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THE "RARE MINERALS" OF THE DEMOCRATIC REPUBLIC OF THE CONGO

(submitted by the Government of the Democratic Republic of the Congo)

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Summary

The present note was prepared by the Service Géologuque et le Service des Mines of the Democratic Republic of the Congo, based on archives and statistics of these two organisations. The resources of beryllium, rare earths (monazite, euxenite), niobium, tantalum (columbo-tantalite, pyrochlore), zirconium, titanium and germanium are successively reviewed. A map locates approximately the deposits mentioned.

The columbo-tantalites are largely exploited. Germanium is recovered as a by-product in the copper-zinc mine of Kipushi. Enormous possibilities exist for niobium, in the form of pyrochlore. The irregularity of monazite production seems to have originated in marketing difficulties.

The prospecting and extraction of beryl might be resumed if the price of that ore were to increase slightly. Owing to distance and high processing costs, the exploitation of the vast reserves of ilmenite and zircon is at present out of the question.

1. Beryllium Ore

Beryl is the only ore of beryllium known in the Congo; it is encountered in Kivu Province and in the NE of Orientale Province where it is associated with pegmatites.

1.1 An Example of Deposits: Kobokobo Pegmatite

(South Kivu, Minière des Grands Lacs Concession). This is a mass 120 m long by 80 m wide situated between intrusive amphibolite and metamorphic schists. The western part of the deposit has large crystals, the eastern part finer crystals. Crystallisation seems to have occurred in the following order:

a) graphic pegmatite

b) thick pegmatite merging into the preceding in which the order of crystallisation seems to be the following: garnet-quartz with black tourmaline, glassy quartz accompanied by beryl, columbite, apatite-microcline-lithia mica-muscovite-tourmaline.

c) crystallisation of bands or pockets of muscovite and bands or compacted masses of microcline (chiefly in the western zone).

In the western zone beryl occurs in a mass of several cubic metres, to the east it is in small crystals. Among the stages of crystallisation there are recognized the potassic, lithic and albitic. Albitisation is quite visible in the eastern part of the deposit. The existence of pockets of uraniferous minerals in the pegmatite should be noted.

The absolute age of the mineralisations is probably as follows:

Graphic pegmatite: 1,115 million years
Microcline and muscovite: ± 900 million years
Uraninite: ± 845 million years.

The Kobokobo pegmatite probably is related to different phases of the magmatic activity linked to a single granite occurrence.

1.2 Prospecting of Beryllium

The Compagnie Minière des Grands Lacs has developed a procedure for geochmeical prospecting for beryllium; three methods are used:

- Reconnaissance prospecting in surface alluvium (sampling every 200 m).
- Prospecting in the pegmatites themselves (sampling by channelling).
- Prospecting of the soils.

In the first two cases the analysis is made with quinalizarine, in the third case with "beryllon". Spectral analysis tests have been made and give good results on the fine sand of alluvium.

1.3 Exploitation: Production

Beryl is no longer exploited at the present time. Kobokobo, where extraction was by open-pit mining, ceased its activity in 1965 because of unprofitability and lack of reserves. Orientale Province has not produced beryl since 1958.

From 1954 to 1965 Kivu produced 5,462 tons of beryl grading about 11.5 per cent BeO.

From 1956 to 1958, Orientale Province supplied 280 tons.

1.4 Outlook

Exploitation of beryl might be resumed if its price rose a little. Several low-grade, large tonnage deposits may well exist in the northern part of Kivu and the southeast of Orientale Province.

2. Monazite (Thorium - Cerium)

2.1 Principal Deposits or Indications

Kivu Province: Quite numerous low-grade alluvial deposits of monazite exist. Monazite appears as a by-product in the exploitation of cassiterite and wolfram. Mashabuta (North Kivu, Kivu-Mines company) irregularly produces monazite with 63 per cent rare earths, among them thorium and cerium. The monazite also contains lanthanum and didymium. Indications are known in the west of Kivu (ex Maniema), where the central part of certain granite massifs is probably mineralised with

monazite and xenotime, and in South Kivu, where anatectic granites are probably the source of alluvial monazite, ilmenite, rutile and corundum in North Kivu.

Kasai Province: In the charnocktitic massif of Luputa in South Kasai, monazite with grades of 1 to 10 kg/m^3 is encountered. At Kanda Kanda the mineralisation is leaner and includes 7.74 per cent ThO_2 and 0.23 per cent Y_3O_8.

Katanga Province: Monazite exists at Shinkolobwe, linked to the uraniferous deposit but poor in thorium.

