REPORT ON THE MINERAL EXPLORATION IN THE HOMA BAY AREA REPUBLIC OF KENYA

PHASE II

MAP (1)

JAPAN INTERNATIONAL COOPERATION AGENCY

METAL MINING AGENCY OF JAPAN

REPORT ON THE MINERAL EXPLORATION IN THE HOMA BAY AREA, REPUBLIC OF KENYA PHASE II MARCH 1988 MAP (1)

17683

REPORT ON THE MINERAL EXPLORATION IN THE HOMA BAY AREA REPUBLIC OF KENYA

PHASE I

MARCH 1988

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

17683

PREFACE

In response to the request of the Government of the Republic of Kenya, the Japanese Government decided to conduct a Mineral Exploration in the Homa Bay Area and entrusted the survey to Japan International Cooperation Agency(JICA) and Metal Mining Agency of Japan(MMAJ).

The JICA and MMAJ sent to the Republic of Kenya a survey team headed by Dr.Kinsuke Uchida from 28 September to 29 December,1987.

The team exchanged views with the officials concerned of the Government of the Republic of Kenya and conducted a field survey in the Homa Bay Area. After the team returned to Japan,further studies were made and the present report has been prepared.

We hope that this report will serve for the development of the Project and contribute to the promation of friendly relations between our two counties.

We wish to express our deep appreciation to the officials concerned of the Government of the Republic of Kenya for their close cooperation extended to the team.

February,1988

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

Junichiro Sato

Junichiro Sato
President
Metal Mining Agency of Japan

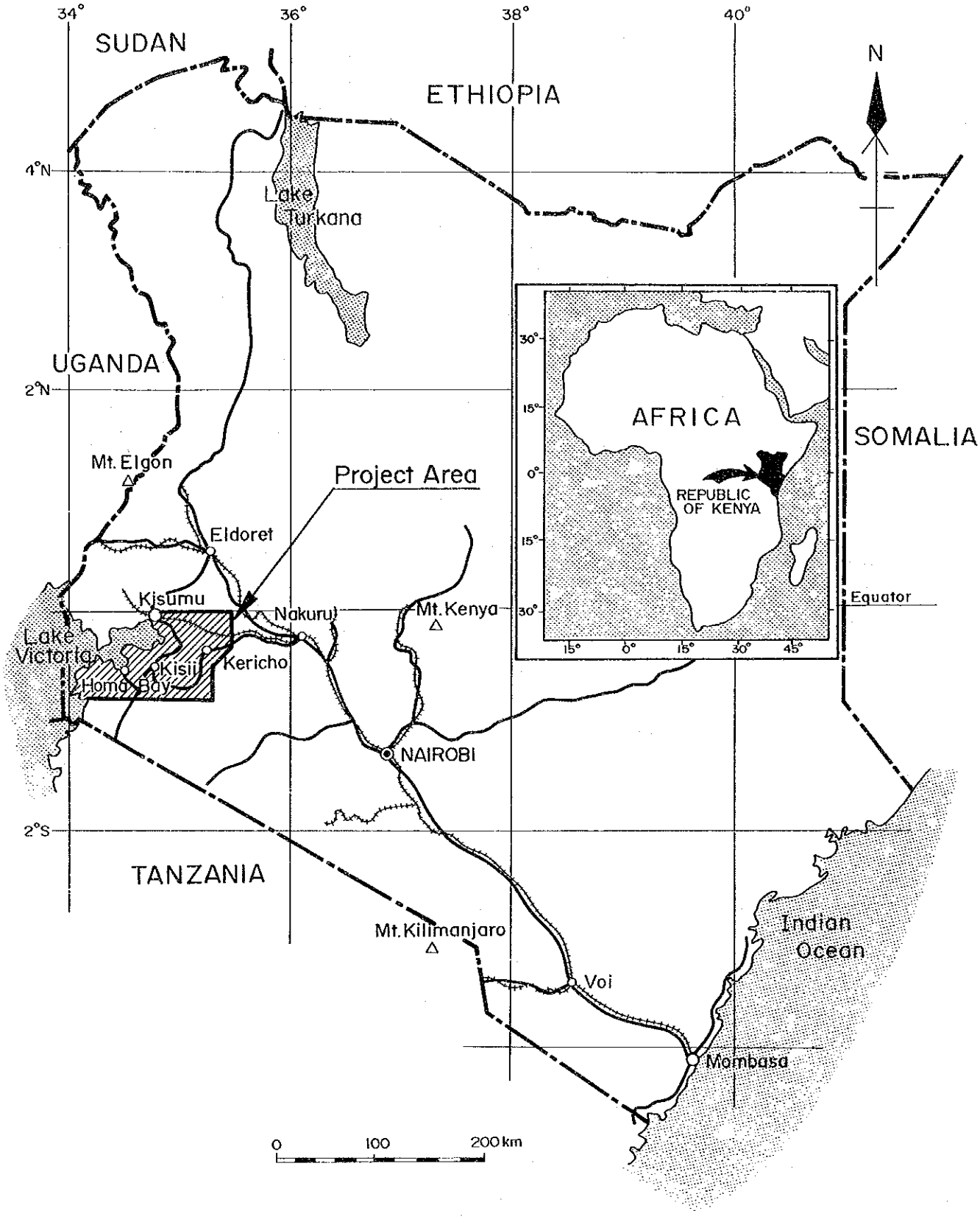


Fig. 1 Location Map of The Project Area

ABSTRACT

The Mineral Exploration Project in the Homa Bay area is a three year project that commenced in the 1987 fiscal year. Its main objective is to explore the mineral resources in the area and to assess it. The programme of the this year includes exploration works of two categories. One is the reconnaissance type geological survey for a wider area,and another is the geological and geochemical surveys for 10 known occurrences of carbonatite. Hereafter,the target area for the former is called as Regional Survey area and those for the latter Semi-detailed areas. The major targets for the geochemical survey is rare earths(REE) and so-called rare metals.

For the Regional survey area(2,750 sq.km),1,117.3 line-km of routes were geologically mapped and the result was compiled into 1/50,000 scale geological maps utilizing available previous data. During the survey,four small outcrops of carbonatitic rocks and a very small occurrence of green copper specks are newly located,and a few small gold operations(lodes and placer) are examined. However,all these are too small to warrant further follow-up exploration.

