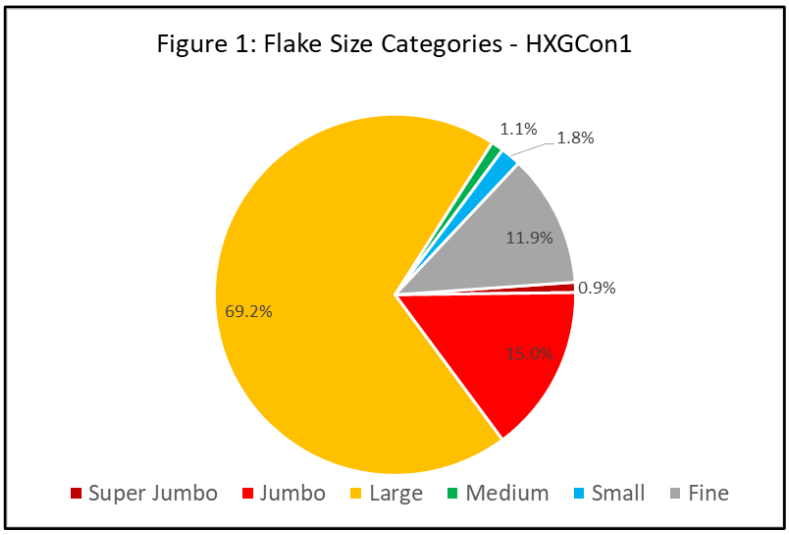
HEXAGON
resources limited
High Purity Flake Graphite for New Technologies

**ASX ANNOUNCEMENT** **3 NOVEMBER 2017**

# MCINTOSH LARGE & JUMBO GRAPHITE FLAKE ENDOWMENT

Hexagon Resources Ltd (ASX: **HXG**) is delighted to provide a further update on the latest results from its current test work program and the impact on its product development strategy for its flagship, Western Australian, McIntosh Graphite Project, namely:

1. McIntosh graphite concentrate contains a significant proportion of larger flake sizes with 85% of flake greater than 180 microns (Large, Jumbo and Super Jumbo). This opens up significant commercial opportunities that had not been previously pursued.




2. Systematic mineralogical review, Scanning Electron Microscopy (**SEM**) scans and multi-element assay profiles confirm the ore type is clean and simple to process, yielding high-grade graphite concentrates.
3. New partnership with a well credentialed US corporation which specialises in graphite-battery technologies across the value chain from research, test work and commercial battery cell manufacturing.
4. Next phase of downstream processing test work is to focus on graphite expansion and non-chemical purification of the graphite concentrate. This additional processing will focus on production of an ultra-pure, graphite concentrate which opens opportunities to produce a portfolio of premium priced products for all of the planned 100ktpa concentrate production.
5. Hexagon's product and marketing strategy has progressed from producing one high-grade, "Small" flake sized concentrate as feed-stock into the Chinese dominated spherical graphite market to focus on more niche markets for higher purity graphite materials suitable for a range of battery types and battery applications as well as other uses for the larger flake products including the expandable graphite sectors and for a variety of advanced metallurgical applications.

## 1. BACKGROUND

Hexagon recently partnered with a US company, referred to as "NAmLab[1]" which specialises in graphite-battery technologies; from research, to test work and commercial manufacturing. NAmLab has been certified by the US Department of Defense to be ISO 9001:2008 compliant in Quality Systems and importantly, has a commercial production arm.

The objective of this partnership is to undertake test work to characterise end use opportunities for McIntosh graphite concentrate with particular focus on higher purity products, aimed primarily at the advanced battery materials trade and other applications such as high-purity larger flake graphite products. There are many niche markets that this test work is assessing, with a view to diversify Hexagon's product range further and increase its exposure to premium graphite pricing opportunities. The partnership with NAmLab provides a credible technical partner to execute the test work that understands the relevant end-use specifications and ultimately, through its commercial links can assist in the marketing process.

Hexagon has recently reported on the evolving nature of its product development and marketing strategy, underpinned by sound test work. The underlying objectives are diversification to enable the sales of c. 100ktpa of graphite concentrate as outlined in the Pre-feasibility Study[2] and premium pricing for higher purity graphite materials.

