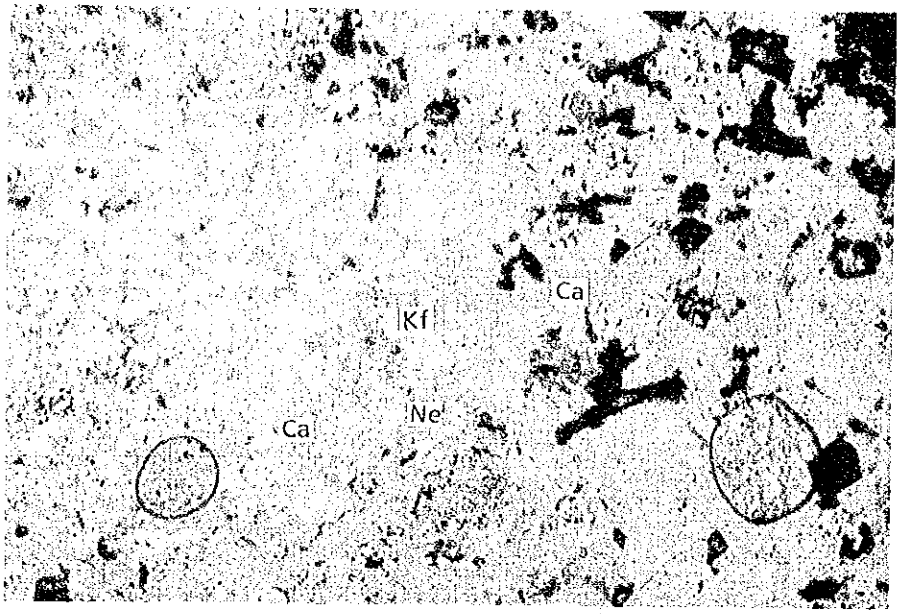

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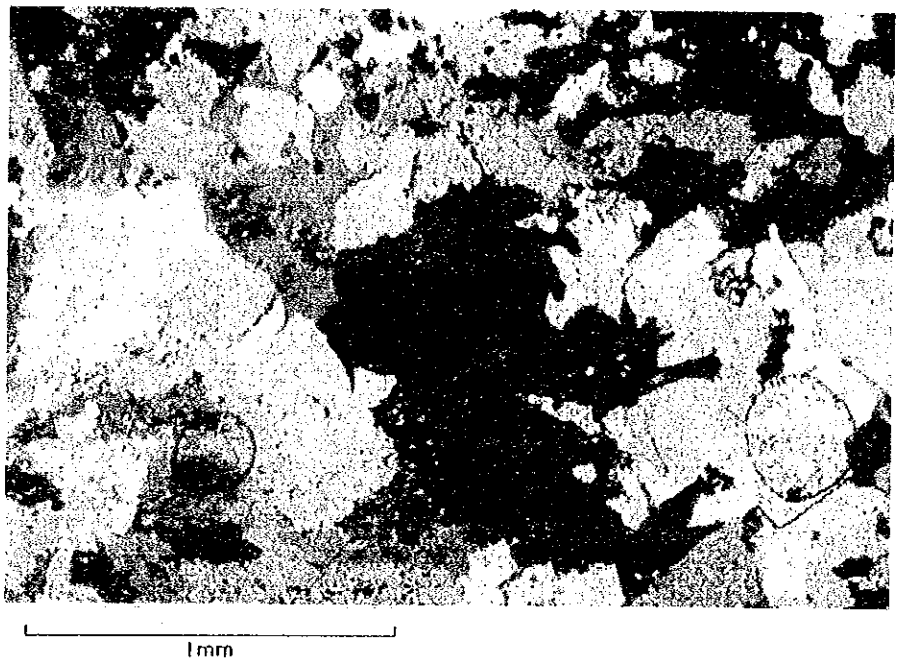
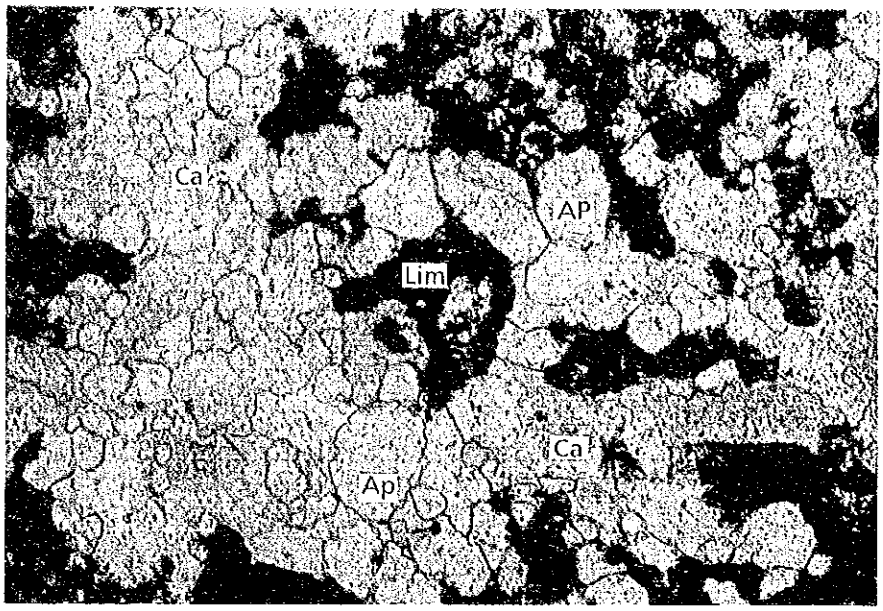


crossed polars

Sample No.: KR-102 (B)
Location : Mrima Hill
Rock name : Calcite Carbonatite

Photomicrographs (thin section)



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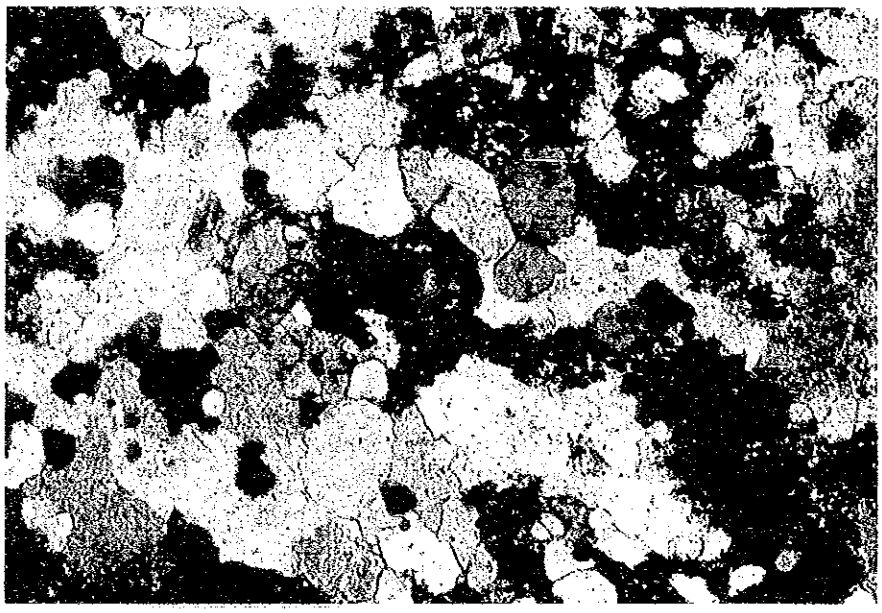
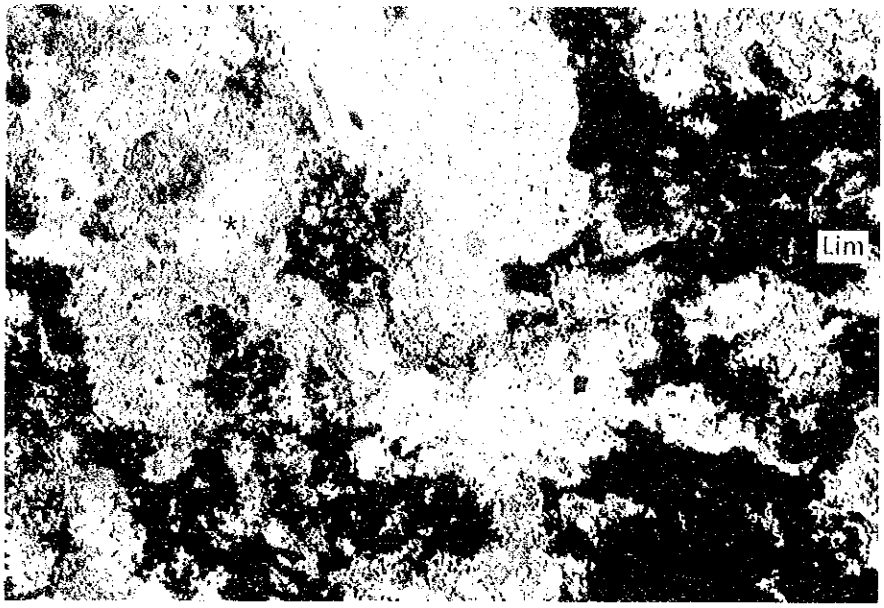


crossed polars

Sample No.: MR-106
Location : Mrima Hill
Rock name : Carbonatite

Photomicrographs (thin section)



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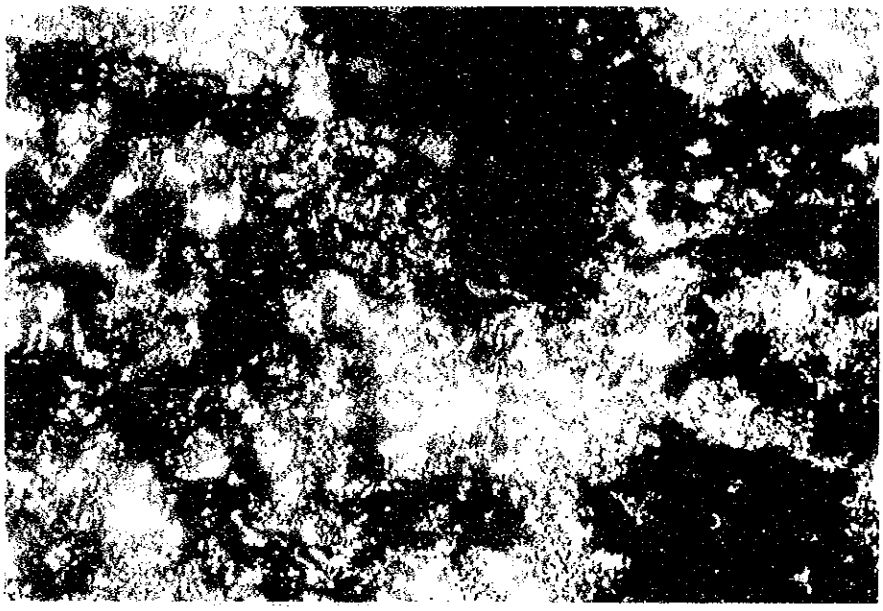


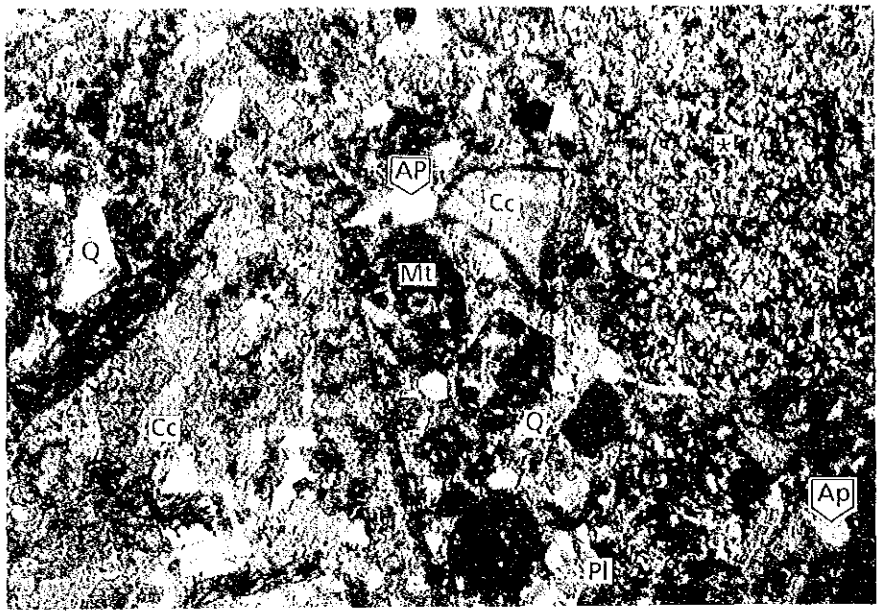
crossed polars

1mm

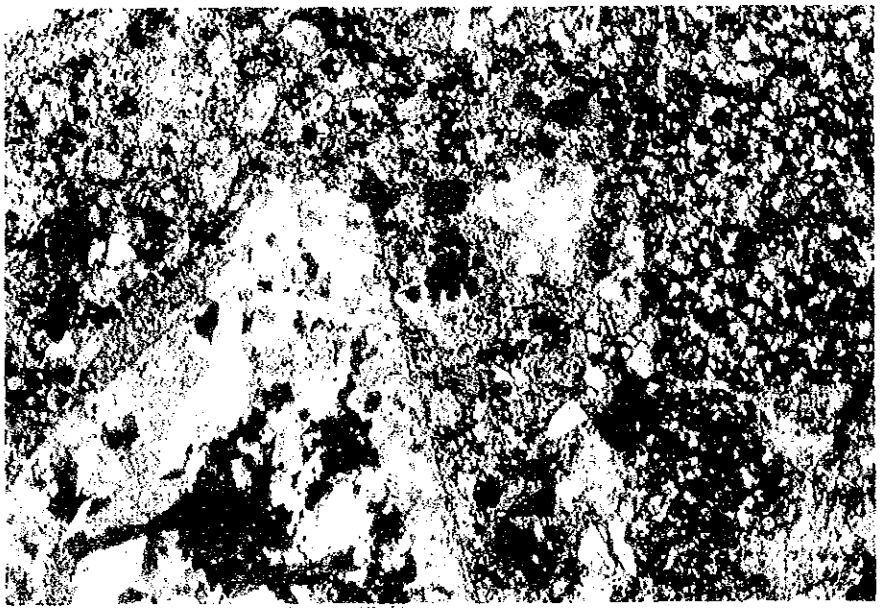
* chalcedony

Sample No.: KR-109
Location : Kiruku Hill
Rock name : Lapilli Tuff
("agglomerate")

Photomicrographs (thin section)



one polar



crossed polars

1mm

* lithic fragment
(sandstone)

Sample No.: MR-113
Location : Mwananyamala
Rock name : Lapilli Tuff

Photomicrographs (thin section)

Summary of Microscopic Observation (Sedimentary Rocks)

Code No.	Sample No.	Rock Name	Detrital Material										Matix						Secondary Minerals			
			Qtz	Kf	Pl	Chl	Mus	Ca	Gar	Tor	Zir	Bi	Ca	Qtz	Se	Chl	Cly	Opq	Ca	Se	Chl	Qtz
1	KR-014	Sandstone	◎	◎	○		△						△	–		–		–	–	△	△	
2	SH-28	Siltstone	◎	△	○		△						△		△		◎	–		△	△	
3	GO-09	Limestone	△					◎					◎					–	△			
4	KR-013	Sandstone	◎	○	◎		–								△	△	–	–		△	△	
5	KR-011	Sandstone	◎	○	◎	△	–			–						△	–					
6	SH-32	Siltstone	◎	○	◎	△	△				–						△	–		△	–	
7	SH-23	Siltstone	◎	○	◎	△	–			–	–						△			△		
8	KR-010	Sandstone	◎	◎	◎	△	–			–	–		○						△	△	–	
9	KR-007	Sandstone	◎	◎	◎	△	–		–		–		△			–				△	–	
10	KR-006	Sandstone	◎	○	○	△	–					○	△			–	–			△	–	
11	SH-05	Calcareous Sandstone	○	△	○	△	△						◎			–				△	–	
12	SH-04	Sandstone	◎	○	○	△	–						△			–	–	–		△		
13	KR-005	Calcareous Sandstone	◎	○	○	△							◎			–	–			△		
14	SH-13	Sandstone	◎	○	○				–					△		–	–			–	–	△
15	MR-001	Sandstone	◎	○	○								○				–	–	△	–		
16	SH-12	Sandstone	◎	○	○								○				–	–	△	–		
17	JA-09	Limestone	△					◎														
18	MW-05	Sandy Ölitic Limestone	△	–	△			◎					◎					◎				
19	MD-08	Sandy Ölitic Limestone	△		–			◎					◎					◎				

