Why The Graphite Sector Is Heating Up, How To Evaluate Opportunities, And What I Own


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- During the graphite boom in 2012, investors experienced a huge run-up in graphite stocks, only to be let down as their performance drastically outpaced their fundamentals. There is now an opportunity for contrarian investors to re-evaluate what's going on in the market. Fundamentals have changed given recent news in the sector, and the stabilization of prices
- In this article I explain what graphite is, different types and deposit geology, current and future uses, supply and demand trends, pricing, a brief market comparison, and most importantly, my six key criteria for what you need to know about investing in graphite
- Blue-sky potential remains enormous from the incremental demand that will be created by 'technology grade graphite' to be used in emerging green initiatives and clean technology
- Supply and demand trends are extremely encouraging - Dubbed a ‘supply critical mineral’ in the U.S., and a ‘strategic mineral’ in the European Union; China has been nationalizing and consolidating its graphite industry; the Tesla gigafactory is supposed to double worldwide graphite demand alone by 2020
- The NIA graphite explorers index is up ~70% YTD, posting most of those gains quietly over the summer.

Whether you realize it or not, graphite is all around you. Right now it's mostly consumed for refractories, batteries, steelmaking, expanded graphite, brake linings, foundry facings and lubricants. But things are changing and incremental demand is forecast to increase substantially due to emerging green initiatives and clean technologies. Graphite is quickly becoming a necessary material in a plethora of high-tech applications, and graphene (which comes from the base material of graphite) has the potential to "change the world".

Many investors are still trying to understand graphite and its market, which is what I'm setting out to help accomplish in this article. I'll explain what graphite is, different types and deposit geology, current and future uses, supply and demand trends, pricing, a brief market comparison, and most importantly, my six key criteria for what you need to know to be an informed investor in the graphite sector.

**What is graphite?**

Graphite is one of the eight allotropes of carbon, and one of only two naturally formed polymers of carbon (along with diamonds). It offers a unique set of properties that have led to its use in a wide and diverse range of industrial applications

Quick Facts -
Different Types of Graphite and Graphite Deposit Geology

Graphite materials fit into two distinct classifications: natural graphite and synthetic graphite. Natural graphite can be further broken down into three primary types: amorphous, flake, and crystalline vein. All three kinds form platy hexagonal crystals giving them their distinct appearances. Each type has distinguishing characteristics and is formed in unique geologic settings. In addition, engineered
synthetic graphite manufactured by calcination and subsequent graphitization of petroleum coke can achieve purity of 99.99% carbon.

**Natural Graphite**

General requirements for the majority of graphite deposits are simple – high grade metamorphism (prolonged heat exposure under high pressure conditions) of carbonaceous or graphitic country rocks. A variation of factors such as the composition of the country rock, tectonic setting, temperature, pressure, oxygen and other conditions will determine the deposit style and the type of graphite present. A minority of graphite deposits will form under different conditions such as contact metamorphism (skarn style), hydrothermal, magmatic or residual styles of mineralization.

**Amorphous: very fine flake, lowest value, metamorphosed coal/carbon rich sediments**

- Formed by metamorphism of coal or carbon-rich sediments
- Most abundant type of graphite, constitutes a large part of the global graphite production
- Product is microcrystalline graphite less than 70 microns (-200 Mesh) in size
- Deposits typically range from 30% to over 90% Cg, and usually are lower in purity than other natural graphite, typically ranging from 60% to 90% carbon
- At 80-85% Cg, the amorphous variety is used for lower-priced applications and amounts to 50% of the total natural graphite market
- Some of the best examples of such deposits are found in China and Mexico

**Crystalline-Flake: flat, plate-like particles with hexagonal edges, metamorphosed silica & carbonaceous sediments**

High-purity flake graphite demand is overtaking the amorphous variety as emerging new technology applications such as batteries and flexible graphite products are beginning to represent a significantly larger portion of graphite market end users.

- It can be found globally, however it is rarer than amorphous graphite
- Silica metamorphosed rock deposits are typically associated with quartz-mica schist, quartzite, and gneiss. Average grades of around 10%-12% Cg, outliers are as low as 2% and as high as 60% Cg. The purity of the graphite in these deposits tends to be between 85% and 98% carbon
Carbonate rich metamorphosed rock deposits are hosted within marbles often containing quartzite and gneiss. Average grade ranges from 1% to 10% Cg, and can produce the entire range of flake sizes with purities between 85% and 98% carbon.

