



FAR EAST
C A P I T A L

The Mining Investment Experts

"Escaping the Malaise of the Bulks"

*Introducing new materials
and technology
to add zest to the mining sector*

**A Paper for the RIU Sydney Resources Round-Up
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13-14 May, 2015

Introduction

Good morning Ladies and Gentlemen. Welcome to the RIU Sydney Resources Round-Up. Far East Capital was a Founding Sponsor of this Conference, about 10 years ago. I'm very pleased that Far East Capital has resumed its position as a sponsor, following my retirement from Canaccord.

I have an important responsibility this morning. As the first speaker on the program it is incumbent upon me to set the tone for the next two days. If I present a dour outlook for the sector it will weigh heavily on the opening sentiment. If I fill you full of rampant optimism it may bring smiles to your faces, but the wiser heads in the audience don't appreciate naivety. So, what am I going to say, and what will be your response? How about an accurate statement of where we are followed by where we could be going, based on "over the horizon vision."

Where We are Today

We are at the bottom of a 10 year equity market price cycle. We have had the massive party brought on by the incredible growth in the Chinese economy, but we are now suffering from the hangover. Everything is painful. The trouble is, we don't know how long this hangover will last. We look for economic forecasts that could turn the sentiment around, but that is not enough.

The pool of funds that is dedicated to mining investments has largely evaporated. With many stocks having fallen 90% from their cyclical highs, the mining specialists don't have the capital to drive markets higher. They must be very selective. There is an absence of FOMO in the market, so there is no urgency to get set. Previously one would buy on rumour and do the numbers later. Today, there is no such urgency.

Does that mean that there is no value today? On the contrary, there is excellent value in many situations. There is just the lack of willingness to act by investors.

But the concept of value is a moving feast. If you ran the numbers on the iron ore stocks a year ago, or on the oil producers, the value would have looked fine. But since then the price of both of these commodities have collapsed. Only those who could

have seen the future prices of these commodities would have had any insight as to where the share prices would go.

How can you and I gain access to this sort of knowledge? We could ask the analysts, but how many of you know of any truly visionary analysts with such foresight? How many are not being compromised by “group think”. In most cases they are writing research to support corporate deals or house stocks. The independence of broker analysts is very circumspect, no matter how hard the individuals try to be objective. In most cases we don't benefit from true analysis. We see research which comes from cutting and pasting, which is designed to assist salesmen write commission. So what is new?

There are many investors, analysts and salesmen out there who are still licking their wounds from the great bear market in mining and commodities. They are mentally impaired and no longer fit for battle, if that means doing it all over again. We need fresh blood. We need young Turks, who think they are invincible, to kick-start the next cycle. We need optimists who can see opportunity.

While it is true that if you get the cycles right you will always make money, how many investors really do get it right? How many confuse the concept of value, particularly relative value of different companies across a sector, without considering the big picture. Too many I would suggest.

So, today, we are in the same place we have been many times before in the markets. We are at the bottom of a cycle but the turning point is somewhat elongated as we seek to flush out the excesses of the previous bull market. There are too many junior companies that serve no purpose, and need to fail, because they are distracting us from those that have a future. The beggars are always the ones that make the most noise and crowd the passageways.

We were at this point back in the early noughties, when the dotcom boom was raging. No-one wanted to know mining, but a junior company that announced it was considering a dotcom deal could easily see its share price double or triple on no detail. It is a little more considered today, but it is at a similar stage of the cycle. The best way

to breathe life into the share price of a junior mining company is to announce a technology deal.

And that brings us onto the more inspiration part of my paper today. Rather than go through all sorts of economic and market evidence that may point to the turning point in the cycle – which doesn't require any magical skill – I would rather look towards areas where there are no established cycles and no institutional shareholders overhanging the market. I would rather look for new growth curves that have no ceilings. I would rather look to where mining and technology meet, to provide new, disruptive opportunities. This is not about making money on routine swings and roundabouts. This is about looking over the horizon to the future.

We find comfort in order. When we know the rules and we all play by them, there is order and security. But that order will always be challenged by parties that seek to profit from change. Investors are looking for disruptive technologies that are game changers. They are looking to be inspired by possibilities. These are the investors who will make the super profits in the future. Structural reform and incremental change may improve one's competitive position vis a vis other producers, but such initiatives won't open new horizons.