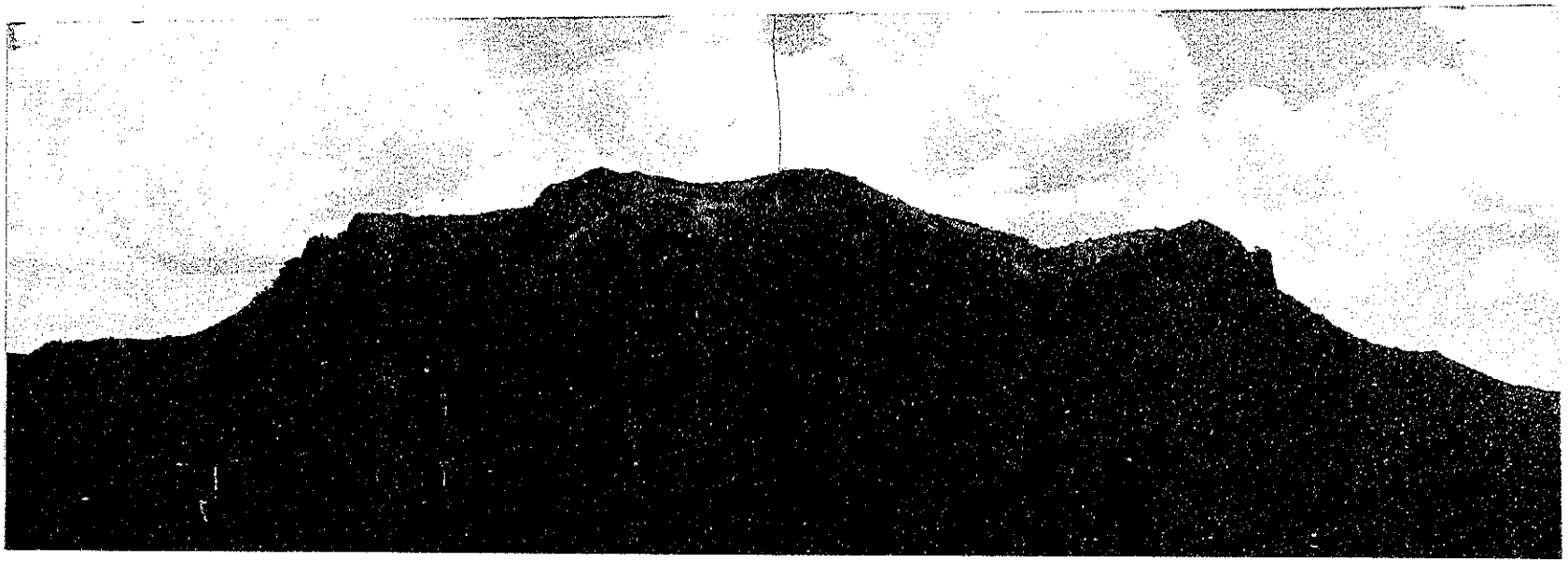
For the Semi-detailed areas(total 190 sq.km),274.2 line-km of routes were geologically mapped and 1/10,000 geological maps are compiled,and 1520 geochemical samples were collected along the routes. 1510 samples were tested for 17 minor elements(10 REEs and U,Th,Nb,Y,Sr,Ba,and P).

Eight of the ten Semi-detailed Survey areas are located within the Regional Survey area. However,the two,Buru and Legetet Hills,are situated outside it. Buru Hill was selected as a target,since some samples,which had been collected by MMAJ in 1981 during its ground-thruth for the Technical Development Project for Interpretation of Remote Sensing Imageries,had indicated fairly high REE contents. A grid-sampling was carried out for each of Buru and Ndiru(in the Homa Bay area) Pospcts,as the results of the experimental radiometric survey in these two and review of previous works justified a detailed sampling.

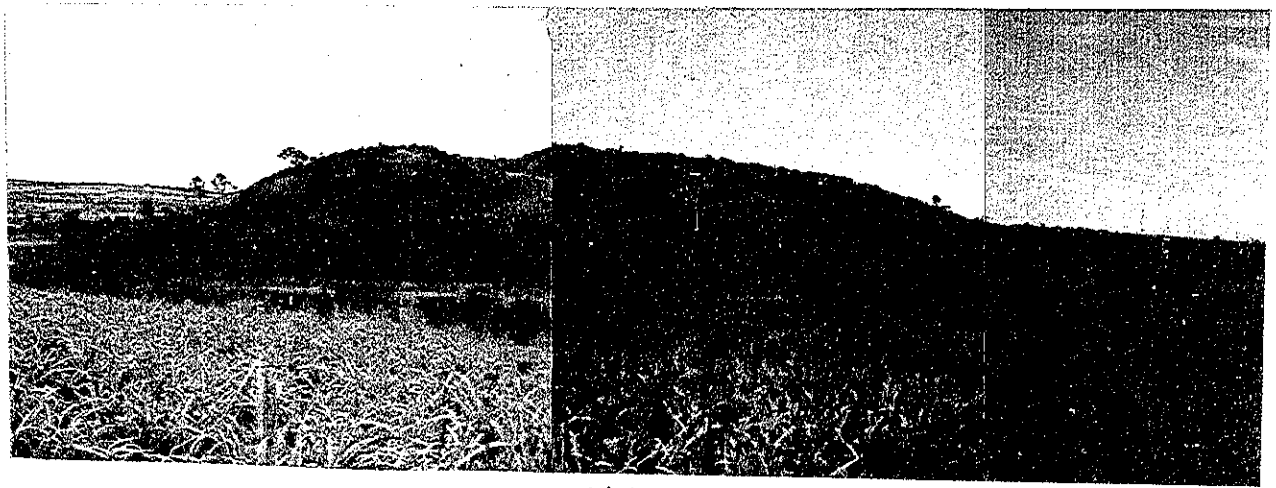
In order to reveal the characteristics of each area and to locate anomalies,the univariate and principal component analyses were carried out for the results of the geochemical analysis. "Mean+1 Standard Deviation", which was calculated from all the samples except the grid ones and soils,is adopted as a threshold value for each element and score of a principal component. Through these studies,it has become obvious that 3 "constituents", light rare earths(LREE;such as La,Ce,Nd etc.),yttrium(Y),and niobium(Nb) are independently representative of the mineralization,and that they are only constituents which may have potential of economical significance. Therefore,discussion is made mostly based on these 3 components.

It is concluded that South and North Ruri Hills(Y and REE),Kuge(Y and REE),and Buru Hill(Y,REE and Nb) are worth for further exploration,as a result of synthesizing the geological and geochemical findings,and other factors. Among these,Buru Hill seems to be the most prospective,since it shows a high concentration of REE(average 1.31% and max.3.98% as combined La,Ce,and Nd) at the surface,and it also has a possibility that Y and Nb might be concentrated at depths,being judged from its occurrence and geochemical features.

In order to explore the above-mentioned four target areas,it is recommended to carry on following works from the Phase II on;diamond drilling, geophysical survey including radiometric survey,trench and/or pit,geochemical grid-sampling,detailed geological mapping, and so forth. At Buru Hill,the rehabilitation of the old inclined shaft is desirable in order to reveal the sub-surface mineralization features.



(a)



(b)

(a) North Ruri carbonatite complex looking southward from a point near Kuge. Scarps in shades are carbonatite cone-sheets dipping inward. Central area of the hill mainly comprises Nyanzian metabasalts.

(b) Buru Hill being looked westward. The whole hillock consists of mineralized and weathered materials.