There are three primary sizes of flake graphite: fine (-100 mesh), medium (+100 mesh) and large flake (+80 mesh)

Most consumers prefer to use high-grade, large-flake graphite for their products, with flake size and purity that determining the price. For example, large-flake graphite (+80 mesh), with high carbon content (94 percent or greater) is the type required for use in lithium-ion batteries, and commands a premium

Flake constitutes 49% of the market

Lump/Vein: platy intergrowths; hydrothermal/skarn/magmatic

Hydrothermal origins, typically occurs in fissure veins or fractures, appearing as massive platy intergrowths of fibrous or needle-like crystalline structures

Deposits can be associated both with metamorphosed calcareous sedimentary and with non-calcareous host rocks

The styles of mineralization are uncommon, poorly understood, and highly localized

The best example is high purity Sri Lanka deposits that run at over 90% Cg with a purity of over 98% carbon.

Zenyetta (ZENYF) in Canada has achieved some very impressive grades

Comprises only 1% of the market

The table below briefly summaries the different forms and occurrences of natural graphite:

<table>
<thead>
<tr>
<th>Deposit type</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disseminated flake graphite in silica-rich meta-sediments</td>
<td>Fine to jumbo flakes. Graphite content from 1% to 10%. E.g. Bislett Creek. Important supply source since 19th Century</td>
</tr>
<tr>
<td>Disseminated flake graphite in marble</td>
<td>Fine to jumbo flakes</td>
</tr>
<tr>
<td>Metamorphosed coal seams</td>
<td>Micrometrical or amorphous material. Significant source of production today</td>
</tr>
<tr>
<td>Vein deposits</td>
<td>Very high grade material featuring massive intergrowths of fibrous graphite. Typical of deposits in Sri Lanka</td>
</tr>
<tr>
<td>Contact metasomatic</td>
<td>Micrometrical or amorphous material. Minor source of production today</td>
</tr>
</tbody>
</table>

Source: [Seymour Pierce Ltd.](https://www.seymourpierce.com)

**Synthetic Graphite**

In order for high-grade natural flake graphite to be equivalent to synthetic graphite for lithium-ion battery manufacturing and graphene production, it must have a purity level of 99.9 percent. Notably, synthetic graphite is made by a petroleum coking process that makes it much more expensive to produce these 99.9 percent purity levels. The important factor about lithium-ion battery production is that these high
purity levels can be obtained by manufacturers with high-purity natural flake graphite at a fraction of the cost of synthetic graphite.

**Spherical Flake Graphite**

Spherical Flake Graphite (‘SFG’) is produced from milling flake graphite into spherical shapes. Spherical graphite is the feedstock for lithium ion battery anode manufacturing, and commands a premium price, around $4,000-$6,000 per tonne. The SFG can undergo additional surface coating, which significantly increases its value. The process is destructive in terms of flake size, with anywhere from a 30%-70% loss ratio, depending on the deposit.

Source: [Northern Graphite](#)

**Expandable Graphite**

Expanded flake graphite is a form of graphite produced using a chemical treatment in which a second material is inserted between the graphene layers of a graphite crystal, essentially expanding the material. The resulting product has an overall decreased bulk density and an approximately 10x increase in surface area. Its new properties make expanded graphite an important material for high temperature and high pressure applications.
Graphite has been referred to as the material used in every industry yet in small enough quantities that no one talks about it. The majority of the world’s graphite is used in traditional applications such as refractories, steel-making, foundry moldings, auto parts, and lubricants. Minor uses such as batteries, pencils, electronics, and numerous other products account for the remaining graphite consumed each year.

Future demand growth is anticipated to be driven by ‘technology grade graphite’, to be used in emerging green initiatives and clean technology. Including applications in fuel cells, lithium-ion and vanadium redox batteries, energy storage, solar power, water purification, and pebble-bed nuclear reactors. Not to mention graphene, coequally dubbed the ‘miracle material’, a one atom thick layer of carbon atoms which some researchers claim “it’s the most important substance to be created since the first synthetic plastic more than 100 years ago.”
The proliferation of lithium-ion batteries in laptops, mobile phones, tablets, powers tools, portable media players, and hybrid/electric vehicles has been and is projected to be a major growth factor for the flake graphite market. Lithium-ion batteries have become the unit of choice for rechargeable applications thanks to their relatively small size, light weight, high power capacity and long standby times. Graphite’s role in these batteries is to form the anode and the units require very high purity, flake graphite as a raw material to produce for the final material needed, spherical graphite. Each lithium-ion battery contains up to 15 times more graphite than lithium to make each battery, and can take up to 40 times more graphite material to produce the finished battery due to waste byproduct during manufacturing. Penetration of hybrid and electric vehicles, which can use up to 10kg and 70kg of graphite per vehicle respectively, has been more limited to date. Depending on how you view the prospects of graphite demand as a function of hybrid and electric vehicle penetration in new car sales, the metrics can be quite compelling:
Fuel Cells

