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Annual Report for EL 35/2010 (Tonganah)
Anniversary date 22/06/2015

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Appendices

Introduction (This section retained from the previous annual report for completeness)

Duggans P/L is involved in exploration activities within Tasmania for high grade silica and other non-metallics.
EL 35/2010 was taken up to investigate the potential for a high grade silica resource contained within the tailings derived from previous mining for kaolin.
While this was the primary objective, the tailings are also being evaluated as a potential raw material in the production of porcelain/ceramics and for use as a supplementary cementiceous material, (SCM), in the cement/concrete construction industry.
Over time the potential of this project has been re-evaluated and the EL area has been extended to encompass other known deposits of kaolinite in the immediate vicinity with a view to extending reserves available and therefore the life of any downstream processing operation. A regional review of potential kaolinite resources has also been undertaken.

During the past year the emphasis has been largely on looking at processing options to produce both metakaolin and a high grade silica product suitable for glass production or potentially solar panel production.

Statement of exploration philosophy and objectives (this section retained from previous annual report for completeness but now includes reference to unmined deposits within the extended EL)

This EL was originally taken up to investigate potential uses for tailings from previous mining and processing of kaolinite. The conventional exploration activities associated with a greenfield site are therefore not entirely applicable.
The ‘ore bodies’ are defined either as tailings or as unmined decomposed granite. The nature of the materials of interest are known and most of the ‘exploration’ activity will focus on more accurately defining the minerals present as well as their proportions and processing techniques to provide products of best value.

Two grades of tailings have been identified;
Coarse tailings consisting of silica crystals nominally 2 to 6mm in size and
Fine tailings consisting of -2mm material.
Both of these grades contain remnant kaolin and feldspar. The coarse tailings have been dumped as dry stockpiles while the fine tailings are contained within a bunded pond structure having been pumped into it as a slurry.
Several, previously evaluated, small bodies of decomposed granite, (satellite ore bodies) have now been included within the extended EL to ensure continuity of supply.

Any subsequent mining activity of the tailings will not conform to conventional operations as it will be confined to the tailings dump areas and importantly, in the case of the fine tailings, will be conducted within an already bunded area which will prevent escape of kaolin rich run off to the wider environment.
Future mining of the ‘satellite ore bodies’ will be subject to normal surface mining protocols and environmental controls.

Site review (this section retained from previous annual report for completeness)

The site, (EL35/2010, encompassing 10 square kilometers) originally defined as; "the operational area, both mining and processing, occupied in the past by Associated Pulp and Paper Mills Limited (APPM) in the extraction and processing of kaolin for use as a paper filler", has been extended, (EL 13/2013), to take in areas of interest to the north and east containing known deposits of kaolin evaluated for kaolin suitable for paper filler but not mined by previous operators.
The EL now has an area of 26 square kilometres and was consolidated under EL 35/2010 with effect from 20 June 2014.
A review of the new site area included familiarisation with the previously tested areas as well as identification of further potential areas of investigation adjacent to these where previous work was curtailed due to low reflectance material.
Further field reconnaissance of these areas over the past 12 months has been carried out to estimate potential reserves.

Work carried out

Field reconnaissance over the extended EL area has been undertaken to get some idea of reserve potential ignoring restrictions imposed by brightness or low reflectance properties, a limitation for paper filling kaolin. Surface geology, known drilling results and landform were the only criteria used as at this stage investment in land disturbance is not considered warranted given the uncertainties regarding processing and marketing.
Deposits known as : North Tonganah, Black creek, Maryvale, West Forester, North Forester and Stronach were evaluated and all but North Tonganah,(now mined out), are considered to have potential for at least double the reserve originally estimated for paper filling kaolin giving a potential reserve of up to 3 mill tonnes of raw decomposed granite equating to approximately 1 million tonnes of kaolinite.

