The Alliance for Responsible Mining Regulation

Review of the Australian Critical Minerals Prospectus - 2022

CRITICAL MINERALS STRATEGY – THE PROSPECTUS

Contents

GENERAL COMMENTS

The authors of the Australia's Critical Minerals; Prospectus present incomplete, and at times incorrect, data that gives a misleading picture of the true state of Australia's potential for successfully and economically mining critical minerals, and indeed for competing on a world stage.

The Prospectus reads like an advertising brochure rather than a technical document to be taken seriously. All information comes directly from hopeful explorers and miners and there appears to have been no attempt to validate any of it. In fact, it appears that Geoscience Australia has not even checked credible and readily available global information such as that from Statista or the United States Geological Service.

Furthermore, the data tables presented are missing key criteria such as Australia's share of global reserves, total world production or key geopolitical information that could be very relevant to decisions around the amount of financial and regulatory support that should be given to mining hopefuls. The table below shows those figures added in for some of the minerals Australia appears to be wanting to promote. As can be seen, not only was some of the data provided in the Prospectus incorrect, but without further data (in red) the limited data presented did not provide sufficient information to even begin a cursory consideration of the wisdom of promoting particular minerals

extraction or processing. E.g. even though Australia might currently rank 6th in reserves, its actual share of global resources being quite low should give pause highly controversial rare earths mining is being promoted,

Mineral	Rare Earth Elements (2020)	Tantalum (2020)	Vanadium (2020)	Cobalt (2021)	Lithium (2019)	Manganese (2020)
World resources	115.8Mt	Unknown	22,000,000 tonnes	7.6 Mt	80Mt	1,332Mt
Australian resources	4.1 Mt REE oxide	99.4 kt Ta	~~7,408 kt~~ 4,000kt	1,495 kt	6,174 kt Li	276 Mt (Mn ore)
Share of KNOWN world reserves	3.50%	Unknown	18.20%	18%	8%	17.30%
World ranking for resources	6	~~1*~~ Unknown	~~2~~ 3	2	~~2~~ 5	4 3
World production	243,300 tonnes	1700 tonnes	86,000 tonnes	170,000 tonnes	86,000 tonnes	18,490ktonne
Australian production	17,000 tonnes	30 tonnes	0	5,630 tonnes	42,000 tonnes	3,300ktonne
Share of world production	~~8%~~ 7%	~~4%~~ 1.8%	0%	3%	49%	~~12%~~ 18%

Australia has

24 commodities ranked in the top five

for world economic resources, including cobalt, lithium, manganese, tungsten and vanadium.

Figure 1: Claim made on page 19 of the prospectus

This statement is not supported by the Prospectus. In fact, the prospectus only shows a 'ranking' for 13 of the 26 minerals. The other thirteen are classed as negligible, unknown or not available. Further of the 11 being claimed to be in the top five there is no context to enable informed judgement about the significance of the 'ranking' – including the source and strength of competitors. Politicians and the Australian public expect the data presented in documents that will strongly influence strategy and impose a large burden on taxpayer dollars to be accurate. In this case the claims are accurate but risk being misleading as being in the top 5 does not indicate % of 'resource' and economic viability.

Enthusiastic support may be well-intentioned but without sufficient context, the data and claims risk being highly misleading as it's readily evident that purportedly being in the 'top 5' does not indicate the actual % of the resource or its economic viability.

An example of this is the information relating to Lithium. The prospectus incorrectly states that Australia is 2nd for Global Resources, when in fact it is 5th and only has 8% of those resources. Furthermore, even though it was one of the bigger producers in 2019 (despite its relatively low resource share) countries such as Bolivia and Argentina that have far better reserves are intending to become major produces and could provide competition that Australia cannot possibly compete against. (This is of course independent of the global push to recycle lithium batteries which will reduce demand even further.)

RARE EARTHS ELEMENTS

Once again the information provided in the prospectus is somewhat misleading. "

You can see that Australia has only 3.5% of rare earths globally and that 'friendly' countries with far greater reserves (Vietnam, Brazil and India) have barely started production yet. In fact both Vietnam (22Mt) and Brazil (21Mt) have more than times the reserves of Australia but their mine production is amongst the lowest of all countries at only 1,000 tonnes each.