A fuel cell is a device that converts the chemical energy from a fuel into electricity through a chemical reaction with oxygen or another oxidizing agent. Fuel cells designed based on Proton Exchange Membrane technology use graphite’s thermal and electrical capabilities in its power generation process. In its Automotive Executive Survey, KPMG reported that fuel cell technology may become the next significant power source. As more environmentally conscious and energy efficient automotive designs are created and manufactured, large amounts of graphite will be needed; current fuel cell models require up to 80kg.

Graphite in Pebble Bed Nuclear Reactors

A Pebble Bed Nuclear Reactor (“PBNR”) is a small, modular nuclear reactor that uses graphite spheres to hold the uranium fuel, and gas cooling system. Relative to traditional reactors, PBMRs have a lower capex and opex, are more efficient, and will cool naturally if shut down. The initial prototype is operational in China, with the first two of thirty these Chinese government plans to commission before 2020. The U.S. may also become a major consumer, based on University of West Virginia researchers estimate that 500 new 100 GW pebble reactors will be installed in the US by 2020 with an estimated graphite requirement of 400,000 tonnes. It is estimated that every 1,000 MW of PBMR capacity requires 3,000 tonnes of graphite at startup and 600-1,000 tonnes per year to operate.
Graphene

Colloquially dubbed ‘the wonder material’, graphene is pure carbon material that’s just one atom thick, and nearly transparent when laid out in thin sheets. It has the potential to revolutionize future technologies, offering possibilities ranging from faster computers to new insights into quantum physics.

In their revolutionary publication “Electric Field Effect in Atomically Thin Carbon Films” in Science Magazine in October 2004, Andre Geim and Konstantin Novoselov - along with a team of six academic peers - demonstrated that single layers of carbon could be isolated with the carbon atoms arranged into tightly bound hexagons just one atom thick – thus, creating graphene. In 2010, the Nobel Prize for Physics was awarded to Geim and Novoselov for their achievement.
James Hone, research scientist and mechanical engineering professor for Columbia University performed tests on graphene and commented that it’s “the strongest material ever measured, some 200 times stronger than structural steel… It would take an elephant, balanced on a pencil, to break through a sheet of graphene the thickness of Saran-Wrap.”

An article in the Wall Street Journal noted that there has been a “patent land rush” in the graphene sector. As of May 2013, there were 9,218 published graphene patents, up 19% Y/Y and more than quintupling over the past five years. Some of the majors with patents include Samsung, IBM, Lockheed Martin, Apple, Saab, and Exxon Mobil. It seems that with such a plethora of published patents, and more being filed everyday, it seems extremely likely that we’re going to see a number of graphene products within the next 2 to 5 years.

To date, the development of graphene market has been limited primarily to R&D, with worldwide mass production not having been realized. A report by BCC Research, “Graphene: Technologies, Applications and Markets” estimates that the graphene market will have sales of ~$195 million by 2018, reaching $1.3 billion by 2020, with a five-year CAGR of $47.1%. The global graphene market was reportedly $9 million in 2012, with most of these sales being concentrated in semiconductor, electronics, battery energy and composite materials. Longer-term, the market has been forecast to rapidly grow to ~$80 billion.

Primary applications for graphene are focused around electronics and efficiency within generally within these components:

- Solar: 50-100x more efficient
- Semiconductor: 50-100x faster
- Aircraft: 70% weight reduction
- Military: Stealth properties allowing “invisibility” of aircraft to radar

For those interested in watching some videos to learn more about graphene, here are links to a few videos: BBC video, Columbia video, Yale video.