Qtz : Quartz　　Gar : Garnet　　Kf : Potassium feldspar　　Zir : Zircon　　Pl : Plagioclase
Bi : Biotite　　Chl : Chlorite　　Mus : Muscovite　　Se : Sericite　　Ca : Calcite
Cly : Clay　　Tor : Tourmaline　　Opq : Opaque minerals

◎ abundant　　○ common　　△ minor　　– rare

Microscopic Observation of Rocks in Thin Section (Sedimentary Rocks) (1)

Code No.	Sample Name	Macroscopic Features	Microscopic Features	Identified Minerals and Material		Unidentified Minerals and Material	Source (or remakrs)
				Detrital Material	Matrix		
KR-014	SANDSTONE	• Light gray • Compact • Transparent grains (dominant) and milky white grains. • No lamination and grading texture • Including mudstone clasts.	• Moderately - sorted • Immature	• Quartz, ≒ 35%, < 3mm, subangular to angular, mostly monocrystalline (igneous origin) • Alkali feldspar, ≒ 35 %, < 2 mm, altered to calcite and sericite • Plagioclase, ≒ 25 %, < 1.5 mm, subangular to angular, altered to sericite • Chlorite • Muscovite • Calcite • Biotite • Garnet	• (< 5 %, very little) • Calcite	Clay material	Granitic rocks and/or gneiss Formation: Taru (middle)
SH-28	SILTSTONE	• Light grayish brown • Massive • No lamination and grading • Compact	• Roughly parallel alignment of muscovite flakes, indicating bedding or lamination • Well-sorted • Much matrix and mineralogically immature.	(≒50%) • Quartz, ≒ 33 %, < 0.2 mm, subround ~ subangular • Plagioclase, ≒ 10 %, smaller than Quartz, subangular • Alkali feldspar, < 5 %, smaller than Quartz • Muscovite, < 2 %	• Clay material • Sericite or illite • Chlorite	• Clay material • Opaque minerals	Granitic rocks and/or gneiss Formation: Taru (upper)

Microscopic Observation of Rocks in Thin Section (Sedimentary Rocks) (2)

Code No.	Sample Name	Macroscopic Features	Microscopic Features	Identified Minerals and Material		Unidentified Minerals and Material	Source (or remarks)
				Detrital Material	Matrix		
GO-09	LIMESTONE	• Gray ~dark gray • Massive • Compact/not porous	• Consisting mainly of micrite. • Recrystallized peloids • Porous parts filled with sparry calcite	• Calcite, > 95 %, (calcite vein) (i) peloid-like grains lacking interal structure and composed of micrite (ii) very fine-grained micrite. (iii) secondarily precipitated sparry calcite • Quartz, silt size, subangular ~ angular, monocrystalline		• Clay material	Formation: Maji ya Chumvi (lower)
KR-013	SANDSTONE	• Light brown • Compact and Massive • With obscure lamination	• Well-sorted • Mature	(> 90 %) • Quartz, ≒ 50 %, < 0.2 mm, subangular ~ angular • Plagioclase, ≒ 30 %, < 0.2 mm, subangular ~ angular • Alkali feldspar, ≒ 10 %, < 0.2 mm, subangular ~ angular, cloudy due to alteration, altered to sericite • Muscovite, rare • Zircon • Apatite	(< 10 %) • Sericite, chlorite, other clay minerals.	• Clay material • Opaque minerals	• Granitic and/or gneissose rocks Formation: Maji ya Chumvi (lower)

Microscopic Observation of Rocks in Thin Section (Sedimentary Rocks) (3)

Code No.	Sample Name	Macroscopic Features	Microscopic Features	Identified Minerals and Material		Unidentified Minerals and Material	Source (or remarks)
				Detrital Material	Matrix		
KR-011	SANDSTONE		• Moderately sorted • Roughly parallel alignment of muscovite and biotite, flakes, indicating bedding.	(80 ~ 85 %) • Quartz, > 50 %, < 0.15 mm, angular ~ subangular • Plagioclase, ≒ 20 %, < 0.15 mm, angular ~ subangular • Alkali feldspar, ≒ 15 %, < 0.15 mm, angular ~ subangular, altered to sericite. • Chlorite, ≧ 5 % • Bioteite, ≧ 5 % • Muscovite, a few % • Tourmaline, a few % • Zircon, a few %	• Chlorite • Clay minerals	• Clay material • Opaque minerals	Formation: Maji ya Chumvi (middle)
SH-32	SILTSTONE	• Yellowish brown • Compact and massive • No lamination	• Well-sorted • Mineralogically immature	• Quartz, ≒ 30 %, < 0.2 mm, subangular, indicating metamorphic origin. • Plagioclase, ≒ 20 %, smaller than Quartz • Alkali feldspar, ≒ 10 %, small, subangular, cloudy due to alteration, altered to sericite • Muscovite, a few % • Chlorite • Zircon	(35 ~ 40 %) • Clay mineral • Opaque mineral	• Clay material • Opaque minerals	Formation: Maji ya Chumvi (middle) • Fossil bed

Microscopic Observation of Rocks in Thin Section (Sedimentary Rocks) (4)

Code No.	Sample Name	Macroscopic Features	Microscopic Features	Identified Minerals and Material		Unidentified Minerals and Material	Source (or remarks)
				Detrital Material	Matrix		
SH-23	SILTSTONE	• Light brownish gray • Laminated texture • Compact	• Well-sorted • Irregular grain contacts (sometimes), because of pressure-solution during diagenesis.	(≒ 80 %) • Quartz, ≒ 45 %, < 0.15 mm, subangular ~ angular • Plagioclase, ≒ 25 %, subangular ~ angular • Alkali feldspar, ≒ 5 %, altered to sericite • Chlorite, <a few % • Muscovite • Tourmaline • Zircon • Opaque minerals	• Clay	• Clay material • Opaque minerals	Formation: Maji ya Chumvi (upper)
KR-010	SANDSTONE	• Light gray ~ white • Obscure lamination • Arkosic	• Moderately - Sorted • Originally "clean" sandstone, lacking clay matrix • Irregular and wavy grain contacts, because of pressure-sollution during diagenesis	(≒ 85 %) • Quartz, ≒ 30 %, < 0.025 mm, subangular ~ angular • Plagioclase, ≒ 25 %, < 0.025 mm, subangular ~ angular • Alkali feldspar, ≒ 25 %, < 0.025 mm, subangular ~ angular • Chlorite (origin biotite) • Muscovite • Zircon • Sphene • Tourmaline	(≤ 15 %) • Calcite • Clay minerals (chlorite)	• Clay material	Formation: Maji ya Chumvi (upper)

Microscopic Observation of Rocks in Thin Section (Sedimentary Rocks) (5)

Code No.	Sample Name	Macroscopic Features	Microscopic Features	Identified Minerals and Material		Unidentified Minerals and Material	Source (or remarks)
				Detrital Material	Matrix		
KR-007	SANDSTONE	• Light gray • Milky white patches • Massive and compact • No lamination	• Moderately - sorted • Irregular grain contacts because of pressure - solution during diagenesis	(≧ 90 %) • Quartz, ≒ 35 %, < 0.25 mm, subangular ~ subrounded • Plagioclase, ≒ 30 %, < 0.25 mm, subangular ~ subrounded • Alkali feldspar, ≒ 25 %, < 0.25 mm, subangular ~ subrounded, frequently altered • Chlorite (origin biotite), 5 % • Muscovite • Garnet • Zircon • Allanite	• Calcite (Clay)	• Clay material	Formation: Mariakani (lower)
KR-006	MICACEOUS SANDSTONE	• Gray • Lamination due to mica flakes • Compact	• Poorly or moderately - sorted • Parallel alignment of biotite flakes (indicating bedding and/or lamination)	(80 ~ 85 %) • Quartz, ≒ 30 %, < 0.2 mm, subrounded ~ subangular • Plagioclase, ≒ 20 %, subangular • Alkali feldspar, ≒ 20 %, subrounded, altered to sericite • Biotite and Chlorite, ≒ 15 % • Muscovite	• Chlorite • Clay material		Formation: Mariakani (lower)

Microscopic Observation of Rocks in Thin Section (Sedimentary Rocks) (6)

Code No.	Sample Name	Macroscopic Features	Microscopic Features	Identified Minerals and Material		Unidentified Minerals and Material	Source (or remarks)
				Detrital Material	Matrix		
SH-05	CALCAREOUS SANDSTONE (SILTSTONE)	• Light gray • Massive • Obscure lamination • Compact and hard	• Moderately - sorted clastic grains abundant.	• Quartz, ≒ 25 %, < 0.2 mm, subrounded ~ subangular • Plagioclase, ≒ 10 %, < 0.2 mm, subrounded ~ subangular • Alkali feldspar, ≒ 10 %, < 0.2 mm, subrounded ~ subangular, altered to sericite. • Muscovite • Chlorite • Zircon • Sphene • Tourmaline • Garnet (• Biotite)	(≥ 50 %) • Calcite (• Chlorite) • Clay	Clay material	Formation: Mariakani (middle)
SH-04	SANDSTONE	• Light yellowish brown • Massive • Compact, not so hard	• Moderately - sorted • Parallel alignment of biotite flakes, indicating bedding or lamination.	(80 ~ 85%) • Quartz, ≒ 35 %, < 0.25 mm, subangular • Alkali feldspar, ≒ 25 %, < 0.2 mm, subangular, altered to sericite • Plagioclase, ≒ 20 %, < 0.2 mm, subangular • Chlorite (origin biotite), ≒ 5 % • Muscovite • Zircon • Garnet	• Calcite (• Chlorite) (• Clay) • Opaque	• Clay material • Opaque minerals	Formation: Mariakani (middle)

Microscopic Observation of Rocks in Thin Section (Sedimentary Rocks) (7)

Code No.	Sample Name	Macroscopic Features	Microscopic Features	Identified Minerals and Material		Unidentified Minerals and Material	Source (or remarks)
				Detrital Material	Matrix		
KR-005	CALCAREOUS SANDSTONE		• Moderately ~ well-sorted • Roughly parallel alignment of biotite flakes	(≒ 50 %) • Quartz, ≒ 25 %, < 0.25 mm, subangular • Plagioclase, ≒ 15 %, < 0.25 mm, subangular • Alkali feldspar, ≒ 10 %, altered to calcite or sericite • Chlorite (origin biotite) • Garnet • Apatite • Zircon • Sphene	(≒ 50 %) • Calcite • Clay	• Clay material	Formation: Mariakani (upper)
SH-13	SANDSTONE	• Light gray • Hard, but porous	• Originally porous quartzose sandstone with rounded quartz grains • Well - cemented by secondally quartz	(≒ 85 %) • Quartz, 40 %, ≒0.5 mm, rounded ~ subrounded • Plagioclase, 25 %, ≒0.5 mm, subrounded • Alkali feldspar, ≒ 15 % • Garnet • Zircon	• Opaque materials • Chlorite • Secondary precipitated quartz (• Clay)	• Opaque minerals • Clay material	Formation: Mazeras (upper)

Microscopic Observation of Rocks in Thin Section (Sedimentary Rocks) (8)

Code No.	Sample Name	Macroscopic Features	Microscopic Features	Identified Minerals and Material		Unidentified Minerals and Material	Source (or remarks)
				Detrital Material	Matrix		
KR-001	SANDSTONE		• Moderately to poorly sorted • Well-cemented by secondarily, pricipitated silica (similar to SH-13)	(≒ 80 %) • Quartz, ≒ 40 %, < 1.0 mm, originally rounded ~ subrounded • Plagioclase, ≒ 25 %, < 0.5 mm, subrounded • Alkali feldspar, ≒ 15 %, subrounded, altered to sericite • Zircon (• Dolomite)	• Calcite • Opaque mineral (• Clay)	• Opaque minerals • Clay material	Formation: Mazeras (middle)
SH-12	SANDSTONE	• Light brownish gray • Massive • Porous • No lamination	• Moderately ~ well sorted • Originally porous sandstone • Quartz grains are well cemented by over growth silica precipitated during diagenesis.	(≒ 90 %) • Quartz, ≒ 45 %, < 0.45 mm, originally rounded • Plagioclase, ≒ 30 %, < 0.45 mm, rounded, slightly altered • Garnet • Apatite • Zircon • Sphene • Muscovite	• Secondary quartz • Clay material (sericite)	• Clay material	Formation: Mazeras (upper)
JA-09	LIMESTONE	• Light yellowish white • Compact • Porous • No lamination and stratified texture	• Recrystallized limestone (dolomite) • Mosaic texture is similar to neomorphic fabric.	• Calcium carbonate (or dolomite), > 95 %. • Detrital quartz grains, a few %, mostly rounded • Alkali feldspar, rare, altered		• Calcite	Formation: Kambe

Microscopic Observation of Rocks in Thin Section (Sedimentary Rocks) (9)

Code No.	Sample Name	Macroscopic Features	Microscopic Features	Identified Minerals and Material		Unidentified Minerals and Material	Source (or remarks)
				Detrital Material	Matrix		
MW-05	SANDY ÖOLITIC LIMESTONE (Sandy öosparite)	• Gray • Massive • With dark transparent spots • No lamination or stratification	• Spherical or ellipsoidal grains, showing radial and concentric structure are öoids. (Nuclei of them are probably micrite.) • Matrix among the öoids is sparry calcite cement. • No carbonate-mud in matrix shows "wash-out" • Rarely, öoids with a large nuclei of quartz and thin öolitic lamina. (Superficial öoids)	• Öoid, ≒ 30 %, < 2 mm • Detrital Quartz, ≒ 15 %, < 2 mm, subangular • Detrital plagioclase, ≒ 5 % • Detrital alkali feldspar • Echinoderm fragments • Zircon	• Sparry Calcite (Secondarily precipitated calcite.)	• Clay material	Formation: Kambe
MD-08	SANDY ÖOLITIC LIMESTONE (Sandy, poorly-washed, öosparite)	• Light gray • Compact and massive • No lamination and stratification	• Abundant öoids with poorly - preserved concentric structure. • Nuclei of them are quartz, calcite, garnet, and foraminifer. • The structure may have been lost by mictritization	• Öoid, ≒ 35 %, < 0.5 mm • Detrital quartz, ≒ 5 %, < 1.0 mm • Detrital Plagioclase	(≧ 55 %) • Sparry calcite • Micritic calcite (• Clay material)		Formation: Kambe

Photomicrographs of Rocks in Thin Section

(Sedimentary Rocks)

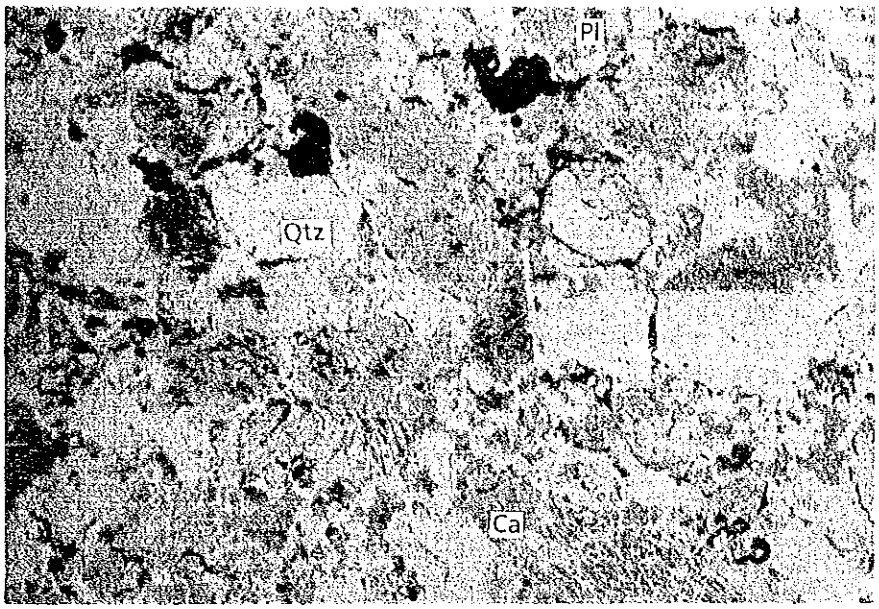
Abbreviations

Minerals

Qtz	: quartz	Kf	: potassium feldspar
Pl	: plagioclase	Bi	: biotite
Hor	: hornblende	Cpx	: clinopyroxene
Ne	: nepheline	Ol	: olivine
Cn	: cancrinite	Sd	: sodalite
Ap	: apatite	Ti	: titanite
Gar	: garnet	Tor	: tourmaline
Zir	: zircon	Ru	: rutile
Chl	: chlorite	Serp	: serpentine
Mus	: muscovites	Ca	: calcite
Cr	: cristobalite	Se	: sericite
Non	: nontronite	Sm	: smectite
Anl	: analcime	Lim	: limonite
Mt	: magnetite		

