determinations, chemical analyses for major elements and rare earths, and X-ray powder diffraction analyses to identify minerals.

The results of the field survey are finished into the 1 to 50,000 scale geological maps.

The literatures "Geology of the Gwasi Area" by McCall (1958) and "Carbonatite-Nephelinite Volcanism" by LeBas (1977) provided with indispensable primary information for this year's survey. The basic data in the former were utilized for this year's survey in general. The latter was useful not only for the investigation of carbonatite-nephelinite plutonic complexes in the semi-detailed survey but also for that of basement rocks in the Regional Survey because the writer had renovated the interpretation by incorporating all the past geological data.

In addition to the above information, unpublished geological work sheets, included in "Mineral Resources Investigation in Western Kenya" funded by the United Nation's Revoluving Funds, were made available and very much helpful as well.

1-3 Geology, Stratigraphy and Mineralization

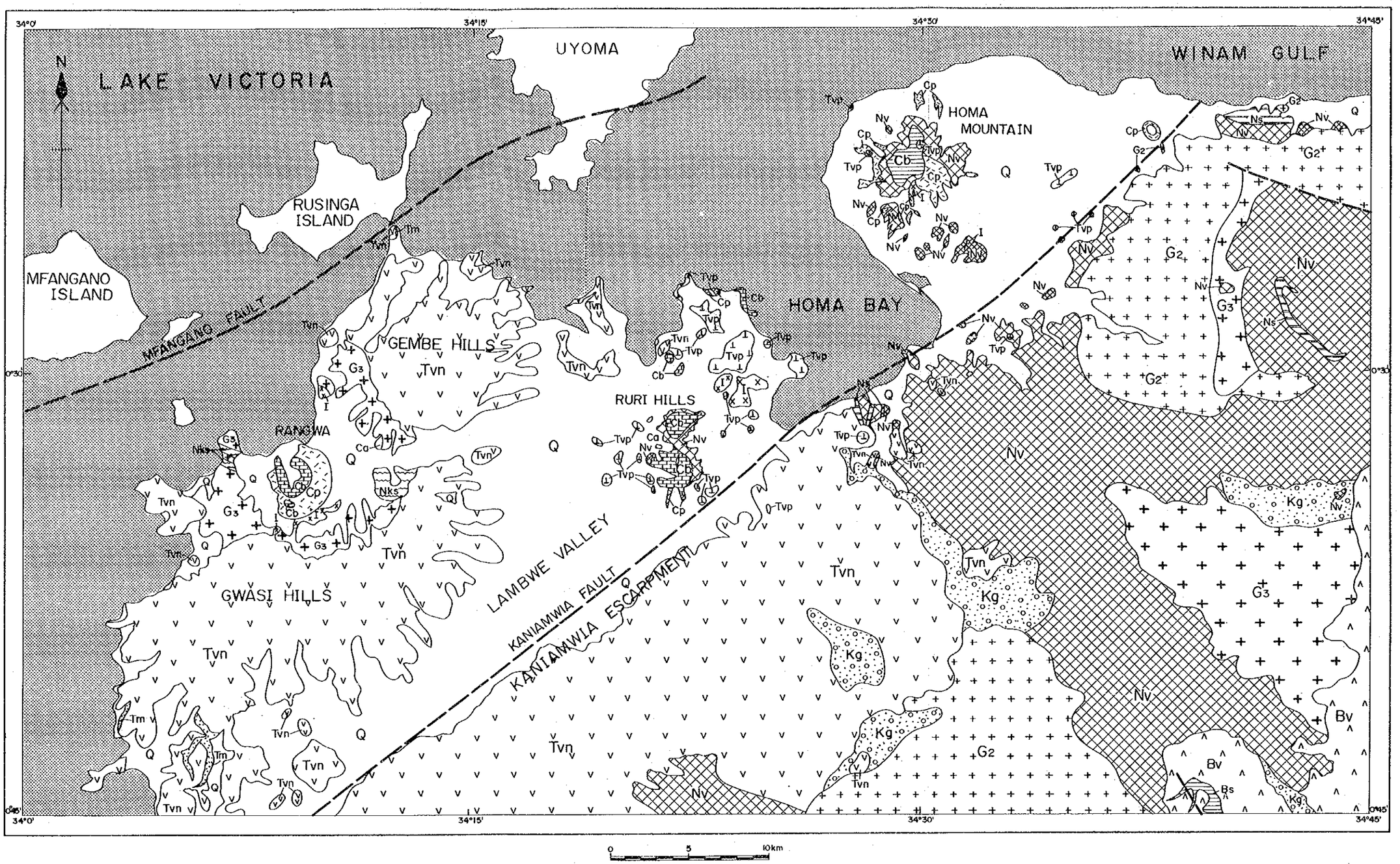
(1) General Geology

The Survey area is bisected by a major fault (Kaniamwia) trending in a NE-SW direction. This foult bounds the southeastern side of the Kavirondo Rift which branche off westerly from the centre of the Kenya Rift. There distribute plutonic and volcanic rocks of carbonatite-nephelinite series of Tertiary and Quarternary ages, basement granitoid inliers within volcanics and Quarternary alluvials to the northwest of the fault, while the rocks to the southeast of the fault comprise Archean greenstones and sediments (the Nyanzian and the Kavirondian Systems), intrusions and nephelinitic volcanics overlying the Precambrian.

The stratigraphy of the Precambrian and the sequence of alkaline plutonisms and volcanisms of Tertiary and Quarternary ages are presented in Table II-1-1 and Table II-1-2 according to LeBas (1977).

(2) Precambrian

Since almost none of K-Ar age determination, chemical analysis or microscopic observation has been done for the Precambrian rocks in this year's Regional Survey, mainly the distributions and the megascopic characters are hereunder described.



LEGEND

Quaternary
- Q — Alluvium

Tertiary
- Tvp — Phonolites
- Tvn — Nephelinitic, Volcanic rocks
- Tm — Sedimentary rocks

BUKOBAN SYSTEM (Pre-Cambrian)
- Bv — Volcanic rocks
- Bs — Sedimentary rocks

KAVIRONDIAN SYSTEM
- Kg — Conglomerate, sandstone

NYANZIAN SYSTEM (Pre-Cambrian)
- Nks — Kaksingiri schists
- Ns — Metasediments
- Nv — Metavolcanic rocks

INTRUSIVE ROCKS

Tertiary
- Cb — Carbonatite complex
- Cp — Calcareous Pyroclastic rocks
- I — Alkaline intrusives

Pre-Cambrian
- G_3 — Granitic rocks (Post-KAVIRONDIAN)
- G_2 — Granitic rocks (Post-NYANZIAN)

Major faults

Fig. II-1-3-1 Geological Map of The Homa Bay Area

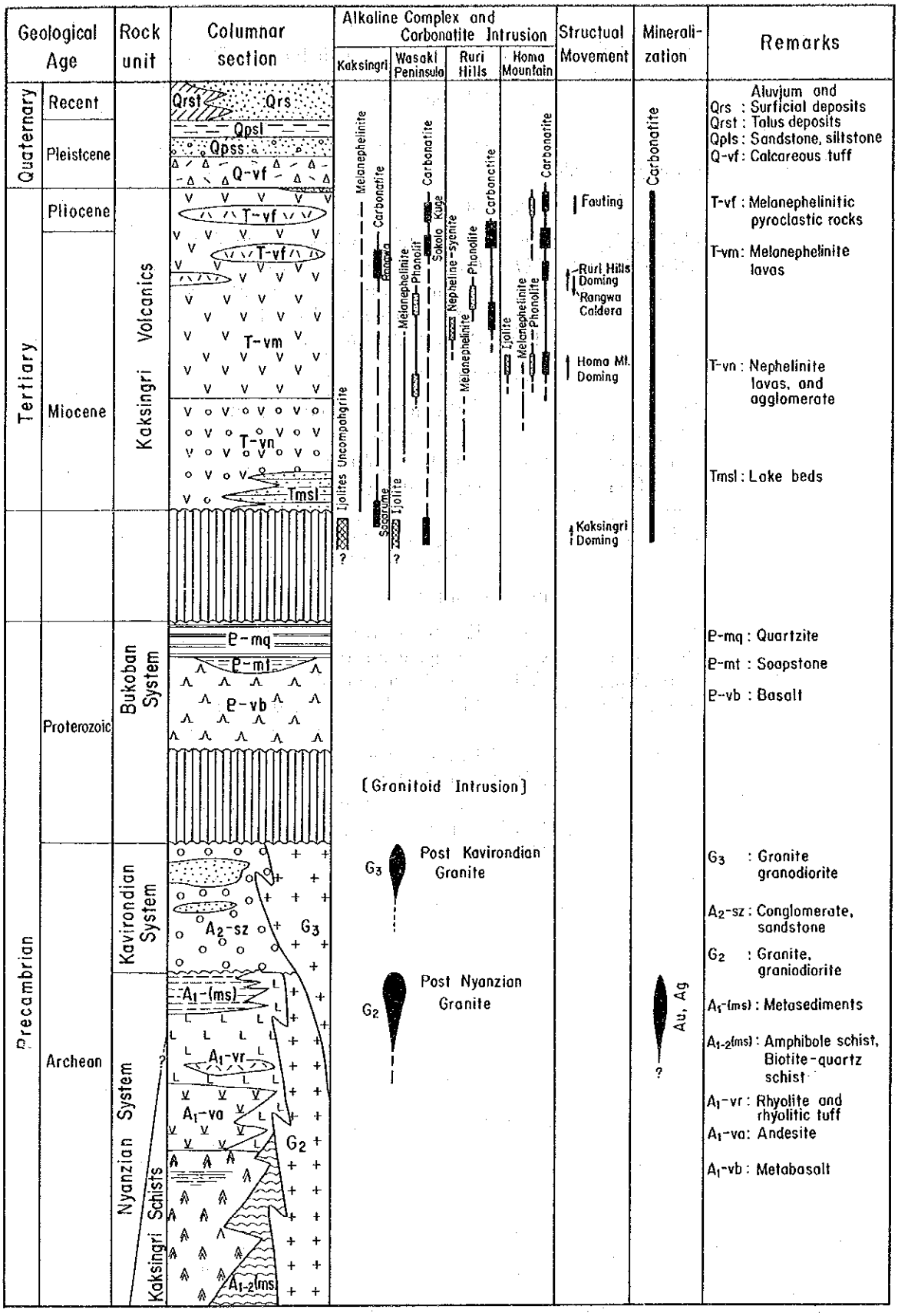


Fig. II-1-3-2 Generalized Geological Columnar Section of the Homa Bay Area

TABLE II-1-1 PRE-CAMBRIAN FORMATIONS IN THE HOMA BAY AREA

(After LeBas, 1977)

Tertiary volcanics		
	unconformity	
Bukoban (?) (Kisii Series)	BA	Andesites, felsites and rhyolites
	BQ	Quartzites and cherts
	BB	Basalts (906±35, 964±35 m.y. (Briden *et al.*, 1971))
	BBP	Porphyritic basalts
	unconformity	
Post-Kavirondian intrusions (~2500 m.y.)		Kaksingiri granodiorite and adamellite
	G_3	Wanjare granite
		Nyagongo granite
Kavirondian	K	Conglomerates and grits (and volcanics in adjacent areas)
	unconformity	
Post-Nyanzian intrusions (~2800 m.y.)	G_2	Kitere granite
	G_2	Oyugis granite
	G_2P	Wasaki porphyrite
	D	Minor dolerites and diorites
Nyanzian	NR	Banded ironstones, cherts and shales; Rhyolites, tuffs and agglomerates
	NA	Andesites, dacites and shales
	NB	Basalts

TABLE II-1-2 SUMMARY OF EVENTS OF THE HOMA BAY PROVINCE, WESTERN KENYA (After LeBas, 1977)

m.y.	1. Kisingiri	2. Wasaki Peninsula	3. Ruri Hills	4. Homa Mountain	Associated events
1				Chiewo carbonatite.	Lake Simbi crater.
2				Phonolites.	Samanga fault phonolites.
3		Okuge carbonatite.	Cone-sheet	Melilitites.	Formation of Kavirondo
4			and	Cone-sheet	Lake (present Gulf).
5		Sokolo carbonatite.	later	and later	
6			carbonatites.	carbonatites.	Doming of 4.
7	Ekiojango and				
8	Kinyamungu		Pyroclastic activity	Sövite.	
9	carbonatities.		Phonolite plugs.		Doming of 3.
10	Rangwa caldera.	Phonolite plugs.	Sövite.		Kaniamwia and
11	Melanephelinite		Nepheline-syenite.	Breccia.	Mfanganu faults.
12	lavas and			Sövite.	Doming of 4.
13	agglomerates of	Central and fissure		Phonolite and ijolite.	Kericho flood phonolites.
14	Gembe, Gwasi,	eruption of			
15	Kaniamwia, Uyoma,	Nyamaji phonolites.		Melanephelinite	
16	Mfanganu and	Melanephelinite	Melanephelinite	lavas.	
17	Rusinga.	lavas.	lavas.		
18		Tuffs and agglomerates.			
19					
20	erosion	erosion			Rusinga and Karungu deposits in Lower Miocene Lake of Nyanza.
21					
22					
>22	Rukungu vent and crater.	Usaki ijolite.			Doming of 1 and 2.
	Kiyako and Nyamgurka	Wasaki carbonatite.			Lower Miocene erosion
	carbonatites.	Uyi/Angalo ijolite.			surface.
	Sagurume ijolites				
	and uncompahgrite.				

(A) Nyanzian System

The Nyanzian System is the oldest of all the systems in the regional area and is distributed in the Ruri, the Kuge, and the Home Muntain areas, and also an area to the east of the town of Homa Bay (Kendu Bay and Oyugis map areas).

This system is composed mainly composed of volcanic rocks which are stratigraphically classified into metabasalt, andesites and metasediments, rhyolites and porpohyritic rhyolite in ascending order according to McCall (1958) and LeBas (1977).

However, their stratigraphic relations are not always clear due to deformations by severe tectonisms.

Metabasalt (Al-vb): The unit is distributed in the Ruri Hills, the Kuge and the eastern part of the Survey area. The rocks in the Ruri Hills and the Kuge are bluish green or dark green, hard, compact, fine grained and mostly aphanitic. The green colour is possibly due to chloitization of mafic minerals. These rocks have been extremely shattered by intrusion of the carbonatite complexes in the Ruri Hills and the Kuge and are very fragmental on outcrops.

Those in the eastern part alternate with rhyolitic rocks and are arranged in the E-W or the NW-SE direction. They are bluish green, generally massive but occasionally schistose; porphyritic and often vesicular or amigdaroidal. Dolerite dikes also occur in association with these rocks and are believed to be intrusions brought by the same volcanisms that have extruded the basalt.

Metasediments (Al-(ms)): This is unit distributed in three localities, to the east of the town of Homa Bay, to the east of Kendu Bay and around the Wire Hill to the north of the Oyugis, in association with basalt or rhyolite.

The rocks comprise light brown or grey tuffaceous siltstones, shales and charty shales. Beddings are generally clear often with development of finely layered structures.

Micaceous schists are observed to the west of the Wire Hill and to the east of the Oyugis where the rock are well developed with schistosity.

Andesitic Rocks (Al-va): The unit occurs in belts trending the E-W direction is the central eastern part of the Survey area (the Oyugis Map area), and also is distributed in the Homa Mountain area. The rocks in the central eastern part are greyish green or light green and porphyritic or vitreous. It is not always easy to distinguish the rocks from the metabasalt but they are characteristically poor in mafic minerals and rare in

amigdaroids or in cavities.

Those in the Homa Mountain area occur in association with rhyolites or dacite. It is very difficult to distinguish these rocks from rhyolites or dacites because they are extremely shattered. Chloritized pyroxenes and feldspars are observed in specimens of the weakly altered rocks.

Rhyolitic Rocks (Al-vr): The rocks are distributed widely in the eastern part of the Survey area (the Oyugis and the Kendu Bay map areas), and also in the Homa Mountain area.

They comprise two facies, lavas and tuffs which alternate with each other though the lavas are much predominated to tuffs. The lavas show variable colours such as grey white, light brown, yellowish white, light red and others which often form layering structures. They are generally siliceous and comprise two kinds, porphyritic and aphanitic. The porphyritic one contains numerous phenocrysts of quartz and feldspars up to 3 mm across in vitreous ground masses. These rocks form a number of oval shaped small hills with long axes ranging from 1 to 2 km, and short axes ranging from several hundreds metres to 1 km, which stand out several tens metres above the surrounding plains. These small hills are arranged in a wedge configuration with its southern wing running the NW-SE direction and its northern wing running in the E-W direction. This peculiar arrangement may indicate positions of rhyolite extrusions (volcanic necks) or of anticlines of folded structures. Aphanitic, vitreous rhyolitic rocks fill in among these hills.

The tuffs distribute in limited areas to the south of Oyugis. The rocks are milky white or light grey, fine grained and developed with fine layerings.

Porphyritic Rhyolite (Al-vrp): The unit forms a large body with a length of 4 km, a width of 2 km and a relative high of 250 m, forming the Wire Hill to the north of the Oyugis. The nature of the rocks are similar to the rhyolitic rocks above described, the porphyritic facies in particular. However, they are distinguished in the geological maps because gossans, possibly having been derived from sulphides, are distributed particularly in the body of this unite.

The result of the microscopic observation of a sample (RT-77) of these rocks is shown in APX-3.

(B) Kaksingri Schists

The Kaksingri Schist unit is distributed symmetrically to the west northwest and to the east southeast of the Rangwa Carbonatite Complex in the western part of the Survey area with the Complex between, a part from

each other for about 10 km. Both of the areas distributed by the schist unit are elongated in a direction of WNW-ESE and appear to be linearly aligned.

The rocks of this unit are intruded by granitoids and found in fragments of the Kavirondian rocks. Their age is presumed to be equal to that of the Nyanzian System (LeBas 1977).

The unit are divided into two facies, the hornblende schist and the biotite-quartz schist.

Hornblende Schist (Al-msh): The rocks are dark green or dark brown, fine grained and schistose. Hornblendes and feldspars are megascopically observed and are arranged in a finely layered fashion.

A sample (RN-139) collected to the west-northwest of Rangwa consists primarily of hornblendes and feldspars with minor amounts of quartz and opaques under the microscope as shown in APX-3.

Biotite-Quartz Schist (Al-ms bq): The rocks are dark grey, hard, compact and extremely schistose. Quartz and feldspar are abundantly observed and micas are aligned along schistosities megascopically. A sample (RN-126) collected to the west northwest of Rangwa consists primarily of quartz, feldspars, biotite and muscovite accompanied with apatite, tourmaline and zircon under the microscope as shown in APX-2.

(C) Kavirondian System

The system distributes in the central southern part and the southeastern corner of the Survey area, unconformably overlying the the Nyanzian System and the post-Nyanzian Granitoids and being overlain by the Bukoban System and the Tertiary Volcanics.

The system comprises sandstones and conglomerates, of which the conglomerates are predominant to the sandstone in the central southern part and only the sandstones are distributed in the southeastern corner.

Conglomerates.Sandstones (Al-sz); The conglomerates contain rounded fragments up to 1 m across in coarse grit matrices. The rounded fragments are of the post-Nyanzian granite or granodiorite and the Nyanzian rocks mainly andesites and rhyolites, and are characteristically high in roundness. These fragments are extremely variable in sizes and poorly sorted. Some facies are abundant in fragments and others are poor grading into sandstones. The matrices of the conglomerates are grey, greyish brown or bluish grey and hard, and consist of course feldspathic sands or fine lithic fragments.

The sandstones are the same as the matrices of the conglomerates in nature.

Kitere Granite (G2): The botholith occupies an area of approximately 110 sq.km in the Survey area and extends southwards out of the area. The rocks comprise primarily grey, to light red and fine to medium grained hornblende-biotite granite and granodiorite accompanied by red biotite granite. Hornblende dominates to biotite in the granodiorite and inversely biotite to hornblende in the granite. These mafic minerals are partly altered to chlorite or epidote. The rocks are homogeneous in appearances and has no foliated structures.

It is believed that the Au mineralization of the Migori Gold Belt have been generated in relation with the intrusive activities of the Kiere granite.

Oyugis Granite (G2): The batholith, similar in its size to the Kitere batholith, occupies an area of approximately 120 sq.km and extends eastwards out of the Survey area. However, its distribution is limited to the southeast side of the Kaniamwia fault.

The rocks are mostly of hornblende biotite granite which is light red due to abundant potash feldspar, and generally medium and partly coarse grained. But biotite-hornblende granodiorite also occurs subordinately and distributes in the southern part of the batholith with forming a elongated body in the E-W direction for a length of 1 to 2 km. Hornblende in both the granite and the granodiorite is generally chloritized. The rocks are often well developed with schistosities near the contact to the intruded Nyanzian System or adjacent to the Kaniamwia fault.

(F) Post-Kavirondian Intrusives (G3):

The intrusives comprise the granitic rocks around Rangwa (the Kaksingri Gronodioi Complex) in the western part of the Survey area, the batholithic body (the Wanjare Granite) in the southeastern part stock elongated in the N-S direction in the northeastern part and diorite dikes and stocks of small scales.

