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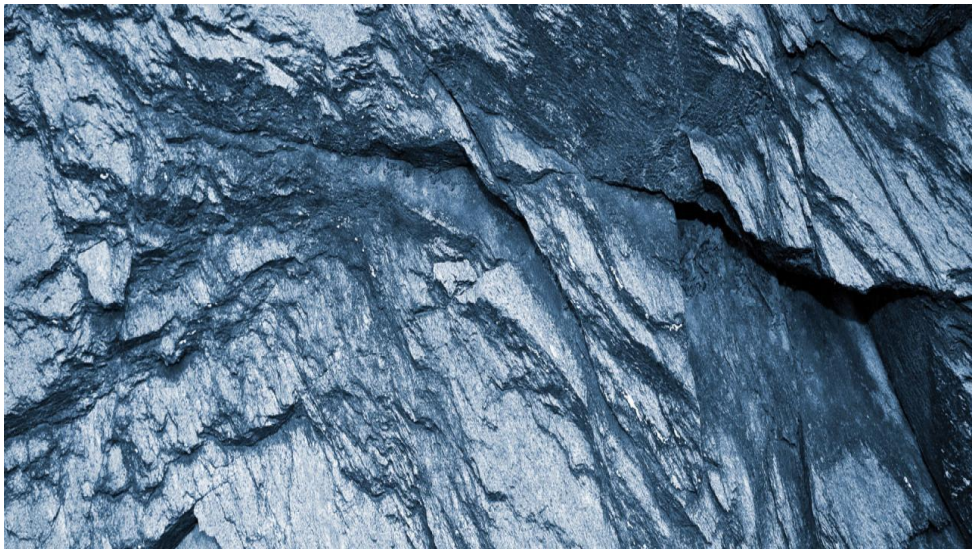


Graphite : Nature's Wonder Metal

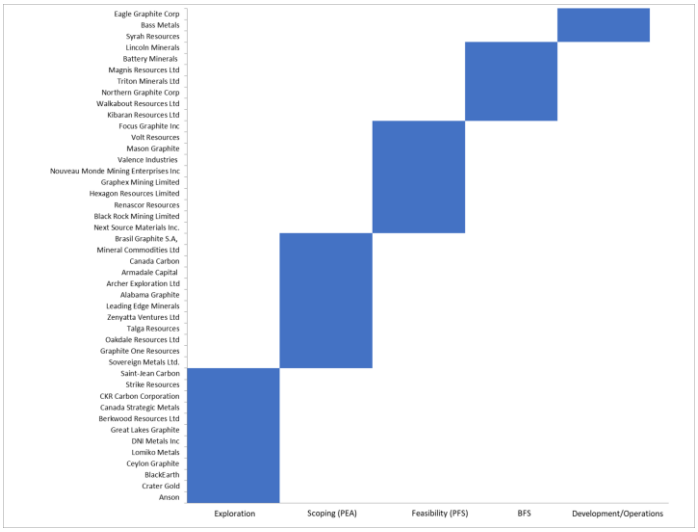
Authors: **Daniel Bloor**

5/25/2018

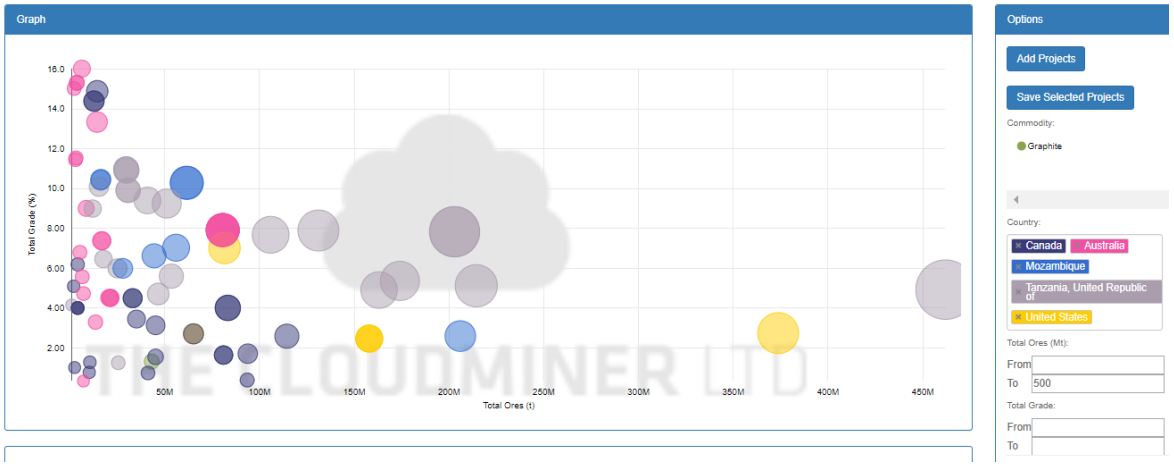
With the ever evolving world of technology the last few years have seen several minerals stand out for obvious reasons. Lithium, cobalt, vanadium and of course graphite have all had their rallies and continue to perform well underpinned by the electric vehicle boom.

