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STATUS OF DEVELOPMENT OF CERTAIN NEW METALS AND MINERALS IN KENYA

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Table of contents

A. INTRODUCTION

This report has been prepared for the Seminar on New Metals and Minerals to be held in Addis Ababa on 5-10 February 1968 under the auspices of the United Nations Economic Commission for Africa. The metals which have been listed for discussion are: beryllium, caesium, columbium (niobium), germanium, hafnium, rare-earths, tantalum, titanium, yttrium and zirconium. The report deals with the occurrence and economic potential of menerals bearing these metals in Kenya, together with an account of their exploitation, extraction and processing to the extent that they have been developed.

Information for this report has been obtained mainly from the publications of the Mines and Geological Department of Kenya, to which acknowledgement is gratefully made. The following sources of information have been of particular value: the Mines and Geological Department Annual Reports for 1933 to 1955, the Geological Survey Reports, the Geological Survey Bulletins and Information Circulars.

Information on the occurrence and production of minerals of the rarer metals in Kenya has been given by Hitchen (1937), Pulfrey (1947, 1954, 1960), Dodson (1957), Du Bois (1966), Mason (1967), and more detailed information is contained in the Kenya Mines and Geological Department Annual Reports for 1933 to 1965 and the Geological Survey Reports (1933-1967). Summaries have been given by Pelletier (1964) and de Kun (1965), and Dixey (1969, 1962, 1963, 1964) has reviewed the mineral resources potential in reports prepared for the United Nations Economic Commission for Africa.

Additional information on beryllium has been given by the Atomic Energy Authority (1958) and Du Bois and Horne (1962); on radioactive ores by MacLeod (1959) and Darnley (1959, 1961); and on niobium and the rare-earths by Deans (1955), Hawes (1958), Pickup *et al.* (1960), Coetzee and Edwards (1959), Bakes *et al.* (1964), Harris (1964, 1965), Deans (1966), Harris and Jackson (1966), Heinrich (1966) and Mason (1966).

Maps of mineral localities in Kenya have been given by Pulfrey (1947, 1954, 1960), Dixey (1963), Pelletier (1964) and Du Bois (1966), and are also contained in the Kenya Atlas (1959, 1962) and the Handbook on the Natural Resources of East Africa (Russell, 1961).

Further information is contained in unpublished reports of the Kenya Mines and Geological Department (listed in the Annual Reports for 1933 to 1965).

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The author wishes to thank Dr. L.D. Sanders, Commissioner of Mines and Geology, and Mr. N.P. Dosaj, Librarian, Mines and Geological Department, Kenya, for assistance with information; also Professor S.H. Ominde and Mr. G. D'Souza, Department of Geography, University College, Nairobi, for assistance with the figures.

B. HISTORY OF THE SEARCH FOR MINERALS IN KENYA

Due credit for our present knowledge of the economic minerals in Kenya must be given to the Mines and Geological Department of Kenya which has been responsible not only for the geological survey of the country, but also for carrying out detailed investigations on many aspects of mineral resources. The Department has completed the mapping of over 60 per cent of Kenya, has published an impressive number of regional reports and has aided and helped mining activities in many ways -- by identifying and analyzing specimens, giving advice on pegging and developing claims, improving communications, revising mining laws, training of local prospectors, etc. The Annual Reports for 1933-1965 of the Mines and Geological Department of Kenya give an account of the varied activities of the Department.

When the Mines and Geological Department was established in 1933, the winning of gold was the main mining activity of the country, but the efforts of the Department were soon directed at developing other minerals as well, such as asbestos, carbon dioxide, cement, ceramic materials, copper, diatomite, graphite, gypsum, kaolin, kyanite and mullite, limestone and lime products, meerschaum, mica, pumice, pyrite, salt, silver, soda-ash (which later became the chief mineral production), talc and vermiculite. The account which follows refers particularly to the minerals under discussion.

