Multiple Mineralisation Events Demonstrated in Complex Li-Cs-Ta Pegmatites at Buchanan Creek, Queensland

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Characterisation of pegmatite dykes from Buchanan Creek, located in the Georgetown Inlier, Northeast Queensland, has produced a detailed story of polyphase deformation within the sampled Li-Cs-Ta (LCT) pegmatite dykes. The primary lithium ore mineral spodumene has recently been identified in this system, in addition to other Li-bearing phases, including amblygonite, lepidolite, and rare elbaite. Caesium and rubidium mineralisation is strongly associated with micas, including the first reported instance of sokolovaite (Cs-polylithionite) in Australia. A multidisciplinary approach encompassing regional mapping, bulk rock geochemical sampling, visual and hyperspectral logging of drill core, and microanalysis (micro-XRF, LIBS, TIMA, Raman, LA-ICPMS) have been applied to characterising the Buchanan Creek LCT pegmatite system. The ca. 1550 Ma Buchanan Creek pegmatites are hosted within tightly-folded, lower greenschist facies Paleoproterozoic dolerite and metasedimentary rocks. Complex pegmatites of the Buchanan Creek area are lenticular in shape, and are typically oriented northwest, following the strong regional S1 foliation. Dykes display strong internal zonation, commonly having a quartz core, with a lepidolite dominated (± quartz, albite, amblygonite) intermediate zone, and an albite-muscovite dominated wall zone. Where present, spodumene and amblygonite are most abundant in the core to intermediate zones of the studied dykes. Cassiterite, tantalite, and microlite are late in the mineralisation sequence, and are commonly associated with albite, and late crosscutting aplitic dykes. Spodumene appears to have formed early in the paragenetic sequence, and subsequently has been largely replaced by amblygonite. Further deformation and remineralisation of incompatible elements (Li, Cs, Rb) is indicated by common brecciation of amblygonite, infilled by early trilithionite, and later polylithionite. Collectively, these observations demonstrate multiple fluid-flow and deformation events affecting the distribution of critical metals and the mineralogy of this system, providing key insights for the future exploration of this system.