A New Age of Materials

Most of you probably haven't thought about it, but we are in a transitional point in mining. We have the dinosaur-like commodities such as iron ore and coal that depend upon scale and infrastructure. These are dominated by huge mining companies. At the same time we have the more mammal-like commodities that cover specialty metals such as antimony, cobalt, scandium, titanium, tungsten and vanadium to name a few. In many cases we are still exploring new applications for these specialty metals.

What are metals used for? They are materials used for building. Whether it be in construction of structures or components in industry, the metals are machined and fabricated to produce many products. However, as we develop expertise in materials we are coming up with better alternatives. Plastics came into widespread use in the 20th century, displacing metals throughout industry and particularly in consumer

products. Refinement of plastics and the combination with other materials has been an ongoing exercise. Development of polymers has been a logical extension of the trend, offering advantages in weight and flexibility.

Continuing along the same vein of efficiency and flexibility, the nanomaterials industry, first launched 40 years ago, has opened up new frontiers in manufacturing and the employment of materials. It is a direct competitor to the metals business. It is displacing metals in many cases. By 2018, it is estimated that sales of nanomaterials will total US\$30bn, based on forecast growth rates of 5-10% p.a. Graphene is a nanomaterial.

Graphene

There has never been a material talked about with more hyperbole than graphene. There has never been anything promoted with more potential to change our industrial world than graphene, so the understandable reaction of anyone being introduced to graphene is one of scepticism. This is not surprising. What is different with graphene is that it is being promoted by the scientific community more consistently and more vocally than by the entrepreneurial businessman.

In Australia, we are familiar with promoters of mining projects and opportunities. We are familiar with bioscience and technology promoters, and our experiences have given us reason to be sceptical about the promises being made for graphene. How can something be so revolutionary, so disruptive, and yet be tangible? That is the hurdle in perception facing the investor.

Graphene presents us with a generational change in technology, taking the field of nano-science one step further. Nano-science that has given us the capability of identifying and separating a material than can be combined with many other materials to achieve performance levels not otherwise considered possible. Graphene is that facilitator.

What is Graphene and How Does it fit with the Mining Sector?

Graphene is a natural material that is the basic building block of graphite, achieved

when the thickness is reduced to less than 10 atoms. Though it was “discovered” in the 1940s, it took until 2004, before scientists figured out how to isolate it from graphite particles, using the simple “scotch tape” exfoliation method. Since then there has been tremendous interest in graphene with research scientists demonstrating its suitability for combination with a vast range of materials, to greatly enhance the performance of those materials. There has also been an explosion in the number of patents being taken out as industry has been preparing for the start of the new and deeply disruptive “graphene age”.

Graphene is not exclusively about mining and mining stocks, though some mining companies may have a window of opportunity to participate at the front end of the supply chain. Care needs to be taken with mining graphite companies that profess an ability to produce graphene from their ore. Most won't be able to. The best they can do is to produce concentrates that will be shipped off to specialists who further concentrate the material, at great cost, to achieve 99.99% purity.

There are exceptions though. Talga Resources is an obvious one. It could be the dominant supplier of bulk graphene from its unusual, high-grade deposit in Sweden. Recent test work undertaken by MRL Corporation, on its ultra-high grade deposits in Sri Lanka, suggest that it too may be a candidate for low cost production of graphene using a single step process direct from raw ore. Both of these companies could bring product to the market, massively undercutting the price of graphene. In doing so, they will be important facilitators to large-scale commercialisation of graphene.

Whether these companies become vertically integrated, and benefit from multiple points in the value chain, will depend upon management and corporate objectives.

What are the Amazing Properties of Graphene?

It is;

The thinnest material It is only one carbon atom in thickness i.e. only ~0.345 nm thick.
Consider that DNA is 25 nm in size.

Stronger than steel It is one of the hardest materials in the world, being harder than diamonds and 200x stronger than steel (1,100TPa/125 GPa) of

the same thickness but it is very flexible and will not break. As an example, a graphene sheet 1 m² in size could support a 4 kg cat, but that sheet would weigh only as much as the cat's whiskers

- Optical properties** One atom thick layer sheets absorb ~2.3% visible light, making it transparent.
- Light and stretchable** It weighs only 0.77 milligrams per square meter and is stretchable up to 20% of its initial length. It has the largest volume to surface area ratio of any material.
- Impermeable** It is completely impermeable. Even helium atoms cannot pass through it.
- Thermal conductivity** It is a perfect thermal conductor (over 5,000 W/mK), having 5x the conductivity of graphite. It conducts heat in all directions i.e. it is an isotropic conductor.
- Electronic properties** It has the highest electrical current density (one million times that of copper) and the highest intrinsic mobility (100x that of silicon). It has a lower resistivity than any other known material, at room temperature.
- Chemical properties** It is an inert material and does not readily react with other atoms. However, it can "absorb" different atoms and molecules, leading to changes in its properties. It can be functionalised by several different chemical groups, resulting in different materials such as graphene oxide and fluorinated graphene.

