

AusImm
THE MINERALS INSTITUTE

CRITICAL MINERALS 2013

4 - 5 June 2013, Perth, Western Australia

Dubbo Zirconia Project

NSW Australia

The Pilot Plant: Key to Successful Process and Market Development

4 June 2013

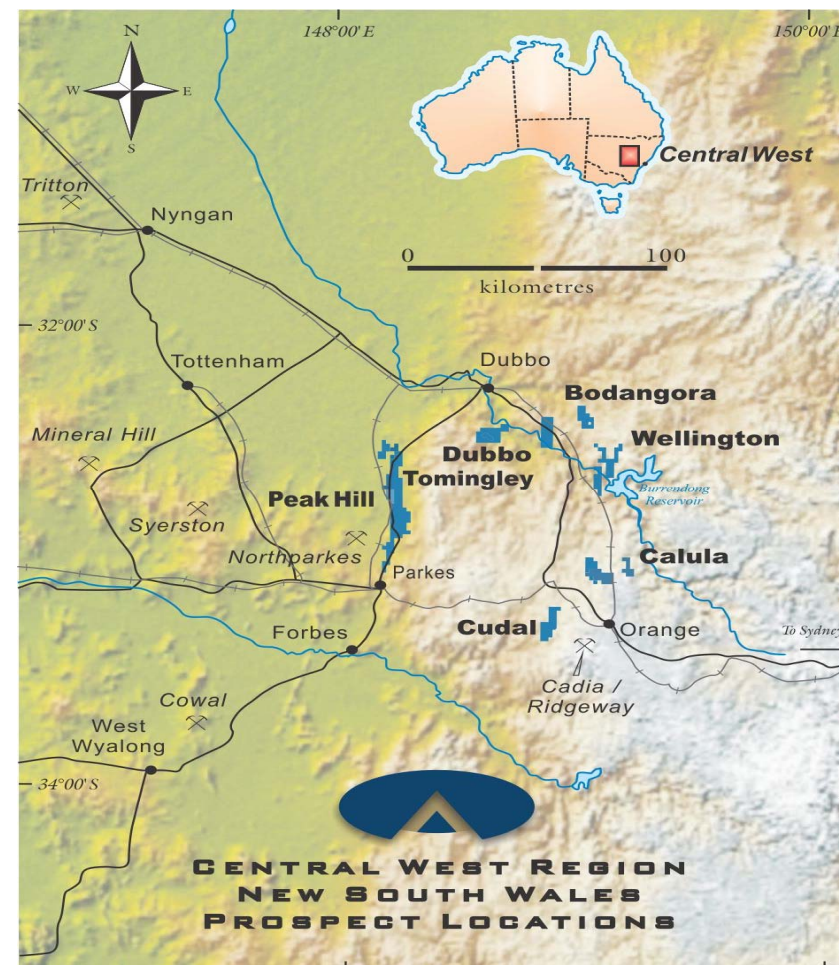


**AUSTRALIAN
ZIRCONIA LTD**



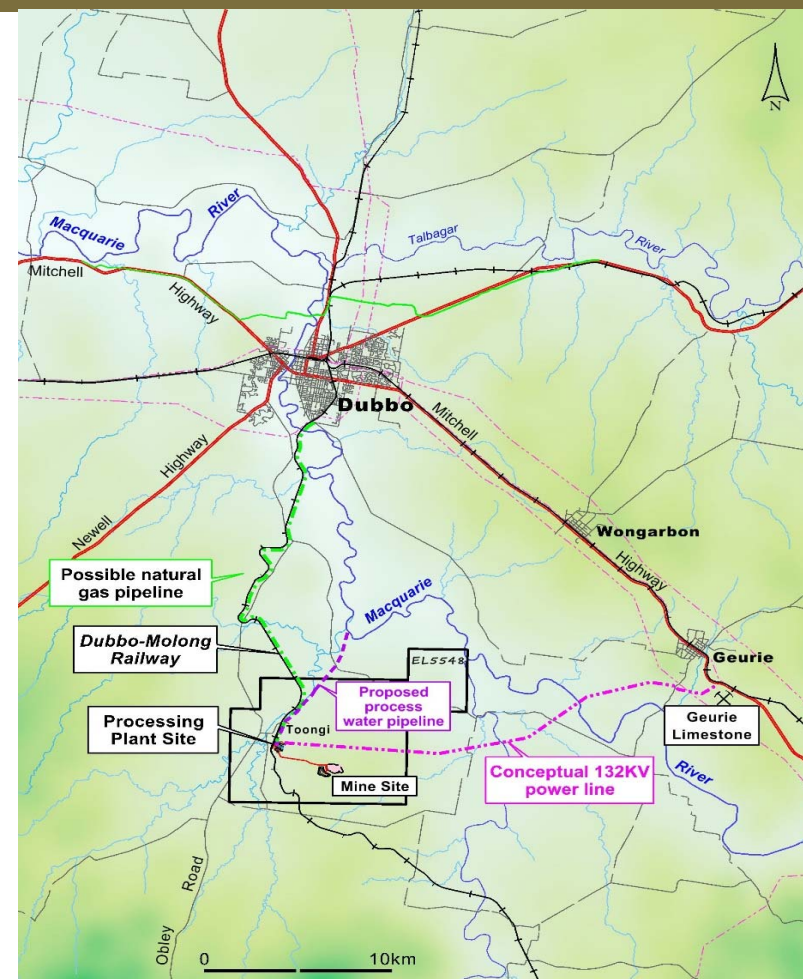
**ALKANE
RESOURCES LTD**

- Listed on ASX since 1969, also listed on OTCQX
- Market cap \$200M
- 6,100 shareholders (85% Australian)
- Multi commodity explorer, miner and developer focused on Central West of NSW
- Active in region for more than 20 years
- Developed Peak Hill Gold Mine in 1996, operated to 2005
- Tomingley Gold Mine construction underway, first gold production early 2014
- World-class Dubbo Zirconia Project (DZP) progressing toward development decision
- Successful ongoing exploration with long term plan of project development pipeline



