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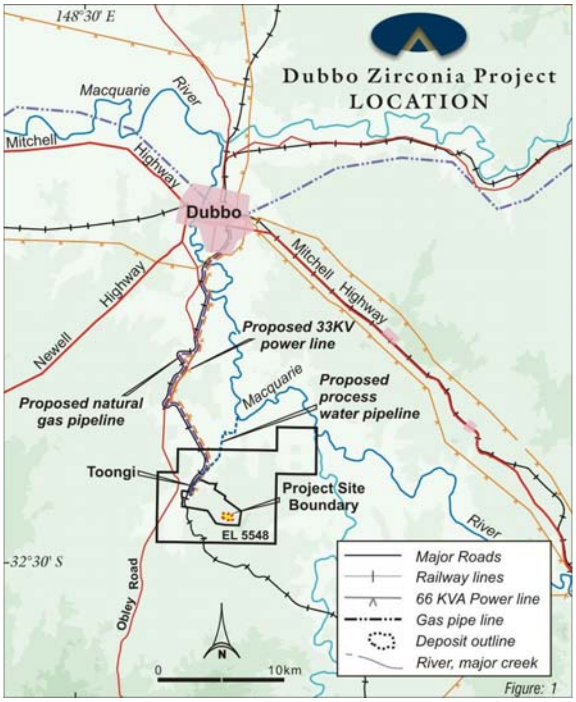
THE DUBBO ZIRCONIA PROJECT

Long term production of zirconium, hafnium, niobium, tantalum, yttrium and rare earths

Introduction

The Dubbo Zirconia Project (DZP) is located 30 kilometres south of the large regional centre of Dubbo (figure 1), approximately 400km north-west of Sydney in the Central West Region of New South Wales. The Project is held by Australian Zirconia Ltd (AZL), a wholly owned subsidiary of Alkane Resources Ltd, and is centred on the Toongi trachyte intrusive. The intrusive contains highly elevated levels of zirconium, niobium, tantalum, yttrium and rare earth elements and constitutes a world class resource of these metals.



The DZP site has many infrastructure advantages with power and gas available from the state grids at Dubbo, and water accessible from the Macquarie River 10 kilometres to the north. Numerous local roads service the site from Dubbo and the nearby Newell and Mitchell Highways. The currently disused Dubbo to Molong railway passes immediately to the west and south of the site and could be reactivated to provide supply for process chemicals. The city of Dubbo with a population near 40,000 would be the source for an anticipated basic start up operating workforce of 65 to 85.

The Company has carefully evaluated the commercial viability of the DZP since the discovery of the orebody and remains convinced that the Project will become an important contributor to the zirconium, niobium-tantalum and rare earth industries over many years. A feasibility study was completed in 2002 but at that time some process and market issues remained to be resolved. A definitive feasibility study is in progress, which includes operation of a demonstration pilot plant at the facilities of the Australian Nuclear Science and Technology (ANSTO) at Lucas Heights in the south of Sydney, and is scheduled for completion by the middle of 2010.

Geological Setting

The Toongi intrusive is a Jurassic aged trachyte plug with approximate dimensions of 900 metres east-west and 600 metres north-south and appears to be near vertical and of indeterminate depth. The intrusive exhibits uniformly elevated grades for zirconium, hafnium, niobium, tantalum, yttrium and rare earth elements (REE's) laterally and vertically.

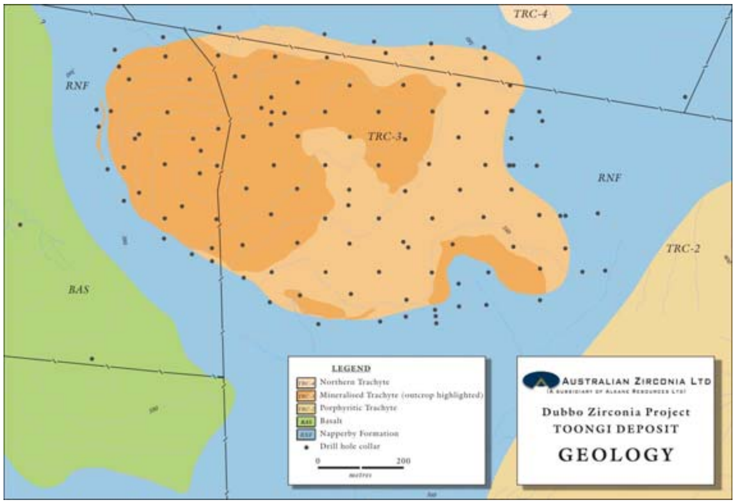
Mineralogical (SEM) studies indicate that ore minerals are very fine grained being less than 100μm in size (most less than 20μm) and generally of extremely rare compositions. Unnamed calcium and REE-rich zirconosilicates (similar to eudialyite or armstrongite) are the dominant ore minerals of zirconium and yttrium while natroniobite ($NaNbO_3$) and calcian bastnasite are the major source of niobium and REE's respectively. All these minerals are soluble in sulphuric acid and only minor amounts of refractory zircon and a refractory niobium mineral (possibly columbite) have been detected.

