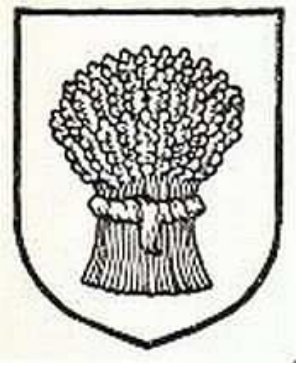
Monday, February 18, 2019



HALLGARTEN & COMPANY

Sector Review

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Revisiting Graphite

The Least-Hyped Corner of the Battery Metals World

Revisiting Graphite

Less Hype More Action

- + Since 2017 the price of most grades of graphite have recovered in a measured way from the depressed levels of mid-decade
- + The graphite space had its mini-boom in 2012/3 but has been largely a province of serious developers with advanced projects since, in contrast to the lithium/cobalt *promoterati*
- + The EV boom opens up a potential upside for graphite miners provided the growth in supply is matched to the growing demand
- + A high proportion of graphite developers have projects with advanced studies, meaning ready-to-go, which can be a good or a bad thing
- + Most are targeting value-added in graphite anodes for the Lithium-ion battery market but traditional usages should not be overlooked
- + Surging needle coke prices are cramping the potential of synthetic graphite to harvest extra demand for LiBs
- + Syrah is having trouble meeting its production targets. Any undershoot is good for the graphite price outlook and bad for Syrah's finances
- ✘ Graphite price movements and stockpiled quantities remain essentially at the discretion of the Chinese
- ✘ Market could be flooded short-term by the massively oversized Syrah mine in Mozambique

The Truism of Graphite

In all the noise and fury of the battery metals space the specific mineral that has the most serious companies, with the highest proportion of advanced projects, in terms of having FS, BFS or PFS in hand is the graphite space. None of the others (lithium, cobalt etc) come vaguely near, swamped as they are with wannabes, *promoterati* and arm-wavers.

In this review we shall look at what graphite is and its usages (without rehearsing *ad nauseam* the EV "boom"), its pricing and the likely players and their current status.

After the Cull

Using our system of classifying booms/boomlets and slumps as Lithium 1.0 and Rare Earths 1.0, the graphite space might tentatively be said to have just entered the Graphite 2.0 phase. Why the word "tentative"? The first flush of the graphite "boom" was in 2012/3 but was it really a boom? In comparison to Rare Earths and the more recent Lithium and Cobalt surges it scarcely rates. One of its problems was that the excitement was generated in the depth of the prolonged 2011-16 mining slump.

It was a bright light on the horizon but was quickly extinguished by the sheer lack of money in the market. Maybe 30 graphite plays arose out of the passing storm which compared to the Lithium and Rare Earth booms was very little to work with. In reality though thirty was probably all the market needed to eventually produce maybe 10 survivors that move to production.

So at best we would call what happened in 2013 a boomlet.

Fast forward (well, slow forward) to 2019 and we have a hardy band of survivors and only one from the ranks of wannabes in 2013 has arrived at production and that is Syrah Resources, which is a true behemoth, and maybe too large for its own (and the sub-space's) good.

The 800lb gorillas of 2013 were Syrah and Zenyatta and the rest of the field were comparative midgets. As mentioned, Syrah has gone onto become a producer while Zenyatta has given credence to the expression "one day a rooster, next day a feather duster". More on them anon.

A couple of handfuls of the minor players have survived, and although we cannot use the word "prospered" they have moved forward, albeit glacially, considering the market was not prepared to give most of them extra money until the EV wave arrived to float their boats again.

The Field

Or at least part of the field…

	Ticker	CapEx	Grade Cg Resource	Cost per Tonne	Location	Status
Leading Edge Materials	TSX.v: LEM	US$16.7mn	9.3%	US$730	Sweden	Mothballed
Northern Graphite Corp	TSX-v: NGC	USD$85.5mn	2.2%	US$766	Canada	Feasibility 2012, PEA 2018
Nextsource Materials	TSX: NEXT	C$18.4mn	6.1%	US$353	Madagascar	Feasibility 2015
Syrah Resources Ltd	ASX: SYR	US$300mn	19.0%	US$475	Mozambique	Producing at 50%
Nouveau Monde Mining	TSX-v: NOU	USD$230mn	4.0%	US$532	Canada	PEA 2016
Focus Graphite	TSX.v: FMS	US$141mn	15.0%	US$468	Canada	Feasibility 2014
Kibaran Resources	ASX: KNL	US$77.5mn	8.3%	US$500	Tanzania	Feasibility 2015
Mason Graphite	TSX.v: LLG	CAD$258mn	28.0%	US$505	Canada	Feasibility 2018
Zen Graphene	TSX-v: ZEN	US$411mn	3.9%	US$2,046	Canada	PEA 2015
Elcora Resources	TSX: ERA	-	n/a	n/a	Sri Lanka	Mothballed

Graphite

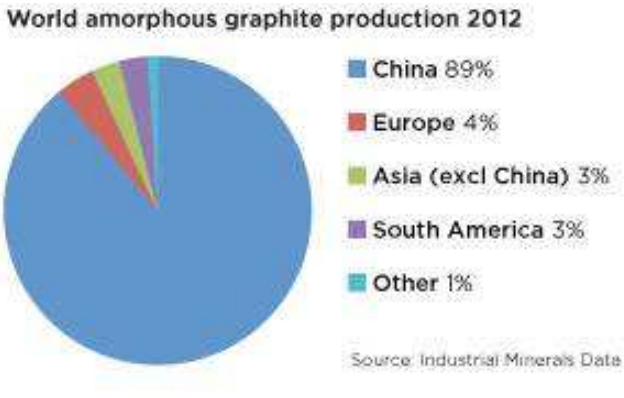
The mineral graphite is an allotrope of carbon and is naturally-occurring form of carbon. Its name comes from the Greek word for writing (due to its use as pencil "lead") and has the chemical symbol C (as do diamonds and coal). The application for graphitic material is constantly evolving due to its unique chemical, electrical and thermal properties. It maintains its stability and strength under temperatures in excess of 3,000°C and is very resistant to chemical corrosion. It is also one of the lightest of all reinforcing elements and has high natural lubricating abilities.