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PART-I. GENERAL

PART 1 GENERAL

1. Introduction

1-1. Objective of the project

The main objective of the Survey is to explore and to assess the mineral potential of the Survey Area,as mentioned in the Scope of Work for the Mineral Exploration in the Homabay Area. The Scope of Work was agreed in July 1987 between the Government of Kenya through Ministry of Environment and Natural Resources(MENR),and the Japan International Cooperation Agency(JICA) and the Metal Mining Agency of Japan(MMAJ).

The present Survey is a three-year project commenced from the fiscal year 1987. For the year(Phase I),the efforts have maily been concentrated on the exploration of rare earths and so-called rare metals associated with carbonatites and their related rocks.

1-2. Project areas and works carried out

For the Phase I, two types of exploration works have been carried out; one is the reconnaissance type regional geological mapping for an area covering approximately 2700 sq.km(Regional Survey),and another is the semi-detailed survey for selected 10 known carbonatitic occurrences totalling about 190 sq.km(Semi-detailed Survey). The latter includes geological mapping and geochemical sampling. The project areas are shown in Fig.1 and 2, and the statistics of the works carried out is listed in TABLE I-1-1 and I-1-2.

1-3. Personnel involved and Exloration period

The field work was executed by the field team dispatched by MMAJ/JICA in cooperation with the Mines and Geological Department of Kenya(NGD).

The field team stayed in Kenya in a period between September 30 and December 27 1987,during which it engaged in the field works in the Homa Bsy Area from October 3 through December 19.

The member of the preliminary mission is listed in TABLE I-1-3 together with that from the Kenyan side. The member list of the field team is shown in TABLE-1-1-4.

TABLE I-1-1 PROJECT AREAS AND WORKS--PLANNED vs ACTUAL--

Name of Area	Area (sq.km)	Quantity of field works	
		Planned	Actually done
REGIONAL SURVEY	2,750	Route:990km	1,117.3km
SEMI-DETAILED SURVEY			
Rangwa	26.50		
Sagarume-Nyamgurka	9.75	Route length:	Route length:
South Ruri	20.00	190km	274.2km
North Ruri	15.00	Geochemical	Geochemical
Kuge,Lwala	6.25	Sampes to be	Samples
Ngou,Kuwor	0.60	collected:	collected:
Ugongo,Uyi,Kiyanya,Sokolo	8.40	1,500pcs	1,520pcs
Homa Mountain	69.80		Analyzed:
Buru Hill	4.00		1509pcs
Legetet Hill	30.00		
Sub-total SEMI-DETAILED	190.00		

TABL I-1-2 NUMBER OF SAMPLES TESTED--BY AREA

Area	Geochem.Samples*0			Items tested					
	Rock	Soil (*7)	Total	Thin sect.	Poli-shed	Assay *1	Assay *2	K-Ar Date	X-ray diff.
Regional Survey	0	0	0	11	0	4	0	3	0
Rangwa	211	27 (33)	238 (244)	3	0	1	2	0	1
Sagarume *3	76	0	76	3	0	2	1	1	0
North and South Ruri	258	19 (23)	277 (281)	3 3	1 0	0 1	2 2	0 0	2 0
Kuge *4	51	0	51	2	1	0	2	0	1
Ngou *5	15	0	15	1	0	0	1	0	0
Soklo *6	94	0	94	4	1	1	2	0	2
Homa Mountain	486	5 (6)	491 (492)	4	2	1	2	0	0
Ndiru H	90	0	90	7	3	0	6	0	1
Buru Hill	61	0	61	8	7	10	0	0	4
Legetet H	116	0	116	3	0	1	2	1	0
Total	1459	51 (62)	1509 1520)	52	15	21	22	5	11

