

Appendix 4

Microscopic observations and
microphotographs (Polished section)

Microscopic Observation (Polished Section)

No.	Sample No.	Sector	Locality	Rock name	Magnetite	Hematite	Ilmenite	Rutile	Goethite	Mn oxide	Pyrite	Marcasite	Pyrrhotite	Sphalerite	Galena	Pyrochlore	Chalcopyrite	Covellite	Monazite	
1	S0102	Songwe	JMS-1	Sovite																
2	S0204	"	" 2	Carbonatite				3												
3	S0207	"	" 2	Mn oxide	1				3											
4	S0310	"	" 3	Carbonatite						3										
5	S0403	"	" 4	"																
6	S0605	"	" 6	Mn oxide																
7	JMS-6	"	" 6	Mepherine syenite																
8	S0801	"	" 8	Calc-silicate rock	2			1												
9	S1003	"	" 10	Calc-silicate rock	2															
10	S1006	"	" 10	Carbonatite																
11	S1009	"	" 10	"	1															
12	S1015	"	" 10	"																
13	S1105	"	" 11	"	1															
14	T0106	Tundulu	JMT-1	Calc-silicate rock	3															
15	T0108	"	" 1	Carbonatite	4															
16	T0113	"	" 1	"	2															
17	T0209	"	" 2	"	3															
18	T0210	"	" 2	"	4															
19	T0602	"	" 6	"	3															
20	JMT-6	"	" 6	"	2															
21	T0608	"	" 6	"	3															
22	T0707	"	" 7	"	2															
23	T1004	"	" 10	Mn ore																
24	T1204	"	" 12	Carbonatite	3															
25	T1216	"	" 12	"	3															
26	T1610	"	" 16	"																
27	T1611	"	" 16	"																
28	T2201	"	" 22	Fe-Mn oxide																
29	T2211	"	" 22	Calc-silicate rock	2															
30	Nata 1	"	Surface	Fe ore	2															
31	Nata 2	"	"	"	4															
32	7YR2	Songwe	"	"	4															
33	7YR14	"	"	Magnetite	3															
34	7X030	"	"	K-feldspar	4															
35	7Y167	Tundulu	"	Magnetite-cb	4															
36	7Y174	"	"	Biotite silic rock	3															
37	7Y179	"	"	Apatite rock	3															
38	7Y181	"	"	"	1															
39	7Y211	"	"	"	1															
40	7Y226	Kangankunde	"	Carbonatite	3															2

4 : Abundant 3 : Common 2 : Little 1 : Rare

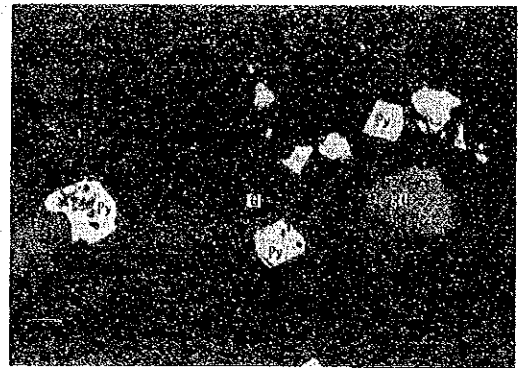
①

Sample No. : S0102
Sector : Songwe Locality : JMS-1 14.0^m
Rock name : White Colored Carbonatite
Observation Note:

The specimen is white colored carbonatite weakly disseminated with pyrite.

Pyrite occurs as an euhedral grain less than 0.2 mm in diameter. Pyrrhotite occurs as small amoeboid-shape inclusions in some pyrite.

Rutile show mosaic intergrowth in botryoidal mass, which might be the pseudomorph after ilmenite.

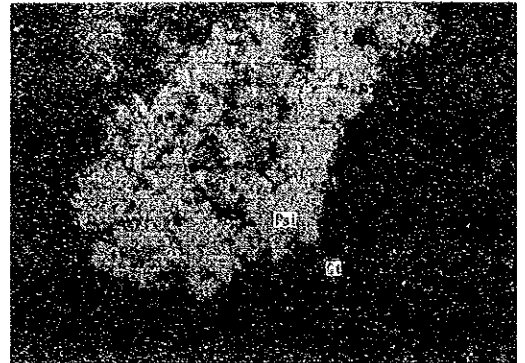


②

Sample No. : S0204
Sector : Songwe Locality : JMS-2 24.9^m
Rock name : Reddish oxidized rock
Observation Note:

Opaque minerals are rare, and are scattered widely.

Psilomelane like mineral shows creamy to greyish white color with strong anisotropy. The minerals form botryoidal aggregate of minute acicular crystals. The qualitative analysis by EPMA shows the existence of Ba, Ca, Zn, Fe and K. Goethite coexists with psilomelane like minerals in the botryoidal aggregate. The other occurrence of goethite shows concentric zonal texture that suggests the decomposition from pyrrhotite or pyrite.

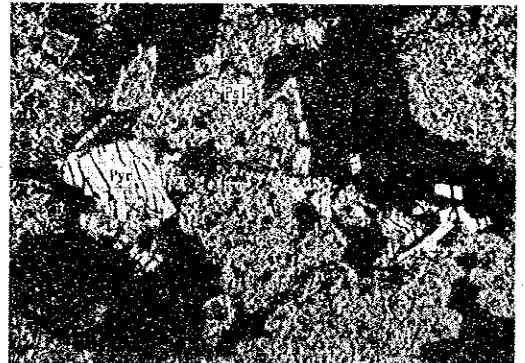


③

Sample No. : S0207
Sector : Songwe Locality : JMS-2 40.8^m
Rock name : Massive oxidized Fe-Mn ore.
Observation Note:

The EPMA analysis and microscopic observation suggest that there are two kinds of minerals of Mn-O system. Both minerals occur as coarse (less than 0.1 mm in diameter) euhedral tabular or prismatic crystals. One shows creamy greyish color with strong anisotropy. Twinning and cleavage vertical against to twinning plane are observed. The other shows more yellowish color with distinct anisotropy. The former might be pyrolusite and the latter ramsdellite. These minerals are often enclosed in the aggregate of the fine grains of goethite and psilomelane like minerals. Psilomelane like mineral shows color of bluish grey to greyish white with strong anisotropy.

Hematite also occurs as mosaic intergrowth with Mn-minerals and goethite. Magnetite occasionally occurs as euhedral grains, and is decomposed into hematite with lattice-shaped replacement texture.



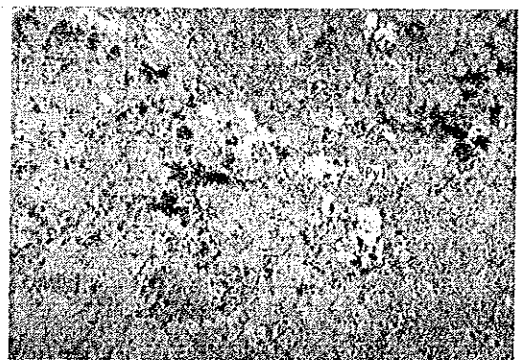
④

Sample No. : S0310
Sector : Songwe Locality : JMS-3 52.5^m
Rock name : Carbonatite
Observation Note :

The specimen is composed essentially of white carbonatite with mosaic texture.

Pyrite occurs as euhedral grain less than 0.2mm in diameter and is not so common. goethite is also small in amount and shows close intergrowth with carbonate.

Pyrochlore occurs as an euhedral to subhedral grain less than 0.2mm in diameter and is scattered widely in carbonate mass.



⑤

Sample No. : S0403
Sector : Songwe Locality : JMS-4 29.0m
Rock name : Carbonatite
Observation Note :

The specimen is dark brown carbonatite with abundant goethite. Opaque minerals are rare and are scattered widely. Goethite occurs as anhedral grains and is usually found associated with calcite, suggesting that these minerals are derived from ankerite. A small amount of cubic grains like pyrite is also observed, but is completely replaced by Fe-oxide.