Dubbo Zirconia Project

- Located 30 km south of Dubbo
- World class resource of zirconium, hafnium, niobium, tantalum, yttrium and light and heavy rare earths elements
- DFS April 2013, DZP “technically and financially robust project”
- Base case of 20 year mine life and 1Mtpa production gives NPV of \$1.23 billion
- Mine life to be in excess of 70 years
- EIS lodged shortly with NSW Department of Planning and Infrastructure
- Expected to start production Q1 2016





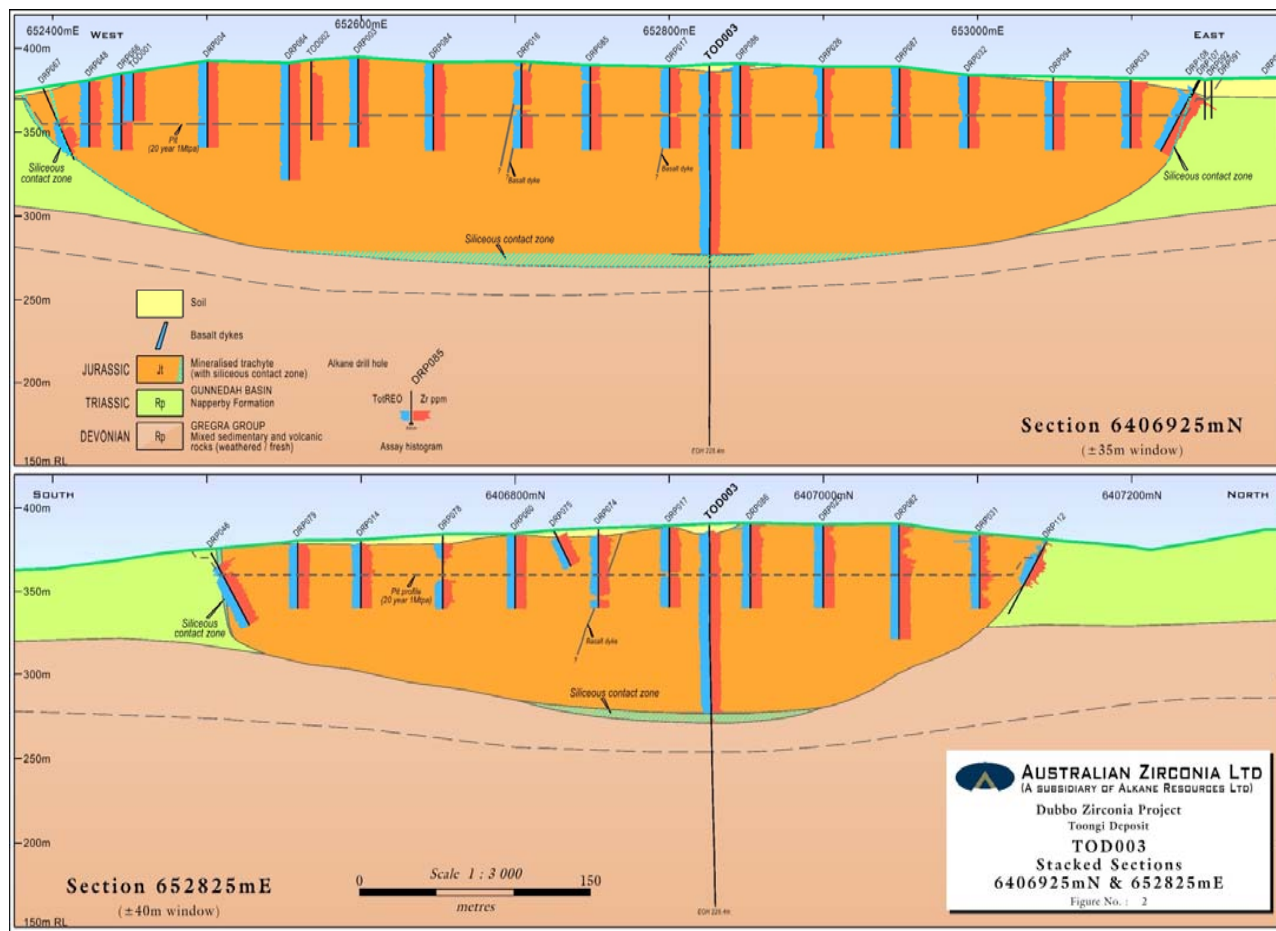
**Jurassic aged trachyte intrusive or
lava flow**

-  Mineralised Trachyte
-  Basalt
-  Napperby Formation
-  Drill hole collar

- K-feldspar - partly sericitised ~30 - 40%
- albite (sodic feldspar) ~30 - 40%
- aegerine (sodic clinopyroxene) ~15 - 20%
- minor calcite, siderite, quartz, rhodocrosite