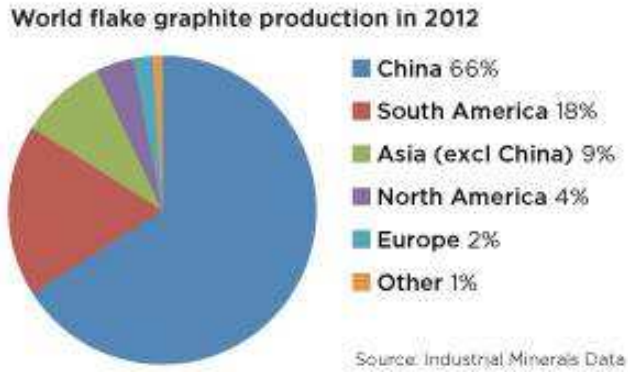
The mineral is starting the be considered as one of the more strategic elements in some surveys coming out of leading industrial nations, though this is relatively new as its main uses were for cathodes (mainly synthetic graphite in steel production and aluminium smelting) and steel-industry crucibles which, while important, scarcely rank as strategic uses. Two qualities of graphite that are driving the new applications are its electrical conducting powers and its lubricant qualities (both in wet and dry forms). Much talk relates to the new application on the block, graphene, which has been endowed with a variety of powers by its enthusiasts. We shall not digress into it here for it seems to be a usage that we do not need to justify the market for more graphite production and has gained the taint of over-hyping that occurs when a new application falls into the hands of Vancouver's corporate promoters.

The proven usage that has generated most excitement in recent times is that of batteries, primarily nickel-metal-hydride and lithium-ion batteries. The demand is not phantom by any means as it has been a prime driver of graphite demand since the late 1980s. The underlying reason for this growth was the expansion in usage of portable electronics, such as portable CD players and power tools. Laptops, mobile phones, tablet, and smartphone products have increased the demand for batteries. Electric vehicle batteries are anticipated to increase graphite demand.

Natural and synthetic graphite are used to construct the anode of all major battery technologies. The Lithium-ion battery utilizes roughly twice the amount of graphite than Lithium carbonate. As an example, a lithium-ion battery in a fully electric Nissan Leaf contains nearly 40 kg of graphite. An oft-quoted statistic is that the average lithium-ion battery in a cellphone or laptop has ten times as much graphite as there is lithium.

A lot of the more bulk uses of graphite utilize the more prolific grades; hence the lack of crisis mode in governments with relation to this mineral.





Origins and Grades

The largest producer is China (according to Industrial Minerals- Fastmarkets figures – shown at the right). The most well-known traditional Western supplier is Canada which is somewhat of a swing producer with the only player being Timcal, owned by the French group Imerys. Its mine is currently mothballed, and they have said ore will be depleted by 2020/21.

Graphite is developed as an accessory mineral as laminated aggregates dispersed through schistose and siliceous metamorphic rocks. Graphite is an opaque mineral with six-sided form and crystallises in the hexagonal system with

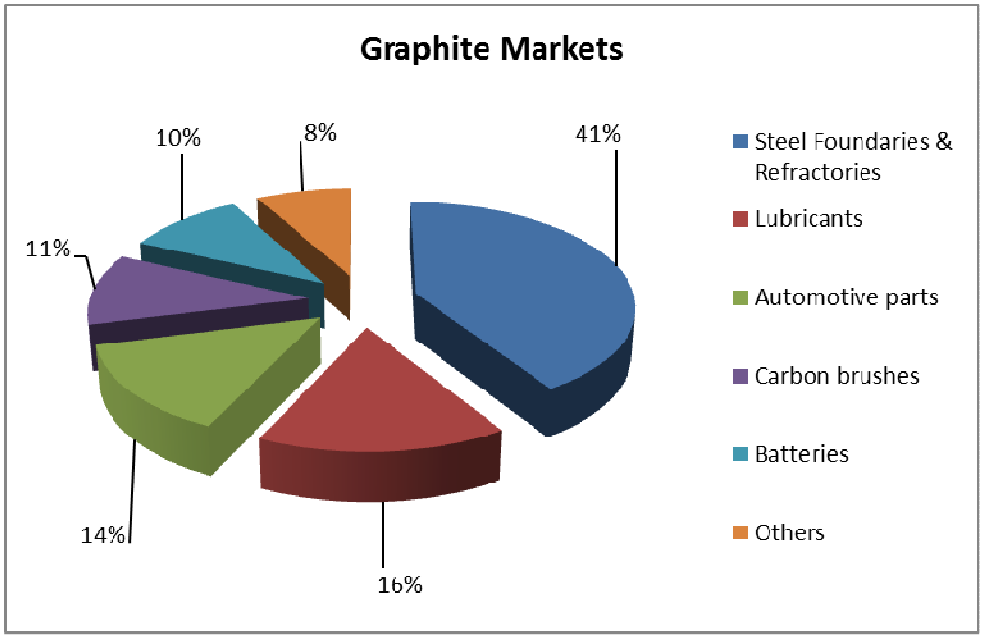
rhombohedral symmetry. It has a perfect basal cleavage and thus presents as flat flakes. These have a metallic lustre. Graphite is found as both flakes (>70µm) and a finer-grained amorphous, microcrystalline type.

Graphite Reality Check

Firstly we shall start with the great truism of the graphite space: the West needs its own secure sources of supply but no one is willing to pay a premium for that security, or for environmentally sustainable supply either, especially when they are trying to drive battery costs down.

The second truism may seem an oxymoron but is worth repeating: deposits produce a range of flake sizes. The prices of XL flake categories are much better than small flake, but the markets are not nearly as big. The flake graphite market is 750,000 tpa. All graphite juniors are basing their economics, such as they are, on being able to achieve high large/XL flake prices. But there is only room for one or two new producers (or a multiple of that if Syrah did not exist).

All that being said, there is an opportunity in graphite, but it is not just in batteries. Below can be seen the current usages for graphite.