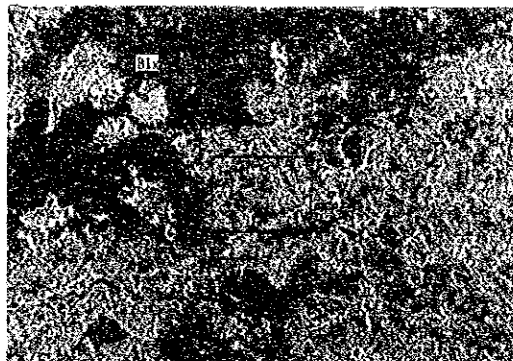
0 0.2mm

⑥

Sample No. : S0605
Sector : Songwe Locality : JMS-6 14.6m
Rock name : Oxidized Fe-Mn ore.
Observation Note:

Bixbyite or jacobsite like minerals occur as euhedral crystals or granular aggregate. The mineral shows brownish gray color and isotropy. The qualitative analysis shows Fe-Mn-oxide. Partly the mineral is decomposed to intergrowth of hematites and braunite like minerals. Braunite like mineral forms finely granular masses. The enclosed photograph of X-

In some parts, goethite are also associated with hematite and Mn-minerals. They occur as fine irregular crystals.

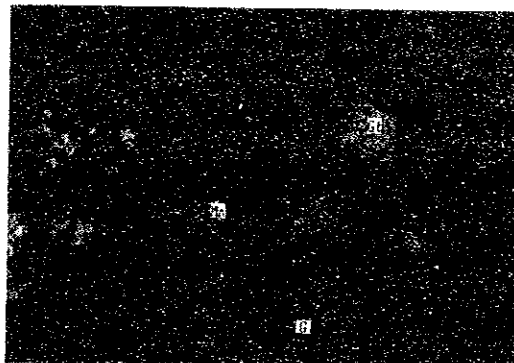


0 0.2mm

⑦

Sample No. : JMS6
Sector : Songwe Locality : JMS-6 46.2m
Rock name : Pinkish oxidized igneous rock
Observation Note :

Opaque minerals are rare, and primary mineral is only pyrite which occurs as euhedral grain of about 0.02 mm in diameter. Many pyrite grains have changed to goethite which form cubic pseudomorph. Some goethite might be decomposed from pyrrhotite. Only one grain of relic pyrrhotite is observed in the goethite. Rutiles are scattered in the specimen, and the fine crystals form irregular-shaped aggregate. Small anhedral Mn-oxide minerals occur in the boundary between rock-forming minerals.



0 0.1mm

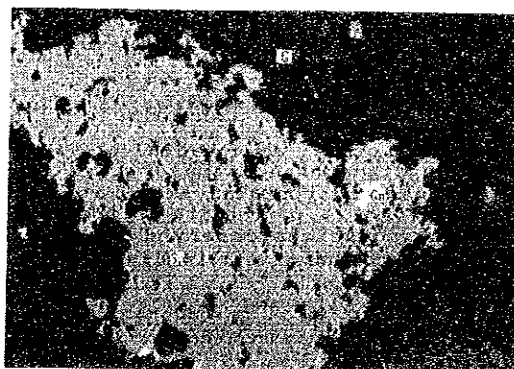
⑧

Sample No. : S0801
Sector : Songwe Locality : JMS-8 2.3m
Rock Name : Carbonatite
Observation Note:

Opaque mineral is very rare. and shows simple assemblage.

Magnetite occur as euhedral to subhedral primary rock-forming minerals. The grain size is less than 0.1 mm in diameter. Hematite occurs in the margin of magnetite, and looks like decomposed crystal from magnetite, in spite of the lack of lattice-shaped replacement texture.

Sphalerite occurs as irregular form and shows rather distinct internal reflection. Some sphalerite grains include small grains of galena (3 micron in diameter) and pyrite (5 micron). Pyrite also occurs as coarse euhedral crystal less than 0.5 mm in diameter. Those pyrites contain small inclusions of pyrrhotite.



0 0.1mm

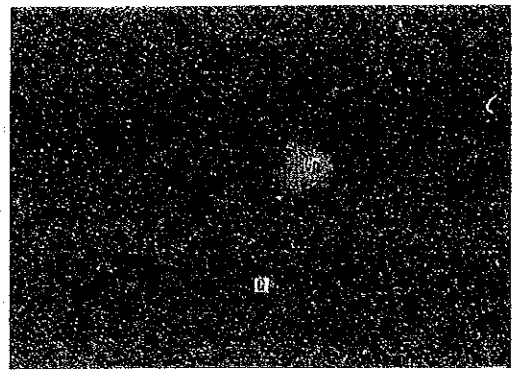
⑨

Sample No. : S1003
Sector : Songwe Locality : JMS-10 13.9m
Rock name : Carbonate silicate rock
Observation Note:

Opaque minerals are rare, and are disseminated widely in the specimen.

Rutile shows subhedral to anhedral shape, and the grain size is less than 0.1 mm in diameter. Pseudobrookite occurs in the rutile with sandwich texture, and also occurs as single irregular grain. There are a few very small grains showing bright yellowish color without anisotropy. EPMA analysis shows Ca, Al, Fe and Mn oxide but mineral name could not be determined.

Pyrite occurs as enrounded form, and the margin is decomposed into goethite. Occasionally galena occurs as small (less than 0.03 mm) anhedral grains.

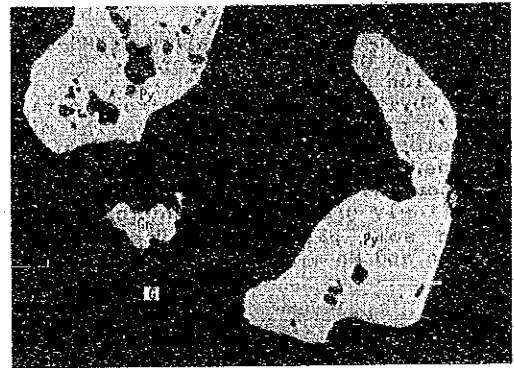


⑩

Sample No. : S1006
Sector : Songwe Locality : JMS-10 25.0m
Rock name : Pinkish carbonatite
Observation Note:

Coarse grains of pyrite are disseminated in the specimen. Pyrite occurs as euhedral to subhedral grains less than 0.2 mm in diameter, with abundant inclusions of gangue minerals. Galena is rarely observed in the grain boundary of pyrite and in gangue minerals. The grain size is approximately 0.1mm in diameter. Pyrrhotite also occurs as amoeboid-shaped inclusions in pyrite. Marcasite like mineral is rarely observed. The grain size is so small to identify in detail.

Fe bearing rutile occurs as aggregate with mosaic texture. It is common to be associated with monazite like minerals.



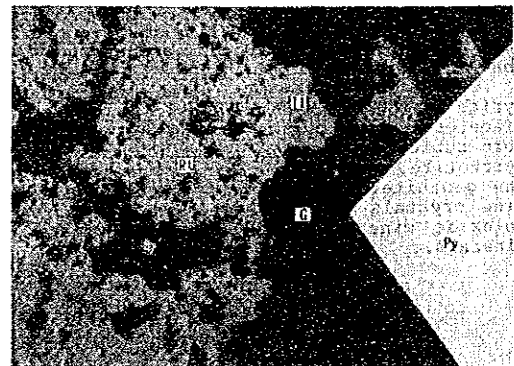
⑪

Sample No. : S1009
Sector : Songwe Locality : JMS-10 33.8m
Rock name : Brownish layered carbonatite
Observation Note:

The specimen shows slightly layered texture, and a layer is enriched in opaque minerals.

Pyrite occurs as large euhedral grains less than 1.0 mm in diameter, and includes many inclusions of pyrrhotite, sphalerite, galena and other gangue minerals.

More predominant opaque minerals are aggregate of rutile and ilmenite with mosaic texture. Rutile contains niobium and vanadium (qualitative results from EPMA), hence it might be better to call Nb-rutile. Ilmenite contains neither Nb nor V, but only contains small amount of Ca and Mn. Small amount of magnetite can be observed as relic crystals that is decomposed into hematite in the margin.

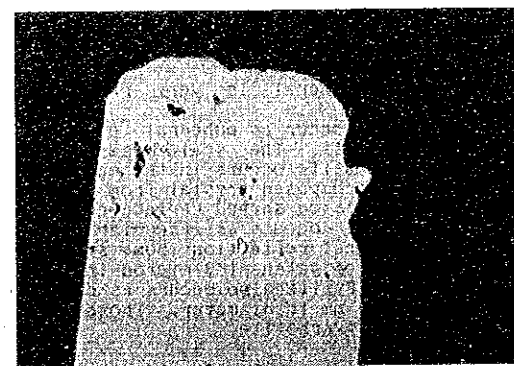


⑫

Sample No. : S1015
Sector : Songwe Locality : JMS-10 49.8m
Rock name : Carbonatite
Observation Note:

Small amount of pyrite are scattered widely in the specimen.

