase (dusty), microperthite, biotite, nepheline, cancrinite minor constituents: aegirine, plagioclase, sphene, magnetite, apatite secondary minerals: carbonate</p>
6Y047R	Mongolwe	Nepheline syenite	<p>nepheline syenite medium-grained texture main constituents: orthoclase, microperthite, aegirine, nepheline, cancrinite, sodalite, pectolite minor constituents: plagioclase, biotite, sphene, magnetite, apatite, carbonate</p>
6Y061R	Kangankunde	Carbonatite	<p>carbonatite mosaic texture main constituents: carbonate (calcite, dolomite) accessory mineral: apatite secondary mineral: epidote, opaque mineral</p>
6Y062R	Kangankunde	Carbonatite	<p>carbonatite mosaic texture main constituents: carbonate (calcite, dolomite) minor constituents: quartz, plagioclase secondary minerals: opaque mineral</p>

Sample No.	Sector	Rock name	Microscopic observation
6Y063R	Kangankunde	Carbonatite	<p>carbonatite porphyritic texture main constituents: carbonate (calcite, dolomite), K-feldspar minor constituents: quartz, plagioclase accessory mineral: zircon secondary minerals: opaque mineral, epidote</p>
6Y064R	Kangankunde	Carbonatite	<p>carbonatite mosaic texture main constituents: carbonate (calcite, dolomite) minor constituents: quartz, K-feldspar secondary minerals: opaque mineral</p>
6Y071R	Kapiri	Hornblende diorite Carbonatized tuff	<p>hornblende diorite medium-grained, granular texture main constituents: hornblende, plagioclase, orthoclase minor constituents: biotite, sphene, apatite secondary minerals: carbonate, limonite, hematite</p> <p>strongly carbonatized tuff crystals: plagioclase (altered to albite + calcite) hornblende (altered to calcite + albite + opaque) aegirine (altered to calcite + opaque) hematite</p> <p>matrix: carbonate, sericite, biotite, albite, limonite</p>

Sample No.	Sector	Rock name	Microscopic observation
6Y072R	Kpiri	Carbonatized tuff	<p>strongly carbonatized tuff crystals: plagioclase (altered to albite + calcite) augite-aegirine (altered to calcite) biotite, apatite, zircon matrix: carbonate, limonite, albite</p>
6Y073R	Nsala	Lamprophyre	<p>vogesite ? intersertal texture main constituents: anorthoclase, plagioclase, augite-aegirine minor constituents: nepheline accessory minerals: cancrinite, magnetite, zeolite, sphene, apatite secondary minerals: carbonate, pectolite, limonite</p>
6Y074R	Nsala	Lamprophyre	<p>camptonite ? porphyritic, intersertal texture phenocrysts: augite-aegirine, olivine, plagioclase ? (altered to calcite + albite ?) Clinopyroxene shows notable zonal structure at marginal part and partial alteration to carbonate. Olivine has thick mantle of opaque + carbonate + plagioclase groundmass: K-feldspar (sanidine?) biotite, augite-aegirine, cancrinite, magnetite, sphene, apatite secondary minerals: calcite, carbonate, opaque, albite?</p>

Appendix 6 Microphotographs (Thin Section)

[Abbreviations]

Aeg	- - - -	aegirine
An	- - - -	anorthoclase
Ap	- - - -	apatite
Arf	- - - -	arfvedsonite
Bi	- - - -	biotite
Cal	- - - -	calcite
Carb	- - - -	carbonate minerals
Chl	- - - -	chlorite
Cn	- - - -	cancrinite
Cpx	- - - -	clinopyroxene
Ep	- - - -	epidote
Gar	- - - -	garnet
Hb	- - - -	hornblende
Kf	- - - -	alkali feldspar
Lim	- - - -	limonite
Ms	- - - -	muscovite
Nef	- - - -	nepheline
Opq	- - - -	opaque minerals
Opx	- - - -	orthopyroxene
Pl	- - - -	plagioclase
Pyl	- - - -	pyrochlore
Qz	- - - -	quartz
Sd	- - - -	sanidine
Sph	- - - -	sphene
Zeo	- - - -	zeolite



0 0.5mm

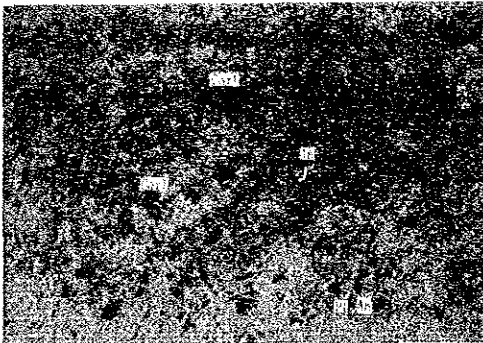
Sample No : 6H001R
Rock Name : Monzonite
Sector : Nkalonje
Texture : Medium grained

(Plain polarized light)



0 0.5mm

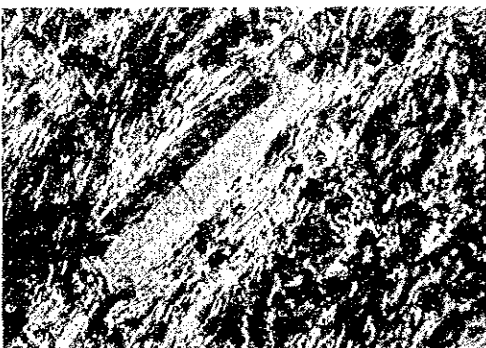
(Crossed polarized light)



0 0.5mm

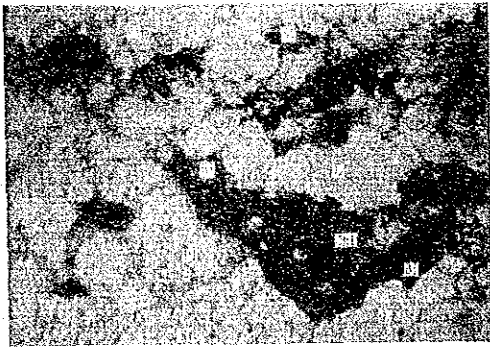
Sample No : 6H003R
Rock Name : Trachyte
Sector : Salambidwa
Texture : Trachytic

(Plain polarized light)



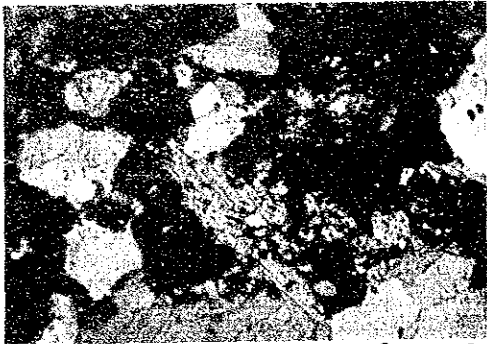
0 0.5mm

(Crossed polarized light)

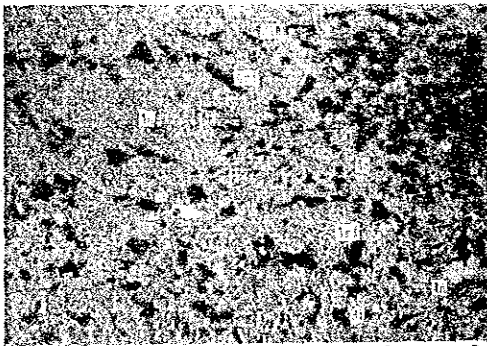


Sample No : 6H006R
Rock Name : Granulite
Sector : Chipalanje
Texture : Granular

(Plain polarized light)

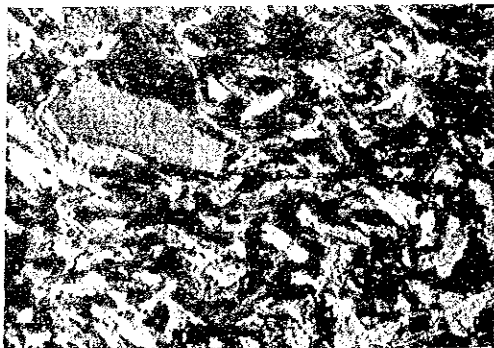


(Crossed polarized light)

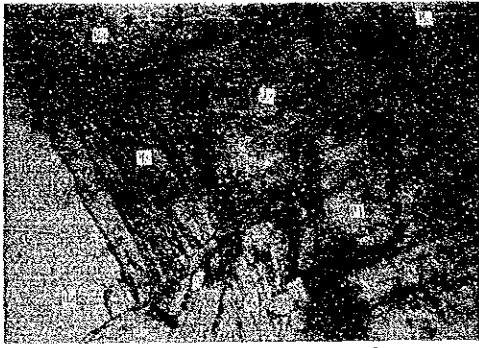


Sample No : 6H014R
Rock Name : Trachyte
Sector : Mongolwe
Texture : Trachytic

(Plain polarized light)