Kaksingri Granodiorite Complex: The complex surrounds a circular area with a diametre of approximately 14 km which includes the Rangwa carbonatite complex in the centre, and forms a circular inlier with widths of 2 to 3 km within the Kaksingri Volcanics. It is situated in the periphery of the zone uplifted by intrusion of the carbonatite-alkaline rock complex of Tertiary in the Rangwa area. The rocks are mostly medium to coarse grained granodiorite and fine to coarse grained laucocratic rock (granite or adomellite) accompanied by aplite and diorite.

The granodiorite, being grey, contains hornblende or biotite or both and megacrysts of plagioclase exceeding 10 mm in length particularly in

These conglomerates and the sandstones look massive without any development of beddings.

(D) Bukoban System

The system occupies the northwestern end of the Kishii Series widely being distributed in the southeastern part of the Survey area and is arbitrarily correlated to the Bukoban Series. It overlies the Nyanzian and Kavirondian Systems and also the post-Kavirondian granite in the southeastern end of the Survey area.

The Bukoban System in this area consist primarily of basalt interbedded with quartzites in places and occasionally developed with soap stones (called Kishii stone) underneath the quartzite. These rocks, different from the basalts of the Nyanzian System, form a open-folded structures but lie flat in general.

Basalt (P-vb): The rocks are dark grey or dark green, fine grained and aphanitic or porplyritic. It is easy to identify the rocks of the Nyanzian basalt because of their weak alteration. Though fine grained compact rock are predominated, the rocks containing phenocrysts of feldspars and pyroxenes or having amigdaroidal textures are not uncommon. They are generally weathered in extreme degrees and often turn into reddish soils.

Kishii Soapstone (P-mt): The rocks are distributed partially in the southwestern Hills of the Bukoban System, and are formed in the basalts underneath the quartzite as above described. However, it has not been cleared if the rocks are alteration products of the basalt.

They are slight greyish brown, massive and soft, and consist primarily of sericite and kaolinite with suboridinate amounts of chlorite, epidote and quartz in variable proportions.

Quartzite (P-mq): The rocks are distributed in a limited area in the hills of the southwestern part of the Bukoban System. They are light grey or white, fine grained, thinly layerd and occasionally interbedded with thin beds of greywacke. They occupy the roofs of the hill and form open-folded structures with axes trending the N-S and the WNW-ESE directions.

(E) Post-Nyanzian Intrusives

The intrusives intrude the Nyanzian System and are unconformably overlain by the Kavirondian System. They include granitic batholiths in the central south (the Kitere Granite) and the northeast (the Oyugis Granite) of the Survey area, and dioritic and doleritic intrusions (dikes) of small scales. These small scale intrusions are indistinguishable from those of the post-Kavirondian intrusives and are shown on the geological maps as minor intrusions.

coarse grained portions.

The leucocratic granite or adamellite is white to light red, occasionally light green due to alteration, and poor in mafics. Judging from the variation in quartz contents both granite and adamellite are included in this type of rocks. The potash feldspar in the rocks are mostly microcline according to McCall (1958) and LeBas (1977).

Both the granodiorite and the leucocratic rocks are often schistose and granulated possibly due to destruction and deformation.

Wanjare Granite: The batholith occupies a massive area of approximately 100 sq.km. The rocks are homogeneous in nature, and are mostly light red, medium grained and mafic poor granite. Fine grained and coare grained facies are observed respectively in the perphery and the inside of the batholith.

A sample (RN-139) of fine grained granite collected at the northwestern end of the batholith contains quartz, perthite, plagioclase and a minor amount of biotite under the microscope as shown in APX-2.

Stock Elongated in the N-S Direction in the Northeastern Part of the Survey Area: The stock is located between the G2 granite and the Nyanzian volcanics. The rocks are light red or occasionally light green due to alteration, rich in potash feldspar and poor in quartz and mafic minerals. Their compositions range from granite to quartz monzonite. A very minor amount of mafic minerals, comprising hornblende and biotite, are generally altered to epidote or chlorite. The rocks are spotted with iron oxide minerals and dirty in appearances. Schistosities or gneissosities are well developed in the direction parallel to the elongation (the NNE-SSW direction) of the stock.

Diorite (D): The rocks are distributed in the southeastern part (in the Oyugis map area) of the Survey area in forms of dykes and stocks of small scales. The intrusions trend in the NW-SE or the E-W direction in general and include two facies: the one is dark greyish green, fine or partly medium grained and equigranular, and the other characteristically contains feldspar phenocrysts.

The result of the microscopic observation for a sample (RN284) collected to the west-southwest of Oyugis is shown in APX-2.

Fenitized Grnitic Rocks (P-mf): The Kitre Granite is intensively fenitized near the contacts to the Tertiary alkaline intrusives. The fenitized granitic rocks have undergone mylonitization to variable degrees and characteristically contain minerals rich in Na and/or K. The most intensive fenitization is observed in the Sagarume-Nyamgurka area, one of the

semi-detailed survey areas (see II-2-5).

(3) Tertiary System

The Tertiary system in the Survey area comprises lake deposites, nephelinitic volcanics, phonolite, carbonititic rocks and alkaline plutonics and dykes.

Those which are distributed only in the semi-detailed survey areas are excluded from the description hereunder.

(A) Lake Deposits (Tmsl)

The deposits are distributed horizontally near the southeastern end and around the Mbita point in the northwestern part of the Survey area.

The deposits consists of light brown, calearеous and tuffaceous sandstones which are massive or weakly developed with beddings and contain well rounded nephelinite fragments. The sandstones are occasionally interbedded with calearеous pebble sandstone layers. The tuffaceous sandstones are generally inhomogeneous and often contain boulders of nephelinite and wood fragment replaced by carbonate minerals.

The deposits are of early Miocene and the oldest of the Tertiary system in the area.

(B) Nephelinitic Volcanics

The Kaksingri Volcano centering Rangwa is the largest stratovolcano in the western Kenya, which have extruded nephelinitic volcanics in an extensive area exceeding 2,000 sq.km. The western half of the Survey area is largely occupied by the volcanics.

The nephelinitic volcanics comprise nephelinitic agglomerates, mela-nephelinite or melilitite, and mela-nephelinitic pyrodostics.

Nepheliitic Agglomerates and Pyroclastics (T-vn): The rocks are distributed near the coast of Lake Victoria in the southwestern part of the Survey area, and are located at the bottom of the Kaksingri volcano.

They contain dark brown, angular or rounded fragments of nephelinite lavas in tuffaceous matrices which show variable colour such as brown, yellowish brown, light brown and others. Sizes and amounts of fragments are also variable and facies change from lapilli tuffs to volcanic breccias or agglomerate.

This unit, exceeding 300 m in thickness, is believed to have been extruded from the Rangwa crater according to McCall (1958).

Mela-nephelinite or Melilitite (T-vm): This unit constitute the major part of the Kaksingri volcanics and distributes in the Gwasi and the Gembe hills around Rangwa and in the central part of the Survey area to the southeast of the Kaniamwia fault. The unit forms a flat plain slightly

inclining southeastwards in the central part of the Survey area.

The melanephelinite and the melilitite are almost indistinguishable megascopically. Both are black, dark grey or dark green and generally coarse in textures, containing phenocrysts inhomogeneously. They vary considerably in facies, from one which is fine grained compact to another which is abundant in coarse grained phenocrysts mostly of dark green pyroxene and rarely of nepheline. The rocks are strongly magnetic and judged to contain a substantial amount of magnetite.

Samples collected in the southwestern Gembe Hill (RT-3) and in the northern Gwasi Hill (PR-79) were examined under the microscope and chemically analized. The results are, together with their normative compositions plotted on triangular diagrams for the classification of alkaline volcanic rocks, presented in APX-2 and APX-8a for the sample RT-38 and in APX-8 and APX-8b for the sample RP-79. Both the samples contain abundant melitite and are judged to be of melilitite. Their normative compositions are plotted in the melanephelinite domain in the diagrams.

The results of the K-Ar age determinations for these samples are presented in APX-10. The result for the sample from the Gwasi Hill (RT-38) indicates the rock to be of 14.4 ± 0.8 Ma in the K-Ar age which supports the LeBas's view (1977), while the other sample from the Gembe Hill are measured at 4.5 ± 0.5 Ma which is considerably in disagreement with the post views. This discrepany is left to be solved in the future.

Melanephelinitic pyroclastics (T-vf): The above unite is often accompanied by pyroclastic facies. The portions relatively dominated by pyroclastics are distinguished as a mapable unit. The rocks distribute mostly on the ridge of the Gwashi Hill and in the Gembe Hill, and vary in facies from tuffs to volcanic breccias.

(C) Phonolite (T-vp):

A total number of more than 80 phonolite bodies are located in the Survey area; more than 60 bodies of large and small sizes in an area of approximately 150 sq.km including the Ruri Hills, the Wasaki peninsula and their neibours, about 20 bodiees in the Homa mountain and adjacent area, and one in the Asego mountain in the suburbs of the Homa Bay town. The majority of them is distributed in the Kavirondo Rift to the northwest of the Kaniamwia fault, and only a few are situated near and to the southeast of the fault. They are circular, oval or twin-circular in plan and cone-shaped. Their sizes range ordinarily from 50 m to 1,000 m in diameters and their relative hights from several tens up to about 100 m. However, the one near Nyamaji to the northwest of the North Ruri Hill is exceptionally

large in its size, having a long axis of 3 km, a short axis of 1.5 km and a relative height of 300 m. Most of the phonolite bodies form cones with their rounded tops and show peculiar topographic features. With no or almost no rocks of the same natures being located around the phonolite bodies, most of them are possibly volcanic necks and some with larger sizes may be lava domes. Other than these, phonolite dykes also occur in the South Ruri Hill area, one of the semi-detailed survey areas.

The phonolite is grey or greenish grey and generally vitreous, and contains nepheline, potash feldspar, pyroxene and rarely phlogopite. Small bodies are totally aphanitic and large bodies are aphanitic in their paripheries and porphyritic in their inner sides in most cases.

The result of the microsopic observation for a sample (WR-122) collected at Nyamaji is presented in APX-2.

(D) Carbonatitic Rocks

The so called carbonatitic rocks of the Survey area comprise (i) carbonatite proper including sovite, alvikite, ferrocarbonatite and their breccias (ii) carbonititic or calcareous pyroclastic of the same origin, (iii) breccias containing angular fragments of carbonatites and (iv) breccias occurring in close association with carbonatites. Most of these are distributed in the semi-detailed Survey areas and are described in the semi-detailed survey report. Accordingly, the carbonatitic rocks newly located by this year's Regional Survey are described hereunder.

Carbonatite 3 km Northwest of the Top of the Gwasi Hill: The carbonatite includes a melanephelinite lava over the Gwasi hill are a brown fine grained alvikite dyke with a width of about 5 m distributing in the post-Kavirondian granite towards its contact. Ferrocarbonatite dikelets crosscut the alvikite dykes, adjacent to which small stocks of ijolite are exposed. A sample (WR-108) of the alvikite contains carbonates, apatite and opaques accounting for 20% of the sample under the microscope as shown in APX-2.

Carbonatite 5 km Southeast of the town of Sindo facing the Kaksingri bay: The carbonatite forms an isolated body with a diametre exceeding 5 m across in the area distributed by hornblende schists (the Kaksingri schist) and schistose gronite to the east of Rangwa. The rocks are light-green and consist of aggregates of fine and coarse grained carbonates. A sample (RT-46) of the rocks contains calcite, dolomite, apatite, chlorite, microcline and very minor opaques under the microscope as shown in APX-2.

Carbonatites at 2 localities in the vicinity of the town of Homa Bay: Alvikitic carbonate rocks are located near the coast of Lake Victoria, 8 km

northeast of the town of Homa Bay, where metavolcanics of the Nyanzian System are distributed. The rocks are strongly weathered, brown to white, and highly developed with banded structures.

Alvikitic carbonate rocks, white, fine grained and banded form a group of float in a tiny area less than 0.5 m across in diameter at a location 2.5 km east northeast of the Asego mountain to the east of the town of Homa Bay. The floats occur mixed with those of the Nyanzian metavolcanics.

(E) Alkaline Plutonic Rocks

The alkaline plutonic rocks include ijolite, uncompahgrite, pyroxenite and nepheline syenite. Of these, only the ijolite body 4 km northeast of the North Ruri Hill (Usaki Ijolite Complex, LeBas 1977) is located outside of the semi-detailed survey areas.

Usaki Ijolite Complex (I): The complex, partly covered by alluvials, occupies an area 3.5 km long and 2 km wide and comprises coarse grained ijolite, microijolite and pyroxinite. The rocks are developed with banded, breccia and other structures. LeBas (1977) has divided the complex into pyroxinite rich in diopside, microijolite and urtite in intruding order.

A sample (WR-136) of the ijolite collected in the southern part of the complex were examined under the microscope and submitted to the chemical analysis, the results of which are presented in APX-2 and APX-8. The normative composition (APX-8a) is plotted on the triangular diagram (APX-8b) for the classification of alkaline plutonic rocks. The K-Ar age determination is also made for the sample and the result indicate the K-Ar age of 16.2 ± 0.8 Ma for the sample as shown in APX-10. The age is correlated with the midle-Miocene and differs from the LeBas's view (1977) which places the age of the intrusion prior to Miocene.

(F) Dikes (D)

Small dikes of phonolite, nephelinite, pyroxenite, dolerite gabbro and quartz porphyry are locally distributed. The former three are intrusions of Tertiary and the latter three those of Precambrian.

(4) Quartenary

(A) Lake Deposits (Qpsl)

The deposits are distributed widely from the outskirt of the Homa Mountain to the lake side. The deposits are nearly flat-bedded and consist of careareous tuffs which are light yellow or light grey and well-developed with beddings. The deposits form 20 m high cliffs facing the lake and are

thinly covered by surface deposits towards the inland, with sporadic exposure.

(B) Surficial Deposits and Alluvials (Ors)

Surficial deposit and alluvials are extensively developed in the Kavirondo Rift to the northwest of the Kaniamwia fault. They are distributed mainly in the Lambwe valley, the outskirt of the Rangwa carbonatite centre and around the Homa Bay.

(5) Mineralization

There is no record which indicates that any metaliferous deposits have been explited in the Survey area. Mineral occurrences located by this year's Survey are hereunder describes.

(A) Carbonatite

Small outcrops of carbonatitic rocks are newly found at 4 localities, excluding those in the semi-detailed survey areas. Of these, two are located around the Rangwa and the other to the east northeast of the town of Homa Bay. They occurs in a form of dykes of small scales.

(B) Au Vein

Gold mining sites are confirmed at three localities in the eastern part of the Survey area. Quartz veins in the Nyanzian metavolcanics are being mined at the two localities. At third locality, panning operation is observed and gold ocurrence is unknown.

A white quartz vein ranging from 5 to 10 cm in width occurs in the schistosed Nyanzian metavolcanics (basic schist) and are being mined. A total number of about 30 local people and engaged in mining, crushing and panning. A sample (RT-90) collected from the quartz vein is assayed at 3.3 g/t Au and 2.0 g/t Ag.

The survey are is neigbouring to the Migori gold belt which is one of the gold producing area in west Kenya. A sample of a quartz vein in the Homa Mountain semi-detailed survey area is also assayed at 31.3 g/t Au and 5.0 g/t Ag. It may be worthwhile to pay attention on gold occurrences as well in the future investigation.

(C) Copper Mineralization

A occurrence of copper mineralization is newly located at 7 km northeast of the Kendu Bay. Another occurrence is the massive sulphide deposits at the Wire Hill 4 km north of the Oyugis. The deposits have once been explored by taking advantage of United Nation Revoluving Funds.

The former occurrence is green Cu-oxide stains, possibly malachite along fractures in granite rich in potash foldspar. However, the Cu con-

tent is estimated at less than 0.10% and its extention appears to be very limited. The occurrence is too small and weak in mineralization to chase any further.

At the latter occurrence in the Wire Hill, a massive iron-oxide gossan hosted by rhyolitic rocks are located for a length of approximately 30 m in a newly opened road cut. However, no copper minerals are identified in this year's survey. The exploration having utilized UNRF concluded that the occurrence would be of a possible Kuroko type and should be carefully explored.

2. Semi-detailed survey areas

2-1. General features

Both geological mapping and geochemical survey were carried out in ten areas totalling about 190 sq.km. A total of 274.2 line-km of routes were geologically mapped, and 1520 geochemical samples were collected along the routes,1509 of which were chemically analyzed for 17 minor elements including major rare earths(REE),which are the elements of the prime interest of the present Phase. The analyzed samples include 52 soil samples from 3 areas,and 139 grid samples from two prospects Buru Hill and Ndiru Hill. All the samples other than 52 soils are rock-chips.

Besides geochemical analysis,some samples were used for microscopcal observation,bulk chemical analysis for major rock-forming elements,K-Ar age determination,and X-ray diffraction,

The breakdown of statistics such as size of the studied areas,number of samples collected and analyzed,items and number of tested samples,analyzed compositions etc.are summarized in TABLE I-1-1 and I-1-2 in Part I.

Geological observations were first plotted in 1/5,000 Fact Maps,then were compiled into 1/10,000 Geological Maps. For the assay results of geochemical samples,both univariate statistical analysis and principal component analysis were carried out. 1/10,000 Sample Location Maps and Geochemical Interpretation Maps were prepared and anomalies were located. Finally,prospective targets were selected by coorelating the anomalies with geology,and by integrating all the available factors into consideration. The results of the exploration in individual areas are described in the sections from the next 2-4 on,and the conclusion will be mentioned in Part III. Here,in this section,methods and/or procedures of the field operation, chemical analysis,data processing and presentation of the results are briefly described.

2-2. Methods and procedures

(1) Geological mapping

Field survey was carried out using 1/5,000 topographic maps as base maps,which had been photographically enlarged from 1/50,000 topographic maps published by the Kenya Survey and re-drafted. The routes were selected to cover a target area as uniformly as possible. At the same time,the known geological trend in that area was also taken into consideration for the

selection. The original target was to select them at a rate of 1km/sq.km in average. The actually covered routes are mostly on the ridges,as geochemical sampling was carried out at the same time.

A 50 to 100m vinyl chain was used on mapping for the positioning of sampling sites. A field party usually consisted of a geologist,a field assistant,who was a secondary school graduate employed at Homa Bay,and 3 to 4 casual laborers hired at the target area for the day. The field work was usually done by 3 to 5 field parties.

(2) Geochemical survey

(A) Samples and sampling

The geochemical sampling was carried out at the same time with geological mapping. 8 samples/km(=sq.km) in average was an originally designed target of the sampling interval(=density). In the Buru Hill and Ndiru Hill prospects, a grid sampling was carried out,the details of which are described in 2-10 and 2-11.

The majority of the samples collected is rock-chip,since (a)all the Semi-detailed survey areas consist of small isolated hills or mountains so that the primary geochemical dispersion can easily be traced by rock chips, (b)soils are not well developed in this region,and (c)it is much easier for the interpretation of the results when the samples are of the same type.

As for the soil samples,which were collected only for reference purpose,62 were collected and 51 were analyzed,excluding some ones collected sporadically and isolatedly. The analyzed samples are as follows:(a) 25 from the flat in the Rangwa Center,(b)21 from a flat surrounded by the ridges that consist of the carbonatite ring at the western part of South Ruri Hill,and from a flat along a creek at the western part of North Ruri Hill, and (c)5 from an old pit by the Finnish Team.

Fist-size samples were taken for rocks. Soil samples of about 200g each were collected and sent to analysis without sieving,after being dried naturally in kraft paper bags.

Sample locations.except those from Buru and Ndiru Hills,were plotted in the 1/10,000 topographic maps at the Base Camp in Homa Bay,and their UTM co-ordinates were read by a digitizer in Japan. The sample locations of both from Buru and Ndiru Hills were plotted in 1/2,000 sketch maps. The approximate UTM co-ordinates of the former were manually read to input into computer,whereas those from the latter were not,as they had not been tied with any existing triangular station. Therefore,no co-ordinates of Ndiru Hill are listed in APPENDIX-13.

(B) Chemical analysis and results

The elements analyzed and their detection limits are shown below. 49 samples that had exceeded 1% of total REE value were re-assayed for 4 elements;Th,La,Ce, and Nd. The results of U,Gd and Tm are excluded from the statistical analyses,since more than half of them are below the detection limits. As to P,the analytical method was changed to the ore grade assay from that for geochemical level on the way half,as it was noticed that the results of chemical analyses cited in LeBas's volume(1977) indicated that a large number of samples might exceed the upper limit(1%) of geochemical analysis. The analysis for REE was carried out by Neutron Activation Analysis(NAA).

DETECTION LIMITS OF 17 ELEMENTS ANALYZED

Elem	U	Th	La	Ce	Nd	Sm	Eu	Gd	Tb	Tm	Yb	Lu	Y	Nb	Sr	Ba	P(%)
ppm	1	1	1	2	5	0.1	0.1	50	0.1	0.1	0.1	0.1	5	5	1	10	0.01

* All the results are listed in APPENDIX-13.

* Accuracy of Gd seems to be very poor.

(3) Radiometric and magnetic susceptibility surveys

Trial measurement of total gamma-ray was carried out at Ndiru Hill and Buru Hill prospects, and Kuge and Soklo areas,in order to test the applicability of it to REE exploration. The measurement was done using a Differential Spectrometer GRS-500 made by EDA,Canada. Correlation is recognized between gamma-ray and such elements as Th,Y,Sm,Eu,and Tb,as described in 2-7,-8,-10,and -11 in Part-II,and III-1-2(2). The result shows that it is quite a useful tool for REE exploration,especially for a reconnaissance, as it is very handy and easy to handle,and the results can instantly be obtained at the very site.

