

Kimberlites and lamproites in Zambia

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Introduction

Zambia lies between the Archean Kaapvaal-Zimbabwe Craton to the South and the Archean Congo-Kasai Craton to the Northwest (Figure 1). The most westerly part of Northwestern Zambia is underlain by the Congo-Kasai Craton and the Northeastern part of Zambia is underlain by the Bangweulu Block which has an inferred Archean basement. Much of Zambia, however, is underlain by Proterozoic and early Palaeozoic fold belts: the Irumide Fold Belt (ca.1050–950 Ma), the Lufilian Arc (ca.850–450 Ma), and the Mozambique Belt (ca.460 Ma). Considerable areas are covered by continental sediments and basalts of the Karoo System and younger Kalahari sediments and sands.

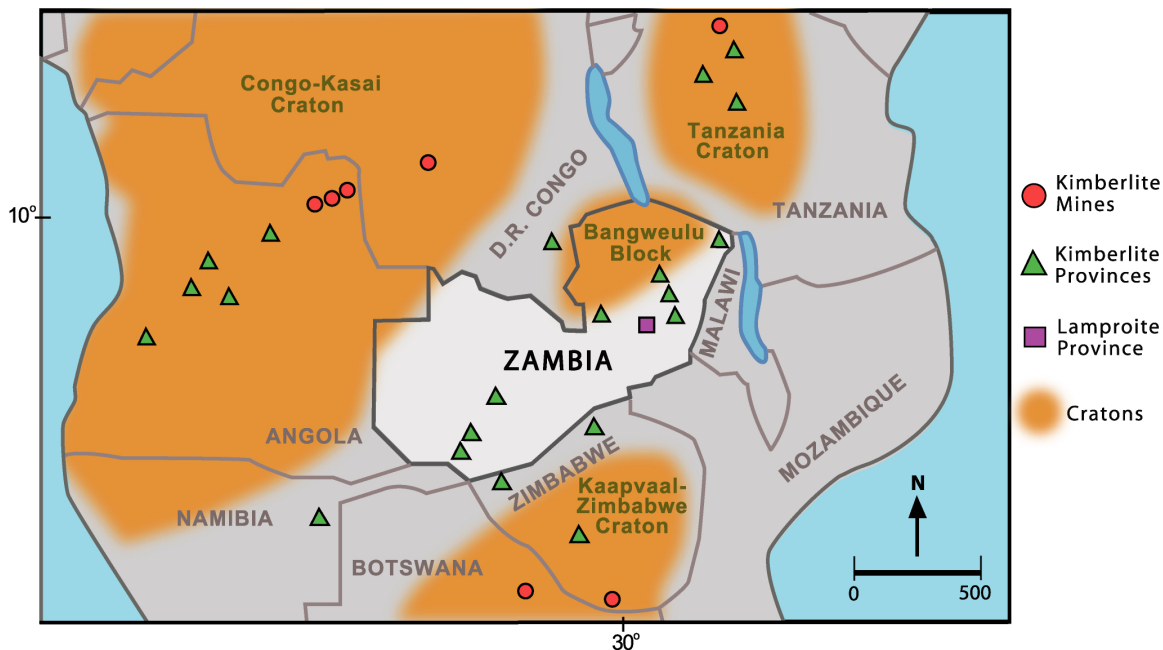


Figure 1: Cratonic Setting of Zambia

Kimberlite and Lamproite Provinces

Systematic diamond exploration was undertaken over most of the country by De Beers between the mid-1950s and the mid-1980s. Several kimberlite and one lamproite province have been discovered together with numerous occurrences of small diamonds and indicator minerals. Intrusions occur in and on the flanks of the Luangwa Rift Valley, a downfaulted NE trending graben. Four groups have been defined along a 300 km zone. At Isoka, (Figure 2) in the northern end of the valley, sixteen kimberlites, up to 23 ha, show two alignments: NE and NW. In the North Luangwa National Park, five kimberlites and five dykes trend to the NW. Further south, at Panela on the eastern side of the valley, eight kimberlites are aligned NNW. These 3 provinces were detected by routine reconnaissance stream and soil sampling. Small, alluvial diamonds were found during exploration work and bulk samples of kimberlite produced a number of small diamonds.