**Weathering down to ~15 metres depth
No impact on mineral assemblage**

DZP sections & ore mineralogy



Zirconium
Heavy REs

eudialyte
armstrongite

$\text{ZrSiO}_4 \pm \text{Ca, Y, HREE, H}_2\text{O} + ?\text{U}$

< 2 μm - 50 μm

Niobium/
Tantalum

natroniobite

$\text{NaNbO}_3 + \text{Ta} + ?\text{Th}$
also NbFeSiO_4

< 30 μm

Rare Earths

calcian
basnaesite
rare ancylite

$\text{Ca(REE)(CO}_3\text{)F}$
 $\text{Sr(REE)(CO}_3\text{)H}_2\text{O}$

< 100 μm

**The deposit does not contain zircon;
pyrochlore; columbite; monazite or xenotime**

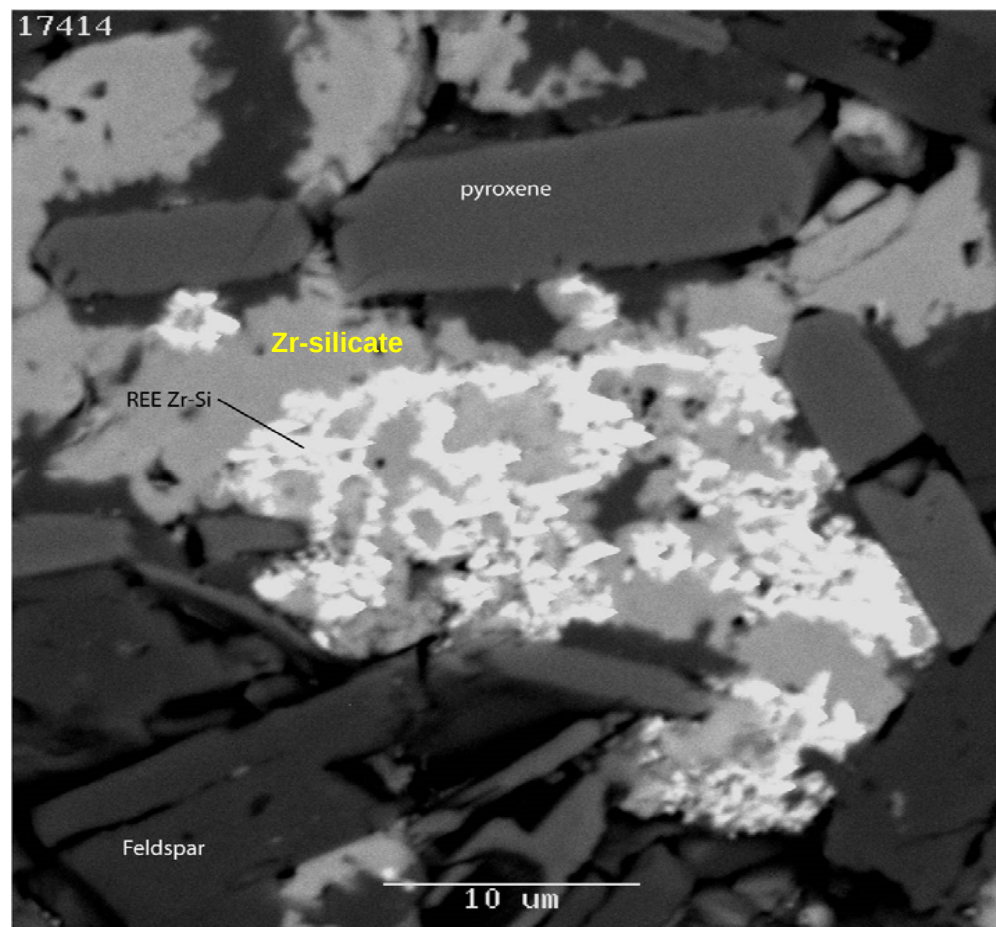
80 year open pit mine life

Zirconium Minerals

BSE image x 2300:

HREE-rich Zr-Si hosted within
Zr-silicate

ANSTO March 2007

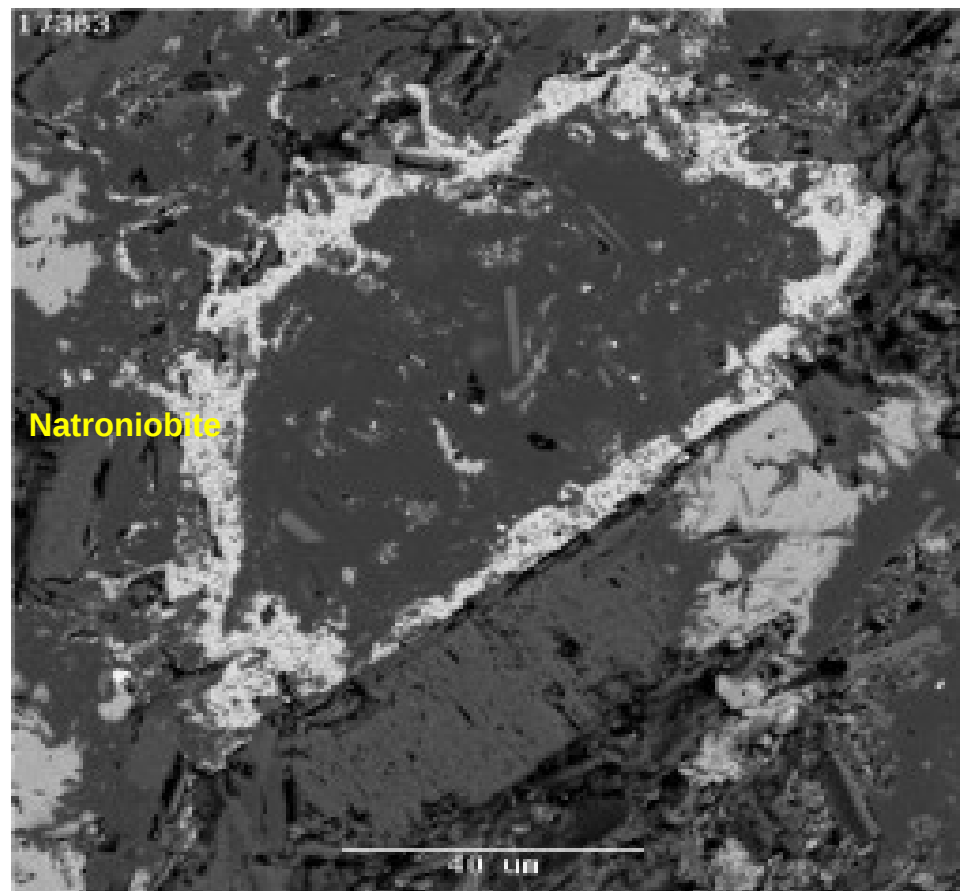


Niobium Minerals

BSE image x 600:

Natroniobite in Fe-Mn carbonate

ANSTO March 2007

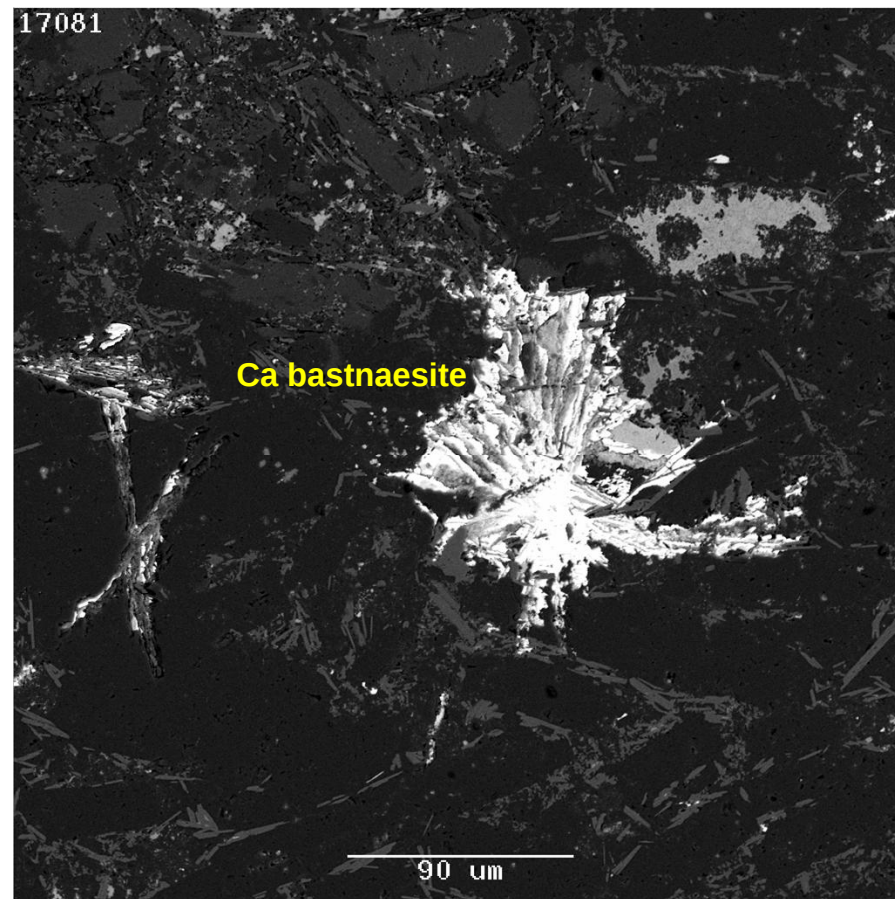


Light Rare Earth Minerals

BSE image x 250:

Ca-bastnaesite

ANSTO March 2007



Based upon earlier work program (1984 - 1988) on a different project, DZP process development work began in 1999 and the basic flow sheet trialed at mini-pilot plant stage in 2001 - 2002

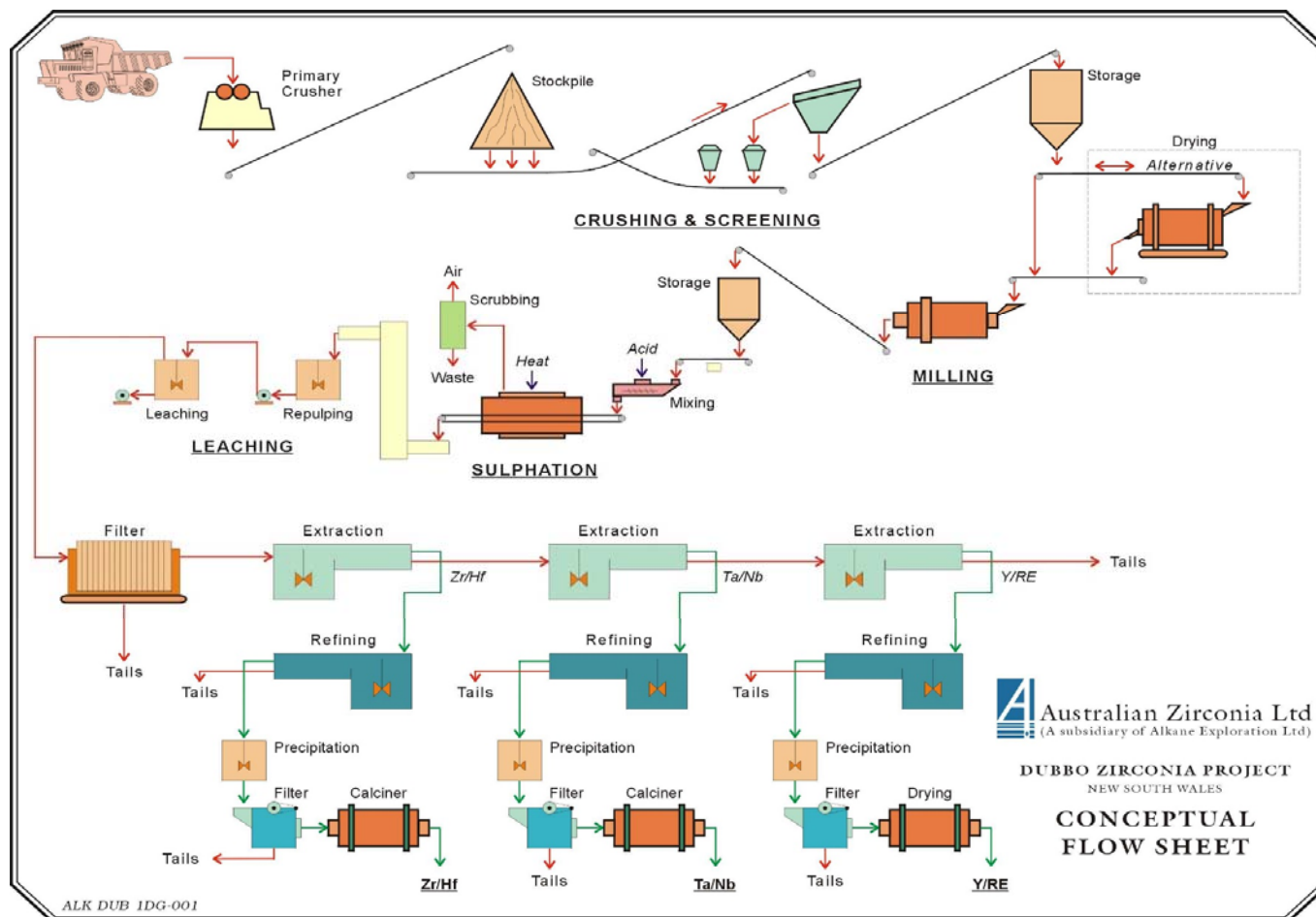
- Preliminary test work on HCl, HF, NaOH leaching, and H₂SO₄ roasting and leaching
- Preliminary flotation to assess potential for pre-concentration
- Scan of various physical separation processes
- Definitive flotation test work for pre-concentration

Only H₂SO₄ roast/leach gave potentially viable process as ore minerals readily soluble in sulphuric (95% recovery) but little of host rock dissolved (FeMn carbonates only)

PROCESS

Whole of ore sulphuric acid roast leach, solvent extraction separation and chemical refining of zirconium and niobium products.

