

Fingerboards Mineral Sands Project

Comments by Andrew Helps
Delegated Toxic Metal Expert to the
UNEP Global Mercury Partnership

Data from my comments on the Draft Workplan

- Reference : A. Helps file 8350 Revision 5 dated 03/04/2021

Why build this mine at Lindenow?

- A very small sub-economic resource by global standards!
- China has a major undeveloped resource near Whusu in Tianshan North Western China.
- In December 2013, following the end of the Global Conference to start the Minamata Convention on Mercury at Kumamoto Japan, I visited the Whusu site with the Chinese Chief Air Pollution Scientist and a large departmental cadre.
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China

Due to past experience with the Wusu REE mines polluting the environment and poisoning crops and people, China now has a policy, where possible to develop these resources offshore!

The Lindenow Resource

- There are two sources of data on the ore body;
 1. The KALBAR Mineral Product qualities document
 2. Soil and water testing in October 2020 carried out by myself at Lindenow

Mineral product qualities

Premium Zircon		
ZrO2	%	>68.0
SiO2	%	32.5
Al2O3	%	0.1
Fe2O3	%	0.04
TiO2	%	<0.1
MgO	%	0.01
MnO	%	<0.01
CeO2	%	0.02
P2O5	%	0.22
Th	ppm	300
U	ppm	420

Aperture (um)	Wt%	Cum Wt%
150	0.0%	0.0%
106	0.8%	0.8%
90	6.5%	7.3%
75	18.2%	25.5%
63	36.9%	62.4%
45	35.1%	97.5%
0	2.5%	100.0%
TOTAL	100.0%	

Primary Ilmenite				
		Year 1	Year 2	Year 3-5
TiO2	%	54.3	54.2	53.8
Fe2O3(calc)	%	16.9	16.3	15.2
FeO	%	23.2	23.9	25.8
SiO2	%	0.3	0.4	0.4
Al2O3	%	0.3	0.4	0.3
Cr2O3	%	0.25	0.26	0.22
MgO	%	1.5	1.5	1.4
MnO	%	1.4	1.4	1.4
ZrO2	%	0.15	0.14	0.14
P2O5	%	0.04	0.04	0.04
U XRF	ppm	0	14	0
Th XRF	ppm	46	64	58
V2O5	%	0.29	0.28	0.27
Nb2O5	%	0.07	0.07	0.07
CaO	%	0.03	0.02	0.02
SO3	%	-	-	-
K2O	%	0.01	0.01	0.01
CeO2	%	-	-	-

Cum Wt%			
Aperture (um)	Year 1	Year 2	Year 3-5
+ 150um	0.4%	0.2%	0.2%
- 150um, + 106um	6.0%	3.7%	4.5%
- 106um, + 90um	19.7%	15.5%	19.4%
- 90um, + 75um	44.7%	41.9%	45.5%
- 75um, + 63um	79.7%	76.9%	77.1%
- 63um, + 45um	96.8%	97.1%	96.3%
- 45um	100.0%	100.0%	100.0%

Rare Earth Concentrate		
REO	%	45.63
ReO + Y2O3	%	54.00%
La2O3	%	8.72%
CeO2	%	19.36%
Pr6O11	%	2.18%
Nd2O3	%	7.73%
Sm2O3	%	1.50%
Eu2O3	%	0.08%
Gd2O3	%	1.35%
Tb4O7	%	0.21%
Dy2O3	%	1.60%
Ho2O3	%	0.36%
Er2O3	%	1.16%
Tm2O3	%	0.18%
Yb2O3	%	1.0%
Lu2O3	%	0.2%
Y2O3	%	8.4%

Aperture (um)	Wt%	Cum Wt%
106	1.1%	1.1%
90	10.8%	11.9%
75	27.6%	39.5%
63	31.3%	70.8%
45	27.6%	98.3%
0	1.7%	100.0%
TOTAL	100.0%	

Rutile 92		
TiO2	%	92.7
Fe2O3	%	0.5
SiO2	%	3.7
Al2O3	%	0.6
Cr2O3	%	0.1
MgO	%	0.1
MnO	%	0
ZrO2	%	1.1
P2O5	%	0
U XRF	ppm	41
Th XRF	ppm	75
V2O5	%	0.3
Nb2O5	%	0.3
CaO	%	0
SO3	%	-
K2O	%	0.1
CeO2	%	0
SnO2	%	0.05

Cum Wt%	
Aperture (um)	HiTi 92
+ 150um	0.0%
- 150um, + 106um	7.9%
- 106um, + 90um	24.3%
- 90um, + 75um	54.8%
- 75um, + 63um	87.5%
- 63um, + 45um	99.3%
- 45um	100.0%



Fingerboards Mineral Sands Project
ANALYSTS PRESENTATION

Mineral Product Qualities Document

- This is a very simple snapshot of what is in the KALBAR ore body.
- However this document does not explore the toxicology or the various minerals in the ore body.
- This document is not of a standard that would allow it to be used to test the commercial viability of the proposed KALBAR Mine.