There exists a significant niche opportunity in the production of large, and particularly XL, flake graphite in North America, upgrading it into value added products, and selling them into North America (and European) industrial markets. Production of large/XL flake graphite is declining and there are shortages because most comes from Shandong Province in China which is suffering from the depletion of ore reserves and strict environmental regulations. Production growth in China is coming from Heilongjiang Province, which is almost all small flake and destined for the LiB market.

Large/XL flake graphite is mainly used in higher price, high margin industrial markets. In the West, these

markets are dominated by a small number of trading companies, most of which are privately owned. They essentially buy, grade, inventory, repackage and do value added processing on Chinese graphite and sell it into many small, specialty markets. This should be a matter of concern to the US (and particularly the US military).

The prices they get are far higher than those quoted by industry sources that get data from a small number of large volume "commodity" buyers. These companies are effectively sales agents for Chinese graphite miners and as we have seen over the last year the relationship between China and the US is in rocky territory indeed. Almost none of these intermediaries own their own source of supply and the only North American graphite mine (that of Imerys) will be closing in the next year or two due to the depletion of reserves.

With respect to the bigger picture, potential demand growth from producers of Lithium ion batteries used in the EV and grid storage markets has focused a lot of attention on graphite, but junior graphite wannabees are facing a number of significant challenges.

Almost all LiB anode material is manufactured in China from small flake graphite and there is excess production capacity. Some analysts talk about aging, declining graphite mines in China and environmental closures but they are referring to the traditional production areas in Shandong Province. Graphite production capacity in Heilongjiang Province is expanding, there is currently excess capacity and resources are very large. As a result, the anode material market is a low margin, competitive business and will be for some time. Excess capacity may eventually be used up but only after the substantial growth forecasts for EVs are realized.

Pricing

Graphite comes in widely varying grades. Not surprisingly this is because of graphite's abundance in the earth's surface. Thus it is not a rare commodity, however, it is very much less common in some specifications and it is these that make the difference between a so-so project and one with a unique product the market will pay a premium for.

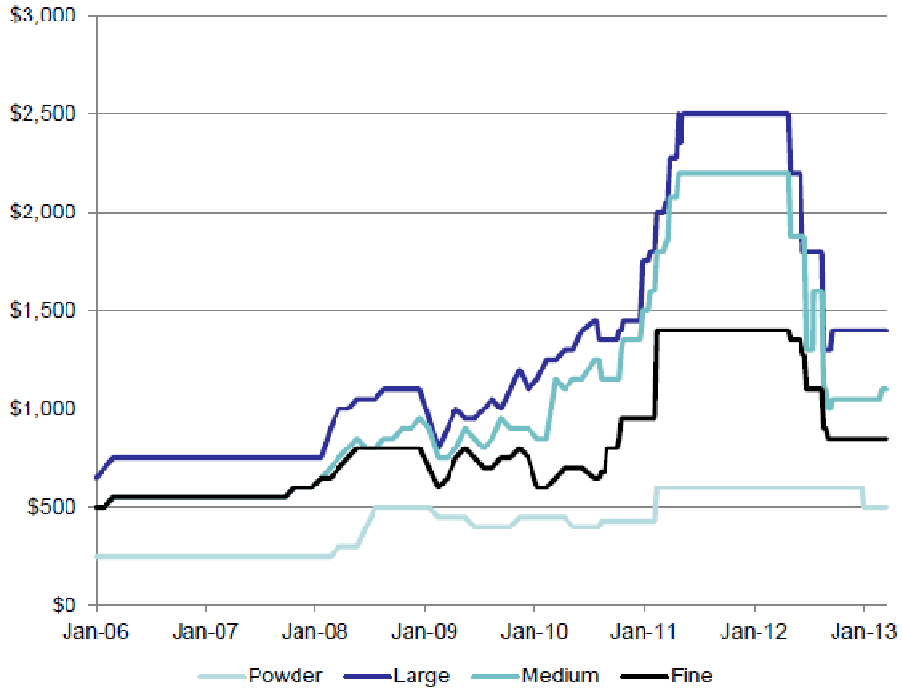
The previous time that graphite flake prices breached the $1,000 mark per ton was the in the early 1990s. This was a recovery from a long period of oversupply and was driven by new demand from steel refractories and the replacement of asbestos in brake linings. Japan overtook the US as the leading mass producer of cars which added a new layer of demand to the graphite industry.

This phase only lasted until 1994 when prices again halved to around US450 per ton. This was due to China emerging as a world power in flake graphite production and prices crashed to all-time lows. As Chinese producers focused on exporting and gaining market share from Europe and North America, flake graphite went into freefall.

As with so many other mineral commodities that the Chinese turned their tender mercies towards a long period of stagnation followed. The world became reliant on low cost flake graphite from China. The volume and quality at which China could produce flake ensured only the niche, specialist and value-added producers (e.g. Timcal/Imerys) survived elsewhere in the world. With Western consumers unwilling to sign long-term contracts with depressed prices and over-supply there was little to scope for

new non-Chinese entrants on the production side. It took over 15 years for any significant price rises to return.

Graphite prices rose strongly between early 2008 and their peak in 2012. The rise over that time was fivefold. This move was due to growing demand from new applications and supply constraints in China. The chart that follows highlights this move.



