The discovery and geology of the Leliyn graphite deposit

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Kingsland Minerals' Leliyn graphite deposit near Pine Creek is Australia's largest graphite deposit in terms of contained graphitic carbon. While the presence of graphitic schist has long been known, it has only recently that the economic potential of the deposit has been recognized. This paper describes the exploration and discovery history of Leliyn and focuses on the recent work that will define the maiden Mineral Resource statement to be released in March 2024.

Graphite in the Northern Territory

There is limited information about graphite exploration in the Northern Territory (NT). Indeed, the data is so sparse that one can conclude that there has not been any targeted exploration focused on graphite in the NT. A search of historic exploration reports on file in the Northern Territory Geological Survey (NTGS) data system, GEMIS[3], reveals very few descriptions of graphite in the Territory. The only recorded production is from the vicinity of the Golden Dyke mine in the Burrundie district from which two tonnes of graphite was mined in 1924 for use as a pigment in paint manufacture. Good-quality graphite had also been reported from the Finniss River area, but no production was recorded (Crohn 1966).

Geology of Leliyn

The Leliyn graphite deposit is hosted in graphitic schists within the Mount Partridge Group of Early Proterozoic sediments. The Mount Partridge Group is divided into several subgroups, the oldest of which is the Mundogie Sandstone. The Mundogie Sandstone was deposited under shallow-marine conditions and comprises arkose, subarkose, feldspathic arenite, quartzite, conglomerate, phyllite, and siltstone (Ahmad *et al* 2013). It has also been described as containing carbonaceous phyllites (Ahmed *et al* 1993).

The graphitic schist was formed by contact metamorphism related to the Cullen Granite's intrusion into carbonaceous sediments of the Mundogie Sandstone. The graphitic schists are somewhat interbedded with zones of hornfelsed sediments, which have little or no carbon content. A layer of quartzites forms a prominent ridge with the graphitic schists lying between this and the granites.

Figure 1 shows the geology of the area based on the government 1:100 000 map sheets, including location of the recent drilling (**Figure 2**).

Exploration at Leliyn

Exploration in the area of the Leliyn graphite deposit had previously targeted uranium and base metals. CRA Exploration identified several base metal soil anomalies along the graphitic schist in 1976 but did not regard them as having potential so the project was relinquished. Anomalous base metal mineralisation was described as hosted by 'ferruginous hornfelsed graphitic shales' (Ikstrums 1979).

In 1979, the Australia and New Zealand Exploration Company pegged the area for tungsten and uranium exploration. Mapping indicated a series of greywackes and carbonaceous shales along the contact of the Cullen Granite. The sediments at the contact were described with 'the effects of contact metamorphism evident in the sediments with chiastolite and signs of hornfelsing and sericitization'. A program of soil sampling, stream sampling, and ground radiometric surveys were completed with little potential for mineralisation recognized. The tenement was subsequently relinquished (Davies 1981).

Greenex, a division of Greenbushes Tin Ltd, explored the area in 1982 for gold and tin/tantalum. A program of stream sampling and chip sampling failed to locate potential economic mineralisation so the tenement was relinquished. Their geology map of the area did not delineate the graphitic schist unit adjacent to the Cullen Granite contact (Birrell 1982).

Total Energy Australia acquired the area in 1984 to complement their adjacent tenement, which contained their newly discovered Cleo uranium deposit (now owned by Kingsland Minerals). Mapping in 1984 delineated a series of dolomites/shales containing carbonaceous shales along the contact of the Cullen Granite (Earthrowl 1985). Several low-level uranium anomalies were identified but the potential was downgraded after several percussion holes were drilled in 1988. Little or no uranium mineralisation was encountered in the eight holes drilled; however, several did intersect significant widths of graphitic schist although the graphite content was not assayed. The tenement was subsequently dropped.

Tenements pegged in 1990 covered most of the project area. Aztec Mining Company subsequently explored the tenement as part of an earn-in agreement. The target for exploration again was base metals, gold and uranium. As part of this program, Aztec drilled four diamond drillholes. These holes intersected zones of graphitic schist. Ten samples were submitted for petrographic analysis. Hole ASDDH-1 at 75.8 m was described as having especially coarse and abundant graphite (Butler 1994). Additional occurrences of graphite were recorded in holes ASDDH-3 and ASDDH-4, where at 142 m downhole, flaky graphite from 10 micron to 1 mm made up an estimated 10% of the sample collected. Despite these very positive descriptions, Aztec pulled out of the joint venture in 1996 due to the low potential for a significant base metal discovery.