Others

Cly	: clay	Opq	: opaque minerals



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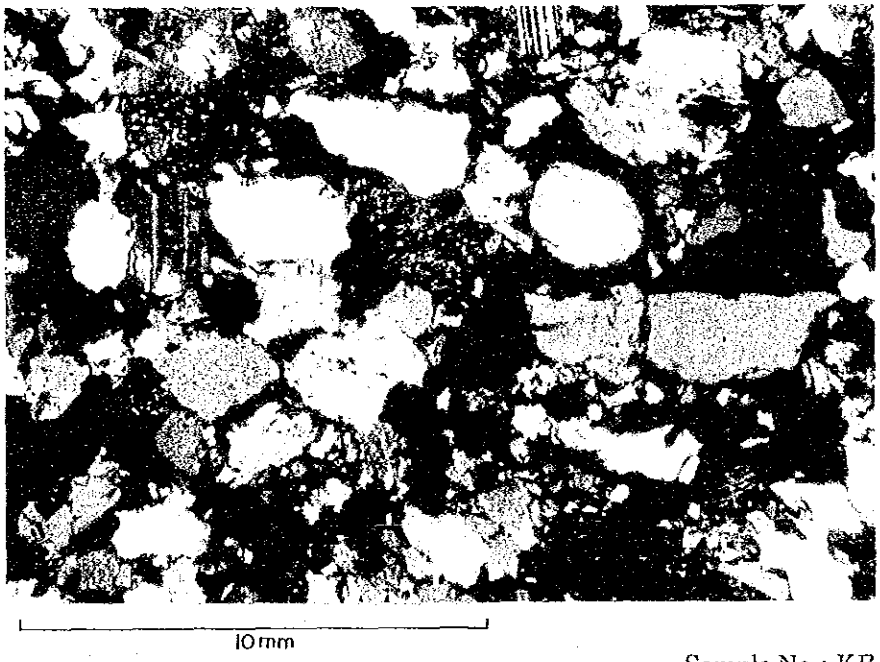
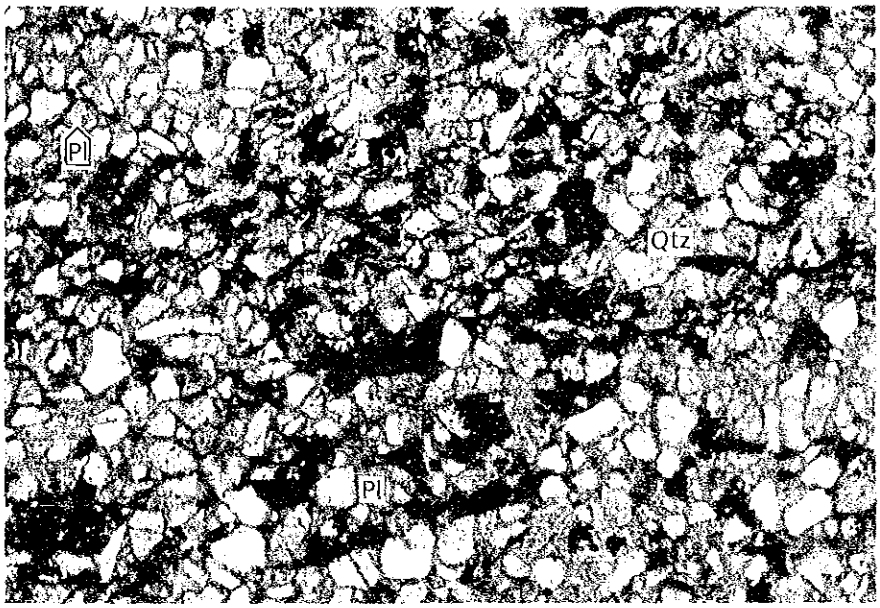


crossed polars

Sample No.: KR-014
Formation : Taru Formation (middle)
Location : East of Taru Town
Rock name : Sandstone

Photomicrographs (thin section)



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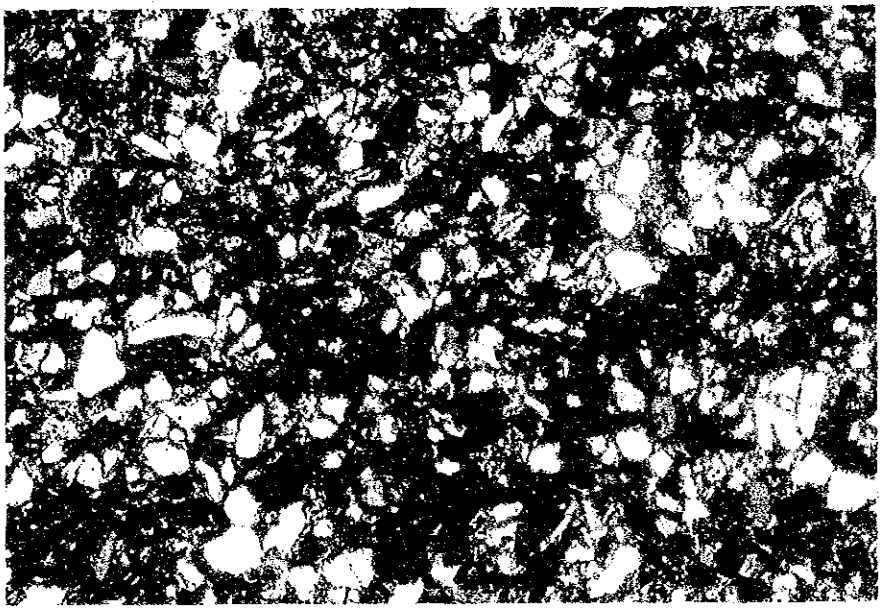
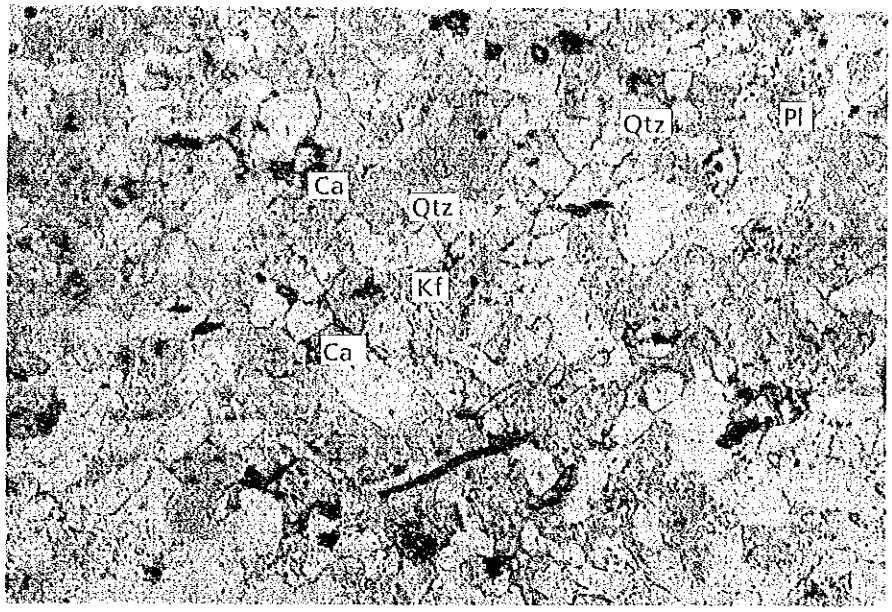


crossed polars

Sample No.: SH-32
Formation : Maji ya Chumvi Formation (middle)
Location : West of Bamba
Rock name : Siltstone

Photomicrographs (thin section)



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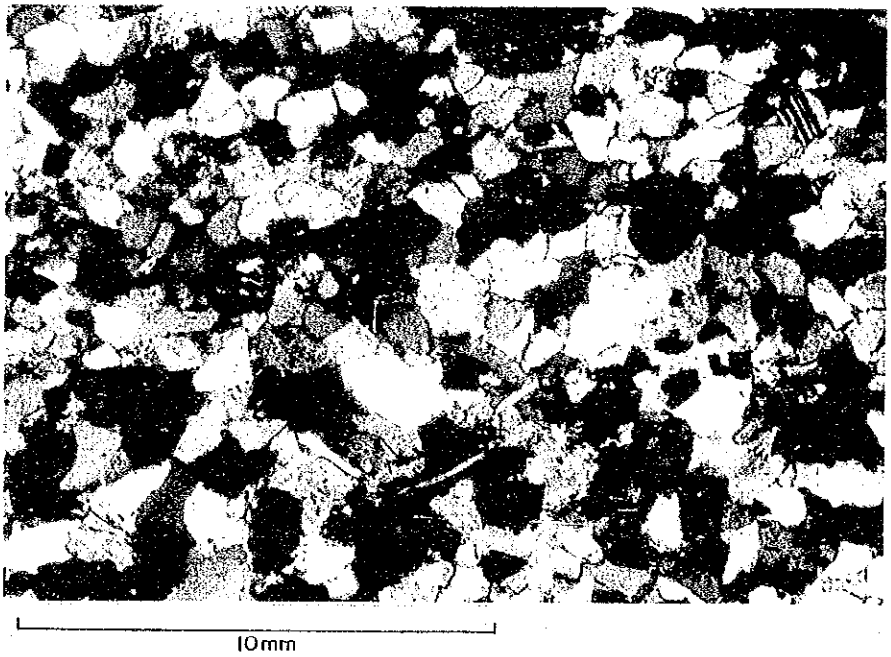
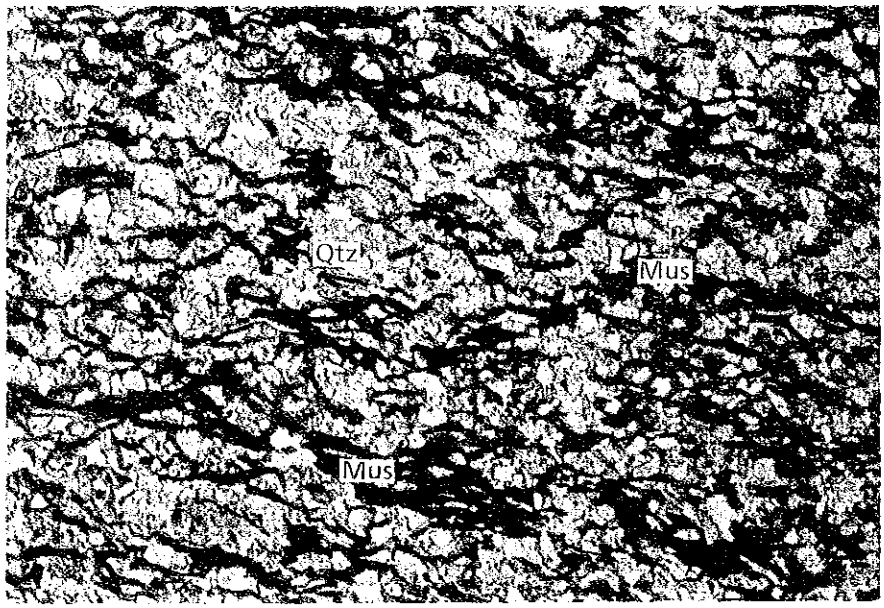


crossed polars

Sample No.: KR-010
Formation : Maji ya Chumvi Formation (upper)
Location : Maji ya Chumvi
Rock name : Sandstone

Photomicrographs (thin section)



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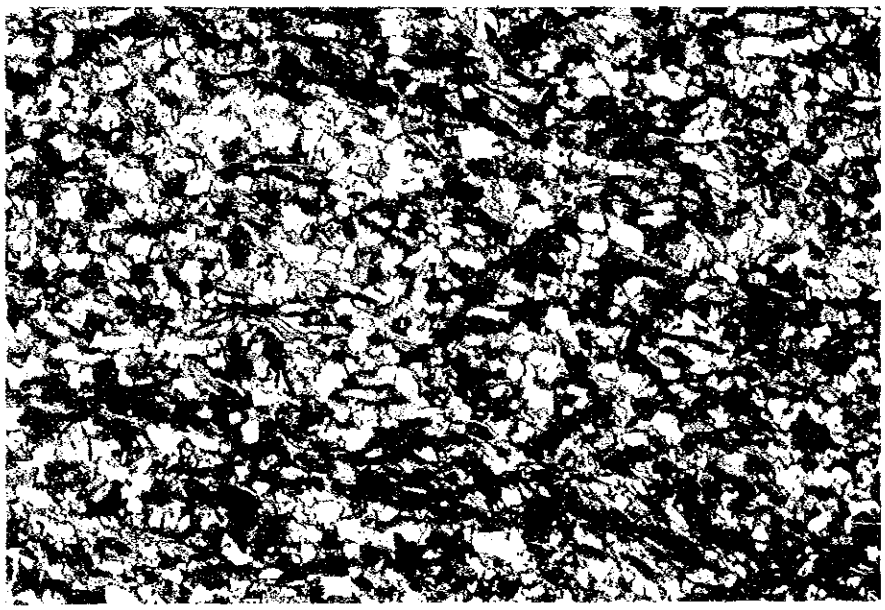
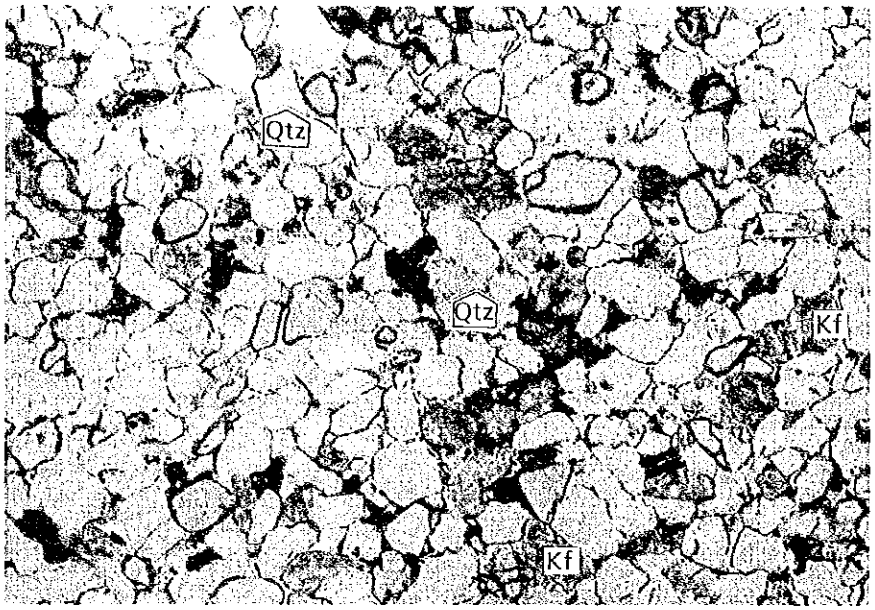


crossed polars

1mm

Sample No.: KR-006
Formation : Mariakani Formation (lower)
Location : Northwest of Mazeras
Rock name : Sandstone

Photomicrographs (thin section)