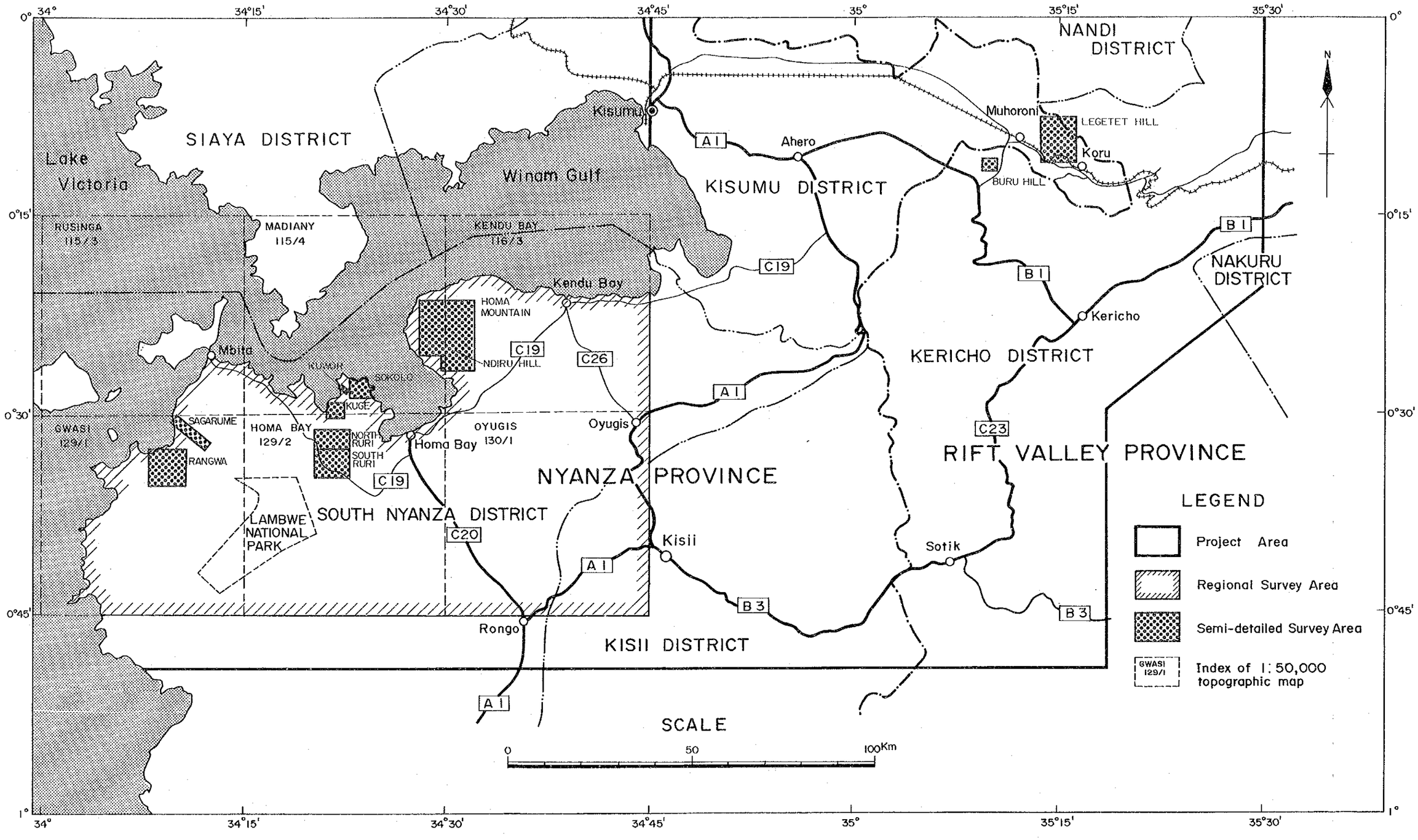


Fig. 2 Location Map of Phase I Survey Area

REMARKS FOR TABLE I-1-2 of previous page

^0: Geochem.Samples:U,Th,La,Ce,Nd,Sm,Eu,Gd,Tb,Tm,Yb,Lu(12),Nb,Sr,Y,Ba,P(5)
*1: Silicate rocks and mineralized materials:SiO2,TiO2,FeO,Fe2O3,MnO,MgO, CaO,K2O,Na2O,Al2O3,P2O5,H2O+,LOI.(13 elements).
*2: Carbonatitic rocks:SiO2,TiO2,FeO,Fe2O3,MnO,MgO,CaO,K2O,Na2O,Al2O3,P2O5, H2O+,LOI,CO2(14).U,Th,La,Ce,Nd,Sm,Eu,Gd,Tb.Tm,Yb,Lu (12 elements).Nb, Sr,Y,Ba(4 elements).
*3: Sagarume:Sagarume-Nyamgurka.
*4: Kuge:Kuge,Lwala, *5 Ngou:Ngou,Kwor.
*6: Soklo:Ugongo,Uyi,Kiyanya,Soklo.
*7: Number in ( )=samples collected. Sporadically collected soil samples were not analyzed.

TABLE I-1-3 PRELIMINARY MISSION AND KENYAN PERSONNEL ATTENDED THE MEETING

JAPANESE SIDE		KENYAN SIDE	
Mr.Yoshio Matsukawa	MMAJ	Mr.A.C.arap Lang'at Permanent Secretary	MENR
Mr.Hiroaki Yokoi	MITI*1	Mr.C.Mbindyo Permanent Secretary	MF*2
Mr.Toshihiko Hayashi	MMAJ	Mr.W.K.Maluki Principal Planning Officer	MENR
		Mr.F.G.Theuri Acting Chief Geologist(then)	MGD

*1 MITI:Ministry of International Trade and Industry of Japan
*2 MF:Ministry of Finance of Kenya

TABLE I-1-4 MEMBER LIST OF FIELD TEAM

JAPANESE SIDE		KENYAN SIDE	
Dr.Kinsuke Uchida Leader	MMAJ	Mr.Issac Onuonga Co-leader	MGD
Mr.Haruo Watanabe	MMAJ	Mr.Peter Ongaga	MGD
Mr.Hidetoshi Takaoka	MMAJ	Mr.John Kibe	MGD
Mr.Atsumu Nonami	MMAJ		

2 Geographial background

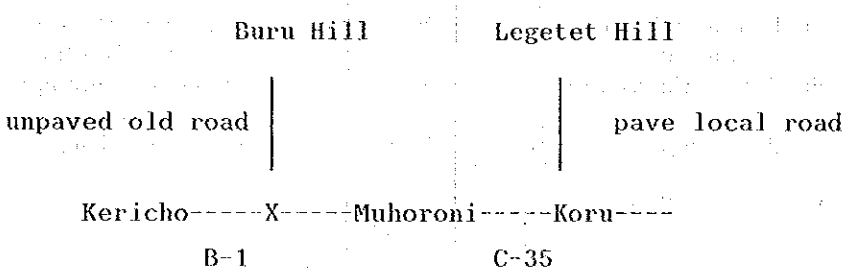
2-1.Location and infrastructure

The project area is located in the western part of the Republic of Kenya(Fig.1), The whole target area of the Regional Survey of the present phase is situated in two districts of the Nyanza Province,the Kisii and South Nyanza. Eight of ten Semi-detailed Survey areas are included within the Regional Survey area,whereas the rest are located in the Kericho district of the Rift Valley province(Fig.2). All the areas are included in the LakeBasin Development Authority Area.

The township of Homa Bay, where the Base Camp of the field work was established,is located approximately at the center of the Regional Survey Area, and is some 270km west-northwest of the capital. The town is accessed by car from Nairobi via the following route,all the roads of which are asphalted. The road distance between Nairobi and Homa Bay is about 400km and it takes about 7 to 7.5 hours.

Nairobi		Makutano		Kericho		Sotik		Kisii		Rongo		Homa Bay
	A-104		B-1		C-23		B-3		A-1		C-20	

Two isolated Semi-detailed areas Buru Hill and Legetet Hill are easily accessed from Kericho via B-1 and C-35.



The railway between Nairobi and Kisumu passes by Koru and Muhoroni,but no railway is extended to the Regional Survey Area.

The direct dial call is possible both for local and overseas calls from Homa Bay.

There are various high tension power lines in the vicinity of Koru and Muhoroni,on the other hand there is virtually no power line in the Regional Survey Area.

2-2. Physiography

The Regional Survey area may physiographically be devided into three units reflecting the underlying geology,as it straddles the southeastern boundary faults of the Kavirondo Rift which is regarded as a sideshoot of the East Africa Rift Valley(cf. 3-2,and Fig.I-1-3). One of the most conspicuous surficial expression of the faults is the Kaniamwia Escarpment in the southwestern part of the area.

The first unit is the southeastern part of the boundary faults,where low reliefed rolling hills occur, gradually increasing altituede towards southeastern corner of the area(around sl.1850m at the corner).

The second is the plain between the boundary faults and Lake Victoria (sl.1136m),where alluvium sediments cover the surface(less than 100m above the Lake level).

The third is high reliefed hills of carbonatite-alkaline complexes such as Gwasi Hills(2272m),Gembe Hills(1900m),Ruri Hills(1706m),Homa Mountain(1750m) etc. These are located within the second and their ring-shaped scarp features are quite impressive as well as cone-shaped small plugs of phonolitic rocks. Among these,the double-ring structure of the Tertiary Kisingiri volcano,the outer ring of which is expressed by the ridge connecting Gwasi and Gembe hills and the inner by the ridges of Rangwa,is noteworthy.

The two isolated Semi-detailed areas,Buru and Legetet Hills are near the northeast corner of the Kavirondo Rift where the Quaternary volcanics from the East Africa Rift Valley cover the graben(Fig.I-3-1). Buru Hill forms a small discrete hill and Legetet Hill forms a parasite hill at the foot of the huge dissected Tertiary Tinderet volcano.

There are only a few permanent rivers within the Regional Survey area, however,in the vicinity of Buru and Legetet Hills,there are permanent water flows in the upstreams of the Nyando River.