Graphite offers several applications beyond that of batteries such as expandable graphite, used as a fire retardant and then of course there is graphene - the wonder material that is set to change the world once consistent low cost production and the application thereof is solved. For all the glory there are few current commercial applications yet graphite is the raw material that has withstood the test of time. From its humble origins as the lead in a pencil or for its use in cannon balls defending the oceans right through to its use in paint, application in medicine and to what is today's cutting edge technology, graphite has stood the test of time .

The CloudMiner (TCM) have been involved in graphite since our companies inception 5.5 years ago, having reviewed assets from Tanzania, Madagascar, Australia and Canada to name but a few. There has been no shortage of studies completed globally during this period however the number of projects that have made it to production remains minimal, the only notable one of scale being Syrah Resource's Balama Project, Mozambique.



Current Status of Pre-Production Projects Globally

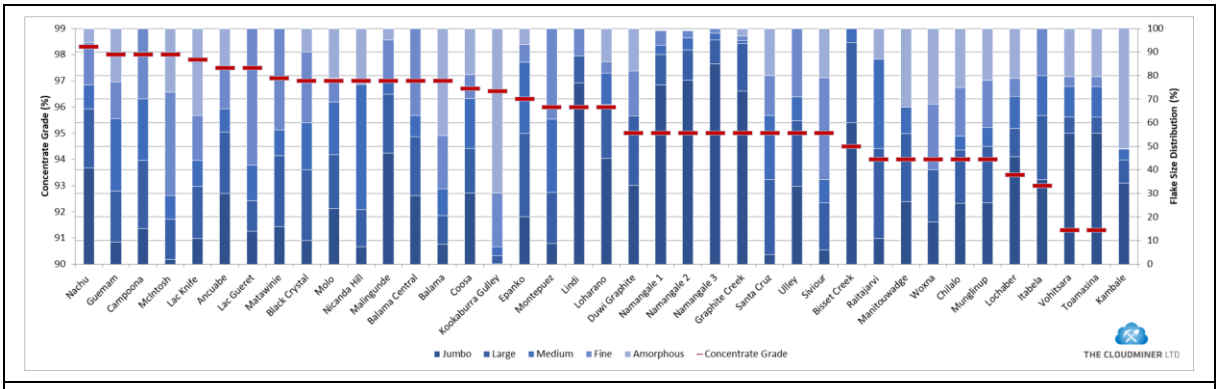


Select Resource Peer Analysis between N. America and E. Africa

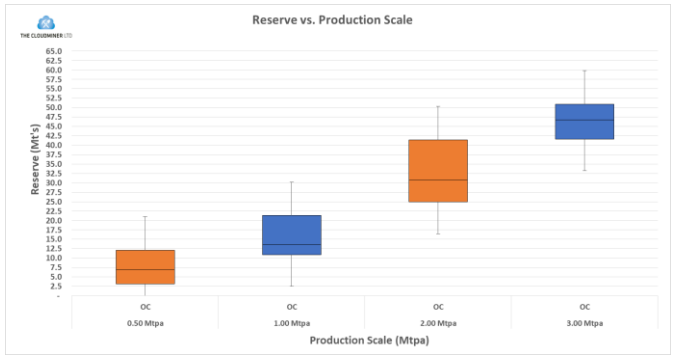
Graphite offers a complex conundrum with each project being good in its own right and often for different reasons to the next. Grade which is so often discussed as a key factor for most commodities under the old cliche "grade is king" is not always the telling sign of a good graphite project. While East African assets can indeed boast both impressive grades and in some cases size,

this is not always the case for N. American nor Australian assets as can be seen in the Resource Peer Analysis above.

Graphite as discussed does not necessarily conform to this golden rule with the flake-size distribution, type and location of impurities and the ease in which to upgrade the product all playing important roles in what makes a project "good". Concentrate grade for example ranks highly for N. American assets as can be seen below with the majority of the top 10 being Canadian, while Jumbo flakes are more prevalent in E. African Assets. Australia's McIntosh Project boasts both good concentrate grades and excellent metallurgy for the expandable market in yet another twist.