The orebody also contains low level uranium and thorium values but is not classified as a radioactive ore.

Drilling to date consists of 120, largely vertical, reverse circulation and two diamond drill holes completed on a staggered 100 metre by 50 metre grid (figure 2). Most holes were drilled to a vertical depth of 55 metres but several deeper drill holes confirmed the continuity of ore grades to 100 metres depth.

Current identified mineral resources stand at:-

MEASURED RESOURCES (0-55m, 340mRL)	**35.7 million tonnes**	**1.96% ZrO_2, 0.04% HfO_2, 0.46% Nb_2O_5, 0.03% Ta_2O_5, 0,14% Y_2O_3, 0.745% Total REO, 0.014 U_3O_8,**
INFERRED RESOURCES (55-100m, 295mRL)	**37.5 million tonnes**	**1.96% ZrO_2, 0.04% HfO_2, 0.46% Nb_2O_5, 0.03% Ta_2O_5, 0,14% Y_2O_3, 0.745% Total REO, 0.014 U_3O_8,**
TOTAL	**73.2 million tonnes**	**Similar grades**



Process Flow Sheet

Flow sheet development for recovery of value metals from the Toongi deposit has taken place over many years, but in 1999 a concerted effort was initiated to push the project towards commercial development, and a feasibility study was initiated under the management of TZ Minerals International Pty Ltd.

A number of process routes have been tested, and these included physical beneficiation of ore minerals, and various chemical leaches and solvent extraction recovery of products. Physical beneficiation was not successful due to the fine grain size of the ore minerals and while moderately positive results were generated from various chemical leaches, only sulphuric acid produced results that could be considered to have economic potential.

In 2002 the process was trialled at mini-pilot plant level, and the several products recovered were distributed internationally for assessment and comment. As a result, and following further process review, another program involving a larger demonstration pilot plant is in operation to fully evaluate the robustness of the flow sheet and also produce substantial volume of products for further market assessment.

The current flow sheet (figure 3) has several proprietary components and only a broad summary is included here. The process can be broadly divided into four steps: **Mining**; **Sulphation**; **Extraction**; and **Refining.**

Mining: The ore will be mined by conventional open cut techniques followed by crushing and grinding.

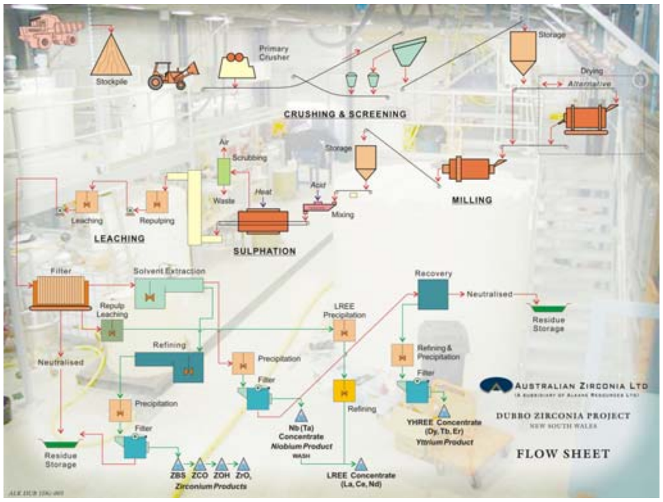
Sulphation: Grinding is followed by low temperature sulphation roasting with concentrated sulphuric acid. Cooled roaster product is leached in water and filtered to produce a stable pregnant leach solution (PLS).

Extraction: PLS is contacted with a commercially available organic solvent extractant, in commonly used solvent diluents. The zirconium is preferentially extracted, with niobium-tantalum and the yttrium-rare earths remaining with the PLS to be recovered in subsequent flow sheet steps.

The zirconium is stripped from the loaded organic and precipitated by adjusting pH. The now barren organic is re-generated in two steps prior to return and re-used in the extraction stage.