The following is a table of graphite uses by type and application:
<table>
<thead>
<tr>
<th>Usage</th>
<th>Synthetic</th>
<th>Amorphous</th>
<th>Flake</th>
<th>Vein</th>
<th>Expanded Graphite</th>
<th>Spherical Graphite</th>
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<tbody>
<tr>
<td>Graphite fibers, nanotubes &amp; nanoparticles - Insulation, reinforcing agent in polymers</td>
<td></td>
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<tr>
<td>for solar cells, electrical circuits, military, wind energy, aerospace and automotive</td>
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<td>applications</td>
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<td>Refractories - crucibles, carbon-magnesite bricks (liners in electric arc furnaces and</td>
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<td>steel ladles), alumina-graphite casting ware, gunning and ramming mixes for monolithic</td>
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<td>refractories, stopper heads for steel ladles</td>
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<td>Batteries &amp; energy storage - batteries, fuel cells, photovoltaic solar cells</td>
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<td>Construction materials - fillers, infrared shielding, heat conductivity, heating systems</td>
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<td>Industrial paint pigment and coatings - high resistance to weathering and inerter</td>
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<td>Lubricants - used in forging, thread anti-seize agent, gear lubricant in mining equipment,</td>
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<td>Electrical components, powder metallurgy, plastic and resin additives</td>
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<td>Carbon brushes and bearings in motors &amp; generators</td>
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<td>Electrodes for electric arc furnaces</td>
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<td>Graphite grinding wheels - mirror grinding and polishing</td>
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<td>Friction materials - brake linings, pads</td>
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<td>Nuclear reactors</td>
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<td>Foundry mold facings</td>
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<td>Pencils</td>
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<td>Rubber additives</td>
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<td>Steel making - carbon raiser additives</td>
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<tr>
<td>Catalysts</td>
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<td>Graphite foil, heat sinks, gaskets, seals</td>
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<tr>
<td>Flame retardants additives</td>
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<tr>
<td>Graphene</td>
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</tbody>
</table>

◆ – Major source; ● – minor source of graphite for that particular use

Source: SGL Group, Superior Graphite, Asbury Carbon, Industrial Minerals and other public filings, IAS

Graphite Properties Required by Industrial Application
As you can see, the properties vary widely by industrial use. Each company ultimately using the graphite material requires their own distinct custom optimization and provides the graphite companies with a spec. sheet which determines the exact parameters for the processing.

Source: [Canada Carbon Industrial Applications](#)
Market History

Graphite has historically been a private industry with deals done behind closed doors and for undisclosed prices. However, the exploration boom that started in 2011 has drastically changed the industry landscape.

Over the past five years or so, graphite has experienced a sharp rise and fall in demand. With the associated price volatility investors have been the losers, and traders the winners.

*Industrial Alliance Securities noted in November* that the total number of graphite exploration companies jumped to 73 with 176 projects, from 36 and 98 in May 2012, which has resulted in a dilution of value in the sector with the average market cap. down by 40% to $13.9 million.

That said, the industry as a whole has benefitted more than anyone. Over the same time, the total market cap. of all companies in the sector grew by 27% to $1.04 billion. The influx of new entrants has created more transparent pricing, and a more sophisticated investor in this sector. An abundance of new, high quality resources have been discovered worldwide that nobody ever knew existed.

As an homage to my home country, Canada hosts 71% of the graphite projects currently being developed. Approximately 45% of the world's listed mining companies, over 1600, are listed on the TSX and TSX-Venture, and Canada has some of the world's best geologists and mining executives. Canada has great infrastructure and is very mining friendly.

**Public Graphite Companies (2013)**

![Graph showing public graphite companies](image)

*Source: Industrial Alliance Securities*

During the initial ‘graphite rush’ that I just discussed, investors were commonly mislead by two similar stories:

1. **Companies were touting that they achieved purity in excess of 99%C as though that was unique to their deposit**
More bench scale testing needs to be carried out to determine the most cost efficient methods to produce such a pure concentrate. It's not that 99% is rare, it's how much processing and purification needs to be carried out by the end user to increase the concentrate value. The highest prices, whether flake or vein material, are associated with the highest purity because they requirement the least refinement.

2. Some companies suggested that they were targeting synthetic graphite markets with their natural graphite product

Which is easier said than done, as engineering synthetic graphite requires specific structure, shape, and other product-specific characteristics that not every deposit has out of the ground, at least not economically. These characteristics are not to be overlooked.

Market Conditions

![Graphite Market Chart](image)

Source: [Visual Capitalist](https://visualcapitalist.com)

Natural graphite demand is shifting from the amorphous variety (down ~52% per annum over the last decade) to large, high-purity flake graphite (growing at ~75% per annum) as emerging applications such as batteries and flexible graphite products begin to represent a larger portion of graphite market end uses, according to recent market research. Flake demand was driven by growth in the steel and automotive industries, as well as the rapid development of new applications of graphite in high-technology fields. This caused prices to surge from about $700/t in 2005, to about $3,000/t in 2012.