Trial measurement of magnetic susceptibility was also carried out at the Buru Hill prospect,together with the geochemical sampling and gamma-ray measurement. The equipment used is Kappameter KT-5 made by GEOFIZIKA BRNO, Czechoslovakia. No correlation is observed with gamma-ray,REE,Th and Y,but low to moderate correlation coefficients are obtained with Nb(0.41) and P (0.33). There is a possibility that the correlation with Nb would become

much higher,if the primary mineralization were considered. Because,in the case of this prospect,a large amount of magnetite have been changed to limonite by strong oxidation. Therefore,it is considered that the magnetic susceptibility can also be a useful indicator for the exploration of carbonatites of deeper facies that might bear magnetite,apatite,and niobium, though it can not be a very good indicator for REE.

2-3. Data processing and presentation

(1) Regional survey

The result of the regional geological survey is compiled in 6 sheets of 1/50,000 Geological Maps, which are attached as plates: Rusinga(PL-1), Gwasi(PL-2), Madiany(PL-3), Homa Bay(PL-4), Kendu Bay(PL-5), and Oyugis (PL-6). These are simplified and integrated into a smaller scale map to be inserted as Fig.II-1-3-1.

(2) Simi-datailed areas

(A) Geological mapping

The result of the geological mapping of 10 Semi-detailed Survey areas is compiled in 8 sheets(*1) of 1/10,000 Geological Maps, which are attached as plates: Rangwa(PL-8), Sagarume-Nyamgurka(PL-9), South Ruri and North Ruri (PL-10), Kuge-Lwala(PL-11), Ugongo-Uyi-Kiyanya-Sokolo and Ngou-Kuwor (PL-12), Homa Mountain(PL-13), Buru Hill(PL-14), and Legetet Hill(PL-15). These are reduced on a scale, and inserted in the text as figures.

For the Ndiru Hill prospect in the Homa Mountain Area, where a grid-sampling was carried out, only a reduced scale sketch map is attached as an inserted figure without a full scale plate, because the accuracy the base topo. map is not guaranteed; the original map is drafted on a 1/2,000 scale based on a simplified chaining with a hand-held compass(Clino-compass) and a vinyl chain.

For the Buru Hill prospect,which is at the center of the Buru Hill area and also grid-sampled, no large scale plate is prepared. For, the Ores that cover the whole hillock except few outcrops of gnesses at its foot was unable to classify during the present sampling.

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* 1: The "South Ruri" and "North Ruri" areas, and the "Ugongo-Uyi-Kiyanya-Sokolo" and "Ngou-Kuwor" areas are adjacent each other, respectively. Therefore, they are combined into two blocks for convenience' sake.

(B) Geochemical survey

"Definition of the rare earths"

There are some different definitions of rare earths: The rare earth metals proper are those 15 elements with atomic numbers from 57 to 71(lanthanum to lutetium)(same as lanthanide elements). Some people designate it as 17 elements including yttrium and scandium, and in some other case even beryllium,zirconium,hafnium and thorium are included. In this report the definition of narrouw sense is adopted, and rare earths proper(REE) and yttrium(Y) are separately dealt. The reasons are;(a) at the Buru Hill prospect, where the stage of exploration has been most stepped up, REE and Y show obviously different features both in areal distribution and in the results of the principal component analysis, (b) the demand structure in the market is clearly different between Y,and REE especially light rare earths(LREE).

"Grouping of samples for data processing"

The data processing of the results of the geochemical analysis was carried out mainly for 4 classified groups: (i)1325 rock-chip samples from the Semi-detailed areas excluding grid samples and soils. (ii) 47 grid-sampled rock-chips from the Buru Hill prospect except 2 gneisses. (iii) 90 grid-sampled rock-chips from the Ndiru Hill. (iv) 51 soils from Rangwa, N & S Ruris, and Homa Mountain.

Besides these 4 groups, univariate analysis for all the 1509 samples was added to know the averages by rock types.

The methods of statistical analyses applied for the groups are listed in TABLE II-2-1.

TABLE II-2-1 GROUPS FOR DATA PROCESING AND METHODS APPLIED

GROUP	Univariate statistical analysis	Correlation analysis	Principal component analysis
(i)"All Areas"			
* 1325 rock-chips	X	X	X
* Each of 8 Areas	X	--	--
(ii) Buru Hill prospcet(47)	X	X	X
(iii) Ndiru Hill prospect(90)	X	X	X
(iv) Soils			
* 51 samples	X	--	--
* Each of 3 Areas	X		
1509 samples	X	--	--

"Univariate statistical analysis"

It was decided to process the data on a logarithmic scale, after the patterns of histograms and cummulative frequency curves are exaimined both on log and antilog scales(APPENDIX-14).

It was decided to apply the same threshold values calculated from 1325 rock-chip samples to all the areas for selecting anomalous values: A value more than "Mean + 1 Standard Deviation" is defined as "anomalous" and more than "Mean + 2 SD" as "highly anomalous", respectively.

An anomaly is defined as an area where there are 2 or more highly anomalous and several anomalous values concentratedly occurring.

The summary of the analysis for 1325 rock-chips from "ALL AREAS" is presented in TABLE II-2-1A.

"Correlation analysis"

Correlation coefficients were calculated by group for all the combinations of the 14 elements. Scattered diagrams were printed out by X-Y plotter. However, they are attached to the report from the reason mentioned below.

"Principal component analysis"

Principal component analysis was tried to "ALL AREAS","Buru Hill" and "Ndiru Hill", since it was considered that the method would be useful as the number of elements to be processed is quite large.

"Presentation of the results"

i) A huge number of data, diagrams, and maps have been printed out by computer. Howerver, only some selected ones are attached to the report, as it is impossible to take all them up.

For 10 Semi-detailed Survey areas, 8 sheets each of Location Maps of Geochemical Samples(PL-26 to -33) and Geochemical Interpretation Maps(PL-18 to -25) are attached as full scale plates, and the latter are reduced on a scale to be inserted in the text as Figures.

In the Interpretaion Maps, the points that show anomalous and highly anomalous values for 4 elements(Nb, P, Y, and La), which were selected as representative of the mineralization from the principal component analysis, are marked, and the anomalies are delineated from these anomalous points of two ranks.

ii) For the Buru and Ndiru Hills prospects, concentration curves(iso-grade curves) are prepared, as the results of grid-samples are availble. The adoptd compositions are 3 chemical ones such as Nb, Y, and "La+Ce+Nd", and gamma-ray readings. The compositions were selected from the the results of principal component analysis. The maps used for presentation are all inserted Figures of reduced scale, from the same reasons as mentioned in (A).

iii) TABLEs for SUMMARY OF UNIVARIATE STATISTICAL ANALYSIS are prepared for "ALL AREAS(1325 rock chips)", "8 Semi-detailed Survey areas", and "2 prospects". TABLEs for SUMMARY OF CORRELATION COEFFICIENTS and PRINCIPAL COMPONENT ANALYSIS, are attached for "ALL AREAS", and "2 prospects".

iv) Major maps and tables on geochemical survey are shown in TABLE II-2-2. Besides these shown in the table, a number of diagrams and tables are attached in the text.

TABLE II-2-1A SUMMARY OF STATISTICS OF GEOCHEMICAL ANALYSIS ALL THE AREAS

Item or Element	Unit	Number	Max.	Min.	Mean (m)	St.dev (S)*1	m+1s	m+2s	Remark
P	%	1325	14.5	0.004	0.173	0.55	0.61	2.17	
Ba	ppm	1325	80700	20.0	2300	0.51	7370	23600	
Sr	ppm	1325	11800	11.0	1080	0.48	3260	9820	
Nb	ppm	1325	12000	2.50	148	0.62	620	2600	
Y	ppm	1325	1360	2.50	63.9	0.37	148	344	
U	ppm	1325							
Th	ppm	1325	2360	0.50	20.3	0.67	95	440	
La	ppm	1325	14300	0.50	178	0.63	767	3300	
Ce	ppm	1325	17700	0.50	283	0.64	1240	5460	
Nd	ppm	1325	3000	0.00	97.2	0.67	450	2090	
Sm	ppm	1325	4920	0.50	15.4	0.56	56.3	206	
Eu	ppm	1325	163	0.50	4.96	0.53	16.8	56.9	
Gd	ppm	1325							
Tb	ppm	1325	44.0	0.50	1.90	0.49	5.94	18.6	
Tm	ppm	1325							
Yb	ppm	1325	94.3	0.50	2.69	0.46	7.72	22.1	
Lu	ppm	1325	14.0	0.50	0.51	0.38	1.23	2.97	

*1: Standard deviation in logarithmic scale

TABLE II-2-2 GROUPS FOR DATA PROCESSING AND MAJOR ATTACHED DATA —GEOCHEMICAL SURVEY— —

Groups for data processing	Univariate Statistical Analysis: Histogram and Cummulative Frequency Curv	Univariate Statistical Analysis: Location Maps of Geochemical Samples	Univariate Statistical Analysis: Geochemical Interpretation Maps	Univariate Statistical Analysis: Distribution of CONTENT (Isograde map)	Univariate Statistical Analysis: Chondrite-normalized Abundances of REE	Univariate Statistical Analysis: Summary of Univariate statistical A.	Correlation Analysis: Summar of Correlation Coeffocients	Principal Component Analys.: Summary of Principal Component A.
ALL AREAs: "ALL AREAS" (1325 rock-chip samples)	* APPENDIX-14 (By element)					*TALBE III-1-2-2A	*TABLE III-1--2-3	*TABLE III -2-4
ALL AREAs: INDIVIDUAL 8 SEMI-DETAILED AREAS		* Plates 1/10,000 for Individual Areas	* Plates 1/10,000 * Figures of reduced scale		*Figures in Part-III *Figures;Kuge -Lwaia and Legetet Hill	* TABLES in Section of each area		
BURU HILL PROSPECT (47 rock-chip samples excluding 2 gneisses)	*Not attached	*(Fig. Distribution maps)		*Figures in Part II Nb, Y, La+Ce+Nd	*Figure in Part II. *Figs in III	*TALBE II-2-(11-2)and 11-3	*TABLE II-2-11-4	*TABLE II-2-11-5
NDIRU HILL PROSPECT (90 rock-chip samples)	*Not attched	*(Fig. Distribution maps)		*Figures in Part II Nb, Y, La+Ce+Nd	*Figure in Part II	*TABLE II-2-10-1	*TABLE II-2-10-2	*TABLE II-2-10-3
SOILS: 3 AREAS (51 samples Rangwa:25/N-S Ruris:21/ Homa:5)		*Plates 1/10,000 for each area				* TABLES in Section of each area		
ALL THE SAMPLES (Including Buru & Ndiru & Soils: Averages of 43 rock types are calculated, some of which are used for calculating chondrite normalized abundances by rock types)					*Figures in Part III (types of carbonatites, alkaline Rocks)			

2-4. Rangwa Area

The Rangwa is a cone shaped hill located in the central part of the Kisingri volcano which occupies an extensive area of more than 2000 km^2 on the sothern coast of the Winamu Winamu in the Lake Victoria.

The Kisingri volcano, being one of the largest carbonatite-alkaline rock complexes, has a cauldron structure which was brought about by eruptions of large scales and is a reputated field for gelogists to comprehend te modes of intrision and extrusion because its whole structure is well exposed due to erosion.

(1) Geographical background

(A) Location and Access

The Rangwa area is located about 35 km west of the town of Homa Bay, facing the Kaksingri bay on the east coast of the Lake Victoria, and occupies a rectangular area of 26.5 km^2, 5 km wide in the east-west direction and 5.3 km long in the north-south direction.

The roads, C-19, E-118 and D-210 (unpaved, all weather) lead to the the area from the town of Homa Bay, around the southern foot hill of the South Ruri Hill and via the town of Sindo, the centre of the Kaksingri Bay.

It takes about 1 hour by car for a distance of approximately 45 km.

(B) Physiography

The Rangwa is a cone shaped hill with an incomplete circular outline broken at its northern side. Its peak stands out about 600 m above the surrounding plain. A creek runs down from the centre of the hill northwestwards.

There are a group of volcanic cones which are arranged in a circular patern 2 to 3 km across in diameter and form elevated grounds in the hill.

These volcanic cones are surrounded by a circular cliff, a caldera wall, approximately 4 km across in diameter.

The outside of the caldera wall forms a gentle slope of thick talus deposits.

The slopes along the creet in the hill are also steep and have developed slopes of talus deposits at the foot-hills.

(2) Previous Work

The Rangwa is described in detail in "Geology of the Gwasi Area", the explanatory note for the 1 to 125,000 geological maps by McCall (1958), and in "Carbonatite-Nephelinite Volcanism" by LeBas (1977).

TABLE II-2-4-2-1 SUMMARY OF PREVIOUS WORKS: RANGWA AREA

Organization &/or Authors	Purpose	Period	Works carried out	Summary of result and Reccomendation, if any	References and/or Remarks
Geological Survey of Finland Idman, H. & Mulaha, T.	To explore phosphatic materials and niobium possibility.	April 1984 to July 1985	RECONNAISSANCE PHASE *Rangwa carb. centre rock: 139 samples soil: 129 samples P2O5 : 142 assays Nb2O5: 34 assays	*Both the carbonatites themselves & residual soil in this centre were considered the most prmising among the 12 carb.-alk. rock complexes examined in W. Kenya.	* Idman, H. and Mulaha, T. (1986): Report on assesment for phosphates and niobium in carbonatitic and alkaline silicate complexes in Western Kenya, South Nyanza District--Industrial Materials Project Kenya-Finland Technical Cooperation. Submitted by Geological Survey of Finland. * If MGD had provided this report beforehand, plan for present programme to this area might have been changed a great deal.
			DETAILED INVESTIGATIONS *Area: approx: 0.6 sq. km *Soil: 50m-grid surface sampling in 0.42 sq. km 44 pits totalling 330m 511 P2O5 & 267 Nb2O5 assays. *Bedrock: Geol. mapping in 1/2000 on lines. 3 Longyear DHs: Σ=542m 5 Winkie DHs: Σ=165m 368 P2O5 & 209 Nb2O5 assays. *Ore dressing tests: Flotation & solubitity tests for both phosphatic carb. & soil were carried out. But only negative results were obtained.	* 10-100m wide zone with 4-5% P2O5 (69000sq m) around carb. in which 0.4-0.6%Nb2O5 associates. No pedrological zoning or 2ndary enrichment down to 10m. * DHs failed to prove any promising phosphatic target. Best intersect.: 3.87% P2O5 for 39m in DH-1 & 5.78% P2O5 for 27m in DH-7; Pyrochlore only local & weak: 0.4-0.7% Nb2O5 & up to a few m thick. * Further work neither with the low-grade phosphatic alvikites nor the low-grade residual soil can be recommended.	

The investigations of the mineralization in the Rangwa Area by a Finnish Team are summerized in Table II-2-4-2-1.

The team has concluded the Rangwa area to be the most promising of all the carbonatite-alkaline rock complexes in the western Kenya for phosphate and niobium mineralization.

(3) Geology

(A) General geology

The geological plan and profiles are shown in Fig. II-2-4-1 and plate 8.

The geology of this area comprises granitoids of the basement, pyroclastics, carbonatites, carbonatitic breccias, talus deposits, and alluvials and surface soils.

Lithology and distribution of each geologic unit are to be described as follows according to the classification adopted in the geological maps.

Granitoids (G3): The rocks occupies a very limited area in the south-eastern part of the Rangwa Area.

The majority of the rocks are light grey or light grey brown, leucocratic and medium grained.

They are often granular and gneissic due to mylonitization and contain an appreciable amount of porphyroclasts.

Films or veinlets of green minerals (?aegirine) are developed in those near the contact to the alkaline rock intrusions due to fenitization.

Ijolite, Uncomphgrite (I): The intrusions are distributed in the southern part of the Rangwa Area and consist of uncompahgrite and ijolite.

The rocks are grey, greenish grey or drak grey in colour.

Ijolite is invariably coarse grained and holocrystalline, while uncompahgrite is variable in grain sizes ranging from fine to coarse and holocrystalline.

The results of the microscopic observation and the chemical analysis, and the normative composition of the sample (RN-54) collected in the south-central part of the ijolite body are presented in Apx. 3, Apx. 8 and Apx. 8a.

The normative composition is protted on the diagram for alkaline plutonic classification (Fig. 8b).

Pyroclastics: The unit is further subdivided into the 5 subunits in stratigraphically ascending order as follows.

Tuff Breccias (T-vfl): The subunit occupies mainly the northeastern part and a very limited area of the southern end of the Rangwa Area.

The rocks, dark grey to brown in colour, contains fragments of carbonatites and felsic rocks in calcareous and feldspathic matrices.

Steep cliffs are well developed in the area distributed by those rocks.

Banded Tuffs (T-vf2): The subunit is distributed in narrow strips along the periphery of the Rangwa complex in the northwestern and southeastern parts of the Rangwa Area.

The rocks are light grey to light greyish brown, coloured and fine to coarse grained, and laminated calcareous tuffs.

Banded Calcareous Tuffs/Lapilli Tuffs (T-vf3): The subunit is distributed widely around the core intrusion of carbonite in the Rangwa Area, and consists of grey coloured tuffs and lapilli tuffs.

The lapilli tuffs contain abundant acretional lapilli of less than 1 cm in diametre and accidental fragments of basement rocks, intrusions, nephelinites, carbonatite and others in calcareous matrices in which abundant biotites are occasionally observed.

The tuffs are interbedded with the lapilli tuffs.

Thinly bedded structures are well developed both in the tuffs and the lapilli tuffs.

Calcareous Tuff Breccias/Volcanic Breccias (T-vf4): The subunit is distributes in the northeastern part of the Rangwa Area.

The rocks of this unit, grey in colour, contain angular fragments in calcareous tuffaceous matrices.

The angular fragments, ranging from several to several tens centimetres in diameter, comprise primarily basement rocks, alkaline intrusions and alkaline extrusions, but abundant carbonatite fragments are occasionally contained in the rocks.

The results of the microscopic observation of a carbonatite fragments (40292E) are presented in Apx. 3.

Lapilli Tuffs/Tuff Breccias (T-Vf5): The subunit is distributed in the inner-most part the Rangwa Carbonatite Intrusive Zone (Carbonatite Center).

The rocks of this subunit, grey or light brown in colour, contain abundant angular carbonatite fragments of less than several centimetres in diameter and pumices of less than 1 cm in diametre in calcareous and tuffaceous matrices which are often stained by iron oxides and solidified.

Carbonatitic Breccias (Cbrc): The unit is distributed in the centre of the Rangwa Area with an area of approximately 2 km across in diameter (Carbonatite Centre).

The rocks, grey or light brown, are composed of abundant angular carbonatite fragments ranging from several to several teens centrimetres in diametre and an limited amount of accidental fragments in very minor matrices.

This unit often grades into mossive carbonatite.

The carbonatite fragments are mostly of fine to medium grained alvikite and occasionally of sovite.

Ferrocarbonatite fragments are rarely contained.

Carbonatite (C): The unit constitues the carbonatite centre together with the carbonatitic breccia (Cbrc).

Minor occurrences of this unit are also known outside the Carbonatite Centre.

The carbonatite in the Carbonatite Centre occurs in forms of dikes or necks several tens to hundreds metres wide or across, and comprises fine to medium grained alvikite and medium grained sovite, locally associated with ferrocarbonatite.

Apatite, magnetite and biotite are megascopically identified in the rocks. Layered concentration of these minerals form banded structures.

The results of the microscopic observation and the chemical analysis are presented in Apx. 3 and in Apx. 8.

Talus Deposits (Qrst): The unit is distributed along the foot-hill of the steep cliffs of the caldera wall and also within the Carbonatite Centre.

Thickness of the talus deposits exceeds 100 m at the bottom of the caldera wall.

Soils and Surface Deposits (Qrs): The unit consists dark brown to reddish brown soil and sands containing a small amount of gravels.