Refining: The stripping and precipitation steps have been developed to preferentially exclude minor impurity elements from the final product. Final washing in water enables a high purity (~99% calcined) acid soluble zirconium basic sulphate product (ZBS) to be produced. This product may be used directly in some applications, or as an intermediate product for further downstream production of other advanced products.

AZL has also successfully converted the ZBS to zirconium hydroxide (ZOH) in which the residual sulphate levels are exceptionally low (~0.01% S). A zirconium carbonate (ZBC) has also been produced but is not yet completed to final specifications. The trial zirconia (ZrO_2) product has been produced from ZOH with ZrO_2 content at ~99%. The physical properties of this product are still to be determined but it appears to be acceptable for certain applications. All products include hafnium, but the process does naturally exclude Hf with the ratio of Zr:Hf dropping from 50:1 in the ore to 350:1 in the products.



Niobium (and tantalum) concentrate is precipitated (~77% Nb_2O_5) directly from the PLS after zirconium extraction. Some residual zirconium, and light rare earth elements are co-precipitated but it is possible to reduce the level of these impurities by subsequent leaching in weak acid.

The primary filter cake retains the majority of the light rare earths and a process to recover these is being developed. The leachate from the filter cake contains economic levels of lanthanum, cerium and neodymium.

The PLS remaining after zirconium and niobium recovery is enriched in yttrium and heavy rare earths. Currently ANSTO is developing a process to recover a mixed yttrium and heavy rare earth concentrate with relatively high concentrations of the important yttrium, terbium and dysprosium.

The existing flow sheet could also allow for the separation of zirconium from hafnium and preparation of individual metals. Separation of yttrium from the rare earths is possible, although there are currently no further plans to separate the individual rare earths. Uranium is removed from the zirconium stream, otherwise it contaminates the final products and depending upon State approvals, uranium could also be recovered to a saleable product. Thorium is similarly removed from the niobium product and could also be recovered if a market developed for this metal. The current flow sheet design has both uranium and thorium being stabilised and dispersed into the residue storage facility.

Markets

Zirconium: More than 95% of current world production of zirconia and zirconium chemicals comes from processing of zircon. Zircon is generally a by-product of the mining of placer deposits for ilmenite and associated titanium minerals, and hence its availability is governed by the demand for titanium minerals. Small amounts of baddeleyite, a naturally occurring zirconia, are also recovered as a by product of other metal mining.

Zircon is processed in a number of locations world wide but China currently dominates supply of processed zirconium products and world output is approaching 100,000 tonnes pa. Processing of zircon takes two general routes. The first using an electric arc furnace produces fused zirconia which has specific end uses, mainly as ceramic pigments. Chemical leaching is the second process which generates a variety of products (including "chemical" zirconias) which are used in many applications ranging from drying agents, fire retardants, advanced ceramics, electronics and catalysts. These zirconias are also a key component of Solid Oxide Fuel Cells, a developing and important source of "clean" electricity.

About 15% is processed to recover separated zirconium and hafnium metal for uses in nuclear power plants and conversion to special alloys. Hafnium is also being used in new generation micro processors.

Niobium: Brazil dominates the world production of primary raw materials for the niobium business (~86,000 tonnes Nb equivalent) with the output of pyrochlore from the Araxa carbonatite and a smaller production of from Catalao. These account for 90% of current world output and most is converted to ferro-niobium for the steel industry. The remainder is processed to Nb_2O_5 and niobium metal in Europe and the US for use in super alloys, specialty glasses and ceramics.

Yttrium – Rare Earths: Current world demand is estimated to be around 122,500 tonnes in various forms as carbonates, chlorides, oxides and occasionally as individual metals. China dominates with production of bastnasite/monazite as a by-product from the iron ore mine at Baotou and many other smaller sources. Over the last few years there has been a concerted effort in China to consolidate the rare earth industry but it remains a major producer of rare earth products. China is also now restricting export of rare earth raw materials and this has caused a dramatic shift in demand and pricing. As would be expected the uses of the suite of elements is diverse and includes specialty glasses, phosphors, permanent magnets, lasers, pigments, alloys, catalysts and rechargeable batteries.

Project Production

The 2002 feasibility targeted a 200,000 tonne per annum ore throughput which would produce a suite of products comprising about 9,000 tonnes of zirconium chemicals (~3,000t ZrO_2 equivalent); 1,000 tonnes of niobium-tantalum concentrate (~700t Nb_2O_5); 2,400 tonnes of yttrium-rare earth concentrate (~1,200t YREE); and possibly 25 tonnes of uranium concentrate, although uranium production in NSW is currently prohibited.