Mineral	Rare Earth Elements (2020)
World resources	115.8Mt
Australian resources	4.1 Mt REE oxide
Share of KNOWN world reserves	3.50%
World ranking for resources	6
World production	243,300 tonnes
Australian production	17,000 tonnes
Share of world production	~~8%~~ 7%

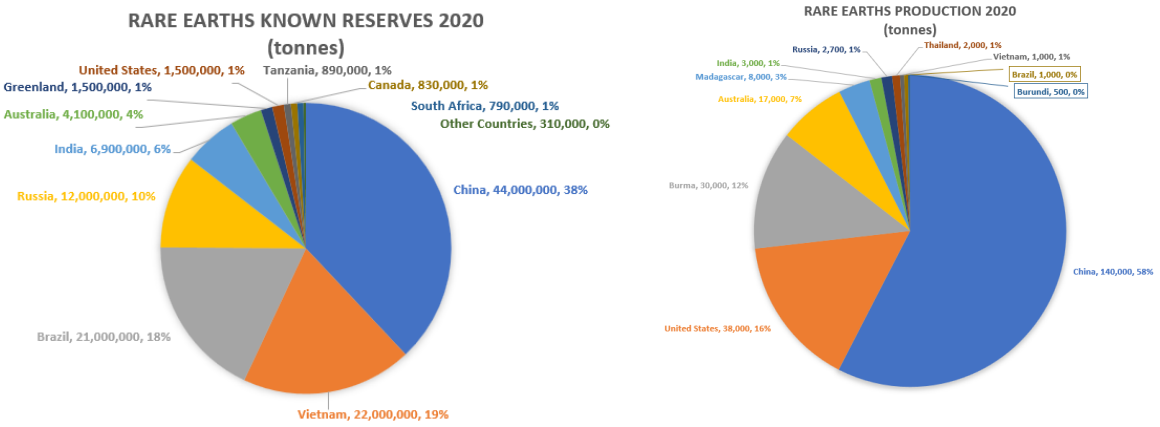
Further a number of countries for which reserves aren't known, including Thailand, were responsible for almost 17% of global production.

As countries like Vietnam, Brazil and India start to produce at a far greater rate, the true picture for Australia becomes apparent as it cannot possibly compete cost wise (let alone in terms of emissions) and any attempt by Australia to 'beat the gun' will leave our country in a rapid race to the bottom. It makes no economic sense for Australia to get caught up in a market that is so perilous and in which we have absolutely no competitive advantage. Unfettered investment in similarly poor economic projects, has left Australia littered with unrehabilitated and abandoned mines. Unfortunately such investment has been encouraged and indeed promoted by inept and irresponsible regulators who are never held to account for what appear to be criminally negligent decisions.

Table 1: Data from https://www.visualcapitalist.com/rare-earth-elements-where-in-the-world-are-they/

Country	Known Reserves (tonnes)	% of Total Known Reserves	Rank for Reserves	Mine Production 2020 (tonnes)	% of Global Mine Production	Rank for production
China	44,000,000	38.0%	1	140,000	57.5%	1
Vietnam	22,000,000	19.0%	2	1,000	0.4%	9
Brazil	21,000,000	18.1%	3	1,000	0.4%	10
Russia	12,000,000	10.4%	4	2,700	1.1%	7
India	6,900,000	6.0%	5	3,000	1.2%	6
Australia	***4,100,000***	***3.5%***	***6***	***17,000***	***7.0%***	***4***
Greenland	1,500,000	1.3%	8	-		
United States	1,500,000	1.3%	7	38,000	15.6%	2
Tanzania	890,000	0.8%	9	-		
Canada	830,000	0.7%	10	-		
South Africa	790,000	0.7%	11	-		
Other Countrie	310,000	0.3%		100	0.0%	
Burma	N/A			30,000	12.3%	3
Madagascar	N/A			8,000	3.3%	5
Thailand	N/A			2,000	0.8%	8
Burundi	N/A			500	0.2%	11
World Total	**115,820,000**	**100.0%**		**243,300**	**100.0%**	

Figure 2: Rare Earths - Known Global Reserves and Production



LITHIUM

https://www.nsenergybusiness.com/features/six-largest-lithium-reserves-world/

Article by Andrew Fawthrop 19 Nov 2020

Lithium is growing in demand, but many of the countries with the biggest-known reserves have yet to successfully commercialise the resource at scale.