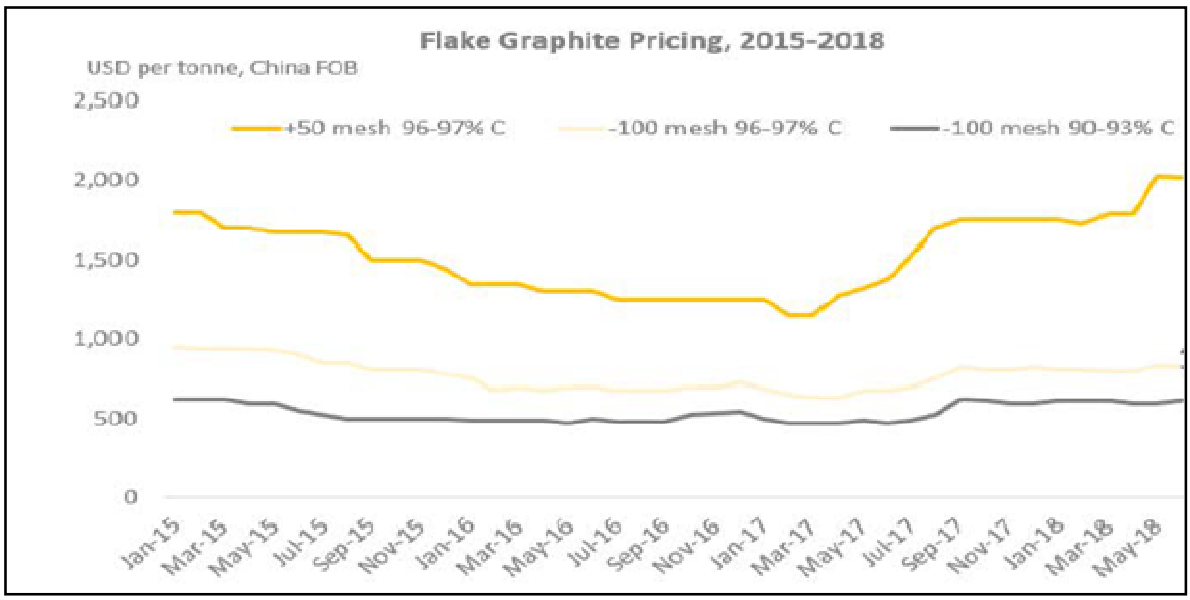
The European graphite market is estimated to consume approximately 20% of the global demand for natural flake graphite, or around 500,000 tonnes per annum. Currently more than 90% of Europe's graphite demand is imported, mainly from China.

Graphite Prices – The Recent Trend

While graphite shows little potential for the same type of price squeeze that has propelled other battery metals higher, there is a distinct feeling that major Western end-users want to see a non-Chinese graphite supply (and downstream value-added chain) industry evolve so they will not be vulnerable to Chinese policy gyrations or attempts at market manipulation.

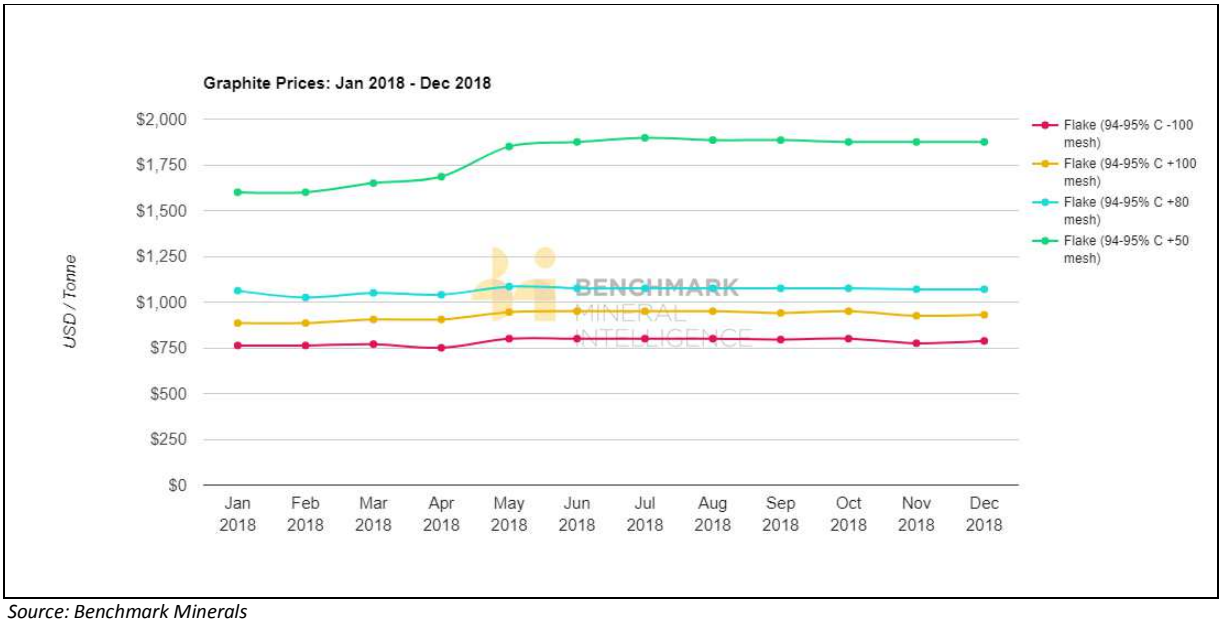
The turn in graphite prices occurred in mid-2017 with the price of large flake (+80 mesh) graphite increasing by around 30% in the space of a few months, again breaching the key US$1,000/tonne (FOB China) level. The move was driven by tightness in the supply of large and XL flake graphite and some

speculative investment.



Source: Benchmark Minerals

European and North American prices usually trade US$50-100/tonne higher than China FOB, most of the time. XL flake (+50 mesh) prices have also risen significantly while smaller flake sizes have experienced more moderate price increases.
Since the price uplift of 2017/18 the mineral in all its categories has largely flatlined:



Source: Benchmark Minerals

Reasons cited for the revival in graphite prices included:

- Production and supply problems in China due to stricter enforcement of environmental and safety standards and restrictions on the use of dynamite in some areas. High purity and large flake sizes have been particularly affected. Also, production costs have continued to increase due to environmental regulations, higher taxes and land fees, labour and power cost inflation and shortages of ore supply.

- China is introducing a new environmental tax in January, 2019 which is expected to have a significant effect on the graphite industry and has announced its intention to build a graphite stockpile equal to 80% of annual production by 2020.

- The steel industry started to recover in 2017 but has been flatlining of late. Refractories remain the largest market for flake graphite and mainly require larger flake sizes.

- Continued strong growth in lithium ion battery demand. Small flake graphite is used to make LiB anode material because it has been plentiful and low cost which may change if EV growth projections materialize. Also, synthetic graphite prices have surged due to environmental and capacity problems relating to its main use in electrodes for the steel industry. This is seriously affecting the supply and pricing of synthetic LiB anode material which makes natural graphite more attractive.