Between 1988 and 2007, little focused exploration took place. Tenements covered areas close to the Frances Creek iron ore mine so exploration tended to focus on the

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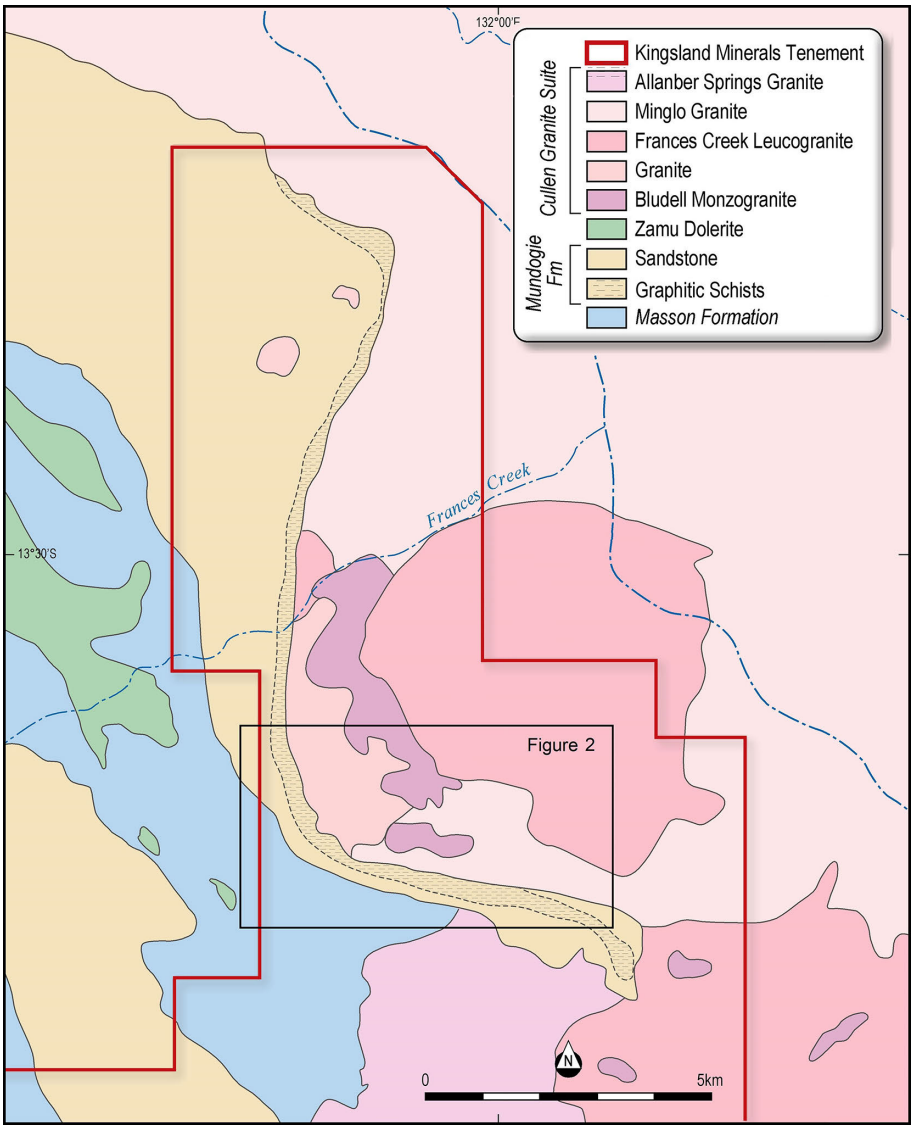

Figure 1. Geology of Leliyn Graphite Deposit (after Australia 1:100 000 geological map series). Inset is location of recent drilling (**Figure 2**).