No defined rare earth recovery circuit (prices very low with dominance by China)



DZP Mini Pilot Plant 2001 -2002



**Mini pilot plant at
SGS Lakefield in Perth**



**Mini pilot plant solvent
extraction circuit**

**Mini pilot plant roaster
and off-take gas scrubber**



**Mini pilot plant
zirconium sulphate
thickener**

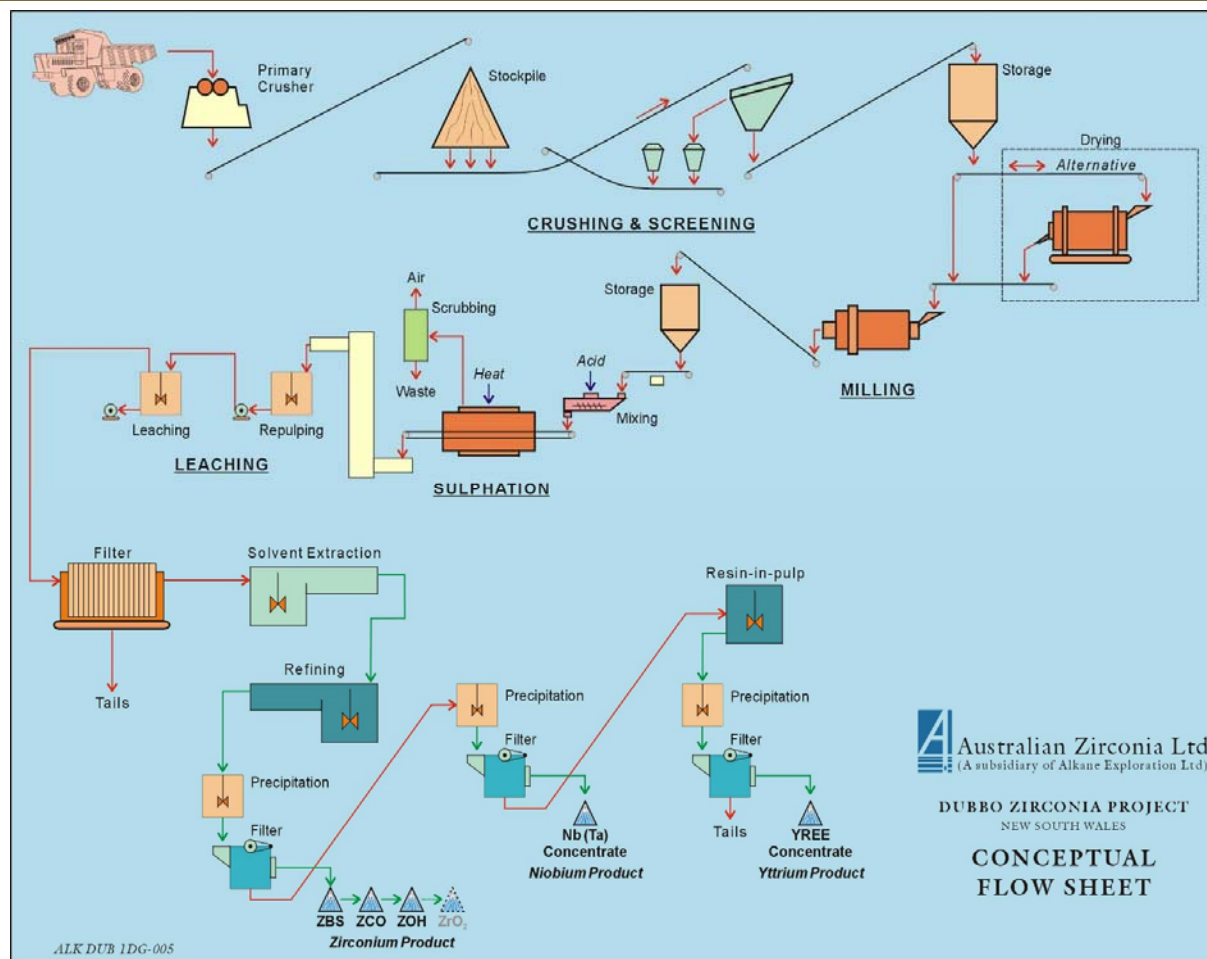


- Zirconium and niobium products (~100g) from mini pilot plant distributed to potential international customers
- Favourable feedback but larger samples needed for full technical evaluation
- Feasibility without any rare earth revenue weak; project temporarily parked
- Process review (2003) recommends optimisation program and operation of large scale demonstration pilot plant (DPP) to process at larger scale and produce larger product samples for evaluation



DZP Metallurgy Phase Two 2006 - 2008

- **2006 program commences at ANSTO in Sydney to optimize the Zr and Nb circuit, and incorporate a rare earth recovery in the flowsheet**
- **\$3.3m grant from AusIndustry to assist funding of construction and operating of the DPP**
- **No solvent extraction for niobium and rare earths recovery**
- **Resin-in-pulp trialed for REE recovery**
- **REE prices show signs of improvement**
- **Demonstration pilot plant built 2007 and commences operation in 2008**