(B) Geological Structures

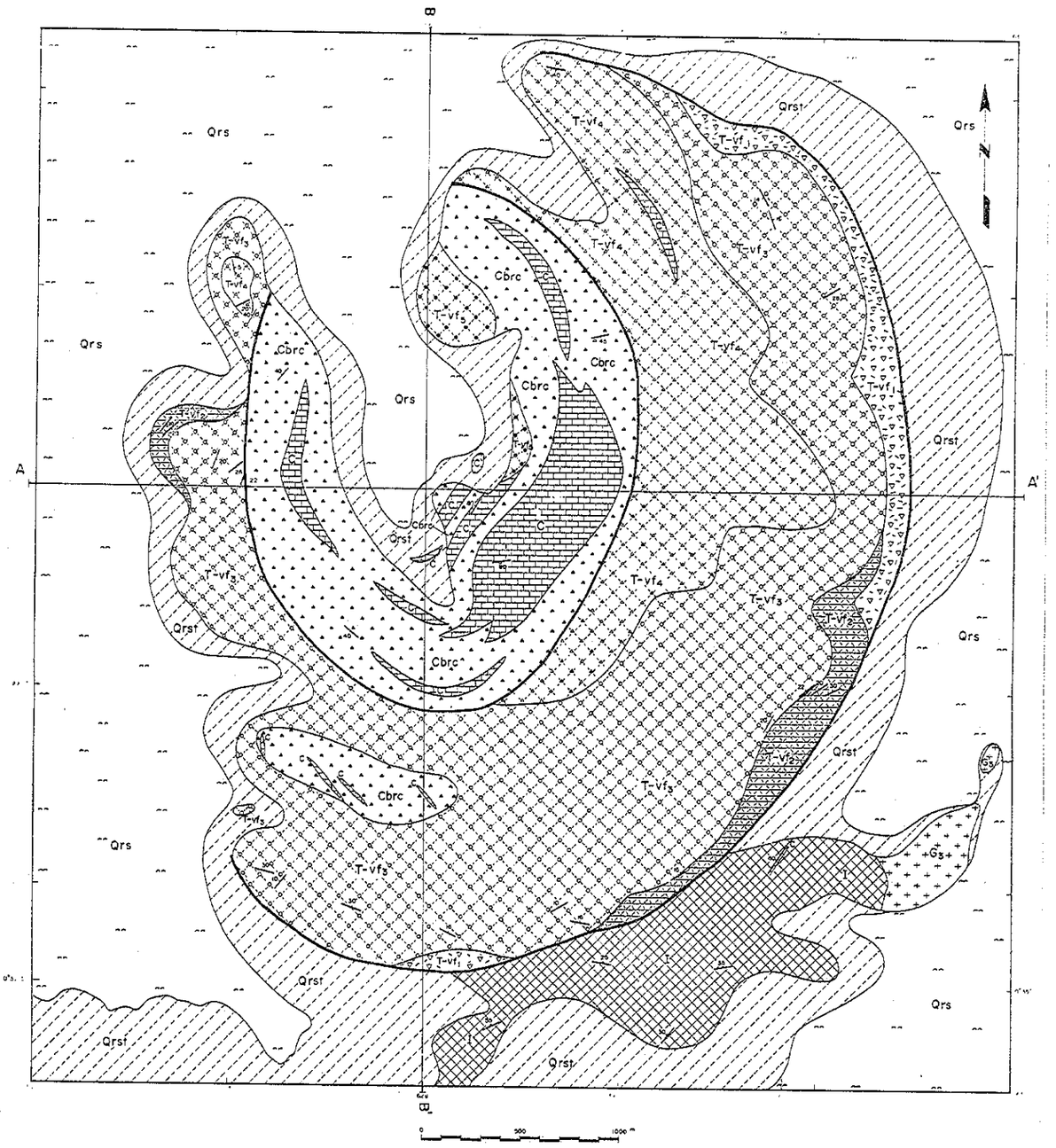
The Rangwa Area is located in the centre of the Kaksingri volcano.

The original cone shape of the volcano has been deformed due to erosion, and only the eastern half of the caldera wall approximately 4 km across remains at the present time.

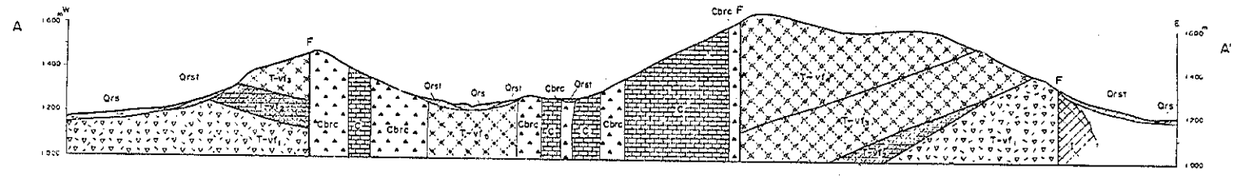
The Carbonatite Centre, located within the caldera, consits of carbonatite intrusions arranged in a concentric fashion, the outer diametre of which reaches approximately 2 km.

The outer rims of the caldera and the Carbonatite Centre dip vertically.

The pyroclastics within the caldera dip toward the carbonatite centre by 20 to 30 degrees.



SECTION ALONG A – A'



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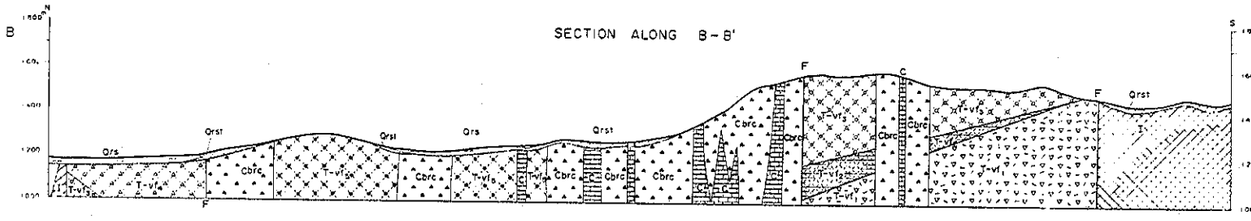


LEGEND

- Qrs — Surficial deposits
- Qrst — Talus deposits
- $T\text{-}vf_5$ — Lapilli tuff, tuff breccia
- C — Carbonatite, mainly olivikite with subordinate ferrocarbonatite
- Cbrc — Carbonatitic breccia with massive part of carbonatite
- Strike and dip of bedding
- Strike and dip of flow banding
- Strike and dip of joint
- Dykes and sheets with dip
- $T\text{-}vf_4$ — Calcareous tuff breccia, volcanic breccia (Upper agglomerate)
- $T\text{-}vf_3$ — Banded calcareous tuff, lapilli tuff
- $T\text{-}vf_2$ — Bedded tuff
- $T\text{-}vf_1$ — Tuff breccia (Lower agglomerate)
- I — Ijolite, uncompahgrite
- G_s — Granite, granodiorite (Post Kovirondian)
- Existing fault
- Inferred fault
- A——A' Line of section

Fig. II-2-4-1 Geological Map of the Rangwa Area

(4) Geochemical Survey

(A) Sampling

Survey lines were mainly set on ridges covering whole area of the Rangwa body, and 211 rock samples including all facies in the area were collected. In addition to rock samples, 27 soil samples were collected in a flat area along the central valley of Rangwa to investigate secondary enrichment of elements from rock to soil.

Location of samples is shown in Plate 26.

(B) Statistical Values and the Characteristic

The summary of the assay results of rock samples and soil samples are listed in Table II-2-4-4-1 and II-2-4-4-2 respectively.

Means for each element of rock samples are higher in P and Nb and lower in Ba, Sr, Y and REE than that of the "All the Areas". The lower values of P and Nb which are thought to represent deeper facies of carbonatite indicate that the erosion level of the Rangwa are in somewhat deeper part than other carbonatite bodies in the Homa Bay area.

(C) Interpretation of Geochemical Anamaly

Geochemical anomalies in the area are plotted in Plate 18 and Fig. II-2-4-2.

Rock geochemistry; There are many samples which have anomalous values for P, Ba, Nb, LREE and HREE, and almost all samples are in the Carbonatite Center of Rangwa. But number of samples having anomalous value for those element except P and Tb are not so large compared with the total number of samples.

Samples having anomalous value for P exceed 25% of all, but, only two samples have highly anomalous value, resulting to form no anomaly for P in the area. In case of Tb, situation is same as P. No sample having highly anomalous value for Nb was collected in the survey.

Soil geochemistry; means for each elements except Sr are 2 to 10 times and equal to the value of m + 1s of those of the "All the Areas". The fact that parent rocks of these soil samples are carbonatites in the Rangwa Carbonatite Center, indicate secondary enrichment of elements from carbonatite to soil. It is noteworthy that Nb among analytical elements, has higher mean (1,010 ppm) than that of Buru Hill prospect (688 ppm). The sample which has maximum value for P (6,300 ppm) in the area was collected just below a ferrocarbonatite dyke.

TALBE II-2-4-4-1 SUMMARY OF STATISTICS OF GEOCHEMICAL ANALYSIS -RANGWA AREA

Item or Element	Unit	Nos. of Sample	Max.	Min.	Mean (m)	Number of samples ≧ m+1s	≧ m+2s	Remark
P	%	211	2.84	0.01	0.31	52	2	
Ba	ppm	211	27000	200	2260	19	1	
Sr	ppm	211	9740	30.0	815	5	0	
Nb	ppm	211	1470	15.0	211	10	0	
Y	ppm	211	580	2.50	50.9	3	1	
U	ppm	211	300					
Th	ppm	211	340	0.50	5.71	8	0	
La	ppm	211	2300	12.0	110	10	0	
Ce	ppm	211	3100	10	130	10	0	
Nd	ppm	211	1210	2.50	37.3	12	0	
Sm	ppm	211	140	1.67	8.26	13	0	
Eu	ppm	211	40.0	0.1	2.80	12	0	
Gd	ppm	211	200					
Tb	ppm	211	18.0	0.05	1.86	37	0	
Tm	ppm	211	8.0					
Yb	ppm	211	26.0	0.05	1.83	4	2	
Lu	ppm	211	3.20	0.05	0.32	4	1	

TABLE II-2-4-4-2 SUMMARY OF STATISTICS OF GEOCHEMICAL ANYALYSIS(SOIL) RANGWA AREA

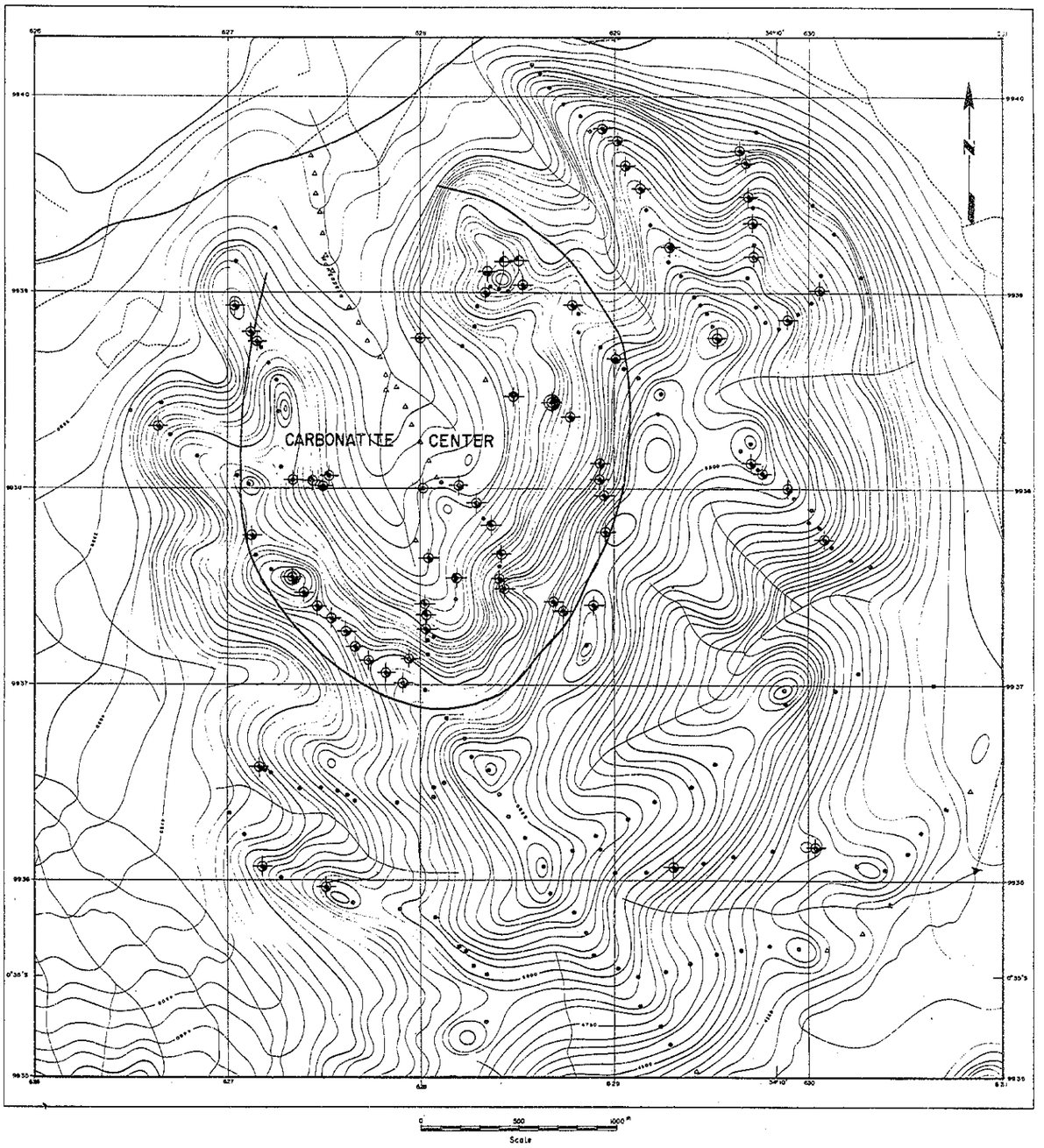
Element	Unit	Number	Max.	Min.	Mean (m)	St. dev (S)*1	m+1s *2	m+2s *2	Remark
P	%	27	1.34	0.34	0.85	0.18	1.28	2.64	
Ba	ppm	27	33700	340	5110	0.44	14200	39300	
Sr	ppm	27	1420	301	755	0.16	1080	1550	
Nb	ppm	27	6300	140	1010	0.36	2310	5290	
Y	ppm	27	360	54.0	175	0.23	294	495	
U	ppm		13						
Th	ppm	27	375	5.00	65.8	0.50	208	658	
La	ppm	27	1510	85.0	564	0.32	1180	2480	
Ce	ppm	27	2650	171	1090	0.34	2350	5090	
Nd	ppm	27	823	77.0	376	0.29	738	1450	
Sm	ppm	27	88.5	8.10	46.1	0.26	84.1	154	
Eu	ppm	27	28.1	2.90	14.1	0.26	25.5	46.0	
Gd	ppm		— —						
Tb	ppm	27	10.2	2.50	5.07	0.15	7.22	10.3	
Tm	ppm		18						
Yb	ppm	27	19.7	0.15	6.80	0.60	27.2	109	
Lu	ppm	27	2.20	0.20	1.18	0.21	1.93	3.16	

*1: Standard deviation in logarithmic scale.
*2: Calcultedfor the 27 samples within this area.

(5) Discussion

Through geological and geochemical survey, Rangwa carbonatite body is considered to be eroded much deeper than that of Ruri Hills and Homa Mountain. Consequently contents of elements such as Nb and P which are thought to represent a deeper section of carbonatite intrusion, are in somewhat high levels than others.

But samples having highly anomalous values to form anomaly zone were rare, so target area for further exploration was not found in this area.



LEGEND

- Non anomalous sample
- Anomalous sample (≧ m + 1S , < m + 2S)
- Highly anomalous sample (≧ m + 2S)
- Soil sample

Classification

Element	Anomalous, ≧ m+1S, <m+2S	Highly anomalous ≧ m + 2S
La ppm	≧ 767 , < 3,300	≧ 3,300
Y ppm	≧ 148 , < 344	≧ 344
Nb ppm	≧ 620 , < 2,600	≧ 2,600
P %	≧ 0.61 , < 2.17	≧ 2.17

m : mean , S : standard deviation

Figures are of 1325 rock samples from all the Semi-detailed Survey Areas other than the grid-sampled areas in the Buru and Ndiru Hills.

Fig. II-2-4-2 Geochemical Interpretation Map of the Rangwa Area

2-5 Sagarume-Nyamguruka Area

Prior to the eruptin of the Kaksingri volcano, centering the Rangwa Area, the basement was uplifted due to intrusion of alkaline plutones.

The Sagarume-Nyamguruka Area in located at the northeastern edge of the basement uplift zone, several teens kilometres across in diametre, centring the Rangwa Area, and is distributed by basement granitoids, alcaline rocks and minor carbonatites.

The basement granitoids, being intruded by the alkaline rocks and the carbonatite, are fenitized.

(1) Geographical Background

(A) Location and Access

The Sagarume-Nyamguruka Area is located approximately 30 km west of the town of Homa Bay or 2.5 km northeast of the Rangwa Area.

The Project Area encompass a rectangular area of 9.75 km^2, 6.5 km long in the NW-SE direction and 1.5 km wide in the NE-SW direction.

The access to the Area is the same as to the Rangwa and the roads C-19, E-118 and D-210 (unpaved, all weather) lead to the Area around the southern foot hills of the South Ruri Hill and via the town of Sindo (about 2 km SE of the Aved) the centre of the Kaksingri Bay.

It takes about 50 minutes by car for a distance of approximately 40 km.

(B) Physiogrpahy

The Sagarume-Nyamguruka Area is located in the southeastern foot-hills of the Gembe Hills, a part of the Kaksingri volcano.

The basement granitoids and the alkaline plutonic rocks are distributed on the gentle slopes of the foot-hills and form small rolling hills aligned in the NW-SE direction.

These hills range from 1,200 to 1,400 m above sea level and from 60 to 250 m above the level of Lake Victoria in elevations.

(2) Geology

(A) General Geology

The geological plan and profiles are presented in Fig. II-2-5-1, and Plate 9.

The geology of the Area comprises granitoids (G_3), fenitized granitoids (P-mf), ijolites (I), micro-ijlites and pyroxenites (ImP), dolerites

(D), gabbros (B), siliceous breccias (Brc), albikite (Ca) and soils and surface deposits.

Granitoids (G3): This unit is distributed in the northeastern half of the Area and consists of white to light red coloured, medium to coarse grained leucogranite, grey coloured, medium grained biotite granodiorite and granitic rocks of intermediate composition between these two kinds, including apltic portions.

Gneissosities are weakly developed in general.

The rocks intruded possibly later than the age of Kavirondian of the Precambian era, according to McCall (1958).

Fenitized Granitoids (P-mf): The unit is distributed adjacent to the microijolites and the pyroxenites units (described later in this section), forms a belt of about 150 m in width, and grades into the granitoids unit (G_3) in the Sagarume Area.

A wider distribution of this unit is located in the southeastern part of the Area and also grades into the granitoid unit northeastwards. However, no ijolite intrusion is located on the surface in this part of the Area. It has been suggested that ijolite intrusions may exist at depth o the southwest of this part of the Area.

The fenitized granitoids unit was produced by mylonitization and altreation of the granitoids unite due to intrusion of ijolite.

LeBas devided this unit into 4 zones (1977).

The fenitized granitoids are characterized by development of gneissosity, porpyroclastic feldspers (and quartz in part), porphyroblastic alkaline feldspars, and of veinlets of green coloured minerals and by mylonitic granulation of constituent minerals due to mylonitization and alteration caused by intrusion of ijolite.

The degree of the fenitization increases from the granitoid side towards the ijolite side.

The results of the microscopic obesrvation and the chemical analysis (major rock forming elements) of the fenitized granitoid sample (99685 G) collected in the central southeastern part of the Area are presented in Apx. 3 and Apx. 8, and its normative composition in Apx. 8a. The normative composition is plotted on the Quartz-Orthoclose-Plagioclase diagram.

Secondary aegirine is identified under the microscope.

The result of the chemical analysis indicates that the fenitized granitoids are of granite orgin.

Ijolites (I): The unit distributes to the south of Sagarume.

The rocks are grey to greenish grey, coarse grained, and holoerystalline.

Nephelines, pyroxenes and a minor amount of potash feldspar are megascopically identified in the rocks.

The results of the microscopic observation and the chemical analysis (major rock forming elements) of the ijolite sample (99712G) collected to the south of Sagarume are presented in Apx. 3 and Apx. 8, and its normative composition in Apx. 8a.

The normative composition is plotted on the diagram for the alkaline plutonic rock classification (Apx. 8b), and belongs to the ijolite domain closer towards the urtite domain.

The result of the K-Ar age determination for the ijolite sample (99712G) is presented in Apx. 10.

The K-Ar age, 25.8 Ma, is correlated to the late 1st Stage of the alkaline-silicate activity (25 - 40 Ma) of the Kaksingri volcanic system (LeBas, 1977).

Microijolites/Pyroxenits (ImP): The unit is the marginal facies of the ijolites distributing in the Sagarume Area.

The rocks consist of dark greenish grey to dark grey microijolite and dark greenish grey, fine grained pyroxenite cropping out in a belt ranging fro 50 to 100 m in width.

Dolerites (D) and Gabbros (B): These rocks croops out at several localites in the southeastern part of the Area. Their relation to the granitoids and the fenitized granitoids is unknown.

Pyroxinite (Px): Pyroxinite dikes of less than 10 m in width intrude the granitoids in the northern part of the Sagarume Area.

Breccias (Brc): The breccias crops out at 3 localities in the central, the central eastern and the southern parts of the Area. At the former two localities, they occur adjacent to or to the proximity of alvikite and contain granitoid fragments in siliceous matrices.

At the third locality, the rocks contain angular nephelinite (or phonolite) fragments and may be of breccias forming a vent.

Alvikite (Ca): A massive body of alvikite is located in the southeastern part (Nyamguruka) of the Area. Albikite dikes less than several metres wide occur in other localities.

The alvikite body in the Nyamguruka Area) consists of brown, fine to medium grained rocks megascopically containing carbonates, minor micas and weathered green minerals and is intruded by ferrocarbonatite dikelets of less than several tens centimetres.