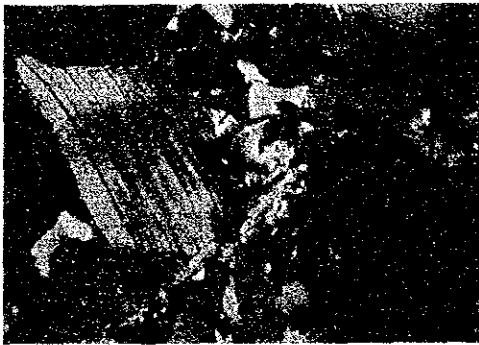
(Crossed polarized light)



0 0.5mm

Sample No : 6H015R
Rock Name : Granulite
Sector : Chaumbwi
Texture : Granular

(Plain polarized light)



0 0.5mm

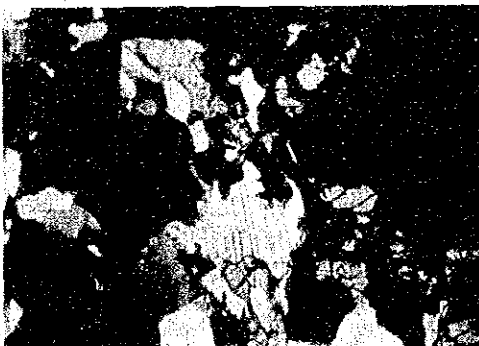
(Crossed polarized light)



0 0.5mm

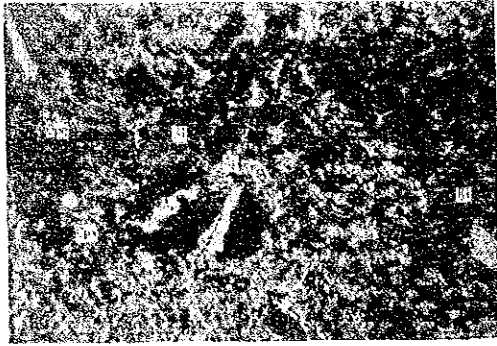
Sample No : 6H016R
Rock Name : Granulite
Sector : Chaumbwi
Texture : Granular

(Plain polarized light)



0 0.5mm

(Crossed polarized light)



0 0.5mm

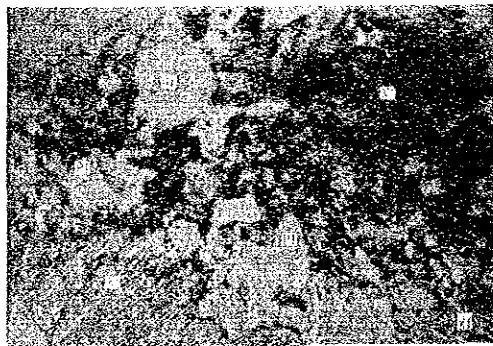
Sample No : 6H017R
Rock Name : Lamprophyre
Sector : Achirundu
Texture : Porphyritic

(Plain polarized light)



0 0.5mm

(Crossed polarized light)



0 0.5mm

Sample No : 6H023R
Rock Name : Quartz Syenite
Sector : Chiloli
Texture : Mosaic

(Plain polarized light)



0 0.5mm

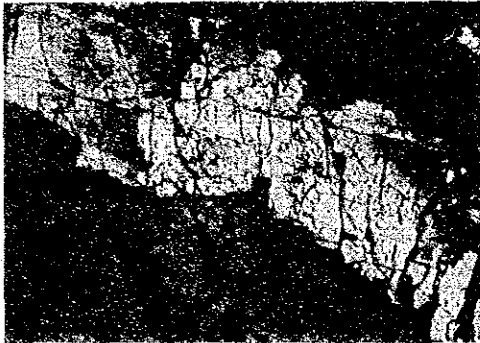
(Crossed polarized light)



0 0.5mm

Sample No : 6H024R
Rock Name : Clinopyroxenite
Sector : Chiloli
Texture : Coarse-grained

(Plain polarized light)



0 0.5mm

(Crossed polarized light)



0 0.5mm

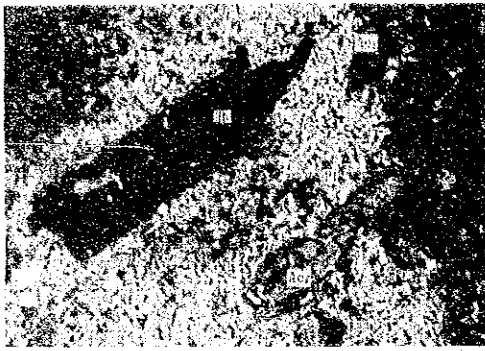
Sample No : 6H027R
Rock Name : Lamprophyre
Sector : Kawanula
Texture : Porphyritic

(Plain polarized light)



0 0.5mm

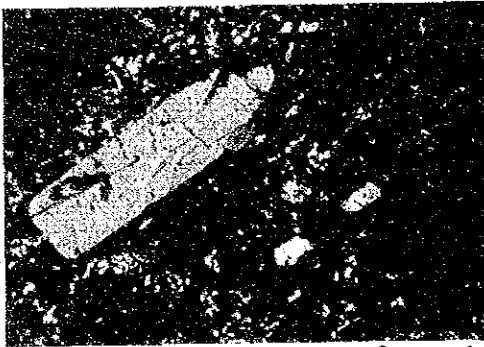
(Crossed polarized light)



0 0.5mm

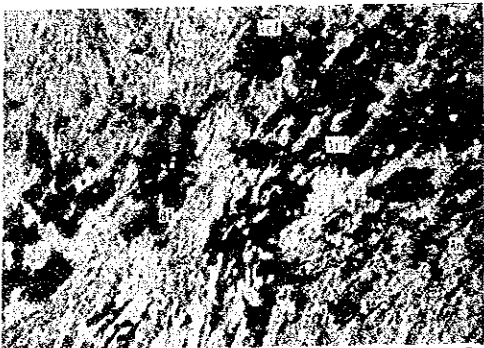
Sample No : 6H030R
Rock Name : Trachyte
Sector : Liperembe
Texture : Porphyritic

(Plain polarized light)



0 0.5mm

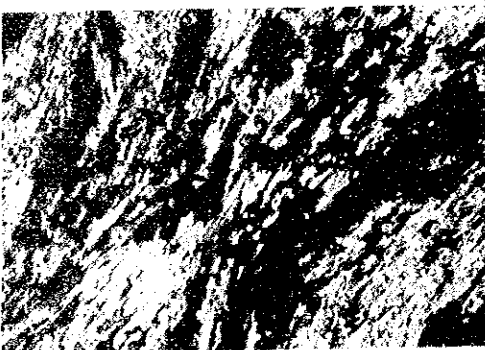
(Crossed polarized light)



0 0.5mm

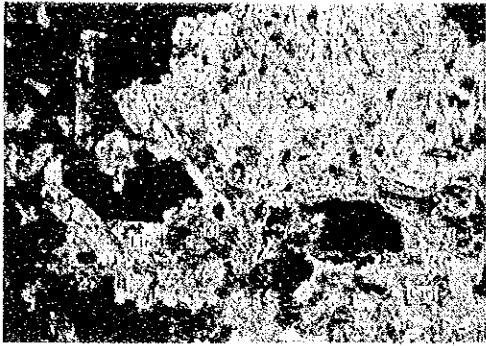
Sample No : 6H031R
Rock Name : Phonolite
Sector : Nsengwa
Texture : Trachytic

(Plain polarized light)



0 0.5mm

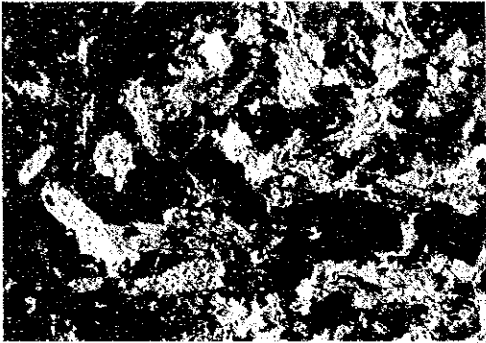
(Crossed polarized light)



0 0.5mm

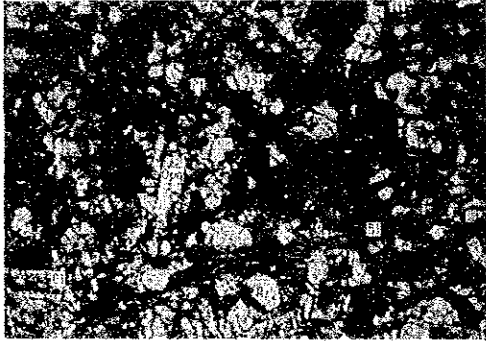
Sample No : 6M001R
Rock Name : Syenite aplite
Sector : Tundulu
Texture : Fine-grained granular

(Plain polarized light)