Pyrite occurs as euhedral or subhedral grain of about 0.3 mm in diameter and small grain of 0.01mm in diameter. The large grain contains small amoeboid-shaped pyrrhotite. The grain size of pyrrhotite is from 0.01mm to 0.05mm. Small pyrite is sometimes observed in the monazite like gangue minerals. The shape is irregular. The other mineral can not be observed.



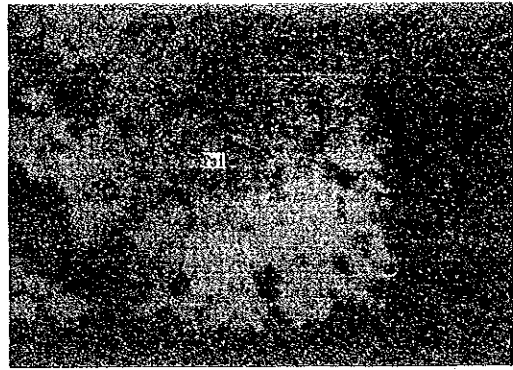
13

Sample No. : S1105
Sector : Songwe Locality : JMS-11 16.4m
Rock name : Brownish oxidized carbonatite
Observation Note:

Opaque minerals occur commonly as botryoidal masses composed mainly of Mn-oxide minerals.

Psilomelane like minerals show bluish grey to greyish white color with strong anisotropy. The forms are aggregates of minute acicular crystals with goethite. According to EPMA analysis, the psilomelane like minerals contains some amount of Ba (result from EPMA). Other Mn-minerals might also be contained in the botryoidal masses. Some goethite shows concentric zonal replacement texture, which might be pseudomorph from pyrite or pyrrhotite.

Magnetite occasionally occurs as euhedral grains, but almost whole area is decomposed to hematite with lattice-shaped texture.



0 0.1mm

14

Sample No. : T0106
Sector : Tundulu Locality : JMT-1 22.6m
Rock name : Carbonate silicate rock
Observation Note:

Magnetite occurs as euhedral to subhedral grains of about 0.2 mm in diameter. Ilmenite occurs in magnetite grain showing sandwich or lamellae texture. Hematite occurs as irregular shape in the margin of magnetite grain. Also hematite occurs along the ilmenite lamella in magnetite. Tabular-shaped rutile occurs associating with magnetite.

Pyrite occurs as euhedral to subhedral grain including small spots of pyrrhotite. Sometimes pyrite is decomposed to goethite which shows concentric zonal texture. Marcasite is associated with pyrite as lath-shaped intergrowth, which might be decomposed from pyrrhotite.



0 0.1mm

15

Sample No. : T0108
Sector : Tundulu Locality : JMT-1 26.8m
Rock name : Heterogeneous carbonatite
Observation Note:

The specimen is composed of melanocratic, brownish and leucocratic parts.

Magnetite occurs as euhedral grains of 0.3-0.5 mm size in the melanocratic part. The margin is decomposed into hematite. Lattice-shaped replacement texture is not common. Pyrite occurs as euhedral to subhedral grains less than 0.5 mm in diameter, and is associated with lath-shaped marcasite. Rutile occurs as tabular-shaped euhedral grain.

Pyrrhotite is included as spotted or amoeboid-shaped crystals in pyrite grain. Sphalerite also coexists with pyrite.



0 0.1mm

16

Sample No. : T0113
Sector : Tundulu Locality : JMT-1 42.7m
Rock name : Carbonatite
Observation Note:

The specimen is white colored carbonatite, associated with biotite and aegirine.

Pyrite is found as anhedral to subhedral grain less than 0.3mm in across and sometimes alter to hematite in the margin of it.

A small amount of goethite is also observed.



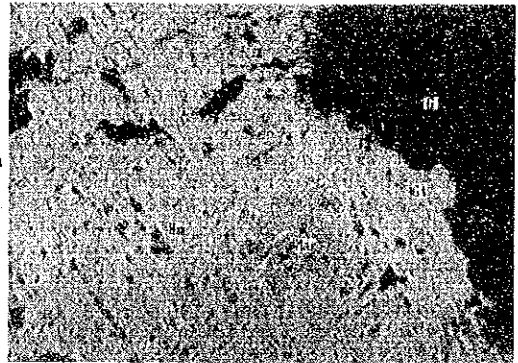
0 0.5mm

17

Sample No. : T0209
Sector : Tundulu Locality : JMT-2 44.4m
Rock name : Carbonatite with botryoidal masses
Observation Note:

Opaque minerals occur commonly as botryoidal masses composed mainly of iron oxide minerals.

Magnetite occurs as euhedral to subhedral grains of 0.1 to 0.5 mm in diameter, and is oxidized to hematite with lattice-shaped replacement texture. Occasionally outer margin of these iron oxide is enclosed by goethite. Goethite is also decomposed from pyrite or pyrrhotite, and shows concentric zoning. Rutile forms aggregate of tabular crystals, and also shows myrmekitic intergrowth with gangue minerals.



0 0.1mm

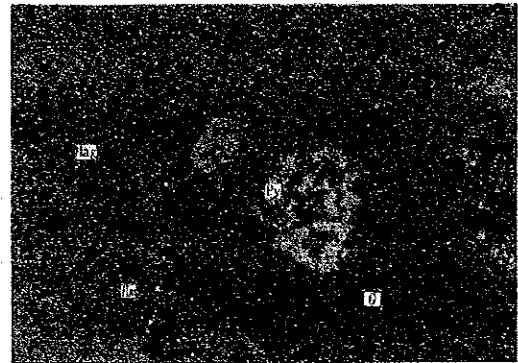
18

Sample No. : T0210
Sector : Tundulu Locality : JMT-2 45.5m
Rock name : Oxidized carbonatite with botryoidal masses.
Observation Note:

Primary assemblage of opaque minerals might be magnetite, rutile and pyrite.

Magnetite is euhedral to subhedral. The grain size is less than 1.0 mm, and the magnetite is decomposed into hematite in the margin with lattice-shaped texture. Rutile occurs as an euhedral grain. The aggregate of rutile, pseudobrookite and hematite might be pseudomorph from ilmenite.

Pyrite occurs as euhedral to subhedral grains of about 0.3 mm size, and often includes small grains of hematite and goethite. Some pyrite are coated by goethite. Marcasite is occasionally observed as lath-shaped texture.



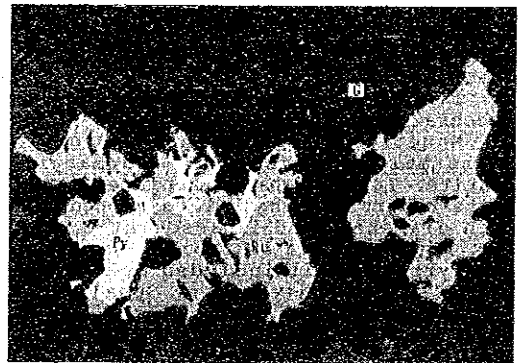
0 0.2mm

19

Sample No. : T0602
Sector : Tundulu Locality : JMT-6 6.5m
Rock name : Fresh carbonatite with banding structure
Observation Note:

The specimen shows banding structure, and opaque minerals are scattered in the one layer.

Magnetite occurs as euhedral to subhedral grains of about 0.3 mm in diameter. Some magnetites contain the exsolution lamellae (1 micron wide) of spinel like gangue minerals and ilmenite. Ilmenite also occurs as myrmekitic intergrowth with gangue minerals. Hematite occurs in the margin of magnetite and along the ilmenite lamellae. Rutile is also observed, and coexists with pyrite. Pyrite and pyrrhotite coexist together, and the latter is partly decomposed into marcasite.