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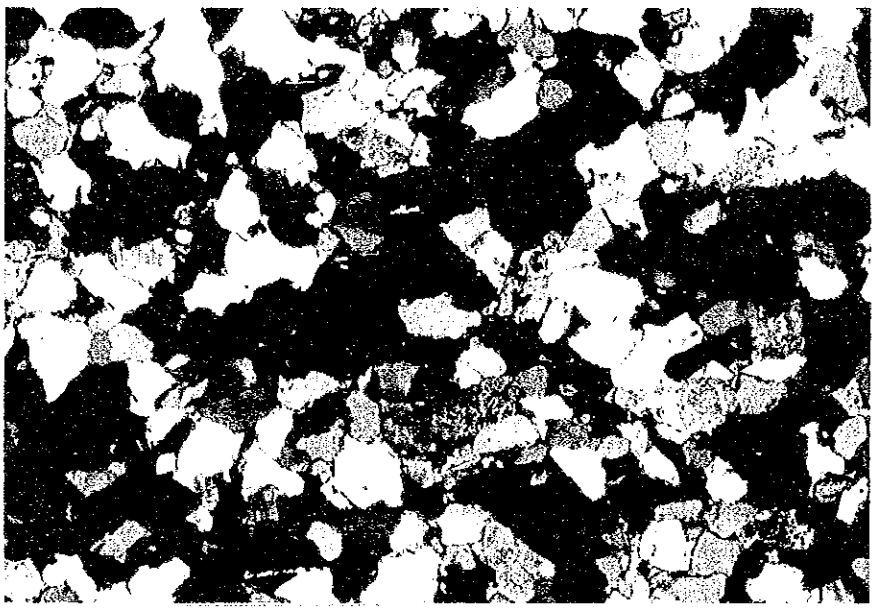


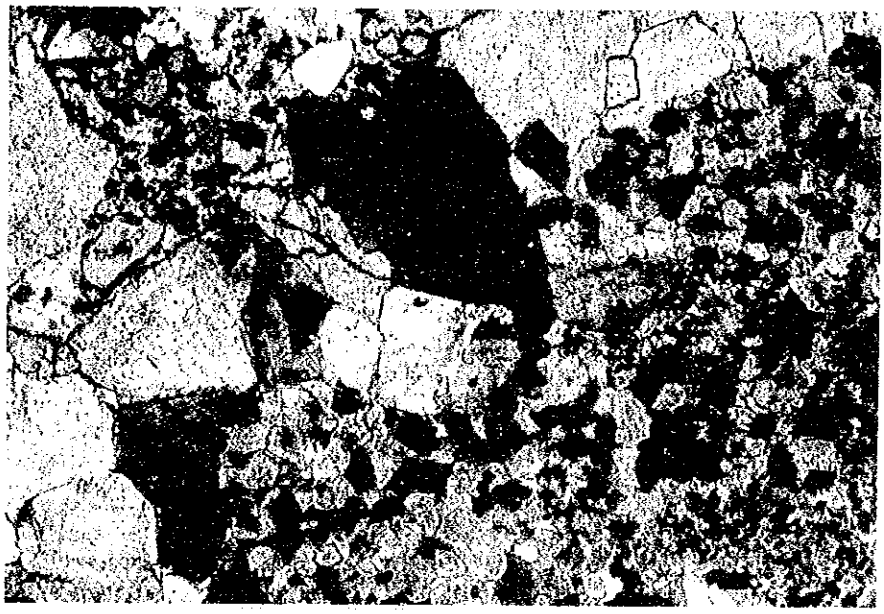
crossed polars

1mm

Sample No.: SH-12
Formation : Mazeras Formation (upper)
Location : South of Bamba
Rock name : Sandstone

Photomicrographs (thin section)

one polar

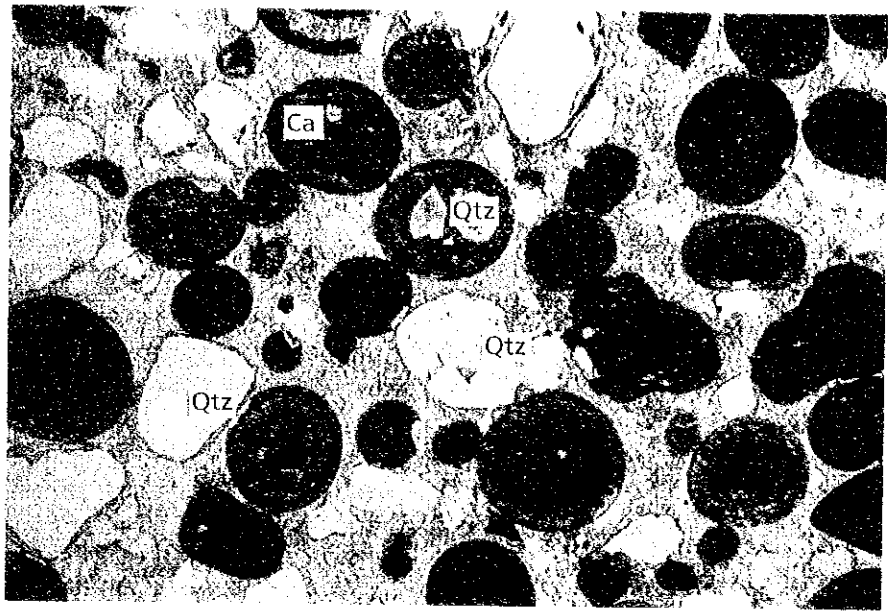


crossed polars

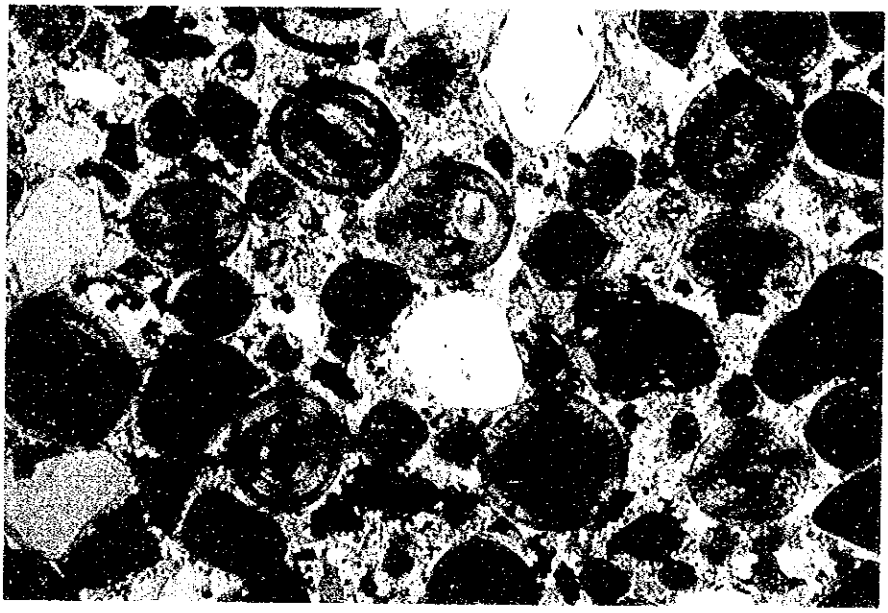
1mm

Sample No.: JA-09
Formation : Kambe Formation
Location : Jaribuni
Rock name : Limestone

Photomicrographs (thin section)



one polar



crossed polars

Sample No.: MW-05
Formation : Kambe Formation
Location : Mwachi Forest
Rock name : Sandy Ölitic Limestone

Photomicrographs (thin section)

Appendix -III

MICROSCOPIC OBSERVATION OF ORE MINERALS IN POLISHED SECTION

Summary of Microscopic Observation of Polished Sections (1)

Code No.	Sample No.	Sampling Area	Ga	Sph	Cpy	Py	Mac	Ja	Mck	Tet	Stm	Ar	An	Bo	Dg	Cv	Cc	Hm	Goe	Gp	Mn	Qtz	Ca	Ba
1	KN-05	Kinangoni	◎	×	○	○	△	×	×	×			◎			×		×	×			○		
2	KN-09		×			×							◎			×		×	×			○		
3	KN-10					○	○						○					×	×			○		
4	KN-25		○								×	×	◎			△			×			◎		
5	KN-26		△			△	○						◎			○			×			○		
6	KN-27		○		×	○	◎						○			×						○		
7	KN-34A		◎	×	×	×	○						◎			△	×					○		
8	KN-34B		△	◎	×	△	×						△			×						○		○
9	KN-34C		△			○	○													×		◎		
10	KN-34D		○	◎	×	△	△															○		
11	KN-35		◎		△	×	△			×									×			◎		○
12	VT-01	Vitengeni	◎	○	×											×				×		○		◎
13	VT-03A		○		◎								△			×	△		×			◎	△	
14	VT-03B		◎		△	×	×						△			△	×		×			◎	△	
15	VT-05		◎										△											○
16	VT-06		△			×							○			×	×					◎		△
17	VT-09					×																		◎
18	VT-10			×	×	×																		◎
19	VT-11		○			×							△									○		◎
20	VT-13				×																			◎
21	VT-15		◎										○									×		○
22	VT-16A		◎		×											△						×		◎
23	VT-16B		◎			×							○			○	×							◎
24	VT-16C		◎	○	△											△						○		○
25	VT-23												×											◎
26	VT-24												×											◎
27	JA-07	Jaribuni																	◎					
28	JA-08					○													◎					
29	TO-07	Kiwara Hill																			◎	○		
30	TO-09																				◎	○		△
31	GO-01	Kiwara Hill Goshi																	×					◎
32	GO-02																		○			◎		○
33	GO-03																			×				◎
34	CH-04	Chang'ombe																	○	×		◎		

(to be continued)

Summary of Microscopic Observation of Polished Sections (2)

Code No.	Sample No.	Sampling Area	Ga	Sph	Cpy	Py	Mac	Ja	Mck	Tet	Stm	Ar	An	Bo	Dg	Cv	Cc	Hm	Goe	Gp	Mn	Qtz	Ca	Ba
35	MW-02	Mwachi River (Tributary)	○	◎		△																△	○	
36	MW-06		◎			△							○						△	×		◎	◎	
37	MW-07		○	◎	×	×				×			×						×				◎	
38	MW-10		△	◎									○						×			△	◎	
39	MW-14																				×		◎	
40	MW-16			◎		△													△			○	○	
41	MK-11	Mkundi			○	×								×	×					×		◎		
42	MK-12				△	◎																		
43	MK-14				◎	×										○						◎		
44	MK-17		◎										○			△	△					◎		
45	MK-22					◎																○		
46	KR-103				◎	△										×	×					◎		
47	TO-01	Lunga-Lunga				×																		◎
48	TO-04		◎	◎	△											×	×					×		◎
49	MI-04	Mwereni	◎										×											◎
50	KV-03	Kavuluni				×																△	△	◎

Ga : galena　Sph : sphalerite　Cpy : chalcopyrite　Py : pyrite　Mac : marcasite　Ja : jalpaite
Mck : mckinstryite　Tet : tetrahedrite　Stm : stromeyerite　Ar : argentite　An : angiesite　Bo : bornite
Dg : digenite　Cv : covellite　Cc : chalcocite　Hm : hematite　Goe : goethite　Gp : graphite
Mn : Mn-mineral　Qtz : quartz　Ca : calcite　Ba : barite (witherite)

◎ : abundant　○ : common　△ : little　× : rare

Microscopic Observation of Ore Minerals in Polished Sections (1)

KN-05

The specimen is galena ore with chalcopyrite, pyrite, marcasite, sphalerite and others. Aggregates of euhedral pyrite (0.05-0.1 mm in size) scatter as clots in the galena ore. Lath-shaped marcasite (0.003×0.01 mm in size) is included in pyrite aggregate. Chalcopyrite (0.02 – 0.1 mm in size) surrounds the aggregate of pyrite, and coexists with irregular shaped sphalerite, jalpaite, mckingstryite and tetrahedrite. Sphalerite is also included as a subhedral grain (0.01 – 0.05 mm in the size) in galena. Irregular shaped jalpaite (0.005 – 0.05 mm in size), mckinstryite (0.01 mm in size) and tetrahedrite (0.01 mm in size) occur in galena near the boundary with chalcopyrite or pyrite.

KN-09

The specimen is strongly oxidized. Anglesite which might have replaced galena is predominant. Sulfide minerals are rare, and occur in anglesite: Galena has remained as a small relic grain (0.001 – 0.01 mm in size). A small amount of fine grained pyrite (0.005 mm in size) has also remained, but many pyrite might have been oxidized to goethite in anglesite. Irregular agrregates of covellite (0.005 – 0.02 mm in size) are scattered in anglesite. A few amount of spherical shaped hematite (?) (0.05 mm in diameter) is also observed in anglesite.

KN-10

The specimen is oxidized and contains a small amount of sulfide minerals. Galena has been replaced by anglesite in the rim, and has remained as a relic grain (0.01 – 0.1 mm in size). A small amount of fabric covellite, rounded or irregular shaped pyrite, and irregular shaped chalcocite also scatter in anglesite. A small amount of hematite and goethite is observed near the rim of anglesite or in the grain boundary.

KN-25

Two oxidized lead veins (3 mm in width) occur in quartz vein. Euhedral quartz (0.1 – 0.2 mm in size) grows such as the teeth of a comb. The lead mineral is mainly anglesite which has replaced galena. The galena which is included completely in quartz crystal has remained unchanged. Anglesite includes small relic galena, aggregates of covellite, and a less amount of argentite and stromeyerite. Stromeyerite occurs as a euhedral crystal (0.01×0.03 mm in size) and is enclosed by irregular shaped argentite. Aggregates of goethite (0.1 mm in size) scatter in the silicified wall rock.

KN-26

Predominant ore mineral is anglesite. Pyrite, marcasite, galena and covellite are also observed. Anglesite has changed from galena, which is observed as a small relic mineral in the anglesite. Pyrite and marcasite scatter in anglesite and in gangue minerals as a euhedral to subhedral crystal (0.1 – 1 mm in size), and some of them are cracked. Covellite occurs in anglesite, and it might be secondary mineral after chalcopyrite. Goethite (?) also occurs in anglesite.

KN-27

Marcasite and galena mainly occupy the specimen. Aggregate of tablet marcasite (0.002×0.01 mm in size) shows moss like or bricks like texture. Marcasite also occurs as a narrow veinlet (0.001 mm in width) in galena and gangue minerals. Euhedral to subhedral pyrite (1 mm in size) scatters in the aggregate of marcasite and in gangue minerals. Galena has been replaced by anglesite in the rim and along the cracks. Chalcopyrite occurs in galena, and many grains of chalcopyrite have changed to covellite.

KN-34A

Anglesite is predominant in the specimen, and the aggregates (1 – 2 mm in size) of marcasite of moss like texture scatter in anglesite. Galena (0.002 – 0.1 mm in size) has remained as an irregular relic mineral in anglesite. Some grains of chalcopyrite (0.01 mm in size) are observed in anglesite, but other many grains have been replaced by covellite and chalcocite. A small amount of sphalerite (0.01 – 0.1 mm in size) is observed in some parts of anglesite, and includes no other sulfide minerals.

KN-34B

Sphalerite is predominant in the sample, and has widely altered to gangue minerals along its lattice and crack. Anglesite occupies some cracks in sphalerite. Galena has remained as a relic mineral in anglesite, and coexisting with covellite. Covellite is secondary production after chalcopyrite, and is observed in the central part of anglesite in the cracks of sphalerite. A few grains of unchanged chalcopyrite (0.01 – 0.02 mm in size) are observed in fresh sphalerite. Pyrite and marcasite (0.001 – 0.01 mm in size) occur in the grain boundary of sphalerite.

Microscopic Observation of Ore Minerals in Polished Sections (2)

KN-34C

Pyrite and marcasite disseminate in a silicified breccia. The aggregate of pyrite (0.02 mm in size) and marcasite (0.002×0.05 mm in size) form the aggregate (1 – 2 mm in size) of moss like texture, and galena occupies the grain boundary of marcasite. Graphite (?) (0.05 mm in size) is observed in the specimen.