The following are charts relating to graphite price trends:
The recent slowdown of the Chinese economy combined with the lack of growth in the U.S., Japan, and Europe has caused prices to fall about 50% from recent highs. That said, prices are still double their aforementioned lows, and prices commanded for large and extra-large flake graphite have relatively remained high.

In February, the USGS released updated metrics stating worldwide demand for graphite increased steadily throughout 2012 and into 2013. Global economic improvement, and advances in purification technology and techniques have led to the development of new applications for graphite in high-technology fields which in turn have dramatically increased demand.
Total worldwide demand for graphite is expected to increase dramatically over the next decade. It has been declared a ‘supply critical mineral’ in the U.S., and a ‘strategic mineral’ in the European Union.
Yet future supply is far from certain. As you can see in the metrics from the USGS above, China produces more than 70% of the world’s graphite (~70% amorphous, ~30% flake, with the majority being +200 mesh, not large flake). Supply security of natural resources has been a growing issue in the United States, especially as more minerals have been extensively profiled and technological applications have increased.

In February 2014, Dr. Latiff, Director of the Intelligence and Security Research Center, reported strong bipartisan support for a critical mineral policy act, seeking the reinstatement of mining and processing critical minerals in the United States. The U.S. imports 100% of its graphite, and believes that there is potentially a national security issue created when a supplier controls more than 50% of an industry.

Only government intervention, such as import taxes or subsidies can result in rapid change in order to bring more Western graphite mining projects online. As policymakers begin at a minimum, accepting the need to protect domestic resources, and at best, nationalizing resources, this can only bode well for niche mineral development projects.

Resource nationalism is a growing threat to the supply side of graphite since the large majority of global graphite production currently comes from China. However, this dynamic is rapidly changing. In April, the Heilongjiang province announced plans to crack down on polluting flake graphite operations, and start consolidation of mines over the next 18 months. Depending on how serious the Chinese government is about its announced plans, the implications of this announcement will be rather wide ranging.

Additionally, to further protect its domestic graphite supply and encourage value added processing at home, China has already imposed a 20% export duty on graphite, as well as a 17% VAT, and instituted an export licensing system.
Right now it appears that demand is starting to outpace supply creating a worldwide graphite supply deficit. Recent reports from Industrial Minerals indicate that graphite prices have stabilized, as producers are near their marginal cost of production which should limit further price declines, and all current indications point to there being supply shortfall of graphite over the next 5 years. Experts forecast that demand is going to far outpace supply - especially when it comes to securing a steady supply of high-purity graphite, which is one of the things that we as investors need to look out for when considering investing in a project (more on specific criteria later).

It’s also prudent to mention that Tesla Motors (TSLA) has broken ground on its “gigafactory” in Reno, Nevada, which is projected to need over 100,000 tonnes of graphite/year to service its 500,000 Tesla electric vehicles by 2020. Tesla is planning to partner with some majors, namely Panasonic - Samsung and Apple have also been tossed around – and commence battery production around 2017, effectively more than doubling the world’s current battery output.
Adam Jonas, an analyst at Morgan Stanley commented, “We believe we are witnessing the most disruptive intersection of manufacturing, innovation and capital experienced by the auto industry in more than a century. Tesla may be in position to disrupt industries well beyond the realm of traditional auto manufacturing. It’s not just cars.”

Sales of electric vehicles are going parabolic, with the one limiting factor for Tesla right now being battery supply. Vehicles powered by electricity and initiatives supporting sustainable and renewable energy are becoming increasingly popular not just among the public, but importantly, lawmakers. While you could get involved in the gigafactory in a number of different ways, I think going after the suppliers of raw materials is the best method, and while you could invest in graphite, lithium, or cobalt (and to a lesser extent, nickel, bauxite, and copper), ~50% of the raw material needed for the Tesla lithium-ion battery will be graphite.
In early 2012 speculators drove prices up, many new companies entered the market to fill the supply-side void, and then the euphoria ended, investors realized that most projects were still years away from production, and prices have since leveled off.

Low-quality graphite prices have for the most part, been eroding over the past 18 months. The abundance of the lower value, very fine graphite coming out of China has taken its toll on the prices, with even flake graphite slipping towards the bottom end of its existing ranges.