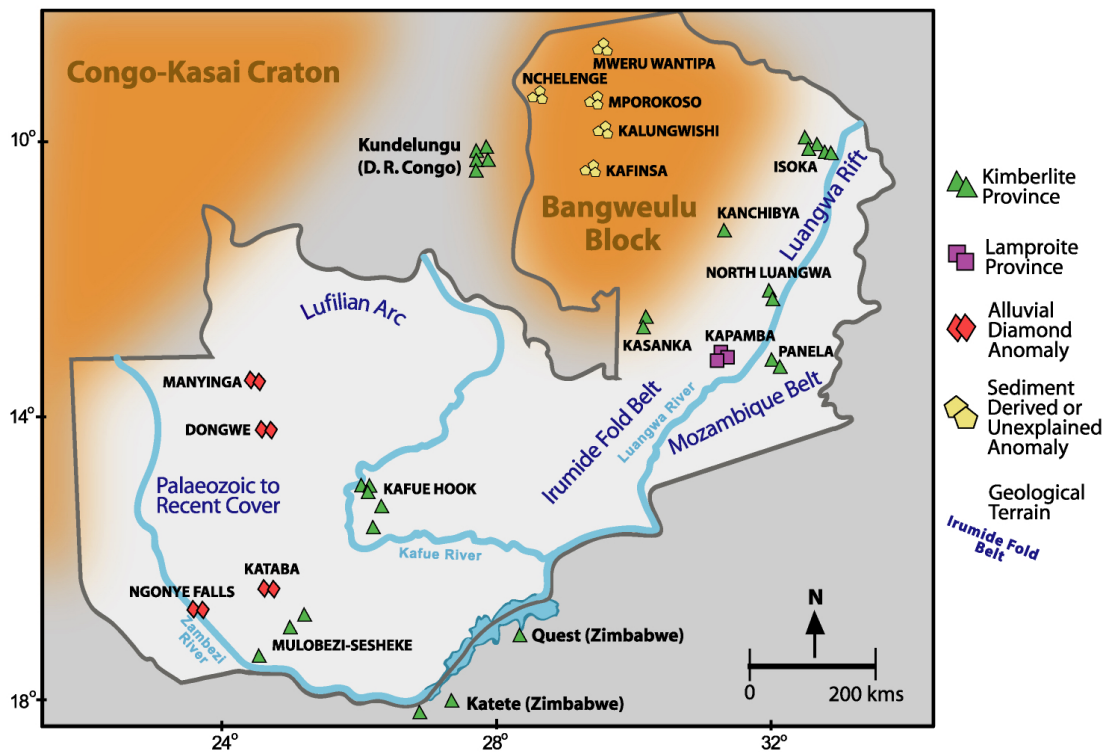


Figure 2: Provinces, Anomalies & Geological Terrains of Zambia

In the other province in the Luangwa Rift, at Kapamba, there are fourteen bodies or groups of bodies and an associated suite of dykes trending NW to SE over a distance of 25 km. Initial discovery was by photogeological mapping. These intrusions have been classified as lamproites (Scott-Smith et al 1989). The highest concentration of diamonds in Zambia was found in surface gravels over the largest body, the 45 ha P2. However subsequent testing of large volumes of material from this and many of the other bodies, discounted the possibility of economic exploitation. All of the Luangwa Rift provinces intrude Upper Karoo sediments and by inference are younger than ca.250 Ma. At Kapamba, U-Pb perovskite analyses yielded an age of 178 Ma for the emplacement of the lamproites (Tappe et al. 2023). Recent geophysical studies across the Luangwa Rift suggest the presence of relatively cold cratonic lithosphere ($\leq 42 \text{ mW/m}^2$) down to at least 180 km at the time of lamproite volcanism (Ngwenya and Tappe, 2021).