2.2 Production

Seventy-one tons were extracted from 1951 to 1965, originating chiefly from Mashabuto.

1951	= 37 t
1952	= 44 t
1953	= 11 t
1954	= 4 t
1955	= 4 t
1956	= 1 t
1957 to 1964	= nil
1965	= 20 t
1966	= nil
Total	71 tons

2.3 Outlook

The irregularity of production seems to have originated in market difficulties. It is possible to envisage prospecting in South Kivu and the recovery of monazite from certain tailings.

3. Euxenites

An indication was noted in the SE of Orientale Province (Liha). More exactly, the occurrence is a tantalo-euxenite, a tantalate of yttrium with rare earths, related to pegmatites.

Others may perhaps exist also in North Katanga.

4. Niobium - Tantalum

4.1 The Columbo-tantalites

4.1.1 Principal Deposits

This ore is very widely exploited in the Congo, with quite good grades on the average. It is almost always recovered from stanniferous mixtures. This is the case in Kivu, where some thirty deposits are known. Output at the present time comes chiefly from the Kivu-Mine companies (Kigulube, Binakwa-Obaye-Mumba) and Phibraki (South Kigulube).

4.1.2 Types of Deposits

The columbo-tantalite deposits are alluvial, eluvial or primary.

In the primary deposits columbo-tantalite is found either in pegmatite veins or quartz veins, generally in the heart of granite massifs or very near their borders in surrounding country rock.

4.1.3 Prospecting

Prospecting for columbo-tantalite is done either by the normal method of alluvial prospecting or by geochemistry. The Compagnie Minière des Grands Lacs has developed a geochemical method including three types of investigation:

a) Sampling of eluvium along roads and tracks

b) Sampling of surface alluvium along streams

c) Sampling of earth on hills

Analysis is made by chromatography, X-rays, or spectrography.

4.1.4 Mining

Kivu columbo-tantalite is mined with cassiterite and exported in the form of mixed concentrates to Europe where the separation is made.

In Katanga extraction is from smelter slags.

4.1.5 Production

Production 1966: Kivu, 14,778 kg; Katanga, 81,600 kg.

Earlier production

From 1934 to the end of 1965, 6,654 tons of columbo-tantalite were extracted, with 55 per cent X_2O_5.

1934/37	271 t
1938	151
1939	164
1940	268
1941	208
1942	127
1943	151
1944	294
1945	198
1946	168
1947	185
1948	190
1949	196
1950	227
1951	180
1952	160
1953	367
1954	458
1955	622
1956	518
1957	298
1958	288
1959	260

1960	236
1961	67
1962	146
1963	117
1964	47
1965	92

4.1.6 Remarks

Like the other ore of tantalum, originating from pegmatites, it should be noted that microlite is quite frequent in Kivu. Prospecting is done by the same methods as for columbo-tantalite.

4.2 Pyrochlore

Two large deposits are known in the Congo: Lueshe and Bingo, both in North Kivu. Prospecting has been done by the Société Minière de Lueshe (SOMINLU), a Congolese corporation constituted 16 June 1960 by association of the companies SOMIKUBI and Union Carbide. The exploitation permit for Lueshe has been granted, but the application for Bingo is still in suspense. SOMINLU wants to install a pilot plant for pre-concentration of pyrochlore at Bingo, the carbonatites being richer and less complex there than at Lueshe.

4.2.1 Type of Deposit

Bingo: The deposit is formed of altered banks of syenite and carbonatite in the heart of a syenitic massif itself encircled by granites. The alteration of the country rock extends more than 100 m in depth. The syenites are transformed into bright clay, while the carbonatites yield banded clays ranging from yellow to dark brown according to the concentration of iron and manganese oxides.

Pyrochlore forms the most important ore of niobium, sometimes accompanied by columbite. It consists of small octahedral cyrstals of low density: 3.3 and containing:

- 60 to 66 per cent of niobium pentoxide with barium and phosphorus
- 1.25 per cent thorium
- Less than 1 per cent of tantalum pentoxide.

Kreshe: This is a carbonatite massif more than 2.5 km in diameter whose important minerals are prochlore, apatite, zircon and iron sulphides. The deposit is intrusive in schists and quartzites; its heart is formed by a large core of syenite containing cancrinite and calcite.

The carbonatites are of the sovite or rauhaugite type. Through impoverishment in calcite and enrichment in iron oxide, sovite gives "ferruginous zones" rich in apatite and pyrochlore.