However, Industrial Minerals believes that the Heilongjiang announcement “could put at least 50% of flake graphite supply from both provinces under threat throughout 2014. This equates to 24% or 90,000 tonnes of global flake graphite output in 2013.” When Simon Moores of Industrial Minerals was asked about his prediction for graphite prices in 2015, he commented that he thinks “the industry has seen the bottom of graphite prices and should expect a rise from here... [flake graphite prices] remain 60% higher than pre-recession levels in 2008-2009. Other commodities, especially fluorspar, have crashed and hit all-time lows. Graphite has not done that.”

And remember, there are three very important components to consider when trying to determine what price graphite can command:

- **Size of the flake**: Small, Medium, Large, or Jumbo
- **Grade**: The carbon content of the graphite flake
- **Purity**: The purity of the graphite flake on recovery (99.9% purity is considered “battery grade”, is necessary for graphene production, and is the purity level of synthetic graphite, which is very expensive compared to natural graphite)

<table>
<thead>
<tr>
<th>Product</th>
<th>Mesh size</th>
<th>Minimum Size (microns)</th>
<th>Price (US$/t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jumbo flake</td>
<td>48</td>
<td>325</td>
<td>1,800-2,400 (94-97 TGC)</td>
</tr>
<tr>
<td>Large flake</td>
<td>80</td>
<td>150</td>
<td>1,400-1,800 (94-97 TGC)</td>
</tr>
<tr>
<td>Medium flake</td>
<td>100</td>
<td>75</td>
<td>1,050-1,400 (94-97 TGC)</td>
</tr>
<tr>
<td>Fine flake</td>
<td>200</td>
<td>45</td>
<td>950-1,050 (94-97 TGC)</td>
</tr>
<tr>
<td>Amorphous</td>
<td>&lt;200</td>
<td>&lt;45</td>
<td>600-800 (90-95 TGC)</td>
</tr>
</tbody>
</table>

*Mesh size = number of opening per sq inch of screen
10C = Total graphic content

Source: [Northern Graphite](#)

While there has been an excess of supply hitting the market recently, it is low grade and not suitable for high-end applications. Remember, there is no spot price for graphite. Companies sign off-take agreements and produce graphite to customer spec, negotiating price on a deal-by-deal basis. Coated **spherical graphite sells for around $6,000-$10,000 per tonne**, and **synthetic around $20,000**. That’s where the big money is. So the low-grade stuff coming out of China, isn’t anywhere near the quality that investors are seeing in markets like North America.

**Market Comparison**

The following consists of Technology Metals Research Advanced Graphite Projects Index and provides facts on natural-graphite projects currently underway around the world, which have been formally defined as mineral resources or reserves:
What You Need To Know As An Investor in Graphite

Although many graphite explorers seem to think ‘bigger is better’ and although tonnes and graphitic grade are key metrics when evaluating projects, a number of factors actually need to be considered from an investor’s perspective.

I suggest that you reflect on these six key factors when evaluating a graphite opportunity:

1. Deposit size and quality
2. Location and infrastructure
3. Flake size and distribution
4. Product purity
5. Product off-take agreements
6. Timeframe to production

The first two considerations are very important. When it comes to deposit size, bigger doesn’t mean better. It’s about how feasible the project is, which is based much more on grade. It’s not that it’s necessarily bad if a company has a low in-situ grade for their project, most grades can be upgraded significantly through processing, however the mining costs can be daunting. For example, it would take the movement of six times the volume of material to mine a 4% Cg deposit, as it would take a 24% Cg deposit. So as an investor you need to consider what the project wholly entails. Significant capex requirements can dilute your investment, low grades necessitate much higher opex, and the geology of the deposit affects the metallurgy and what final applications that material can be used for. My ideal project would be a graphite mine that would produce in excess of 94% purity, with as much large (+80 mesh) and jumbo (+48 mesh) flake as possible. Graphite meeting that criteria would generally meet the standards for a wide variety of applications and would fetch a premium after upgrading and purification.

When it comes to the third factor, flake size and distribution, a number of facts hold true. First, the larger the flake size, the higher the purity of graphite. Second, the larger the flake size, the higher the prices (all
other things considered equal). Last, market applications drive demand, so deposits with relatively high proportions of ultrafine graphite may not ever go into production as the segment is most at risk of over-supply.

The fourth factor, purity after simple processing (i.e., before acid or thermal upgrading) is particularly important because it is a key determinant in saleability of the product. It’s also a very important factor in relation to operating expenses, because the more upgrading the graphite material needs to undergo, the higher the production cost potentially will be.

The fifth factor, product offtake agreements and MOUs are significant in determining the long-term success of a graphite company, as the graphite market is largely based on contracted sales agreements between buyers and sellers based off of the buyer’s custom specs. So companies that already have these agreements in place are heavily de-risked compared to their peers.

