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New Geochronological, Isotopic and Fluid Inclusion Study Constraints on the Formation of the World-class Bikita LCT Pegmatite Deposit

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The increasing demand for metals such as Li and Ta used by high technology applications (e.g., renewable energies, electronics) led to increasing exploration activities on lithium-cesium-tantalum (LCT) pegmatite deposits worldwide. LCT pegmatites are interpreted to be linked to granitic systems and represent the geochemically most enriched, highest fractionated portions of initially granitic melts and thus can host economic quantities of various metals (i.e., Li, Cs, Ta, Nb, Sn, Rb, Be). However, many economic LCT pegmatite deposits (e.g., Tanco/Canada, Greenbushes, Wodgina/Western Australia) are situated in greenstone belt successions on Archean Cratons making those prospective exploration areas [1].

The Bikita LCT pegmatite deposit located in the Zimbabwe Craton represents a typical example of Archean LCT pegmatites. The pegmatites are hosted by metavolcanic rocks of the Masvingo greenstone belt [2] and represent the highest evolved portions of a 20 km long NE-SW striking pegmatite field. The Bikita pegmatite is currently mined for Li (petalite) and Cs (pollucite). Age dating of different minerals range from 2630 Ma to 2200 Ma. Tantalite and columbite yield U/Pb ages (LA-ICP-MS) between 2630 Ma to 2615 Ma, which is interpreted as major period of crystallisation. In contrast, $^{40}Ar/^{39}Ar$ ages of micas range from 2300 Ma to 2200 Ma, which indicates that the Bikita LCT pegmatite deposit was affected by late stage thermal and/or mineralogical events that took place after the initial emplacement of the pegmatite.

Fluid inclusions were studied in quartz, pollucite, petalite and apatite. Primary and pseudosecondary inclusions hosted in quartz and pollucite are aqueous two-phase H_2O-NaCl and H_2O-CO_2-CH_4-NaCl inclusions. The total homogenisation temperatures of quartz-hosted, CO_2-bearing inclusions range from 280°C to 355°C (L-V) and have salinities between 3.9 and 14.2 wt.% $NaCl_{equiv}$. Pollucite-hosted inclusions containing CO_2 show homogenisation temperatures between 230°C and 285°C (L) and ranges in salinity ranges between 2.9 and 13 wt.% $NaCl_{equiv}$. Bulk stable carbon isotope analyses of fluid inclusion CO_2 show $\delta^{13}C$ ratios between -4.5 and -3.2 ‰ either indicating degassing of the mantle or devolatilisation of greenstone belt rocks [3].

Both, the isotopic mineral ages as well as combined fluid inclusion and C-isotopic investigations revealed that the formation of the Bikita LCT pegmatite deposits was not related to a single magmatic event. Mica ages that considerably postdate the crystallisation of tantalite and columbite suggest late

hydrothermal (?) overprint. In addition, carbon isotopes admit the incorporation of both, mantle or crustal components into the evolution of the Bikita LCT pegmatite deposit.

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