0 0.5mm

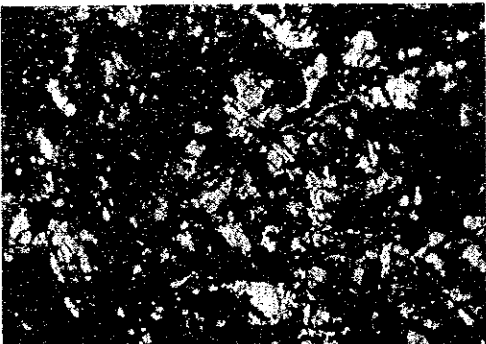
(Crossed polarized light)



0 0.5mm

Sample No : 6M002R
Rock Name : Trachyte
Sector : Tundulu
Texture : Inter granular

(Plain polarized light)



0 0.5mm

(Crossed polarized light)



Sample No : 6M003R
Rock Name : Nepheline
Sector : Tundulu
Texture : Granular

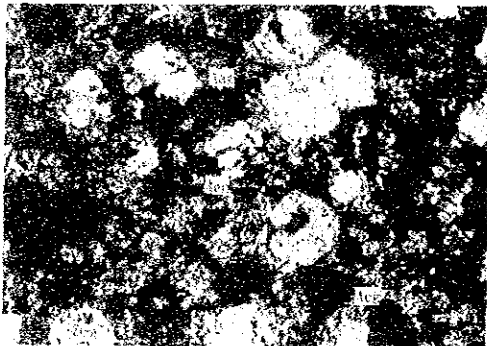
(Plain polarized light)

0 0.5mm



(Crossed polarized light)

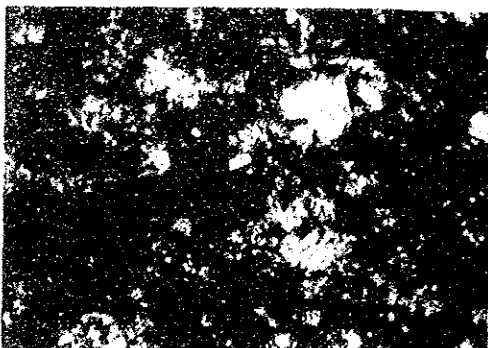
0 0.5mm



Sample No : 6M008R
Rock Name : Phonolite
Sector : Matoponi
Texture : Spherulitic

(Plain polarized light)

0 0.5mm



(Crossed polarized light)

0 0.5mm

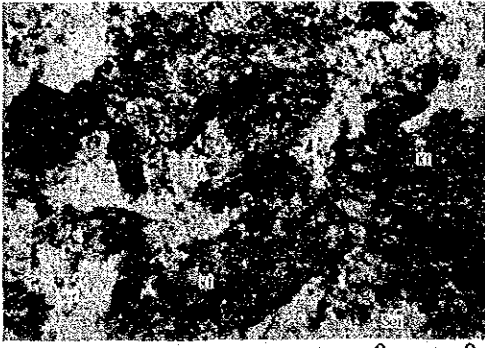


Sample No : 6M010R
Rock Name : Granulite
Sector : Matoponi
Texture : Granular

(Plain polarized light)

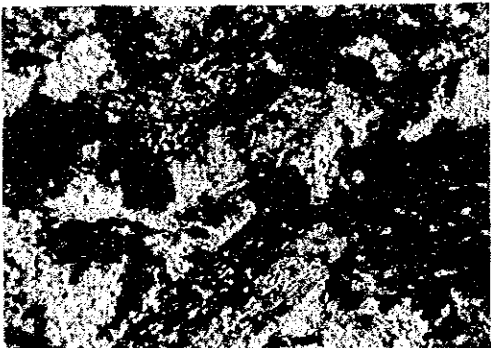


(Crossed polarized light)



Sample No : 6M012R
Rock Name : Syenite porphyry
Sector : Namangale
Texture : Trachytic

(Plain polarized light)



(Crossed polarized light)



0 0.5mm

Sample No : 6M018R
Rock Name : Monzonite
Sector : Tundulu
Texture : Fine-grained

(Plain polarized light)



0 0.5mm

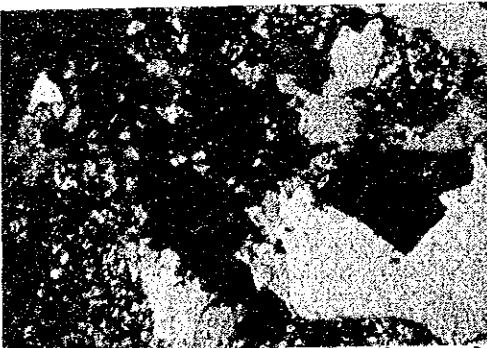
(Crossed polarized light)



0 0.5mm

Sample No : 6M030R
Rock Name : Carbonatite
Sector : Chilwa Island
Texture : Porphyritic

(Plain polarized light)



0 0.5mm

(Crossed polarized light)

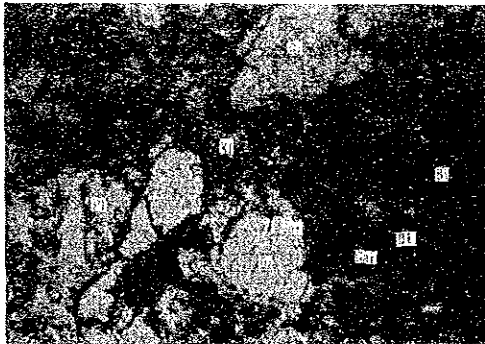


Sample No : 6M033R
Rock Name : Monzonite
Sector : Chilwa Island
Texture : Fine-grained

(Plain polarized light)



(Crossed polarized light)

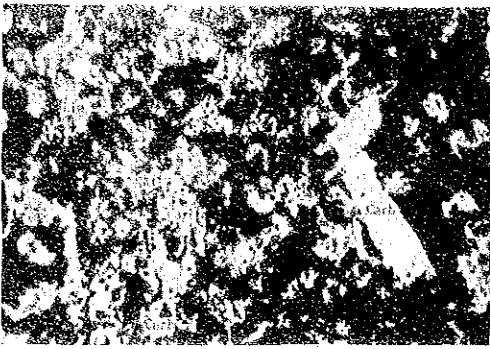


Sample No : 6M041R
Rock Name : Granulite
Sector : Chikala
Texture : Granular

(Plain polarized light)



(Crossed polarized light)



Sample No : 6M055R
Rock Name : Carbonatite
Sector : Kapiri
Texture : Intersertal

(Plain polarized light)



(Crossed polarized light)

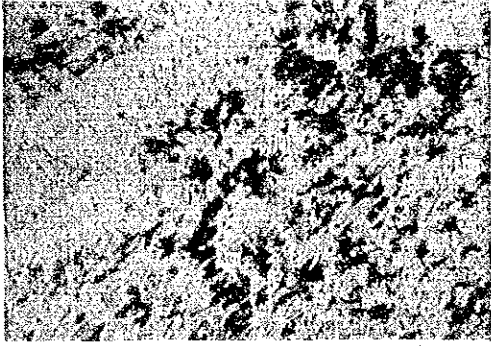


Sample No : 6M062R
Rock Name : Lamprophyre
Sector : Nsala
Texture : Holocrystalline

(Plain polarized light)



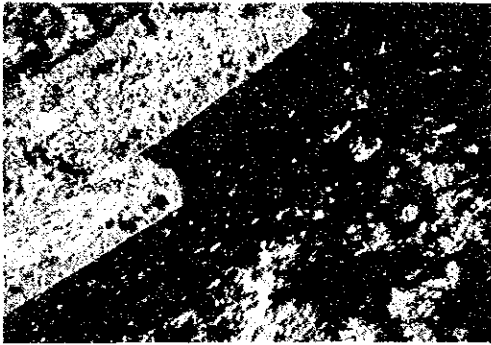
(Crossed polarized light)



0 0.5mm

Sample No : 6M064R
Rock Name : Trachyte
Sector : Aligomba
Texture : Trachytic

(Plain polarized light)



0 0.5mm

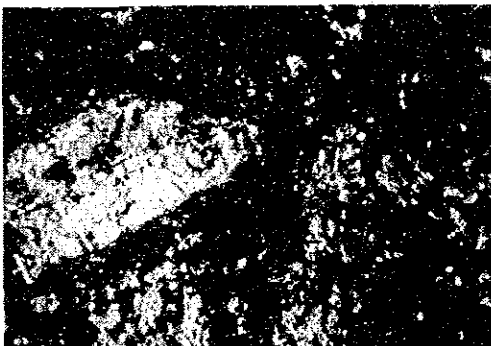
(Crossed polarized light)



0 0.5mm

Sample No : 6M065R
Rock Name : Lamprophyre
Sector : Aligomba
Texture : Porphyritic

(Plain polarized light)



