

THE DUBBO ZIRCONIA PROJECT

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

Introduction

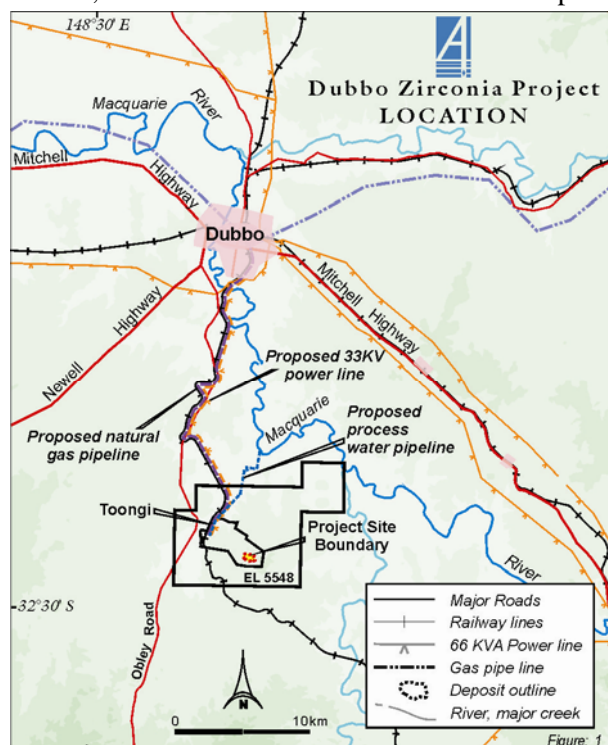
The Dubbo Zirconia Project (DZP) is located 30 kilometres south of the large regional centre of Dubbo (figure 1), approximately 400km north-west of Sydney in the Central West Region of New South Wales. The Project is held by Australian Zirconia Ltd (AZL), a wholly owned subsidiary of Alkane Resources 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 conceptual 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 chemicals and niobium-tantalum industries over many years. A major feasibility study was completed in 2002 but at that time some process and market issues remained to be resolved. Further development work is underway however neither start date nor initial production rate has been finalised.