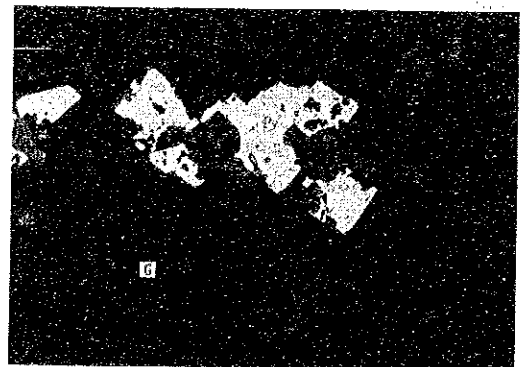
0 0.1mm

20

Sample No. : JMT6
Sector : Tundulu Locality : JMT-6 18.6m
Rock name : Carbonatite with veinlet of opaque minerals
Observation Note :

The opaque mineral assemblage is very simple in this specimen. Pyrite occurs as euhedral to subhedral grains. The large grains contain small spots of pyrrhotite. Marcasite occurs as lath-shaped grains, decomposed from pyrrhotite, and is associated with pyrite.

In the country rock opaque mineral is not observed.



0 0.2mm

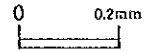
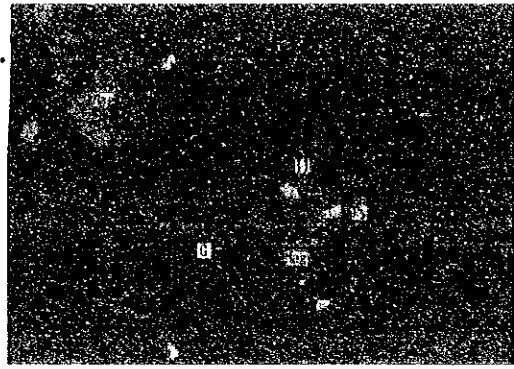
21

Sample No. : T0608
Sector : Tundulu Locality : JMT-6 46.6^m
Rock name : White carbonatite with a layer of opaque minerals.
Observation Note:

Opaque minerals occur in a layer and its assamblage is rather simple.

Magnetite occurs as euhedral to subhedral grains less than 0.1 mm in diameter, and has remained unchanged to hematite. Ilmenite occurs mainly as tabular-shaped euhedral grains. Also ilmenite occurs as exsolution lamellae in magnetite, and as myrmekitic intergrowth with other gangue minerals.

Pyrite occurs as euhedral to subhedral grain, coexisting with magnetite and ilmenite. Partly pyrite is associated with marcasite.



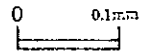
22

Sample No. : T0707
Sector : Tundulu Locality : JMT-7 21.0^m
Rock name : Magnetite-carbonatite
Observation Note :

Opaque minerals are a small amount of magnetite, hematite, goethite, Fe-Mn oxide and rutile, with accessory pyrite. The primary minerals may be magnetite and ilmenite, which are decomposed strongly to oxidized phases.

Magnetite occurs as an euhedral grain less than 0.1mm in diameter and is decomposed to hematite with lattice-shaped replacement texture.

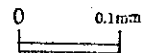
Hematite occurs as anhedral grains and sometimes form concentric zonal texture with goethite.



23

Sample No. : T1004
Sector : Tundulu Locality : JMT-10 27.7^m
Rock name : Massive oxidized Mn ore
Observation Note:

There are two kinds of minerals of Mn-O systems. Both minerals occur as euhedral tabular or prismatic crystals. One shows creamy greyish color with strong anisotropy. Twinning is observed, and the cleavage is vertical against to twinning plane. The other shows more yellowish color with anisotropy. The former might be pyrolusite and the latter ramsdellite. These minerals are often enclosed in the aggregate of the small grains of goethite and psilomelane like mineral. The psilomelane like mineral forms finely crystalline aggregates, and often shows the myrmekitic like intergrowth with goethite (result from EPMA).



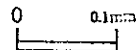
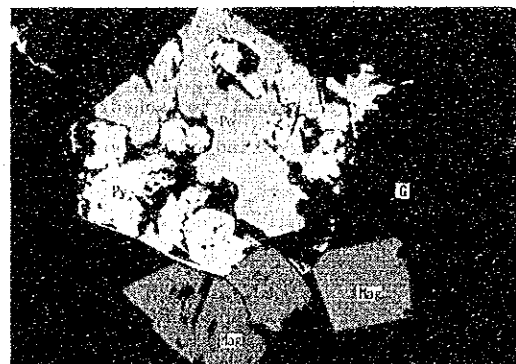
24

Sample No. : T1204
Sector : Tundulu Locality : JMT-12 13.9^m
Rock name : Layered carbonatite
Observation Note:

The specimen shows layered structure composed of leucocratic and melanocratic parts. Opaque minerals occur mainly in the melanocratic part.

Magnetite occurs as euhedral to subhedral grains of about 0.1 mm in diameter. Ilmenite occurs also as tabular euhedral grains, and occasionally shows eutectic intergrowth with gangue minerals. The exsolution lamella of ilmenite is rarely observed in magnetite. Rutile occurs as euhedral grains of 0.05 mm size, but is not common.

Pyrrhotite occurs as euhedral grains less than 0.1 mm in diameter, and is associated with pyrite. Pyrrhotite is partly decomposed to marcasite, and also partly decomposed to unknown minerals. This mineral is situated between fresh pyrrhotite and marcasite. The sulfur content is same with that of pyrrhotite, but the iron content is similar to that of pyrite. The qualitative data shows the existence of oxygen. Hence this is thought to be metastable oxidized pyrrhotite.



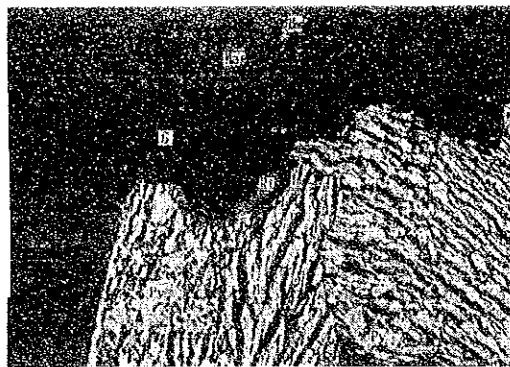
25

Sample No. : T1216
Sector : Tundulu Locality : JMT-12 47.9m
Rock name : Carbonatite
Observation Note:

Small amount of opaque minerals are scattered widely in the melanocratic part of specimen.

Magnetite is euhedral of about 0.1 mm size. Hematite coexists closely with magnetite. In spite of the lack of lattice-shaped replacement texture, hematite looks oxidation product from magnetite. Occasionally rutile occurs as euhedral grains of about 0.05 mm in diameter.

Pyrite occurs as subhedral grains of 0.2 mm, and anhedral grains if it is associated with marcasite. Marcasite shows lath-shaped texture. Pyrrhotite occurs as amoeboid-shaped inclusions in pyrite.



0 0.2mm

26

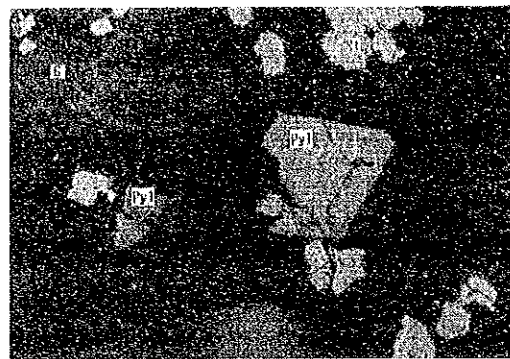
Sample No. : T1610
Sector : Tundulu Locality : JMT-16 45.2m
Rock name : Carbonatite
Observation Note :

The specimen includes a small amount of pyrochlore, rutile and goethite, with accessory pyrite.

Pyrochlore is found as an euhedral grain less than 0.2mm in across and is scattered in carbonate mass.

Goethite shows network texture and forms a cubic pseudomorph after pyrite.

Rutile occurs as an euhedral grain less than 0.1mm in across and is scattered widely.



0 0.2mm

27

Sample No. : T1611
Sector : Tundulu Locality : JMT-16 50.0m
Rock name : Sulfide bearing carbonatite
Observation Note :

The specimen includes a small sulfide mass.

It is composed mainly of sphalerite and pyrite, with subordinate amounts of goethite, chalcopyrite and covellite. Sphalerite shows coarse-grained, euhedral crystals and includes many tiny blebs of chalcopyrite.