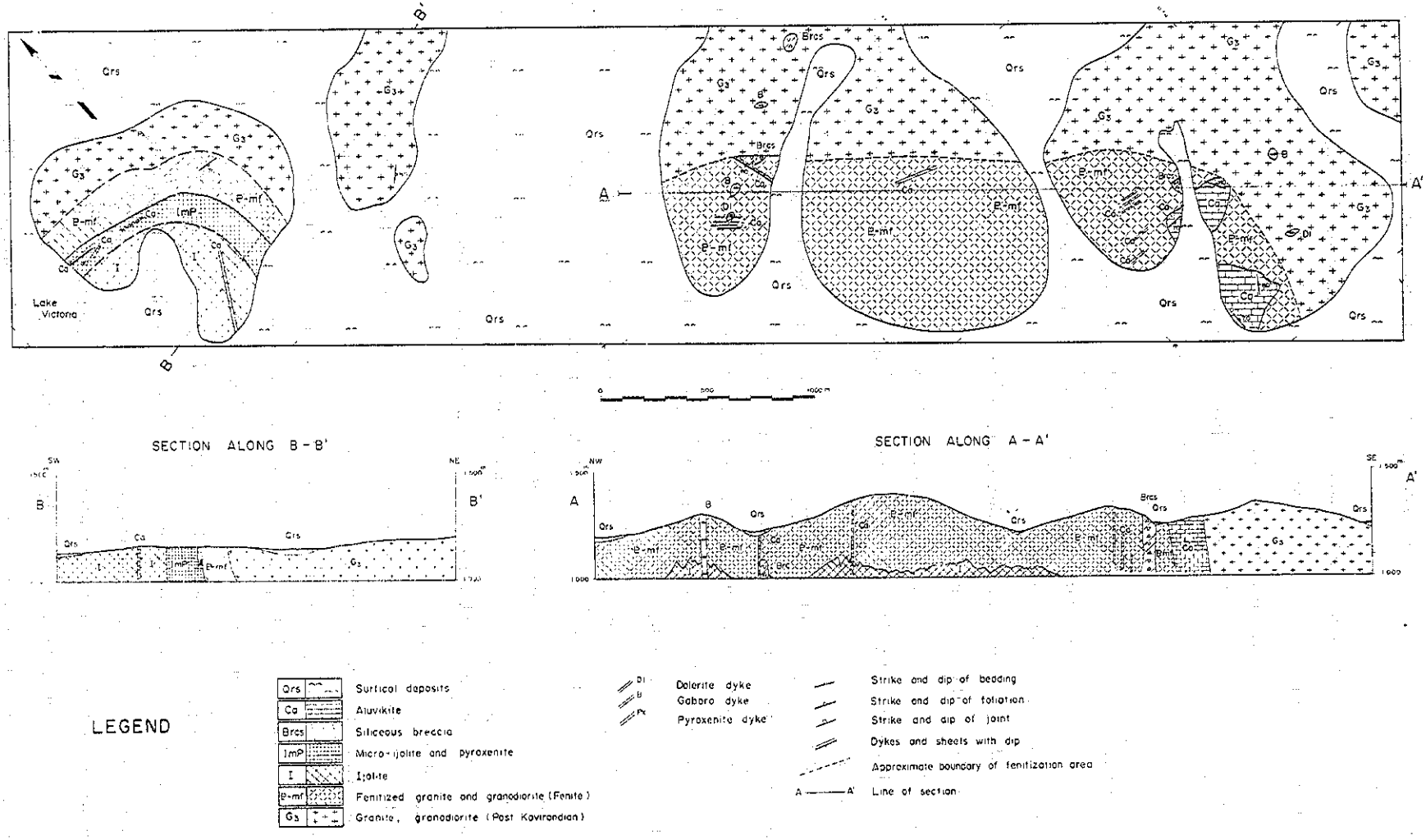


Fig. II-2-5-1 Geological Map of the Sagarume-Nyamgurka Area

The results of the microscopic observation and the chemical analysis of the albikite sample (99729G) collected near the contact to the fenitized granitoids are shown in apx. 3 and Apx. 8.

Dikelets of the albikite intrude the ijolite unit in the southern and the western parts of the Sagarume Area.

The 0.5 m + wide dikelet in the southern part consists of very fine grained rocks and is continuous for more than 600 m.

That in the western part is a breccia dikelete consisting of fine grained rocks.

(B) Geological Structures

The Area is located at the northeastern end of the circular uplifting zone of the basement having been formed by intrusions of ijolites-syenites.

Zones of various degrees of fenitization are arranged in a concentric fashion in the Sagarume Area.

Without an exposure of ijolite intrusions in the Nyamguruka Area, ijolite intrusions have been presumed at depth beneath the fenitized granitoid.

(4) Geochemical Survey

(A) Sampling

Rock samples were collected on a group of hills aligning in NW-SE direction only where exposure of rocks were seen in the area. The other area forms colluvial slope of Gembe Hill which is composed of melanephelinitic volcanic rocks. Carbonatitic rocks in the area are restricted in small areas, so the number of carbonatite samples is only 22 in 76 total samples. Other 54 samples include fenite, ijolite and granitic rocks.

Location of samples is shown in Plate 27.

(B) Statistical Values and the Characteristic

The summary of the assay results of samples is listed in Table II-5-4-1.

TABLE II-2-5-4-1 SUMMARY OF STATISTICS OF GEOCHEMICAL ANALYSIS —SAGARUME AREA —

Element	Unit	Number	Max.	Min.	Mean (m)	Number of samples ≧m+1s	Number of samples ≧m+2s	Remark
P	%	76	14.5	7.00	0.10	7	1	14.4% *2
Ba	ppm	76	13100	30.0	948	3	0	
Sr	ppm	76	9330	52.0	732	5	0	
Nb	ppm	76	735	2.50	32.0	1	0	
Y	ppm	76	220	10	43.1	3	0	
U	ppm	76	29					
Th	ppm	76	215	0.00	9.26	3	0	
La	ppm	76	1690	5.00	67.7	7	0	
Ce	ppm	76	2650	8.00	136	8	0	
Nd	ppm	76	1180	2.50	52.4	12	0	
Sm	ppm	76	245	0.70	10.2	18	0	
Eu	ppm	76	37.2	0.20	2.86	15	0	
Gd	ppm	76	120					
Tb	ppm	76	12.2	0.05	0.83	4	0	
Tm	ppm	76	3					
Yb	ppm	76	17.1	0.05	0.95	3	0	
Lu	ppm	76	3.20	0.05	0.27	2	1	

*1: Standard deviation in logarithmic scale
*2: 14.5% P is the highest value in all the Semi-detailed areas.

Means of each analytical elements are very low and are 1/2 to 1/3 of that of the "All the Areas", reflecting minor occurrences of carbonatites in the area. Maximum value (14.5%) of P is also the maximum of the "All the Areas".

(C) Interpretation of Geochemical Anomaly

Interpretation result of geochemical anomaly in the area is shown in Plate 19 and Fig. I-5-2.

In the Sagarume area which is located in the northwestern part of the area, only two samples have anomalous value for P or P, Y and Sm, and others have not at all. So no anomaly zone was picked up in the area.

In the Nyamgurka area located in the central and southeastern part of the area, anomalous values for P, La, Ce, Nd, Sm and Eu were detected from some carbonatites which occur as small dykes of massive bodies. But any samples which have highly anomalous value were not detected from those carbonatites.

The sample which has the maximum value (14.5%) for P in "All the Areas" was collected in a fenite zone located southeastern end of the area. The fact that the sample has no anomalous value for REE except Lu (3.2 ppm), but has pretty high value for Sr (9930 ppm) may indicate local mineralization of minerals including P and Sr, but very minor REE.

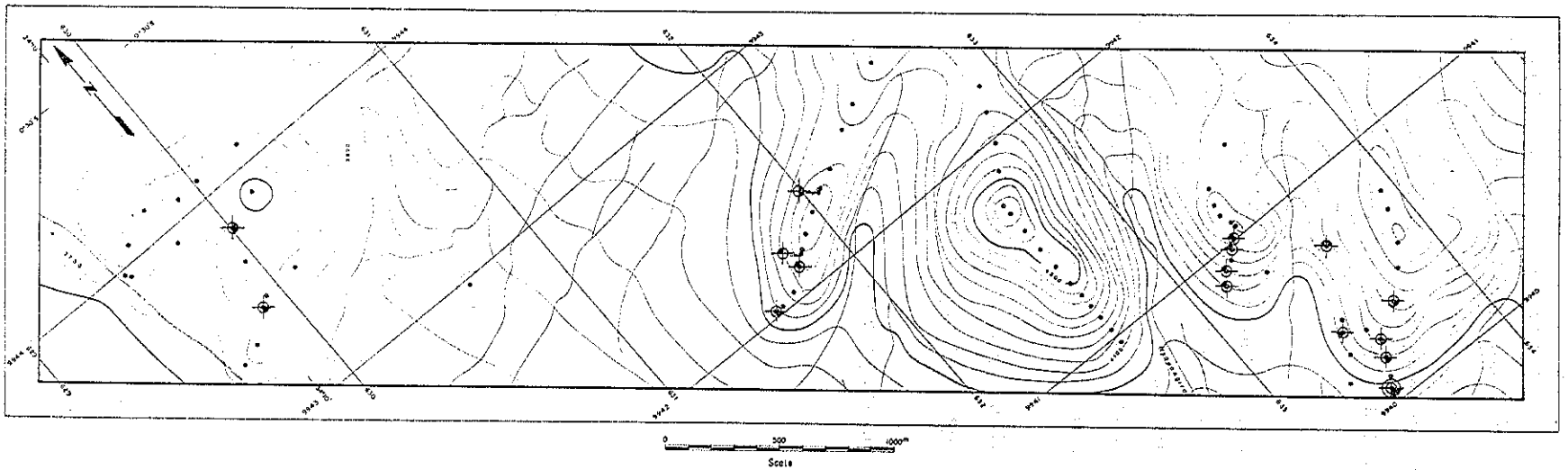
(5) Discussion

Through geological survey, it turned out that this area has very minor occurrence of carbonatite, especially ferrocabonatite which is thought to have close relation with mineralization of REE.

Through geochemical survey, on the other hand, any anomaly was not found in this area, though there were a few alvikite samples which had anomalous values for P, Y and REE.

Samples from ijolites and fenites which exist abundantly in this area did not have any anomalous value, excepting only one sample which was highly anomalous for P.

Consequently, necessity of further detailed survey is thought to be very low for this area.



LEGEND

Non anomalous sample

Anomalous sample
(≧ m + 1S , <m + 2S)

Highly anomalous sample
(≧ m + 2S)

Classification

Element	Anomalous, ≧ m+1S, <m+2S	Highly anomalous ≧ m + 2S
La ppm	≧ 767 , < 3,300	≧ 3,300
Y ppm	≧ 148 , < 344	≧ 344
Nb ppm	≧ 620 , < 2,600	≧ 2,600
P %	≧ 0.61 , < 2.17	≧ 2.17

m : mean , S : standard deviation

Figures are of 1325 rock samples from all the Semi-detailed Survey Areas other than the grid-sampled areas in the Buru and Ndiru Hills.

Fig. II-2-5-2 Geochemical Interpretation Map of the Sagarume-Nyamgurka Area

2-6 South and North Ruri Area

North Ruri Hill and South Ruri Hill (called Ruri Hills collectively) are formed of one of the three largest carbonatite-alkaline rock complex units and are a pair of hills which stand out above the surrounding alluvial plain and are composed of two typical cone sheets.

(1) Geographical Background

(A) Location and Access

The North and the South Ruri Hills are located 10 km to the west and 11 km to the west southwest of the town of Homa Bay respectively.

The North and South Ruri Area occupies an area of 35 km^2, 7 km long in the NS direction and 5 km wide in the EW direction, and is situated 5 to 10 km off the coast of the Winum Gulf towards the inland side.

The unpaved road C-19 leads to the Area from the town of Homa Bay and the unpaved road E-17 surrounds the two hills.

It takes 30 minutes to the foot of the South Hill and 40 minutes to that of the North Hill for distances of 18 and 22 km respectively from the town of Homa Bay.

(B) Physiography

The North and South Ruri Hills are cone shaped hills 2.5 and 3 km across in diametre respectively and their peaks stand out approximately 450 m above the surrounding alluvial plain.

The range including the two hills runs in the N-S direction and is composed of gentle slopes at its foot where basement rocks are distributed, and of gentle slopes where carbonatite cone sheetes are developed.

Numerous volcanic necks of phonolite are located within and around the both hill.

The volcanic necks arounds the hills form a group of small hills in the alluvial plain.

(3) Geology

(A) General Geology

The geological plan and profiles are presented in Fig. II-2-6-1 and Plate 10.

Lithology and distribution of each geologic unit are to be described as follows according to the classification adopted in the geological maps.

Nyanzian Metabasalt (Al-bv): The unit is distributed in the piedmonts

of the two hills except for the southern foot of the South Ruri Hill.

The rocks are variable in colours such as grey, greenish brown, greyish grey, dark green and others, and are fine grained compact metamorphics derived of basalts.

Calcite veinlets and iron stains are often developed in the rocks. It is difficult to distinguish mafic menierals due to alteration.

Many of outcrops are composed of aggregations of fine rock fragments, which suggests that the rocks have been inensely shattered.

Intensively Shuttered Metabasalt Associated with Carbonatite Sheets (Al-vbc): The unite distributed in the centre of the North Ruri Hill surrounded by the carbonatite complex unit and, consisting of green to greyish green metabasalt, is intruded in a concentric fashion by light brown to grey alvikite dikes ranging from several tens centimetres to several teens metres.

The metabasalt is finely fragmental and the alvikite forms outstanding solid outcrops.

Dikes of brown ferrocarbonatite are also found in the unit but minor in amount.

There are some occurrences of the shattered metabasalt in which networks of alvikite and ferrocarbonatite dikelets are formed.

Nepheline Syenite (Sy): The unit occurs to the north of the North Ruri Hill as small stocks and to the northeast of the South Ruri Hill as dykes.

Though there has been noted a number of stocks of this unit by McCall (1952) and LeBas (1977), the present investigation has confirmed only the occurrences above described.

The rocks, intruding the basement metabasalt, are grey in colour and megascopically consist of potash foldspars, nepheline and pyroxene phenocrysts in fine grained groundmasses less than 1 mm across in particle sizes.

Such rock forming minerals as nepheline, potash feldspar aegirine, clinopyroxene, natronite, analcime and cancrinite are identified under microscope in the sample (100132G) collected in the North Ruri Hill Area as shown in Apx. 3.

Phonolite (T-vp): There are 33 volcanic necks and 2 dikes of phonolite within and around the carbonatite complexes both in the North and the South Ruri Hill Areas.

The volcanic necks are cone shaped and, circular, oval or twin-circular in plan.

The volcanic necks in the South Ruri Hill Area are generally larger in sizes than those in the north Ruri Hill, and the largest of them reach 600 m in diametre.

The highest peak of the volcanic necks around the carbonatite complexes has a relative hight of 120 m above the bottom of the neck.

The largest phonolite dike runs from the top of the South Ruri Hill north northeasterly and is 700 m long and 20 m wide.

Other dikes are much smaller in scales and less than several metre wide.

Phonolite intrudes the basement rocks. The dikes apparently intrude the albikite. However, the relation of the volcanic necks to other facies of the carbonatite complexes is not necessarily clear.

The rocks are grey to greenish grey and vitreous, and contain phenocrysts of nepheline, potash feldspar, and pyroxene.

The sizable volcanic necks are aphanitic in the outer zones and porphyritic in the cores in general.

A small volcanic neck, located approximately 700 m south of the top of the North Ruri Hill, indicates a peculiar facies containing a large amount of phlogopite up to 2 cm across.

Sovite (Cs): The unit is distributed mostly in the South Ruri Hill Carbonatite Complex and partly in the North Ruri Hill Carbonatite Complex, forming lenticular bodies less than 100 m wide.

The sovite occurs as xenoliths in the alvikite and as fragments in the carbonatite breccias and has apparently preceeded these facies. However, the relation of the sovite to other facies of the carbonatite complexes is not necessarily clear.

The unit comprises rocks of light grey coloured coarse grained and grey coloured, medium to coarse grained facies which contain a minor amount of mafic minerals.

The microscopic observation identified calcite, zoisite, potash feldspar and quartz in a sample (100152G) of the former facies collected in the South Ruri Hill Area, and calcite, aegirine, apatite and biotite in a sample (100127) of the latter facies collected in the North Ruri Hill Area as shown in APX-3.

Alvikite (Ca): The unit is the main facies of the carbonatite complexes in this Area.

Both the North Ruri Hill and the South Ruri Hill carbonatite complexes are distributed in massive circular forms. However, concentric structures are clearly observed within the complexes in the airphotos.

As the outer contacts of the complexes dip towards the centre, they are ring complexes having conical shapes.

The Alvikite occur as dikes intruding the basement rocks in the piedmonts of the hills and as a group of dikes arranged in a concentric fashion.

The rocks show variable colours such as grey, light brown, brown, yellowish white and others.

The variation in colour is mainly caused by oxidation of iron bearing minerals due to weathering but also, in some case, corresponds to differences in kinds and amounts of rock forming minerals.

The rocks are generally fine grained but occasionally medium grained.

The major constituent minerals are carbonates (mainly calcite), magretite, biotite, apatite and occasionally aegirine augite.

The microscopic observation of a sample (99543G) collected in the North Ruri Hill Area identified pyrochlore in addition to the above minerals as shown in Apx. 3.

Ferrocarbonatite (Cf): The unit occurs as dikes intruding primarily the alvikite and occasionally the basement metabasalt, and is distributed mainly in the South Ruri Hill Area and in a limited area to the south of the North Ruri Hill.

In most cases, a single dike, upto several metres in width, does not occur in a mapable size and numerous narrow dikes form a group.

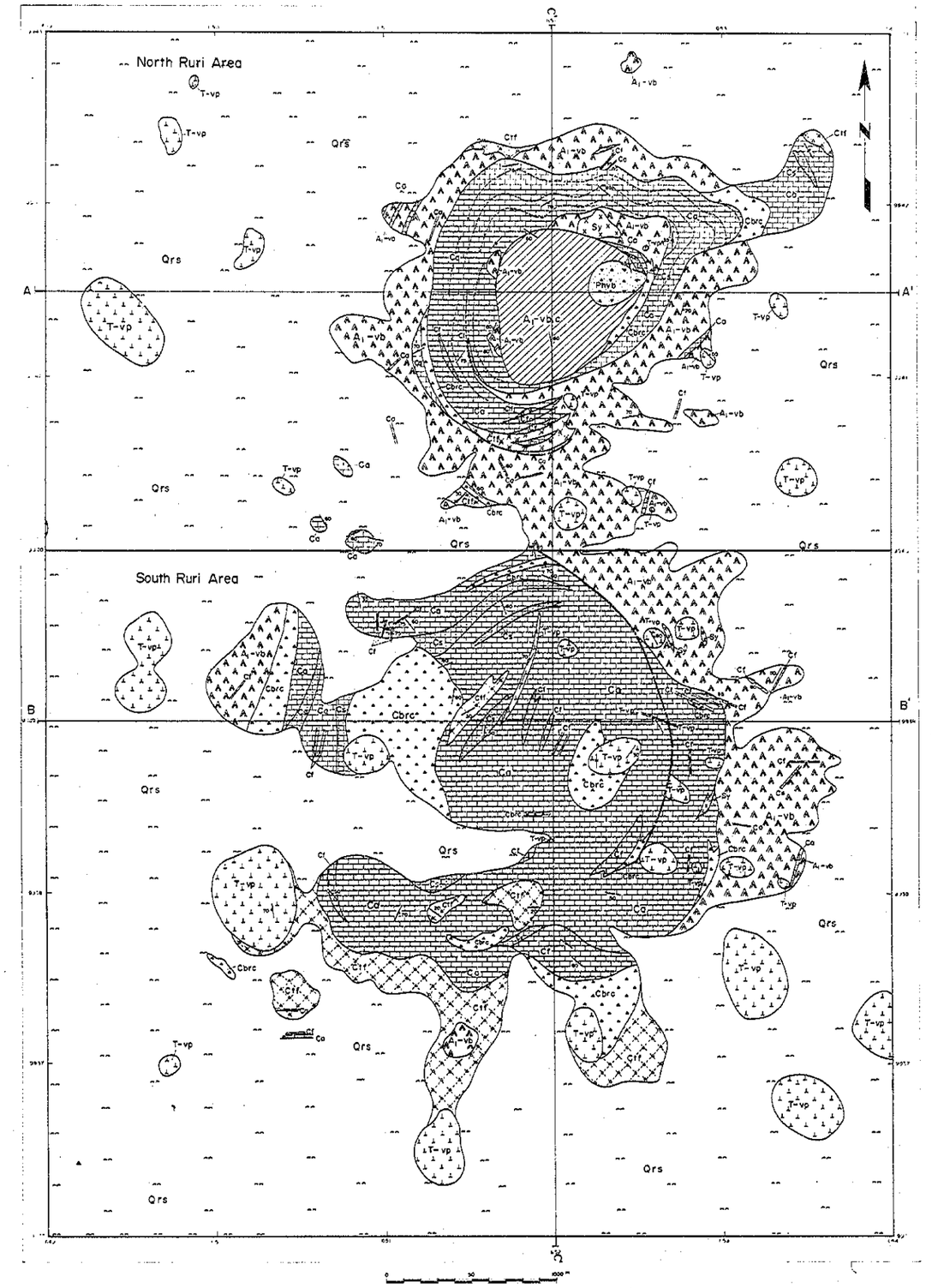
Most of the dikes which are outlined with widths ranging from several tens to several hundreds metres in the geological maps, are groups of narrow dikes.

An exception is a massive ferrocarbonatite body of 700 m in length and 300 m in width, located to the south of the South Ruri Hill.