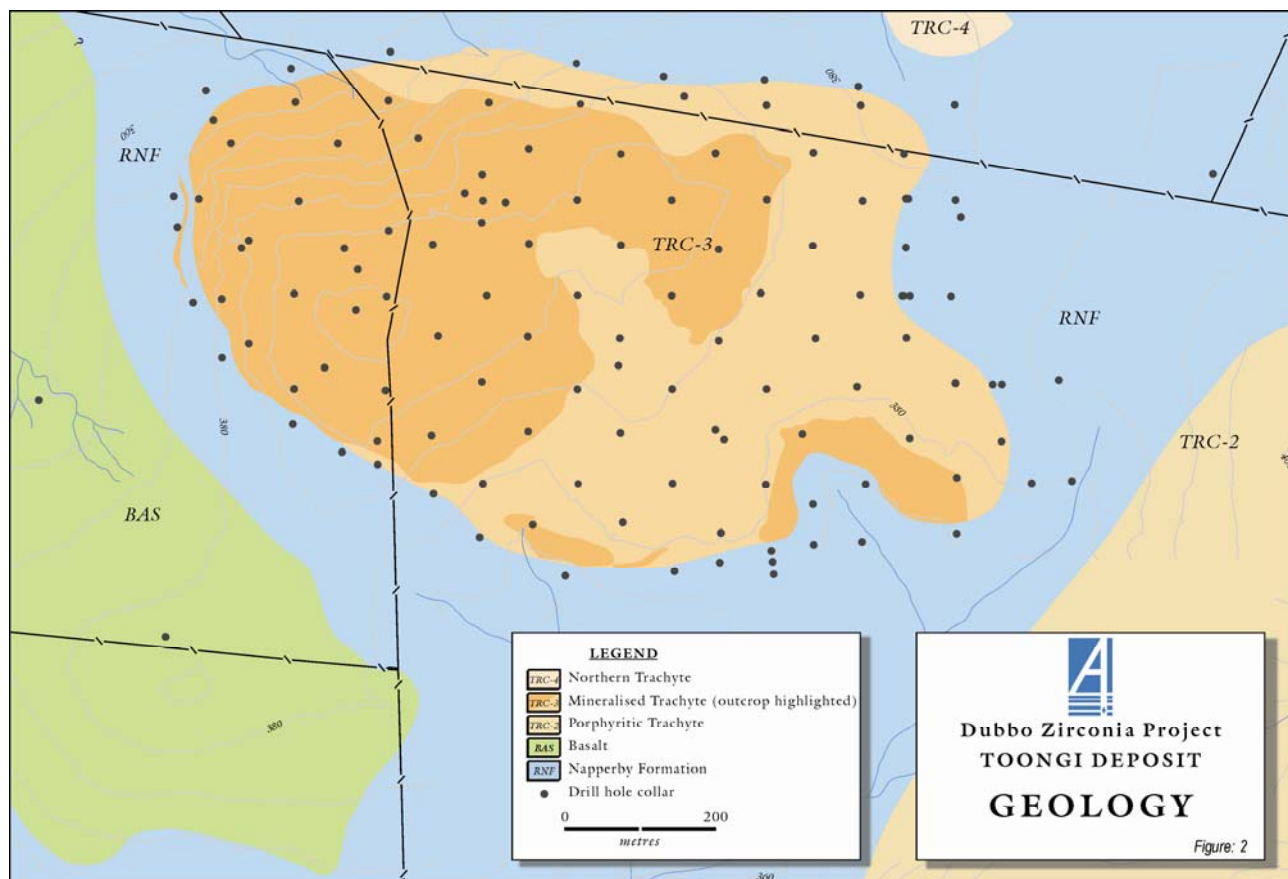
Geological Setting

The Toongi intrusive is a Jurassic aged trachyte plug intruded (figure 2) into a flat lying sequence of interbedded sandstone, siltstone and basalt which occur along the southern margin of the Great Australian Basin. The trachyte is one of a number of alkaline bodies which form part of a relatively extensive alkaline volcanic complex in the Dubbo region, which in turn is related to the major Eastern Australian alkaline igneous event.



The Toongi trachyte is a roughly elliptical body with approximate dimensions of 850 metres east-west and 550 metres north-south and appears to be near vertical and of indeterminate depth. The rock is comprised dominantly of K-feldspar, albite and aegerine microphenocrysts in a very fine grained groundmass of similar composition. Limited mineralogical and textural variations, such as vesiculation and coarser grain sizes, have been identified and are associated with minor grade variations, but overall the intrusive exhibits uniformly elevated grades for zirconium, hafnium, niobium, tantalum, yttrium and rare earth elements (REE's).

The orebody also contains low level uranium and thorium values but is not classified as a radioactive ore. The contact of the intrusive is marked by an intensely silicified and veined chilled margin which is commonly of low grade and low metallurgical recoveries. Narrow (2-3 metre) basalt dykes cross-cut the body. Weathering of the ore body is limited to 15 metres depth however minor oxidation effects are observed to 40 metres. There is some evidence that the depth of oxidation is greater in the eastern portions of the intrusive.



Mineralogical (SEM) studies indicate that ore minerals are extremely 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 eudialyte 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.

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.

Analysis of the ore elements is complicated by the high concentrations of relatively rare elemental associations. Instability of solutions hinder ICP techniques and interference from other elements is a significant problem with XRF analyses. Numerous intra and inter-laboratory checks, including neutron activation, have led to a greater understanding of the analytical problems and the grades assigned to the resource are now considered robust.