0 0.5mm

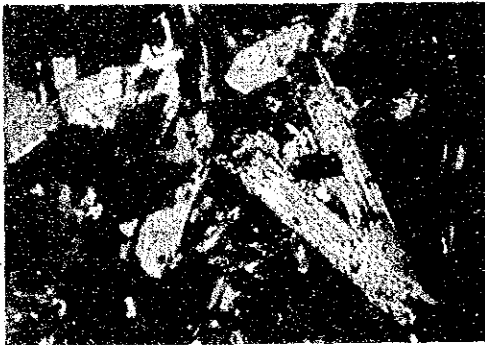
(Crossed polarized light)



0 0.5mm

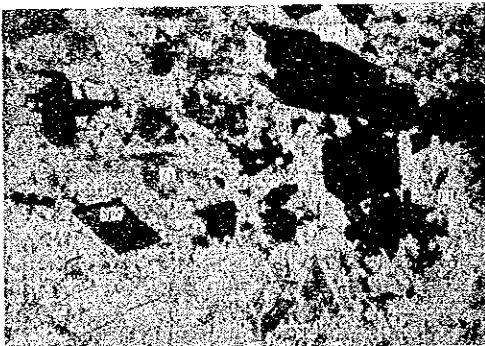
Sample No : 6M071R
Rock Name : Ne-monzonite
Sector : Kadongosi
Texture : Medium-grained

(Plain polarized light)



0 0.5mm

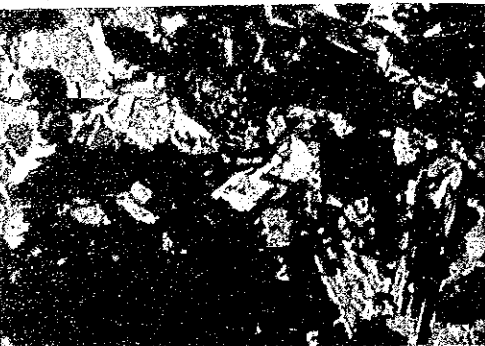
(Crossed polarized light)



0 0.5mm

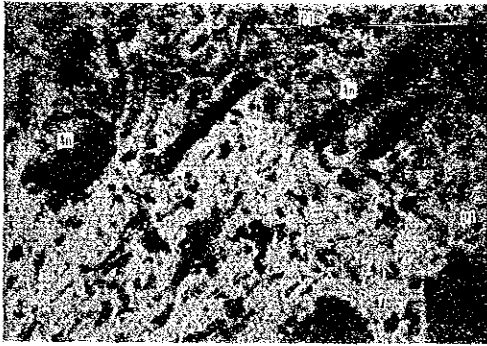
Sample No : 6M072R
Rock Name : Monzonite
Sector : Kadongosi
Texture : Medium-grained

(Plain polarized light)



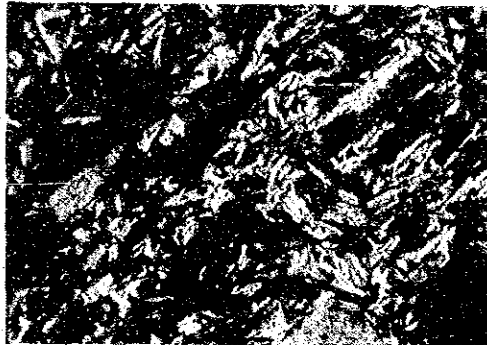
0 0.5mm

(Crossed polarized light)

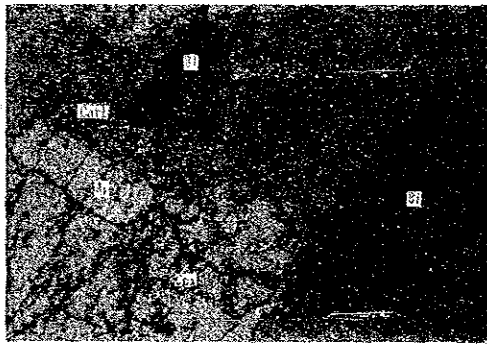


Sample No : 6M073R
Rock Name : Trachyte
Sector : Mlindi
Texture : Trachytic

(Plain polarized light)

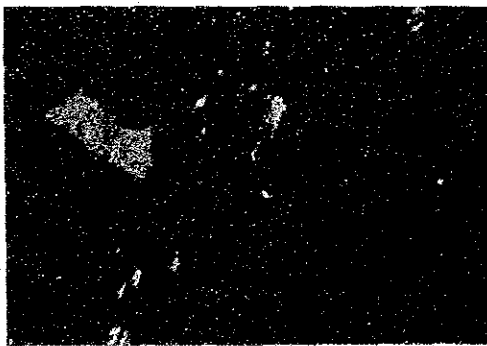


(Crossed polarized light)

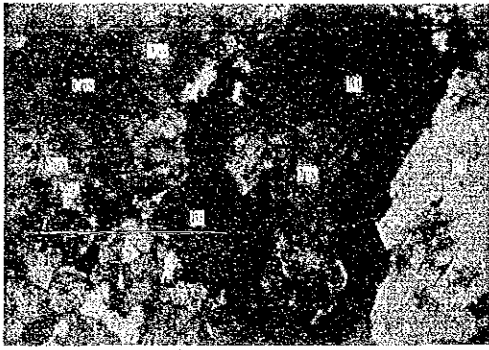


Sample No : 6M078R
Rock Name : Phlogopite-clinopyroxenite
Sector : Mlindi
Texture : Coarse-grained

(Plain polarized light)

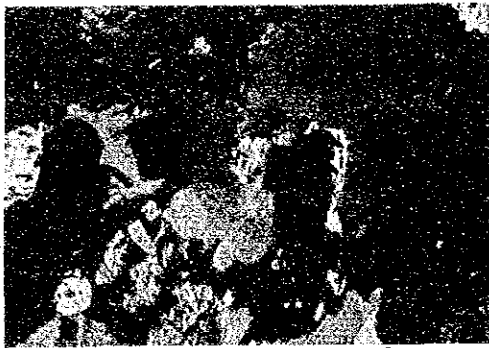


(Crossed polarized light)

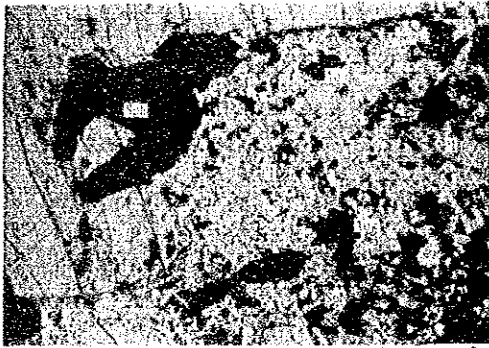


Sample No : 6M079R
Rock Name : Gabbro
Sector : Mlindi
Texture : Granular

(Plain polarized light)

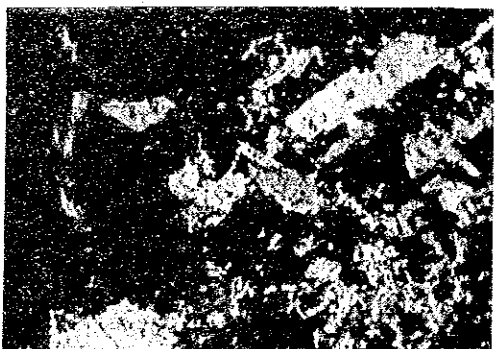


(Crossed polarized light)



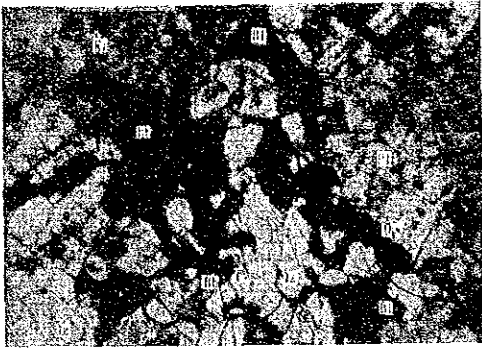
Sample No : 6Y006R
Rock Name : Phonolite
Sector : Tundulu
Texture : Porphyritic

(Plain polarized light)

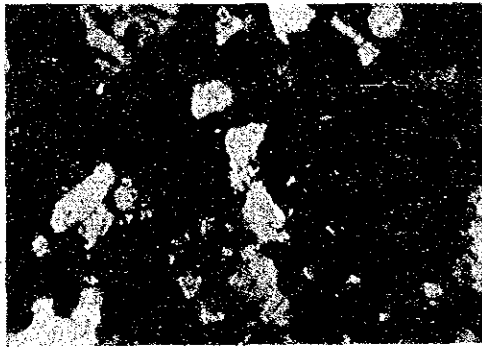


(Crossed polarized light)