The rocks are variable in colours depending on kinds and amounts of constituent minerals or degrees of oxidation of iron-bearing minerals due to weathering but show dark colours such as dark brown, brown or reddish brown in general.

Magnetite and other iron oxides are magascopically identified. Carbonates are also identified by forming in reaction to hydrochloric acid.

Several kinds of unidentified opaque minerals are observed under the microscope in addition to carbonates in a sample (99502G) collected in the South Ruri Hill Area.



LEGEND

- Qrs — Surficial deposits
- T-vp — Phonolite, mainly plugs and dykes
- Phvb — Phonolitic vent breccia with some carbonatite breccia
- Ctf — Calcareous tuff, tuff breccia
- Cf — Ferrocarbonatite
- Ca — Alvikite
- Cs — Sovite
- Cbrc — Carbonatitic breccia
- Sy — Nepheline syenite
- A1-vbc — Shattered Nyanzian metabasalt with dyke swarms of carbonatite
- A1-vb — Nyanzian metabasalt

- Strike and dip of bedding
- Strike and dip of flow banding
- Strike and dip of joint
- Dykes and sheets with dip
- Structural trend from aerial photographs
- Existing fault
- Inferred fault
- A —— A' Line of section

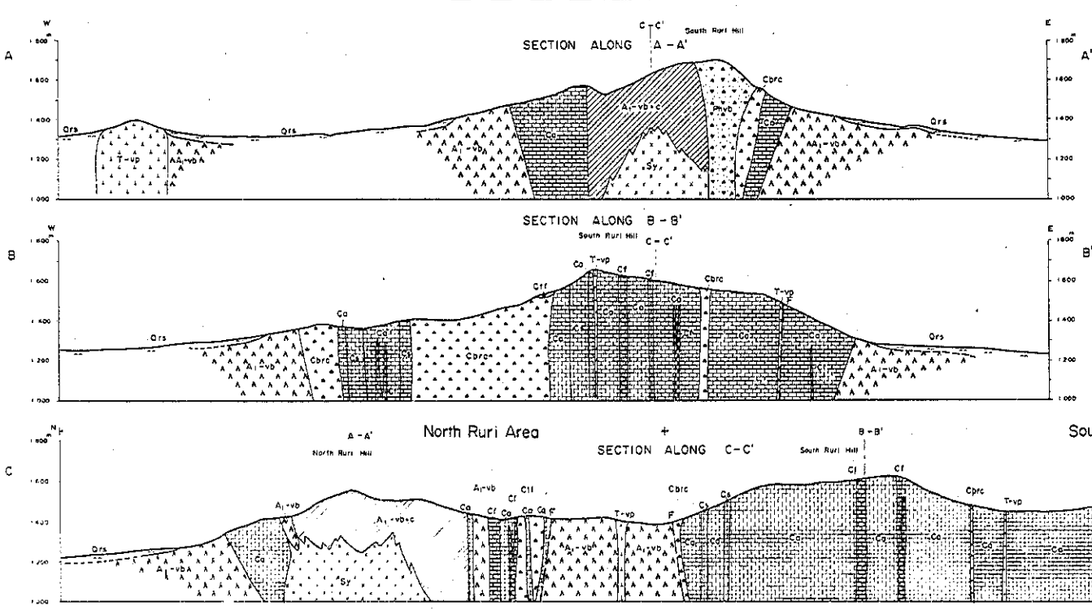


Fig. II-2-6-1 Geological Map of the South Ruri and the North Ruri Area

Carbonatitic Breccias (Cbre): The unit is distributed mainly in the peripheral zones of the North and the South Ruri Hill Carbonatite Complexes and
in a limited area in the centre of the South Ruri Hill Complex associated with a phonolite volcanic neck.

The rocks consist of light brown to brown carbonatite tuffs and tuff breccias containing various kinds of angular fragments in fine grained carbonatitic matrices and often grade into alvikite.

In most cases, fragments of sovite, alvikite or ferrocarbonatite are contained in appreciable amounts.

Other frgments are of metabasalt, granitoids, alkaline intrusive rocks and various rocks, the proportional quantities of which varies in places.

Though it is observed that the rocks intrude steeply the perpheral zones of the carbonatite complexes, their occurrences suggest that extrusive facies may be included in substantial proportion.

Calcareous Tuffs and Tuff Breccias (Crf): The unit is distributed in the southern piedmont and the centre of the South Ruri Hill, and in the southern part of the North Ruri Hill Area.

The rocks contain angular fragments of basement rocks, alkaline plutonic rocks and volcanics in light grey calcareous and tuffaceous matrices.

Carbonatite fragments are rarely included.

Magnetite and biotite are megascopically identified in the matrices.

It is, a presumable that this unit may precede carbonititic facies constituting the carbonatite complexed because narrow dykes of alvikite intrude this unit at several localities.

Phonolitic Vent Breccias (Cvbrc): The unit forms a oval body of 350 m in its long axis and 200 m in its short axis centring the peak of the North Ruri Hill.

The rocks are light greenish brown to light brown in colour and contain a large amount of angular phonolite fragments up to 30 cm across in diametre in calcareous tuff matrices, in which networks of carbonate veinlets are developed.

The phonolite fragments characteristically contain megacrysts of brown micas (?phlogopite) up to 1 cm in diametre and magnetite.

It is judged from its occurrence that the unit represents a intrusive breccia facies.

Soils and Surficial Deposits (Qys): The unit is distributed along creeks in the piedmonts and consists mainly of sands and gravels with a poor development of soils.

(B) Geological Structure

Both the North and the South Ruri Hills have domal structures.

The central carbonatite complexes occupy the roofs of the domes and the outer contacts dip steeply outwards.

The surrounding basement has steep dips near the contact to the carbonatite intrusions but gentle dips away from the intrusions.

These structural features may have been formed by the intrusive activities of the ijolite and the subsequent carbonatite.

The carbonatite complexes show cone sheet structure.

In the North Ruri Hill in particular, it is clearly observed that numerous sheets of carbonatite dip towards the centre of the complex with angles ranging from 40 to 60 degrees.

The basement metabasalt is left as a roof pendant on the top of the North Ruri Hill at an elevation of 1,600 m above sea level.

In the South Ruri Hill, the metabasalt distributes up to an elevation of 1,450 m above sea level but no roof pendant is left on the top of the Hill.

A number of the phonolite volcanic necks are distributed in the South Ruri Hill Area but only a few in the North Ruri Hill Area.

The vent breccia at the centre of the North Ruri Hill appears to grade into a volcanic vent to the depth.

In summary, the North Ruri Hill Carbonatite Complex may represent a shallow facies relative to the South Ruri Hill Carbonatite Complex.

The North Ruri Hill Complex is smaller in scale than the South Ruri Hills.

(4) Geochemical Survey

(A) Sampling

Both rocks and soils were sampled in the area.

Rock samples were collected in Ruri Hills being composed mainly of carbonatites, and in the surrounding piedmont where Nyanzian rocks and carbonatitic pyroclastics were exposed. The number of samples is 136 in the South Ruri and 122 in the North Ruri, totaling 258.

Soil samples were collected in a flat area along a valley running westward from just south of the South Ruri Peak, and western piedmont of the North Ruri where scattered exposures of carbonatite were seen. The number of samles in the former is 9, and the later 10, totaling 19.

Location of samples is shown in Plate 28.

TABLE II-2-6-4-1 SUMMARY OF STATISTICS OF GEOCHEMICAL ANALYSIS-S.& N.RURI HILLS-

Element	Unit	No of sample	Max.	Min.	Mean (m)	Number of samples ≧ m+1s	Number of samples ≧m+2s	Remark
P	%	258	2.77	4.00	0.11	22	2	
Ba	ppm	258	32600	30.0	1710	37	3	
Sr	ppm	258	11000	68.0	1330	51	1	
Nb	ppm	258	2100	2.50	127	19	0	
Y	ppm	258	1360	5.00	69.1	28	15	*2
U	ppm	258	130					
Th	ppm	258	1840	0.50	31.9	42	10	
La	ppm	258	14300	0.50	206	34	17	*3
Ce	ppm	258	17700	3.00	364	45	15	*4
Nd	ppm	258	2500	2.50	116	55	1	
Sm	ppm	258	450	0.70	18.3	58	5	
Eu	ppm	258	140	0.05	6.65	61	7	
Gd	ppm	258	450					
Tb	ppm	258	44.0	0.05	2.44	41	5	*5
Tm	ppm	258	23					
Yb	ppm	258	82.0	0.60	3.83	37	10	
Lu	ppm	258	14.0	0.1	0.76	34	12	

*1: Standard deviation in logarithmic scale.
*2: Highest except Buru Hill(4800). *3 & 4: Highest except Ndiru Hill.
*5: Highest except Nduru Hill. *6: Highest in 1509 samples.

TABLE II-2-6-4-2 SUMMARY OF STATISTICS OF GEOCHEMICAL ANALYSIS(SOIL) RANGWA AREA

Element	Unit	Number	Max.	Min.	Mean (m)	St.dev (S)*1	m+1s	m+2s	Remark
P	%	27	1.34	0.34	0.85	0.18	0.46	2.64	
Ba	ppm	27	33700	340	5110	0.44	14200	39300	
Sr	ppm	27	1420	301	755	0.16	1080	1550	
Nb	ppm	27	6300	140	1010	0.36	2310	5290	
Y	ppm	27	360	54.0	175	0.23	294	495	
U	ppm								
Th	ppm	27	375	5.00	65.8	0.50	208	658	
La	ppm	27	1510	85.0	564	0.32	1180	2480	
Ce	ppm	27	2650	171	1090	0.34	2350	5090	
Nd	ppm	27	823	77.0	376	0.29	738	1450	
Sm	ppm	27	88.5	8.10	46.1	0.26	84.1	154	
Eu	ppm	27	28.1	2.90	14.1	0.26	25.5	46.0	
Gd	ppm								
Tb	ppm	27	10.2	2.50	5.07	0.15	7.22	10.3	
Tm	ppm								
Yb	ppm	27	19.7	0.15	6.80	0.60	27.2	109	
Lu	ppm	27	2.20	0.20	1.18	0.21	1.93	3.16	

*1: Standard deviation in logarithmic scale.
* : Calculated for the samples within this area.

(B) Statistical Values and the Characteristic

The summary of the assay results of rock and soil samples are shown in Table II-2-6-4-1 and II-2-6-4-2 respectively.

Means for each element of rock samples are 10 - 20% lower in P, Ba, Sr and Nb, and 20 - 50% higher in Y and REE than that of the "All the Areas", having a reversal tendency to the Rangwa. This is thought to indicate that the carbonatites in the Ruri Hills are not eroded deeper than that of Rangwa. The maximum values of the area for Y (1,360 ppm), La (14,300 ppm) Ce, (17,700 ppm) and Lu (14.0 ppm) are also that of the "All the Areas".

Means for elements of soil samples are 1.4 to 2.2 times in P, Ba, Y and LREE and 3.1 time in Nb of that of the "All the Areas". This may indicate certain secondary enrichment of elements from rock to soil, though these soil samples were collected in areas where carbonatites were distributed and contents of elements were though to be originally higher than means of rock samples.

(C) Interpretation of Geochemical anomalies

Interpretation result of geochemical anomalies in the area are shown in Plate 20 and Fig. II-2-6-2.

In rock geochemistry, anomalous values are seen much in Sr and REE, and highly anomalous values in Y, Th, Ce, Yb and Lu.

Samples having anomalous values are usually distributed in the carbonatite zone widely, but no prominent concentration of the samples were observed.

Highly anomalous samples, on the other hand, are distributed in the marginal zones of carbonatite cone sheets of the Ruri Hills, and type of all these samples are of ferrocrabonatite.

Consequently following three geochemical anomalies were found.

Anomaly Located at 0.8 km North of the North Ruri Peak

This anomaly is located on the contact zone between Nyanzian metabasalt and the carbonatite cone sheet of North Ruri, where ferrocarbonatites occur as swarms of dykes or network veinlets in alvikites and metabaslats. In this anomaly, three contiguous samples have highly anomalous values for Y, and one of three samples has maximum value of Y (1,360 ppm) in the "All the Areas". Analytical results for main elements are as follows.

Sample No.	Nb	Y	La	Ce	Nd	Sm	Eu
100136G	205	420	11060	14700	1800	270	66
100237G	740	1360	7530	11900	1900	360	95
100138G	765	460	280	430	190	73	30

(ppm)

Anomaly Located at 0.9 km Southwest of the North Ruri Peak

This anomaly is on the southwest part of North Ruri carbonatite cone sheet where alvilcites and metabasalts are distributed irregularly and swarms of ferrocarbonatite have intruded them. This anomaly includes 5 highly anomalous samples for Y, LREE etc. Analytical results of these samples for main elements are as follows:

Sample No.	Nb	Y	La	Ce	Nd	Sm	Eu
99550G	135	550	4860	6500	1300	190	54
99551G	45	290	5260	7500	1300	160	43
99552G	150	320	4060	4900	1000	100	43
100421G	12	410	12650	17700	1800	160	42
100425G	70	1170	1500	2200	870	420	140

(ppm)

Anomaly Located 1.5 km East-northeast of the South Ruri Peak

This anomaly is on the marginal zone between carbonatite cone sheet of the South Ruri and Nyanzian metabasalt, where massive alvikites and metabasalts are intruded by many small forrocarbonatite dykes. This anomaly include two samples which have highly anomalous value for Y and L-MREE. Analytical results of two samples for main elements are as follows:

Sample No.	Nb	Y	La	Ce	Nd	Sm	Eu
99503G	240	410	5790	8800	600	190	48
99505G	54	660	8830	12500	1200	240	61

(ppm)

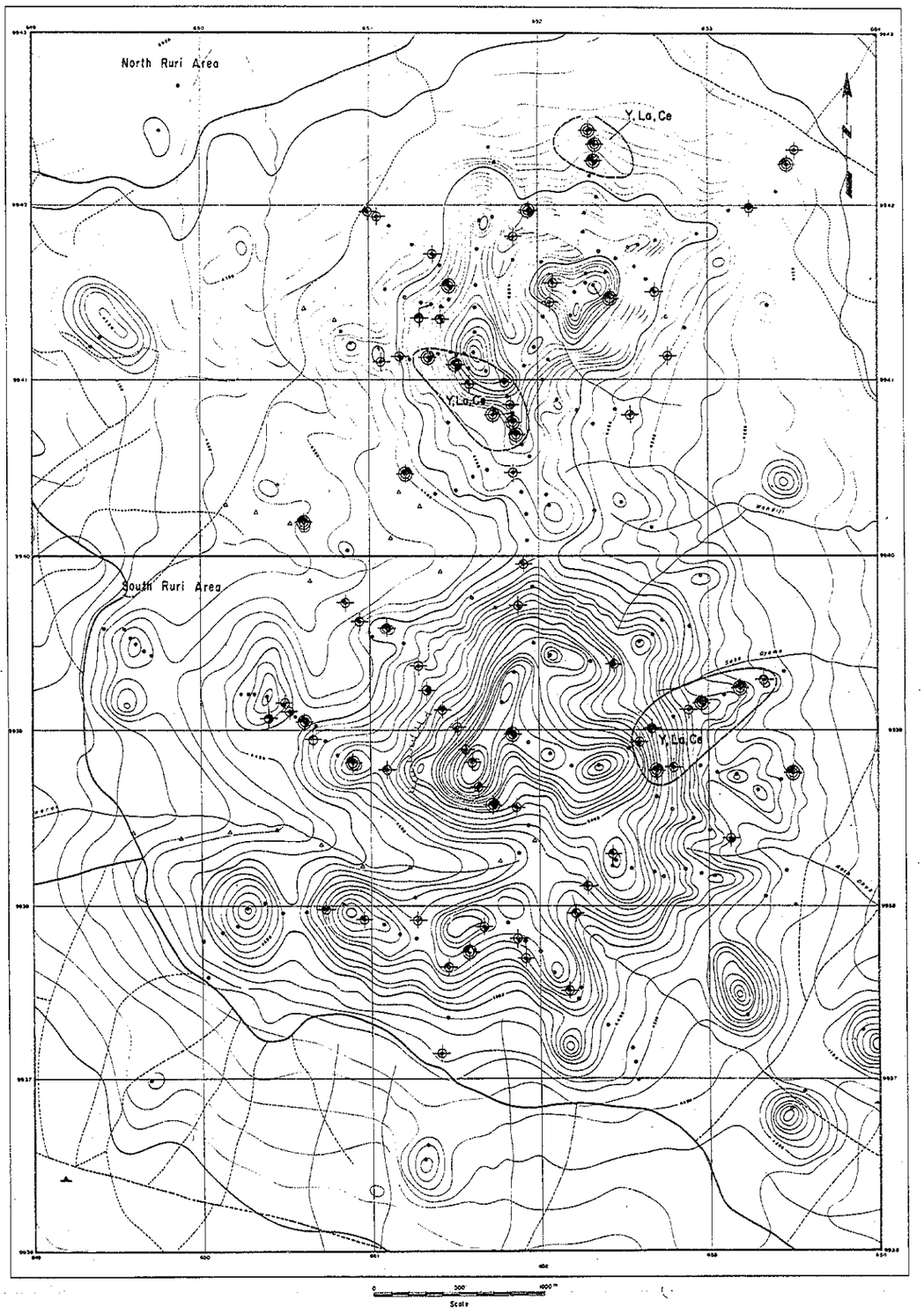
In soil geochemistry, no sample which had highly anomalous value for any elements was detected. Some secondary enrichment was thought to be seen in soil samples, but their contents were not so high to form an anomaly.

(5) Discussion

Geological survey revealed that shallow facies of carbonatite cone sheets are exposed in the Ruri Hills, and ferrocarbonatite are mainly distributed on marginal zones between carbonatite cone sheets and Nyanzian metabasalts as dykes of several 10 cm to several meters and dyke swarms less than several 10 cm in width.

Through geochemical survey, it turned out that the carbonatites in this area are somewhat rich in Y and REE, and poor in Nb and P, and rocks which have highly anomalous vaues for analytical elements are limited to ferrocarbonatite.

Consequently, three anomalies which have suitable condition for Y and REE mineralization were extracted as target areas for further detailed works.



LEGEND

- Non anomalous sample
- Anomalous sample (≧ m + 1S , < m + 2S)
- Highly anomalous sample (≧ m + 2S)
- Geochemicaly anomalous zone (Target area)
- Soil sample

Classification

Element	Anomalous, ≧ m+1S, <m+2S	Highly anomalous ≧ m + 2S
La ppm	≧ 767 , < 3,300	≧ 3,300
Y ppm	≧ 148 , < 344	≧ 344
Nb ppm	≧ 620 , < 2,600	≧ 2,600
P %	≧ 0.61 , < 2.17	≧ 2.17

m : mean , S : standard deviation

Figures are of 1325 rock samples from all the Semi-detailed Survey Areas other than the grid-sampled areas in the Buru and Ndiru Hills.

Fig. II-2-6-2 Geochemical Interpretation Map of the South Ruri and the North Ruri Area

2-7 Kuge-Lwala Area

Ijolite and carbonatite bodies are known to be distributed at several localities in the Wasaki peninsula to the west of the town of Homa Bay.

The Kuge-Lwala Area includes a small carbonatite body located at the southwest end of the carbonatite occurring area above mentiond.

(1)Geographical Background

(A) Location and Access

Kuge is located at the root of the Wasaki peninsula to the west of the Homa Bay and faces the Mirunda Bay to the west.

The Kuge-Lwala Area, situated 12km northwest of the town of Homa Bay, occupies a square area of 6.25 sq.km, 2.5km long both in the NS and EW direction.

One can reach the Area from the town of Homa Bay by taking an unpaved all weather road C-19 to the south foot of the South Ruri Hill,then another unpaved all weather road E-17 along the eastern piedmonts of the Ruri Hills to the north end of the hill and finally a local path which becomes often unpassable under wet conditions.

It takes about 50 minutes by car for a distance of approximately 30km from the town of Homa Bay.

(B) Physiography

The Area comprises a rolling hill running in the direction of NW-SE.

The top of the hill reaches approximately 1200m above sae level or approximately 60m above the level of Lake Victoria in its elevation.

(2) Previous Work

An explanatry note "Geology of the Gwasi Area" for the 1 to 125000 scale geological map(McCall,1958) has been published for the geology of this area.

McCall has commented in the explanatory note that in the Kuge Area there are some carbonatite breccias which show radioactivities 10 times of the background.

LeBas(1977) has petrologically examined the Kuge Area in detail in a series of his research studies.

The Finnish team(Iddam et al.1986) has carried out a preliminary investigation of the area in a series of the exploration for phosphate and niobate in the western Kenya, and has chemically analized 16 samples for phosphates and 4 samples for niobate,

(3) Geology

(A) General Geology

The geology of this area comprises the basement Nyanzian metabasalt, Tertiary volcanics, carbonatites, ferruginous breccias and Quarternary surfical deposits.

The geological plan and cross sections of this Area are presented in Fig.II-2-7-1 and Plate-11.

The distribution and the lithology of each geologic unit are hereunder described according to the classification adopted in the geological maps.

Nyanzian Metabasalt(A1-vb)

The unit is distributed in the southern part of the Area and in the area from the top of the Kuge Hill in the center to the south.

The rocks of the unit are hard and compact in general.

The rocks in the southern part are massive, while those on the top of the Hill, being surrounded by carbonatites,are extremely shattered and fragmental.

