Application of gravity to the Finniss Lithium Project

David Rawlings[1,2]

Core Lithium has been exploring the Bynoe Pegmatite Field, located just 15 km south of Darwin, since April 2016 and has now progressed the project through various stages of feasibility and approvals for mining development. This paper will focus on the application of recently-acquired gravity data to the exploration for lithium-rich pegmatite deposits.

The Bynoe lithium-rich pegmatites have intruded the Finniss River Group, the youngest part of the Pine Creek Orogen. The magmatic source is currently interpreted to be the geochemically-similar Two Sisters Granite, which outcrops to the west and possibly underpins the entire area (Ahmad 1995, Frater 2005).

The original objective of the gravity survey outlined here was to test whether pegmatite presence, style and fertility are at least in part related to the geometry of the underlying granite roof in the Bynoe Pegmatite Field. The previous gravity dataset in the Finniss area is a very broad 11 km spacing, the results of which were interpreted to imply a regular upwards slope of the upper granite contact from east to west. This is consistent with the metamorphic gradient and the transition to the high-grade Litchfield Complex to the west. However, there is potential for this to be an accreted terrain that underwent metamorphism prior to emplacement of the Two Sisters Granite. If so, then this broad gravity data might reflect lower crustal architecture rather than the shallower granite roof. The slope might be entirely different. The previous gravity data spacing was also not sufficient to decipher the mesoscale geometry of the contact, which may play an important role of localising pegmatites, such as above apophyses on top of the granite. The apparent clustering of pegmatites in several areas (groups; Frater 2005) within the Bynoe Field was thought to be directly related to this geometry (eg Leviathan, Kings Table, Observation Hill Groups etc).

Core Lithium requested and was granted collaborative Government support to collect closed-spaced gravity over the project area to assist in exploration and to improve the NT Governments regional gravity dataset in the Pine Creek Orogen.

The Finniss Gravity Survey was carried out by Daishsat Pty Ltd between 3 to 18 August 2020 via the ground collection on a 500×500 m or 500×1000 m grid of gravity stations through the majority of Core Lithium's landholding and along the main gazetted roads. The data has been terrain corrected and processed. Various images and processed data can be found in the public report supplied to the Northern Territory Geological Survey (Rawlings 2020).

The survey was successful in achieving a number of planned objectives. Processed gravity data neatly maps granite geometry at macro- and meso-scale. The regional gravity field would appear to be related to deep crustal structure and not granite geometry. Based on the residual gravity data (**Figure 1**), granite has been differentiated into three main bodies: Two Sisters Granite in the west; the concealed shallow-level Ringwood pluton in the southeast; and a linear north-northeast deep-level granite in the middle that has a spatial connection with economic pegmatites.

Pegmatites are largely restricted to the gravity highs ('belts') that are interpreted to be the shoulders of the central granite body. The Grants belt in the west hosts almost all the strongly-mineralised pegmatites, while the Sandras belt in the east has thus far been found to be less fertile but nonetheless is still prospective for lithium-bearing pegmatites. Steep-dipping pegmatites reside on the crest, with shallow-dipping bodies at the flank, and to some extent, above the larger granite bodies. The shape of the granite apophysis, therefore, exerts a strong control on the structural regime above it into which pegmatites are emplaced. The steep-dipping and shallow-dipping styles currently recognised in the Bynoe Field thus have a spatial relationship with the gravity-implied roof geometry.

The heat-flow created by the regional-scale and meso-scale depth-to-granite is also likely to have controlled the depth at which pegmatites are fertile for lithium precipitation and preservation.

Most importantly, the survey highlights the Grants belt, a major north-northeast-trending gravity high and lithium-pegmatite corridor that extends from Kings Table Group in the north to the Leviathan Group in the south, and includes the lithium-rich Observation Hill Group (**Figure 2**; main prospect are Grants, Carlton, Hang Gong). There is no reason to believe that these pegmatite groups are clusters. It appears more likely that the current apparent distribution of pegmatites in this belt is due to exploration maturity as large tracts of ground between Grants and Leviathan are covered in a thick mantle of laterite or estuarine cover and have not been effectively explored to date. The River Annie Group appears to relate to a separate gravity high on the eastern side of the central gravity ridge. There is no logical explanation for the larger pegmatite size or lower fertility of these pegmatites at present. This may also reflect exploration maturity.

The gravity data also demonstrate that magnetic data are sometimes deceiving. There is no evidence for the linear granite belt on Core Lithium's 75 m-spaced regional magnetic grid, but the Ringwood pluton is manifest nicely by the same data (**Figure 3**).

In conclusion, the gravity survey demonstrates unequivocally that the gravity methodology is a very useful tool for pegmatite exploration and granite mapping.