KN-34D

Sphalerite-galena-quartz veins (1 cm in width) are in the silicified sedimentary rock. Sphalerite is predominant in the veins, and its internal reflection is frequently observed. The intergrowth texture of sphalerite with different hardness is partly remarkable, which might be coexisting texture of sphalerites of different compositions. Sometimes, however, it looks like twinned lamella. Galena (0.1 – 2 mm in size) occurs in the wall rock size in the vein. A small amount of chalcopyrite (0.01 – 0.02 mm in size) occurs in sphalerite. The veinlets of pyrite-marcasite (0.1 mm in width) and galena (0.005 mm in width) at later stage are obversed along the crack of sphalerite.

KN-35

The specimen is a galena-quartz vein (5 mm in width) in a silicified rock. Main sulfide mineral is galena, which occupies a half size of the vein. Galena is rather pure, and includes a small amount of chalcopyrite, marcasite and Ag tetrahedrite. Chalcopyrite (0.2 mm in size) occurs as a subhedral crystal. Marcasite occurs in the vein wall (0.01 mm in width), and also occurs along the crack of galena. Ag tetrahedrite (0.02 – 0.05 mm in size) occurs as a subhedral crashed crystal in galena. Pyrite disseminates in the wall rock, and graphite (?) also occurs in the wall rock.

VT-01

Galena predominantly disseminates as an irregular shape (0.2 mm in size) in the quartz and barite vein. Subhedral sphalerite (0.01 – 0.1 mm in size) predated galena in the vein. Some grains show internal reflection. Galena surrounds the grain of sphalerite and also occurs along the crack of sphalerite (0.005 – 0.01 mm in width). Anhedral galena (0.01 – 0.1 mm in size) also disseminated in the vein. A small amount of chalcopyrite is observed, and covellite has replaced chalcopyrite.

VT-03A

Ore minerals consist mainly of chalcopyrite and galena in calcite-quartz vein. Chalcopyrites are distributed as massive aggregates, and also disseminates in gangue minerals. The anisotropy is weak but distinct in chalcopyrite. Chalcopyrite includes small grains of galena (0.02 mm in size). Many cracks develop in chalcopyrite, and are composed of some secondary minerals; chalcopyrite has changed to covellite partly, to chalcocite abundantly (0.005 – 0.1 mm in width), and to goethite in thin film (0.005 mm in width), from the chalcopyrite size to the crack side. Partly anglesite fill the crack. Irregular shaped galena disseminate as a later stage mineral. Galena has changed to anglesite in the rim.

VT-03B

The specimen is galena ore in calcite-quartz vein. Galena has precipitated as massive aggregates, which postdated quartz. A small amount of irregular shaped chalcopyrite coexists with galena. Small grains of euhedral pyrite (0.005 mm in size) occurs in galena. Acicular covellites have recrystallized in the rim, along the cracks and in the grain boundary of galena and chalcopyrite. In some parts, covellite coexists with chalcocite, anglesite and goethite (?).

VT-05

The specimen is galena crystals, and no other sulfide minerals are observed. Galena has been replaced by anglesite along the crack, where a fine grained relic galena (0.001 – 0.005 mm in size) has remained. Barite like gangue mineral is also recognized in the crack.

VT-06

Sphalerite predominantly disseminates in quartz vein. Small amount of galena occurs in the grain boundary of quartz, and has strongly altered to anglesite. Chalcocite and covellite coexist with anglesite. After the growth of quartz, galena has precipitated with sphalerite and chalcopyrite. Galena and chalcopyrite have changed to anglesite, chalcocite and covellite, but sphalerite has remained unchanged.

Microscopic Observation of Ore Minerals in Polished Sections (3)

VT-09

The sample is a barite crystal, of which the cleavage is well developed. Only one grain of small pyrite (0.003×0.01 mm in size) is observed. No other sulfide minerals are observed.

VT-10

The sample is composed mainly of barite crystal. Only one grain of sulfide minerals is recognized. Euhedral to subhedral chalcopyrite (0.05 mm in size) includes small grains of anhedral sphalerite (0.01 mm in size) and subhedral pyrite (0.01 mm in size). No other grains of sulfide minerals are not found.

VT-11

Galena and anglesite scatter in brecciated quartz-barite vein. Some grains of galena have strongly changed to anglesite from the rim. Small grained relic galena and covellite (0.001 – 0.005 mm in size) scatter in anglesite. Euhedral tabular barite crystals (1×5 mm in maximum size) can be recognized in the vein.

VT-13

It is barite crystal. A small amount of anhedral chalcopyrite (0.01 – 0.02 mm in size) is included in barite. No other sulfide minerals are found.

VT-15

The specimen is composed mainly of galena. Galena has altered to anglesite in the rim and along the cracks. A small amount of covellite and small relic galena (0.005 mm in size) are found in anglesite along the crack of the primary galena.

VT-16A

The sample is galena and barite ore. A small amount of chalcopyrite (0.05 – 0.1 mm in size) is included in galena. Galena has not altered to anglesite, but covellite (0.005×0.05 mm in size) occurs abundantly in some parts of galena with which primary chalcopyrite has coexisted. The rim of chalcopyrite has also been replaced by covellite. Chalcocite is rare in this sample.

VT-16B

The sample is composed mainly of galena and barite. The barite is disseminated by copper carbonate (maybe malachite?). Galena has changed to anglesite along the cleavage cracks by supergene alteration. Covellite, anglesite, secondary galena and chalcocite occupy the crack. Small grains of pyrite (0.01 mm in size) scatter in the gangue minerals.

VT-16C

Galena occurs predominantly in the sample, forming massive ore and also forming narrow networks (0.01 – 0.2 mm in width). The latter galena includes fine grains of barite(?) and covellite. Sphalerite disseminates in gangue minerals (mainly barite and quartz), and concentrates around the grain of galena. The intergrowth textures of sphalerite with different hardness are partly remarkable, which might be coexisting textures of sphalerites of different compositions, or twinned lamellae. Chalcopyrite (0.1 mm in size) disseminates in the gangue minerals, and the many grains of chalcopyrite have altered to covellite.

VT-23

The sample is a barite crystal. No sulfide mineral is found. A small amount of anglesite (0.01×0.1 mm in size) occurs along the crack in barite.

VT-24

A large galena crystal (15×10 mm in size) occur in barite. Galena has locally altered to anglesite in the rim and also along the cleavage cracks, where small grains (less than 0.02 mm in size) of relic galena are observed.

JA-07

The sample is aggregate of goethite (?). The grain size is so small to identify goethite. The bright part shows twisted veinlet like texture (0.02 mm in width).

JA-08

The sample is composed of pyrite and goethite. The grain size is so small to identify goethite, but EPMA analysis shows the goethite composition. The bright part shows

Microscopic Observation of Ore Minerals in Polished Sections (4)

veinlet like texture (0.02 mm in width). Irregular shaped pyrite occurs in the sample. Pyrite might have crystallized from iron oxide minerals in the later stage.

TO-07

Electron microprobe analyses shows that this sample is composed of manganese oxide minerals, which fill the narrow vein (1 mm in width). Manganese minerals might be aurorite and todorokite.

TO-09

Pyrolusite occurs (2 mm in size) as a cloth in the mixture of manganese oxide minerals, which might consist of aurorite, todorokite and barite, from the data of qualitative microprobe analyses and X-ray diffractometer. Microprobe analysis data suggests the rather high concentration of barium in the sample.

GO-01

The sample is barite crystal. A small amount of quartz occurs along the crack of barite, and includes small grain of goethite (0.05 mm in size). There is no sulfide mineral.

GO-02

The sample has been oxidized. Goethite (0.005 mm in size) is observed as aggregate in the grain boundary of quartz. Small grains of euhedral barite (0.02×0.04 mm in size) and quartz (0.03×0.05 mm in size) occur in the aggregate of goethite.

GO-03

The sample is a pure barite crystal, of which the cleavages develop well. No sulfide minerals are observed.

CH-04

The specimen is oxidized ore. Goethite has coated the grain boundary or the cavity between quartz crystals. Goethite forms layered texture; the aggregate (0.01 – 0.03 mm in width) is compact and bright in the cavity side, and is fine mixture with gangue minerals in the quartz side. Graphite occurs in the druse in the grain boundary of gangue minerals.

MW-02

The specimen consists of sphalerite, calcite, galena, and pyrite. Sphalerite (5 mm in size) scatters predominantly in the secimen. Galena (0.5 mm in size) occurs as an anhedral grain in the rim of sphalerite, coexisting with euhedral pyrite. A small amount of pyrite (0.01 – 0.1 mm in size) is slightly creamy and shows weak anisotropy.

MW-06

Galena, quartz and calcite vein (5 mm in width) occurs in sandstone. Galena (1 mm in size) is found in the grain boundary of calcite in the vein, and anhedral galena (0.1 mm in size) disseminate in the sandstone. Both galenas have been replaced by anglesite in the rim, A small amount of anhedral pyrite (0.02 mm in size) disseminates in the vein and in the sandstone, and have been replaced by goethite in the rim. A few amount of graphite(?) occurs in the sandstone.

MW-07

The vein is composed of sphalerite, galena, chalcopyrite and calcite. Sphalerite show the internal reflection without any mineral inclusions. Galena postdated sphalerite, and the margin has partly altered to anglesite. A small amount of chalcopyrite occurs as a small grain (0.5 mm in size) in galena. A few amount of Ag bearing tetrahedrite occurs in the crack of sphalerite in galena. Pyrite (0.02 in size) disseminates in calcite, and is also found around the sphalerite and galena.

MW-10

A vein of sphalerite and calcite is in the sample. Sphalerite is large crystal (2 – 3 mm in size), and rather wide cracks (0.1 mm in width) develop in sphalerite. The crack is occupied by gangue minerals, and by a small amount of galena and chalcopyrite (0.01 mm in size). The galena has been replaced by anglesite in the rim and along the crack. The direction of the crack in galena is independent to those in sphalerite. Fine grained euhedral to subhedral pyrite (0.01 – 0.05 mm in size) has been replaced by goethite along the rim.

MW-14

The sample is composed of white (calcite) and brownish (Mn bearing?) carbonate to the naked eye. A small amount of Mn mineral (gaudefroyite? EPMA analysis detected Mn

Microscopic Observation of Ore Minerals in Polished Sections (5)

and Ca, but C and B have not been examined) of euhedral acicular prism occurs in the grain boundary of brownish carbonate.

MW-16

Ore minerals are large sphalerite and a small amount of pyrite. Two euhedral crystals of sphalerite (10×5 mm in size) occur in quartz and calcite vein. The pale brownish yellow colored sphalerite shows internal reflection, and the crystal growth bands are recognized to the naked eye by color difference. Small grains of gangue minerals (0.02 mm in size) and cavities scatter along the growth band. Pyrite is disseminated in quartz as euhedral grain (0.05 mm in size), and has been replaced by goethite along the rim.

MK-11

A small amount of subhedral chalcopyrite is disseminated in gangue minerals which are mainly quartz. Many chalcopyrite have changed to bornite, to digenite, to chalcocite, and to gangue mineral (mainly goethite) with advancing the supergene alteration. Covellite is not observed in this sample. Pyrite is rare, but disseminates in gangue minerals. Graphite (?) occurs coexisting with clay minerals.

MK-12

Cubic shaped pyrite (0.01－0.1 mm in size) disseminates in silicified rock. Some pyrites show growth zoning texture. In that case, the central pyrite is more clean and lighter, and the marginal pyrite includes many fine dotts (less than 0.001 mm in size) of gangue minerals and cavity. A small amount of irregular shaped chalcopyrite (0.01 mm in size) also disseminates in the rock.

MK-14

Chalcopyrite (1－2 mm in size) scatters in the silica rich vein. The color of chalcopyrite is darker in the central part of crystal than the marginal part and than the part near inclusions. Covellite has replaced chalcopyrite from the rim. A small amount of euhedral to subhedral pyrite (0.01－0.05 mm in size) is included in the chalcopyrite, and also disseminates in the vein.

MK-17

The specimen is galena ore. Some grains of galena have been replaced by secondary minerals along the cracks and in the rim. The progressive pattern of alteration is from primary galena, to covellite (0.001－0.005 mm in width), and to chalcocite-anglesite-galena mixture (up to 0.05 mm in width). The grain sizes of chalcocite, galena and anglesite are very fine less than 0.001 mm. Ag is detected in this alteration zone, but the identification was impossible by its fine grain size.

MK-22

Almost all minerals are composed of pyrite. Pyrite occurs in two modes. Cubic shaped pyrite (0.1 to 0.5 mm in size) scatters in the sample, and fine grained pyrites form the layered band (0.005－0.01 mm in width). Euhedral rutile occurs in the pyrite. The sample includes many cavity. The occurrences of pyrite and cavity suggest the supergene precipitation for this sample.

KR-103

Irregular shaped chalcopyrite (0.1 to 2 mm in size) disseminates in quartz and barite(?). Some grains of chalcopyrite have been replaced by covellite, chalcocite and gangue mineral from the rim and along the crack. The width of replacement is up to 0.02 mm. A small amount of euhedral pyrite (0.05 mm in size) scatters in chalcopyrite and also disseminates in gangue minerals. The mineral assemblage is so simple.

TO-01

The specimen is a single barite crystal. The cleavage develops well. Sulfide minerals are rare, and a few grains of subhedral pyrite (0.001－0.005 mm in size) are included in barite crystal. Aggregates of angular shaped rutile (0.02×0.05 in size) occur in the cracks of barite.

TO-04

The breccias of galena (7 mm in size) and sphalerite (0.1 to 5 mm in size) scatter in brecciated barite vein. Some grains of sphalerite are crashed and small grains of pyrite occur in the rim of sphalerite. Galena is angular and includes gangue mineral (barite?, 0.01－0.05 mm in size) near the rim. Specimen includes a small amount of chalcopyrite (0.01 mm in size), which have been replaced by covellite and chalcocite in the rim.

Microscopic Observation of Ore Minerals in Polished Sections (6)

MI-04

The specimen is composed mainly of galena, and is accompanied by barite(?). Galena has been replaced by anglesite in the rim and along the cracks. Fine grains (0.001 – 0.005 mm in size) of irregular shaped relic galena have remained in anglesite. Anglesite also occurs in the cracks of barite.

KV-03

Barite predominates in the specimen. The color is quite creamy, and quartz and calcite might be also included. Sulfide mineral is rare. Only one grain of subhedral pyrite (0.005 mm in size) is included in barite crystal. Rectangular shaped rutile (0.02×0.04 mm in size) is found in the barite.