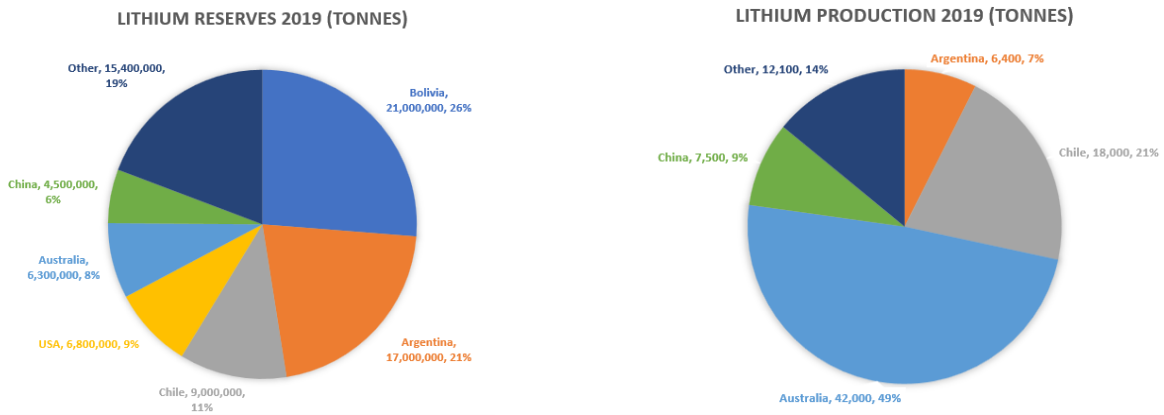
As of 2019 there were 80 million tonnes of identified reserves and the amount keeps growing as more countries encourage exploration and development. In fact, Bolivia has the largest reserves, produced nothing in 2019 but intends to capitalise on those reserves become one of the largest producers of lithium globally**.**

In 2019 Australia produced 49% of global lithium despite having only 8% of global reserves. Given the intention of other countries in a far more advantageous position to invest in Lithium mining Australia must proceed with caution in investing government funds in new mines – in particular those that are highly speculative and for which there are no independent sources of information about reserves, ease of access, extraction and transport, environmental impacts, capacity for rehabilitation and financial viability.

Table 2: Data from https://www.nsenergybusiness.com/features/six-largest-lithium-reserves-world/

LITHIUM (2019)	Resource (tonnes)	% of Global Resource	Production tonnes)	% of Global Production
Bolivia	21,000,000	26%		0%
Argentina	17,000,000	21%	6,400	7%
Chile	9,000,000	11%	18,000	21%
USA	6,800,000	9%		0%
Australia	6,300,000	8%	42,000	49%
China	4,500,000	6%	7,500	9%
Other	15,400,000	19%	12,100	14%
TOTAL	80,000,000	100%	86,000	100%

Figure 3: Lithium – Known Global Reserves and Production



COBALT

The Prospectus was correct in stating that Australia has the second largest reserve in the world

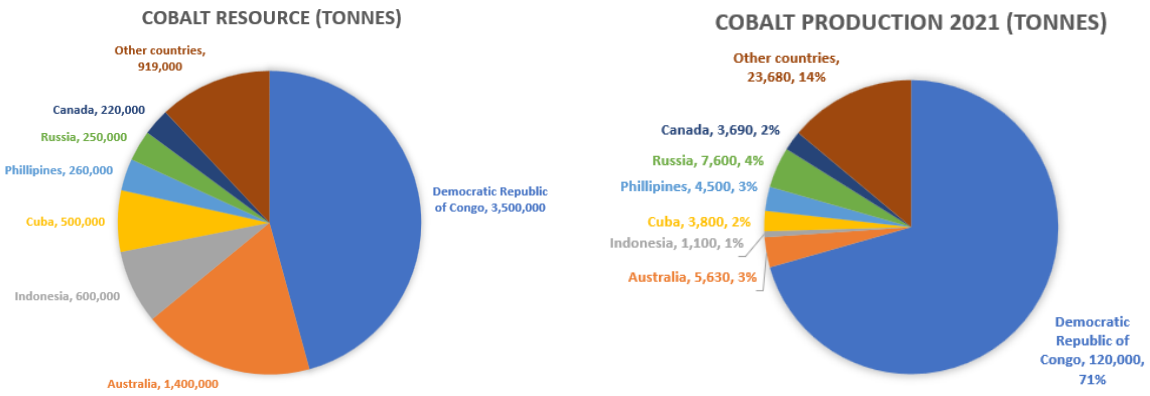
Mineral	Cobalt (2021)
World resources (EDR 2020)	7.6 Mt
Australian resources (EDR 2020)	1,495 kt
Share of world reserves	18%
World ranking for resources	2
World production 2021	170,000 tonnes
Australian production 2021	5,630 tonnes
Share of world production 2021	3%

