Tesla's Supply Chain – Triumph of Hope over Experience?

They say that second marriages are the triumph of hope over experience but we can't help thinking the same of Tesla's "belief" that when miners said to it that they would be able to provide enough Lithium, Cobalt and Graphite for its Gigafactory it actually believed them. We can't escape the feeling that the texting acronym ROFL (Rolling On the Floor Laughing) was made for exactly this situation.

However for a long time Tesla have painted themselves as being "the smartest guy in the room" and yet are we really supposed to swallow the line that Tesla actually believed that a whole swathe of projects in metals critical to their project would come to fruition when educated and informed people in the mining space knew that they would not? It would appear to be more of a case of didn't want to know rather than didn't know…

In this piece we shall follow on from the firestorm that John Peterson created in his piece last week with a specific look at how credible the chance of any of the many projects in the three metals of import actually becoming productive was over the last five years.

Lithium

We have been covering this metal since late last decade. Prior to that point (like Rare Earths) there had been so few players that they were well below any analyst's radar. Moreover, with the pre-2008 focus on staples like precious metals and base metals, the specialty metals scarcely got a look-in. Our first exposure was the Rincon asset then embedded in an ASX-listed entity Admiralty Resources. Lingering effects of the 2008 crisis eventually forced Admiralty to divest this is to Cayman

Island based resource fund, Sentient, who have held it ever since. At the time we thought this was the vanguard of the Lithium push that would break the Cartel and fill the demand gap in the middle of this decade. Instead the asset appears to be totally becalmed and it most definitely has not filled any gap, real or imagined.

Then came the Lithium boom. The great star performer was Talison Lithium which was cobbled together out of the old Greenbushes asset (ergo, a past-producer) and the assets of Salares Lithium in Chile. The high-point of the first flush was this company being bought for over $600mn by a Chinese group in league with Rockwood (one of the Cartel).

What was an initial field of around twenty lithium wannabes has shrunk by half over the last five years and is only now showing an uptick in interested new entrants. But as they say in the classics, “too little too late” to save Tesla’s bacon. It’s probably worth repeating here our Lithium Lifecycle chart, as a picture tells a thousand words:

An interesting microcosm of Tesla’s dilemma is that it signed a much vaunted deal with Bacanora Minerals. That fired up the stock price of BCN but did not bring in a single dime from Tesla in terms of investment. The attitude seemed to be “announce the deal, lift the price, go finance yourself”. Easier said than done as we all know when the capex is north of $100mn. Understandably BCN has started to lose some of its rosy glow and the task of raising all the funds has now fallen upon the company. However even with the best will in the world (and easy money) this project would be years away from production.

If Tesla had really believed in this project or any other one, it should have taken a strategic stake and made funds available to move things along. Frankly, it did not.

Cobalt

This metal has until recently been one of the least talked about in the battery supply chain probably because it has an LME quoted price and thus this has given many the illusion that it is a “major trade metal”. Wrong! To put this in perspective the LME warehouses only have 614 tonnes of this metal in stock. Not exactly a base on which to build a major battery industry and still get a good night’s sleep.

But doesn’t it come as a by-product of major mines in other base metals? Oh, you mean the copper mines of the DRC with their on-again, off-again restrictions on exports and conflict mineral overtones? Or do you mean the big nickel mines, such as Ambartovy and Moa Bay that are scarcely fountains of cashflow for their owners (e.g. Sherritt et al.)? It is most correct to say that any manufacturer of size relying upon major base metals mines to continue providing them with cheap by-product Cobalt had better dust off their candles and light them to the Gods of Mining. The quantities produced from these mines is essentially driven by demand for the major metals and no major is going to ramp up copper or nickel production at a loss, or at breakeven, just to keep Tesla supplied with the Cobalt it needs.

As can be seen below has been on a long slide and has only just started to tick up. Frankly its price could double, but if the prices of nickel and copper have not moved commensurately, then it is unlikely majors will ramp up production.

This brings us then to the subject of primary Cobalt mines. These are rare unicorns indeed. Much air has been expended on this subject over the last fifteen years but little has been achieved in terms of bringing mines to production. The USGS produced a report on the Cobalt production outlook in 2013 and

it included a frighteningly long table with the names of Cobalt projects that had been stopped in their tracks, mothballed or permanently decommissioned.

Below is our Lifecycle graph for the listed Cobalt developers, that we know of. This is the scantiest population of any of our “lifecycle graphs”.

Formation Metals (FCO.to) is the obvious candidate for Tesla to “take out” if Tesla starts getting serious but even then, the project would probably not fully supply Tesla’s needs. Then it might need to move on to the NiCoCo project of Fortune Minerals (FT.to) to be fully self-sufficient. The others are all too early stage or too small to be realistic help in ameliorating Tesla’s looming Cobalt crunch.