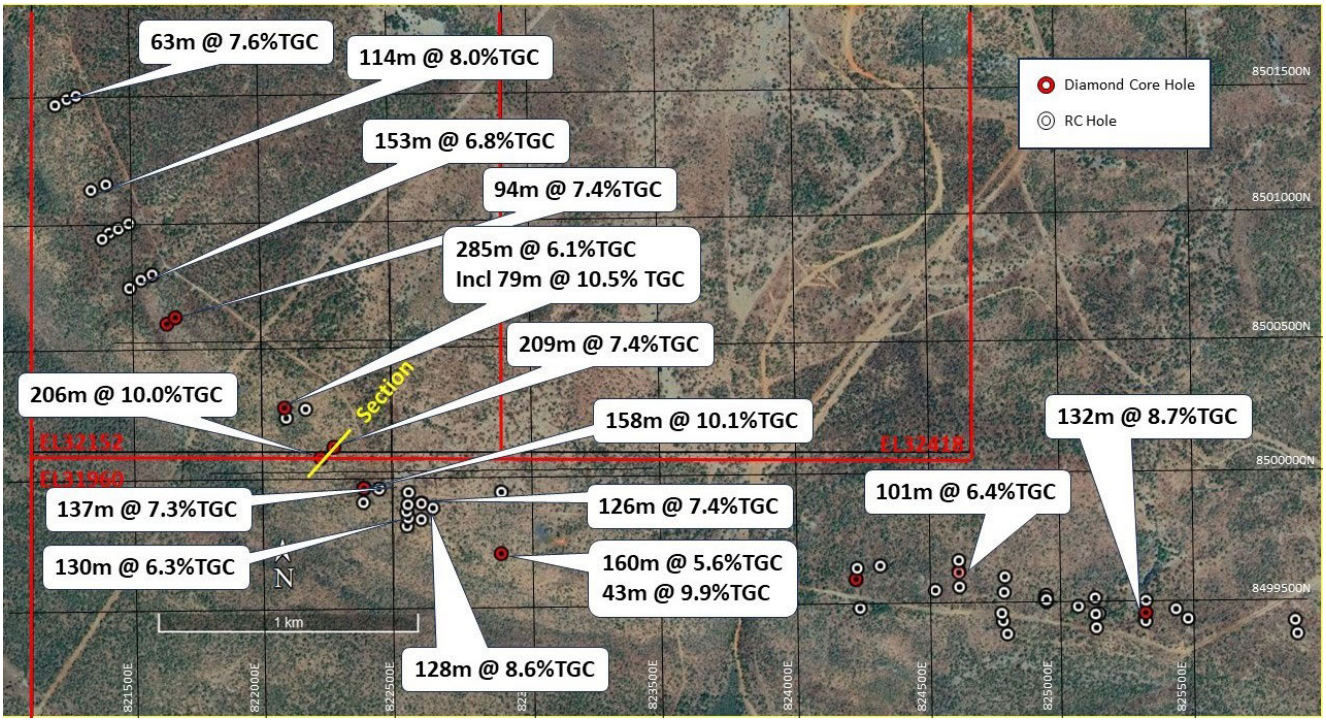

Figure 2. Plan showing drilling locations and significant intersections (Kingsland 2023 c,d).

western parts of the tenements, targeting iron ore and gold. Exploration over the area of Leliyn did not recommence until 2012 when Thundelarra Exploration explored the area for base metals and uranium. Thundelarra drilled RC holes targeting copper mineralisation along the graphitic schist zone. The potential of the schist to contain graphite mineralisation was recognised and in 2012, some RC holes were re-sampled and assayed for graphite (Thundelarra 2012). Despite recognizing this potential, no follow-up exploration for graphite was conducted. In 2016, a diamond drillhole targeted a strong magnetic anomaly within the graphite schist. This hole was not initially assayed but a series of core samples were collected downhole and assayed for total graphitic carbon (TGC); thin sections were also made for petrographic study. The assays and petrography returned good TGC grades and flake graphite (Thundelarra 2016). However, the tenement package was subsequently relinquished and then picked up by Trafalgar Resources, who vended the tenements into the Kingsland Minerals listing project portfolio in 2022.

Kingsland Minerals' exploration program

Kingsland Mineral's initial focus was the uranium deposit at Cleo. Drilling during 2022 intersected significant uranium mineralisation but also intersected wide zones of graphitic schist. Buoyed by this, and the historic information from Thundelarra, Kingsland announced Leliyn as a graphite discovery on 1 February 2023 (Kingsland 2023a); this was followed up with an 'Exploration Target' announcement on 21 March 2023 (Kingsland 2023b). The Exploration Target area was confined to a 5 km strike length of the graphitic schist easily accessible from the Mary River Station access road. There is an additional ~15 km of strike length of graphitic schists within the Kingsland tenure that remains untested.

Drilling commenced in May 2023 and by December 2023, a total of 53 RC holes and 11 diamond core holes had been completed. This initial program was wide-spaced and aimed at confirming continuity of the graphitic schist and graphite mineralisation. The drilling was successful in achieving these aims with many holes intersecting broad (>100 m), high-grade (~10% TGC) graphite mineralisation. **Figure 2** shows the drillhole locations and the significant graphite results. A typical cross section is presented in **Figure 3**. The completed drilling will form the basis for an Inferred Mineral Resource estimate due for release in March 2024.