Sample No : 6Y010R
Rock Name : Granulite
Sector : Tundulu
Texture : Granular

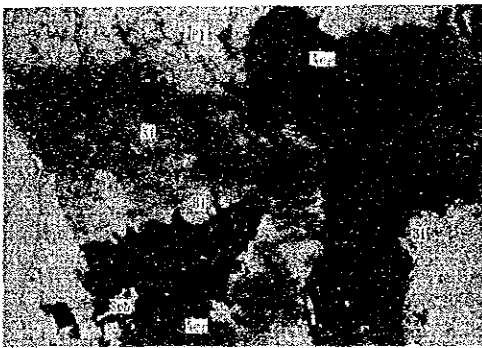


(Plain polarized light)

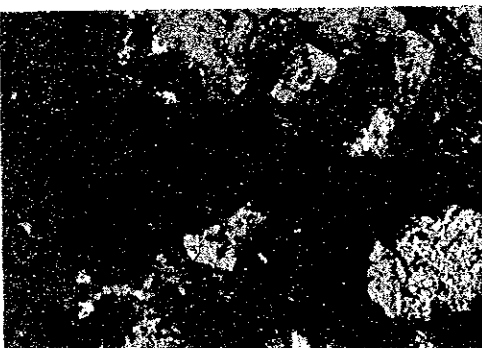


(Crossed polarized light)

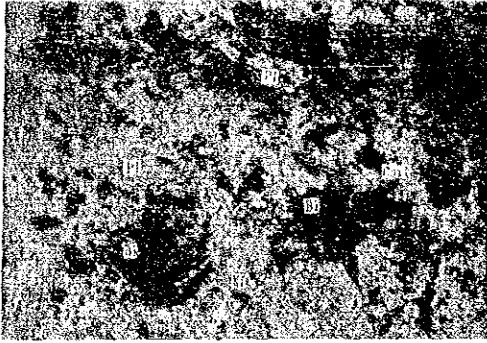
Sample No : 6Y019R
Rock Name : Nepheline Syenite
Sector : Songwe
Texture : Medium-grained



(Plain polarized light)



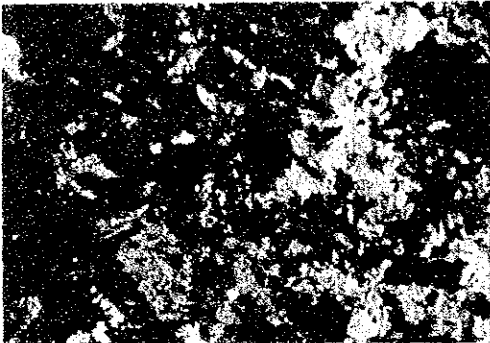
(Crossed polarized light)



Sample No : 6Y023R
Rock Name : Trachyte
Sector : Namangale
Texture : Porphyritic

(Plain polarized light)

0 0.5mm



(Crossed polarized light)

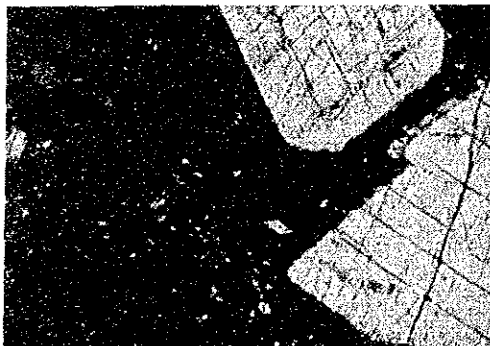
0 0.5mm



Sample No : 6Y026R
Rock Name : Phonolite
Sector : Namangale
Texture : Porphyritic

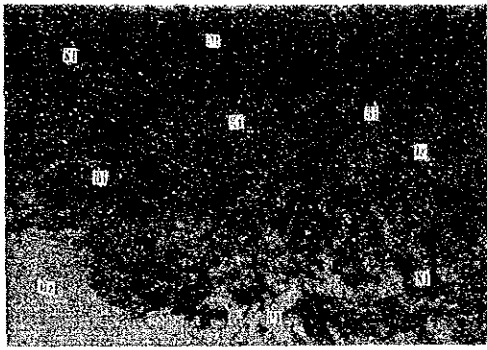
(Plain polarized light)

0 0.5mm



(Crossed polarized light)

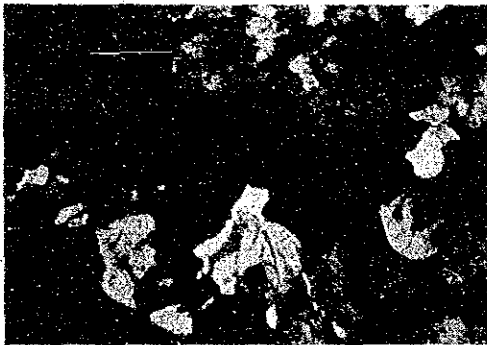
0 0.5mm



0 0.5mm

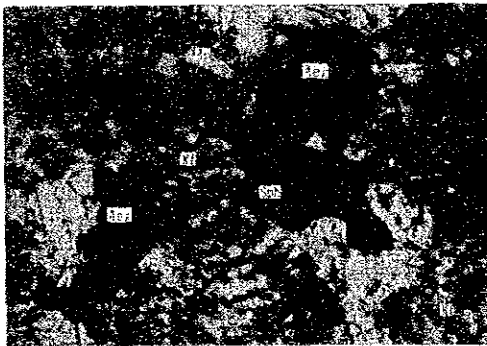
Sample No : 6Y031R
Rock Name : Quartz Syenite
Sector : Naminga
Texture : Mosaic

(Plain polarized light)



0 0.5mm

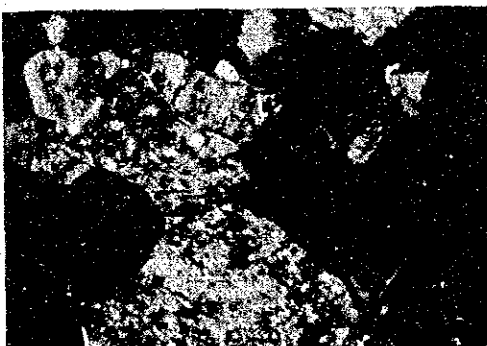
(Crossed polarized light)



0 0.5mm

Sample No : 6Y042R
Rock Name : Nepheline Syenite
Sector : Chikala
Texture : Medium-grained

(Plain polarized light)



0 0.5mm

(Crossed polarized light)

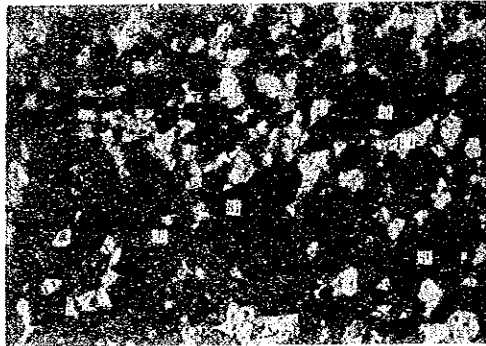


Sample No : 6Y044R
Rock Name : Nepheline Syenite
Sector : Chikala
Texture : Medium-grained

(Plain polarized light)

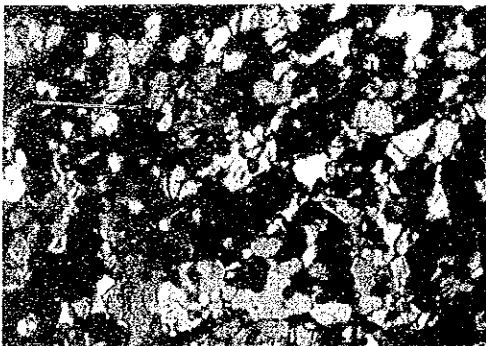


(Crossed polarized light)



Sample No : 6Y045R
Rock Name : Amphibolite
Sector : Chikala
Texture : Granular

(Plain polarized light)



(Crossed polarized light)

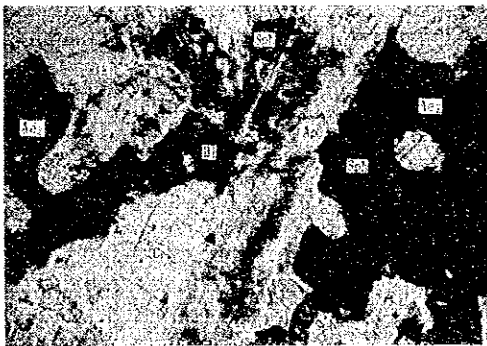


Sample No : 6Y046R
Rock Name : Nepheline Syenite
Sector : Mongolwe
Texture : Medium-grained

(Plain polarized light)

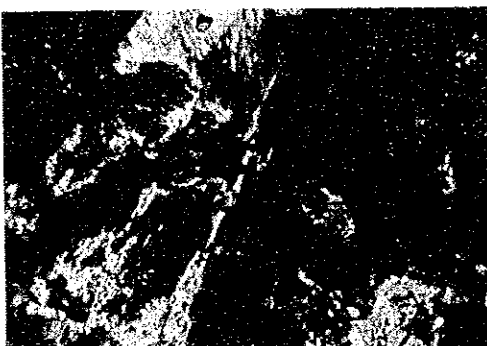


(Crossed polarized light)

