Unusual spodumene pegmatites from the Late Kibaran of southern Natal, South Africa

R.J. Thomas\(^a\), D. Bühmann\(^b\), W.D. Bullen\(^a\), A.J. Scogings\(^c\) and D. De Bruin\(^b\)

\(^a\)Geological Survey, P.O. Box 900, Pietermaritzburg, 3200 South Africa
\(^b\)Geological Survey, P. Bag XI12, Pretoria, 0001 South Africa
\(^c\)507 Roper St., Baileys Muckleneuk, Pretoria, 0181 South Africa

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Abstract

Significant quantities of spodumene have been identified from a number of leucocratic pegmatoid bodies which crop out on The Corner, near Highbury, Port Shepstone District, in the southern part of the ~1 Ga Natal Metamorphic Province. The mineralized rocks form part of a suite of sub-concordant, predominantly aplite sills which intruded high-grade mafic gneisses of the Mucklebraes Formation. The entire package lies within a synformally folded klippen structure. The spodumene-bearing sills, which are up to 15 m thick, were emplaced at several structural levels along the northern limb of the synform. These white, coarse-grained rocks are composed of quartz, albite, microcline and spodumene, with traces of white Li-mica, garnet, graphite and very rare beryl. Pale yellowish-green to pink spodumene, syngyctically intergrown with quartz (SQI), forms irregular to ovoid poikilocrysts up to 40 cm across. This texture is characteristic of spodumene that has replaced primary petalite and the composition of the SQI is comparable with published petalite analyses. This isochemical inversion model is supported by an observed volume change, evidenced by the radial cracks which commonly surround isolated SQI crystals. The \(P-T\) conditions of formation of SQI are consistent with near-isobaric cooling models which have been proposed for this part of the Natal belt. Geochemical analyses show that the Li-pegmatites are highly silicic with variable K/Na ratios and low Fe. Trace-element abundances (including \(\text{H}_2\text{O}\) and F) are low, with the exception of Rb. The largely anhydrous mineral assemblages (coupled with the absence of other mineral phases typically associated with Li-pegmatites), textural relationships and geochemistry suggests that the Highbury Pegmatites crystallized from relatively high-temperature, volatile-poor liquids under conditions of low \(f_{\text{H}_2\text{O}}\) and low \(f_{\text{O}_2}\). Consequently, the Li-pegmatites are considered to be late-stage differentiates of the characteristically anhydrous garnet leucogranites and charnockites of the Margate Suite, with which they share many mineralogical and geochemical similarities. The lithium may have been scavenged from country rock metasediments during anatexis. A simple gravimetric test shows that the spodumene can be efficiently beneficiated to a product with ~7% \(\text{Li}_2\text{O}\). In view of the increasing economic importance of Li-minerals and the easily accessible position of the Highbury Pegmatite, coupled with feldspar and dimension stone as possible by-products, the prospects for future exploitation are considered favourable.

1. Introduction

The pure white, sheet-like aplite and leucopegmatite intrusions of the Highbury area, some 18 km north of Port Shepstone (Natal), form an integral part of the ~1 Ga Natal Metamorphic