What does the data tell us?

- The KALBAR page 22 data(my slide 6) provides an insight to the toxic metal levels at a percentage level in the ore body
- The Air Screening levels required by Vic EPA SEPP Air Quality Management (Publication 1191 December 2007) (The PEM) are at Parts per billion (PPB)
- The proposed Kalbar operations are clearly a Level 1 operation as defined on page 6 of the PEM
- There is no indication that the EPA is updating the PEM as required by the legislated 10 year rule.

Additional EPA Failures

- State Environment Protection Policy (SEPP) 240 Air Quality Management was due for renewal (updating) by December 2011
- SEPP 160 Groundwater's of Victoria was due to be updated by December 2007
- SEPP 95 Prevention/Management of contamination of land) was due to be updated by June 2012
- SEPP 107 (Waters of Victoria) was due to be updated by August 2009.

Will the EPA Deliver

- The fact that these five critical SEPP's will be expired before the Panel hearing for this proposal, exposes the community to a higher risk and over a long period of time.
- The East Gippsland community needs to be putting public pressure on the Environment Minister to step in and force the EPA to update to Worlds Best Standard (USEPA) these critical SEPP's.

The page 22 Data

- My concerns are based on the data in the second column “Primary Ilmenite”
- This data has obviously been laboratory separated for an ore sample or a mixture of ore samples.
- This data gives a good indication of the carcinogenic metals that are in the Kalbar ore
- I have further concerns that the consultant employed by the proponents (Kalbar) is actively demonstrating that corporately they do not understand the risks from airborne and water born toxic metals.

The Measurement Levels

- The Kalbar Resources page 22 data is in percentage terms (parts per 100)
- Normal pollution measurements for metals from a laboratory are:
 - Parts per million for soil samples (mg/kg)
 - Parts per billion for air samples ($\mu\text{g}/\text{m}^3$)
 - Part per billion for water samples ($\mu\text{g}/\text{L}$)

Airborne Carcinogens

- TiO₂ (Titanium) is quoted at 54% in the primary Ilmenite.
- California EPA in June 2015 classed airborne unbound particles of respirable size Titanium Dioxide as a carcinogen.
- The USEPA Regional Screening levels set a trigger level of 0.0100 ug/m³ for Titanium in residential air and 0.0440 ug/m³ for Titanium in industrial air (e.g the mine workings and the Mine buffer Zone).
- It is very clear that the mine will never be able to deliver compliance to this USEPA standard

The Other Metals

- The KALBAR retained consultants, for unexplained but obvious reasons only provided data on 11 metals in their so called “Draft Workplan.”
- The actual lab report would have had data on 34 metals plus sulphur

All data from ATSDR Minimal Risk Levels and or ATSDR Substance Priority List

1. **Aluminium** ATSDR listed Neurological toxicant. USEPA RSL air limit 0.5200 ug/m³.
Theoretical Dose / Day (TDD) 10.32 mg/kg/day.
2. **Arsenic** ATSDR Rank #1 as a Carcinogen. USEPA Resident air limit 0.00065 ug/m³.
Chronic Oral ingestion 0.0003 mg/kg/day
3. **Barium** ATSDR Rank #134 USEPA Resident air limit 0.00108 ug/m³.
Chronic Oral 0.2 mg/kg /day. End point Renal failure
4. **Boron** ATSDR Ranked as HEAST, Residential air limit 2.10 ug/m³.
Acute Inhalation risk 2.1 ug/m³, Oral 0.2 mg/kg/day
5. **Copper** ATSDR Rank #125 Chronic MRL 0.01 mg/kg/day Vic EPA limit is 33 ug/m³.
6. **Iron** ATSDR Resident Air limit carcinogenic target risk 0.01626 ug/m³.
7. **Manganese** ATSDR Rank #140 soluble in water ATSDR USEPA Air Limit 0.05 ug/m³.
8. **Molybdenum** ATSDR Rank #326 ATSDR MRL Air 0.00004 mg/m³ tapwater 10 mg/L
9. **Nickel** ATSDR Rank #57 ATSDR MRL 0.00009 mg/m³ tap water 20 ug/L.
10. **Strontium** ATSDR Rank #123 Same toxicity as Arsenic.
11. **Zinc** ATSDR Rank #75 ATSDR MRL 0.00260 mg/m³ TDD 2.00056 mg/day.