2-3. Climate and vegetation

The climate in the project area is semi-arid with annual precipitation of about 1000 to 1200mm and humidity of about 60%. There are two rainy seasons;the long rains from March to May or June,and the short rains in November and December. The temperature changes little throughout the year, averaging 24 C,but sometimes rising up to 40 C(LeBas 1977).

In general the natural vegetation of the project area is rather poor, as its climate is semi-arid,belonging to savanna,and as the area is heavily inhabited.

The plains in the Regional Survey area are more or less covered with fields of maize,millet,cassava,and cotton. These are often fringed by sisal (Agave sisalana). However,the lands do not seem fertile. On the other hand, a small fraction at the southeastern corner of the area,which belongs to the Kisii district,is fertile and used as fields for vegetables as well as maize. Also the flat lands in the proximity of Legetet and Buru Hills are fully utilized for a large scale sugar cane plantation.

Most of the hilly carbonatite-alkaline centers are open grass land, with scattered acacia trees(Acacia drepanolobium and other species),Cactus Euporbia(Euphorbia ingens),thorn bush,etc.

2-4. Others

The township of Homa Bay is both the administrative and commercial center, where the offices of the District Commissioner and County Council, the District Head Quarter of Police etc. are located. A modern hotel and a hospital are availble,and foreign exchange is possible in a bank.

3. Previous geological information

3-1. Previous works

Major governmental publications on the overall Kenyan geology and/or mineral resources are as follows: DuBois(1966),Pulfrey and Walsh(1969),Geological Survey of Kenya(1962a,b).

There are a number of papers on the Rift Valley and carbonatite of either Eastern Africa or Kenya,among which books by Heinrich(1966),Tuttle and Gittins(ed.1966) and LeBas(ed.1977) are quite informative. Especially, the work by LeBas and others deals with most of the Semi-detailed areas of the present Phase comprehensively and in detail, and is quite useful.

The quadragle geologic maps that cover the present poject areas are Kericho(Binge 1962) and Gwasi(McCall 1958). These have provided the basic information for the compilation of the geologic map of the Regional Survey area.

Mineral exploration activities for limited commoditics and areas have intermittently been carried out within the present project area either by private sectors or foreign governmental organizations in the form of co-operation. Among these,the projects,reports of which have so far been available for us,are listed in TABLE I-3-1.

Further details on previous works for individual areas or prospects will be described in PART II.

3-2. Geological setting of the project area

The present project area is located at the southwestern corner of Kenya,some 50 to 120km west from the western margin of the East Africa Rift Valley and includes the southwestern part of the Kavirondo Rift. The latter is considered to be a sideshoot of the former,and the faults that limit the southeastern boundary of the Kavirondo Rift run diagonally in the ENE-WSW direction in the Regional Survey area. Among the boundary faults,the Kaniamwia and Kendu Bay faults are phsyographically prominent,and north-western part of these faults forms a graben(Fig.1-3-1).

The project area is mainly underlain by Pre-Cambrian rocks;granites, the Nyanzian greenstone belt system, and possible Kavirondian conglomerates and grits. These are intruded by several granitic plutons. Gneisses of the so-called Basement System(the Mozambique Metamorphic Rocks) occur only in some limited areas at the northeastern corner of the graben such as in the the proximity of Buru Hill.

Carbonatite-alkaline ring complexes of the Tertiary and/or later occur mainly in the graben,forming discrete hills such as Gwasi Hill,Ruri Hills, Homa Mountain etc. Most of these are selected as the Semi-detailed areas of the present Phase. The Quaternary sediments occur covering the lowland of the graben.

The major known mineral occurrences in the project area are gold veins in the Nyanzian greenstone belt and their derivative placer,base-metals of volcanogenic massive sulfides in the Nyanzian greenstone belt,hematite-magnetite,niobium,phosphorous,and rare-earths related with carbonatite complexes. More detailed description on mineral occurrences is made in PART II.

The geological succession and its relationship with economic minerals of Kenya are shown in TABLE I-3-2.

TABLE I-3-1 MAJOR PREVIOUS MINERAL EXPLORTAION WORKS IN THE PROJECT AREA

Area/Prospect *1	Commodities	Organization	Period	Reference/ Remarks
Buru Hill	Nb (pyrochlore & manazite)	New Consolidated Gold Fields Ltd	6/'56-/'58	Cluver(1958)
Buru Hill, Legetet Hill etc.	*2 (Rare earths)	Metal Mining Agency of Japan		MMAJ(1981)(in Jpn). *2:Primary aim was ground truth of LANDSAT imagery
Oyugis (Wire Hill)	Base-metal (massive-sulphide)	United Nations Revolving Fund	11/'80-01/'84	UN Revolv.F.(1978) Final Report Part I
Koru (and Songhor)	Cement raw materials	Geological Survey of Finland		Alviola et al.(1985)
Most of Semi-detailed areas of present Phase	P and Nb	Geological Survey of Finland		Idman and Mulaha (1986)
Ndiru Hill	P and Nb	Geological Survey of Finland		Mulaha(19861)

*1: Areas or prospects that are in the present project area are described.