[1] Core Lithium, Level 1, 366 King William Street, Adelaide SA 5000, Australia
[2] Email: drawlings@corelithium.com.au

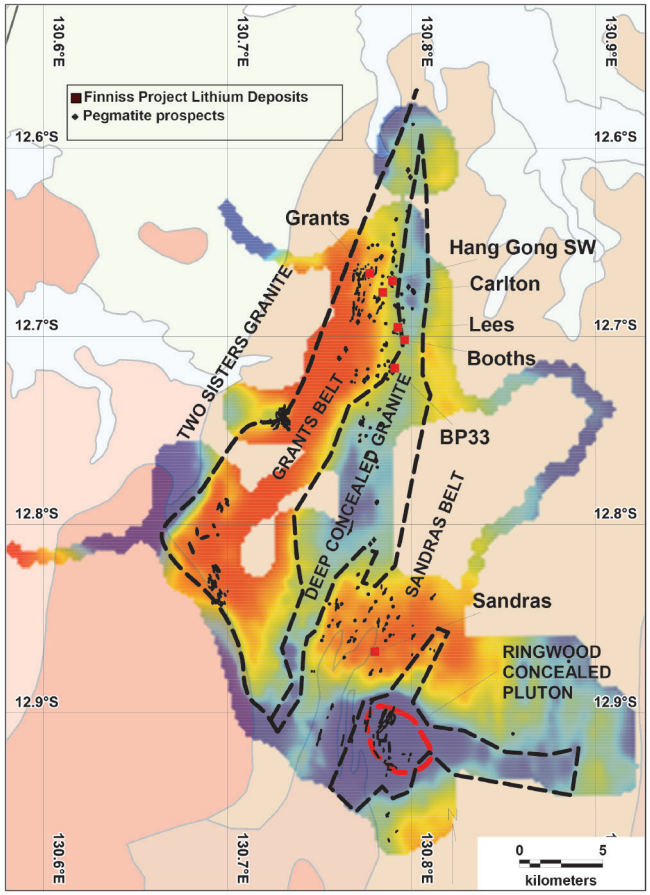

Figure 1. Residual Gravity grid for the Finniss Lithium Project area.

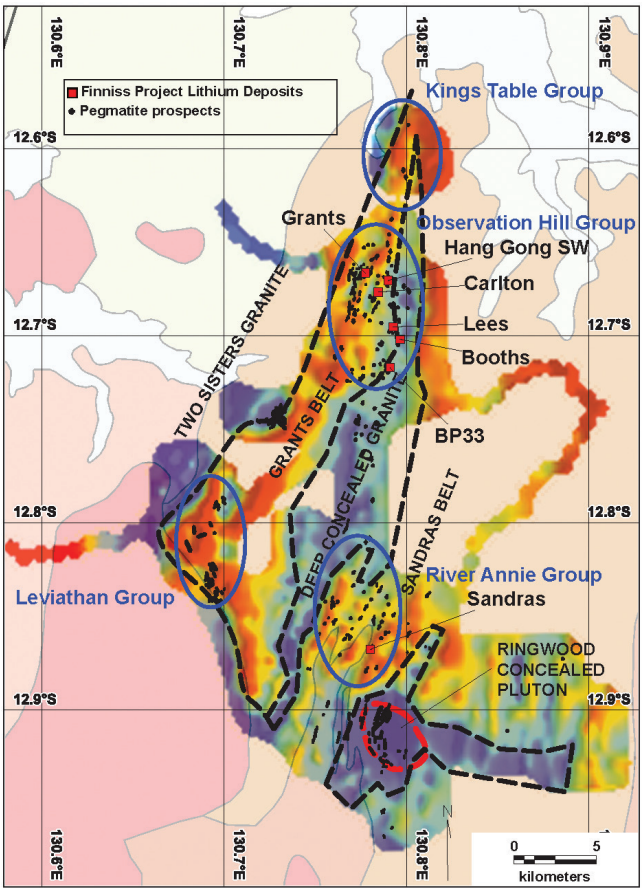

Figure 2. First Vertical Derivative grid for the Finniss Lithium Project area.

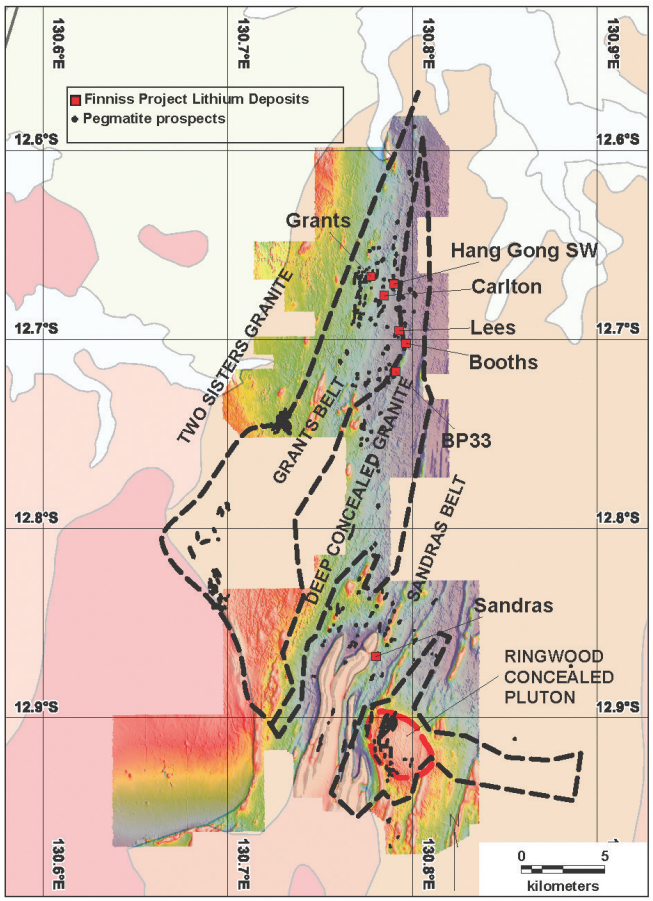

Figure 3. Magnetic grid for the Finniss Lithium Project area.

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