During the 1939-45 World War, aid from the Colonial Development Fund helped in the exploration for strategic minerals, and with the development of atomic power, the publication in 1949 of a Ministry of Supplies offer to purchase uranium minerals aroused the interest of prospectors in a search for radioactive ores. This led to the exploitation of small quantities of samarskite-fergusonite-davidite-monazite from pegmatites in the Loldaika Hills north of Nanyuki in 1949 and monazite-samarskite from pegmatites in West Suk in 1951. Although an intense search was made in subsequent years, which led to the finding of small quantities of radioactive minerals and rare-earths either in small concentrations in pegmatites or as disseminations in country-rock, no deposits were found to be worth exploitation.

The need for beryllium in radioactive piles stimulated the search for beryl and some was found in the baragoi area in 1952 and later elsewhere. Small quantities were extracted in 1952 and sporadically in subsequent years, totalling 15 long tons. At the instigation of the UK Atomic Energy Authority, geochemical work on the occurrence of beryllium in Kenya rocks was carried out in the period 1956-1960 with a view to determining the likelihood of the presence of disseminated deposits of beryllium minerals, but apart from certain anomalies requiring further prospecting, no favourable indications were obtained.

In 1952 the Mines and Geological Department of Kenya carried out a preliminary radiometric survey of the carbonatite centres of Homa Mountain and the Ruri Hills in Western Kenya where radioactivity in the soils was traced to the presence of minerals of the microlite-pyrochlore and euxenite-polycrase groups. In the same year tests with a Geiger counter on Mrima Hill during the mapping of the region by the Kenya Geological Survey showed the manganess-iron deposits (which had been known since 1919) to be radioactive. In the following year disseminated rare-earths, contained in pyrochlore and monazite, were found in the soil mantle. Systematic prospecting continued in 1954-55 by means of detailed pitting and a radiometric survey, and the reserves were estimated at 30M tons to an average depth of 21 ft over an area of some 577 acres, the ore averaging 0.27% Nb_2O_5 and 3.1 per cent of combined rare-earth oxides; deeper pitting gave higher values up to 1.8 per cent Nb_2O_5 and 14.6 per cent rare-earth oxides. Samples were sent to UK for ore-dressing research, but beneficiation problems proved to be too difficult. The Anglo-American Corporation of South Africa Ltd. became interested in the deposit and carried out detailed work in 1955-56, with the assistance of the Geological Survey until about 1961. Further drilling and pitting confirmed a high-grade area comprising a reserve 1M tons of ore, assaying at 1.5-2 per cent of Nb_2O_5 and 17 per cent of rare-earths. Reports were prepared by the Mineral Resources Division of the Overseas Geological Survey, London, the UK Atomic Energy Authority, Harwell, and the Warren

Spring Laboratory, Stevenage, England, but the extraction problems were found unsurmountable and the deposits remain unexploited (Mason, 1967; Harris and Jackson, 1967).

After completing the major part of the investigations on Mrima Hill, the Kenya Mines and Geological Department turned its attention to the niobium and rare-earth occurrences in the carbonatites of South Nyanza. In 1954-56 the Survey investigated the occurrence of perovskite in uncompahgrite at Rangwa. Aerial radiometric and magnetometric surveys, field prospecting and geological mapping were carried out, but the results were disappointing. The Survey determined the perovskite to contain 56.36 per cent of TiO_2, 0.56 per cent Nb_2O_5 and 0.73 per cent of rare-earths and to form 5 per cent of the uncompahgrite, with segregations reaching 30 per cent in places. In 1956-57 the carbonatites of Ruri and Homa Mountains were prospected and mapped, and although the presence of pyrochlore and rare-earths was confirmed, no deposits of economic value were found.

Interest in the niobium investigations at Mrima Hill and in Nyanza Province encouraged prospectors to search for columbite in pegmatites and about 2,000 lb of the mineral were produced in the period 1955-1962 from the West Suk, Machakos, Sultan Hamud, Boji Hill and Nachola areas. The columbite contained an appreciable amount of tantalum.

An aerial scintillometer survey of Kenya was carried out in 1958 by the UK Atomic Energy Authority (Cambray and Hill, 1960), followed in 1958-60 by a radiometric road survey by the Kenya Mines and Geological Department which confirmed that high radioactive responses are generally associated with carbonatite occurrences. Several areas of radioactive anomalies were examined, such as the Kulahu area in 1959, the Mid-Galana, Uregi and Chemilil areas in 1960, the coast hinterland in 1961 and Kilifi in 1962. Various other occurrences of rare-earths were prospected.