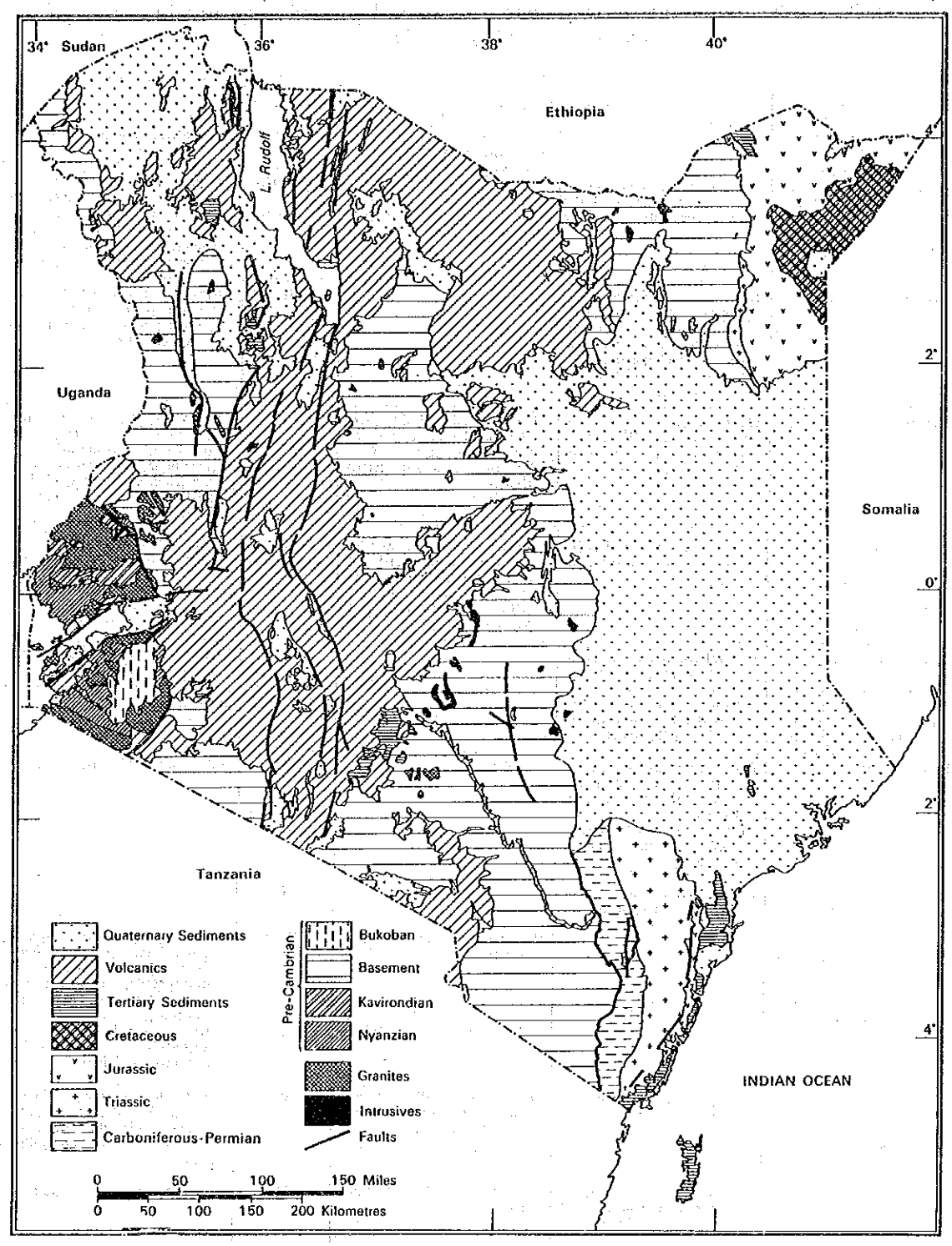


Fig. 3 Simplified Geological Map of Kenya

(*After* Pulfrey, W. and Walsh, J. 1969)

TABLE I-3-2 Geological Succession and Economic Minerals, Kenya (after Pulfrey et al., 1969)

Geological Age	Representatives		Approximate age in millions of years	Associated Economic Minerals*
	Bedded Rocks	Intrusive Rocks		
RECENT	Soils, alluvials, beach sands, Magadi soda lake, hot-spring deposits.		up to 1/40	TRONA, SALT, kaolin, brickearths, clays, sand, manganese, gypsum, guano, mineral pigments, meerschaum, (alum, diamonds, rubies, sapphires, ilmenite, monazite, rutile, zircon, nitre).
PLEISTOCENE	Raised coral reef and sandstones at the coast. Rift Valley and other inland sediments, some volcanic rocks of the Highlands and North-Eastern and Eastern Provinces.		up to 2	LIMESTONE, DIATOMITE, GYPSUM, pumice, pozzolana, bentonitic clays, manganese, kaolin, (sulphur, cement-stones).
TERTIARY	Coastal sediments. Volcanic rocks of the Highlands, western and northern Kenya. Inland Miocene.	Alkaline syenites, ijolites, etc. of volcanic centres such as Mt. Kenya, Ruri, etc. Carbonatites of south-western Kenya.	2–25	LIMESTONES, CARBON DIOXIDE, BUILDING-STONE, ROADSTONE and BALLAST, bentonitic clays, pozzolana, lead, barytes, fluorite (zinc, cinnabar, nepheline, apatite, pyrochlore, monazite, wollastonite).
CRETACEOUS	Coastal sediments and sediments of north-east Kenya.	Ijolites and alkaline syenites of Jombo at the coast and east Kitui. Alkaline dykes at the Coast and in east Kitui. Carbonatite at Mrima (Coast).	60–120	Manganese, pyrochlore, rare earth minerals.
JURASSIC	Coastal sediments and sediments of north-east Kenya		120–150	LIMESTONES, SHALES (for cement and ceramics), gypsum, ballast.
TRIASSIC, PERMIAN, CARBONIFEROUS? } KAROO	Sediments of the coast hinterland. Sediments of north-east Kenya(?).		150–250	Ballast.
PRECAMBRIAN	*Kisii Series* (Bukoban System)—Sediments and volcanics of south-western Kenya.	Dolerites.	600	SOAPSTONE, gold, (cassiterite).
	Embu series—Metamorphosed sediments, central Kenya.		?	
	Ablun Series—Metamorphosed sediments, north-east Kenya.		?	
		Pegmatites in the Basement System.	500–600	Mica, piezo-electric quartz, samarskite, columbite, beryl, felspar, (amblygonite, bismuth, ilmenorutile, amazonite, zinc spinel, fluorspar, rare earth minerals).
		Gabbros of western Kenya; dunites.	?	Chromite, garnierite, magnesite, vermiculite, corundum sapphire, (olivine).
	Basement System—Gneisses and schists.	Norites and allied rocks, minor peridotites, pyroxenites and granites.	600+	LIMESTONES, MARBLE, WOLLASTONITE, kyanite, asbestos, magnesite, dolomitic limestones, garnet, rutile, ilmenite, sillimanite.
	Kavirondian System—sediments and volcanics of south-western Kenya.	Granites, syenites, dolerites etc.	2,200	GOLD, silver, (molybdenite).
	Nyanzian System—Sediments and volcanics of south-western Kenya.	Granites, epidiorites, etc.	2,200+	GOLD, COPPER, zinc, silver, pyrite, (cobalt, scheelite, arsenic, fluorite).

*Minerals and rocks that are of notable economic importance in Kenya are indicated in capitals, less important minerals (which are not all being worked at present) in lower case letters and minerals known but not yet worked by parentheses.

4. Summary of present activity

4-1.Regional mapping

Four small outcrops of carbonatitic rocks and an occurrence of very weak green copper specks were newly located. Three small scale gold works and the volcanogenic massive sulfide mineralization of the Wire Hill prospect that had been explored by the UN Revolving Fund.were quickly examined. The locations of these are plotted in Fig.II-1-3-x and the findings are summarized in TABLE I-4-1. The assay result of the sample No.RT-90 in the TABLE is 3.3g/t Au and 2.0g/t Ag.

It is considered that no further follow-up is justified for the carbonatitic and green copper occurrences,as these are of extremely small scale. However,it may be necessary to pay attention to gold,since the project area is adjacent to the long known Migori Gold Field,and there occur rocks of possibe equivalents of the Greenstone Belt,which is believed throughout the world to be one of the favourable hosts for the gold mineralization.