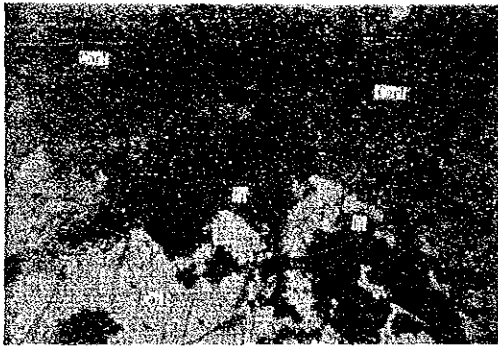


Sample No : 6Y047R
Rock Name : Nepheline Syenite
Sector : Mongolwe
Texture : Medium-grained

(Plain polarized light)



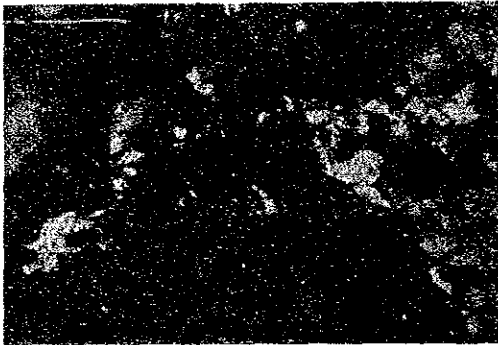
(Crossed polarized light)



0 0.5mm

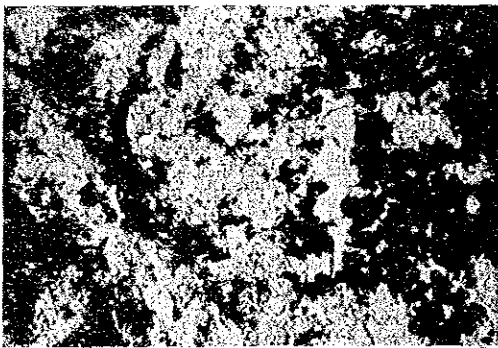
Sample No : 6Y061R
Rock Name : Carbonatite
Sector : Kangankunde
Texture : Mosaic

(Plain polarized light)



0 0.5mm

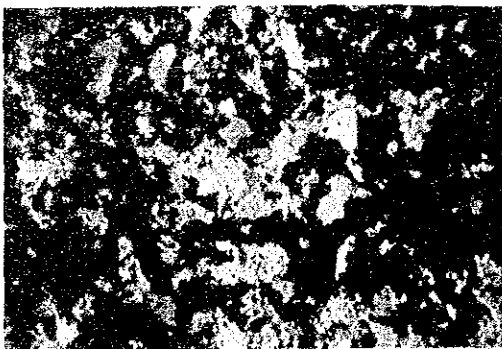
(Crossed polarized light)



0 0.5mm

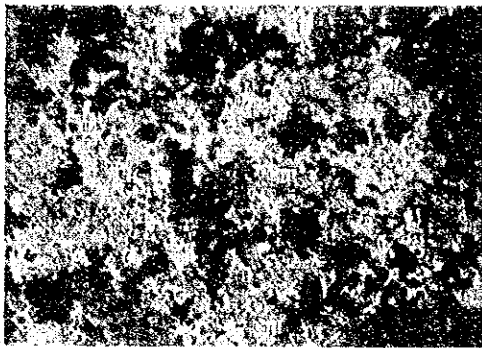
Sample No : 6Y062R
Rock Name : Carbonatite
Sector : Kangankunde
Texture : Mosaic

(Plain polarized light)



0 0.5mm

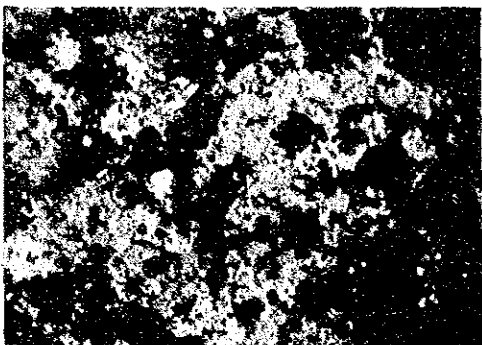
(Crossed polarized light)



0 0.5mm

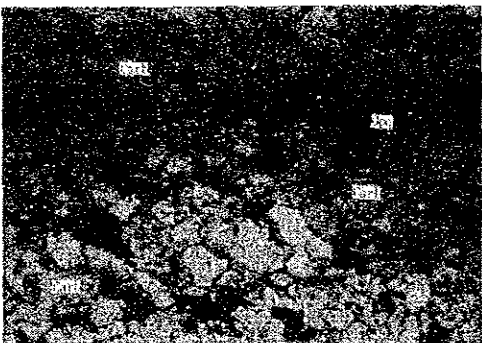
Sample No : 6Y063R
Rock Name : Carbonatite
Sector : Kangankunde
Texture : Porphyritic

(Plain polarized light)



0 0.5mm

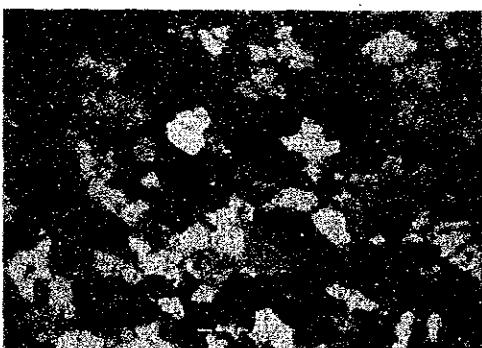
(Crossed polarized light)



0 0.5mm

Sample No : 6Y064R
Rock Name : Carbonatite
Sector : Kangankunde
Texture : Mosaic

(Plain polarized light)



0 0.5mm

(Crossed polarized light)



0 0.5mm

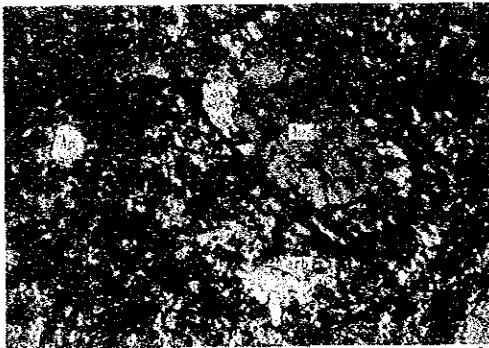
Sample No : 6Y071R
Rock Name : Hornblende diorite
Sector : Kapiri
Texture : Granular

(Plain polarized light)



0 0.5mm

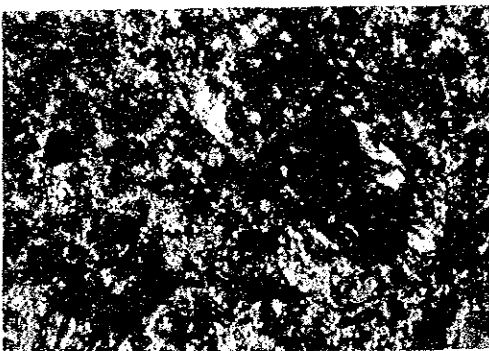
(Crossed polarized light)



0 0.5mm

Sample No : 6Y072R
Rock Name : Carbonatized tuff
Sector : Kapiri
Texture :

(Plain polarized light)



0 0.5mm

(Crossed polarized light)



0 0.5mm

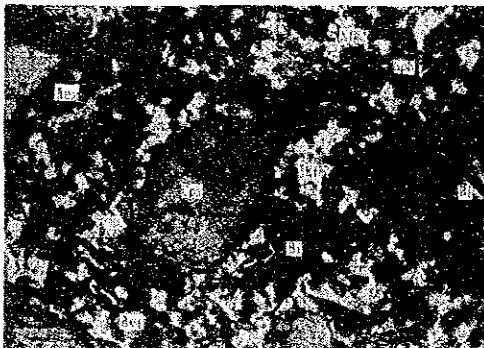
Sample No : 6Y073R
Rock Name : Lamprophyre
Sector : Nsala
Texture : Intersertal

(Plain polarized light)



0 0.5mm

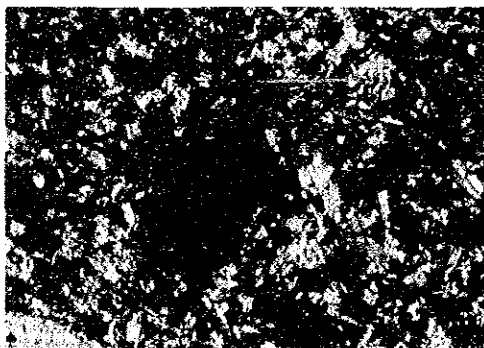
(Crossed polarized light)



0 0.5mm

Sample No : 6Y074R
Rock Name : Lamprophyre
Sector : Nsala
Texture : Porphyritic

(Plain polarized light)