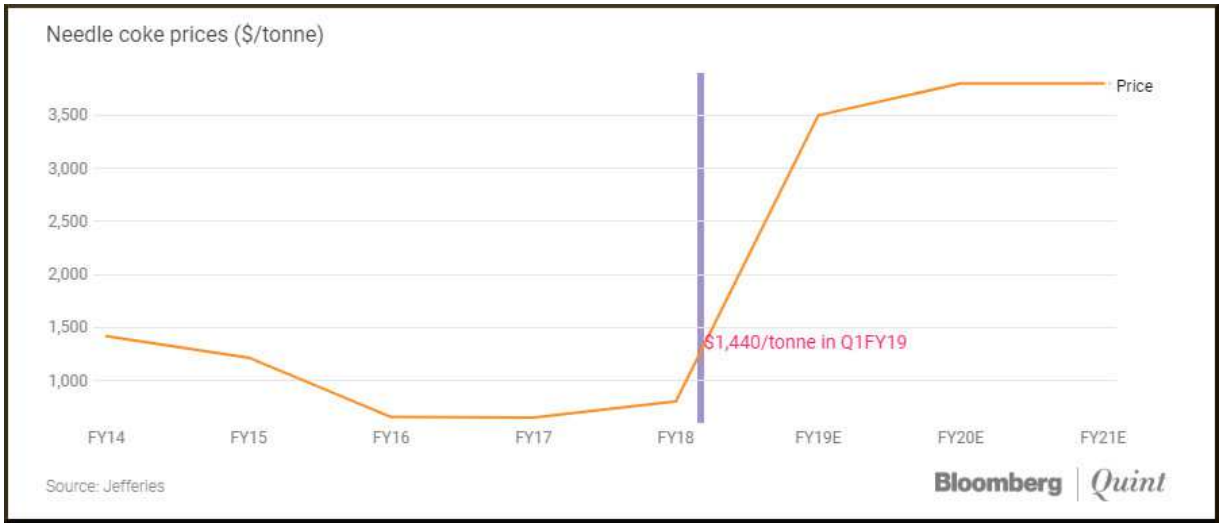
- XL flake production is declining as resources in Shandong Province, a major source, are being depleted and it has also been heavily affected by environmental closures. Heilongjiang Province, the largest producing region, has mainly smaller flake.

- The expandable graphite market, which is largely based on XL flake, is one of the fastest growing along with LiBs and this is putting additional pressure on prices. Expandable graphite is used for thermal management in consumer electronics, as a gasket material in the automotive, petroleum, chemical and nuclear industries, to make conductive plates for fuel cells and flow batteries, and as a fire retardant.

Needle-Coke - An Oft-Overlooked Factor

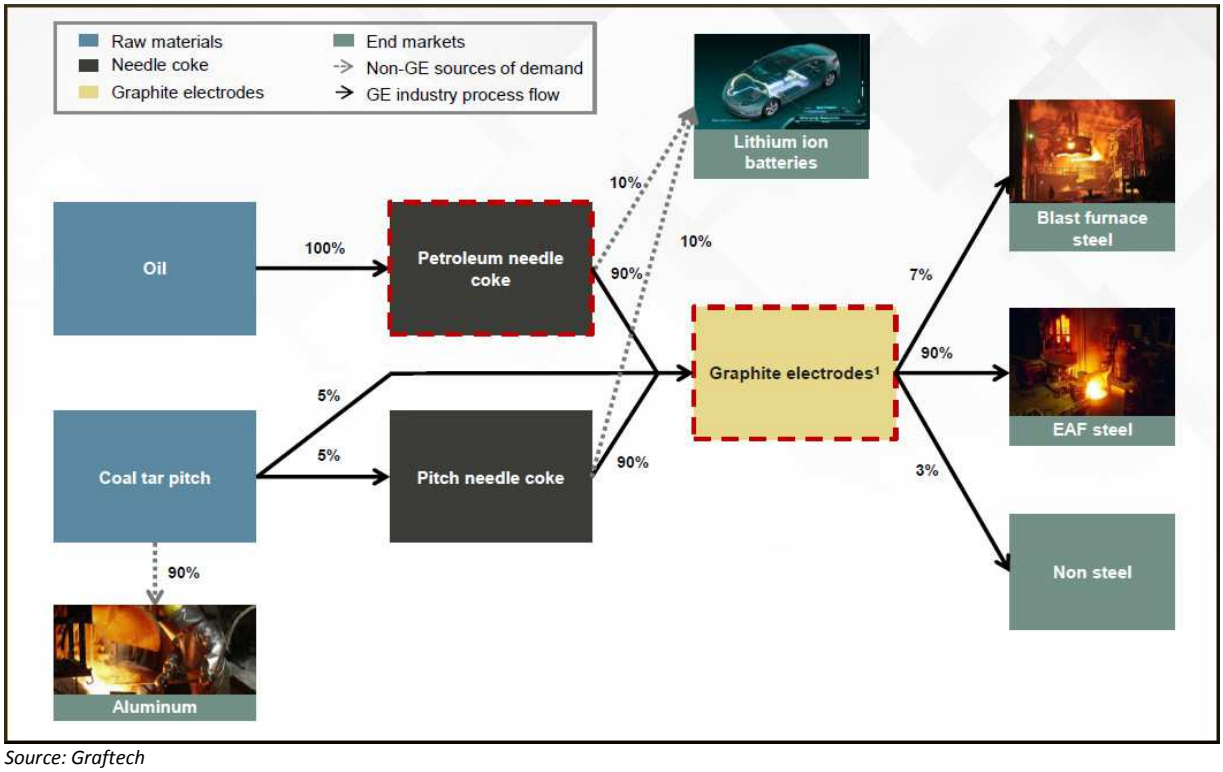
Needle coke is the key raw material for producing synthetic graphite for electrodes. The seldom mentioned (in mining circles) reality is that synthetic graphite is currently the source for 40-50% of the graphite for LiBs. In 2018 the cost of needle coke rose to its highest in five years at $1,440 a tonne in the quarter ended June.