Pyrite occurs euhedral to subhedral grains, sometimes veinlets in the cracks. A small amount of covellite is found in the margin of sphalerite.



0 0.1mm

28

Sample No. : T2201
Sector : Tundulu Locality : JMT-22 11.3m
Rock name : Fe-Mn ore
Observation Note :

Opaque minerals are only Fe-Mn oxide occurs as fine-grained, subhedral to anhedral grains and is scattered widely.

It shows sometimes a kind of concentric zonal texture.



0 0.1mm

29

Sample No. : T2211
Sector : Tundulu Locality : JMT-22 46.9m
Rock name : Fe ore
Observation Note :

The specimen includes many kinds of iron minerals and rutile as opaque minerals.

Iron minerals are pyrite, goethite, magnetite, marcasite and pyrrhotite.

Pyrite occurs as euhedral to subhedral less than 2.0mm in across and is partly decomposed to goethite with graphic replacement texture.

Magnetite, less than 0.05mm in across, and rutile, less than 1.0mm in across, are scattered widely in gangue minerals and small in amount.



0 0.2mm

30

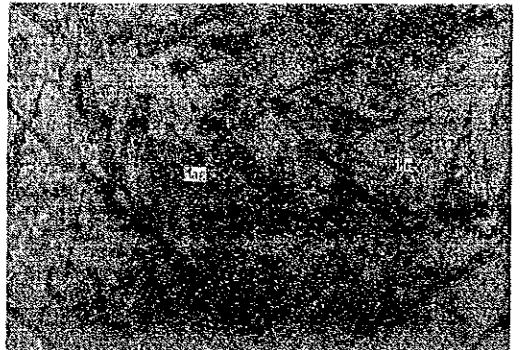
Sample No. : Nata 1
Sector : Tundulu Locality : Surface
Rock name : Fe ore
Observation Note :

The specimen is a massive hematite-magnetite ore.

It consists essentially of hematite and magnetite, with accessory ilmenite and goethite.

Magnetite is decomposed strongly to hematite with lattice-shaped replacement texture.

Hematite replaces magnetite and forms exsolution intergrowths with ilmenite and/or goethite.



0 0.04mm

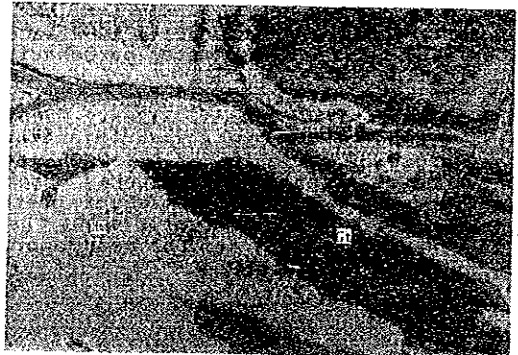
31

Sample No. : Nata 2
Sector : Tundulu Locality : Surface
Rock name : Fe ore
Observation Note :

The specimen is very similar to sample no. Nata. 1, but consists mainly of hematite and goethite, with a subordinate amount of Fe-Mn oxide.

Hematite and goethite make an aggregate with cell-shaped network and concentric zonal structure. Hematite consists of the margin of the cell-wall and goethite is observed in some of the inside of cell.

The other inside of cell are vacant, suggesting that goethite has been dissolved.



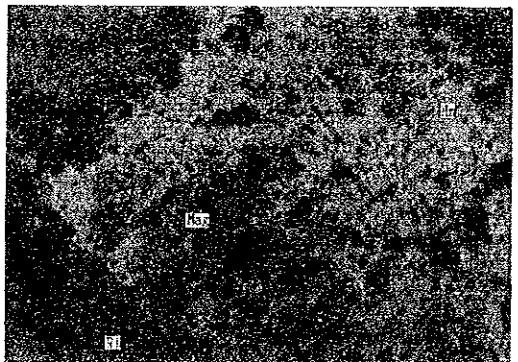
0 0.2mm

32

Sample No. : 7YR2
Sector : Songwe Locality : Surface
Rock name : Fe ore
Observation Note :

The specimen is compact magnetite ore. Magnetite occurs as euhedral or subhedral grains, and is decomposed strongly to lattice-shaped hematite. The pseudomorph from tabular-shaped ilmenite occurs in the magnetite or its boundary. The pseudomorph consist of the mosaic or irregular intergrowth of rutile, hematite and pseudobrookite. The color of hematite is slightly darker than that in magnetite, then it is possible to be ilmeno-hematite or hemo-ilmenite.

Goethite is also observed in the grain boundary of magnetite with concentric zonal pseudomorph, which is decomposed from pyrite or pyrrhotite.



0 0.04mm

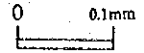
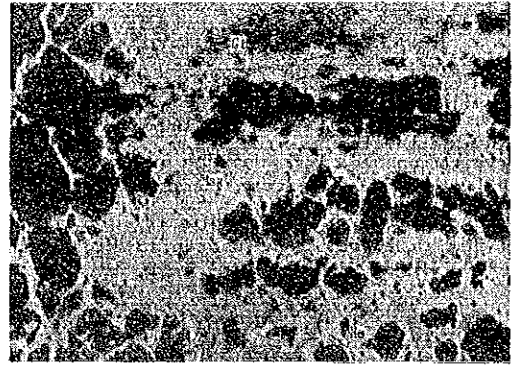
33

Sample No. : 7YR14
Sector : Songwe Locality : Surface
Rock name : Strongly oxidized Fe-Ti vein in carbonatite
Observation Note:

Fe-Ti oxide vein of 5 mm in wide and narrow veinlet of 0.1 mm are observed in the specimen. The vein is composed of massive part and cell-shaped networks. The principal minerals may be magnetite and ilmenite which decomposed strongly to oxidized phases.

Magnetite occurs as euhedral grain in the massive part, and is decomposed to hematite with lattice-shaped replacement texture. Magnetite remains as a relic mineral. The tabular-shaped pseudomorph from ilmenite is observed in the massive part, and is aggregate of hematite, pseudobrookite and rutile. The primary ilmenite is not observed even as a relic mineral.

The cell-shaped network part consists of rutile and hematite and goethite. Rutile occupies mainly the central zone of the cell-wall like network. Hematite consists of the margin of the cell-wall. Goethite is observed in some of the inside of cell. The other inside of cell are vacant, that suggest the dissolution of goethite.

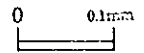
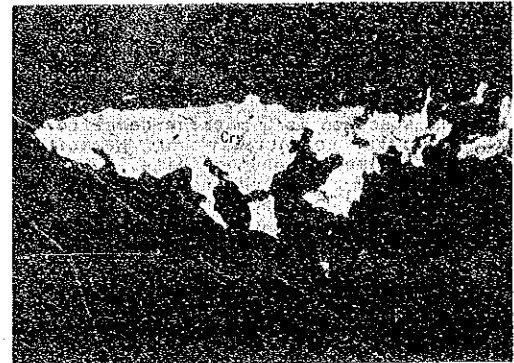


34

Sample No. : 7Y030
Sector : Songwe Locality : Surface
Rock name : K-feldspar rock
Observation Note:

Opaque mineral is rare in the carbonate mineral, and fills only the cracks of carbonate mineral.

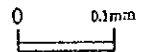
Cryptomelane like mineral is cementing the clacks of carbonates. The mineral shows white to bluish greyish color, and distinct anisotropy. The mineral forms aggregate of minute acicular crystals, and contains K, Ca, Ba, Fe, and Zn other than Mn. Pyrolusite like mineral occurs also in the crack. The optical properties are similar to those of cryptomelene like mineral, but the mineral forms narrow veinlet (2 - 5 micron in wide), or aggregate of small mosaic crystals, and contains less K and Ba.



35

Sample No. : 7Y167
Sector : Tundulu Locality : Surface
Rock name : Iron concentrated carbonatite
Observation Note:

This specimen is predominant in magnetite, pyrite (?) and their oxidized phases. Primary magnetite occurs as euhedral grains of 0.1 to 0.2 mm in diameter. Hematite occurs in the margin of magnetite grains with lattice-shaped texture. Only one relic grain of pyrite is observed in the goethite, and many pseudomorphs composed of goethite show concentric zonal texture. The pseudomorph shows the latter crystallization than magnetite, and the pseudomorph can be thought to be derived from pyrite.