As part of the diamond drilling program, a series of core samples were collected for thin section petrographic analysis. Samples were collected about every 8 m downhole. The petrographic report described the mineralogy of the sample and also the estimated percentage of graphite and the graphite flake size. **Figure 4** shows a detailed view of coarser grained flake graphite aligned parallel to the foliation in the graphite schist host. Platy muscovite–minor quartz (Q) occurs as a syn-tectonic vein. The image was taken with crossed polars under reflected and transmitted light, with a field of view of 1.13 mm.

Conclusion

Kingsland Minerals is firming up Leliyn as a significant graphite discovery. The future demand for fine flake graphite, driven by the growth in electric vehicles and battery storage, will propel the development of graphite projects globally. Leliyn is very well placed to take advantage of this demand, being only 200 km from the Darwin port and close to required infrastructure. The initial work completed to date has indicated the presence of a graphite deposit of considerable size with scope to supply fine flake graphite. Future work will entail infill drilling to increase the confidence in the mineral resource estimate, as well as additional metallurgical test-work to progress the downstream processing capabilities to produce graphite concentrate, micronized graphite and spherical graphite.

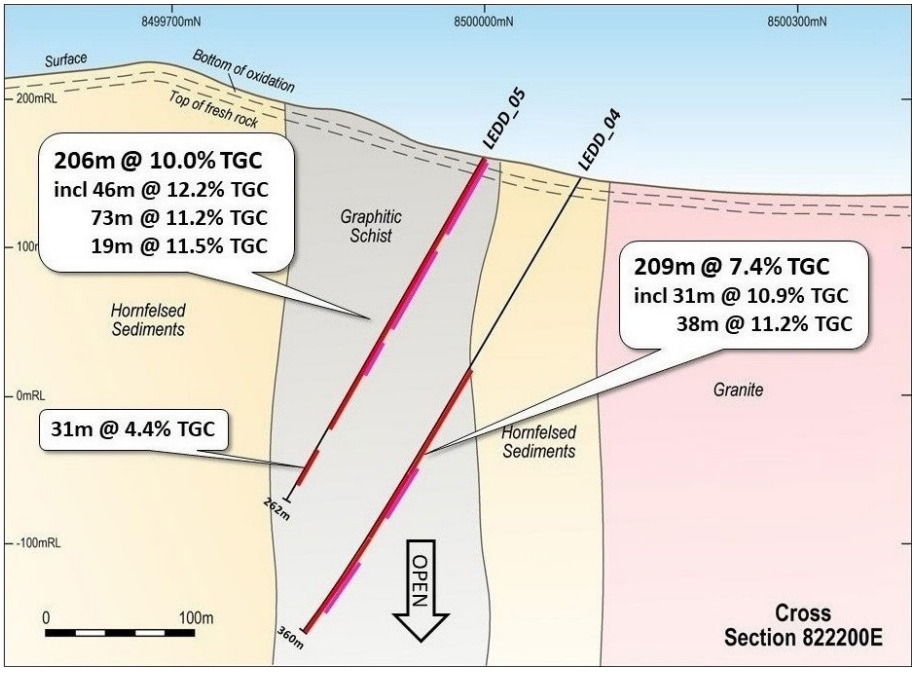

Figure 3. Cross section showing geology (Kingsland 2023c).

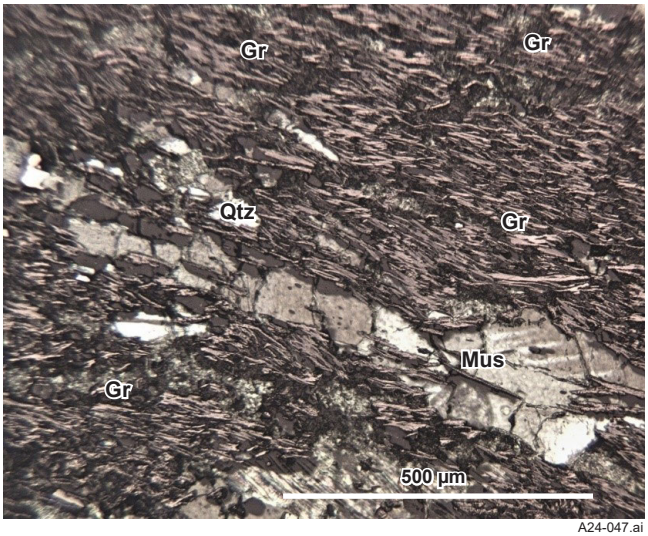

Figure 4. Thin section showing flake graphite (drillhole LEDD_08, 44 m). The image was taken with crossed polars under reflected and transmitted light; field of view 1.13 mm. Gr = graphite, Mus = muscovite, Qtz = quartz.

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