DZP Demonstration Pilot Plant 2008 – 2013



Part of DPP internal at ANSTO

**DPP roaster when installed outside
- originally the ALK's Peak Hill Gold
Mine carbon regen kiln**



**Roaster off-take gas
scrubber**





Primary pressure plate filter

Zirconium precipitation circuit

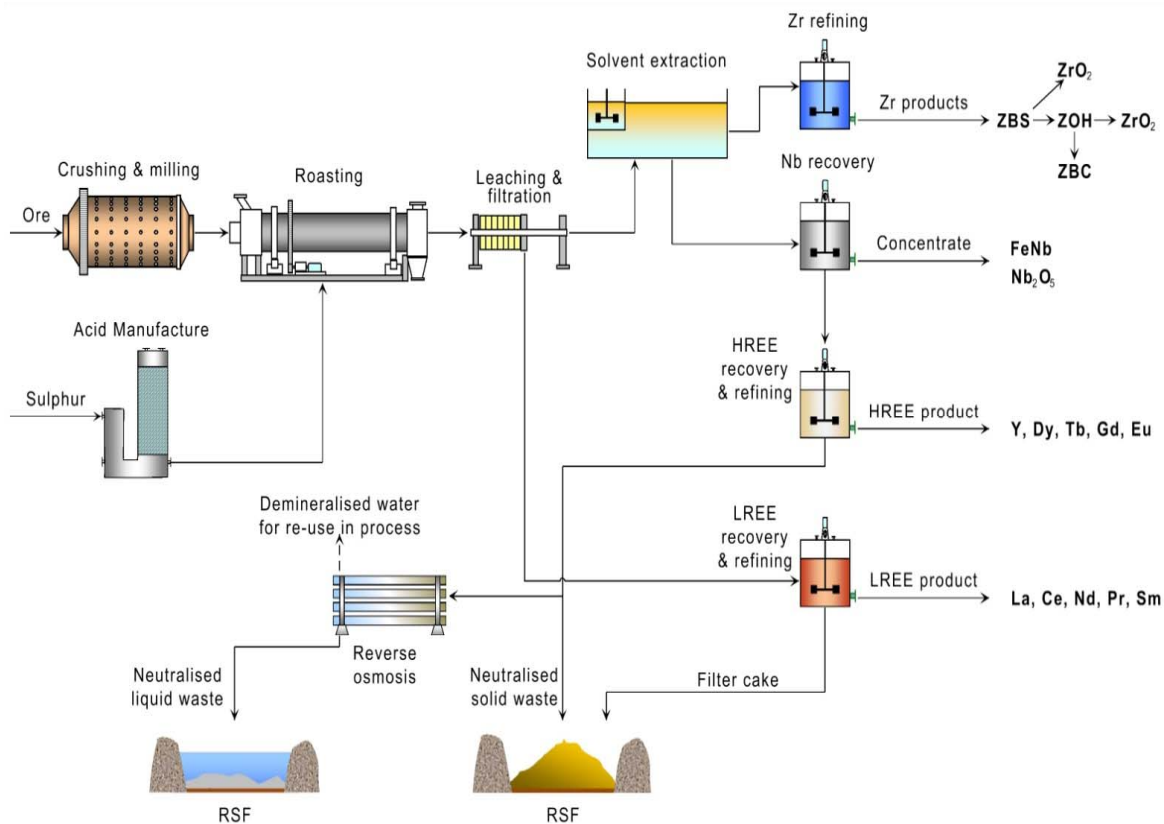


Solvent extraction circuit



Heavy rare earth recovery circuit





This flowsheet used in current feasibility studies. Mass balance measurements enable detailed process data to be generated.

Off-take

Memorandums of Understandings (MOU's) / Agreements

MOU	Product	Details
1	Zirconium	Leading Chemical Company to develop applications for zirconia produced by DZP
2	Zirconium	Australian Mintech Chemical Industries to produce zirconium oxychloride
3	Zirconium	European manufacturing / trading company to market DZP products
4	Niobium	European alloy manufacturer JV to produce and market ferro-niobium
5	YREE	Japan Shin-Etsu Toll treatment JV for separation and sale

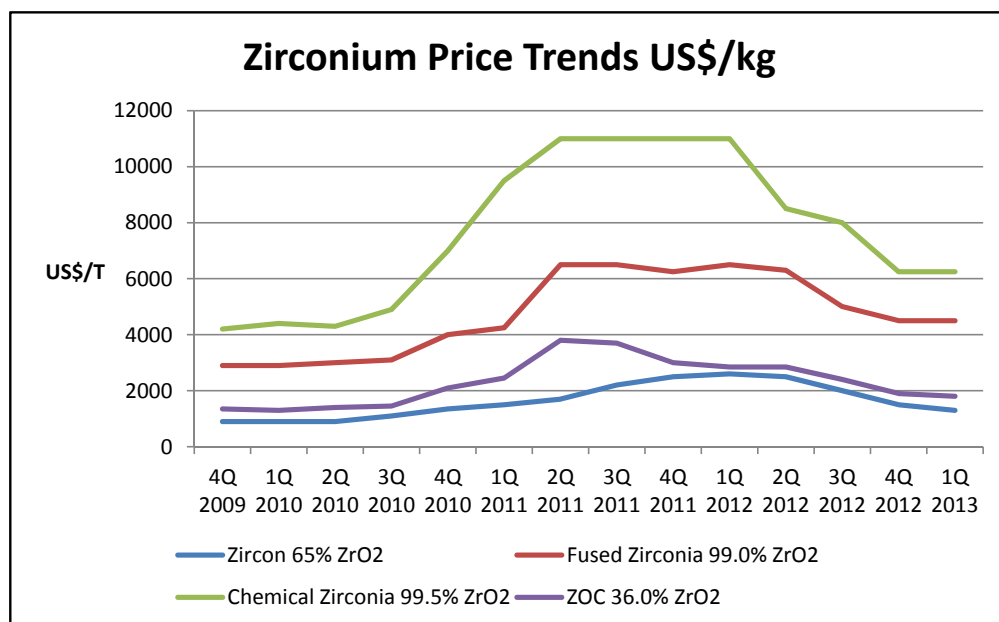
- **Separate project to produce chemical zirconia for ceramics industries ramped up by AZL**
- **Primary filter cake contains ~ 200ppm Ta₂O₅. At 1Mtpa this equates to about 200tpa (>400,000lbs pa).**
- **A program has commenced to review recovery of this valuable Ta₂O₅ product**



Zirconia ball and seat valve

Zirconium

- Zirconium is a corrosion and heat resistant metal, many electronic uses
- Multiple ceramic applications
- Used in a range of components for vehicles, such as car exhausts
- Many chemical applications eg replaced lead as drying agent in paints