Predicting processing performance is essential to consistently meeting offtake specifications. To achieve this the Company has commenced on two distinct test work programs – at opposite ends of the commercialisation path:

- At the "downstream" end, detailed test work examining the properties of McIntosh graphite concentrates relevant to end-users such as purity, flake size and flake morphology as well as various specific attributes relevant to advanced battery material; and
- "upstream" - gathering of mineralogical, elemental and flake size data from drill core samples to create a geo-metallurgical model (Geo-Met Model) for the McIntosh Mineral Resource.

This announcement provides an update on outcomes from these ongoing test work programs.

## 2. "DOWNSTREAM" TEST WORK IN THE UNITED STATES

In September, 25kg of two McIntosh graphite concentrate samples were despatched to NAmLab. The graphite flake concentrate samples included;

- HXGCon1 – generated from batch test work completed in 2016 on a 100kg composite sample of drill core; and
- HXGCon2 and 3 which is the product of the pilot program completed in July 2017.

Both samples were generated using the PFS style process flow sheet and therefore do not include any of the planned process modifications (which will aim to optimise desirable flake characteristics).

The key preliminary results to emerge are:

a. **Large Flake** - the presence of a significant proportion of Large (>180µm) and Jumbo (>300µm) sized flake in HXGCon 1 as shown in Figure 1 and 2. Note, 16% of flake classified as Super Jumbo and Jumbo and 69% of flake classified as Large with only 14% classified as Small or Fine (refer to

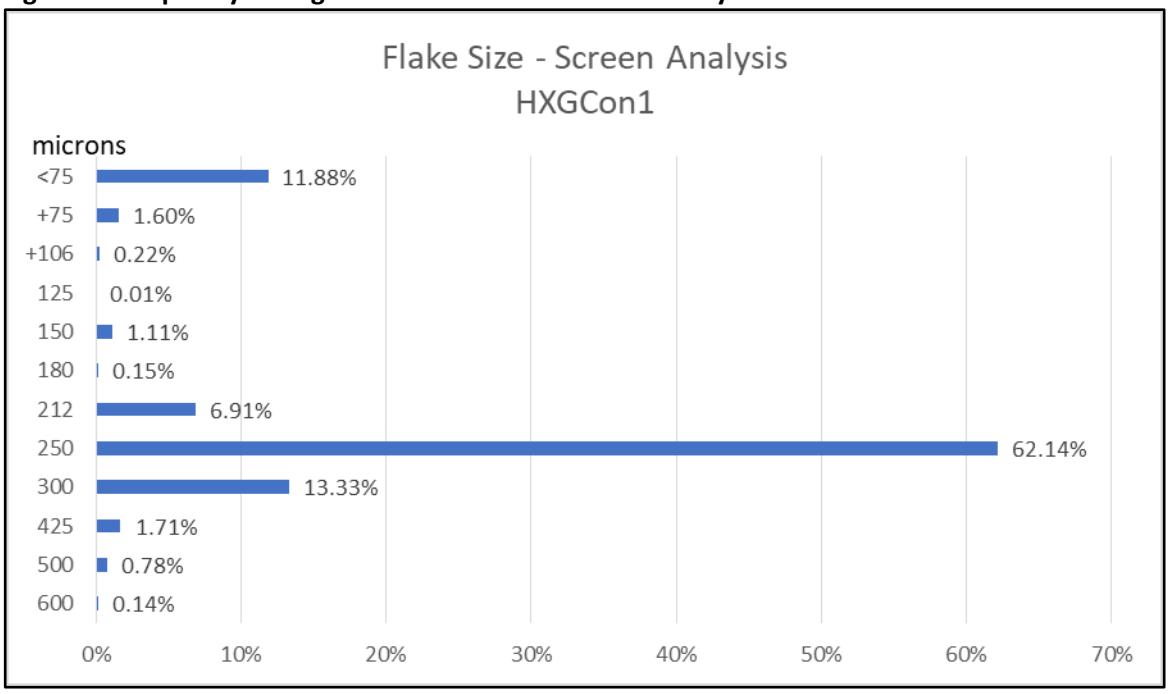
[1] Hexagon Resources does not wish to disclose the name or specific location of the laboratory testing facilities in order to maintain its competitive advantage. For competitive reasons graphite companies do not typically disclose details of the laboratories doing their product test work.