Global flake-size and concentrate grade peer analysis

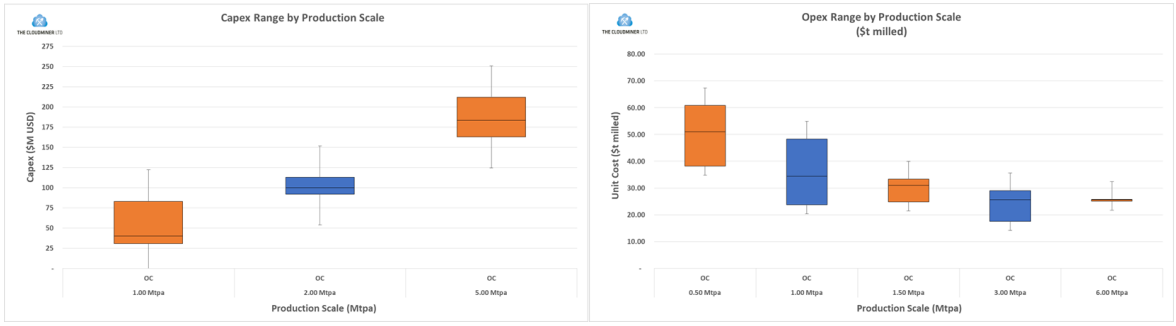


Open Cut Reserve vs. Production Scale

With such variability in both the assets and the application the task facing most asset owners is finding the right industrial partner to provide off take too. Like most industrial mineral producer's knowing your product and finding the right end user is critical. Syrah for example, being the nearest term producer competing with long established incumbents, is ready to shake up the market with their influx of new material on a grand scale. However the neutral remains intrigued to see just which end users will benefit from the material being provided. With production in the range of 100,000 tonnes per annum just how much of a dent will Syrah make into the ever growing critical markets such as hi-tech.

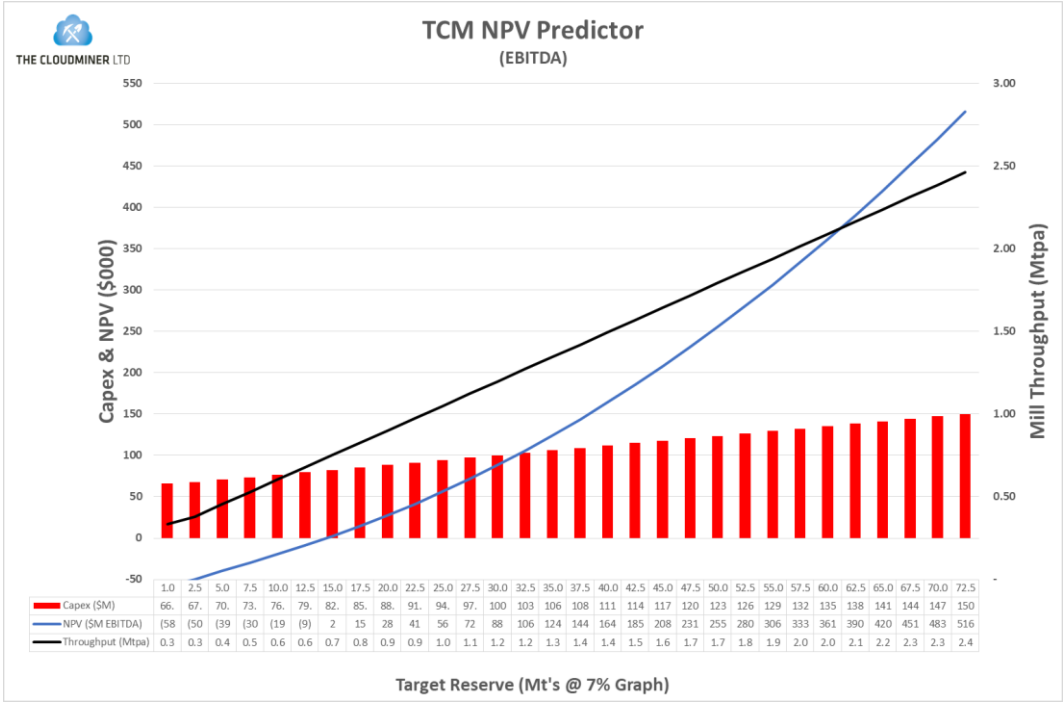
Alternatively simpler modular approaches to production, as first reported in economic studies by Bass Metals and their Madagascar Graphmada Project, have changed the approach to which juniors tackled the capital markets. Graphmada, which currently nears profitable production, began with a much smaller scale operation which in turn meant lower capital requirements in a bid to prove the project and establish a clear market for their product. Using modular technology the company is able to grow in response to the demand increase and in line with their current reserves.