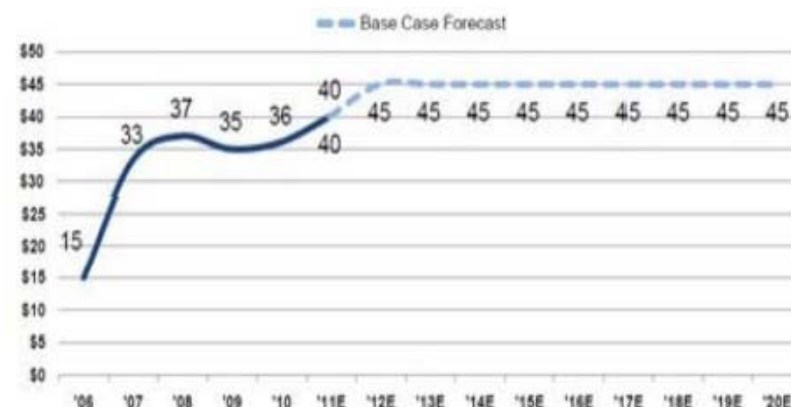
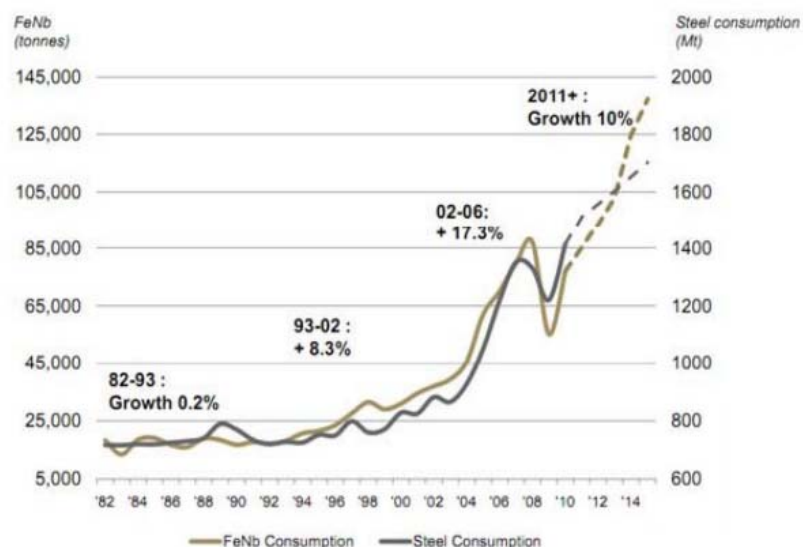


Averaged quarterly prices as compiled from multiple sources

- China currently produces 90% of world downstream zirconium chemicals
- DZP expected to produce 15,800tpa of zirconium products (ZrO₂ units)
- The current prices are the bottom of the cycle and substantial growth expected over the next 10 years

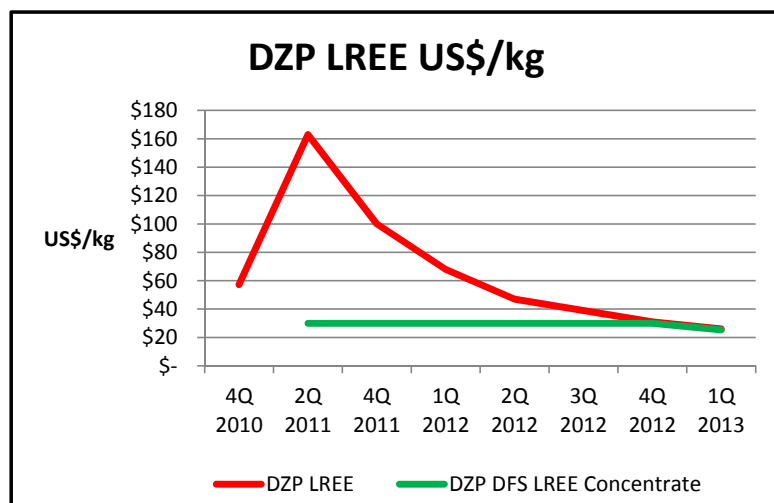
Niobium

- Niobium (Nb) is a soft metal which strengthens alloys, superalloys and steel
- Used in pipeline construction, jet engines, heat-resistant and combustion equipment
- Makes vehicle chassis lighter, reducing overall vehicle weight by 10%, lower fuel consumption and reduces emissions

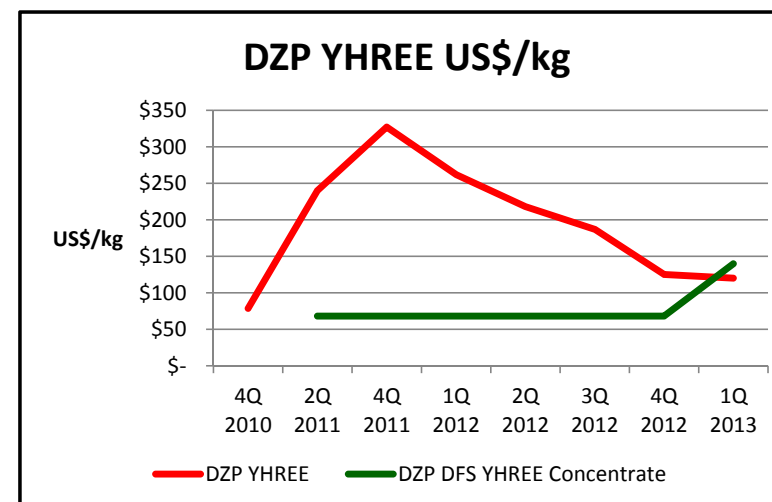


- DZP alternative global supplier and only Australian producer in 2016
- Possible additional tantalum revenue
- Nb price set by the major Brazilian producer, with strong growth anticipated

- REEs a group of 15 (+2) elements in periodic table in two distinctive groups, LREEs and HREEs
- Variable magnetic and chemical properties give rise to many applications
- Used for energy efficiency, new energy sources and emissions minimisation
- China currently produces about 95% of world's REE
- Current depressed market expected to revive over next few years but growth rates will be very variable and based on individual metal demand