TABLE-I-4-1. SUMMARY OF FINDINGS IN THE REGIONAL SURVEY AREA

No.	Type	Location.	Sample	Summary
1	carbonitite	3km NW of Mt. Gwasi	WR-108	Mag. bear.brwn alvk.and dark brwn Fe-carb.intrd. gr-base.w/micro ij.Wd=5m
2	carbonatite	5km SE of Sindo	RT-46	grn-white fenitic sov.in sch-gr base.D=5m
3	carbonatite (?):floats	2.5km WNW of Asego Hill.	RT-60	brwn-white,fine,comp.wkl foliated:alv or meta-Ls
4	carbonatite	8km NE of Homa Bay.Near shore	RT-99	lt-brwn,well bed.sinter-like alv.w/calc-tf.D=5m
5	Au-bear.QV (on work)	3km SW of Wiru Hill.	RT-90	white QV(5-10cm)in Nyzn-zian basic sch.(30 men)
6	Panning Au	5km SSE Oyugis.	--	original loclty unknown
7	Au-bear.QV (on work)	2.5km of Rangwe	--	QVs(5-6cm)in Nyanzian meta-basalt.(>10 men)
8	Cu stain	7km SE of Kendu Bay	RT-83	malc. dissm.& fil,fract. in red qz-monz. on ridge
9	Massuve sulphide	4-5km of Oyugis	--	gossan for ca.30m along road.Explored by UN RF.

4-2. Semi-detailed survey

Geological mapping and geochemical sampling were carried out in the 10 areas. 1/10,000 geological maps were compiled for all the areas,and the geochemical samples were tested for 17 minor elements including 10 rare-earth(REE) elements(see TABLE I-1-2 for elements analyzed).

Univariate statistical analysis and principal component analysis were carried out for the assay results of 4 groups:(1)grid samples from Ndiru Hill prospect in the Homa Mountain area. (2)grid samples from Buru Hill prospect. (3) Soils. (4) 1325 rock chip samples excluding above three. 3 elements U,Gd and Tm were excluded from the analyses,as most of their results are below the detection limits. Ultimately,three "components" light rare earths(LREE) especially La,Ce and Nd,yttrium(Y),and niobium(Nb) were used for locating anomalies,as it became obvious that these would well represent the maineralization from the correlation and principal component analyses,and that only these would have potential of economical significance.

"Mean(M)+1 Standard Deviation(SD)" calculated from 1325 rock samples was adopted as a threshold for analytical values of each element or scores of each principal component. The values over "M+1SD" are defined as " anomalous",and those over "M+2SD" as "highly anomalous",respectively. Major elements and scores of 1st through 4th components were plotted on 1/10,000 topographic maps. An anomaly that comprises several anomalous values and more than two highly anomalous ones was compared with geological factors to select a prospective spot.

Summary of the statistics of the major elements calculated from 1325 rock chips is shown in TABLE I-4-2-1, the maximum and mean values of all the Semi-detailed areas are in TABLE I-4-2-2,and those of the Buru and Ndiru Hills are in TABLE I-4-2-3,respectively.

TABLE I-4-2-1 STATISICS OF MAJOR ELEMENTS

	Max. (ppm)	Mean (ppm)	m+1s	m+2s
Nb	12000	148	620	2600
Y	1360	63.9	148	344
La	14300	178	767	3300
Ce	17700	283	1240	5460
Nd	3000	97.2	450	2090

* Processed on logarithmic scale.
* 1325 rock samples excluding grid ones

TABLE I-4-2-2 MAXIMUM AND MEAN VALUES OF MAJOR ELEMENTS

AREA	SAMPLES	ITEM	Nb (ppm)	Y (ppm)	La (ppm)	Ce (ppm)	Nd (ppm)
Rangwa	211	MAX.	1470	580	2300	3100	1210
		MEAN	211	51	110	130	37
Saga-rume	76	MAX.	735	220	1690	2650	1180
		MEAN	32	43	68	136	52
N.& S. Ruri H	258	MAX.	2100	1360	14300	17700	2500
		MEAN	127	69	206	364	116
Kuge—Lwala	51	MAX.	4150	680	3970	6750	2310
		MEAN	278	110	267	604	262
Soklo-Ngou	109		5500	550	10000	10000	2120
			273	57	242	359	107
Homa Mount.	*1 486	MAX.	12000	910	10700	16100	2200
		MEAN	138	68	212	335	124
Buru H	*2 18	MAX.	3700	1100	13520	16700	2700
		MEAN	37	66	115	186	62
Lege-tet H.	116	MAX.	3800	750	3730	7190	1880
		MEAN	204	74	194	335	127

** : North and South Ruri areas, and Ngou and Soklo areas are treated as an area respectively, as they are closely located.
* 1 : Excludes 90 grid samples from Ndiru Hill prospect.
* 2 : Surrounding area of the grid-sampled section. However, 6 samples from the section are included.

TABL I-4-2-3 MAXIMUM AND MEAN VALUES ---GRID SAMPLES

PROS-pect	SAM-PLES	ITEM	Nb (ppm)	Y (ppm)	La (ppm)	Ce (ppm)	Nd (ppm)
Buru Hill	*1 47	MAX.	4800	3100	19500	20000	2700
		MEAN	688	516	3150	4960	1330
Ndiru Hill	90	MAX.	8200	1700	14720	20800	1200
		MEAN	368	159	700	1370	378

* 1 : Excluding 2 gneiss samples.
Note: Figures in this table are on antilog scale.

5. Conclusion and recommendation

5-1. Conclusion

(1) Regional survey

It is concluded that the newly discovered carbonatitic and copper occurrences are too small to warrant further follow-up. Although gold is not included as a target commodity in the present Phase,it may be worth paying attention to it,as the project area is adjacent to the long known Migori Gold Field,and includes rocks that are considered to be equivalent to those in the Greenstone Belt,which is noted throughout the world as a favourable host for gold mineralization. Generally speaking,the gold mining is different from other metals in a point that it can often been run even by a small group without a large initial investment,so that it has a potential to contribute directly and quickly to the local economy and employment. Nevertheless,it is also required to be careful not to infringe vested rights,as there are already several works in operation.

(2) Semi-detailed survey

The exploration potential of each area has been assessed by integrating the informations from the univariate and principal component analyses of geochemical sampels,and interpretation of geological factors. The details of the assessment will be discussed in 1-2 of Part III,and summary is tabulated in TABLE I-5-1. Some supplements to the TABLE are presented below.

i) It is considered that the commodities which are worth further exploration in the present project area are rare earth(REE) minerals,yttrium(Y), and niobium(Nb). It may also be necessary to pay attention to gold in some way. However, it is concluded that other elements,such as phosphorous etc., are little worth further exploration,as most of their absolute values are low,and relatively higher ones are distributed sparsely and locally,

ii) It is required to carry on some follow-up works in Buru Hill(REE,Y,and Nb),Kuge-Lwala(REE,Y),South Ruri(REE,Y),and North Ruri(REE,Y).(priority is in the order above).

iii) It has been revealed that REE,Y,and Nb are closely related with carbonatite,especially with ferrocarbonatite in general.

iv) The mineralization at Buru Hill is interpreted to be related with carbonatitic intrusion as well,although no carbonate mineral was recognized on the surface during the present study. Because,sovite was intersected in DDHs byNCGF(Cluver;1958) and the chondrite normalized REE patterns suggest the carbonatitic affinity of the mineralization. Here,superimposition of the mineralizations of different stages is inferred,as relatively deeper facies(sovite,magnetite and Nb)and shallower one(LREE and brecciated structures) occur in the same place. The result of the principal component analysis is consistent with the interpretation.