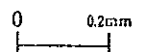


36

Sample No. : 7Y174
Sector : Tundulu Locality : Surface
Rock name : Fresh equigranular Carbonatite
Observation Note:

Predominant opaque minerals is only ilmenite which occurs as tabular euhedral grains of about 0.05 x 0.2 mm size.

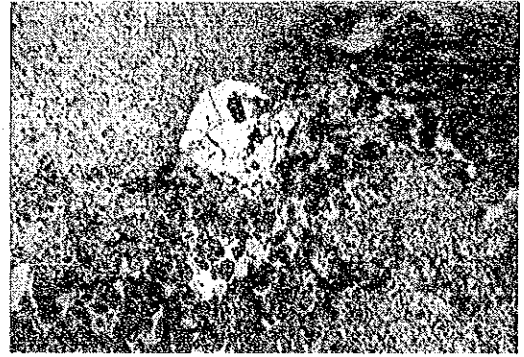
Rutile and pyrite are rare minerals. Very fine grains (about 10 micron in diameter) of rutile occur in the ilmenite and other gangue minerals. Pyrite also occurs as very fine euhedral grains (about 5 micron size) in gangue minerals.



37)

Sample No. : 7Y179
Sector : Tundulu Locality : Surface
Rock name : Carbonatite
Observation Note :

The specimen is goethite-rich carbonatite with lamination. Opaque minerals, except goethite, are rare. Goethite occurs as subhedral to anhedral grains and forms an aggregate with calcite. A small amount of pyrochlore is found as anhedral grain less than 0.3mm in diameter, closely associated with synchisite, rare metal-rich mineral and spatite.



0 0.5mm

38)

Sample No. : 7Y181
Sector : Tundulu Locality : Surface
Rock name : Carbonatite
Observation Note :

The specimen is very similar to sample no.7Y179 in their mineral assemblages. Goethite is predominant and forms usually an aggregate like a pseudomorph after ankerite with calcite. Pyrochlore is found as an euhedral grain less than 0.3mm in diameter and coexists commonly with synchisite and Ti-minerals in the apatite-quartz-rich mass.



0 0.5mm

39)

Sample No. : 7Y211
Sector : Tundulu Locality : Surface
Rock name : Brownish oxidized carbonatite
Observation Note:

The specimen strongly oxidized and opaque minerals are primary Fe-Mn minerals and secondary ones.

Magnetite occurs as euhedral to subhedral grains less than 0.3 mm in diameter, and is strongly decomposed to lattice-shaped hematite in the margin. Ilmenite is completely decomposed to rutile, pseudobrookite and hematite.

Two kinds of Mn-O minerals occur as tabular or prismatic crystals. One shows creamy greyish color with strong anisotropy. Twinning and well-developed cleavage are observed. The other shows more yellowish with distinct anisotropy. These might be pyrolusite and ramsdellite. These minerals are decomposed to the aggregate of small psilomelane like minerals (according to the data from EPMA, small amount of Ba, Al, Fe, and Si are detected).

Psilomelane like minerals shows color of bluish grey to greyish white, and strong anisotropy. The mineral often shows the myrmekitic like intergrowth within the gangue minerals.



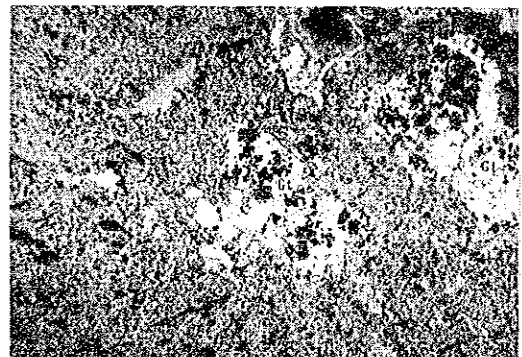
0 0.1mm

40)

Sample No. : 7Y226
Sector : Kangankunde Locality : Surface
Rock name : Carbonatite
Observation Note :

The specimen is greenish, monazite-rich carbonatite. Monazite is mostly fine tabular mineral, occurring as an aggregate in the carbonate-quartz mass.

Opaque minerals are only goethite. Goethite is found as subhedral to anhedral grains, closely associated with carbonate and apatite.



0 0.5mm

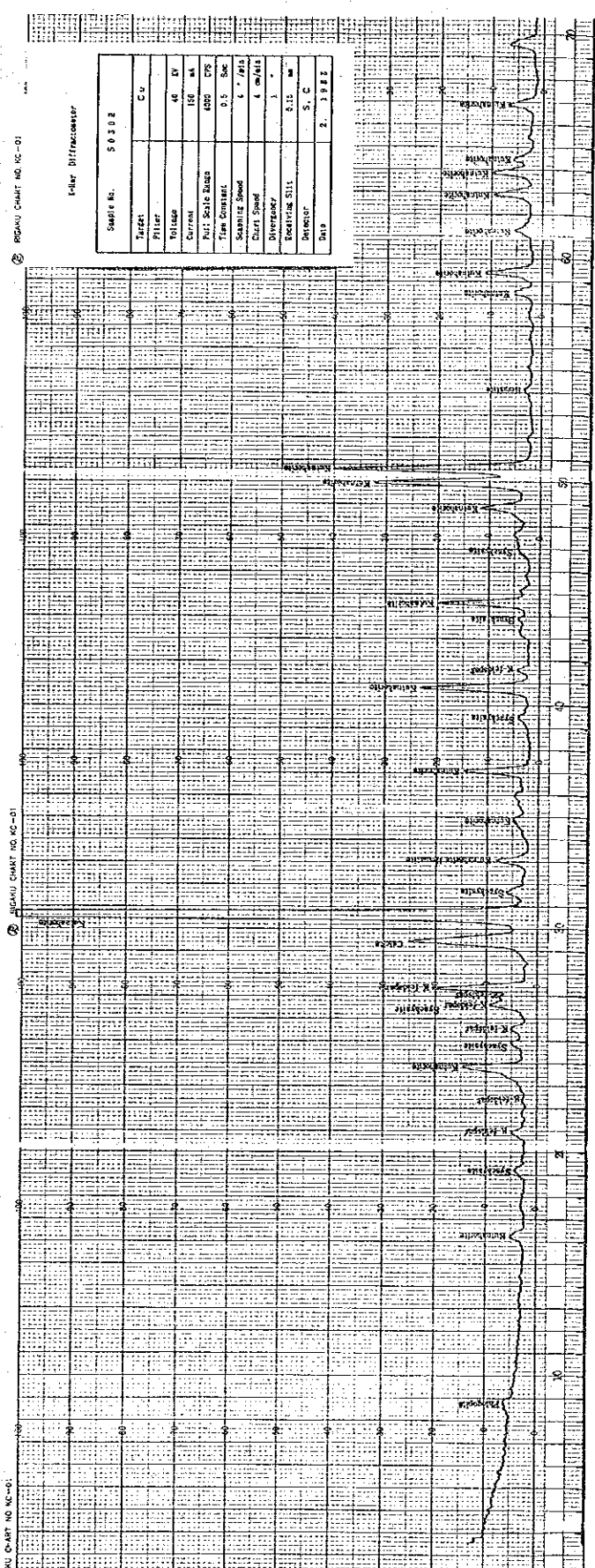
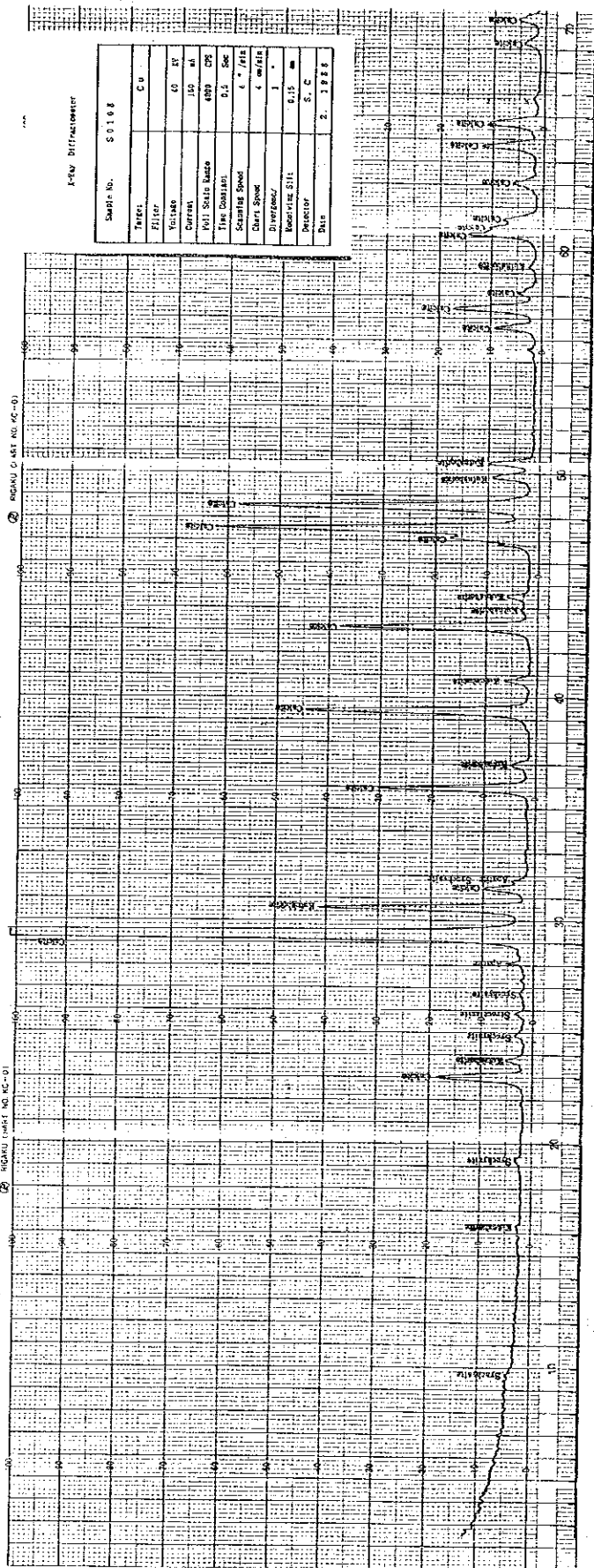
Appendix 5