4.2.2 Prospecting, Grades, Reserves - Treatment Tests

Bingo: The first prospecting was done by scintillometer in 1958. It was followed by a geochemical study of alluvium and eluvium. Chromatographic analyses having shown concentrations of niobium, prospecting was continued systematically by surface samples on a rectangular grid of 50 x 100 m which showed the existence of a deposit: 1200 ha with grades higher than 3 kg/t and 200 ha with grades higher than 2 kg/t; on 68.5 ha the grades rose to 10 kg/t. In this rich zone investigations were extended by trenches, galleries and drilling (350 m of galleries - 1160 m of drilling).

Sampling was done by continuous channels of 1.5 m; analyses were done mostly in the U.S.A. by fluorescence.

The work permitted certain reserves to be estimated at 2,294,000 tons of ore grading 3.6 per cent Nb_2O_5 to a depth of 25 meters under the outcrop. To this must be added 4,812,000 tons of probable reserves grading 2.3 per cent Nb_2O_5.

A first treatment flow-sheet was prepared in the U.S.A. It would be possible thanks to the installation of a pilot plant to obtain pre-concentrates on the site grading 40-45 per cent Nb_2O_5 (Coefficient of recovery: 40 per cent) containing in addition 6.5 per cent P_2O_5 and 7 per cent zircon which it would be desirable to eliminate. Thorium oxides could be recovered from slags resulting from later manufacture of special steels.

Lueshe: Prospecting work began in 1967, and the deposit has been studied from 1958 to 1963. Sampling was done in 770 pits spaced 50 m apart on equidistant lines, first of 100 m, then of 50 m, in 16 drill-holes. (700 m in all), 2,600 m of trenches, 387 m of tunnels, The mineralisation goes more than 40 m in depth. Neighbouring alluvium has been studied.

- average grade in pyrochlore, 66.6 per cent Nb_2O_5
  carbonatites: 7.35 kg/t
- ferruginous zone: 18.1 kg/t
  contact zone: 12.6 kg/t
  alluvium: 1.5 kg/t
- reserves in primary deposit:
  34,496,000 tons of ore proved at 15.4 kg of pyrochlore per ton, 119,496,000 tons probable at 9.7 kg.
- reserves in alluvium:
  500,000 m^3 (gravel + overburden) at 1.55 kg/m^3

Altogether, 1,668,250 tons of proved and probable reserves of pyrochlore.

The reserves uncovered are sufficient for undertaking exploitation which is dependent on the opening of a pilot plant at Bingo. The treatment flow-sheet is not yet ready.

4.2.3 Outlook

The Bingo pilot plant would treat initially 40 t of ore a day, which would enable the flow sheet to be completed. Capacity could be increased thereafter, reserves being more than sufficient. However, there is an economic problem. American imports of niobium come from Canada, Nigeria, and especially from Brazil, which has become a large producer. The sudden appearance of a surplus of niobium on the world market can only precipitate a fall in prices. There would then remain only enterprises whose prices are competitive.

5. Zironcium

The exploitation of the pyrochlore of Lueshe and Bingo will yield zircon as a by-product, but its recovery is likely to be difficult. It would possibly be preferable to depend on alluvium.

It should be noted that the alluvium of a certain number of Kivu streams is rich in zircon. Although concessions for zircon have been requested, no exploitation exists. The problem is economic; high costs of transport do not justify mining. Besides, it seems that the zircon is rather poor in rare earths.

6. Titanium

Ilmenite (titanium oxide) is found in all heavy concentrates originating from granite rocks, and particularly in the gold-bearing concentrates of Kilo-Mote (Orientale Province) and the tin concentrates of North and South Kivu. In the diamond mines of Kasai, at the two sorting central plants of Mbuji-Mayi (Bakwanga) and Tshikapa, large quantities of heavy concentrates containing an appreciable proportion of ilmenite are returned to the stream.

Kasai's reserves are the largest. In the east of the Democratic Republic of the Congo several hundred thousand tons could be rapidly uncovered.

At present this ore is of too little value to offer any economic interest whatever.