PICA EVENTS

- PICA EVENTS ARE THE TECHNICAL TERM FOR CHILDREN AND ADULTS INGESTING SOIL VIA HAND TO MOUTH INGESTION
- US EPA data (Chapter 5 Exposure Factors Handbook) indicates that PICA events are a major source of Titanium ingestion by Children.
- The indicated ingestion level that triggered hospitalisation ranged from 28 to 1000 mg/day

Known Airborne Carcinogens at the Fingerboards

- Cr₂O₃ (Chromium) is quoted at 0.25% in the primary Ilmenite
- Chromium is a USEPA classed carcinogen with male and female developmental impacts
- The USEPA Regional Screening levels set a trigger level of 0.0100 ug/m³ for residential air and 0.0440 ug/m³ for industrial air

Airborne Carcinogens

- V_2O_5 (Vanadium pentoxide) is quoted at 0.29% in the primary Ilmenite
- Vanadium pentoxide is a USEPA classed carcinogen
- The USEPA sets a trigger level of 0.000 ug/m^3 in residential air and 0.0015 ug/m^3 in Industrial air

Airborne Carcinogens

- Th (Thorium) is quoted at 46 ppm
- Thorium is a California EPA class 1 carcinogen
- The USEPA PDRV (Prioritised Dose Response Value) is 0.000185 pCi/m³
- Why have KALBAR's consultants not addressed this issue?

The Risk to Residents

- Kalbar is proposing to mine on average 7 million tons per year (page 13).
- On a 24X7 basis this is 800 tons per hour
- The material will be mined by open cut methods
- The proposal is to transport the ore to a processing plant via truck
- With **at least** 4 airborne carcinogens in the ore the public health risks are very significant (similar to black lung disease)

The Risks to the Environment

- The Carcinogenic metals are all capable of bio-accumulating through food chains.
- Grazing animals and young children are of particular risk as they inhale air from ground level.
- Titanium in particular bio-accumulates through vegetation food chains.
- A grave risk that export foods from the area will be subject to import restriction in Asia
- These issues have already triggered property buy-back's at the Costerfield mine in Central Victoria.

The Risks to the Environment

- The area is subject to mercury pollution from the Gippsland Power stations and historical mining in the catchments.
- The down-wind areas from the mine will rapidly accumulate all the polluting metals deposited out of the air
- The Mitchell River catchment is already mercury polluted from historical mining operations and natural degradation of Cinnabar in two of the upper sub catchments.

The Rare Earth Elements

- There is an interesting and alarming document dated September 2017 (my file # 8279 Rev C) which identifies the Rare Earth Elements in the KALBAR Ore body.
- I have been a referral expert for many years for the USEPA's Office of Pollution Prevention and Toxic's development of the US Toxic Release Inventory (TRI)
- The aim of this inventory is to provide information about toxic chemicals that are released into the environment.
- The TRI has input into the data for the US EPA Regional Screening levels

File 8279 Rev C

8279 Rev C	A Presumed Grab Sample of 1000kg			Dec 17	Is this processed or a Grab Sample?	
			TOTAL REE's	% at Fingerboards	Toxicity Status	
Heavy	Non-magnetic	Less abundant	Europium	Eu ₂ O ₃	0.08	Rapidly Oxidises in air
Heavy	Non-magnetic	Less abundant	Ytterbium	Yb ₂ O ₃	1.00	Safe and stable
Heavy	Magnetic	Less abundant	Terbium	Tb ₄ O ₇	0.21	Reacts with water to create Hydrogen Flammable Moderately toxic
Light	Non-magnetic	Abundant	Lanthanum	La ₂ O ₃	8.72	Used to treat high blood pressure by Chewing it
Heavy	Magnetic	Less abundant	Dysprosium	Dy ₂ O ₃	1.60	Low toxicity
Light	Magnetic	Abundant	Praseodymium	Pr ₆ O ₁₁	2.18	Moderately Toxic - bioaccumulates in the liver - eye irritant
Heavy	Non-magnetic	Less abundant	Gadolinium	Gd ₂ O ₃	1.35	Used as X-ray contrast is viewed as mildly toxic
Light	Magnetic	Abundant	Neodymium	Nd ₂ O ₃	7.73	Can Cause lung Embolisms and damages the liver
Light	Non-magnetic	Abundant	Cerium	Ce ₂ O ₃	19.36	Moderately toxic - lung Irritant and eye irritant
Light	Non-magnetic	Abundant	Samarium	Sm ₂ O ₃	1.50	Not known to be toxic
Heavy	Non-magnetic	Less abundant	Holmium	Ho ₂ O ₃	0.36	Emits toxic fumes under fire conditions
Heavy	Non-magnetic	Less abundant	Erbium	Er ₂ O ₃	1.16	Highly toxic fire and explosion hazard
Heavy	Non-magnetic	Less abundant	Thulium	Tm ₂ O ₃	0.18	Not known to be toxic
Heavy	Non-magnetic	Less abundant	Lutium	Lu ₂ O ₃	0.20	Corrodes in damp air
Heavy	Non-magnetic	Less abundant	Yttrium	Y ₂ O ₃	8.40	Reacts with water to produce Hydrogen gas - fire risk
Heavy	Non-magnetic	Less abundant	Scandium	Sc ₂ O ₃	?	Bioaccumulative
			Promethium - radioactive			
			Other REO			
			Titanium			
			Lithium			
			Palladium			