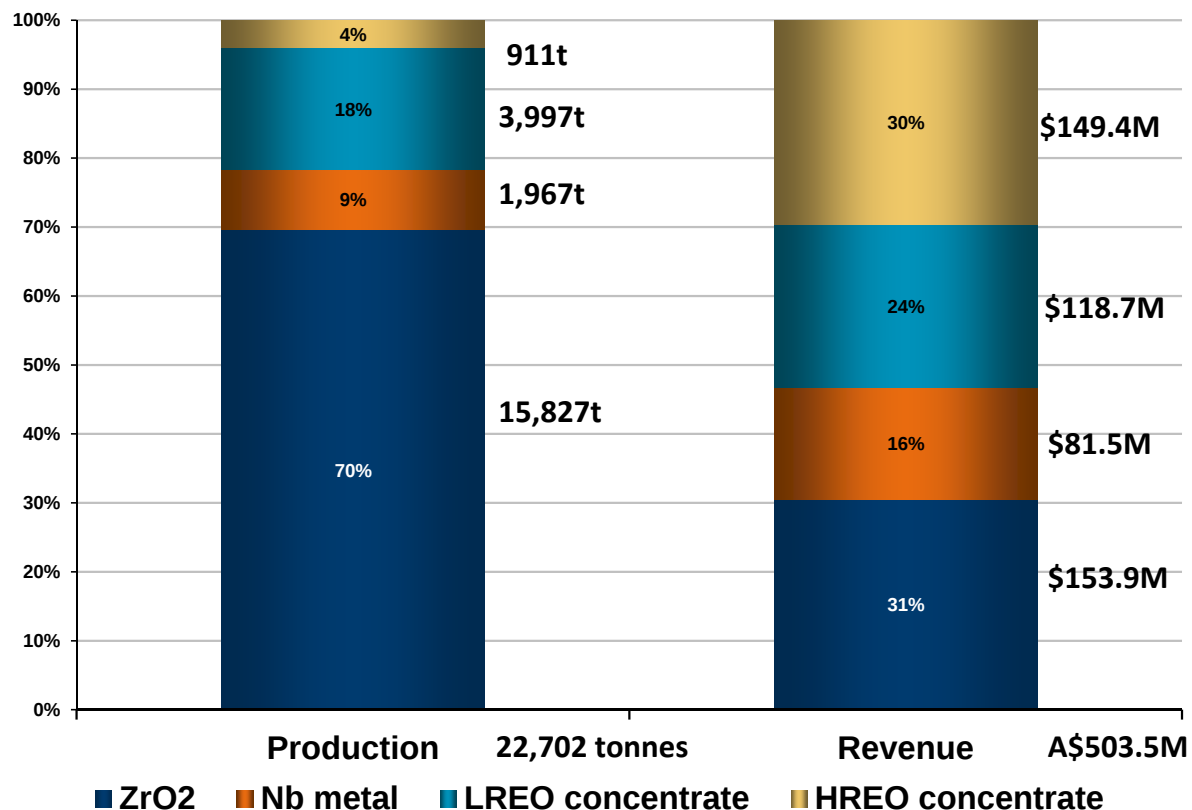


LREE prices for DFS close to current average



YHREE prices used are above current average

DZP Product Output



- The DPP has produced several tonnes of product which has enabled customers to test and confirm interest
- This enabled off-take arrangements to be negotiated and potential revenues to be determined
- This would not be possible without the DPP

- The DPP has determined the chemistry and engineering of the flow sheet, and enabled capital and operating costs to be informed
- This data provides an accurate assessment of the financial robustness of the project
- This would not be possible without the DPP

DUBBO ZIRCONIA PROJECT Financial Summary for 20 year life in A\$	
Project Capacity	1,000,000 tonnes pa
Capex – Plant	\$396.8M
Sulphuric Acid Plant	\$116.6M
Infrastructure + Owners	\$253.4M
SUB TOTAL	\$766.8M
EPCM	\$63.5M
Contingency (20%)	\$166.1M
TOTAL	\$996.4M
Annual Revenue	\$503.5M
Annual Operating Costs	\$213.5M
Annual EBITDA	\$290.0M
IRR*	19.3%
NPV*	\$1,235M



Dubbo Zirconia Project

***A strategic and alternate supply for the zirconium,
niobium and rare earths industries***

***The DZP is an advanced world class project capable of supplying “new age
metals” in to rapidly developing international markets for many years.***

***This would not have been possible without the successful operation of the
demonstration pilot plant.***

www.alkane.com.au

Dubbo Zirconia Project – Mineral Resources

Toongi Deposit	Tonnage (Mt)	ZrO ₂ (%)	HfO ₂ (%)	Nb ₂ O ₅ (%)	Ta ₂ O ₅ (%)	Y ₂ O ₃ (%)	REO (%)
Measured	35.70	1.96	0.04	0.46	0.03	0.14	0.75
Inferred	37.50	1.96	0.04	0.46	0.03	0.14	0.75
Total	73.20	1.96	0.04	0.46	0.03	0.14	0.75

These Mineral Resources are based upon information compiled by Mr Terry Ransted MAusIMM (Alkane Chief Geologist) who is a competent person as defined in the 2004 Edition of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves. Terry Ransted consents to the inclusion in the report of the matters based on his information in the form and context in which it appears. The full details of methodology were given in the 2004 Annual Report.

Dubbo Zirconia Project – Ore Reserves

Toongi Deposit	Tonnage (Mt)	ZrO ₂ (%)	HfO ₂ (%)	Nb ₂ O ₅ (%)	Ta ₂ O ₅ (%)	Y ₂ O ₃ (%)	REO (%)
Proved	8.07	1.91	0.04	0.46	0.03	0.14	0.75
Probable	27.86	1.93	0.04	0.46	0.03	0.14	0.74
Total	35.93	1.93	0.04	0.46	0.03	0.14	0.74

These Ore Reserves are based upon information compiled by Mr Terry Ransted MAusIMM (Alkane Chief Geologist) who is a competent person as defined in the 2004 Edition of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves. The reserves were calculated at a 1.5% combined ZrO₂+Nb₂O₅+Y₂O₃+REO cut off using costs and revenues defined in the notes in ASX Announcement of 16 November 2011. Terry Ransted consents to the inclusion in the report of the matters based on his information in the form and context in which it appears.