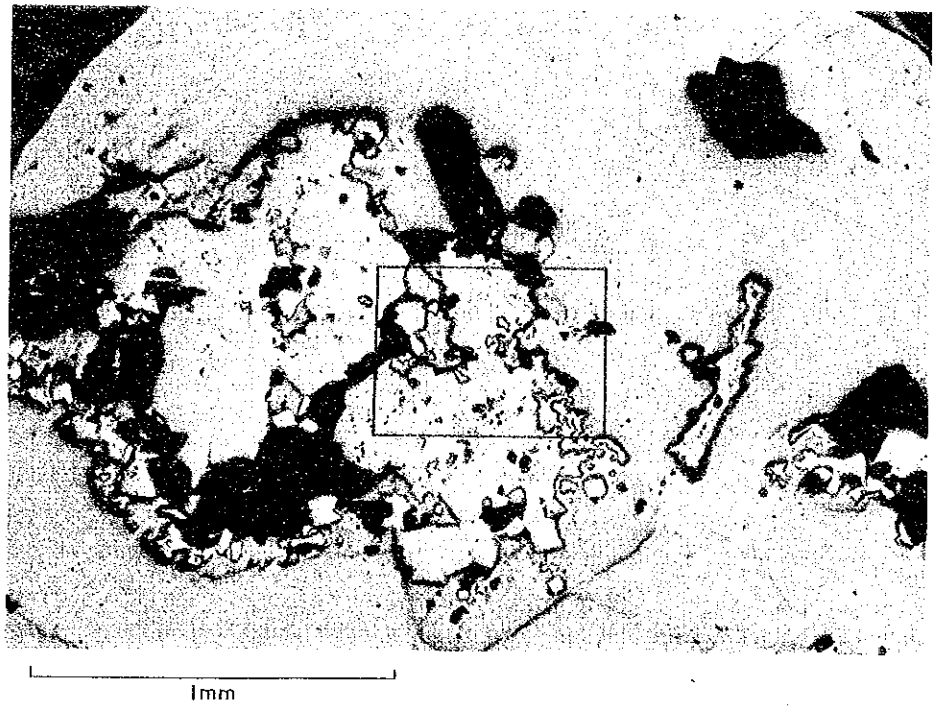
Photomicrographs of Ore Minerals in Polished Section

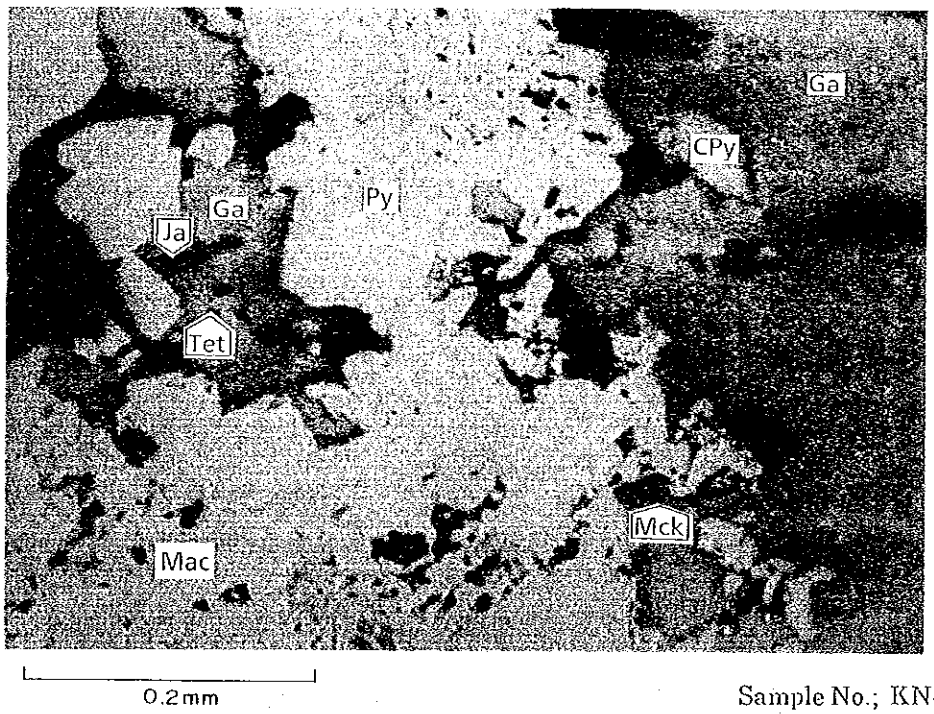
Abbreviations

Minerals

Ga : galena
Cpy : chalcopyrite
Mac : marcasite
Mck : mckinstryite
Stm : stromeyerite
An : anglesite
Dg : digenite
Cc : chalcocite
Goe : goethite
Mn : Mn-mineral
Ca : calcite

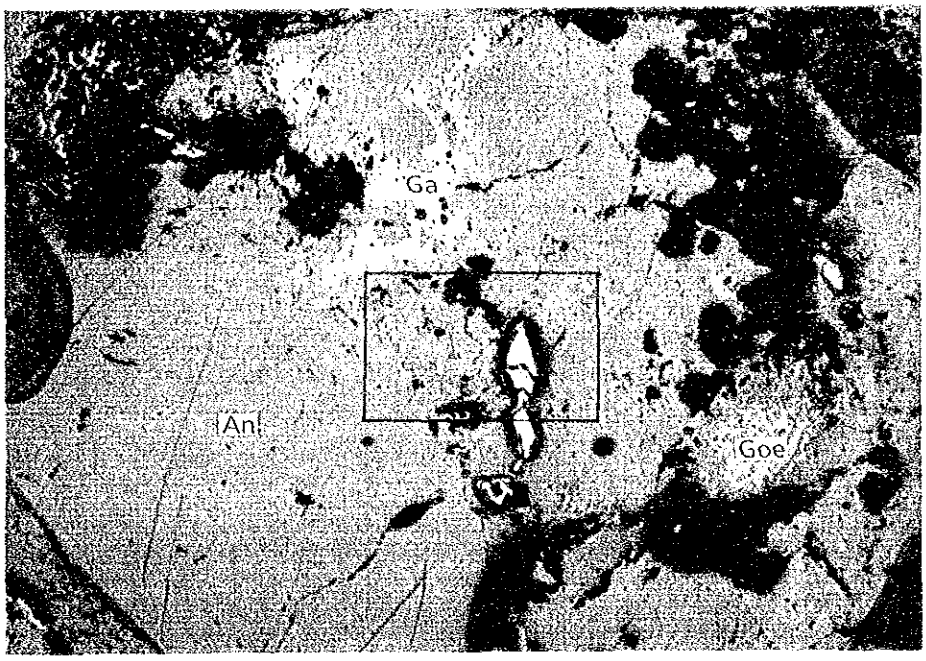
Sph : sphalerite
Py : pyrite
Ja : jalpaite
Tet : tetrahedrite
Ar : argentite
Bo : bornite
Cv : covellite
Hm : hematite
Gp : graphite
Qtz : quartz
Ba : barite (witherite)

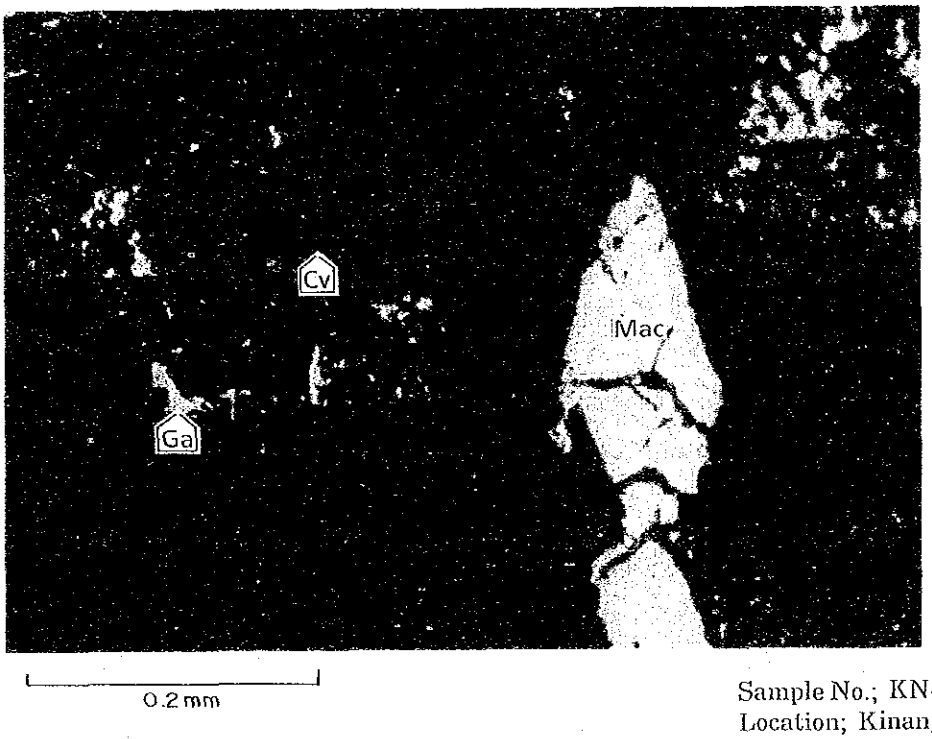




Sample No.; KN-05
Location; Kinangoni

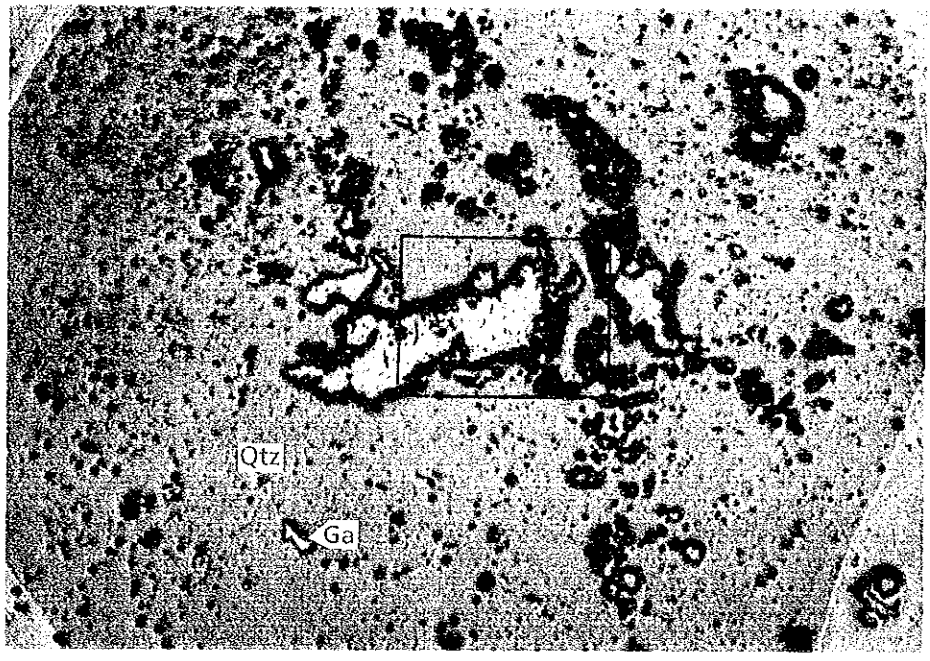
Photomicrographs (Polished section)

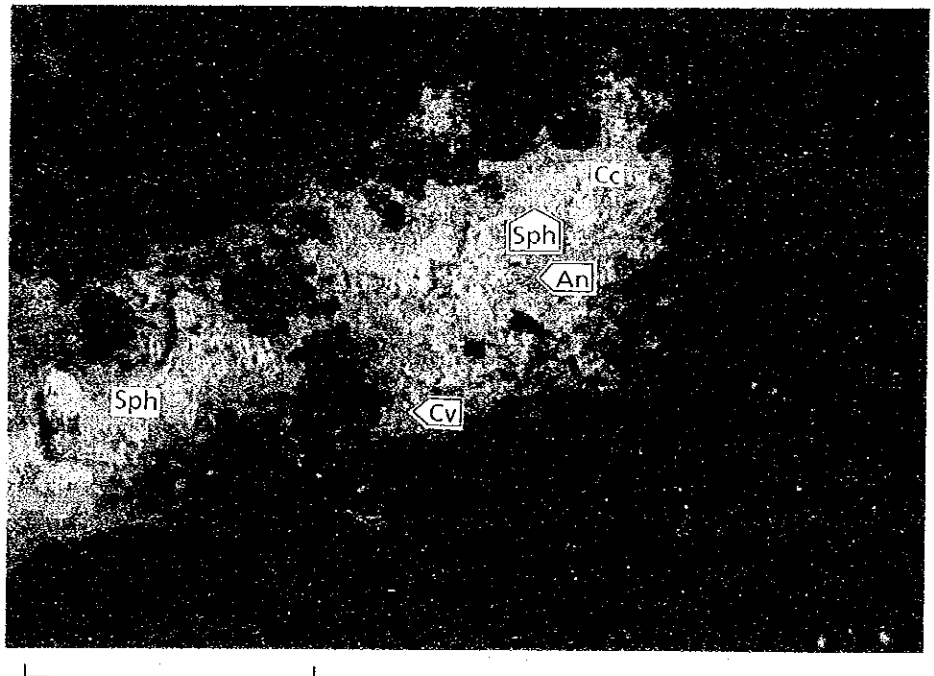




Sample No.; KN-26
Location; Kinangoni

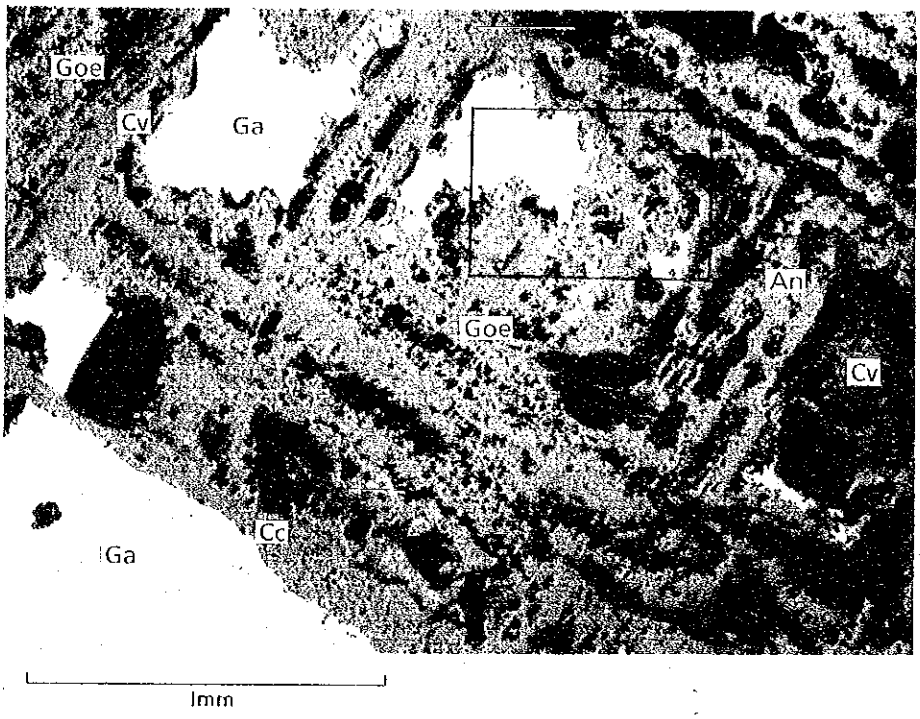
Photomicrographs (Polished section)

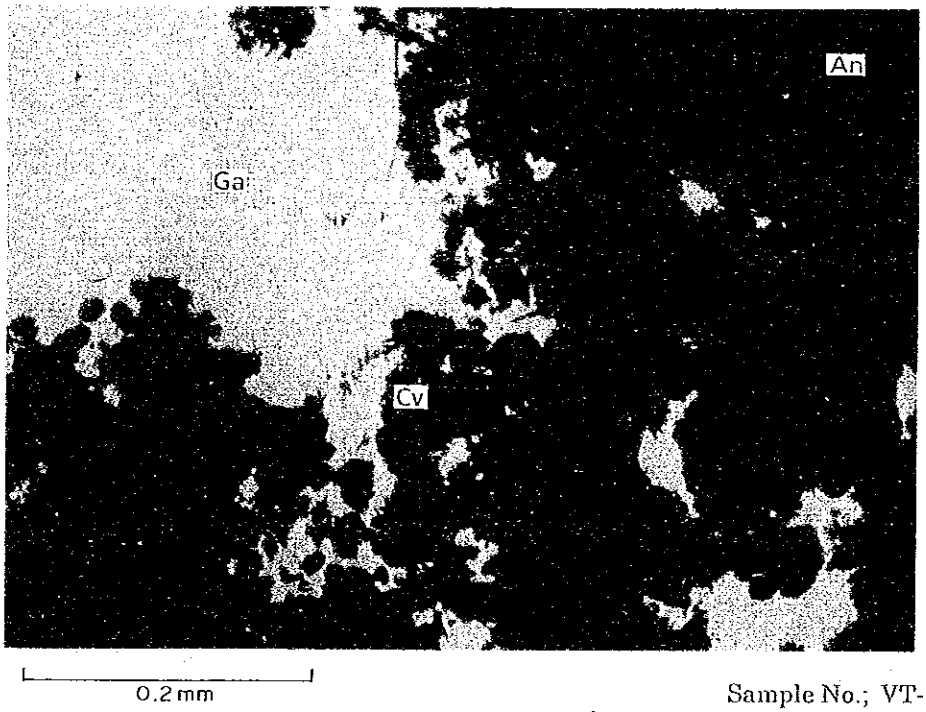




Sample No.; VT-06
Location; Vitengeni

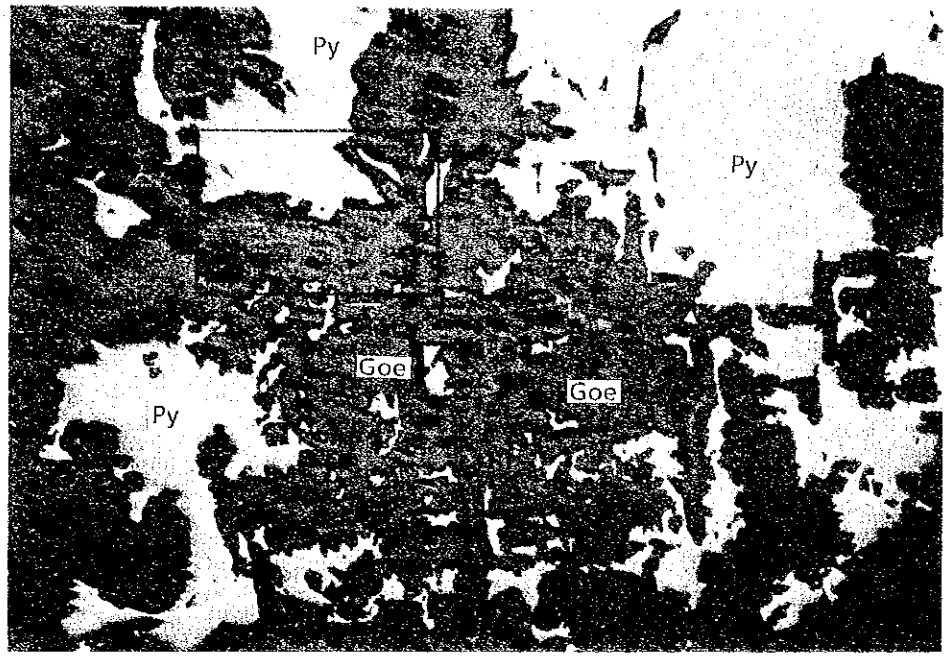
Photomicrographs (Polished section)