Since 1964 detailed investigations with the aid of a Special Fund under the United Nations Development Programme has been carrying out a Mineral Resources Survey in Western Kenya over an area of 11,348 sq mi in Nyanza Province. The final report is in preparation and will shortly be submitted to the Government of Kenya.

Also since 1964 the Government of Canada has been giving assistance to the Geological Survey under the Canadian External Aid Programme.

The general situation concerning the minerals under consideration in Kenya is therefore a disappointing one. The total amounts produced consist of 15 long tons of beryl, 2 long tons of tantalum-bearing columbite and a few pounds of radioactive ores. There has been no production of titanium and zirconium and there appear to be no occurrences of caesium, germanium and hafnium. On the other hand, the Mrima Hill deposits are extremely rich in niobium and rare-earths and represent a great potential if beneficiation problems are resolved in the future.

C. SYSTEMATIC DESCRIPTION OF MINERAL OCCURRENCES IN KENYA

1. Beryllium

The metal is contained virtually in one mineral in Kenya, beryl, which occurs as a minor constituent in mica-bearing granite-pegmatites intruded into the Precambrian Basement System. Nearly all of the beryl is of industrial grade, meeting the buyer's specified minimum content of 10 per cent BeO. The occurrence of beryl in Kenya is showin in Fig. 1.

The production of beryl in Kenya has been a small one, as follows:-

Year	Long tons	Value in £ sterling
1952	1	50
1953	-	-
1954	-	-
1955	-	-
1956	-	-
1957	5	500
1958	3.5	423
1959	2.25	217
1960	1.40	147
1961	0.55	66
1962	-	-
1963	-	-
1964	0.65	64
1965	-	-
1966	-	-
1967	0.3*	150*

(* estimated)

Localities at which beryl has been produced in the past comprise:

(1) the Sebit Mine in the Cherangani Hills in West Suk where green and blue beryl is associated with lepidolite, spessartite and microlite;

(2) Kiambere and the Thura River area in the Embu district where the mineral occurs in association with amazonite, topaz and apatite;

(3) Nachola in the Baragoi area;

(4) Mukaa and Mukuyu in the Southern Machakos district;

(5) Ususu in the Sultan Hamud district;

(6) Kenailmet in the Karasuk district. All of the beryl extracted has been exported as crude ore.

Occurrences of little economic value include:

(1) Wamba, 50 mi south of Maralal;

(2) the Karissa Hills, 15 mi east of Maralal;

(3) Mukogodo, north of the Loldaika Hills in the Nanyuki-Maralal area;

(4) Boji Hill, Dalache, Tumtu and Obe in the Chanler's Falls area;

(5) Namanga-Bissel area; and

(6) the country between Tsavo and Taveta.

Traces of beryllium have been detected in the Mrima Hill complex in the Coast Region, Buru Hill, near Kuhoroni in the Kericho district and elsewhere. Spectrographic determinations by Du Bois and Horne (1962) have not revealed the presence of significant disseminated deposits of beryl, although further prospecting by chemical and electronic methods of areas of detected anomalies has been recommended.

At present small amounts of beryl, var. aquamarine, of blue colour, are mined and locally fashioned into gemstones.

2. Titanium

Titanium-bearing minerals identified in Kenya comprise mainly ilmenite, rutile, ilmenorutile, titanite and perovskite. None has been commercially exploited in Kenya as there are no local industries to absorb the mineral and the freight costs are too prohibitive for an export market. The occurrence of titanium minerals in Kenya is shown in Fig. 1.

Ilmenite has a widespread occurrence in Precambrian Basement System rocks as an accessory constituent in gneisses and pegmatites and in detrital rocks derived from them.

The mineral is present in black magnetite-bearing shore sand extending for a distance of about 8 mi along the Uyoma Peninsula in Western Kenya. Analyses of concentrates after removal of magnetite gave a titania content of 13.8 per cent. The reserves are not known, but are thought to be large.