TCM's data analysis and NPV predictor have been built off the back of modelling over 2000 minerals projects in order to look at such approaches. The use of peer data to determine the potential economics of a subject project offers a quick insight into an asset without full blown studies. While the number of studies that have been reported in the graphite space is still relatively small - approximately 45 in the last 5 years, the trends are clear.



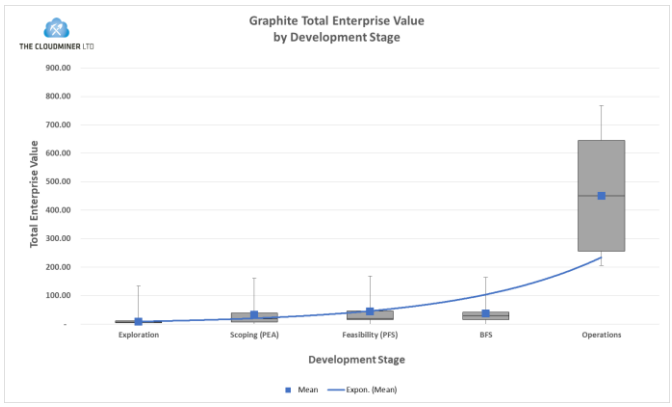
Capital and Operating Costs by Production Scale

In line with a rise in production scale the capital requirements increase also, whereas the operating costs decline as one would imagine with simple economies of scale. The break-even point for an average grade project at 7% contained graphite and using a basket price of US$1200/t of contained graphite would suggest that operations running a 1Mtpa production line would become economic above a reserve size of 15Mt on a pre-tax EBITDA basis. Beyond this the returns continue to be positive.



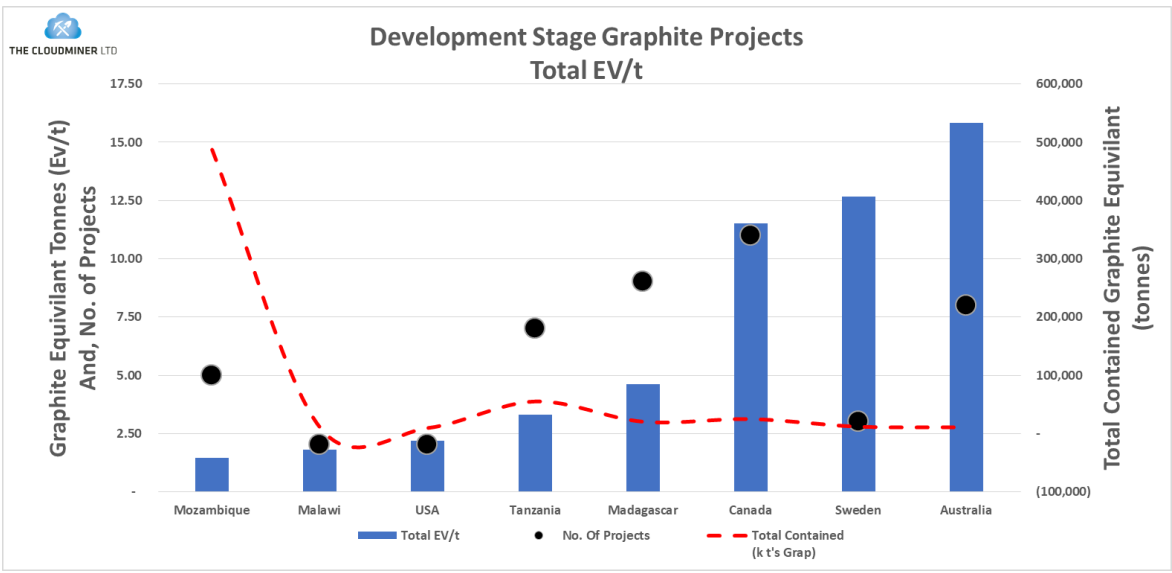
TCM NPV Predictor by Scale (7% TGC, US$1200/t TGC, pre-tax basis)

While understanding the assets geometry, mineralogy, metallurgy and ultimately costs requires a robust understanding by technically competent personnel, as an internal concept it is a useful exercise to continue reviewing the economics of a project based on peer comparison. The results of which can be useful to establish a grade or size target or can assist in screening and ranking projects for further investment purposes prior to a deep dive into the existing information.