This throughput rate was based upon the market assessment at the time and the DZP's ability to establish a credible position. It is now thought that growth in all the product markets could see this production rate easily doubled. There is no resource limitation to the production rate and even at double the original conceptual throughput, the open pit life would be in excess of 200 years.

Current Program

In April 2006, Alkane received a Commercial Ready Grant of A$3.29 million from AusIndustry (Australian Federal Government) to assist with a program of process optimisation, and construction and operation of a Demonstration Pilot Plant (DPP). The work program commenced early July 2006 at the facilities of the ANSTO Minerals Group at Lucas Heights, south of Sydney.

The DPP has confirmed the process flow sheet, is providing engineering data for capital and operating costs and also generating substantial product for market evaluation. The DPP was commissioned in May 2008 and has operated three separate campaigns through to the present. It has processed 70 tonnes of ore and has produced over 1,300kg of zirconium and 300kg of niobium products. The yttrium-rare earth recovery circuits will be added later. Data from the DPP and market assessment will be factored into the 2002 feasibility study which will be revised and updated. A development decision is anticipated by mid 2010, with production possible late 2011 or early 2012.

As with the 2002 study, TZ Minerals International Pty Ltd in Perth remain the program and feasibility managers.

Conclusions

While there are several other deposits of the Dubbo "type" elsewhere in the world, to the best of our knowledge only the DZP has developed a technically viable process capable of delivering saleable products to the markets. The key to the Project's potential viability is the presence of acid soluble ore minerals and that very little of the host trachyte is dissolved at the sulphation stage, limiting the level of the deleterious elements in the subsequent leach solution.

Existing world production of the metal suite is derived from a number of separate sources and the DZP will be a unique combination that is capable of providing variable products into rapidly expanding electronics, ceramics and specialty glass and alloy markets, and more specifically for auto catalytic converters. With zircon supply generally being governed by the demand for titanium products, the DZP assumes strategic significance as a supplier into the zirconium chemicals, zirconia and possibly zirconium and hafnium metal markets.

The demand for niobium and has increased dramatically in the last year, largely driven by demand for special steels, and this has reflected in significant increase in pricing. Specific rare earths, as well as yttrium, such as neodymium, dysprosium and terbium have also seen a dramatic increase in demand and price caused by the growing demand for rechargeable batteries and electric motors in hybrid motor vehicles, and phosphors for energy efficient lighting.

The size of the resource provides a potential source of metals over hundreds of years and it is in a location with very favourable infrastructure and legislative framework, at both a State and Federal level.

Ian Chalmers
Managing Director ***October 2009***

Demonstration Pilot Plant Images:

Main DPP Shed

Internal Main Shed

Rotary Kiln

Primary filter

Solvent Extraction Circuit

Zirconium and Niobium Product Recovery

Zirconium Sulphate Filter

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Probable Outputs

Base case models of 200,000 to 500,000 tonnes per year of ore processed

Product	200ktpa	500ktpa
ZBS, ZOH, ZBC	9,000tpa (3ktpa ZrO_2)	22,500tpa (7.5ktpa ZrO_2)
Nb-Ta concentrate	1,000tpa (0.7ktpa Nb_2O_5)	2,500tpa (1.75ktpa Nb_2O_5)
LREE concentrate	990tpa (REOs)	2,475tpa (REOs)
YREE concentrate	301tpa (REOs)	753tpa (REOs)

- ZBS = zirconium basic sulphate; ZOH = zirconium hydroxide; ZBC = zirconium basic carbonate
- Nb-Ta concentrate = ~76% Nb_2O_5; 1.0% Ta_2O_5 calcined basis

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Yttrium - Rare Earth Individual Production (assumed 70% recovery)

	200ktpa	500ktpa
La_2O_3	252	630
CeO_3	475	1188
Pr_6O_{11}	52	131
Nd_2O_3	182	456
Sm_2O_3	28	71
Total LREE	**990tpa**	**2475tpa**
Eu_2O_3	1	2
Gd_2O_3	28	69
Tb_4O_7	4	11
Dy_2O_3	26	66
Ho_2O_3	5	14
Er_2O_3	15	37
Tm_2O_3	2	5
Yb_2O_3	13	32
Lu_2O_3	2	5
Y_2O_3	204	511
Total YHREE	**301tpa**	**753tpa**
Total YREE	**1291tpa**	**3228tpa**