What Can it be Used For?

Given the qualities the potential uses are almost limitless. Hardly a week goes by without further news telling us of another use that has either been devised or trialed. Most recently there was news of graphene being combined with ceramics to produce artificial hips and knees that have twice the life span, with 10% less friction.

Conductive inks are one of the first commercialized products. I was told recently by a supplier of conductive ink in the UK that a graphene based ink could be produced at a cost of \$20/kg, compared to the cost of a silver based ink, which costs about \$60/kg. Both can sell for around \$200/kg.

Coatings and paints could be rapidly commercialized. Already Tata Steel is coating

steel wire with graphene-based paints as an alternative to zinc coating, with outstanding results. It won't be long before graphene products replace zinc galvanizing.

Screens and displays will be enhanced due to the strength and flexibility of graphene, and the conductivity will make them more efficient.

The addition of graphene to glass bottles will enable a reduction in weight of better than 50% whilst making them stronger. Think of the cost savings in transport.

Electronics, medical and biomedical devices, fuel cells, membranes and photonics will all employ graphene. Perhaps the biggest market of all will be in the filtration of water. Already Lockheed Martin have patented a product that claims to reduce desalination costs by 90%.

Many investors have been getting excited about the potential to use graphite in batteries, pointing to Tesla's initiatives. Well, there have been reports of research showing graphene enhanced anodes having 4x better capacity than conventional anodes. Another company claims to have made a battery with 10x the capacity with a recharging time of only one tenth of current commercial batteries, using graphene.

The list of examples goes on.

Graphene should not be seen as a stand-alone product. We should not be looking for things we can make out of graphene. Rather, we should be looking at what we can add graphene to, in order to make materials more efficient. Tiny amounts of graphene can offer major improvements in the performance of a vast range of materials. When I say tiny, I mean less than 1% of the total volume. Often, performance parameters improve by better than 100%, though each case will be different.

In a presentation given by a high performance pushbike tyre manufacturer in Berlin recently, we heard that the addition of only 3 grams of graphene resulted in performance improvements ranging from 15 to 25%, across a number of parameters. So far the company has produced about 4,000 of these tyres, so it is a commercial product. It estimated that 80 grams of graphene added to automotive tyres could provide similar improvements. An enormous market lies waiting to be tapped.

What are the Implications for Metals and Mining Stocks?

Okay. So graphene is the new wonder material. There are windows of opportunity for mining companies to get involved, if they have the right geology. It seems that the graphite needs to be crystalline, high grade and with minimum impurities – if you want to be at the bottom end of the cost curve. Run-of-the-mill graphite, such as those found in Mozambique and elsewhere, needs to go through a much more expensive process.

But what are the implications for the rest of the mining sector? That is where you need to focus for a minute. Consider that if you add graphene to steel, to aluminium or to copper you greatly improve their performance. You could reduce the amount of steel you need by 50% to achieve the same structural strength. This means you don't need as much iron ore. If you can add graphene to concrete and increase the tensile strength by 40% or more – and tests are confirming this – you won't need Rebar in the concrete. Demand for steel will decline.

If you can add a little graphene to copper you may find that electric motors can use 80% less copper, offering great savings in the weight of electric cars.

Graphene promises to be very disruptive to the metals business. Greater efficiencies will lead to at best moderated growth in demand, and at worst, demand could fall away significantly. Think about who will be the winners and losers. Run your "what if" scenarios to consider the possibilities.

Conclusion

Graphene won't change things overnight. It will take many years for it to be fully commercialised and for it to impact upon the mining industry as we know it today, but it will be another issue that mining companies will have to deal with. It will reinforce the need to have high-grade deposits and a position in the lowest cost quartile. For those companies lucky enough to have the right graphite orebodies, the future looks very rosy indeed. They will be at the technological front of mining and materials. So far I have only identified two of them, but I am sure that more will come along.

So, have I inspired you or depressed you? I suppose it depends upon whether you plan to go ahead in business based on the past, or whether you are going to embrace the future. Hopefully I have taken your mind of the malaise of bulks, at least for a short while.

Thanks