Graphite

For a mineral that is literally as common as dirt, the surprising thing is how little has been achieved by the “wannabes” which makes us think that they just “wannabe bought”. The most suspicious thing is that for a mineral that has minimal processing requirements and very simple mining requirements (quarrying, pretty much) the capexes being touted are truly eye-popping. This brings us to our usual suspicion (very prevalent in the glory days of REEs) that the companies pump up the capexes because if the capexes were smaller than their cash-pile or financing ability then cheeky investors (and offtakers) might say “well, why aren’t you building it?”. This impolite stating of the obvious is a sure conversation killer.

In any case this is all history now as most graphite companies that did not speed towards development now find themselves short of cash and staring the Grim Reaper in the face. Names

like Elcora and Flinders are either in production or on the cusp, while some of those that most vigorously played the "Tesla card" in their promotional efforts are down to their last shilling with little hope of reviving their credibility.

Tesla should move on one of the more stricken players, take it over and then announce that it has satisfied all its foreseeable needs. The mind boggles as to what that will do to the valuations of the other "wannabe Tesla suppliers".

Conclusion

There is an old adage of "put your money where your mouth is" and frankly Tesla has shown zero sign of expediting any of the projects that it has waved its magic wand over. That nothing has happened to move these projects forward thus makes us feel that Tesla's magic wand is limp indeed.

If this failure to abide by the commandment "Secure Thy Supply Chain" has gone unheeded then whatever the market dishes up to the company once it starts to explain away sourcing difficulties will be well-deserved. Did Tesla seriously think it was going to get a free ride from beaten down miners who can scarcely afford to pay their light-bills let alone developing mines with capexes north of $100mn. With Tesla still having a market cap of over $26bn, it could acquire for stock the most likely player in each of the Lithium, Graphite and Cobalt spaces for less than 1% dilution. Think about it…

Bismuth – the X Factor in the

Chinese Dominance Challenge

It seems that there is no end to the number of metal that have gradually fallen totally under the sway of the Chinese. In fact thinking back over the years since the Industrial Revolution in the mid-1800s it is hard to think of another country that ever had such a corner on so much of the periodic table. Before anyone cries “Foul” the Chinese have managed to achieve this NOT by being colonialists and going forth and conquering resource rich regions but by cultivating their own extensive domestic resources. Interestingly though it’s not the bulk metals that the Chinese have the stranglehold on, but rather those metals that are up and coming technology metals or alternatives to existing metals that for one reason or another (mainly environmental) are in the dog-house. Lead being a good example.

That is not to say that some of the actions of China in central and southern Africa in recent times have not had a neo-colonialist tint to them. However, these are not the difference between dominance or not in a particular metal.

According to British Geological Service (BGS) data China is the leading producer of 22 metals, with the next largest being Australia and South Africa, with three each. The position in Rare Earths is well known and we have mentioned the role in Antimony before. Then there is Germanium and Gallium and the subject of this piece, Bismuth.

The Extent of Control

Frankly when we came to look at this metal we were surprised that China should have such a grip. We had imagined that as a well-known ancillary metal in many lead or copper deposits that the production mix would have made its production sources more widely distributed. Looking at the BGS Risk List of Critical Metals (the latest being that of 2012) the rankings

have Bismuth at number four on the list (behind Rare Earths, Tungsten and Antimony). The world market for Bismuth is ~20,000 tonnes per year with China accounting for 60% of world reserves and 80% of world production.

Thus we see that when China sneezes (just like in REE and Antimony) the rest of the market catches a cold. In Bismuth we have seen in recent years a repeat what happened in those other elements with it closing 20% of its production due to environmental and mine safety issues. Then it announced policies to restrict exports. Sound familiar?

The Nature of the Metal

Bismuth (with the chemical symbol Bi) has been known from ancient times, although until the 18th century it was often confused with lead and tin, which share some physical properties. However, Bismuth chemically resembles arsenic and antimony. Elemental bismuth may occur naturally, although its sulfide and oxide form important commercial ores. The free element is 86% as dense as lead.

The etymology is uncertain, but possibly comes from Arabic *bi ismid*, meaning having the properties of antimony or German words *weisse masse* or wismuth ("white mass"), translated in the mid-sixteenth century to New Latin bisemutum.

Bismuth is a brittle metal with a silvery white color when freshly produced, but is often seen in air with a pink tinge owing to surface oxidation. Bismuth is the most naturally diamagnetic element, and has one of the lowest values of thermal conductivity among metals.

Usage – Replacing Lead

Bismuth compounds account for about half the production of bismuth. They are used in cosmetics, pigments, and a few

pharmaceuticals, notably Pepto-Bismol. It is also used in the manufacture of ceramic glazes, crystal ware, and pigments, and as an additive to free-machining steels and malleable iron castings. Bismuth's unusual propensity to expand upon freezing is responsible for some of its uses, such as in casting of printing type.