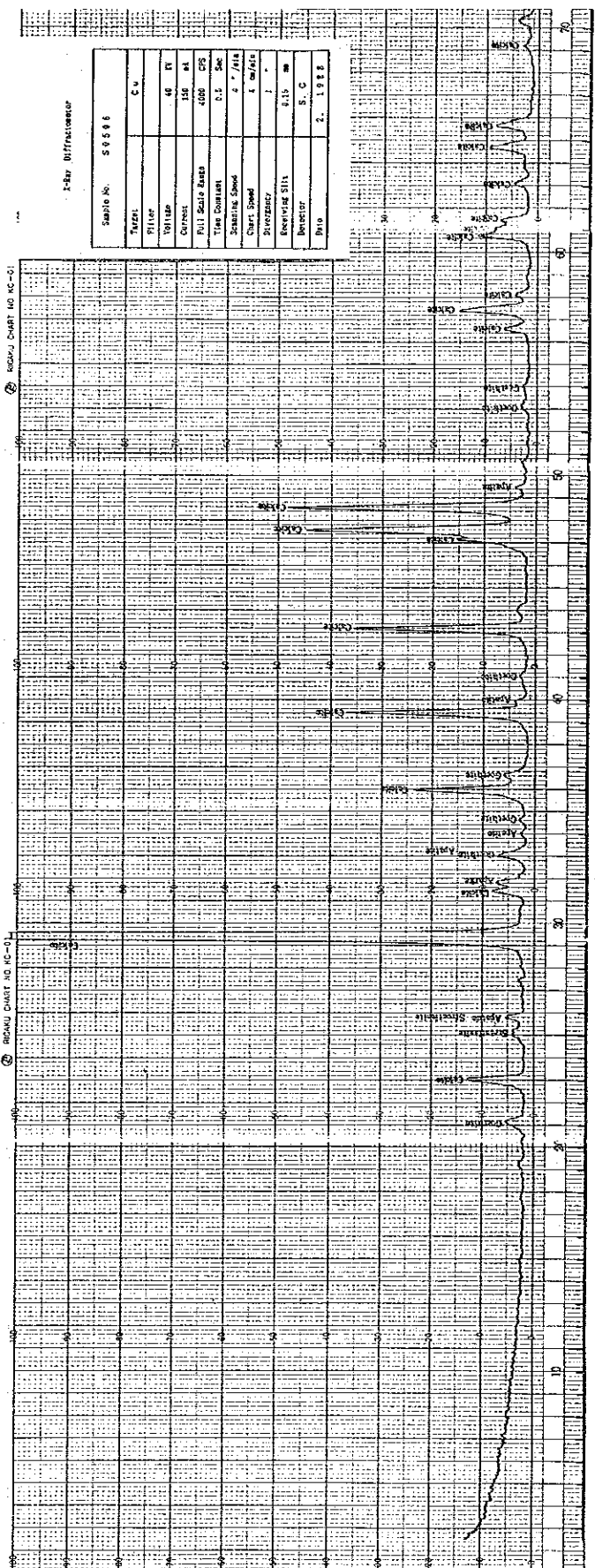
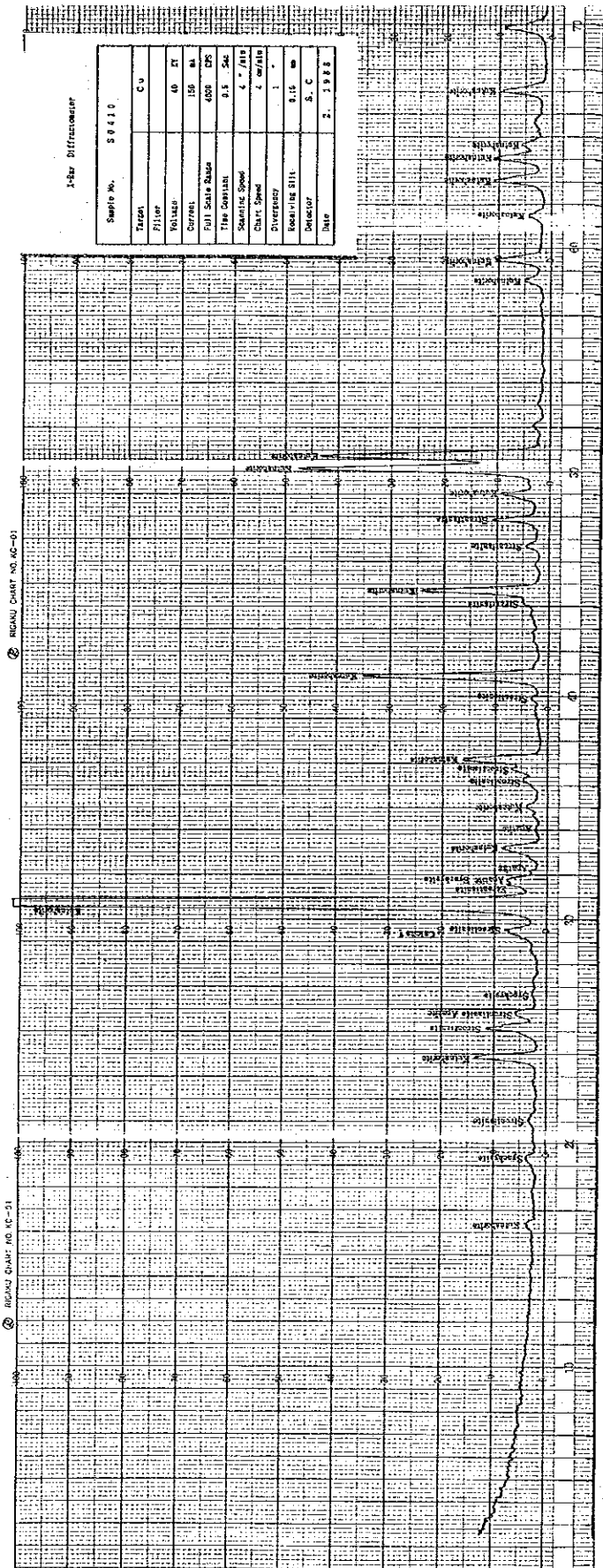
X-ray diffractive analysis and charts

