Barrow Creek Pegmatites

Andrew Bennett[1,2]

Introduction

Core Lithium Limited's ('Core's') Anningie-Barrow Creek Project is located about 200 km north of Alice Springs, Northern Territory. Exploration leases extend over an area of 2800 km^2 (**Figure 1**) that includes a substantial portion of the Northern Arunta Pegmatite Province, as described by Frater (2005).

The region has a history of small-scale tin and tantalum production, mostly in the period between 1935 and 1973. But unlike other Australian pegmatite fields, there has been little or no previous exploration for lithium. Core's initial findings indicate that fertile source regions, the presence of highly fractionated lithium-caesium-tantalum-type (LCT) pegmatites and surface spodumene together suggest potential for a large-scale lithium opportunity.

[1] Core Lithium Limited, PO Box 7890, Perth WA 6850, Australia
[2] Email: abennett@corelithium.com.au

Geological overview

Core's project area is situated in the north-east Aileron Province of the Arunta region. Palaeoproterozoic sedimentary rocks of the Lander Rock Formation, Bullion Schist (1850–1820 Ma) and lesser amphibolite units have been intruded by extensive granites during the Stafford Event (1810–1790 Ma) and the Strangways Event (1730–1710 Ma) (Scrimgeour, 2013). Georgina Basin sediments overlie Proterozoic basement in the project area, particularly in the south.

Numerous faults that trend west to northwest are interpreted from geophysical data. These faults manifest as quartz blows on the surface that define a semi-continuous network from the Barrow Creek Region through to the Tanami Region, parallel to, and coincident with, the Willowra Gravity Ridge. These fundamental crustal-scale features are interpreted as being associated with a buried Palaeoproterozoic-aged continental suture zone (Goleby

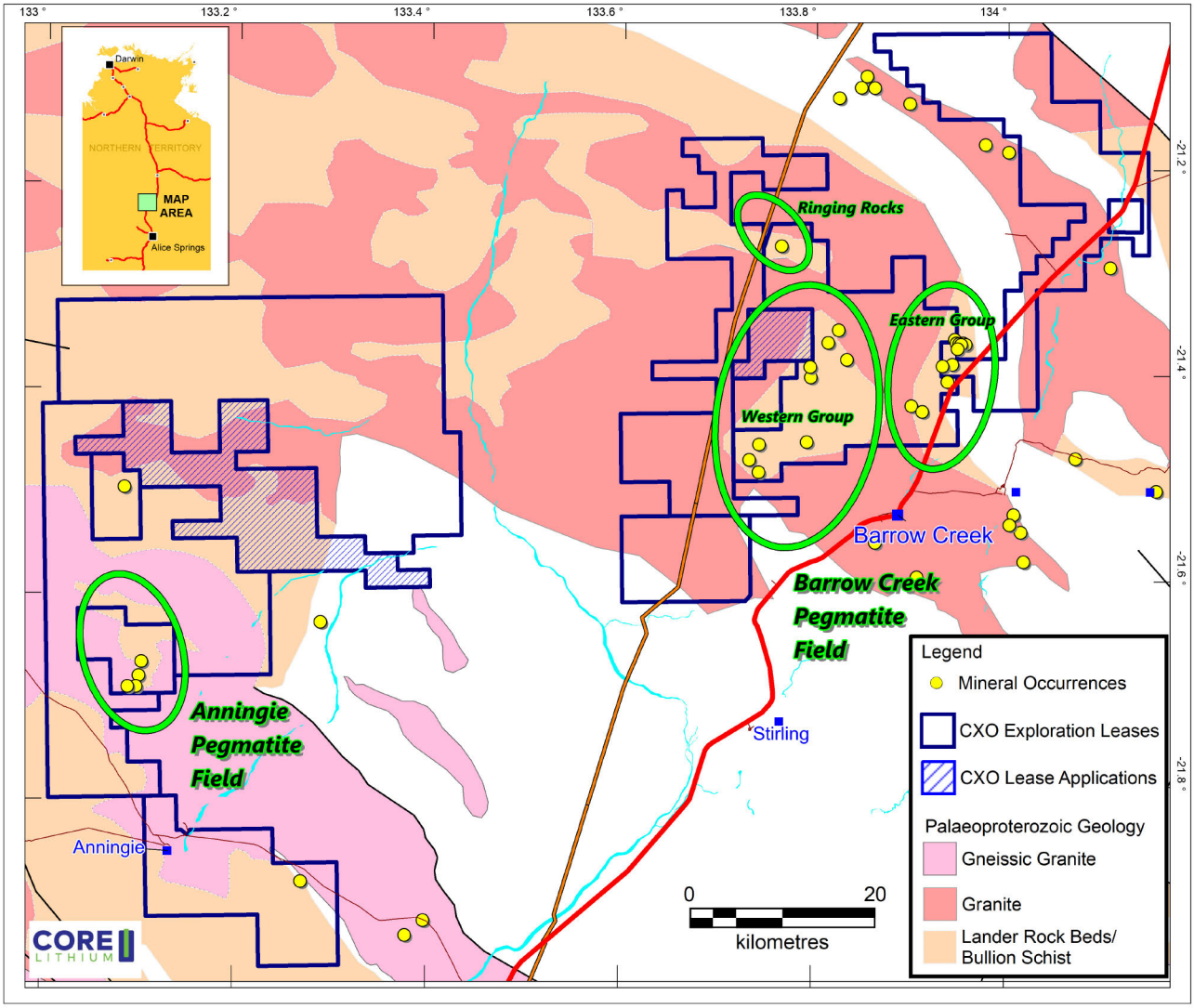

Figure 1. Location and geology of Core Lithium Limited's Anningie-Barrow Creek Project showing main pegmatite fields.