[2] Report to ASX 31 May, 2017

Table 1). Importantly the pilot program (HXGCon2 & 3) actually targeted a c. 100 micron flake size product. Therefore, sample HXGCon1 is the more relevant in terms of concentrate flake size distributions.

This result is very positive. Previous sizing work had indicated that only 30% of flake in concentrate was greater than 150 microns (Medium & Large). Flake size hasn't been a priority until recently due to the previous strong focus on a single flake product destined for the battery anode market and the preconception that approximately 106 microns was the target feed size for a spheroidisation plant. Further work is underway to better understand this flake morphology including the relationship of flake thickness with the various flake size fractions.

**Figure 2: Frequency Histogram from Flake Size Screen Analysis***




**Screen Analysis by RX-29 Ro-Tap Test Sieve Shaker/cross referenced by laser diffraction method (Microtrac S3500).*

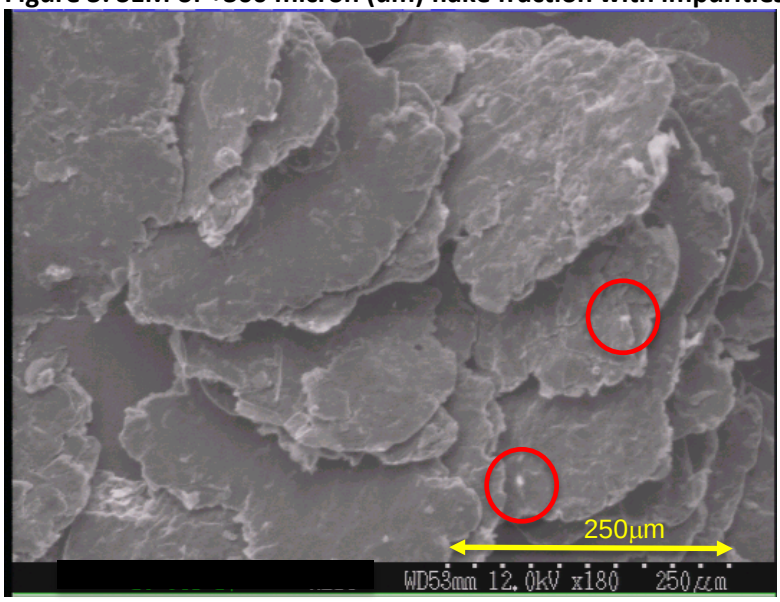
**Table 1: HXGCon1 Flake Size Analysis**

| Microns | Mesh (ASTM) | Size Classification | Weight % |
|---|---|---|---|
| >500 | >35 | Super Jumbo | 0.9% |
| 300-500 | 50 - 35 | Jumbo | 15.0% |
| 180-300 | 80 - 50 | Large | 69.2% |
| 150-180 | 100 - 80 | Medium | 1.1% |
| 75-150 | 200 - 100 | Small | 1.8% |
| <75 | <200 | Fine | 11.9% |
| | | | 100% |

SEM examination of the flakes in various size fractions highlights the large and clean nature of the graphite flakes in the HXGCon1 concentrate as shown in Figure 3.

This updated test work on the concentrates highlights the strengthening potential for the production of premium priced products attributable to large flake size and high-purity.

**Figure 3: SEM of +300 micron (um) flake fraction with impurities circled.**




b. **High-graphite grade and purity** - Confirmation of the high total graphitic carbon (TGC) grades of the concentrates with assays of +97% and up to 98.3% TGC as presented in Table 2.