On the following page can be seen some projections from Jefferies, that estimated the price to more than double to $3,500 by March 2019. The price of finished electrodes has soared making that in some ways a more attractive destination for graphite producers than LiBs. Even if the rise is not as steep as this chart's projection might posit, the prospect of synthetic graphite being dethroned form its dominance in LiBs is very strong.



Source: Jefferies/Bloomberg

Needle coke represents 25%-45% of the cost to produce a graphite electrode with petroleum needle coke. The interesting flowchart below shows the sources and applications of synthetic graphite:



Source: Graftech

Interestingly the largest producers of needle coke are non-Chinese, companies such as Phillips66, C-Chem and Seadrift. Phillips66 is the largest producer of needle coke around the globe with its capacity seizing over 20% of the global total. Few Chinese companies can independently produce high-quality

needle coke because of high technical barriers. Global needle coke capacity reached about 1,600k tonnes in 2017.

In recent years (2012-16) the demand for graphite electrode for electric arc furnaces in steelmaking grew slowly because of a downturn in the steel industry. As the Chinese government pushed to cut excessive overcapacity and get rid of substandard steel products, the demand for electric-arc furnace rose significantly This pushed the demand for graphite electrode higher in 2017, boosting the demand for needle coke. At the same time, rapid growth of EVs increased consumption of needle coke in lithium battery anode material. The demand was about 80k tonnes in 2017 and is predicted to surpass 250k tonnes in 2021.

New petroleum needle coke capacity is expensive and difficult to add and there has been no new greenfield capacity (ex-China) since the 1980s.

Excessive price rises in any metal inevitably prompt a hunt for replacement sources and it is quite possible that the synthetic graphite market will become a victim of high needle coke prices.

Graphite Mining – Big is Certainly Not Better

Gigantism is always a problem in the mining space. Let's start with the reality that the flake graphite market, at least for the moment, is 750,000 tpa.

In the graphite arena, many companies are modelling projects in excess of 50,000 tpa because of their perception that massive throughput is the only way their economics make sense. In doing so they ignore the effect this will have on prices and the challenge of selling large volumes of small flake and fines. Syrah is the poster child for this strategy (with Zenyatta, of old, being of a similar disposition). This has led us to style Syrah as the Molycorp of graphite. Northern Graphite, for example, is taking a more conservative route and starting at 20,000 tpa to 25,000 tpa with expansions as the market grows. Most players have big resources but should only produce what the market can bear.

Syrah – Beware of Companies Named After Wine

Syrah Resources (SYR:ASX) has built and is currently commissioning a mine in Mozambique with a nameplate production capacity of 350,000tpa. This was a dumb idea from the start and it is not going well. Capital costs are more than double original estimates, the project is well behind schedule and after a more than a year of commissioning, it has only achieved 50% of throughput and up to 70% of recoveries. Syrah would have gone bust in September, 2017 and again in 2018 but was bailed out both times by equity financings in Australia. So far it has raised over US$400 million.

The project is cash flow negative and has to increase production (if that is even technically feasible) to lower unit costs but higher production will depress prices and it is unlikely the market can absorb the volume. It is a no-win situation for them. In the interim, Syrah's production has further depressed

prices and uncertainty over its future has put a chill on the financing and development of other projects. Anyone thinking of investing in graphite has to have an opinion on Syrah.

Zenyatta – A Lesson to Us All

The long-term decline and fall of Zenyatta (recently renamed Zen Graphene Solutions) is quite poignant. In fact the chart does not even go back to its apogee in July 2013 when its stock price nearly touched $5.

We met the company back in the heady days of the graphite boomlet in 2012-13 and the company had a $300mn market cap when most of its "competitors" were under $100mn and the majority under $20mn. In their inimitable way institutional investors gravitated towards the same taking comfort in size. The rest is history with the rule being "the bigger they are, the harder they fall".

The thing that struck us at our first encounter was that the company's Albany project was oversized (capex-wise), not only slightly, but massively. Conventional wisdom on Bay Street is that size does matter and you can never be too big. In specialty metals this becomes counterintuitive because if a metal was produced and supplied in such enormous quantities then neither the metal nor its applications would be "special". Indeed they would verge or merge into base metals.

So as the rest of the graphite players scrambled to downsize their projects, Zenyatta stood its ground with the biggest capex for any graphite project on Bay Street. Verily, it seemed to be determined that this should be carved on its corporate gravestone. The problems at its Albany project are multifarious (though it should be noted that with a proposed output of 30,000 tpa, the Albany project is not analogous to Syrah, except in capex).

Firstly, ZEN's deposit is essentially a pipe with a huge strip ratio. The capex includes $55.2mn in waste and overburden removal and sustaining capital has another $188mn in the first seven years of operation for a total of $243mn. Total capex was $412 million which with the sustaining capital took the project to over $700 million.

Secondly, Zen has a 4% grade amorphous graphite deposit, that would not be economic even in China. ZEN claims they have a "special" graphite deposit (and secret sauces as well)) that can be upgraded into high value products using standard industry purification processes. The purification process is standard at a small lab scale but it is an expensive, complex hydrometallurgical process that has never been used on a commercial scale.

Thirdly, ZEN's graphite might be worth $500/t and yet they used US$7,500/t in the PEA because it's all going to be upgraded and sold into "high value" markets. So said them….

All of these are good reasons why the company never tried to go from a PEA to a FS and why the secret sauce from graphene needed to be liberally applied to cover up the strange flavour of the dish being served to the market.

The lack of responsiveness to the market trend ultimately resulted in an investor-led agitation for change which resulted in the long-time CEO being defenestrated and Don Bubar, a figure we have long known in the specialty metals space being emplaced in the role, at least for the interim. The name change to Zen was the signal of the new strategy. Investors from the early years, having lost almost all their investment, will not be feeling very Zen.

Pulling Zenyatta out of its dive though is going to be a harder task than just swapping CEOs and applying the lipstick of a "cool" name. The "others" in the graphite space have spent five years resizing and have relatively "oven-ready" projects on offer for offtakers while Albany is a turkey that doesn't fit in the kitchen let alone the oven.

Comparatively Speaking

We decided to look at some comparatives of names that we have looked at the longest in this space. We have used the same price assumptions for everyone to put them on a comparable basis. An assumption then has to be made about where the product will be sold to calculate concentrate transportation costs.