Enterprise Value by Stage

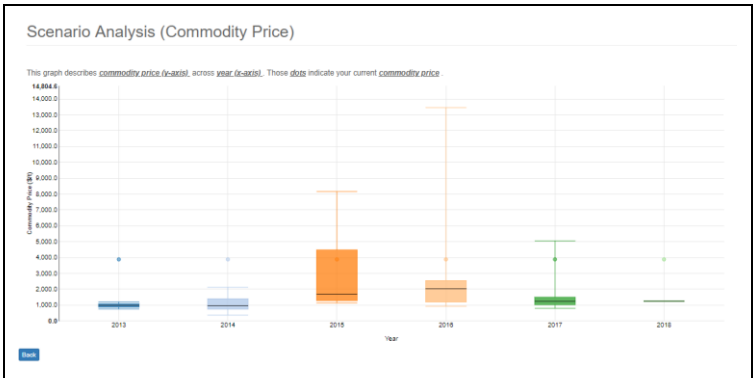
While the NPV of future cash-flows offers a good look at the asset as a standalone producing entity, reviewing the markets perception of a company's flagship project is also useful. The value accretion in de-risking a project through technical studies is well established in the graphite market with the Enterprise Value (EV) growing ever larger the closer to production the project gets. However not all assets are so simple with jurisdiction playing an important role in the valuation process. Australian, Swedish and Canadian assets all carry a premium over East African projects in the public's opinion. Although it should be noted the overall scale of the projects in Canada, Sweden and Australia are lower than their East African peers. Interestingly American assets appear undervalued compared to their western peers.



Total EV/t by Country Analysis

In conclusion over the last few years TCM has been fortunate enough to analyse the economics of the vast majority of the assets and companies in the graphite space. A lot has happened during this period in terms of news flow however the ability to get into production has been a slow race.

Many factors have been responsible for this such as scale, economics and pricing, fiscal changes in policy, ability to raise capital to name but a few, however with the modular approach more projects are nearing production now than ever. During 2015-16 the pricing for graphite was reported with great variability as juniors sought to find the most lucrative of markets, whereas the median over the last couple of years has fallen back in line with those reported in 2013-14 at around US$1100 to US$1200 per tonne. The ability therefore to attract the right end users and off take partners will help establish the winners as some projects seem destined for lucrative hi-tech markets, post additional processing, while other assets remain suitable for the less lucrative yet well established markets.



Past forecast commodity prices for TGC, US$/t,
As reported in technical studies

We look forward to seeing how the sector evolves while pursuing interests in specialty end markets such as Graphene and assisting new emerging graphite projects to find their place in the market.

ABOUT THE CLOUDMINER

The CloudMiner Limited (www.thecloudminer.com) is a web based data analytics software company that specialises in mineral valuations and peer analytics. Created by industry professionals both in mining, data and technology we have been modelling the economics of some 2500 plus projects for the last 5.5 years for project owners, investors and consultants. For more information about the types of services offered please email the team on info@thecloudminer.com.

QUALIFICATIONS AND EXPERIENCE

SENIOR GEOLOGIST

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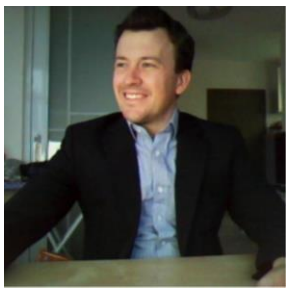
Daniel has over a decade of experience in both mineral and engineering geology with a further three years in the UK financial industry. Having worked with multiple commodities as an exploration and production geologist Daniel moved into consulting where he provides technical due diligence and independent technical assessments for investment purposes. Daniel Co-Founded the CloudMiner Limited in 2012 and has spent the last five years evaluating and researching a wide spectrum of minerals projects around the globe assisted by the TCM proprietary software and database.



SENIOR MINING ENGINEER

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Will is a qualified Mining Engineer with a diverse range of experiences and specialties encompassing both underground and open cut mining across several commodities. This includes specific underground operational experience with the following methodologies; large sub-level caving operations (Cu & Au), board & pillar (coking coal), remnant mining (Au) and cut & fill mining (Au). Technical experience also covers a number of other commodities including uranium, gold, iron ore and high-grade silica. Country specific mining experience includes Australia, Kazakhstan, Mongolia and the Philippines. Roles have varied from design work, modelling, mine planning and scheduling through to feasibility study management and operational management.