All other work undertaken in the past 12 months has related to processing options and considerations related to marketing.
In keeping with the confidentiality agreement with "Calix limited", work was undertaken to identify sizing parameters that resulted in analyses suitable to satisfy their criteria for raw material to produce their "ACTI-Mk95" and "ACTI-Mk70" products. It was found that material less than 0.1 mm met the alumina criteria for "ACTI-Mk70" feedstock while material less than 0.075 mm met the silica criteria for the same feedstock. No sizing resulted in analyses suitable for feedstock for production of "ACTI- Mk95" (See analysis sheets for TK1to9 Appendix 'A').
Samples TK1 to TK 9 were prepared by sieve analysis prior to chemical analysis.
Removal of free silica and size reduction of the kaolinite is required to better fit the criteria.
Laboratory scale ball milling was undertaken with the aim of delaminating the plate stacks in the kaolinite and thus producing a finer product prior to calcining resulting in higher reactivity of the metakaolin. This milling was unsuccessful due to combined water causing 'clagging' of the material.
Milling in a hot environment may overcome this problem as may other more innovative approaches.

Discussion

To revisit the aims of the project; it was envisaged that a dry grinding process after separation of free silica from the kaolin would produce a suitably fine product for the next step, (calcining at 600 to 800 degrees C), to produce Metakaolin or feedstock for "Calix". The silica rich component would then be upgraded to very high grade and sold into the glass, (or preferably the solar panel), production market.
(Note: literature research has identified a new way to make solar panels by electro chemical means under research by the Cambridge University. (Search ffc 'Cambridge process')
Now it is recognised that to achieve these aims while maintaining a relatively simple processing circuit and thereby minimising cost, is more difficult than first thought. Issues that have to be considered or overcome are listed as follows:

Production
Metakaolin production

Separation of kaolin from quartz and remnant feldspar, - to what degree can fine grained silica and feldspar be left in the kaolin without causing detriment to the reactivity of the calcined product ?
Delamination of the kaolinite plate stacks is a necessary process and the best way of doing this for the Tonganah material is yet to be decided.
The original aim of producing Metakaolin from the Tonganah raw material in a completely dry process now seems unlikely so a costly drying phase will be needed prior to calcining.
The cost of production must be minimised because it is believed that pricing of the finished product should not exceed that of Portland cement.
Method of calcining has not been explored at this stage. There is potential to 'flash' calcine rather than the conventional kiln process.
Testing of performance of the metakaolin produced requires making multiple standard concrete test cylinders for strength testing at various set time intervals up to and exceeding 28 days. This makes the testing regime a very long process.

High grade silica production

Production of a silica concentrate from the Tonganah raw material is relatively straight forward but remnant feldspar particles remain in the concentrate and are difficult to remove. Gravity separation techniques are not applicable due to the almost identical specific gravities. Avoidance of methods employing caustic reagents such as hydrofluoric acid is considered desirable.

Marketing
Metakaolin
The cement and concrete industry has now reached a degree of maturity whereby engineers specify certain additives in a concrete mix design to enhance certain properties of the finished concrete. (See 'Benefits of Metakaolin addition' Appendix 'C').
Metakaolin could replace up to 20% of cementiceous material in a mix design and therefore its use would be resisted by the major Portland cement producers.

Once a production process is developed that produces a consistent Metakaolin product from the Tonganah raw material then that product must be accredited and accepted into the market place.

High grade silica
The demand for very high grade silica is increasing, especially for production of solar panels and various qualities of glass. The value and saleability of silica as a raw material is dependent on purity and it becomes of high value at a purity of 99.99% silica, (the starting point for the 'Cambridge process').