et al 2009) recording a multi-phase deformational history from the Palaeoproterozoic through to the ca 300 Ma Alice Springs Orogeny.

The Ooralingie and Bean Tree granites of the Barrow Creek Granite Complex, as well as the Esther Granite, are potentially the parent bodies for critical mineral enrichment of pegmatites in the project area. These syn- to post-tectonic S-type granites contain anomalously high Sn, Li and Cs (Frater 2005, Donnellan 2008) and were intruded during and following the Stafford and Strangways events.

Pegmatites

Clusters of pegmatite outcrops and historical workings are known in the Anningie Pegmatite Field and the Barrow Creek Pegmatite Field, the latter of which is divided into the western pegmatite group and the eastern pegmatite group (**Figure 1**). Pegmatites also occur at Ringing Rocks, where it is likely they have a substantially larger footprint beneath shallow alluvial cover and form a group of their own.

The size and morphology of the pegmatites is variable, as is the metal content both within and between pegmatites. As described by Frater (2005), the pegmatites can pinch, swell, diverge and coalesce. In the Anningie Pegmatite Field, pegmatites are concentrated in the cleavage planes of a folded amphibolite unit. There, the largest pegmatite has a vertical tabular shape, a strike-length of 540 m, and a width in the range 2–25 m. At Ringing Rocks, two large, irregularly shaped pegmatite bodies are exposed, but are interpreted to be a single large pegmatite that has a significantly larger footprint, of approximately 1200 m × 300 m.

Spodumene from the Anningie Pegmatite Field has been confirmed by petrography and XRF analysis (Todd River Resources, 2017). Fourteen samples with Li_2O grades >4% confirm the broader lithium fertility of the region. Mineralogically, pegmatites can be barren or mineralised, and zoned or unzoned. Barren pegmatites typically contain abundant garnet and tourmaline. Zoning, as observed at Anninigie, consists of a spodumene + quartz core that grades into a K-feldspar dominant zone and further to an outer albite-dominated zone. Muscovite + quartz-bearing pegmatites are also observed containing cassiterite, but no known spodumene.

Recent studies

Core's work to date has involved geological mapping, surface prospecting, rock chip sampling, soil sampling and gravity data collection. A research collaboration is currently underway with the University of Western Australia to investigate the geochemical, geochronological and isotopic characteristics of the granites and pegmatites; these new insights that will be used to refine the exploration model and a targeting approach for lithium.

Geochemical studies indicate that the Bullion Schist and Lander Rock Formation have relatively high average lithium contents (up to 240 ppm and 340 ppm respectively). Melting of this lithium-rich source rock and fractionation of the resulting pegmatite (potentially in multiple stages) could