With the problems associated with the Democratic Republic of Congo (Chinese influence, child labour etc) Australia is in an important position regarding Cobalt as few other strategically aligned nations hold high reserves. However Cobalt is mined as a by-product to other minerals and those must be economically and environmentally sustainable to mine. Other nations, including the USA, are developing their own cobalt mines and processing facilities which could provide stable supplies for their defence and battery needs. Successful production will require enduring and stable markets.

Table 3: Data from https://www.kitco.com/news/2022-02-02/Global-cobalt-production-hits-record-in-2021-as-mined-cobalt-output-in-DR-Congo-jumps-22-4.html

COBALT (2021)	Global Resource (tonnes)	% of Global Resource	Global Production (tonnes)	% of Global Production
Democratic Repub	3,500,000	46%	120,000	71%
Australia	***1,400,000***	***18%***	***5,630***	***3%***
Indonesia	600,000	8%	1,100	1%
Cuba	500,000	7%	3,800	2%
Phillipines	260,000	3%	4,500	3%
Russia	250,000	3%	7,600	4%
Canada	220,000	3%	3,690	2%
Other countries	919,000	12%	23,680	14%
TOTAL	**7,649,000**	**100%**	**170,000**	**100%**

Figure 4: Cobalt - Known Global Reserves and Production



MANGANESE

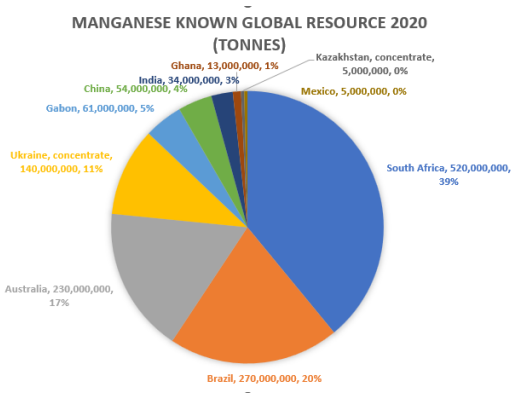
Manganese has no satisfactory substitute for its major applications. Mining is one way to recover the metal, and scouring the seafloor is another way to source it. The metal bearing manganese nodules on the ocean floor also contain nickel, cobalt and copper which make them a potentially lucrative diversified mineral resource. (https://investingnews.com/daily/resource-investing/battery-metals-investing/manganese-investing/top-manganese-producing-countries/)

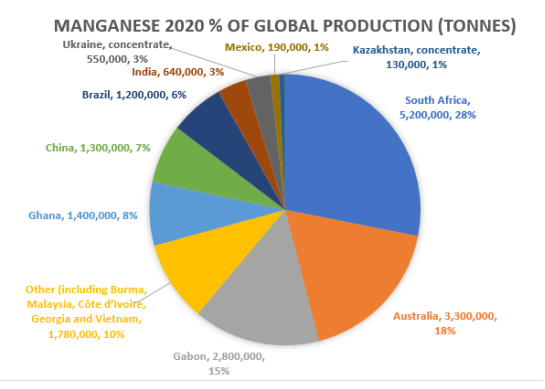
According to the United States Geological Service land-based manganese resources are large but irregularly distributed and if low grade can have high extraction costs. South Africa accounts for about 40% of the world's manganese reserves, and Brazil accounts for about 20% and Australia around 17% (as of 2020). Almost 10% of global production of manganese comes from countries where reserve quantities are unknown.