The mineralization in the ferruginous breccia at Lwala is somewhat similar to that of Buru Hill. And the interpretation of geology at Kuge implies a high level emplacement of the carbonatite complex there. Thes support to explore the depths at Kuge-Lwala.

v) As for gold,the assay result of one of 7 handspecimens taken on a ridge of Homa Mountain is 33g/t Au,though others are trace to 2 g/t. It may be necessary to follow up in some way and sometime.

TABLE I-5-1 SUMMARY OF THE POTENTIAL AREAS FOR FURTHER EXPLORATION

Area	Element	Geology and/or mineralization	Number of Highly Anomalous points*1
South Ruri	Y 、REE	* Mineralization seems to be associated with ferro-carbonatite dykes that occur around a cylindrical carbonatite complex.	* 3 points: Y=420, 660, 600 La=5700, 8830, (1100)
North Ruri	Y 、REE	* Similar to the above. 2 anomalies are located at 0.8km N and 0.9km SW of the summit of Norith Ruri Hill.	* Location-1 Y=420, 460, 1360 La=7530, 11060 * Location-2 Y=550 La=4860, 5260, 4060
Kuge-Luala	Y 、REE	*1:In a ferro-carbonatite dyke that is some 450m long and 30m～40m thick, dipping 30 to 50° W(max. 9350cps γ-ray reading). *2:A ferruginous breccia body itself that resembles Ores of Buru Hill.	*1: 3 points: Y=440, 610, 680 Th=586, 1423, 1683 *2: 2 points Y=360, 450
Homa Mountain	(Au, Ag)	*1:Points of anomalous and highly anomalous values of REE are sporadically distributed within the mountain. Not justified for follow-up. *2:Quartz vein swarm on a ridge about 3km E of the summit.	*1: Sporadically distributed. *2: One sample out of 7 indicates 31.1g/t Au, but others tr levels
Buru Hill	Y 、REE Nb	* Whole the hillock(500mx350mx40m) is strongly mineralized and weathered to form a sort of leached capping. * Averages of almost all REE and Y are about the same levels of"Highly Anomalous values"for"ALL AREAS". * Secondary enrichment of Nb and Y may be expected at the depths. * Primary zoning at the depths might occur(?), as shallow level explression are common at the surface, such as brecciated structure. * Potential surficial expressions of blind plugs at the southern part.	* Arithmetic averages in antilog scale are as follows. * La+ce+Nd=1.31% (Max. 3.98%) * Y=1071ppm (Max. 3100ppm) * Nb=637ppm (Max. 4800ppm)

* 1 A "Highly Anomalous" value is defined as≧"Mean + 2 Standard Deviations" calculated from 1325 rock-chip samples of "All Areas" of Semi-detailed areas.

5-2. Recommendation for the 2nd phase

It is recommended to carry on some of following works.

(1) Buru Hill Area

To carry on a programme concentrated mainly in drilling,the aims of which are as follows.

i) To explore the secondary enrichment zones of niobium and yttrium that may be expected under the leached capping.

ii) To explore at the depths,if there is a vertical zoning of the primary mineralization.

iii)To figure the shape of the bottom of the leached capping,if it is parallel to the present surface or horizontal,as well as its depths.

iv) To explore a potential blind carbonatitic plug that might occur at the depths of the southern foot of the main hillock.

Besides the above,it is recommended to carry on geophysical exploration(detailed gravity and magnetic) in order to study geological structures and to explore another potential blind plug that might occur some 500m S of the hill. It is also recommendable to execute pitting,cleaning of the old inclined shaft,mineralogical and metallurgical tests of Ores.

(2) Kuge-Lwala Area

To carry on an exploration programme concentrated mainly in drilling and geochemical grid-sampling including trenching. The aims of the drilling are as follows.

i) To explore at the depths the ferro-carbonatite dyke located at Kuge,in which a combined anomaly of REE,Y,Th and total gamma-ray is delineated.

ii) To explore Y and REE at the depths in the ferruginous breccia body, which is located at Lwala and resembles Ores at Buru Hill.

(3) South and North Ruri Areas

To carry on an explration programme including mainly geochemical grid-sampling and geological mapping in detail for the anomaly of REE and Y located in the present Phase.

(4) Miscellaneous

To execute some of necessary works from following items,in accordance with the major works to be done: To prepare topographic maps from air photos,to chain geochemical and/or geophysical lines,pits and drill sites, to survey the inclined shaft and tunnels to be rehabilitated,to map or log geolgically the lines,pits,underground works,drill cores and the surface of the target areas and their vicinities.

To adopt the radiometric survey for explortion for REE and/or so-called rare metal minerals,combined with other methods, as it is very easy and speedy to get the results at sites and the result ofthe present Phase has indicates that its readings have some coorelation with REE,Y,or Nb.

PART II. DESCRIPTION OF PROJECT AREAS

1. Regional Survey Area

1-1 General Features

This year's Regional Survey intended to carry out a geological survey for an area of approximately 2,800 sq.km (Regional Survey area), of the whole survey area (Homa Bay) of approximately 10,000 sq.km, where a number of carbonatite bodies had been located.

The purposes of the geological survey were to prepare 6 sets of 1 to 50,000 scale geological maps of the Regional Survey area, to locate previously unknown carbonatite-alkaline rock complex if any and to clarify the occurrences of the mineralization in the area.

The geology of the Regional Survey area consists of green rocks and sediments intruded by granitoids of Precambrian age, and of alkaline plutonics, nephelinites-phonolite volcanics and carbonatites having been produced by alkaline plutonisms and volcanism which initiated in early Tertiary and continued to Quarternary.

The Survey area, being located to the north of the Migori which has been known of one of the gold belts in the western Kenya, includes minor gold deposits of a vein type around granitoids, some of which are being mined in small scales. An investigation was recently carried out for searching possible commercial mineralization of phosophorus and rare earths associated with carbonatite.

1-1 Method and Procedures

Six sheet of 1 to 50,000 scale topographic maps published by Survey of Kenya were used for me geological survey as base maps. The names and the indices for the topographic maps are as follows;

Rusinga (115/3), Gwasi (129/1), Madiany (115/4), Homa Bay (129/2) Kendu Bay (116/1), Oyugis (130/1),

The field survey was done with using the 1 to 25,000 scale topographic maps enlarged from these 1 to 50,000 scale maps. The survey routes were selected on the basis of the detailed examination of the existing data and information.

The geological data obtained by the field survey were incorporated with the results of various laboratory tests for a comprehensive interpretation.

The laboratory tests carried out for rock and ore samples are microscopic observations of thin and polished sections, K-Ar method age