The last factor, timeframe to production is for the most part self-explanatory. While companies that get their product to market first will certainly set the pace in the space, growth metrics suggest that there will be a significant amount of demand in the future and leaves the door open for any company with high-quality graphite and a feasible mine the opportunity to succeed.

*Special note, when it comes to evaluating graphite juniors that are in an earlier stage of the development cycle and don’t have their resource, metallurgy, processing and milling upgrading flow sheet, etc. you need to do your due diligence on the geology of the deposit, historical mining operations in the area or on the property and any metrics associated from them, proximity to more advanced projects that have already have demonstrated successful results, and most importantly in my mind, a good management team with experience in the industry. The graphite community is relatively small, and knowing what you’re doing and having the proper relationships to advance the project are critical to success.

**My Best Stock Pick in the Sector**

While I am currently holding a number of graphite companies in my portfolio right now, including a mix of advanced graphite projects that are either producing or near production, as well companies who are at earlier stages in the resource development cycle, and are still defining their resource, my best stock pick in the sector is Great Lakes Graphite Inc. (GLKIF) (or for more liquidity, TSX-V: GLK)

Here is a picture of some recently collected samples which appear consistent with high quality, large flake graphite for which the area is known for, and also indicate the potential for lump or vein graphite:
Great Lakes needs to do the most work relative to its peers that I’m invested in however I believe that the company offers a lot of upside appreciation from its relatively meager market capitalization of $5.4 million (at the time of writing). The company has a few properties, but is focused on developing the Lochaber property in Quebec - getting it into production by 2017 by leveraging previous work to shorten the path to production (the former owner spent ~$2 million drilling 7,000+ meters and doing particle distribution work). The company’s historically NI 43-101 compliant resource looks like a good start, with drill results grading ~3-4% Cg, and the preliminary metallurgical results look encouraging (48% concentrate +80 mesh, 30.50% concentrate between 80 and 200 mesh; and 21.50% below 200 mesh). Also of note, there are three historical graphite occurrences (the “McLaren”, “Kelly” and “Burke” Showings) and two past producing graphite mines (the “Mayo” and “Plumbago” mines) distributed over an area covering 16km², and just 20-25 miles to the east of Lochaber is Canada Carbon’s (BRUZF) impressive Miller deposit [this article](#) discusses a site visits by analysts to a property).
Given management’s target of initially producing 10,000-12,000 tpd, requiring an estimated $30-$35 million in capex, this lean, scalable project would need the least capital out of any project available to start running its modular quarry operation.

The company is currently working on updating its 43-101 resource calculation and has stated that it’s on track for completion by early November. In the meantime, it’s sent out ~300kg bulk sample to Process Research ORTECH and will run tests on the material such as metallurgical studies, particle size distribution analysis, purity analysis and grade analysis. Material collected from the bulk sample will also be used to initiate a Customer Sampling Program.
In an exclusive interview with the Financial Post, CEO Paul Gorman stated, “We spent the last seven years assessing opportunities in the graphite space. We wanted a high grade graphite project that had already been drilled and that had historic reserves which needed to be upgraded to modern geological standards. The Lochaber graphite property in Quebec checked all the right boxes.”

More importantly though, Great Lakes has an excellent management team, who are very capable of getting this project into production. Paul Gorman, CEO of Great Lakes helped revitalize the junior graphite space in North America in 2008 by funding Industrial Minerals Inc., which became Northern Graphite and assisted 4 other graphite companies in an advisory role. Senior VP, John Carter has an extensive knowledge of mill development and mines in the natural graphite sector, specializing in the engineering, design, and manufacturing of mineral processing equipment for operations such as Timcal (the largest graphite mining company in North America), and recently served as VP at Saint Jean Carbon and Canada Carbon. He’s built dozens of mines in countries through the world. Paul Hynek, Director of Technical Operations, has an extensive background in metallurgical and graphite research, and has co-authored three patents related to battery technology. Paul knows what’s needed and how to create spherical graphite. Lastly, Laura Motolla, a director, is a globally recognized expert in lean mining and mining automation and has worked with a number of impressive clients in the past. So as far capability goes, this team definitely has the right people in place.

