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Contrasting paragenetic evolution of lithium pegmatites: evidence from the Kamativi and Arcadia Pegmatites, Zimbabwe

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The global move to electric vehicles is leading to greatly increased demand for lithium, and particular interest in its main hard-rock source, lithium pegmatites. Zimbabwe hosts several economically important lithium pegmatites and is currently the only country in Africa with an active lithium mine. The mineralogies and parageneses observed in these pegmatites are often complex and highly-variable; however, understanding these complexities is important for mineral processing and geometallurgy. Lithium pegmatites in Zimbabwe can be broadly separated by age and economic endowment. In eastern Zimbabwe, pegmatites are Archaean and typically lithium-dominated, for example Arcadia (where the main lithium mineral is petalite), Bikita (petalite-spodumene) and Zulu (spodumene-lepidolite). In contrast, those in the west of the country are tin-dominated and formed during the Palaeoproterozoic (e.g. Kamativi). As such, we are conducting a combined analytical approach comprising petrography, mineral chemistry, geochronology and isotope geochemistry, to better understand the evolution of these complex pegmatites.

The Palaeoproterozoic Kamativi Pegmatite in western Zimbabwe has a complex paragenesis comprising four key stages: (1) crystallisation of coarse-grained quartz, alkali feldspar and spodumene; (2) widespread albitisation, resulting in the formation of an albite + quartz assemblage containing cassiterite and columbite group minerals; (3) irregular development of a quartz-muscovite greisen; and (4) fluid-induced alteration of earlier phases resulting in the formation of cookeite, clay minerals and zeolites. Fluid-driven processes (stages 2–4) appear to have been key for the development of Kamativi Sn-Ta mineralisation, but also resulted in the destruction of early formed lithium-minerals[1].

Here we present new constraints for the formation age of the Arcadia Pegmatite in eastern Zimbabwe. Arcadia has a very different paragenesis to Kamativi, with a magmatic stage dominated by petalite, quartz and feldspar, and little evidence of either albitisation or greisenisation. However, the final lower temperature stage is intense, although sporadically distributed, and has resulted in the formation of eucryptite, zeolites (e.g. bikitaite) and clay minerals at the expense of petalite.

[1] Shaw, Goodenough & Deady et al. (2022), *Can Min* 60, 957-987.