In the Malindi area, prospecting has been carried out on the beach snds and dunes along the coast north of the township and in Formosa Bay in 1953. The sands were found to contain ilmenite and rutile, together with monazite and various iron minerals. Tests showed that the normal sands usually contain less than 2 per cent of ilmenite, except where they have been concentrated by natural processes. A beach concentrate at Ras Ngomeni was found to contain 3.84 per cent ilmenite while an even higher value of 13.7 per cent ilmenite was recorded from a 5-in band in a dark coarse dune sand near themouth of the Sabaki River.

Ilmenite is abundant as a minor constituent of Precambrian rocks in many parts of Kenya, but no economic deposits have so far been discovered. Among such occurrences may be instanced the following:

(1) near Tulimani in the Machakos district, in schists, gneisses and pegmatites;

(2) two miles west of Voo in the South Kitui district, in quartz-pegmatites;

(3) Kampi ya Moto, north-east of Rongai, in association with specular iron;

(4) two miles north-west of Songhor in the Kisumu district, in a 2-ft vein;

(5) near Lugari in the Kitale district, in association with gold and zircon;

(6) in the Kitui district, in pegmatites, where iron ore segregations have assayed up to 44 per cent TiO_2;

(7) in the Kinna area, in black sands of some of the sand rivers;

(8) in the Kauro-Merille area, in pegmatites;

(9) at Kumbulanawa in the Kora-Kalimangilu area in gabbro;

(10) near Karimante, 25 mi south-east of Meru township, in the form of massive titaniferous iron ore of many millions of tons assaying between 5 and 15 per cent TiO_2.

Rutile is known to occur:

(1) in pegmatites and as an accessory constituent in gneisses of the Basement System of the Southern Machakos district;

(2) in eluvial deposits at Kinyike Hill in the Mtito Andei area;

(3) in stream concentrates of the Kora-Kalimangilu area;

(4) in ilmenite-rich black sands found near the mouths of rivers at the coast. The variety ilmenorutile is known: (1) at Kinyike Hill, and (2) in the Southern Machakos district.

Titanite is a common accessory constituent of the calc-silicate gneisses and granulites of the Basement System.

Perovskite is known at Songhor, north of Kericho, and large amounts of columbium-bearing perovskite have been noted in the uncompahgrite rocks and alluvials derived from them in Kangwa, West Kenya. The perovskite content of the uncompahgrite is 5.30 per cent and the titania content of the perovskite is about 56 per cent.

No production of titanium ores has so far been made in Kenya and the minerals must await development.

3. Zirconium

Zirconium is contained virtually in one mineral in Kenya, zircon, the occurrence of which in Kenya is shown in Fig. 1.

Zircon has been reported at the following localities:

(1) ar Ngomeni, near Malindi, in beach sands in association with ilmenite, magnetite and rutile, but the zircon content is insufficient to justify its extraction, although it might constitute an economic by-product if the other constituents become exploitable;

(2) in the Tiva area of the Kitui area; and

(3) in river sands on the Kaamasai Estate near Songhor.

No deposits of zircon have been worked and the chemical content of the known occurrences does not appear to have been investigated.

4. Caesium, Germanium and Hafnium

No investigations appear to have been carried out on mineral sources of these metals in Kenya.

5. Niobium, Tantalum, Rare-earths and Yttrium

Owing to the common close association of these metals in the mineral deposits of Kenya, it is convenient to treat them together.

Mineral depostis of this group may be considered in three main field associations: (a) pegmatites; (b) carbonatites and (c) other rock types. Most depostis show at least some degree of radioactivity — a property that has often helped to locate them — and differing relative amounts of rare-earth constituents. The occurrence of niobium, tantalum and rare-earth minerals in Kenya is shown in Fig. 2.

(1) Associated with pegmatites

(a) Radioactive ores

Although radioactive minerals were first discovered in Kenya in 1916 when samarskite was found in a pegmatite near Tura, Loldaika Hills, 30 mi north of Nanyuki, their exploitation was achieved only in 1949 because of the demand for raw materials as a source of atomic energy.