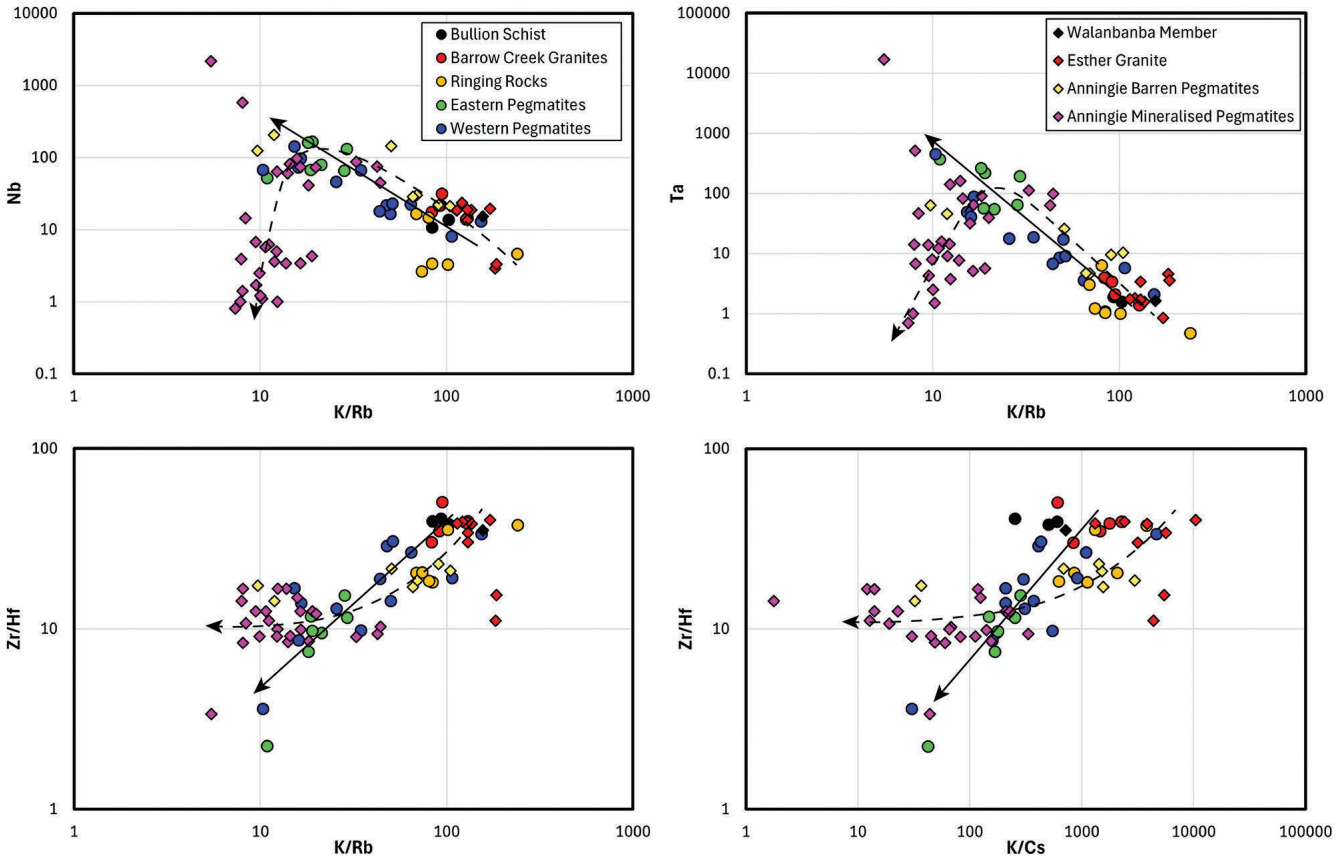

Figure 2. Whole rock geochemical plots for Barrow Creek and Anningie pegmatite fields showing fractionation trends from parent granite to mineralised pegmatite.

produce LCT pegmatites, consistent with experimental evidence proposed by Koopmans *et al* (2024).

The Anningie Pegmatite Field and the Barrow Creek Pegmatite Field (**Figure 2**) show a striking similarity in interpreted fractionation trend. In both cases the fractionation trend projects from the respective parent granite, into barren pegmatites and then mineralised pegmatites, and implies that both fields would have formed under similar conditions or by similar magmatic processes. Although no lithium-bearing silicates have yet been identified in the Barrow Creek Field, the comparable fractionation trend is encouraging. It is possible that lithium-bearing rocks in the Barrow Creek Field are present but have not yet been identified beneath the overlying cover sediments.

Two programs undertaken during the past 12 months have been gratefully co-funded by the Northern Territory Government's drilling and collaboration scheme. The first of these programs involved the re-assay of soil pulps from previous soil sampling programs for a suite of rare-earth elements (REE). The concept was to test the possibility that LCT-pegmatites and NYF-pegmatites may coexist, a possibility raised by the complex tectonic history involving multiple magmatic episodes, and the existence of carbonatite-related mineralisation elsewhere in the Arunta region.

The second co-funded project involved a trial of gravity data collection using a quantum gravimetry technique over the Ringing Rocks target. Ringing Rocks is a high priority target due to its large size and anomalous soil geochemical signature. Collection of close-spaced gravity data will provide enhanced resolution of sub-surface structures along which the pegmatites may be emplaced.

Acknowledgements

Jack Stirling, from the University of Western Australia, is thanked for his valuable insights. The intrepid Core Lithium Limited exploration team are thanked for their hard work.

References

Donnellan N, 2008. *Mount Peake and Lander River, Northern Territory. 1:250 000 geological map series explanatory notes, SF 53-05, SF 53-01.* Northern Territory Geological Survey, Darwin.

Frater KM, 2005. Tin-tantalum pegmatite mineralisation of the Northern Territory. *Northern Territory Geological Survey, Report* 16.

Goleby BR, Huston DL, Lyons P, Vandenberg LC, Bagas L, Davies BM, Jones LEA, Gebre-Mariam M, Johnson W, Smith T and English L, 2009. The Tanami Deep Seismic Reflection Experiment: an insight into gold mineralization and Paleoproterozoic collision in the North Australian Craton. *Tectonophysics* 472(1–4), 169–182.

Koopmans L, Martins T, Linnen R, Gardiner NJ, Breasley CM, Palin RM, Groat LA, Silva D and Robb J, 2024. The formation of lithium-rich pegmatites through multi-stage melting. *Geology* 52(1), 7–11.

Scrimgeour IR, 2013. Chapter 12 - Aileron Province: in Ahmad M and Munson TJ (compilers) *'Geology and mineral resources of the Northern Territory'. Northern Territory Geological Survey, Special Publication 5.*

Todd River Resources, 2017. *High-grade lithium results confirm potential of Bismark Prospect, Walabanba Project, NT.* Australian Securities Exchange announcement: TRT, 21 December 2017.