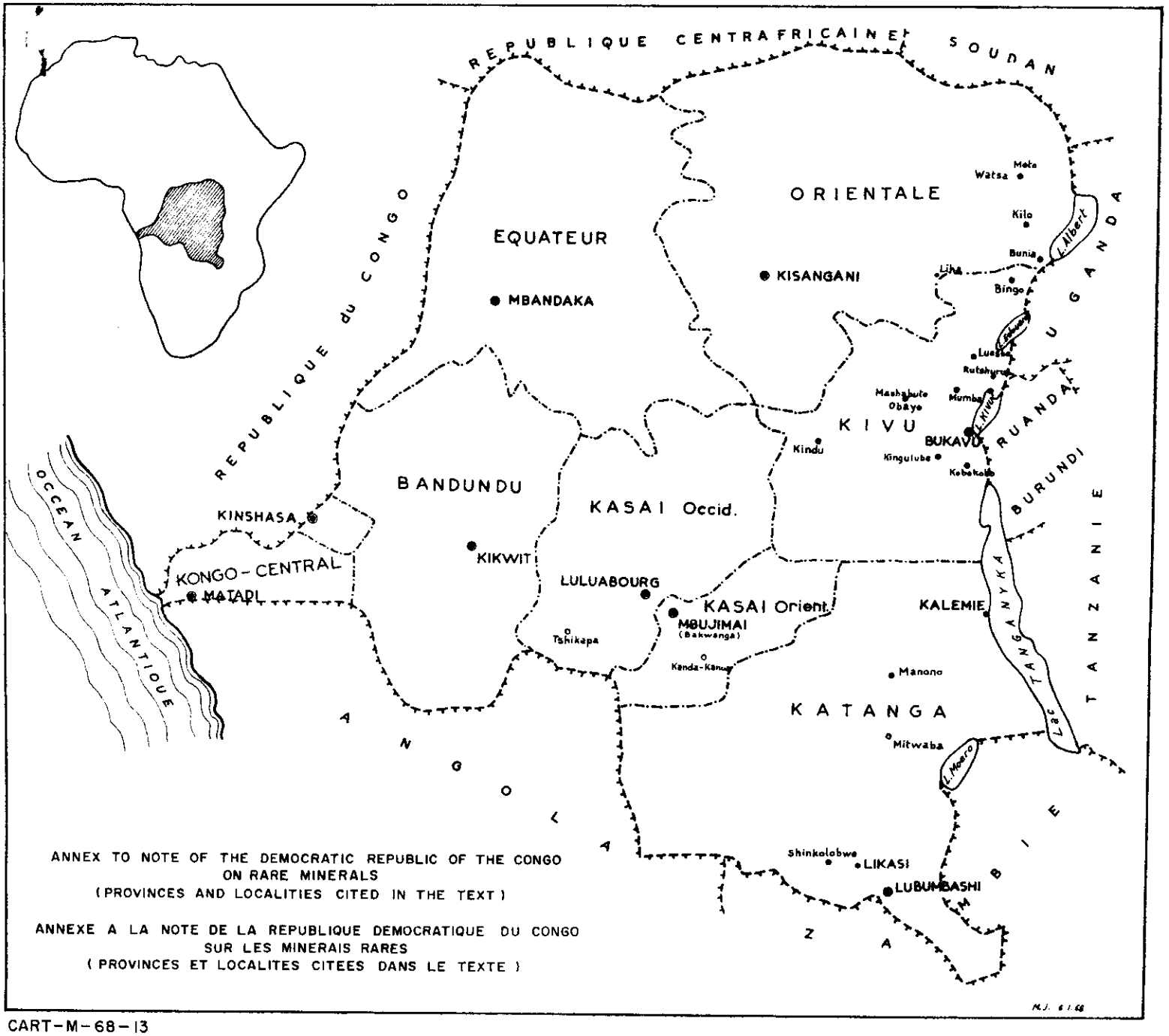
7. Germanium

Since 1954 Gécomin has been recovering germanium from the complex copper-zinc ores of the Kipushi mine, in the form of concentrates which are refined in Europe.

Production in Kg

Year	Germanium Oxide	Ge Metal
1954	1,095	645
1955	2,211	593
1956	4,531	-
1957	13,064	-
1958	23,425	-
1959	-	13,643
1960	-	25,101
1961	-	13,549
1962	-	8,005
1963	-	7,283
1964	-	18,200
1965	-	14,638

Total oxide: 44,326 containing 30,000 kg Ge metal
Total Ge metal: 91,658 kg + 30,000 kg = 121,658 kg



ANNEX TO NOTE OF THE DEMOCRATIC REPUBLIC OF THE CONGO
ON RARE MINERALS
(PROVINCES AND LOCALITIES CITED IN THE TEXT)

ANNEXE A LA NOTE DE LA REPUBLIQUE DEMOCRATIQUE DU CONGO
SUR LES MINERAIS RARES
(PROVINCES ET LOCALITES CITEES DANS LE TEXTE)

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