Tertiary Volcanics

The unit is subdevided into the nephelinite pyroclastics(T-vn), the melanephelinite(T-vm), the porphyritic phonolite(T-vp) and the phonolitic nephelinite(T-vpn).

Each of these facies is distributed collectively on or around the NW-SE.
trending Hill. The relations between the facies are not always clear due to scarcity of outcrops.

Carbonatites

The unit is subdevided into the alvikite(Ca) and the ferrocarbonatite (Cf).

Alvikite(Ca)

The subunit is distributed in the northern part of the Kuge Hill,surrunding the metabasalt.

The rocks of the subunit are greyish brown and fine grained compact carbonate rocks well-developed with banded structures.

The banded structures are formed by layered arrangements mainly of biotite and apatite or occasionally of magnetite.

The rocks are generally stained by iron oxides, particularly near the contact to the ferrocarbonatite.

A sample(100051G)of the rocks collected near the contact to the ferrocarbonatite to the east of the peak of the Kuge has been microscopically ovserved and chemically analized,the results of which are presnted in APX.3 and APX.8.

Ferrocarbonatite(Cf)

The subunit,contacting the alvikite is distributed in the northeastern part of the Kuge Hill continouslly for a length of approximetelly 450m in the N-S direction with widths ranging from 35 to 40m.The ferrocarbonatite body dips 30 to 50 degrees to the west.

It appers from its occurrence to consist of a number of parallel ferro carbonatite dykes,some of which are brecciated.

The rocks are brown,dark grey or yellowish brown and rich in iron, and contain carbonates because they produce foams in reaction to dilated hydrochloric acid.

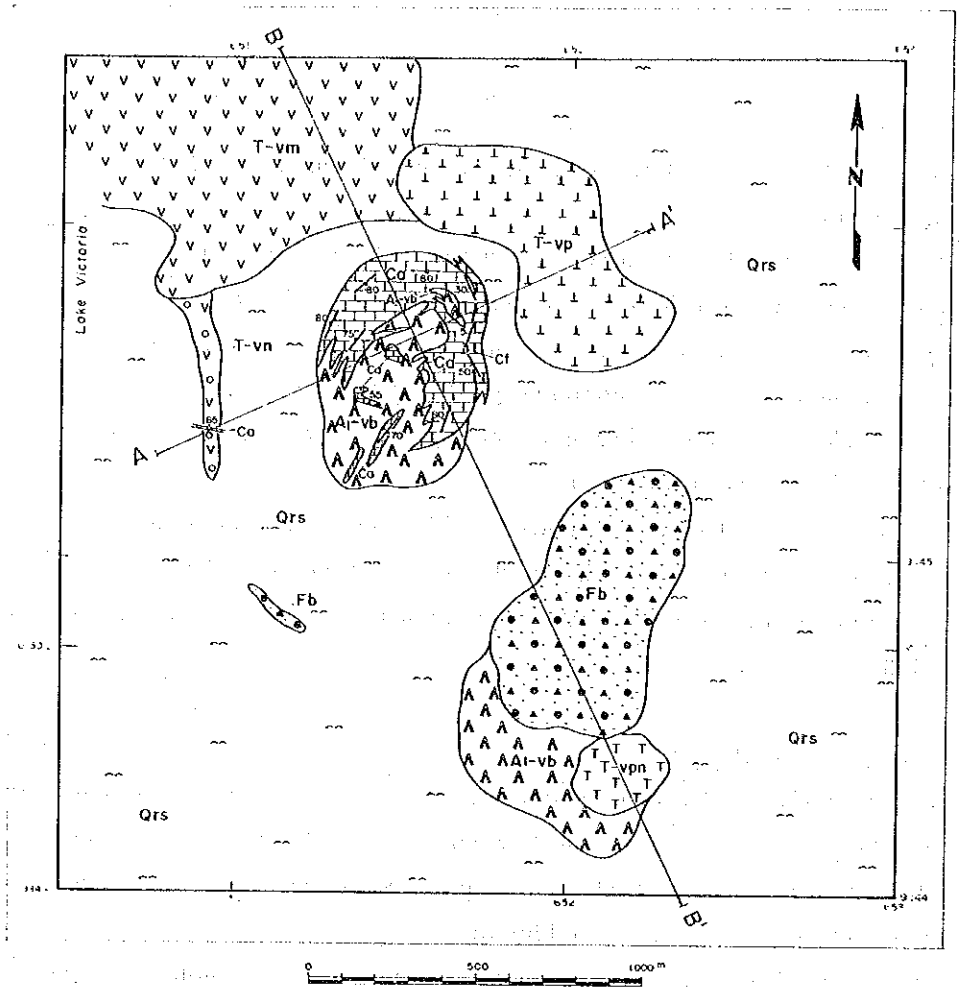
A sample(100053G)of the ferrocarbonatite collected near the center of the body has been examined under the microscope and submitted to a chemical analysis.The result of the microscopic observation are presented in the APX 3 and APX.6 and those of the chemical analysis in the APX.9.

The sample consists under the microscope of approximetely 10% of carbonates and 90% of opaques such as goethite, pyrochlore and hematite.

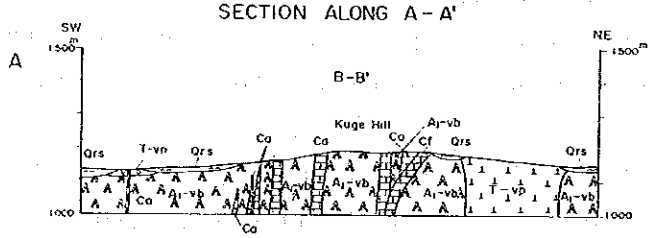
The analytical results indicate that the sample contains 50% of total iron as Fe203 and 2357ppm.of Th, and is notably high in Th content.

A test run of a Gamma-ray scintillometric survey has been carried out over the ferrocarbonatite body. The radioactivity over the tested area has ranged from 1500 to 10000 cps,while the background measured in the town of Homa Bay has been counted at around 200 cps.Redioactivity of higher levels has been detected at the majority of the measured stations.For camparison, the radio activity of the alvikite has ranged between 450 and 800 cps.

Ferruginous Breccia(Fb)



SECTION ALONG A - A'



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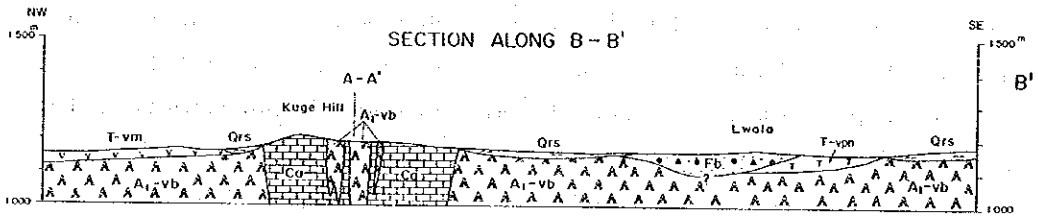


LEGEND

Qrs		Surficial deposits
Fb		Ferrugious breccia
Cf		Ferrocarbonatite
Ca		Alvikite
T-vpn		Phonolitic nephelinite
T-vp		Porhyritic phonolite
T-vm		Olivine melanephelinite
T-vn		Nephelinite agglomerate
A1-vb		Nyanzian metabasalt

Strike and dip of beddiug

Strike and dip of flow banding

Dykes and sheets with dip

A——A' Line of section

Fig. II-2-7-1 Geological Map of the Kuge-Lwala Area

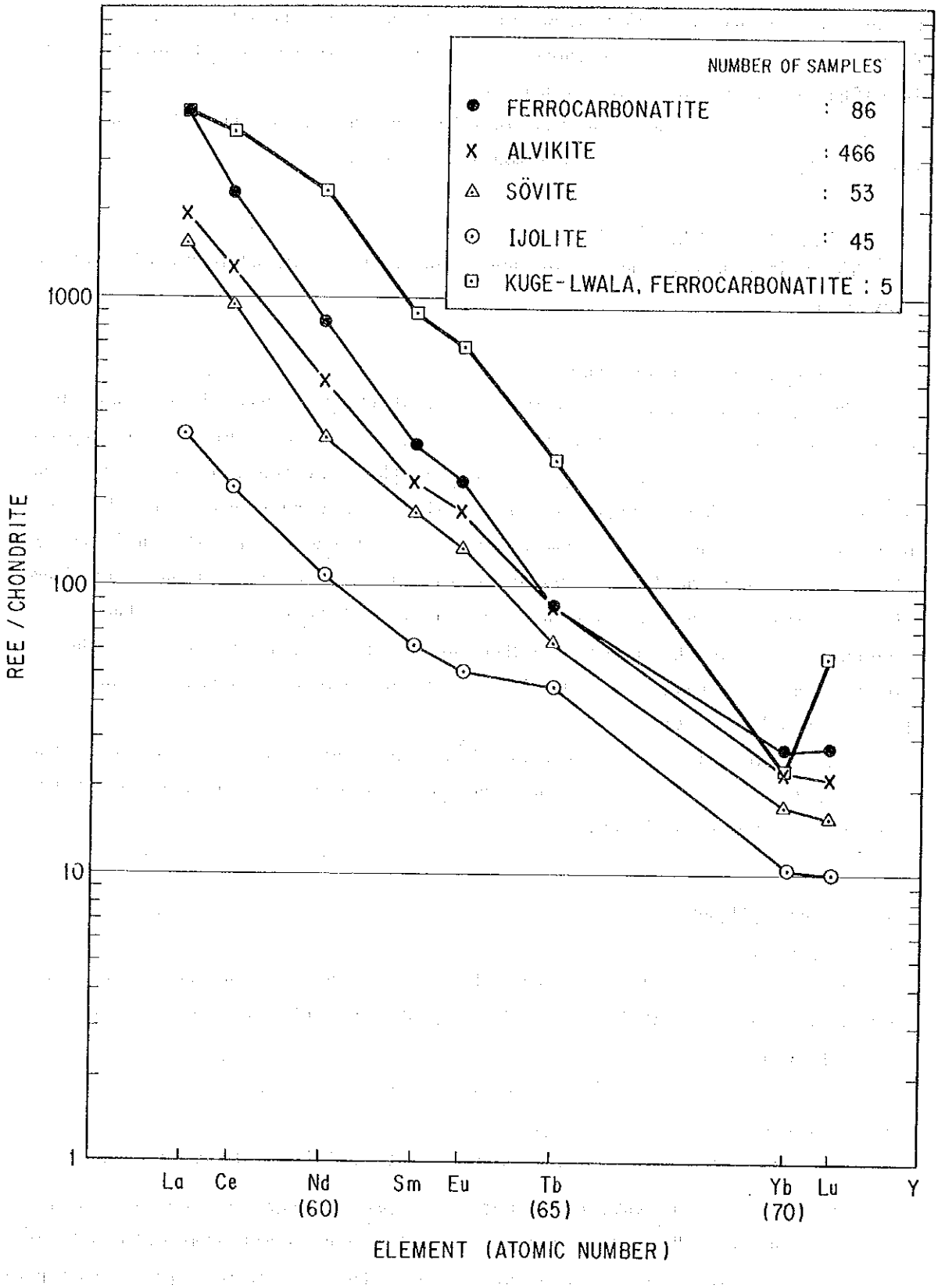


Fig. II-2-7-2 Chondrite-normalized abundances of the REE of Ferro-carbonatites in the Kuge-Lwala Area

The unit is distributed widely to the southeast of the Kuge Hill. The rockes of the unit are dark brown or purplish brown and contain angular fragments of basement rocks,phonolitic-nephelinitic rocks and carbonatites in slightly calcareous iron-rich matrices.

The rocks are also highly radioactive as the ferrocarbonatite and range from 1500 to 6500 cps.in Gamma-ray activity.

Surficial Deposits(Qrs)

The unit consists mainly of sands and gravels. Development of soils is very poor.

(B) Geological Structures

The Nyanzian metabasalt near the top of the Kuge Hill is presumed to have been elevated by about 60m, in comparison with the surrounding eroded surfaces, due to the intrusive activity of the alvikite and the ferrocarbonatite. The elevated portion has a circular structure ranging from 500 to 600m across in diametre and comprises a core of the metabasalt enclosed by the alvikite and the ferrocarbonatite in semicircular fation outwards from the core.The struture is,though much smaller in scale,similar to that around the top of the North Ruri Hill.No carbonatite is obserced in the southern half of this area, which may suggest that a carbonatite cone sheet has not reach the surface

In summary, it may be presumed that the Kuge Area represents the upper-most part of a carbonatite cone sheet and a massive circular carbonatite cone sheet exists at depth.

(4) Geochemical Survey

(A) Sampling

Rock samples totaling 51 including 26 in Kuge carbonatite body, 2 in ferruginous breccia at Lwala and 25 around Kuge and Lwala, were collected in this area.

Location of samples is shown in Plate-29.

(B) Statistical Values and the Characteristic

The summary of the assay results are listed in Table II-7-4-1.

Means for each elements except P are pretty high compared with that of the "All the Areas", and belong to highest group in all semi-detailed survey areas except Buru Hill prospect. Among these elements, Th is most prominent having an average value: 64.0 ppm and the maximum value (2,360 ppm)

which is also the maximum in all semi-detailed survey areas. The high value of Th corresponds to high γ-Ray reading in some part of the area

Average values for each elements of carbonatites taken from Kuge hill proper are much higher than that of whole Kuge area, especially in Nb (444 ppm), Y (200 ppm) and Th (294 ppm).

TABLE II-2-7-4-1 SUMMARY OF STATISTICS OF GEOCHEMICAL ANALYSIS—KUGE - LWALA AREAS

Element	Unit	No. of sample	Max.	Min.	Mean (m)	Number of samples >m+1s	Number of samples >m+2s	Remark
P	%	51	1.36	0.02	0.12	3	0	
Ba	ppm	51	30700	600	4340	11	4	
Sr	ppm	51	5280	186	1250	1	0	
Nb	ppm	51	4150	19.0	278	14	1	
Y	ppm	51	680	19.0	110	19	5	
U	ppm	51						
Th	ppm	51	2360	0.50	64.0	10	8	
La	ppm	51	3970	22.0	267	11	2	
Ce	ppm	51	6750	52.0	604	15	3	
Nd	ppm	51	2310	26.1	262	17	3	
Sm	ppm	51	283	3.40	38.2	22	3	
Eu	ppm	51	74.9	0.00	12.3	23	5	
Gd	ppm	51						
Tb	ppm	51	25.5	0.20	3.43	20	2	
Tm	ppm	51						
Yb	ppm	51	94.3	0.20	3.58	9	5	
Lu	ppm	51	3.10	0.05	0.60	7	3	

*1: Standard deviation in logarithmic scale

(C) Interpretation of Geochemical Anomalies

Interpretation result of geochemical anomalies in the area is shown in Plate 21 and Fig. II-7-3.

20 to 40% of total samples have anomalous values for some elements except P and Sr, and highly anomalous values are seen much in elements such as Ba, Y, Th and Eu.

The area where highly anomalous samples are concentrated is in the ferrocarbonatite zone in Kuge carbonatite body (Kuge anomaly) and the ferruginous breccia at Lwala (Lwala anomaly).

Kuge Anomaly

Analytical results for main elements of five samples taken from the ferrocarbonatite body located in the eastern side of Kuge carbonatite body are as follows;

Sample No.	Nb	Y	La	Ce	Nd	Sm	Eu	Yb
99994G	800	440	3000	6750	2310	180.5	59.9	2.6
100052G	190	270	2630	4910	1440	170.5	47.8	6.7
100053G	275	240	51	415	1145	283.0	74.9	5.0
100054G	990	610	2510	5400	1620	194.5	60.0	8.4
100055G	790	680	226	1930	1935	169.5	58.7	5.5
Average	609	360	1681	3881	1690	199.6	60.3	5.6

(ppm)

Chondrite-normalized abundances of the REE of 5 ferrocarbonatite samples are also ploted in Fig. II-7-2.

It is very noticeable that the means for Y, Sm and Eu of these samples are equal or near to m+2s for that of 1325 samples and the contents of REE are higher than that of ferrocarbonatite in all the semi-detailed survey areas except Buru Hill.

Lwala Anomaly

Analytical results for main elements of two samples are as follows;

Sample No.	Nb	Y	La	Ce	Nd	Sm	Eu	Yb
99988G	635	450	203	248	147	41.0	20.5	25.2
99989G	745	360	223	988	962	96.1	30.4	94.3
Average	690	405	213	616	555	68.6	25.5	59.8

(ppm)

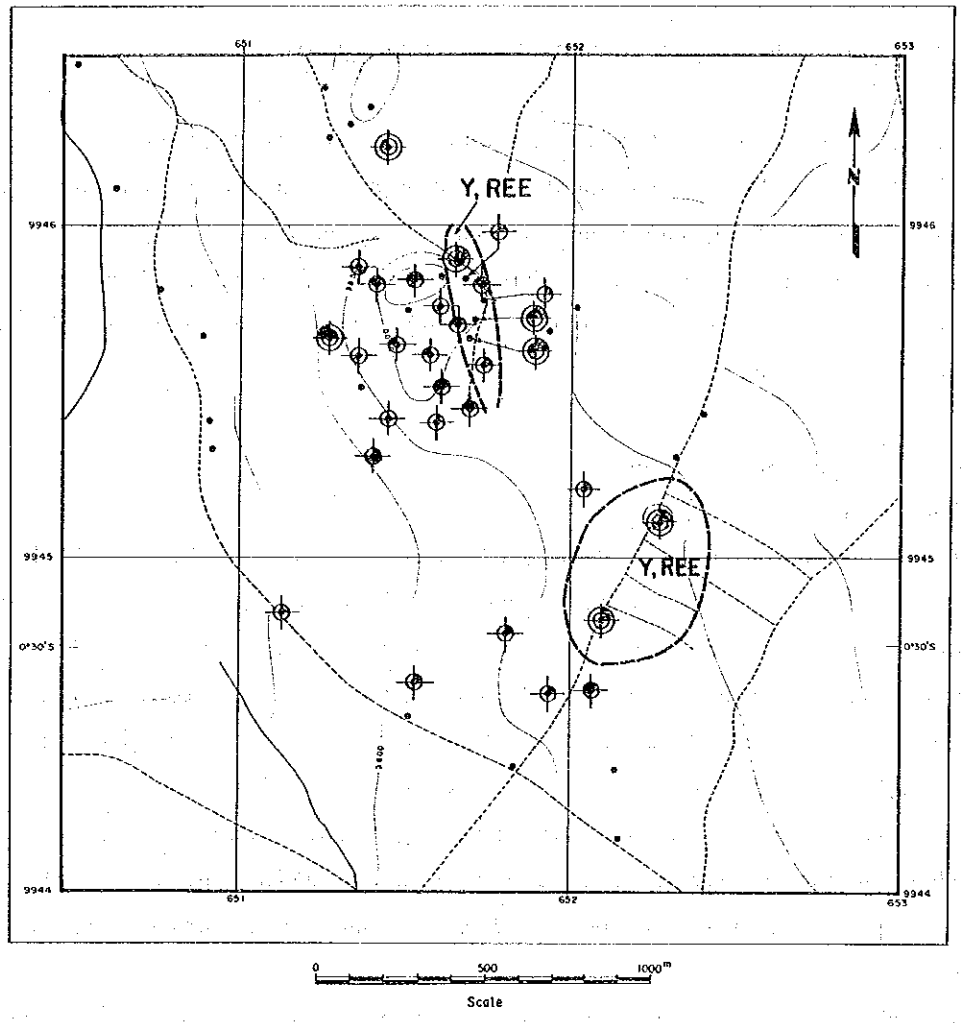
It is very interesting that the anomaly is poor in L-MREE, but rich in Y and Yb, indicating different mineralization from Kuge anomaly. The high value of Yb (94.3 ppm) is correspond to the maximum value in all the semi-detailed survey areas.

(5) Discussion

Through the geological and geochemical survey, it turned out that the occurrences of carbonatites are limited in two zones; Kuge Hill and Lwala and geochemical anomalies also exist in the same places; ferrocarbonatite zone in Kuge Hill and ferruginous breccia zone in Lwala.

Two anomalies seem to be different in mode of minerlization because of different contents of elements. This may be caused by different mode of intrusion of carbonatite or suggest different erosion level in two areas.

It is very desirable to investigate the subsurface geology and mineralization in two areas.



LEGEND

- Non anomalous sample
- Anomalous sample (≧ m + 1S , <m+2S)
- Highly anomalous sample (≧ m + 2S)
- Geochemicaly anomalous zone (Target area)

Classification

Element	Anomalous, ≧ m+1S, <m+2S	Highly anomalous ≧ m + 2S
La ppm	≧ 767 , < 3,300	≧ 3,300
Y ppm	≧ 148 , < 344	≧ 344
Nb ppm	≧ 620 , < 2,600	≧ 2,600
P %	≧ 061 , < 217	≧ 217

m : mean , S : standard deviation

Figures are of 1325 rock samples from all the Semi-detailed Survey Areas other than the grid-sampled areas in the Buru and Ndiru Hills.

Fig. II-2-7-3 Geochemical Interpretation Map of the Kuge-Lwala Area

2-8 Ngou-Kuwor Area and Ugongo-Uyi-Kiyaya-Sokolo Area

These areas are located in the Wasaki peninsular to the north of the Ruri Hills. A number of carbonatite bodie are exposed in the Sokolo, Uyi and Ugongo areas along the coast of Homa Bay and in the Kiyaya area inside the peninsular, and form the Wasaki carbonatite complex. A carbonatite body of a small size is also exposed in the Ngou-Kuwor area in the western side of the peninsula.