Table 4: Data from https://pubs.usgs.gov/periodicals/mcs2021/mcs2021-manganese.pdf

MANGANESE 2020	Global Resource (tonnes)	% of Global Resource	Global Production (tonnes)	% of Global Production
South Africa	520,000,000	39.0%	5,200,000	28.1%
Brazil	270,000,000	20.3%	1,200,000	6.5%
Australia	***230,000,000***	***17.3%***	***3,300,000***	***17.8%***
Ukraine, concentrate	140,000,000	10.5%	550,000	3.0%
Gabon	61,000,000	4.6%	2,800,000	15.1%
China	54,000,000	4.1%	1,300,000	7.0%
India	34,000,000	2.6%	640,000	3.5%
Ghana	13,000,000	1.0%	1,400,000	7.6%
Kazakhstan, concentrate	5,000,000	0.4%	130,000	0.7%
Mexico	5,000,000	0.4%	190,000	1.0%
Burma	NA	NA	400,000	2.2%
Côte d'Ivoire	NA	NA	460,000	2.5%
Georgia	NA	NA	150,000	0.8%
Malaysia	NA	NA	350,000	1.9%
Vietnam	NA	NA	150,000	0.8%
Other countries	NA	NA	270,000	1.5%
World total KNOWN	**1,332,000,000**	**100.0%**	**18,490,000**	**100.0%**

Figure 5: Manganese - Known Global Reserves and Production





VANADIUM

Vanadium is the 22nd most abundant element in the earth's crust – ahead of copper and zinc – and is scattered throughout the earth's crusts and oceans. However, it is hazardous to extract and polluting. "Mining and processing of vanadium can be accompanied by **relatively high discharges of vanadium pentoxide V_2O_5, which is somewhat toxic by inhalation,**" and it "can also be dangerous for animals and plants." (https://www.bbvaopenmind.com/en/science/environment/vanadium-fever/)

According to the United States Geological Services there are suitable substitutes for vanadium in all applications except 'aerospace titanium alloys'. Further, although the US has sufficient 'domestic supply' to meet almost all its demand it still chooses to access vanadium from foreign sources.

Vanadium prices are volatile and impact on production viability and there is also an increasing emphasis on recycling it, thus reducing the need for dependence on new mines.

Given the volatility of the markets, existing suitable processers, and the high potential for contamination from both mining and processing and the abundance of acceptable alternatives, inclusion of vanadium in Australia's critical minerals list appears to be a high risk venture.

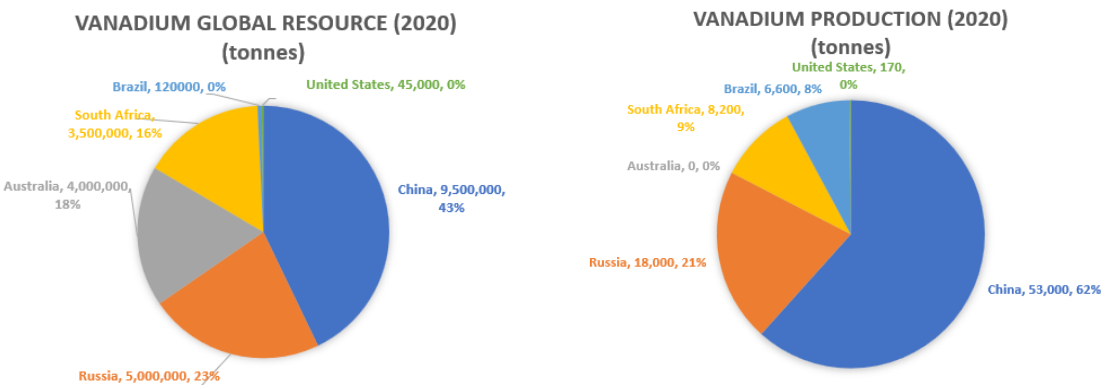
Table 5: Information from prospectus showing corrections in red

Mineral	Vanadium 2020
World resources	22,000,000 tonnes
Australian resources	~~7,408 kt~~ 4,000kt
Share of world reserves	18.20%
World ranking for resources	~~2~~ 3
World production	86,000 tonnes
Australian production	0
Share of world production	0%

Table 6: Data from https://pubs.usgs.gov/periodicals/mcs2021/mcs2021-vanadium.pdf