In spite of the extensive search for radioactive ores, they have been exploited on a very limited scale as follows:

(1) at Tura, Loldaika Hills, a few lb of samarskite were won in 1949 from pockets in pegmatites. The samarskite contained U_3O_8 5.25 per cent, ThO_2 4-6 per cent, Sc_2O_5 0.25-0.50 per cent and was associated with fergusonite, davidite, monazite, allanite, microlite, polycrase and euxenite containing cerium, yttrium, etc.;

(2) in West Suk a small quantity of radioactive monazite and samarskite was extracted in 1951 from pegmatites in association with radioactive monazite-bearing tourmaline; and

(3) at Kenailmet, Karasuk, small quantities of samarskite were found in 1955 in association with columbite in mica-pegmatites. Chemical and spectrographic analyses confirmed the presence of niobates of uranium, yttrium and iron, with subordinate tantalum, titanium, thorium and lanthanons, especially gadolinium, dysprosium and samarium.

Other occurrences are as follows:

(1) samarskite at Kokusan and Morukong, near Kenailmet, Karasuk;

(2) samarskite at Nachola near Baragoi, in association with davidite, low-grade pitchblende, radioactive columbite, fergusonite, euxenite and monazite; and

(3) euxenite in the Mukogodo area, in association with monazite.

The radioactive minerals of Kenya occur in small amounts and so far have made only a slight contribution to the economy of the country.

(b) Niobium and tantalum.

The only mineral exploited for niobium, tantalum or rare-earths in pegmatites of Kenya has been columbite which occurs in association with beryl in the Precambrian Basement System.

The production of columbite in Kenya has been small and sporadic due to the scattered occurrence of the mineral in pegmatites, as follows:

Year	Weight in lb	Value in £
1955	136	90
1956	-	-
1957	-	-
1958	1680	388
1959	1399	376
1960	385	61
1961	-	-
1962	375	50
1963	-	-
1964	-	-
1965	-	-
1966	-	-
1967	-	-
Total:	3975	Total: 965

Areas from which columbite has been extracted comprise:

(1) Kenailmet, Karasuk, where columbite has been known since 1955 in association with mica and samarskite and containing an appreciable tantalum content, with subordinate titanium;

(2) 14 mi north-east of Kima in the Machakos district;

(3) the Sultan Hamud area;

(4) Boji Hill in the Chanler's Falls area;

(5) Nachola, 5 mi west of Baragoi. The Nb_2O_5 content of analysed samples ranged from 33.60 to 64.70 per cent and the Ta_2O_5 content from 8.10 to 15.00 per cent. The material has been exported in the form of crude ore.

Occurrences that have not been exploited are as follows:

(1) Sebit Mine, West Suk, where, microlite (a tantalate of calcium with small quantities of niobium, titanium, rare-earths, etc.) has been found in a pocket of pegmatite in association with columbite, xenotime (yttrium phosphate wtih thorium), beryl, mica and monazite. A chemical analysis of the microlite gave Ta_2O_5 65.5 per cent, Nb_2O_5 2.7 per cent, TiO_2 0.2 per cent. The find was not exploited in view of the small quantity, but it is possible that other microlite-bearing pockets may be found in the pegmatite which reaches a width of 250 ft and a length of over half a mile;

(2) Morumeri, near Kenailmet, Karasuk, where columbite has been found in pegmatites;

(3) the Thura River area, Embu district where small amounts of columbite are present; and

(4) Kokusan, near Kenailmet, Karasuk, where columbite occurs in association with samarskite.

(2) Associated with carbonatites

Localities at which niobium and rare-earth minerals have been found in Kenya are (1) Mrima Hill, Coast Region; (2) S. Nyanza, Western Kenya; and (3) Buru Hill near Muhoroni, Kericho area.

(1) Mrima Hill, Coast Region

Mrima has been extensively explored by Government geologists and prospectors and by a mining company, and is potentially of great importance.

A lateritic soil mantle overlying carbonatite contains goethite, limonite and psilomelane, with barite, gorceixite, monazite, pyrochlore, ilmenite, rutile, ilmenorutile, anatase, brookite, perovskite, magnetite quartz and feldspar.

There are four varieties of pyrochlore (a calcium niobate with rare-earths), the most abundant of which is a barium pyrochlore, pandaite; a second variety contains strontium; a third variety titanium in quantities up to 7.5 per cent and a fourth is a hydrated barium pyrochlore which is abundant only locally.