**Table 2: Summary of Graphite Concentrate assays***

| No. | TGC (%)* | Sample Source |
|---|---|---|
| HXGCon 1 | 97.6 | 2016 Batch test work |
| HXGCon 2a | 98.3 | 2017 Pilot program split 1/3 |
| HXGCon2b | 97.4 | 2017 Pilot program split 1/3 |
| HXGCon3 | 97.7 | 2017 Pilot program split 1/3 |

**Loss on Ignition (LOI950) method.*

SEM observations indicate that the impurities occur on the flake surface, not intercalated within the graphite layers. NAmLab considers that this is very encouraging in that purification will be simple and amenable to "light" purification methods. This is directly linked to the cost inputs and the Company's objective is to be a cost leader in this area to drive profit premiums.

c. **Surface Area, Tap Density and Scott Volume determinations** were also included in the concentrate characterisation tests. NAmLab concluded that the surface areas (by BET determination) were exceptionally low. A low surface area for concentrate material is regarded as an excellent attribute for batteries, which could be linked to a variety of post-processing criteria, including the increased safety of lithium-ion batteries.

Measurements of Tap Density (packed density) and Scott Volume (flow or an apparent density) were average and low respectively. Tap Density relates to charge density for anode utilisation and the impact of the low Scott Volume is largely around packaging to reduce freight costs for example by utilisation of vibrating tables and vacuum bagging.

The next stage of the test work will focus on graphite flake expandability and purification. Positive expansion characteristics for the McIntosh graphite would be a strong endorsement for a highly sought after product and the product diversification strategy being proposed. The objective of the purification test work will be to test the ability to produce an ultra-pure graphite concentrate through several purification techniques. Given that the McIntosh graphite concentrate is already high-grade and doesn't contain significant amounts of known deleterious elements, NAmLab and Hexagon consider this should make purification relatively straight forward and cost effective. This work will

commence imminently and could be a key input factor and differentiating feature to further improve the "premium" specifications.

## 3. UPSTREAM - GEO-MET MODEL INPUTS

A robust Geo-Met model is necessary to provide the geological and spatial framework for ongoing metallurgical test work.

In August, 2017 approximately 100, 3kg to 4kg samples of drill core from the Emperor, Wahoo and Longtom deposits were collected from within each of the geological domains defined for each deposit. A testing program has commenced examining:

- multi-element scans, including possible deleterious elements as well as total graphitic carbon content;
- mineralogical associations and textures of graphite and gangue minerals;
- petrographic determinations of graphite flake length; and
- flake size distributions for each sample from sieve measurements.

To date, very encouraging preliminary results have been received but only for the first 20 samples from the Emperor deposit. These early findings relate to:

a. **Flake Size -** the objective is to understand the insitu flake size distribution around the deposit. The samples assessed petrographically to date, demonstrate that the graphite flakes appear to be discrete, oriented and fairly large with approximately 85% of flakes having lengths greater than 150 microns as summarised in Figure 4.

   It is especially pleasing to see that upstream flake size analysis almost exactly correlates with an independent study in the downstream, presented in Figure 2, above. That study indicates as much as 86.1% of flake being greater than or equal to 150 microns in size.

b. **Clean Mineralogy** – the internal gangue minerals consist mainly of discrete coarse biotite and muscovite with some minor weathered muscovite or sericite present. These minor constituents are important in terms of liberation, amenability to recovery by flotation and purification, however, the concentrate grades already achieved and the SEM scans indicate this is unlikely to be problematical.

   The contained sulphides, comprising mainly magnetic pyrrhotite, are also generally coarse grained and disseminated. These properties offer a variety of process techniques to remove/recover the sulphides, possibly into a saleable sulphide concentrate.

   The photomicrographs presented in Figures 5 and 6 illustrate the coarse graphite flake size, the clean gangue mineralogy and the large grained, disseminated sulphides.

c. **Favourably Low Levels of Deleterious Elements -** whilst determining whether an element is present in sufficient concentration to be "deleterious" very much depends on the end use, testing by Hexagon of both the whole rock samples and finished concentrates, has not identified any concerning concentrations of elements currently considered to be deleterious to utilisation in advanced battery materials.