Further west, on the very edge of the Bangweulu Block, two further kimberlite provinces were detected by routine sampling. At Kanchibya, one pipe of 4.4 ha was discovered. A number of diamonds were recovered in associated drainages and a few were recovered from bulk testing of the body. At Kasanka, ten kimberlites are aligned in a NNE direction. The pipes are small, up to 3.5 ha. No diamonds were recovered from a thorough testing programme. The bodies in these two provinces cut both Muva and Katanga age sediments and are therefore post ca.1800 Ma in age but a minimum intrusion age has not been determined.

There are two kimberlite provinces in the Southwestern part of Zambia. In the Kafue National Park, the Kafue Hook province comprises fourteen kimberlite pipes, or groups of pipes and dykes, found by reconnaissance sampling. The kimberlites fall into a northern group where some of the pipes contain microscopic diamonds and a southern completely barren group. The kimberlites have been intruded into the Hook granite massif, which has been dated at ca.560 Ma, and follow a NW-SE trending joint or fracture system in the granite. The kimberlites contain inclusions of Karoo basalt signifying a post Karoo age of intrusion. No minimum age has been determined. The Mulobezi-Sesheke province lies 200 kms to the SW. Routine loam sampling led to the discovery of seven very small kimberlite pipes and an inferred dyke system beneath between 5 and 60 metres of Kalahari deposits. The pipes are aligned NE-SW in a zone parallel to local structures. Although a few microscopic alluvial diamonds were recovered all of the kimberlites proved barren after extensive sampling. The bodies intrude Karoo basalt which implies a similar maximum age to the kimberlites of the Kafue Hook province.

Unexplained Anomalous Areas

A number of unexplained, or sediment derived, kimberlitic mineral anomalies were identified on the inferred Archaean (De Waele et al. 2006) Bangweulu Block in Northeastern Zambia. Early work here produced the largest single diamond found in Zambia (a stone of 1.362 carats) from a stream draining from the D.R.Congo near Lake Tanganyika. This result could not be repeated after several attempts. Extensive sampling followed in five areas (Figure 2). At Mweru Wantipa, Kafinsa, and Kalungwishi, abundant ilmenite occurs in the soils overlying Mporokoso Goup sediments (1.8-1.1 Ga) and was also recovered from samples of crushed sandstone. A few small diamonds were found but kimberlitic garnet was far less abundant than ilmenite. In the Mporokoso area, also underlain by Mporokoso Goup sediments, a wide scatter of ilmenite was found plus, in places, garnets and two small diamonds. At Nchelenge, ilmenites were recovered from samples of younger, Katanga age sandstones. Thus in these five areas we are led to infer the existence of Precambrian kimberlites, any remnants of which would now presumably be buried beneath a considerable thickness of sediments. In addition some younger, very small, post Mporokoso Goup pipes and dykes may be contributing to the anomalies.

Several areas with anomalous concentrations of small alluvial diamonds were discovered in the Western part of the country. In Northwestern Zambia, a bulk alluvial sample in the Dongwe River (Figure 2) produced three diamonds which collectively weighed almost 1.5 carats. An intensive drainage sampling programme followed and small diamonds were recovered along the whole length of the main stream and along many of the major tributaries. However the average stone size and the grades of the individual sites here and in the Manyinga area were well below potentially economic levels. The scarcity of indicator minerals in relation to diamonds, the surface characteristics of the indicators and the small stone sizes are indicative of a long detrital history and there is no indication of the direction of the source. An intensive ground follow up programme failed to find any kimberlites but a drilling programme located garnet bearing Lower Kalahari fluvial beds, confirming a complex history in this part of the country. In Southwestern Zambia, in the Zambezi river and its tributaries near Ngonye Falls and in adjacent areas (Figure 2) relatively large numbers of diamonds and indicators have been recovered from bulk alluvial samples. The average stone size is small and the size frequencies show a high degree of sorting which could indicate transport over considerable distances. However because of the presence of indicator minerals here and in Kataba, extensive loam sampling was carried out but did not produce any coherent anomalies. Evidence suggests that derivation of the kimberlitic grains is from a secondary, sedimentary host rock in the basal Kalahari sequence.

Since De Beers withdrew from Zambia in the mid 1980s a number of other companies have carried out diamond exploration, essentially in the west of the country. To date no economic discoveries have been made.

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