The main rare-earth minerals present are monazite and gorceixite (essentially a barium aluminium phosphate with rare-earths). Lanthanum and cerium together make up some 90 per cent of the rare-earths, generally followed , in order of importance, by neodymium, praseodymium, samarium, dysprosium, gadolinium, europeum, ytterbium, erbium, and occasionally holmium and thulium. The results of spectrographic analyses of samples of ore from Mrima Hill are given in Table 1.

TABLE 1

Spectrographic analyses of samples of ore from mrima hill

	I %	II %	III %	IV %	V %	VI %
Nb_2O_5	0.6	0.6	1	0.6	0.6	1
Ta_2O_5	0.1	0.1	0.1	-	-	-
ThO_2	<0.05	<0.05	<0.05	0.05	0.05	0.05
TiO_2	5	5c	5	3	5	3
Sc_2O_3	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Y_2O_3	0.1	0.1	0.4	0.4	0.4	0.4
La_2O_3	1	2	5	5	1.5	1.5
CeO_2	1.5	3	15	15	0.5	1.5
Pr_2O_3	0.2	0.2	0.8	0.5	0.5	0.5

TABLE 1 (Cont'd.)

	I %	II %	III %	IV %	V %	VI %
Nd_2O_3	0.5	0.5	2	1.5	0.3	0.2
Sm_2O_3	<0.01	<0.01	<0.01	0.01	-	-
Eu_2O_3	0.01	0.01	0.06	0.1	0.03	0.03
Gd_2O_3	0.02	0.2	0.3	0.1	0.02	0.03
Er_2O_3	0.01	0.01	0.01	0.01	0.01	0.01
Yb_2O_3	0.02	0.005	0.1	0.05	0.01	0.01

In additon, Dy, Ho and Tm have been detected.

The reserves have been estimated 55.7M tons of ore averaging 0.67 per cent Nb_2O_5 down to a depth of 30 ft, with a possible 50M tons containing 0.7 per cent Nb_2O_5 between 30 and 100 ft depth. Below the weathered zone the content appears to be in the range 0.15-0.3 per cent Nb_2O_5. The reserve of rare-earths amounts to 30m tons assaying at 3.1 per cent rare-earth oxides of which 7M tons on the summit average 5 per cent. In one area sampling has shown values exceeding 14 per cent down to a depth of 87 ft.

From the point of view of reserves, the Mrima Hill deposit is one of the richest potential sources of niobium in the world, but all attempts to exploit it have proved unsuccessful. This is due to the fact that the deposit is complex and inhomogeneous and that the pyrochlore and other constituents have been altered during the course of weathering to a disseminated microcrystalline form which readily breaks up into slime-sized particles which so far have defied attempts at physical and chemical beneficiation (North, 1955; Pile, 1958; Collins, 1958; Warren Spring Laboratory Research Reports, 1960-65; Harris and Jackson, 1967).

If an ore-dressing method of extraction (chemical, pyrometallurgical, or even physical) is successful, the Mrima ore will be of great value for besides its rich niobium content, it contains iron, maganese, baryte, phosphate, titanium, thorium, scandium, yttrium, and many rare-earth elements as by-products. The economic potential is increased by the proximity of the deposit to the port of Lombasa and the low mining costs due to the nature of the deposit.

(2) S. Nyanza, Western Kenya

The occurrence of pyrochlore and monazite has been proved in the carbonatite complexes at Homa, Ruri and Rangwa. The minerals are contained in the carbonatite, but investigations by the Mines and Geological Department have not brought to light any workable deposits.

It is possible that when the work of the United Nations Mineral Resources Survey in Western Kenya is completed, the situation may be more optimistic.

(3) Buru Hill near Muhoroni, Kericho area

Small quantities of monazite and pyrochlore containing rare-earths amounting to an average of 1.21 per cent of the soil, have been found on Buru Hill which appears to be a carbonatite plug.

(3) Associated with other rock types

Monazite (cerium phosphate with other rare-earths and thorium) has been reported at the following localities:

(1) South of Mazeras in Jurassic sandstones;

(2) in the Maralal-Baragoi area in Precambrian biotite-gneisses and Tertiary tuffs;

(3) at Bulfayo, Chanler's Falls area, in Precambrian gneisses.

Detrital monazite is known (1) in the alluvials of the Yala River; (2) in streams of the Kora-Kalimangilu area; and (3) in the Galana River near Malindi.