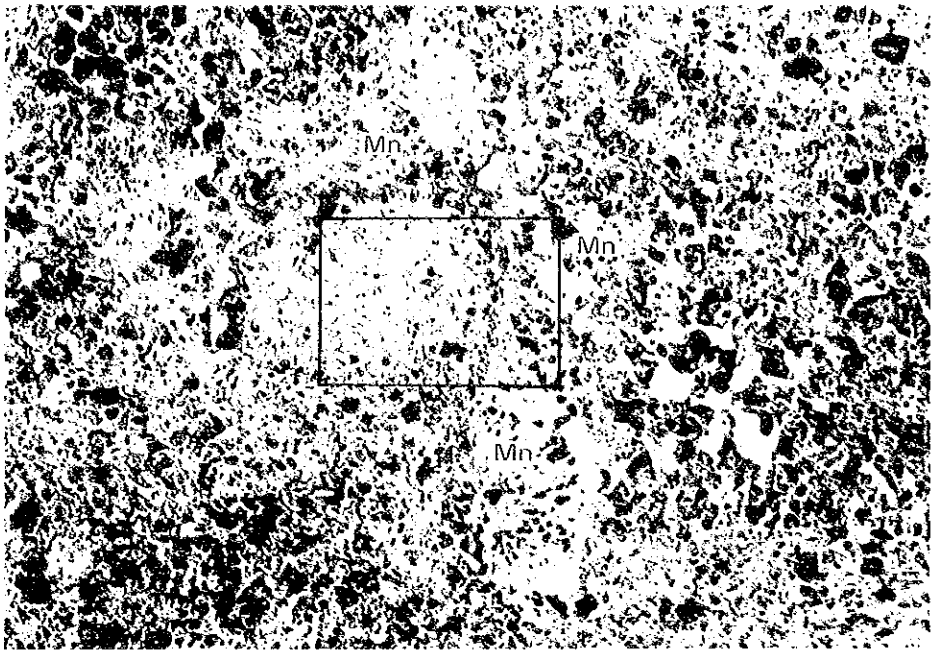
Sample No.; VT-16 B
Location; Vitengeni

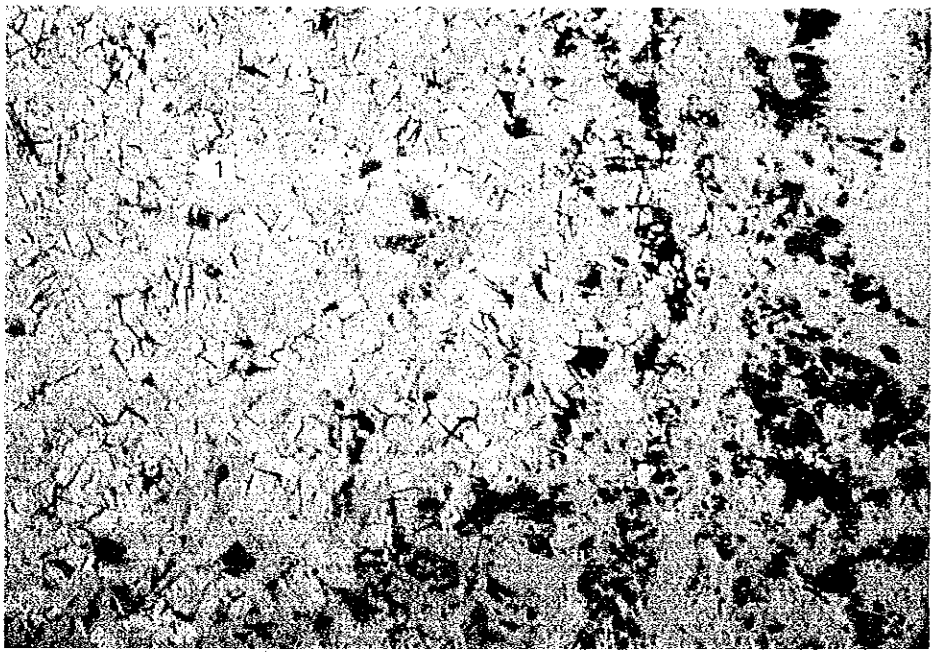
Photomicrographs (Polished section)



Sample No.; JA-08
Location; Jaribuni

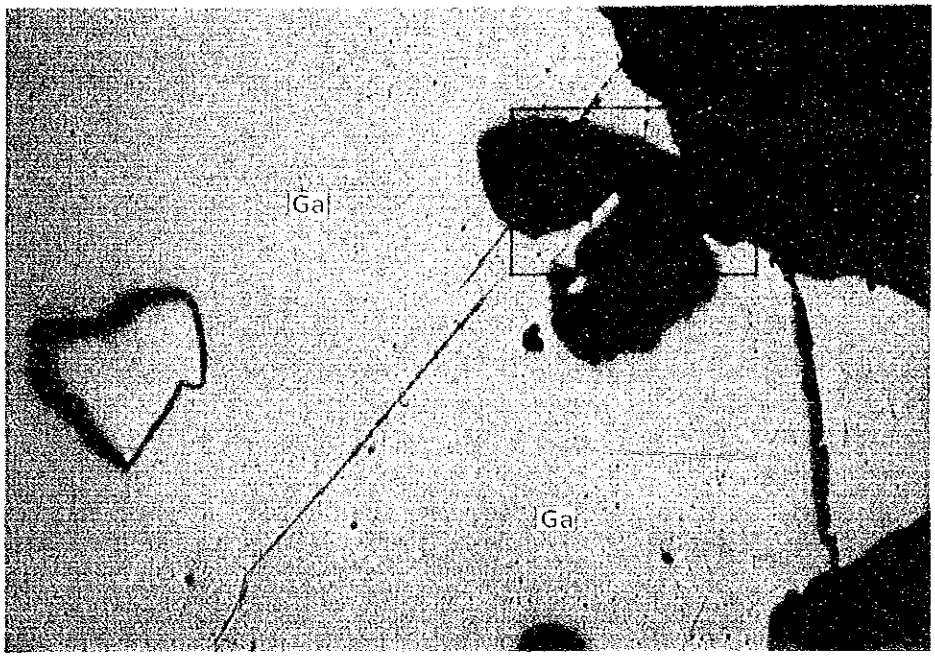
Photomicrographs (Polished section)

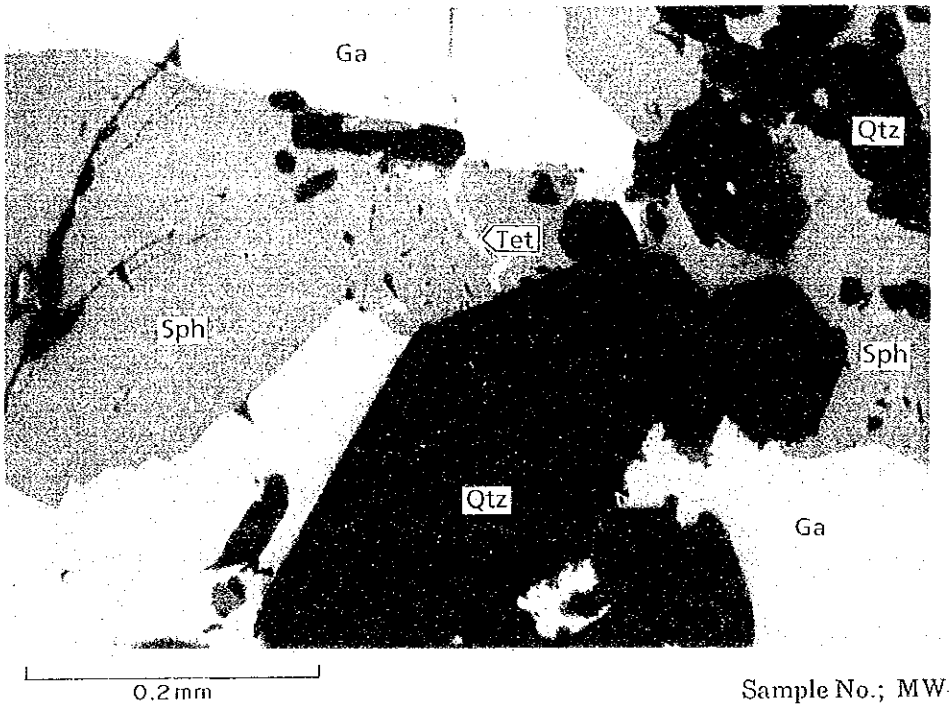




Sample No.; TO-09
Location; Kiwara Hill
1; Pyrolusite

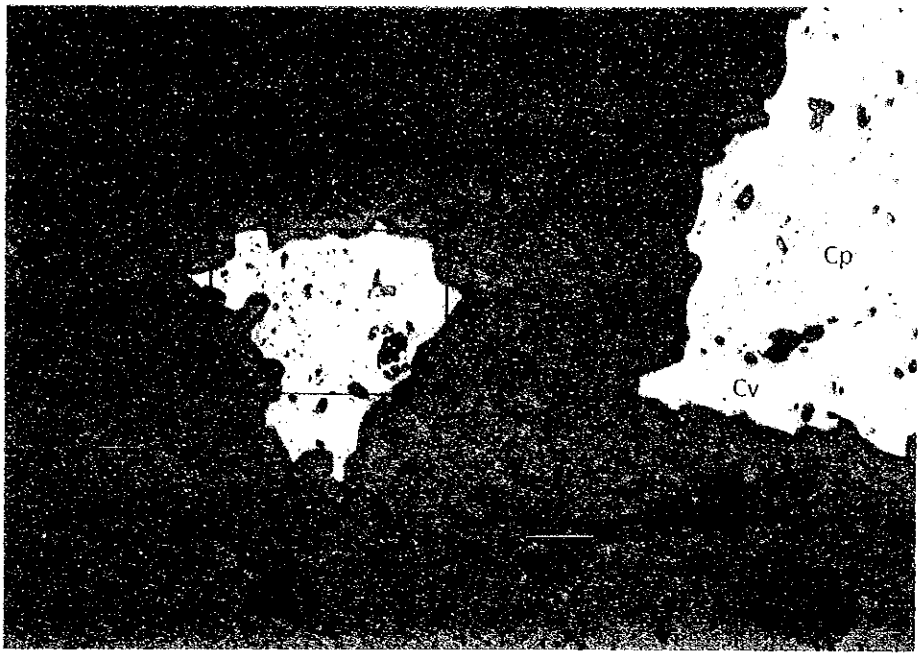
Photomicrographs (Polished section)

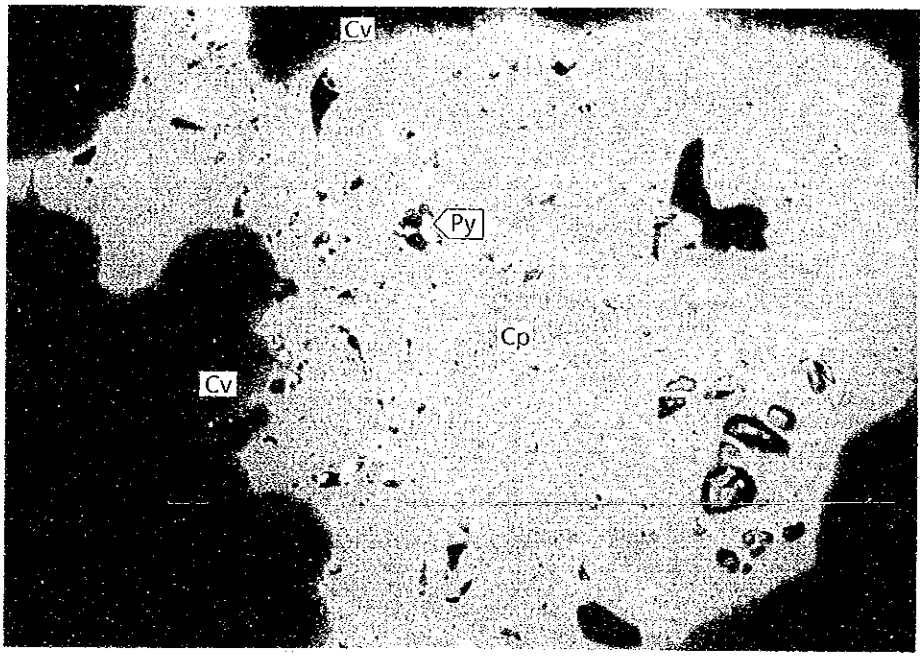




Sample No.; MW-07
Location; Mwachi River

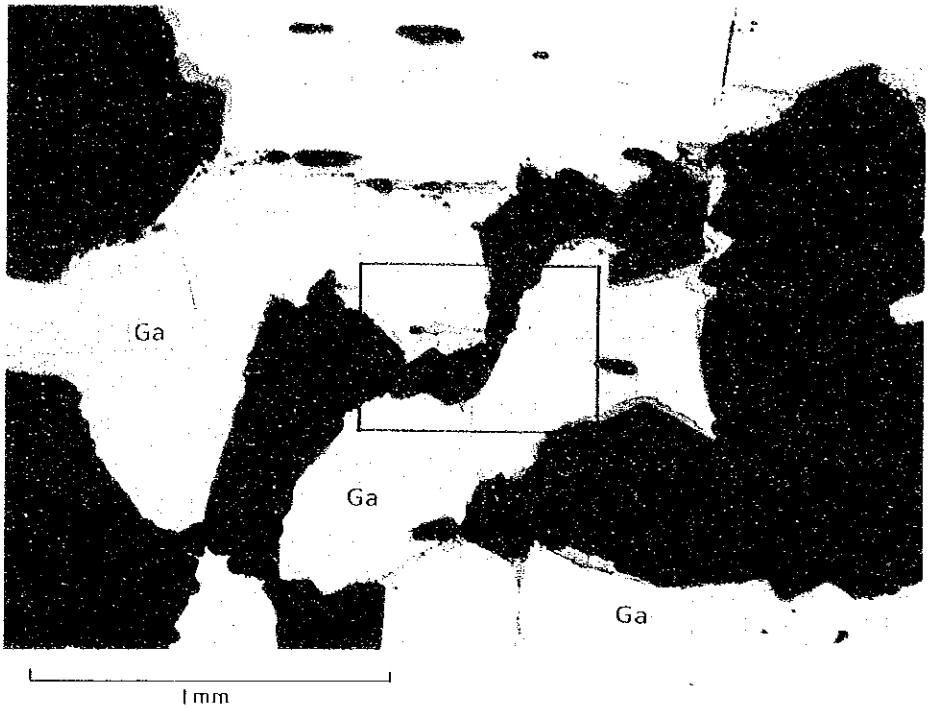
Photomicrographs (Polished section)