This is necessary to adjust for the different locations of the deposits. All the numbers in this spread sheet are pretty well from NI43-101s with concentrate transportation being the only real estimate by us.

With graphite it's not just about grade. It's where one can deliver the product and at what cost. The table that follows is illustrative of this.

Production Metric Comps

(US$)	Northern	Mason	Focus	NOU	Syrah
Grade (%)	2.1%	28%	15%	4.4%	16%
Annual production (tonnes)	**20,800**	**51,900**	**44,300**	**100,000**	**250,000**
Average revenue per tonne	**$1,698.60**	**$837.93**	**$957.60**	**$1,094.90**	**$630.00**
Cost per tonne of ore	$12.96	$102.00	$47.94	$16.23	$58.59
Mine gate costs/t of concentrate	$726.92	$373.41	$339.23	$384.62	$375.00
Concentrate transport/t [3]	$37.50	$131.65	$124.21	$147.50	$100.00
Margin per tonne	**$934.18**	**$332.87**	**$494.16**	**$562.78**	**$155.00**
EBITDA (millions)	$19.43	$17.28	$21.89	$56.28	$38.75
Capital Cost (millions) [4]	**$85.80**	**$211.80**	**$140.90**	**$229.80**	**$300.00**

3. assume 10kt sold in NA, 20kt in Europe, rest in Asia

4. incl working capital, reclamation bonding, capitalized startup costs

Northern Graphite has the lowest grade but the best economics because of the highest revenue per tonne (due to flake size distribution), lowest cost per tonne of ore mined and processed (simple flowsheet with fewer grinding and flotation steps, higher throughput, access to natural gas, good location which affects the cost of labour, supplies and equipment), and low capital costs. This is evidenced by Northern having a similar EBITDA (concentrate production times margin) to Focus and Mason despite having a much lower grade and producing half as much concentrate.

It is notable that very few graphite projects are economic due to low prices and high capital costs. Most are presenting their economics using prices that are much higher than market or mixing in value-added processing to make the mine project look better. Despite LiB demand growth, graphite prices have not responded due to Chinese small flake oversupply and the onset of production from Syrah (even though it's only at 50% of nameplate).

Mine Building Costs

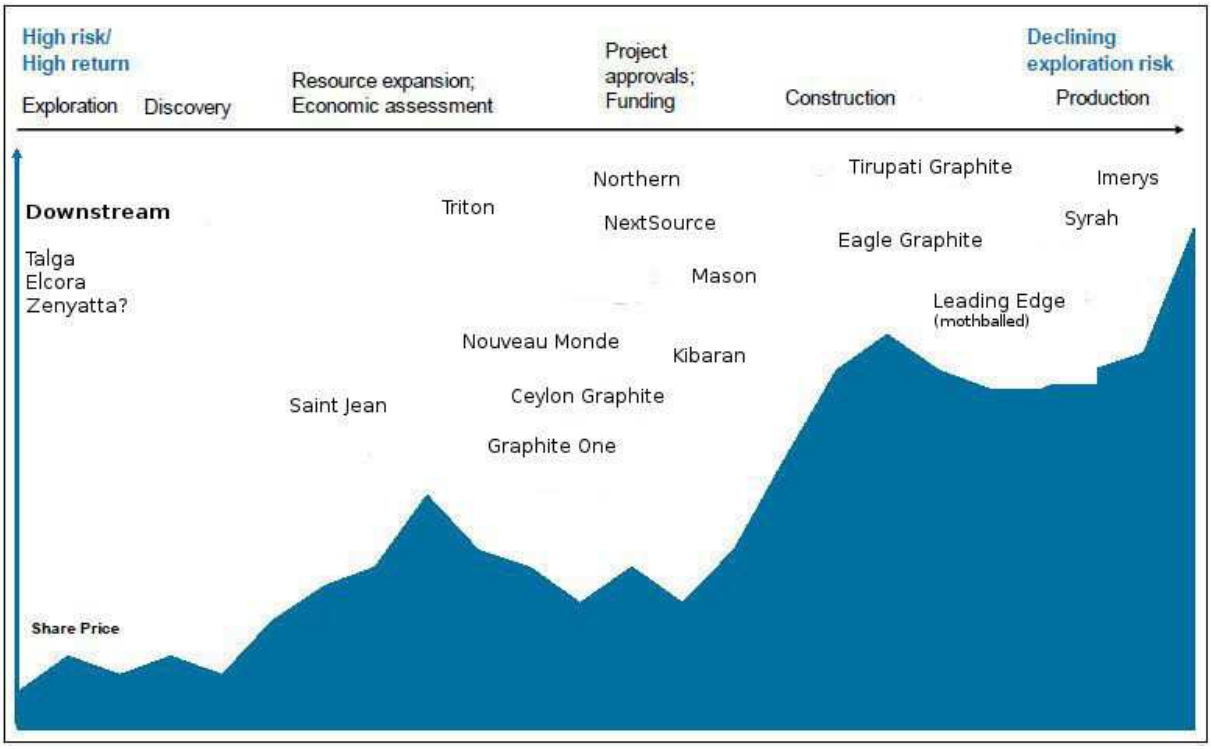
Opinions are divided on how much a graphite mine and its attendant processing facilities should cost. We have met those who are skeptical that a mine can be built for $30mn or $40mn in Africa and we have met others that favour the gargantuan and tout budgets in the multi-hundreds of millions. Imerys,

one of the industry establishment, recently built a 20,000tpa mine in Namibia which involved retrofitting an already existing fluorspar plant and it still cost US$60mn.

Three new graphite mines have come into production in Africa and all have metallurgical problems. Syrah has only attained up to 70% of recoveries on a limited basis and 50% throughput after more than a year of commissioning. The new Imerys mine in Namibia opened and then closed as concentrate purity and throughput design levels could not be achieved. AMG has started up a small 9,000tpa operation in Mozambique which is also having metallurgical challenges. African projects often extoll the benefits of weathered ore which results in lower drilling/blasting/crushing/grinding costs. However, clay minerals can seriously affect recovery, throughput and purity.