Here’s what the timeline to production currently looks like:
Regarding the big spike in price and volume over the past two trading sessions, my assessment is as follows: while the company issued no formal press release, there was an article in the Financial Post disseminated by Globenewswire on Sept. 16th, entitled "Tesla Gigafactory Will Require 8 New Graphite Mines; Great Lakes Graphite Is Fast Tracked to Production" that obviously spiked some investor interest; yesterday afternoon the exchange halted the stock, officially "pending the clarification of news"; this morning the halt was released and the company clarified and retracted certain statements attributed to it, primarily to emphasize that it's (and I’m paraphrasing) still an early stage exploration company.

The TSX and TSX-Venture exchanges have very strict regulatory requirements, are quite familiar with the graphite industry, and are certainly not adverse to halting graphite companies pending news, clarification of news, or just big spikes in price and volume (it’s been done many times before with many companies). Like I’ve emphasized throughout the article, investors must be aware of the inherent risks when evaluating a prospective graphite investment, for which I’ve tried to provide a solid foundation of knowledge to allow someone unfamiliar with the sector to try and delve into. Ultimately, you need to be aware of as much as you can about a company as an investor – not just reading articles in the paper or online – but actually doing your own due diligence; accessing the SEDAR database (at least in Canada) and going through the quarterly financials and MD&A, and calling the company up feeling good about the management team yourself before you make an investment decision, and I believe the exchange wanted to emphasize that too by having the company provide clarification to investors.

Like I opened with at the beginning of this section, Great Lakes probably has the most work to do relative to its peers, but it has a very knowledgeable and capable management team in place, and
appears to have excellent preliminary resource, least to say from an investment standpoint, given some of the world class material that has been confirmed to have come out of the ground from Canada Carbon just down the road, and some of the historic field work samples I believe there’s large upside potential relative to its current market cap. That said, be aware of where this company is at in its development cycle.

The Great Lakes team plans on leveraging its experience and understanding of the graphite market, the customers, their applications and product requirements, and couple it with best practices and modern technology. Great Lakes already has a database of more than 600 customers in its Customer Sampling Program, and is supposed to ship out material in the near future from its initial bulk sample. Expect an updated and compliant NI 43-101 resource, and composite testing and metallurgical results to act as near-term catalysts.

For the latest images from the property, including core and lab photos, geophysical survey, other maps and images, as well as information about the latest work progress, and a detailed description of the property’s history and geologic properties, please click here.

I think that volatility that has come out of the halt, and the recent price and volume action can be attributed to investors just starting to hear about the Great Lakes story and presents investors an attractive entry point.

**Closing Thoughts**

As with anything that gets a lot of publicity and hype, investors experienced a huge run-up in graphite stocks, only to be let down as their performance drastically outpaced their fundamentals.

This has created an opportunity for contrarian investors to re-evaluate what’s going on in the market. Have the fundamentals changed given recent news in the sector, and the stabilization of prices? I say, resoundingly yes.

The National Inflation Association has recently created an index showing the performance of graphite exploration stocks:
U.S. Symbol: Syrah Resources (SYAAF), Mason Graphite (MGPHF), Focus Graphite (FCSMF), Northern Graphite (NGPHF), Flinders Resources (FLNXF), Energizer Resources (ENZR), Canada Carbon (BRUZF), Graphite One (GPHOF), Alabama Graphite (ABGPF), Elcora Resources (N/A), Lomiko Metals (LMRMF), Great Lakes Graphite (SHGIF), Canada Strategic Minerals (CJCFF), Big North Graphite (BNCIF)

Source: National Inflation Association

The NIA graphite explorers index is up ~70% YTD, posting most of those gains quietly over the summer. The blue-sky potential remains enormous from the incremental demand that will be created by technology grade graphite to be used in emerging green initiatives and clean technology including, lithium-ion batteries, fuel cells, solar power, vanadium redox batteries, energy storage, semiconductors, water purification and nuclear energy. Not to mention, the world’s ‘miracle material’, graphene which some researchers claim is “the most important substance to be created since the first synthetic plastic more than 100 years ago.”

Supply and demand trends look extremely good for investors as serious supply concerns coming out of China given recent consolidation of its graphite industry and resource nationalism, coupled with the fact that Tesla’s gigafactory is expected to go into production around 2017, and the fact that it has been considered a ‘supply critical mineral’ in the U.S., and a ‘strategic mineral’ in the European Union, give further credence to my belief that the graphite market is turning around.

More investors should be starting to get interested in the sector again as projects start to come online, major offtake agreements are signed, and prices start to become more transparent. Recent appreciation of
companies in the NIA index is indicative of large upside potential, with many of the more advanced projects leading the way, but still far off of their highs.

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