

Petrogeochemistry of the Lemera Stanniferous Granite Pegmatites and Genesis of the Lemera Tin Deposit, Kibara Belt, DRC

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The eastern part of Democratic Republic of Congo (DRC) is known worldwide for its natural resources, especially columbo-tantalite, cassiterite, beryl, wolfram, and gold. Unfortunately, the petrogenesis of these ore deposits, their classifications, and the entire metallogeny are still not yet well understood due to the lack of recent research and the political instability in the region.

This study has been carried out with the objective of understanding the petrology of the Lemera granite pegmatites and the genesis of the tin ore deposit mined artisanally as cassiterite hosted by quartz veins. The Lemera granite pegmatites are in the LCT (Lithium-Cesium-Tantalum) petrogenetic family of pegmatites, and in spodumene subtype of rare element classification with an enrichment in Rb, Cs, Ba, Nb, Ta, Zr, Hf, and Sn. These elements were concentrated in the late forming major pegmatite minerals, such as micas and K-feldspar, as well as in accessory minerals, such as rutile and ilmenite. Whole rock bulk compositions displayed an enrichment in Rb (32–223 ppm), Cs (1.2–1.9 ppm), Ba (9–411 ppm), Nb (1–8 ppm), Ta (0.2–0.5 ppm), Sn (1–138 ppm), Ti (197.8–1,492 ppm), Zr (7–201 ppm), and Hf (0.5–5.5 ppm), and in the ratios K/Rb (150–272), K/Cs (1,121–23,257), K/Ba (59.9–276), Nb/Ta (3.3–28.8), and Zr/Hf (32–40), reflecting the fertility and high fractionation features of the granite pegmatites. The less evolved pegmatites are richer in Rb, Cs, and Ba than the most evolved and highly fractionated pegmatites, which are richer in Sn-, Nb-, and Ta-bearing cassiterite. The rare earth elements of the Lemera granite pegmatites displayed low abundances with negative Eu anomalies, no Eu anomalies, and positive Eu anomalies with a subhorizontal pattern showing a depletion in the heavy rare earth elements. The granite pegmatites are mildly to strongly peraluminous S-types with an A/CNK ranging between 1.0 and 1.2.

The Lemera granite pegmatites were derived from the syn- to late-parent Kibaran G4 granites, and fractional crystallization is the main process that fostered the two zonation sequences observed in the region. The first zonation is Cs-Rb-Ba enrichment with minor Nb-Ta enrichment along the Kakwende River and the second zonation is a Sn-Nb-Ta enrichment throughout the Kigunga district. The pegmatites appeared to be less fractionated compared to the regionally more well studied Gatumba highly fractionated pegmatites in central Africa, but also they are derived from a different magma source: the Lemera pegmatites were derived from a chlorine-rich magma source whereas the Gatumba pegmatite was derived from a fluorine-rich magma source. The Lemera tin deposit is linked to two main genetic processes: firstly, syn-magmatic cassiterite formed during the crystallization of the Lemera granite pegmatite and, subsequently, later hypogene cassiterite formed in quartz veins from a hydrothermal-magmatic fluid in metasedimentary and altered igneous rocks.