Toxicology of the Rare Earth Elements

- It is important to note that the previous table only deals with a “Grab” sample of separated REO’s in the early stage of the project definition phase.
- We do not know who assembled this sample except that it was for KALBAR
- When I sent the file 8279 Rev C to one of my USEPA toxicologist friends she was very quick to come back with the advice:
 - Samarium self ignites at 150 degrees C
 - Lutetium is a radioactive carcinogen
 - Yttrium reacts with water to produce Hydrogen gas which has a habit of pooling in confined spaces and then exploding

Additional Data

- **All data from ATSDR Minimal Risk Levels and or ATSDR Substance Priority List**

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- 10. **Strontium** ATSDR Rank #123 Same toxicity as Arsenic.
- 11. **Zinc** ATSDR Rank #75 ATSDR MRL 0.00260 mg/m³ TDD 2.00056 mg/day.

The Metals KALBAR Forgot!

1. **Beryllium** USEPA Regional Screening Level (CAS # 7440-41-7) Carcinogenic SL 0.00120 ug/m³ Oral Chronic 0.002mg/kg/day.
- 2. **Bismuth** No ATSDR listed data.
- 3. **Cadmium** USEPA Regional Screening Level (CAS # 7440-43-97) present in the ore body but below reporting level for the ICP MS. Carcinogenic SL 0.00160 ug/m³.
- 4. **Cerium** USEPA Regional Screening Level (CAS # 1306-38-3) present in the water flowing from the ore body at 14 to 66 ug/L. Non carcinogenic SL 0.0940 ug/m³.
- 5. **Chromium** USEPA Regional Screening Level (CAS # 7440-47-3) Normally, in the wild, Chromium exists as ferrous chromite where Cr is in the chromic state which is the most stable oxidation state. TDD is 0.25388 mg/day. Air limit is 0.00059 mg/m³.
- 6. **Gallium** USEPA Regional Screening Level (CAS # 7440-55-3) present in the water in the ore body at 3 to 15 ug/L. Carcinogenic SL 0.00001 mg/m³, TDD 0.0001 mg/day. Present in the water flowing from the ore body at 3-15 ug/L.
- 7. **Lanthanum** USEPA Regional Screening Level (CAS # 7439-91-0) present in the water in the ore body at between 9 and 43 ug/L. Air limit is 0.00018 mg/m³. TDD is 0.00268 mg/day.
- 8. **Lithium** USEPA Regional Screening Level (CAS # 7439-93-2) present in the water in the ore body at 3 to 15 ug/L. Water limit is 0.3852 mg/L, TDD is 0.40442 mg/day.
- 9. **Manganese** USEPA Regional Screening Level (CAS # 7439-96-5) present in the water at between 93 and 120 ug/L. Water limit is 1.36531 mg/L. Air limit is 0.00102 mg/m³, TDD is 1.62443 mg/day
- 10. **Molybdenum** USEPA Regional Screening Level (CAS # 7439-98-7) present in the water at less than 1 ug/L. A significant risk in air, limit is 0.00005 mg/m³, and a TDD of 2.00056 mg/day

The EES Process

- I understand that there were 21 paid bureaucrats on the TCG, 4 representatives of the proponent and no representation from the local community or independent technical and disaster management experience.
- The big risk of this proposal is to the local farmers and residents and the State Government had clearly moved to avoid input and or difficult questions from the impacted farming community or their expert representatives.

The EES Process

- As this proposal has the potential to wipe out or seriously damage farming in the area and significantly damage the already highly polluted Gippsland Lakes RAMSAR and the health and safety of quite a significant population in the area, the Environment Minister should have directed the EPA Chief Scientist to attend and provide scientific input to the TCG.

Public Liability

- Is the proponent going to hold public liability insurance for this project?
- If so how has the risk been costed?
- As some of these carcinogens have long latency periods (15 – 30 years) who is going to hold the long term public liability?



Thank You