Allanite is known in Precambrian biotite-gneisses in the Lobopakeya Hills, Loperot.

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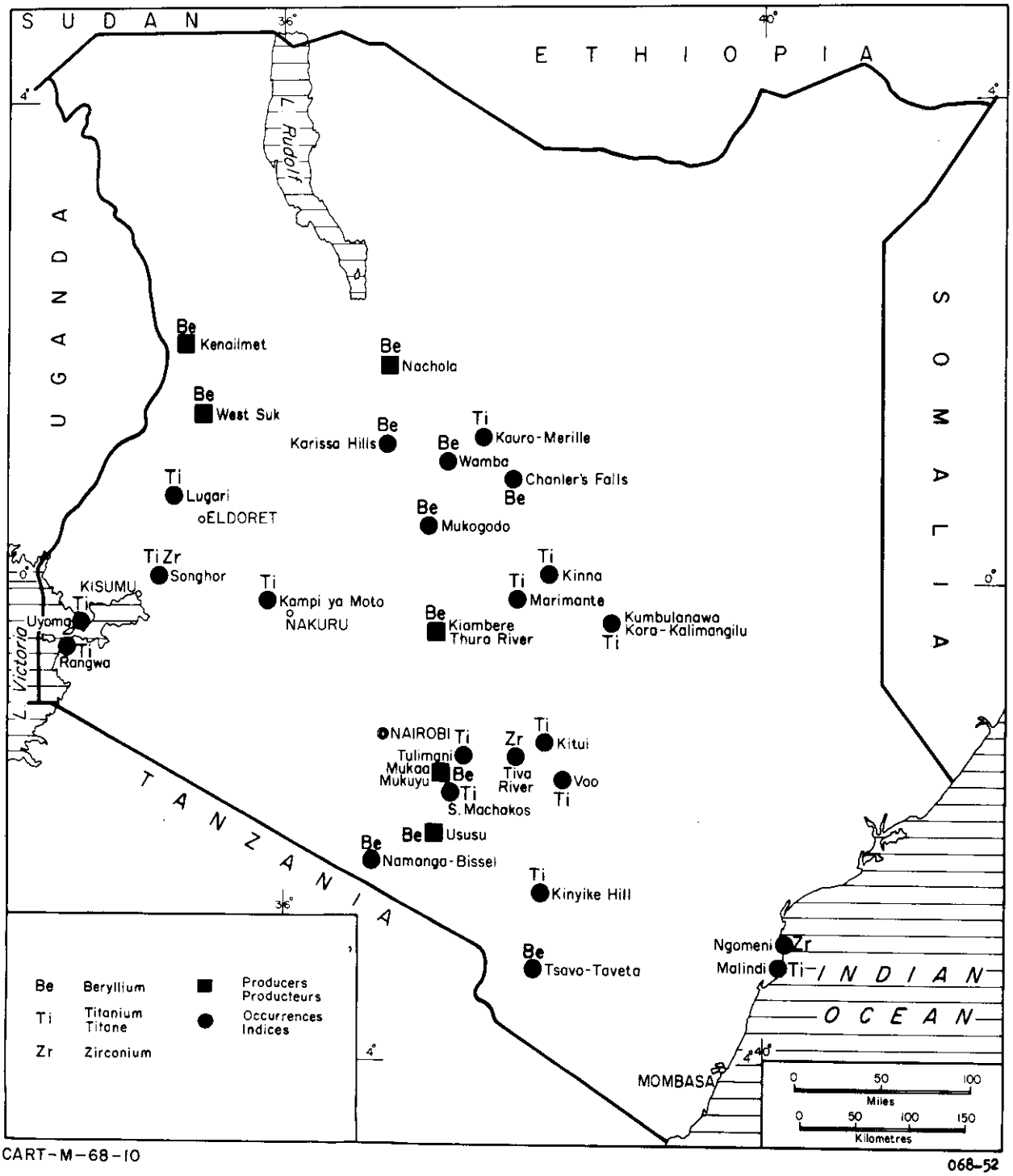
OCCURRENCES OF BERYLLIUM, TITANIUM AND ZIRCONIUM MINERALS IN KENYA
GISEMENTS DE MINERAIS DE BERYLLIUM, TITANE ET ZIRCONIUM AU KENYA