The Graphite "Lifecycle"

Below can be seen our "lifecycle" chart adapted for the Graphite space. Imerys, the grandfather of the industry is clearly ahead. But with its main mine nearing the end of its life and the fluctuating fortunes of its new mine in Namibia the question is who shall be the supplier (if any) to its processing plants and others.



Elcora was briefly producing but our intelligence tells us that has ceased production at its small mine in Sri Lanka. Eagle Graphite has a graphite operation in British Colombia but volumes are so small that it is essentially a pilot plant.

As noted, Syrah Resources, after more than a year of trials and tribulations, has entered the market and declared commercial production in Mozambique even though most recent numbers indicate it is operating at only 50% of nameplate capacity. Its viability was questionable before because the project is "too big for the market" but running at half capacity inevitably raises the question of whether or not it can survive.

After that come a bunch of developers, that are milling around in search of offtakers or financiers.

Interestingly the new kid on the block, Ceylon Graphite (a TSX-V listed entity), looks like it's behind the pack (mainly because it only has one resource estimate, and even that is not on its main K1 project) and yet it is moving full speed ahead with mine rehabilitation at K1 and plans to start exploiting the very rich graphite veins there without dragging through the whole PFS/FS/BFS rigmarole. In fact, reactivation of the mine will cost maybe 20% of what preparing a FS would cost (such are the screwy economics of mining these days). So this project could be in the producer category less than 12 months out from here.

Tirupati Graphite is an upcoming London listing of assets controlled by an Indian group that are currently graphite processors in India and are shortly opening some small mines in Madagascar.

Mason Graphite is stockpiling bits and pieces for a future operation and this is impressing some. They need to be funded yet (and the pieces assembled into a functional entity) before this means they are any more advanced. Their December FS update hiked the capex by over 25%.

NextSource continue with their plans for a modular approach to adding capacity in Madagascar but are not, as yet, producers. This company is not as advanced as we had thought they would be at this time considering their low capex.

Hopefully Leading Edge will return to fray with their plant in Sweden (which briefly got into production several years ago).

In preparing our estimation of where the various players are in the race to the graphite "finish line", we have discarded some well-known names, such as Great Lakes, Lomiko, Focus and Canada Carbon, from the running. The recent travails of Zenyatta (now gone Zen in a makeover) make us suspect it will never be a miner and its releases are focused on its technologies. Likewise with Talga and, seemingly, Elcora.

Great Lakes appear to have dropped any mining pretensions (to focus on processing) and Canada Carbon is going to be a marble miner first (so hard to quantify). Focus is not our radar screen and Lomiko seem to be eternal explorers.

Risks

The risks facing the graphite space at the moment are:

- ✘ Graphite price weakness
- ✘ Manipulation, either covert or overt, by the Chinese of the marketplace

- Financing difficulties
- Excessive supply from too many projects coming on line mid-term

Price weakness is less a case of potential demand faltering (which is highly unlikely) but rather of some sort of malevolent price-spoiling action emanating from China. If it did it would be self-harming in the first instance. With some of the graphite wannabes targeting the value-added chain, lower prices (temporarily) may damage mining margins but it's unlikely they would hurt anode sales prices.

Financing is a perennial issue in mining markets but

As noted many of the remaining graphite projects won't be going anywhere due to excessive capex numbers attached to their aspirations. Syrah will most likely be the only "big" producer to come to market with the other likely entrants being those non-disruptive smaller capex players.

Conclusion

Graphite received little focus in the wave of battery metal obsession that began in 2017. This was probably for the best as it avoided the spike and dump that have afflicted the Lithium and Cobalt wannabes. It also meant that there was no deluge of new graphite names. This kept the field of graphite developers to a reasonable number, and all of the remaining players seem to be serious in their production intentions. As most of them have advanced studies/mineplans in hand, they have their fingers poised above the "Go" button awaiting propitious pricing (and financing) conditions, but then again many have been poised in that position for years now.

Gargantuanism has been the curse of the mining industry this century. Something relatively simple like graphite should have escaped the curse but in the case of the two companies cited (Syrah & Zenyatta), they embraced the philosophy with both hands and made it their strategy. The only player from the Class of 2012/3 that has reached production is the party that one least wants to see in the picture, i.e. Syrah Resources. In our worldview production trumps all but in the graphite space if that production is "dumb production" then it is a lot worse than producing nothing at all. The advent of production at Syrah's mine is watched with trepidation in the graphite space. Perversely if it fails then it is good news for the rest of the graphite community. This might be seen as the last gasp of gargantuanism in the graphite sub-space. Hopefully the operation will continue operating sub-par and thus not reach its nameplate until the market has grown a bit more and some other supply sources (synthetic graphite) have retreated some more.

The deposits most likely to be developed are those with good flake size distribution, a reasonable capital cost and a realistic production level relative to the size of accessible markets. There are one or two Canadian projects that meet these criteria. There are a few players in Tanzania show promise but the new mining law there remains a barrier to development. African projects are tainted somewhat by the metallurgical problems of Syrah and Imerys and the substantial cost overrun of Syrah which demonstrates it is not cheaper to build a mine there.

While graphite shows little potential for the same type of price squeeze that has propelled other battery metals higher, there is a distinct feeling that major Western end-users want to see a non-Chinese graphite supply (and elaboration) industry evolve so they will not be vulnerable to Chinese policy gyrations or attempts at market manipulation.

Several outcomes can be envisaged for the graphite space. In a low demand growth scenario, the oversized production by Syrah causes prices to remain stagnant and possibly decline. In a weak demand outlook or falling prices, Syrah could face financial difficulties and be removed from the picture. This would conversely, possibly, lead to higher prices. In a growing demand outlook (the "EV saves the world" scenario) the excess(ive) supply from Syrah is absorbed by the market with prices remaining stable or moving higher if EV demand exceeds even what Syrah can provide. This provides a scenario for more entrants to move into development.

So we have a strange scenario where things might be good or they might not be with the swing factor being Syrah, a behemoth that should never have happened, a Molycorp in the graphite space. Most players (and investors) have hunkered down waiting to see how this epic struggle of Syrah with itself will play out.

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