0 0.5mm

(Crossed polarized light)

Sample No.	Rock name	Sector	Microscopic observation
6M053R	quartz druse rock	Kangankunde	It is composed mainly of quartz and Fe-oxide mineral, with subordinate amounts of epidote, monazite and rutile. Monazite shows tabular crystals, up to 0.1mm in size and forms partly an aggregate.
6Y003R	feldspathic rock	Tundulu	It is composed mainly of alkali-feldspar, with subordinate amounts of magnetite, limonite, zeolite (?) and plagioclase. Magnetite grains, up to 0.5mm in size, show the exsolution texture with hematite. Limonite shows in anhedral crystal around the magnetite grain.
6Y005R	ankeritic- carbonatite	Tundula	It shows granular texture and is mainly composed of carbonate mineral, apatite and biotite, with accessory magnetite, ilmenite and Fe-oxide mineral. Magnetite in idiomorphic crystals are up to 0.8mm in diameter, closely associated with idiomorphic to by p-idiomorphic ilmenite. Fe-oxide mineral partly replace magnetite crystals.
6Y007R	magnetite ore	Tundulu	Main constituent is magnetite, next in abundance is hematite and pyrite, then ilmenite. Magnetite is large crystal with whisker-like exsolution lamellae of ilmenite, partly hematitized along cracks and cleavages. Pyrite shows idiomorphic crystal up to 0.1mm in size, scattered in magnetite.

Sample No.	Rock name	Sector	Microscopic observation
6M010R	sövite	Chilwa Island	<p>Main constituent is carbonate mineral, next in abundance is Fe-oxide mineral.</p> <p>A small amount of sphalerite and brucite (?) are recognized as accessories.</p> <p>Sphalerite shows yellowish brown color in transmitted light, up to 0.7mm in size.</p> <p>A very little of brucite shown with high-birefringence, is embedded in a matrix of carbonate mineral with Fe-oxide mineral.</p>
6M004R	apatite feldspathic rock	Tundulu	<p>It is composed essentially of quartz and apatite, with subordinate amounts of alkali feldspar and limonite.</p> <p>A little of zircon and rutile are shown as accessory.</p> <p>Rutile showing skeleton forms coexists with apatite and alkali feldspar.</p>
6M044R	monazite bearing carbonatite	Kangankunde	<p>It is composed mainly strontianite and quartz with subordinate amounts of Fe-oxide mineral and monazite.</p> <p>Monazite shows fine-grained, prismatic crystals up to 0.2mm in size, and forms a small aggregate in large crystals of strontianite and quartz.</p>
6M045R	carbonatized feldspathic rock	Kangankunde	<p>The constituents are carbonate mineral, alkali feldspar and Fe-oxide mineral, as accessories quartz, zircon and rutile.</p> <p>Zircon in idiomorphic crystal, develops characteristically pyramid faces, up to 0.2mm in size.</p> <p>Rutile forms sometimes crystal clots and coexists with Fe-oxide mineral.</p>

Sample No.	Rock name	Sector	Microscopic observation
6Y0034R	sövite	Tundulu	<p>It shows granular texture and is mainly composed of carbonate mineral, with subordinate amounts of biotite, apatite and aegirine.</p> <p>As accessory minerals, pyrite and magnetite are shown in anhedral crystals of carbonate mineral.</p> <p>Pyrite shows idiomorphic crystal, but is replaced by Fe-oxide mineral in the interior.</p>
6Y037R	ankeritic-carbonatite	Chilwa Island	<p>The constituent is dusty alkali feldspar up to 1.7mm in long, showing a typical carlsbad twinning.</p> <p>A small amount of carbonate mineral and quartz occupy irregular interspaces of alkali feldspar.</p> <p>Rutile in idiomorphic crystals are scattered in large crystals of alkali feldspar as accessory.</p>



Appendix 8 Microphotographs

(Polished Thin Section and Polished Section)

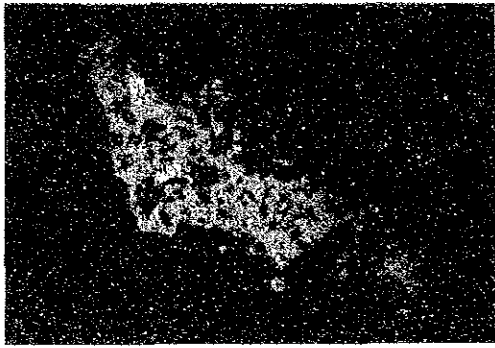
[Abbreviations]

Aeg	- - - -	aegirine
Ap	- - - -	apatite
Bi	- - - -	biotite
Br	- - - -	brucite
Cal	- - - -	calcite
Carb	- - - -	carbonate mineral
Fe	- - - -	Fe-oxide(hydro-oxide)
Goe	- - - -	goethite
Hem	- - - -	hematite
Il	- - - -	ilmenite
Kf	- - - -	alkali feldspar
Mag	- - - -	magnetite
Mz	- - - -	monazite
Opq	- - - -	opaque minerals
Py	- - - -	pyrite
Qz	- - - -	quartz
Rt	- - - -	rutile
Sp	- - - -	sphalerite
St	- - - -	strontianite
Zr	- - - -	zircon

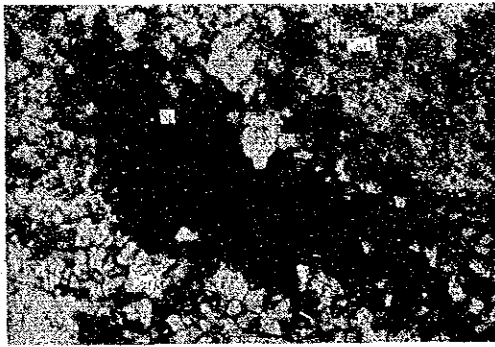
[Legend]

	- - - -	area of characteristic X-ray images by EPMA
	- - - -	point of qualitative and quantitative analysis by EPMA

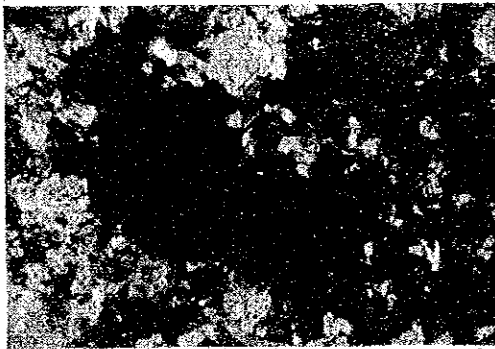
Sample No : 6H010R
Rock Name : Sövite
Sector : Chilwa Island



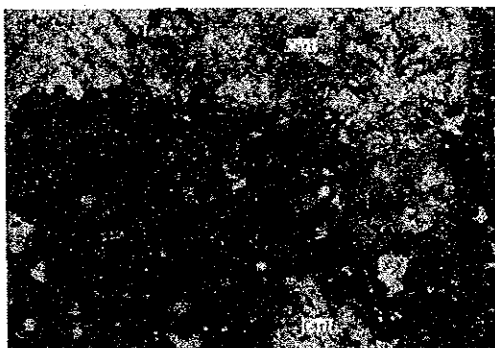
(reflected light)



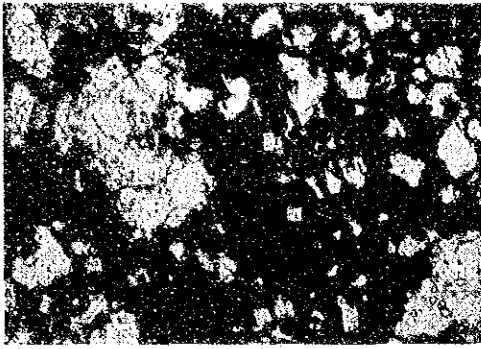
(transmitted light, open nicol)



(transmitted light, crossed nicols)



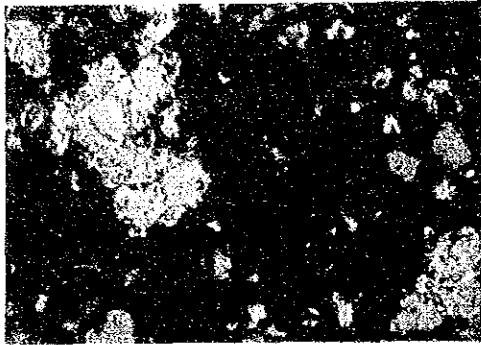
(transmitted light, open nicol)



0 0.2mm

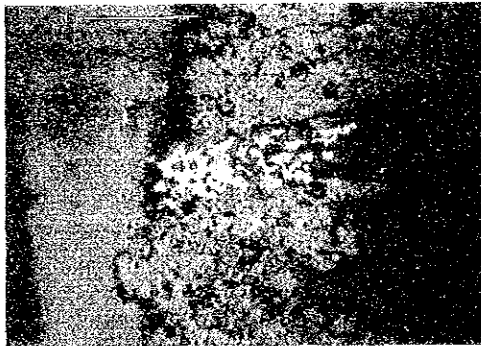
Sample No : 6H010R
Rock Name : Sövite
Sector : Chilwa Island