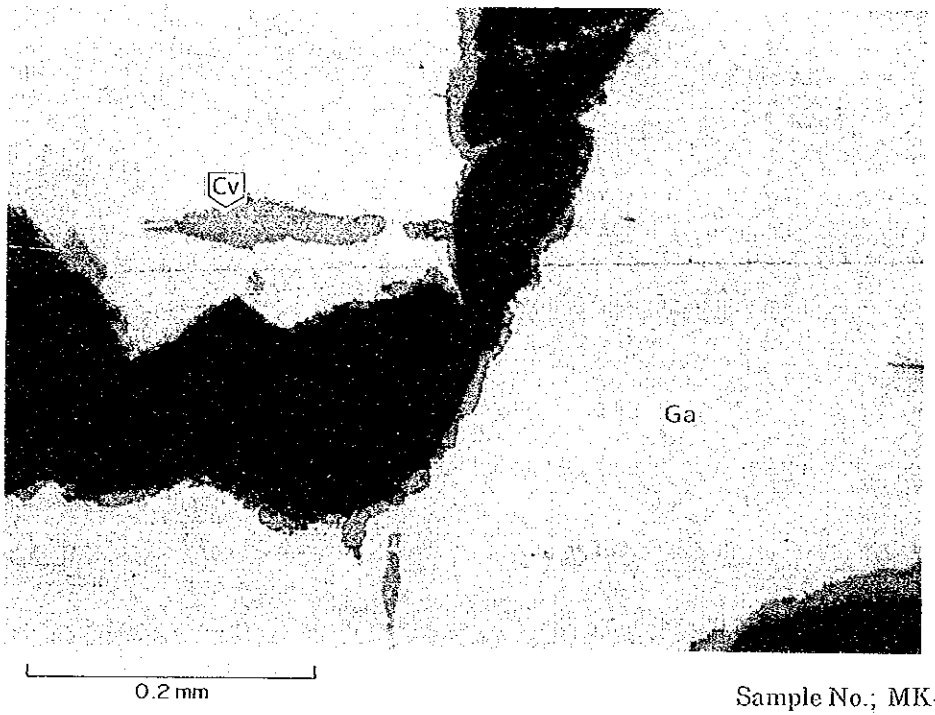




Sample No.; MK-14
Location; Mkundi

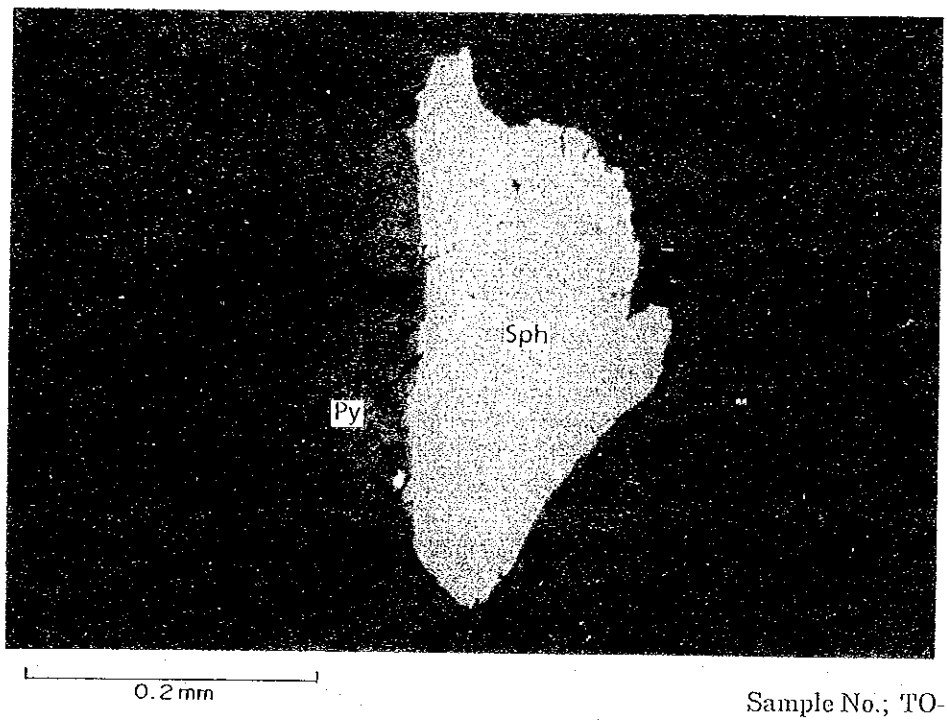
Photomicrographs (Polished section)





Sample No.; MK-17
Location; Mkundi

Photomicrographs (Polished section)



Sample No.; TO-04
Location; Lunga-Lunga

Photomicrographs (Polished section)

Appendix -IV

EPMA ANALYSIS

Minerals

Py	: pyrite	Tet	: tetrahedrite
Sph	: spalerite	Stm	: stromeyerite
Cpy	: chalcopyrite	Hm	: hematite
Ga	: galena	Lm	: limonite
An	: anglesite	Goe-Ja	: goethite-jarosite aggregate
Ba	: barite	Mal	: malachite
Wit	: witherite	Pyr	: pyrolusite
Bac	: barytocalcite	Cry	: cryptomelane
Cv	: covellite	Ho	: hollandite
Qtz	: quartz	Kf	: potassium feldspar
Ca	: calcite	Ab	: albite
Do	: dolomite	Ru	: rutile
		Zi	: zircon

Summary of EPMA Mineral List identified by Qualitative Analysis (1)

Sample Number	Location	Observation	Constituents of Minerals		
			Major	Common	Rare
KN-05	Kinangoni, fault clay of hanging wall, 140 ML pit	Massive galena in hanging wall fault clay	Ga	Cpy, Py	Stm, Sph, Tet
KN-10	Kinangoni, pit bottom	Ga-An vein, Auglesite (secondary) ≫ galena (primary)	An	Ga, Goe-Ja	Py, Cv
KN-27	Kinangoni, 140 ML pit	Massive ore, Ga-An-Py-Mal-Qtz vein	An	Ga, Py	Cpy
KN-34B	Kinangoni, 135~140 ML pit	Sooty black material on barite crystal surface	Sph, An, Qtz	Py	Ga, Cpy
KN-34D	Kinangoni, 135~140 ML pit	Massive sphalerite vein in sandstone	Sph, Qtz		Ga
KN-35	Kinangoni, 140 ML pit	Galena, euhedral, in country rock with quartz and barite	Ga, Qtz	Ba	Py
VT-01	Vitengeni, foot wall of the latest mined-out pit	Qtz-Ba-Ga-green copper vein, massive	Ba	Ga	Sph
VT-05	Vitengeni, float	Massive gelena, single crystal, partially sulfated surface	Ga		
VT-06	Vitengeni, old mining pit	Ga-Sph-Qtz-Ba vein (W = 0.3 m)	Qtz		Ba, Ga
VT-09	Vitengeni, upper part of the latest mined-out pit	Transparent barite crystal	Ba		
VT-10	Vitengeni, upper part of the latest mined-out pit	Barite crystal, sugarly	Ba		

(to be continued)

Summary of EPMA Mineral List identified by Qualitative Analysis (2)

Sample Number	Location	Observation	Constituents of Minerals		
			Major	Common	Rare
VT-15	Vitengeni, stockpiles of sulfide-rich ore	Sulfide ore; galena-anglesite predominant	Qtz	Ga, An, Ba	
VT-16A	Vitengeni, stockpiles of sulfide-rich ore	Sulfide ore; galena-green copper-barite	Ga, Ba, Qtz	An	Cv
JA-08	Jaribuni, mining pit	Massive ore, hematite-pyrite	Py, Hm		
TO-09	Kiwara Hill South	Mn-oxide nodules, cobble~pebble size	Pyr, Cry, Ho	Qtz	Ba, Zi
GO-03	Goshi, old mining pit	Barytes single crystal	Ba		
CH-04	Changómbe north	Limonitic gossan, dark brown~ reddish brown	Qtz, Goe, Hm		Ru, Zi
MW-02	Mwachi River (tributary), downstream from borehole	Sph-Py-Ga-Cal vein, (sphalerite dominant)	Sph, Ga, Mn-rich Ca		Py, Qtz
MK-17	Mkundi North	Ga-Qtz vein & network (W=0.3 m)	Ga, Qtz	An	
MK-22	Mkundi South	Black sooty pyrite in hotspring, colloform structure	Py, Qtz, Kf, Ab		Ga, Zi
TO-01	Lunga-Lunga, old mining pit	Pure barite crystal	Wit		
TO-04	Lunga-Lunga, old mining pit	Ba-Sph-Ga vein	Wit, Qtz	Ga, Bac, Do, Sph	

Abbreviations:

Py; pyrite, Sph; sphalerite, Cpy; chalcopyrite, Ga; galena, An; anglesite, Ba; barite, Wit; witherite, Bac; barytocalcite, Cv; covellite, Tet; tetrahedrite, Stm; stromeyerite, Hm; hematite, Lm; limonite, Goe-Ja; goethite-jarosite aggregate, Mal; malachite, Pyr; pyrolusite, Cry; cryptomelane, Ho; hollandite, Qtz; quartz, Ca; calcite, Do; dolomite, Kf; Potassium feldspar Ab; albite, Ru; rutile, Zi; zircon

Summary of EPMA Quantitative Analysis of Minerals (1)

Sample Number	Minerals	Components	Results (weight %)				Average
KN-05	Pyrite		1	2			
		Fe	44.7	44.7			44.7
		Cu	<0.1	<0.1			<0.1
		Zn	0.4	0.1			0.3
		As	0.6	0.4			0.5
		Sb	0.1	0.1			<0.1
		S	53.9	54.6			54.3
		Total	99.6	99.9			99.8
	Tetrahedrite		3	4	5		
		Cu	30.8	31.6	31.6		31.3
		Fe	4.6	4.5	4.5		4.5
		Ag	10.1	7.8	8.3		8.7
		Zn	0.4	1.7	0.8		1.0
		Sb	29.3	30.3	30.1		29.9
		S	23.2	23.3	23.4		23.3
		Total	98.4	99.2	98.7		98.7
	Stromeyerite		6	7	8		
		Cu	31.0	30.0	30.4		30.5
		Ag	53.2	52.6	52.8		52.9
		Zn	0.2	<0.1	<0.1		<0.1
		Fe	<0.1	0.1	<0.1		<0.1
		Sb	<0.1	<0.1	<0.1		<0.1
		S	15.8	15.7	15.7		15.7
		Total	100.2	98.4	98.9		99.1
	Sphalerite		9	10			
		Zn	65.9	65.1			65.5
		Fe	0.4	1.0			0.7
		Cu	1.8	0.8			1.3
		Ag	0.6	<0.1			0.3
		Sb	0.2	0.1			0.2
		S	32.2	33.1			32.7
		Total	101.1	100.1			100.7
	Chalcopyrite		11	12			
		Cu	34.1	35.2			34.7
		Fe	28.9	28.7			28.8
		Zn	<0.1	0.1			<0.1
		Ag	<0.1	<0.1			<0.1
		Sb	<0.1	<0.1			<0.1
		S	35.5	35.1			35.3
		Total	98.5	99.1			98.8
KN-10	Covellite		1	2			
		Cu	63.5	64.2			63.9
		Fe	<0.1	0.1			<0.1
		Ag	0.7	0.5			0.6
		Zn	<0.1	<0.1			<0.1
		Sb	<0.1	<0.1			<0.1
		S	33.5	33.3			33.4
		Total	97.7	98.1			97.9
	Goethite-Jarosite aggregate		3	4			
		FeO	75.6	72.3			74.0
		SO_2	1.8	1.5			1.7
		SiO_2	2.6	1.3			2.0
		Al_2O_3	1.8	1.4			1.6
		Total	81.8	76.5			79.3
KN-27	Pyrite		1	2			
		Fe	47.3	48.0			47.7
		Cu	<0.1	<0.1			<0.1
		Zn	<0.1	<0.1			<0.1
		As	0.3	0.3			0.3
		Sb	<0.1	<0.1			<0.1
		Ag	<0.1	<0.1			<0.1
		S	53.0	53.2			53.1
		Total	100.6	101.5			101.1
	Chalcopyrite		3	4			
		Cu	33.6	34.3			34.0
		Fe	30.2	30.2			30.2
		Zn	<0.1	0.2			0.1
		Ag	<0.1	<0.1			<0.1
		Sb	<0.1	<0.1			<0.1
		As	0.9	1.3			1.1
		S	35.2	35.1			35.2
		Total	99.9	101.0			100.6

Sample Number	Minerals	Components	Results (weight %)				Average
KN-34B	Pyrite		1	2			
		Fe	46.7	46.7			46.7
		Cu	0.2	0.3			0.3
		Zn	0.5	0.2			0.4
		As	0.1	<0.1			<0.1
		Sb	<0.1	<0.1			<0.1
		Ag	<0.1	<0.1			<0.1
		S	52.9	53.2			53.1
		Total	100.4	100.4			100.5
	Sphalerite		3	4			
		Zn	59.7	60.4			60.1
		Fe	6.2	6.8			6.5
		Cu	0.5	<0.1			0.3
		Ag	<0.1	<0.1			<0.1
		As	0.2	0.1			0.2
		Sb	0.1	0.2			0.2
		S	32.8	33.2			33.0
		Total	99.5	100.7			100.3
KN-34D	Sphalerite		1	2	3		
		Zn	60.8	59.4	58.5		59.6
		Fe	6.6	7.5	8.3		7.5
		Cu	0.1	<0.1	<0.1		<0.1
		Ag	<0.1	<0.1	<0.1		<0.1
		As	<0.1	<0.1	<0.1		<0.1
		Sb	<0.1	<0.1	<0.1		<0.1
		S	32.8	33.5	33.5		33.3
		Total	100.3	100.4	100.3		100.4
KN-35	Pyrite		1	2	3		
		Fe	45.8	47.7	47.4		47.0
		S	52.5	53.7	53.0		53.1
		Total	98.3	101.4	100.4		100.1
	Barite		4	5			
		BaO	65.7	66.3			66.0
		SO_3	33.1	32.8			33.0
		CaO	0.2	0.3			0.3
		FeO	0.2	0.1			0.2
		SrO	0.8	0.7			0.8
		Total	100.0	99.9			100.3
VT-01	Sphalerite		1	2			
		Zn	67.0	66.1			66.6
		Fe	0.2	0.2			0.2
		Cu	0.3	<0.1			0.2
		Ag	<0.1	<0.1			<0.1
		As	<0.1	<0.1			<0.1
		Sb	<0.1	<0.1			<0.1
		S	32.1	32.6			32.4
		Total	99.6	98.9			99.4
	Barite		3	4			
		BaO	66.2	65.9			66.1
		SO_3	33.3	33.5			33.4
		CaO	0.1	<0.1			<0.1
		FeO	0.2	0.2			0.2
		SrO	0.6	0.7			0.7
		Total	100.4	100.3			100.4
VT-06	Barite		1	2			
		BaO	66.8	66.3			66.6
		SO_3	33.2	33.5			33.4
		CaO	0.1	<0.1			<0.1
		FeO	0.2	0.2			0.2
		SrO	0.8	0.6			0.7
		AgO	<0.1	<0.1			<0.1
		Total	101.1	100.6			100.9
VT-09	Barite		1	2			
		BaO	66.4	66.3			66.4
		SO_3	33.3	32.4			32.9
		CaO	0.1	<0.1			<0.1
		FeO	0.2	<0.1			0.1
		SrO	0.9	1.1			1.0
		Total	100.9	99.8			100.4
VT-10	Barite		1	2			
		BaO	66.3	66.5			66.4
		SO_3	33.7	33.4			33.6
		CaO	<0.1	<0.1			<0.1
		FeO	0.2	<0.1			0.1
		SrO	0.7	0.7			0.7
		Total	100.9	100.6			100.8

(to becontonned)