(1) Geographical Background

(A) Location and Access

The Ngou-Kuwor and the Ugongo-Uyi-Kiyaya-Sokolo (the Sokolo hereafter) areas are located respectively 12 km and 10 km northwest of the town of Homa Bay (Fig. 2). The formen occupies a rectangular area, 1.2 km along in the NW-SE direction and 0.5 km wide in the NE-SW direction, and the latter an area of 8.4 sq.km, 3 km in the N-S direction and 3.5 km in the E-W direction, with its eastern side cut by the shore line.

Both the areas are reached by passing through the Kuge-Lwala areas as described in the previous section and then by taking agricultural roads which are passable only by jeeps and trucks but impassable under wet conditions.

It takes about 1 hour for a distance of 35 km to both the areas from the town of Homa Bay.

(B) Physiography

There are 3 small hills arranged approximately in the N-S direction in the western part of the Sokolo area. Three spurs run off north-north westery, northery and northeastery from the top of the southern most hill with an elevation of approximately 1,280 m above sea level or a relative hight of approximately 140 m. Small creeks are developed between the spurs. The coastal area is occupied by swamps except for the Sokolo cape and an area at the northeastern corner. The Sokolo cape consists of a crabonatite body sticking out about 60 m into the Lake and is surrounded by precipices.

(2) Previous Work

These areas are described in the explanatory note "Geology of the Gwashi Area" for the 1 to 125,000 scale geological map by McCall (1958). Lebus (1977) has also undertaken a detailed research work. A exploration

for phosphorus and nioibum has been carried out by a Finnish team (Idaam et. al. 1986) as well.

(3) Geology

(A) General Geology

The geology of these areas comprises basement metavolcanics, fenitized basement rocks, ijolite-nepheline syenite, fenitized volcanics, carbonatitic pyroclastics, sovite, alvikite, ferrocarbonatite, melanephelinite, porphyritic phonolite, phonolite and surface deposits.

Nyanzian Metavolcanics (Al-vb): A limited exposure of this unit is located in the Ugongo area. The rocks are brown, rhyolitic metamorphics.

Fenitized Nyanzian Rocks (Al-mf): The unit is distributed around the above metavolcanics and consists of light brown, fine grained and hard felsite disseminated sporadically with possibly secondary, green and fine grained minerals. The rocks are megascopically judged of rhyolite in origin.

Ijolite and Nepheline Syenite (I): The ijolite and the nepheline syenite bodies of small sizes are located side by side, the former to the west of the latter, at Uyi along the coast in the northeastern corner of the Survey area.

The ijolite is grey, fine grained and holocrystalline and contains more or less coarse grained phenocrysts of nepheline.

The nepheline syenite is greyish green, medium grained and holocrystaline, and is well developed with stringers of carbonates and iron-oxide minerals.

Fenitized Volcanics (T-mf): The rocks are distributed in a very limited area adjacent to the ijolite above mentioned, and are light grey, fine grain and compact. Greenish brown stains due to alteration are often observed in the rocks.

A sample (100323G) of the rocks is observed under the microscope, subjected to the X-ray difraction analysis and analized chemically for major elements, the rsults of which are presented in Apx. 3, APx. 11, and Apx. 8 respectively. The normative composition is presented in Apx. 8a and ploted on the diagram for the classification of alkaline volcanics (A-8b).

The rocks are considerably rich in K_2O and indicate normative compositions of the nephelinite domain.

Carbonititic Pyroclastics (Cp): The unit is distributed at Ugongo and Uyi along the coast, and in every limited areas in the Sokolo point and to the south of Kiyanya, the facies of the unit varies from place to place.

At Ugongo, the unit comprises tuffs or tuff breccias containing angular fragments mainly of phonolite and partly of carbonatite in matrices abundant with carbonate. Around Uyi, the rocks contain angular fragments of carbonatite, ijolite and pyroxenite in calcareous matrices. In the Sokolo point, they are carbonatite-dominated breccias containing accidental fragments such as ijolite. At Kiyanya they are breccias containing phonolite fragments in a dominant proportion.

Sovite (Cs): The unit is distributed along the Uyi coast and in the Sokolo point and forms massive bodies several hundreds metres across in diametre. The rocks consist primarily of coarse grained carbonates ranging in grain sizes from 2 to 6 mm and subordinately of coarse grained biotite upto 8 mm in grain sizes. They are grey white or light brown, and crosscut by dykes of alvikite and ferrocarbonatite.

A sovite sample (100324G) collected in the Sokolo Poit is observed under the microscope, the results of which are presented in Apx. 3 and Apx 6. The sample contains carbonates, biotite, apatite and a minor amount of garnet or spinel.

Alvikite (Ca): The unit distributes along the coast from Sokolo to Uyi and in the northwestern end of the Ngou-Kuwor area, and occurs in forms of a massive body or dikes intruding the Sovite above mentioned.

The rocks are light grey, light brown or grey and fine grined carbonates containing a minor amount of biotite and magnetite.

A sample (100320G) was collected from an alvikite dyke intruding the Sovite at a coast of Uyi for a microscopic observation and an X-ray diffraction analysis, the results of which are presented in Apx. 3 and Apx 6 for the microscopic observation and in Apx. 11 for the X-ray diffraction analysis. The sample consists of calcite, carbonate-hydroxyl apatite, biotite, magnetite and an unidentified brown mineral. Since the rocks indicate strong γ-ray radioactivity, the brown mineral may be a mineral contaning Th.

Ferrocarbonatite (Cf): The unite is distributed along the coast from the Sokolo point to Uyi occurs in forms of a massive body or dykes intruding the sovite or the alvikite. Other distributions are small dykes in the south-eastern, the northwestern and the southwestern parts of the Sokolo area. The rocks of this unit are dark brown, dark grey or reddish brown, fine grained carbonates often stained by iron-oxides.

The results of the microscopic observation and the chemical analyses for major and trace elements are presented in Apx. 3, Apx. 9-(1) and Apx. 9-(2) respectively for a sample collected at a locality 1.5 km west north-

east of the Sokolo point. The sample contains carbonates, apatite, chlorite and approximately 5% of opaque minerals. The total iron content is 6.89% as Fe_2O_3.

Melanephelinite (T-vm): The unit is distributed narrowly in the western part of the Ngou-Kuwor area. The rocks are black to dark grey and prophyritic, containing large phenocrysts of olivine upto 15 mm across and pyroxene upto 7 mm across.

Porphyritic Phonolite (T-vp'): The unit occurs in the southwestern part of the Sokolo area and in the Ngou-Kuwor area in associatin with phonolite. The rocks are grey and porphyritic, containing characteristically phenocrysts of potash feldspar up to 10 mm across and nepheline less than 5 mm across in fine grained crystalline groundmasses which is partly ijolitic in appearance.

Phonolite (T-vp): The unit is distributed in the southwestern, the northwestern and the southeastern part of the Sokolo area, forming volcanic necks or lavas. The rocks of the unit in the southeastern part occupy an edge of the phonolite neck and lavas which constitute the Nyamaji mountain to the south of the Sokolo area. The rocks of this unit, grey and compact, are aphanitic or porphyritic. The aphanitic ones occur as lavas and contain acicular potashi feldspar. The porphyritic ones occur as volcanic necks and contain fine grained potash feldspar and nepheline.

Surficial Deposits (Qrs): The surface deposits widely distribute to the inland side of the rockey belt along the coast and consist of soils and sands mixed with gravels.

(B) Geological Structures

The carbonatite-alkaline plutonic complex intruded during a period of pre-Miocene in the northeastern part of the Wasaki peninsula including the Sokolo and the Uyi areas, and resulted in domal uprift and fenitization of the basement according to LeBus (1977) who studies the carbonatites of this area in detail. Following the intrusions, phonolite volcanisms initiated in Miocene and continued to Pliocene. Phonolite lavas and dykes covered or intruded the pre-Miocene carbonatite. The carbonatite in the Sokolo cap forms a nearly vertical cylindrical body which intruded in the late Miocene.

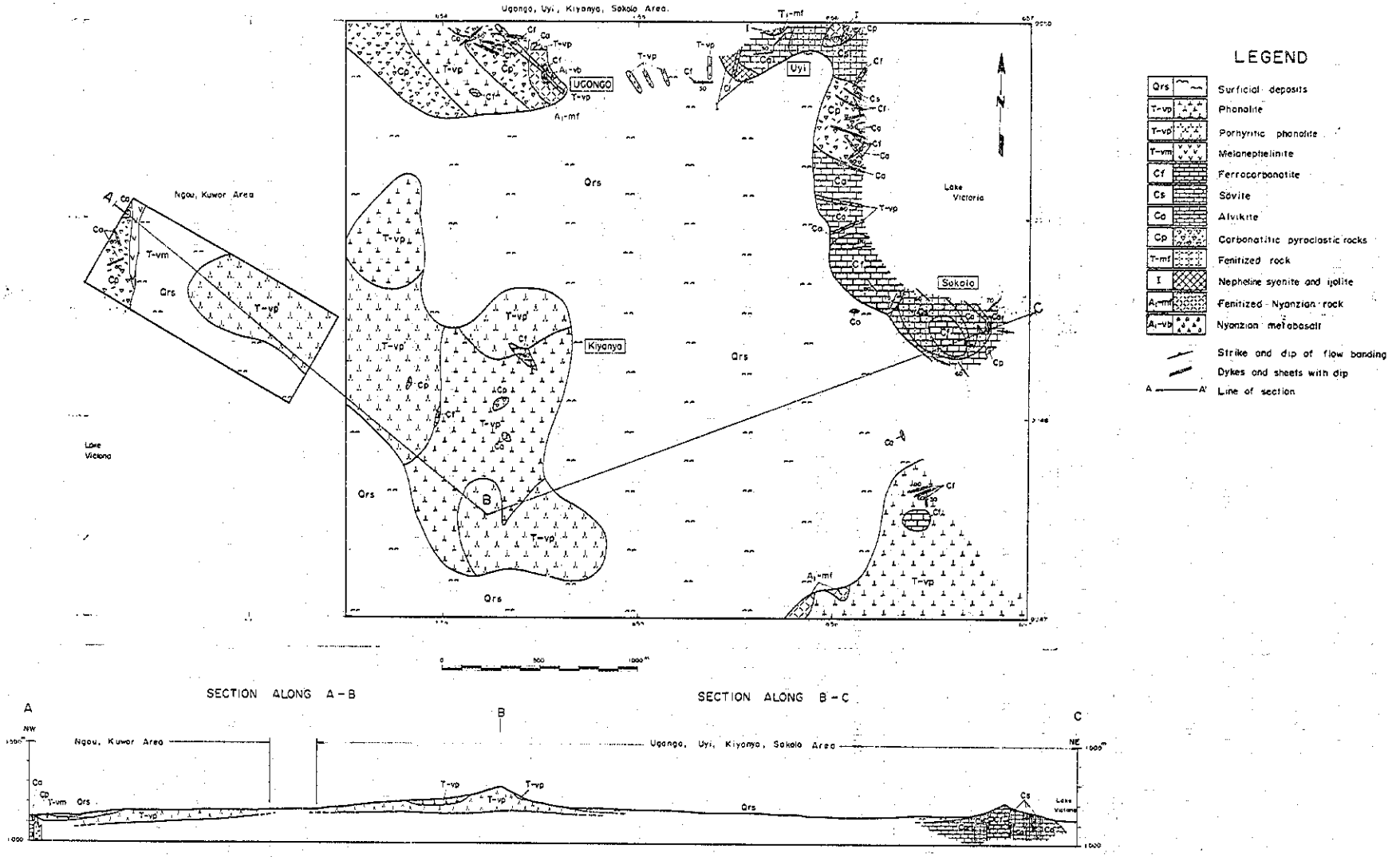


Fig. II-2-8-1 Geological Map of the Ngou-Kuwor and the Ugongo-Uyi-Kiyanya-Sokolo Areas

(4) Geochemical Survey

(A) Sampling

In sokolo area, 94 rock samples were collected at lake sides outcrp in northeast end of the area and hills in wouthwest part of the area.

In Ngou-Kuwar, 15 rock samples were collected along a route in the central part.

(B) Statistical Values and the Characteristics

The summary of the assay results is shown in Table II-2-8-1.

TABLE II-2-8-4-1 SUMMARY OF STATISTICS OF GEOCHEMICAL ANALYSIS-SOKLO & NGOU AREA

Element	Unit	No. of Sample	Max.	Min.	Mean (m)	Numbe of samples ≧ m+1s	≧ m+2s	Remark
P	%	109	1.72	0.02	0.19	13	0	
Ba	ppm	109	31800	110	2100	7	1	
Sr	ppm	109	7600	185	1550	16	0	
Nb	ppm	109	5500	12.0	273	9	2	
Y	ppm	109	550	14.0	56.9	11	1	
U	ppm	109	327					
Th	ppm	109	403	0.00	25.7	8	0	
La	ppm	109	10000	26.0	242	18	2	
Ce	ppm	109	10000	52.0	359	16	3	
Nd	ppm	109	2120	19.0	107	15	1	
Sm	ppm	109	163	2.50	13.4	14	0	
Eu	ppm	109	163	0.90	4.24	11	2	
Gd	ppm	109	---					
Tb	ppm	109	16.0	0.20	1.34	9	0	
Tm	ppm	109	12					
Yb	ppm	109	20.6	0.05	1.96	2	0	
Lu	ppm	109	3.70	0.1	0.45	6	1	

*1: Standard deviation in logarithmic scale.
* Two areas are combined into one unit.

Compared with the means of 1325 samples, the means for each element of rock samples in the area have not show any distinct character though some tendency are there; 10 to 50% hgh content in L-MREE and Sr, 100% high in Nb, somewhat low content in HREE etc.

Fig. III-1-2 also shows that the group of rocks in the area belongs to middle class in all the semi-detailed survey areas.

(C) Interpretation of Chemicasl Anomalies

Plate 22 and Fig. II-2-8-2 show the interpretation result of geochemical anomaly in the area.

In Ugongo-Kwor area, only one albikite sample has an anomalous for P but any other elements.

In Sokolo area, there are some carbonatite samples which have anomalous values for some elements, the number of samples which have highly anomalous values are only 8. The breakdown of 8 samples are as follows;

Highly anomalous elements	Ba	Nb	La, Ce	La,Ce,Nd	Y,La,Ce Eu,Lu	Eu
Number of Samples	1	1	2	1	1	1

Interesting samples among these are following 3 samples:

	Nb	Y	La	Ce	Nd	Sm	Eu
100298G	185	170	>10,000	>10,000	2120	118.0	26.2
100320G	5500	30	213	470	164	11.3	3.9
100323G	5500	56	79	236	109	26.0	1.5

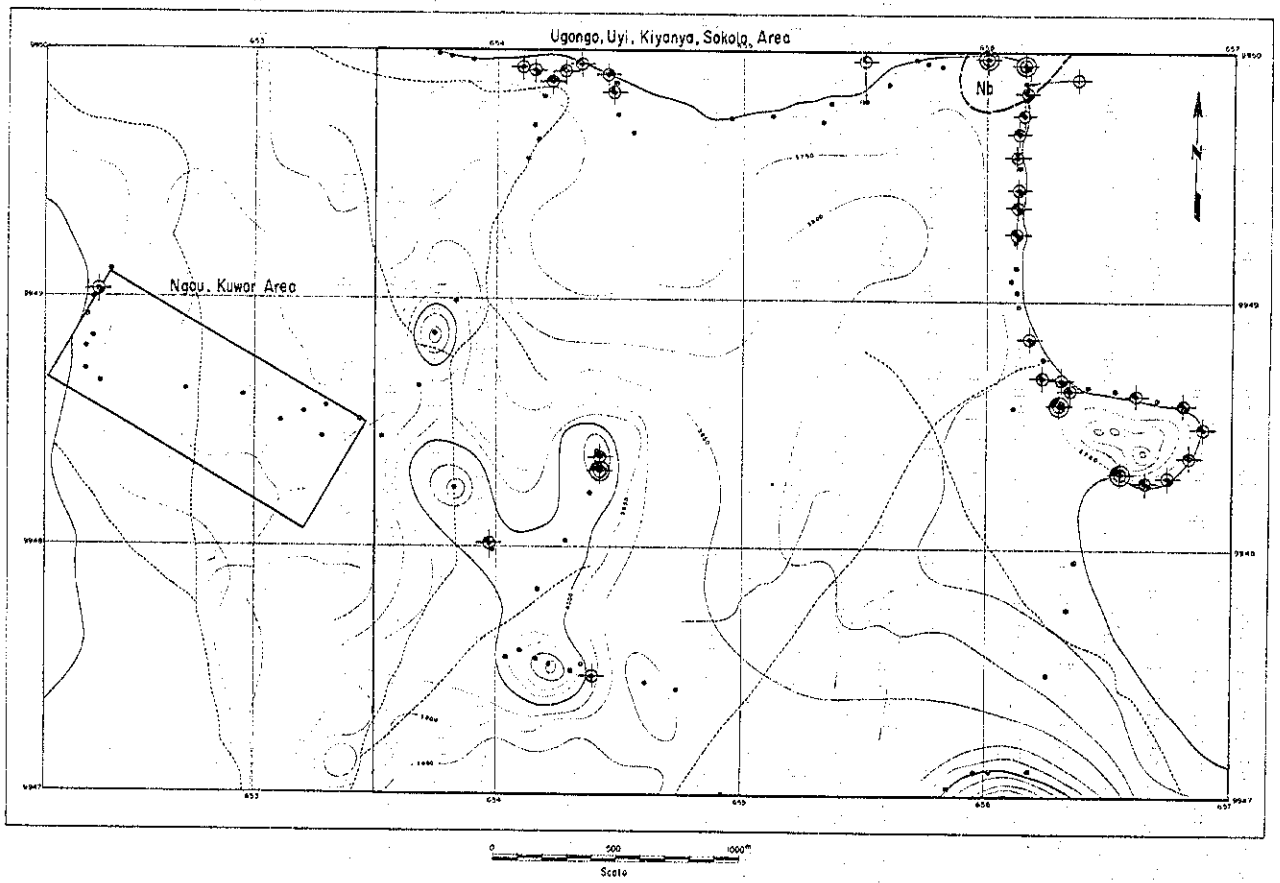
The sample 100298G is from ferrocarbonatite outcropping at the lake side to the west of Sokolo Point, and have high contents of LREE. But neibouring samples do not have highly anomalous values for any elements, resulting to form no anomaly.

The samples, 100320G and 100323G collected at the northeast end of the lake side are sovite and fenite respectively. They have very high contents for Nb (5,500 ppm), though their contents for REE are very low. But the fact that the neighbouring samples of two do not have anomalous values for Nb, indicate local mineralization of Nb at the point of two samples.

(5) Discussion

No distinct anomaly for the area was found through geological and geochemical survey, though several samples from carbonatites or a fenite have highly anomalous values for LREE or Nb.

Then the area is thought to be not an expected target area for further exploration.



LEGEND

- Non anomalous sample
- Anomalous sample (≧ m + 1S , < m + 2S)
- Highly anomalous sample (≧ m + 2S)
- Geochemicaly anomalous zone

Classification

Element	Anomalous, ≧ m+1S, <m+2S	Highly anomalous ≧ m + 2S
La ppm	≧ 767 , < 3,300	≧ 3,300
Y ppm	≧ 148 , < 344	≧ 344
Nb ppm	≧ 620 , < 2,600	≧ 2,600
P %	≧ 061 , < 217	≧ 217

m : mean , S : standard deviation

Figures are of 1325 rock samples from all the Semi-detailed Survey Areas other than the grid-sampled areas in the Buru and Ndiru Hills.

Fig. II-2-8-2 Geochemical Interpretation Map of the Ngou-Kuwor and the Ugongo-Uyi-Kiyanya-Sokolo Areas

2-9. Homa Mountain Area

The Homa Mountain,being situated in a land buldging out from the southern coast of the Winam Gulf ,has a flat topped profile and is one of outstanding features in the area of Lake Victoria.

The mountain is formed of a carbonatite-alkaline rock complex of the largest size in the Homa Bay area.

(1) Geographical background

(A) Location and Access

The Homa Mountain project area is located slightly to the west of the central southern coast of the Winam Gulf and takes an incomplete rectangular from cut by a shove line at its southwest corner,occupying an area of 69.8sq.km,approximately 7.5km wide in the east-west direction and 10km long in the north-south direction.

It is approximately 17km from the town of Homa Bay to the top of the Homa Mountain near the centre of the project area.

An access road(D-219),which branches off from a midway of the submain road (C-19;unpaved,allweather)between the town of Homa Bay and Kendu Bay, leads to the base of the Homa Mountain.It takes about 50 minutes by car to reach the foot-hill of the Homa Mountain from the town of the Homa Bay for a distance of approximately 30km.

The unpaved roads,D-219 and E-215,encircle the foot-hill of the Homa Mountain.

(B) Physiography

The Homa Mountain sticks out sharply from its broad base of gentle slopes and has a flat top with a diameter of approximately 2km across surrounded by a number of steep or gentle secondary hills.

The Mountain has,as a whole,an oval shape approximately 6km in long axis and 5km in short axis.

Its top reaches an elevation of 1571m(5745ft.)above sea level or of 610m above the level of Lake Victoria.