   Analytical scans in this study have identified extremely low to non-detectable concentrations of Cd, Co, Cr, Cu, Mo, Ni, Pb, V and Zn, considered to be "typical" deleterious elements – from the whole rock samples. A low to zero presence means these elements will either not report to a concentrate or will be easier to remove from the concentrate during secondary processing into the value-add product. This is consistent with the concentrate assays highlighting the lower processing risk because the deleterious elements are largely not present to start with.

**Figure 4: Flake Length Distribution – Emperor Deposit.**

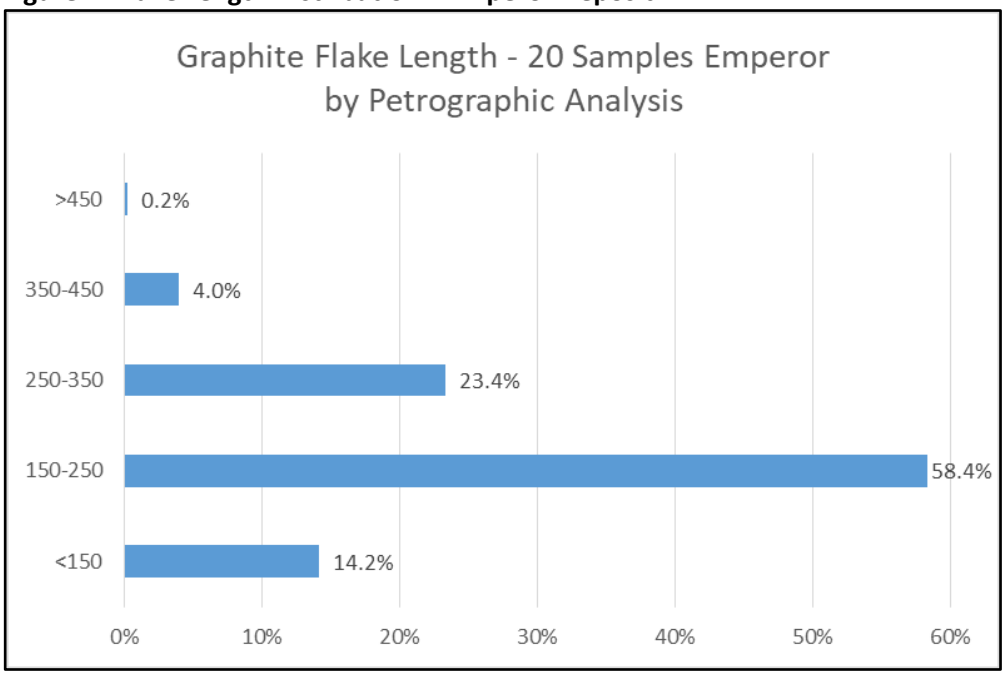
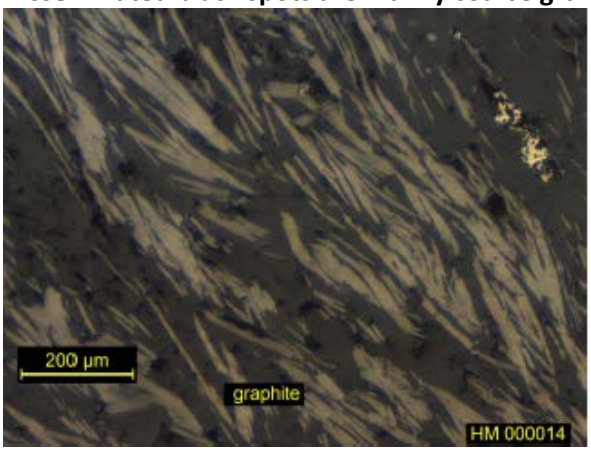
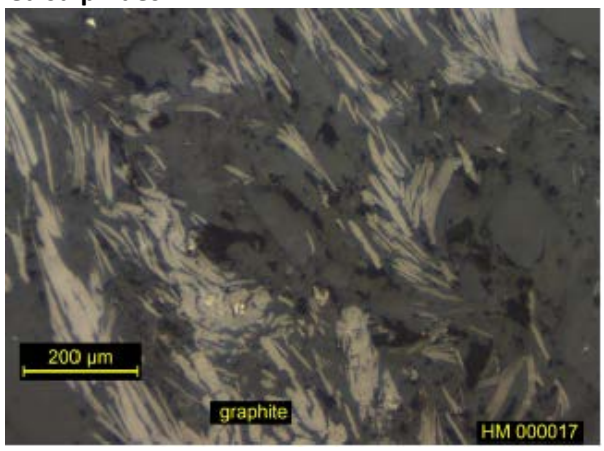