Result of X-ray Diffraction Analysis

No.	Sample No.	Sector	Locality	Rock name	Basinnesite	Strontianite	Synchysite	Calcite	Kutnahorite	Ankerite	Siderite	Quartz	Plagioclase	K-feldspar	Barite	Apatite	Pyroxene	Smectite	Sericite	Phlogopite	Chlorite	Pyrite	Ilmenite	Magnetite	Hematite	Goethite	Brookite	Rutile	Pyrochlore	Monazite	Fluorite
1	S0108	Songwe	JMS- 1 27.3m	Séville	1	1	4	3																							
2	S0308	Songwe	JMS- 3 40.2m	Carbonatite	1	1	2	4																							
3	S0410	Songwe	JMS- 4 50.5m	Carbonatite	2	1	1	4																							
4	S0506	Songwe	JMS- 5 37.0m	Carbonatite	1	1	1	4																							
5	S0602	Songwe	JMS- 6 9.0m	Carbonatite	1	1	1	4																							
6	S0702	Songwe	JMS- 7 6.8m	Carbonatite	2	1	4	1																							
7	S0801	Songwe	JMS- 8 2.3m	Carbonate rock	1	1	4	2																							
8	S0808	Songwe	JMS- 8 21.7m	Carbonate rock	1	1	3	3																							
9	S0903	Songwe	JMS- 9 35.6m	Carbonatite	1	1	4	1																							
10	S1012	Songwe	JMS-10 43.8m	Séville	1	1	4	1																							
11	S1107	Songwe	JMS-11 27.6m	Carbonatite	1	1	4	4																							
12	S1110	Songwe	JMS-11 32.3m	Carbonatite	1	1	4	4																							
13	T0101	Tundulu	JMT- 1 5.2m	Carbonatite	1	1	4	4																							
14	T0113	Tundulu	JMT- 1 42.7m	Carbonatite	1	1	4	4																							
15	T0302	Tundulu	JMT- 3 4.7m	Carbonatite	1	1	4	4																							
16	T0505	Tundulu	JMT- 5 26.2m	Carbonatite	1	1	4	4																							
17	T0507	Tundulu	JMT- 6 43.0m	Calc-silic rock	1	1	4	3																							
18	T0702	Tundulu	JMT- 7 7.0m	Apatite rock	2	2	2	4																							
19	T0707	Tundulu	JMT- 7 21.0m	Carbonatite	2	2	2	4																							
20	JMT7	Tundulu	JMT- 7 50.1m	Phonolite	2	2	3	3																							
21	T0808	Tundulu	JMT- 8 33.7m	Carbonatite	2	2	2	4																							
22	T0908	Tundulu	JMT- 9 42.6m	Feldspathic rock	2	2	3	3																							
23	T1011	Tundulu	JMT-10 48.3m	Carbonatite	1	1	3	3																							
24	T1108	Tundulu	JMT-11 34.5m	Carbonatite	1	1	4	1																							
25	T1208	Tundulu	JMT-12 24.0m	Séville	1	1	4	1																							
26	T1211	Tundulu	JMT-12 34.9m	Carbonatite	1	1	3	4																							
27	T1308	Tundulu	JMT-13 33.8m	Calc-silic-rock	2	2	4	4																							
28	T1610	Tundulu	JMT-16 45.2m	Carbonatite	2	2	3	3																							
29	T1905	Tundulu	JMT-19 34.3m	Carbonatite	2	2	4	4																							
30	T2210	Tundulu	JMT-22 41.6m	Carbonatite	2	2	3	3																							
31	T2402	Tundulu	JMT-24 3.2m	Apatite rock	1	1	4	4																							
32	7YR13	Songwe	Surface	Phonolite	1	1	4	4																							
33	7YR20	Kangankunde	Surface	Carbonatite	1	1	3	3																							
34	7Y160	Tundulu	Surface	Carbonatite	3	3	4	4																							
35	7Y176	Tundulu	Surface	Carbonatite	3	3	4	4																							
36	7Y179	Tundulu	Surface	Carbonatite	2	2	4	4																							
37	7Y181	Tundulu	Surface	Carbonatite	2	2	4	1																							
38	7Y211	Tundulu	Surface	Apatite rock	1	1	3	2																							
39	7Y317	Kangankunde	Surface	Carbonatite	2	2	1	4																							
40	7Y336	Tundulu	Surface	Carbonatite	2	2	1	4																							
				Barite vein	1	1	4	4																							

4 abundant 3 common 2 poor 1 rare





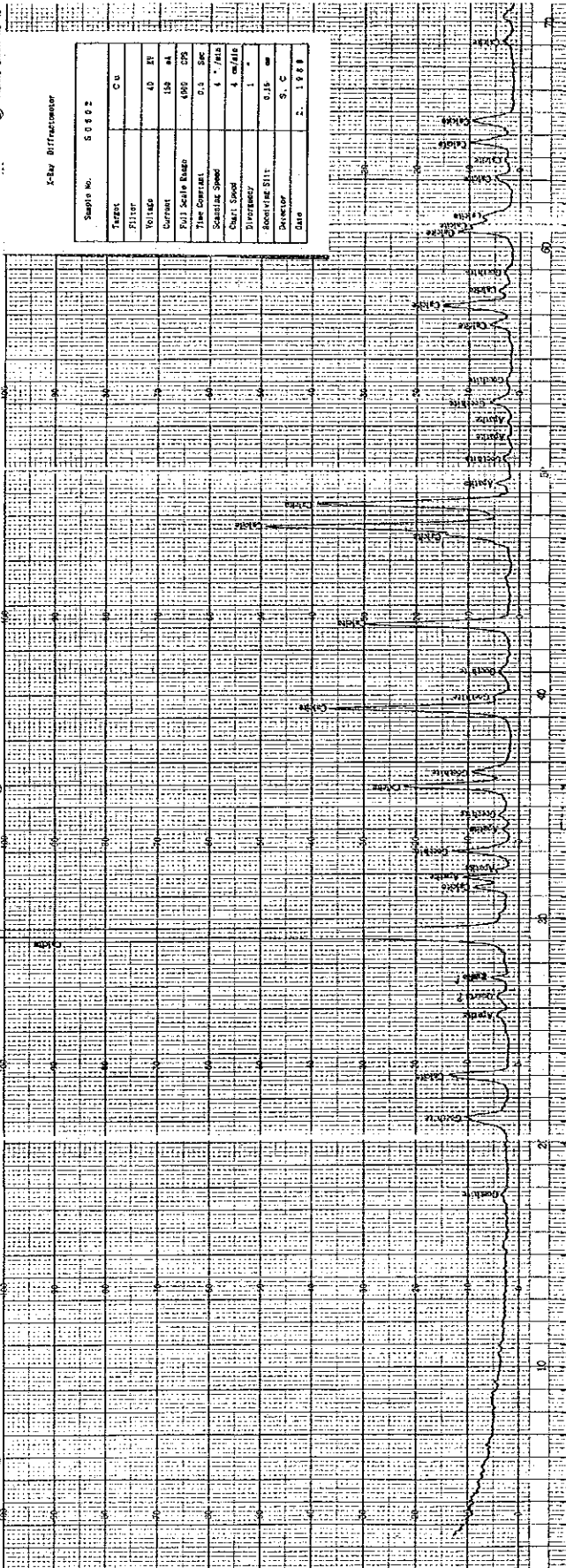
RICARDI CHART NO. KC-01

RICARDI CHART NO. KC-01

RICARDI CHART NO. KC-01

X-Ray Diffractometer

Sample No.	50802
Target	Cu
Filter	
Voltage	40 KV
Current	150 mA
Full Scale Range	400 CPS
Time Constant	0.5 Sec
Scanning Speed	4 / Min
Chart Speed	1 / Min
Divergency	1 °
Receiving slit	0.15 mm
Detector	S. C
Date	2. 1988



RICARDI CHART NO. KC-01

RICARDI CHART NO. KC-01

RICARDI CHART NO. KC-01

X-Ray Diffractometer

Sample No.	50792
Target	Cu
Filter	
Voltage	40 KV
Current	150 mA
Full Scale Range	400 CPS
Time Constant	0.5 Sec
Scanning Speed	4 / Min
Chart Speed	1 / Min
Divergency	1 °
Receiving slit	0.15 mm
Detector	S. C
Date	2. 1988