Current identified mineral resources stand at:-

MEASURED RESOURCES (0-55m, 340mRL)	35.7 million tonnes	1.96% ZrO_2, 0.03% Ta_2O_5, 0.14% Y_2O_3, 0.745% Total REO, 0.014 U_3O_8, 0.04% HfO_2, 0.46% Nb_2O_5
INFERRED RESOURCES (55-100m, 295mRL)	37.5 million tonnes	1.96% ZrO_2, 0.03% Ta_2O_5, 0.14% Y_2O_3, 0.745% Total REO, 0.014 U_3O_8, 0.04% HfO_2, 0.46% Nb_2O_5
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 of optimisation is in progress and a larger demonstration pilot plant was planned to be constructed to fully evaluate the viability of the complete flow sheet. This pilot plant will 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 in 300 kg/t 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 with the controlled addition of an alkaline reagent. 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%) acid soluble zirconium (+hafnium) 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 very high tech materials.

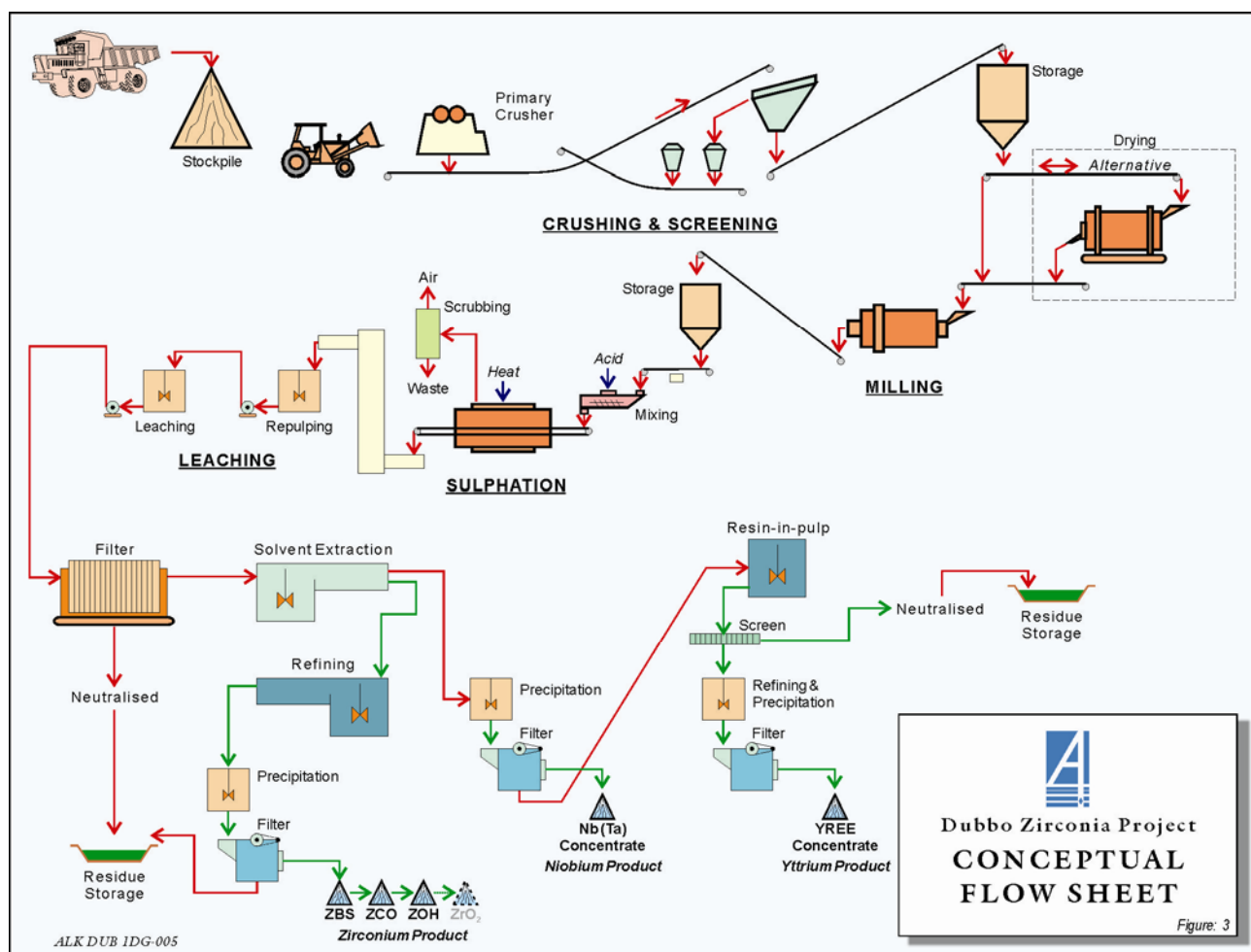
AZL has also successfully converted the ZBS to zirconium hydroxide (ZOH) in which the residual sulphate levels are exceptionally low (~0.01% S). Laboratory experimental production of zirconium carbonate (ZBC) has taken place but is not yet completed to final specifications. The production of zirconia (ZrO_2) can proceed from any of the three intermediate products but the end use of that material dictates the process parameters. All products include hafnium, which occurs naturally with zirconium and has very similar chemical properties.