**Figure 5 and 6: Photomicrographs illustrating large, clean orientated graphite flakes-cream colour. Disseminated black spots are mainly coarse grained sulphides.**




## 4. COMMENTARY

Two test work streams are in progress: at the downstream end, designed to assess what high-tech applications McIntosh graphite concentrate is suitable for; and at the upstream end, to provide sufficient understanding of the variations within each deposit to ensure steady, consistent plant performance to maintain reliable "in-spec" production.

Independently both test work programs are converging on similar observations; some new and others confirming established results, including:

a. A genuine large flake population; sizing analysis of concentrate sample indicates 85.1% of graphite flake is greater than 180 microns (Large, Jumbo and Super Jumbo) and the petrographic estimates (more subjective) indicate 86% of flake is greater than 150 microns;

b. Clean, easy to process ore type as indicated by the mineralogical observations;

c. Impurities tend to aggregate on top of flake graphite concentrate as opposed to being intergrown particles of gangue and graphite mineral, indicating "easier" purification;

d. High-grade and purity graphite concentrate observed through assaying, SEM and petrographic studies; and

e. Favourable battery related attributes of the concentrate material with several unique and very positive aspects, such as low surface area of concentrate.

The test work about to commence on purification of the concentrate is an important aspect of the product development strategy for two core reasons:

- Environmental and Safety: purity is a key requirement for most battery and other advanced graphite applications. In the battery sector, the use of acids, in particular, hazardous hydrofluoric acid is the dominant technique with resultant adverse impacts on the environment and worker safety. Hexagon and NAmLab are testing several thermal purification routes, considered to be environmentally friendly and utilising well-established furnace related industrial equipment and techniques.
- Price premium: production of a range of ultra-high purity intermediate products will generate a significant price premium, in some applications by orders of multiples. This includes purified spherical graphite, for example, which is one of the products Hexagon is targeting.

Purification of the concentrate is regarded as a means to secure high-value offtake for all of the planned 100ktpa of planned graphite concentrate from McIntosh through a diversified range of products.

The partnership with NAmLab is an important relationship for Hexagon to gain a deeper understanding of the technical merits of the McIntosh concentrate and product development and also to leverage off NAmLab's commercial contacts with end-users to secure off-take arrangements.

Hexagon's Managing Director, Mike Rosenstreich said "these flake size results are exactly what we had been aiming to achieve and present a possible game changer in terms of product specification and revenue assumptions. The finding that mineral impurities lightly "pepper" the surface of flake as opposed to being inter-grown with flake could create additional momentum for Hexagon achieving cost leadership. More work is required but we are very excited by the technical skills and market insights contributed by our new American partner."

"All of this work is having a positive impact to shape our product development and marketing strategy further toward product diversification and premium priced products. Our objective is to define a portfolio of high-purity graphite products targeted at the advanced battery sectors comprising lithium-ion and other advanced battery types, as well as other high-end graphite applications."

## 5. COMPETENT PERSONS' ATTRIBUTIONS

***Exploration Results and Mineral Resource Estimates***

The information within this report that relates to exploration results, Exploration Target estimates, geological data and Mineral Resources at the McIntosh Project is based on information compiled by Mr Shane Tomlinson and Mr Mike Rosenstreich who are both employees of the Company. Mr Rosenstreich is a Fellow of The Australasian Institute of Mining and Metallurgy and Mr Tomlinson is a Member of the Australian Institute of Geoscientists. They both, individually have sufficient experience relevant to the styles of mineralisation and types of deposits under consideration and to the activities currently being undertaken to qualify as a Competent Person(s) as defined in the 2012 edition of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves and they consent to the inclusion of this information in the form and context in which it appears in this report.

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