VANADIUM 2020	Global Resource (tonnes)	% of Global Resource	Global Production 2020 (tonnes)	% of Global Production
China	9,500,000	43.2%	53,000	61.6%
Russia	5,000,000	22.7%	18,000	20.9%
Australia	***4,000,000***	***18.2%***	—	***0.0%***
South Africa	3,500,000	15.9%	8,200	9.5%
Brazil	120,000	0.5%	6,600	7.7%
United States	45,000	0.2%	170	0.2%
World total (rounded)	**22,000,000**	**100.0%**	**86,000**	**100.0%**

Figure 6: Vanadium - Known Global Reserves and Production



TANTALUM

Tantalum is used in a wide range of products from electronics to surgical implants. It is highly sought after but is extremely rare (only 2ppm in the Earth's crust).

Mineral	Tantalum (2020)
World resources	Unknown
Australian resources	99.4 kt Ta
Share of world reserves	Unknown
World ranking for resources	~~1~~ Unknown
World production	1700 tonnes
Australian production	30 tonnes
Share of world production	~~4%~~ 1.8%

The information in the Prospectus about Tantalum is quite misleading. While the largest known or verified tantalum reserves are in Brazil and Australia, the combination of demand issues, lack of control over production and sale, and small-scale mining has led to continued domination by African countries in recent years. Other countries that have tantalum reserves of unknown quantities include: China, Burundi, Bolivia, DR Congo, Ethiopia, Mozambique, Nigeria, Rwanda, and Russia. The United States has approximately 55,000 metric tons of tantalum resources identified, however most of the deposits are not economically viable for extraction relative to current tantalum prices.

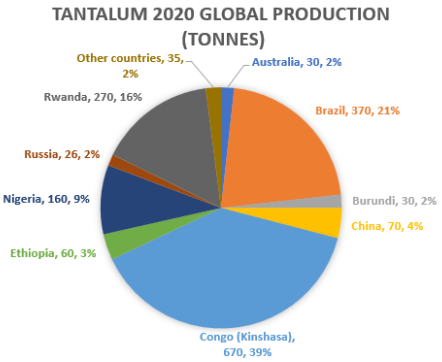
A number of factors make it extremely unlikely that Australia could, without significant government backing become a major supplier of Tantalum. These include price volatily and demand and supply imbalance. (https://www.industryarc.com/Research/Tantalum-Market-Research-503198)

Table 7: Data from https://pubs.usgs.gov/periodicals/mcs2020/mcs2020-tantalum.pdf

TANTALUM 2020	Global Resource (tonnes)	% of Global Resource	Global Production 2020 (tonnes)	% of Global Production (tonnes)
United States	—		—	
Australia	***99,000***		***30***	***1.8%***
Brazil	40,000		370	21.8%
Burundi	NA		30	1.8%
China	NA		70	4.1%
Congo (Kinshasa)	NA		670	39.4%
Ethiopia	NA		60	3.5%
Nigeria	NA		160	9.4%
Russia	NA		26	1.5%
Rwanda	NA		270	15.9%
Other countries	NA		35	2.1%
World total (rounded)	**>140,000**		**1,700**	**100.0%**

GLOBAL RESERVES

The information provided in the Prospectus is very misleading as the total global reserves of Tantalum are unknown. In fact, most of the sources of new production are African countries and Brazil. Tantalum is also sourced as a by-product of tin smeltering and from secondary sources such as municipal waste.



MAGNESIUM

According to the USGA there are multiple sources of magnesium and there are sufficient resources to meet demand into the future. Therefore it appears quite disingenuous to suddenly include it in the Prospectus.

World Primary Production and Reserves:

	Smelter production 2020	Smelter production 2021[e]	Reserves[5]
United States	W	W	Magnesium metal can be derived from seawater, natural brines, dolomite, serpentine, and other minerals. The reserves for this metal are sufficient to supply current and future requirements.
Brazil	18	20	
China	886	800	
Israel	19	22	
Kazakhstan	16	20	
Russia	48	60	
Turkey	12	15	
Ukraine	6	10	
World total (rounded)[6]	1,000	950	

World Resources:[5] Resources from which magnesium may be recovered range from large to virtually unlimited and are globally widespread. Resources of dolomite, serpentine, and magnesium-bearing evaporite minerals are enormous. Magnesium-bearing brines are estimated to constitute a resource in the billions of tons, and magnesium could be recovered from seawater along world coastlines.