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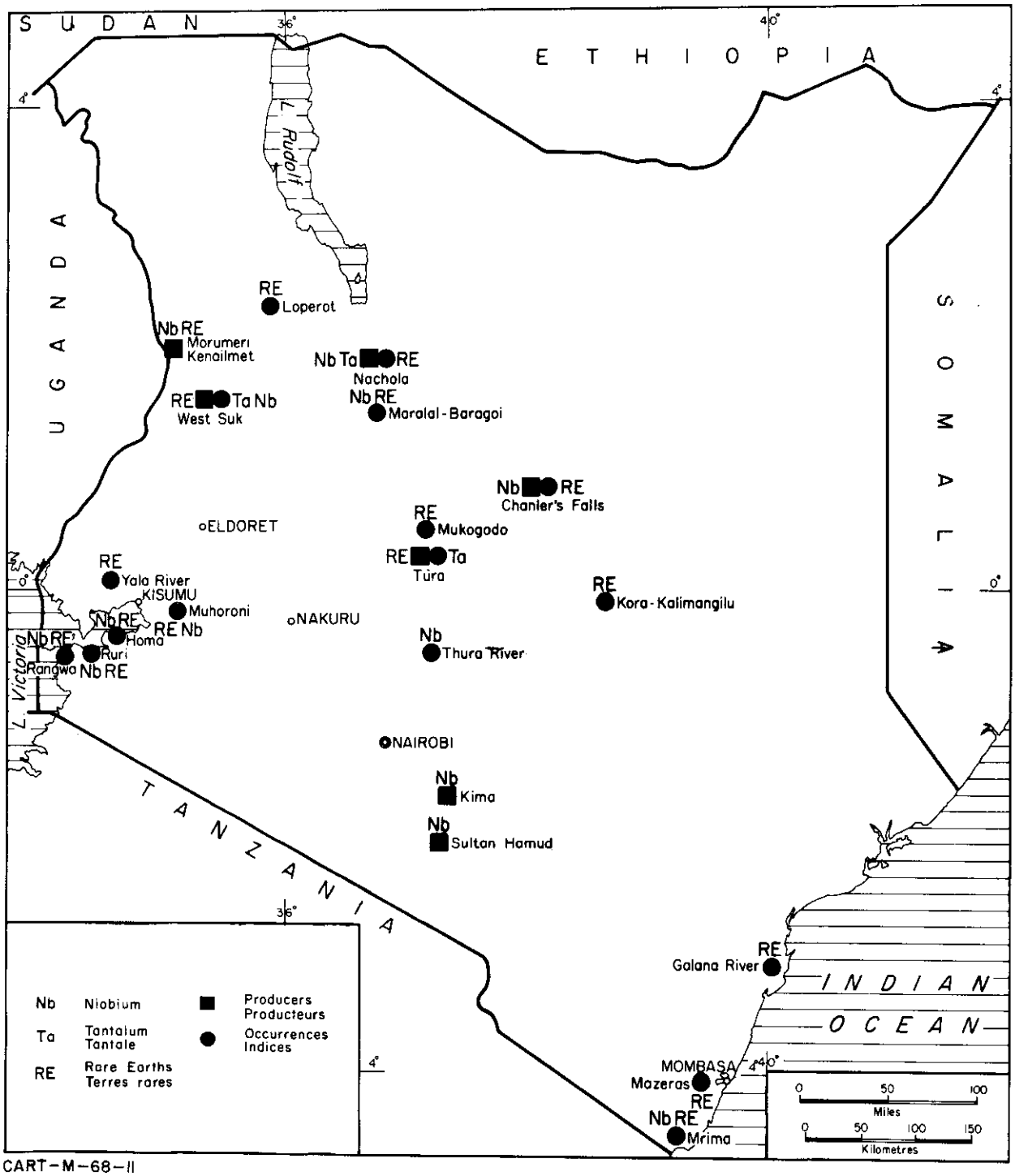
OCCURRENCES OF NIOBIUM, TANTALUM AND RARE EARTHS IN KENYA
GISEMENTS DE NIOBIUM, TANTALE ET TERRES RARES AU KENYA



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