Bismuth has unusually low toxicity for a heavy metal. As a result of moves to reduce exposure of the population to Lead, a wider market opened for bismuth as a metallurgical additive to lead-free pipe fittings and fixtures, and bismuth use in water meters and fixtures has increased in recent years. As the toxicity of lead has become more apparent in recent years, there is an increasing use of bismuth alloys (presently about a third of bismuth production) as a replacement for lead. Researchers in the European Union, Japan, and the United States continued to investigate the use of bismuth in lead-free solders.

Some feel that there is significant growth potential in the use of zinc-bismuth alloys to achieve thinner and more uniform galvanization. Another new application is the use of a bismuth-tellurium oxide alloy film paste for use in the manufacture of semiconductor devices.

One of the more intriguing uses we found out about (which is also massive) is in windscreen "frit". This is the darkish colouring around the edges of a windscreen that protects the glue that holds the glass to the vehicle. This "trivial" usage is on a truly monumental scale with two ounces of Bismuth per car on 80 million vehicles per annum.

Research examining liquid lead-bismuth coolants for use in nuclear reactors was also ongoing. Work was proceeding toward developing a bismuth-containing metal-polymer bullet. However a key thing to remember is that if Bismuth is to even fractionally replace Lead usage then its production would have to be much larger than the current 20,000 tpa. Moreover we

would note that Bismuth currently trades at seven times the price per lb for Lead.

Supply – Tight

As already mentioned the Chinese have a stranglehold on supply but this does not need to be the case, for as we shall see there are quite a lot of bismuth deposits (mostly as a secondary by-product) around the world.

One of the main reasons that China has pulled ahead was because the La Oroya Metallurgical complex in Peru was shuttered in 2009 owing to financial and environmental problems. According to the USGS though, Zinc production was reported to have begun in July 2012 and the lead smelter reportedly resumed operations during the first half of 2013. Although prior to the shutdown the La Oroya complex had been a significant producer of bismuth, it was uncertain whether bismuth production had resumed. Canadian production dropped significantly in recent years owing to ore depletion and closure of the Lead/Zinc Bathurst Mine in New Brunswick.

The chart below shows the estimated Bismuth reserves of the countries with most of the world's known Bismuth. On Canada we would note that it consists of 5,000 tonnes of "Others" and 49,000 tonnes at Fortune's NICO deposit.

The United States ceased production of primary refined bismuth in 1997 and is highly dependent on imports for its supply. A small amount of bismuth is recycled by some domestic firms. Bismuth is contained in some Lead ores mined domestically, but the bismuth-containing residues are not processed domestically and may be exported. In 2013 the value of reported consumption of bismuth was approximately $17 million.

Bismuth Plays

As far as we can work out the plays with meaningful Bismuth in the mix include:

- Blaze International (BLZ.ax) and Meteoric Resources (MEI.ax) at Barkly Creek
- Emmerson Resources (ERM.ax) at Chariot East
- Fortune Minerals (FT.to) at NICO
- Frontier Resources (FNT.ax) at Stormont

Fortune –Cobalt with a Bismuth Chaser

The thing that initially piqued my interest in Bismuth was a conversation with Fortune Minerals, a TSX- listed silver producer that also holds a coal project in BC and a Gold/Cobalt/Bismuth/Copper project in the North West Territories. While our enthusiasm for Cobalt has been aired here before, the Bismuth was the really surprising thing because of the sheer size of the Bismuth resource which represents around 12% of global reserves in this metal in what is also the world's largest Bismuth deposit. The Proven & Probable Reserve of Bismuth at NICO is 102.1mn lbs.

Without going into too much detail at this point, NICO is envisioned by Fortune to hopefully be, when in production, a reliable North American vertically integrated producer of Cobalt and Bismuth. The capex though is a doozey at CAD$589mn.

Conclusion

While China has the overwhelming proportion of the reserves compared to any other country there is no reason why the other countries with Bismuth reserves should not have a higher collective market share than the current mere 20% of global production. Slippage in non-Chinese production has allowed this woeful situation to develop. Canada probably has the most potential to push back into the top ranks with one deposit potentially skewing things in Canada's favour. However, development of a number of mid-sized Cu/Au deposits in

Australia might give a small fillip to that countries current poor positioning. On a broader scale though, the West’s decline might also be attributed to the lack of work on new Lead/Zinc mines. This is a situation we see being reversed in coming years with Zinc back into favour.

Investors should now be on the lookout for Bismuth as a kicker in the by-product mix of up and coming projects. The more metals in a polymetallic equation the better the chance that project’s bottom line will come out positive, with Bismuth being a positive X factor in such an equation.