Niobium (and tantalum) are precipitated as an acid soluble concentrate (80% Nb_2O_5) directly from the PLS after zirconium extraction. Some residual zirconium, and light rare earth elements lanthanum and cerium, are co-precipitated but it is possible to reduce the level of rare earth impurities by subsequent leaching in weak acid if necessary.

The PLS remaining after zirconium and niobium recovery is partially neutralised and this is followed by yttrium-rare earth element extraction onto resins, using a “resin in pulp” technique. Loaded resin is washed, and the yttrium and rare earth elements stripped and subsequent precipitation results in a mixed yttrium and heavy rare earths concentrate, for downstream processing by existing specialist rare earth producers.

A longer term strategy could lead to the separation of zirconium from hafnium and preparation of individual metals. Similarly the niobium could be separated from tantalum, and perhaps separation of yttrium from the 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. Baddeleyite, a naturally occurring zirconia, was recovered from the mining of the Palabora carbonatite in South Africa for copper. However this production ceased in 2003 and only small amounts of baddeleyite are produced from Kola in Russia. 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.

Zircon is processed in a number of locations world wide but China currently dominates supply of processed zirconium products and world output is around 96,000 tonnes. 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. Recent reports highlight the use of hafnium in new generation micro processors.

Niobium: Brazil dominates the world production of primary raw materials for the niobium business (~35,000 tonnes Nb equivalent) with the output of columbite from the Araxa carbonatite and a smaller production of pyrochlore from Catalao. These account for 95% of current world demand 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.

Tantalum: Current world demand for tantalum is around 1,500 tonnes of which nearly half comes from the production of tantalite from pegmatites at Greenbushes and Wodgina in Western Australia. Brazil also contributes about 12% with the remainder coming from very small scale operations in many countries. The tantalite is refined to Ta_2O_5 and tantalum metal by specialist companies in Canada, Germany, Kazakhstan and the US. Most tantalum is used for the production of ceramic capacitors for mobile phones and special alloys.

Yttrium – Rare Earths: The yttrium and rare earth industries are diverse and complex, and accurate figures of output and consumption are difficult to compile. However current world demand is estimated to be around 100,000 tonnes in various forms as chlorides, oxides and occasionally as individual metals. After the partial closure of the Mountain Pass Mine in California in 1998, China dominated 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. Other downstream processors are located in France, Austria, India and Estonia. As would be expected the uses of the suite of elements is diverse and includes specialty glasses, phosphors, specialty magnets, lasers, pigments, alloys and batteries.

Project Production

The 2002 DFS 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 zirconia equivalent); 600 tonnes of niobium-tantalum concentrate; 1,200 tonnes of yttrium-rare earth concentrate; 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.

Current Program

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

The DPP is planned to confirm the process flow sheet, provide engineering data but also generate substantial product for market evaluation. The DPP should be operating in the second half of 2007 and will be run for a minimum of six months, but more likely twelve months depending upon market feedback. 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 2008, with production by the end of 2009.

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. With zircon supply generally being governed by the demand for titanium products, a predicted shortfall is already becoming apparent and the DZP assumes strategic significance as a supplier into the zirconium chemicals, zirconia and possibly zirconium and hafnium metal markets.

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.

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Managing Director

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