(transmitted light, open nicol)



0 0.2mm

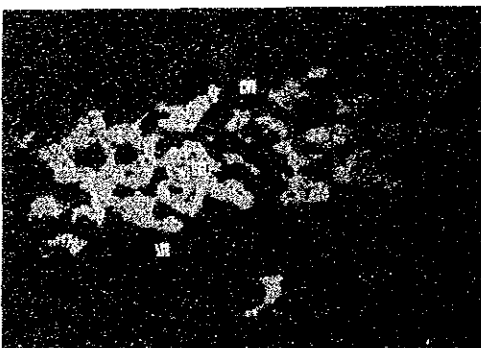
(transmitted light, crossed nicols)



0 0.2mm

Sample No : 6M004R
Rock Name : Apatite feldspathic rock
Sector : Tundulu

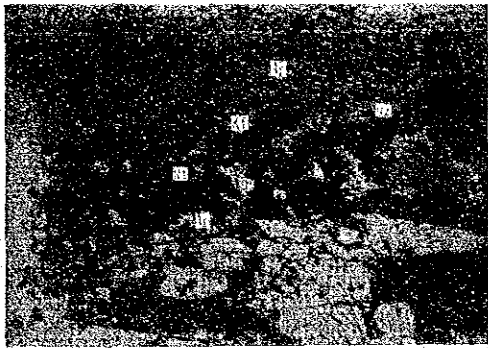
(reflected light)



0 0.2mm

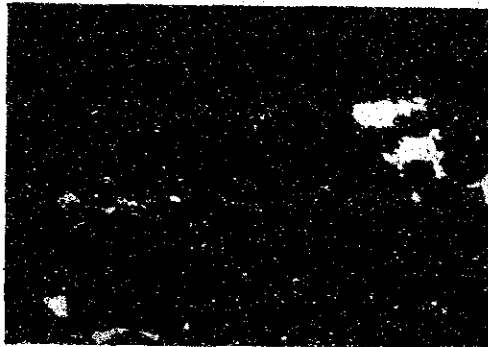
(reflected light)

Sample No : 6M004R
Rock Name : Apatite feldspathic rock
Sector : Tundulu



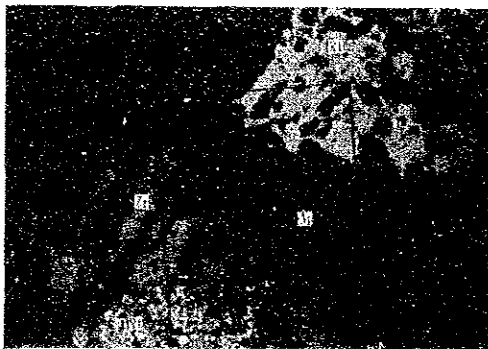
0 0.4mm

(transmitted light,
plain polarized light)



0 0.15mm

(transmitted light,
crossed polarized light)



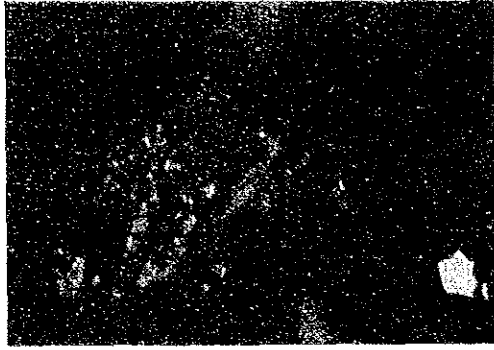
0 0.5mm

(reflected light)



0 0.5mm

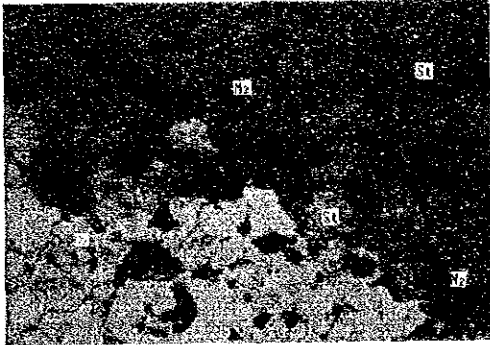
(transmitted light open nicol)



0 0.2mm

Sample No : 6M004R
Rock Name : Apatite feldspathic rock
Sector : Tundulu

(transmitted light, crossed nicols)



0 0.2mm

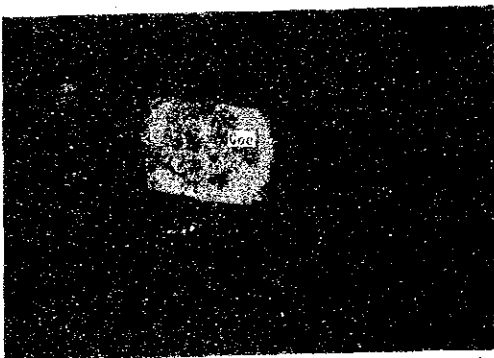
Sample No : 6M044R
Rock Name : Monzonite bearing Carbonatite
Sector : Kangankunde

(transmitted light,
plain polarized light)



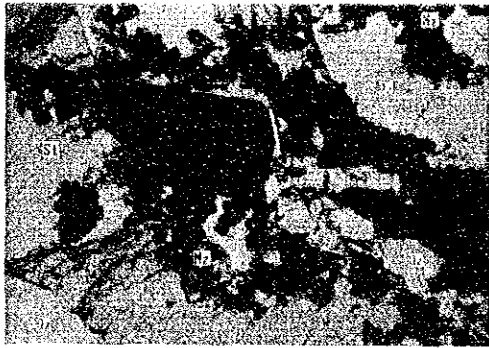
0 0.2mm

(transmitted light,
crossed polarized light)



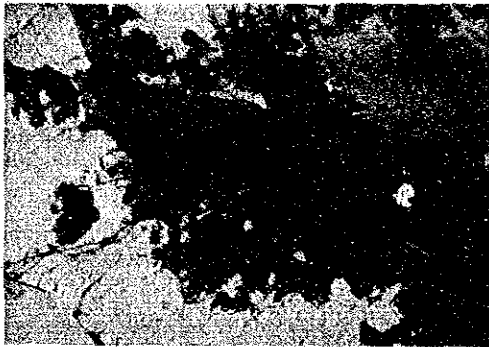
0 0.5mm

(reflected light)

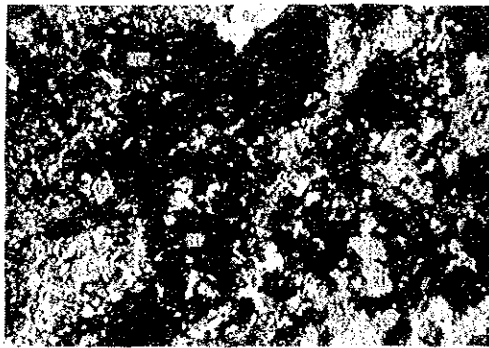


Sample No : 6M044R
Rock Name : Monzonite bearing Carbonatite
Sector : Tundulu

(transmitted light, open nicol)

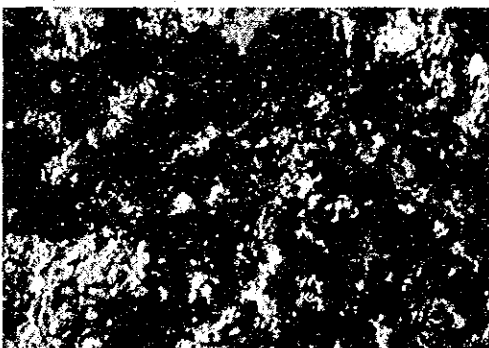


(transmitted light, crossed nicols)



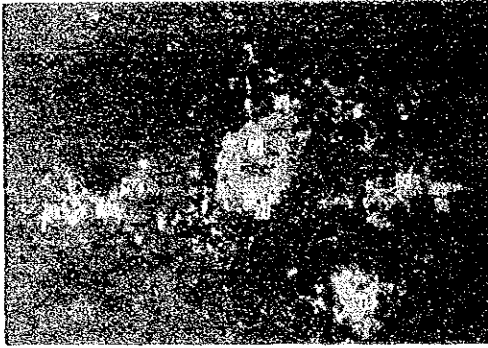
Sample No : 6M045R
Rock Name : Carbonatized feldspathic rock
Sector : Kangankunde

(transmitted light,
plain polarized light)



(transmitted light,
crossed polarized light)

Sample No : 6M045R
Rock Name : Carbonitized feldspathic rock
Sector : Kangankunde



0 0.2mm

(reflected light)



0 0.2mm

(transmitted light, open nicol)



0 0.2mm

(transmitted light, crossed nicols)



0 0.2mm

(reflected light)