The potential for a silicon production facility in Tasmania utilising the 'Cambridge Process' was realised and presentations to politicians undertaken to advise of the inaccessibility of a prime exploration area for high grade silica due to it being 'locked up' because of unwarranted extensions to the World Heritage Area. The potential for the Tonganah silica concentrate to be utilised as the raw material for the Cambridge Process was also explained at these presentations. (See 'Discussion sheet for silicon in Tasmania' appendix 'D')

Contact with others

Liaison with 'Calix' has continued.
Discussions with David Chadwick, (consulting industrial chemist with expertise in processing of fine particulate materials), have been initiated with the aim of formulating a scope of work to progress the project.
Discussions with Chris Browne, (consultant process engineer), have been initiated.
Discussions with Talal Hassan, (CEO Tas Quarries), have been initiated.
Individual presentations to State Resources Minister Paul Harriss and Senator Richard Colbeck have taken place.

Summary of work completed

Review of potential reserves within the extended EL
Liaison with 'Calix Limited'
Liaison with potential consultants
Laboratory work to evaluate particle sizing influence

Environmental considerations

No environmental impacts were created in the past year.

Conclusions

The project continues to show promise for the development of two new industries in Tasmania.
A silicon production facility with potential for downstream production of solar panels, or, failing this, the sale of high grade silica into the glass manufacturing industry.
A metakaolin production facility to provide a much needed supplementary cementiceous material.
As indicated in the previous annual report, the project's scope is such that the resources of Duggans Pty Ltd are insufficient to facilitate meaningful progression and a significant partner is required.
The project continues to be hampered by the lack of a suitable larger business partner interested in pursuing these aims.

Proposed work for the next 12 months

Continue liaison with suitably qualified consultants to design a production facility to produce high grade silica and metakaolin from the available Tonganah raw materials.

References

Relevant references other than those historically specific to the Tonganah area and previous mining and processing are listed as follows:

- 'A simple method to separate quartz and feldspar and its application to TL/OSL methods' (Daniel Fernandez Mosquera and Jorge Sanjurjo Sanchez – October 2007)
- 'Kaolin Wet – Processing' (Prepared by Eng, Atef Helal = May 2012)

Appendix ‘A’

(Analyses and sample preparation notes)

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Project: ME-XRF26

CERTIFICATE OF ANALYSIS BR14145225

Sample Description	Method	ME-XRF26	ME-XRF26	ME-XRF26	ME-XRF26	ME-XRF26	ME-XRF26	ME-XRF26	ME-XRF26	ME-XRF26	ME-XRF26	ME-XRF26	ME-XRF26	ME-XRF26	ME-XRF26	ME-XRF26
	Analyte	Al2O3	BaO	CaO	Cr2O3	Fe2O3	K2O	MgO	MnO	Na2O	P2O5	SO3	SiO2	SrO	TiO2	Total
	Units	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
	LOR	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
TK 1		21.9	0.01	0.04	0.01	1.80	1.16	0.03	0.02	0.07	0.03	0.04	65.9	<0.01	0.51	99.55
TK 2		25.5	0.02	0.02	<0.01	1.00	1.70	0.03	0.02	0.10	0.04	0.03	61.6	<0.01	0.84	99.90
TK 3		30.6	0.02	0.04	0.01	1.06	2.00	0.05	0.02	0.12	0.06	0.03	53.9	<0.01	0.80	99.69
TK 4		33.9	0.02	0.03	<0.01	0.98	1.68	0.04	0.01	0.10	0.07	0.03	49.8	<0.01	0.61	99.58
TK 5		25.9	0.01	0.02	0.01	0.86	1.60	0.02	0.02	0.09	0.04	0.03	61.3	<0.01	0.76	99.80
TK 6		31.0	0.02	0.02	<0.01	0.99	1.96	0.03	0.02	0.11	0.06	0.03	53.4	<0.01	0.78	99.40
TK 7		34.1	0.02	0.03	0.01	0.97	1.64	0.04	<0.01	0.10	0.07	0.03	49.5	<0.01	0.61	99.35
TK 8		28.0	0.02	0.02	0.01	0.89	1.84	0.03	0.02	0.10	0.05	0.03	57.8	<0.01	0.77	99.40
TK 9		33.9	0.02	0.03	<0.01	0.98	1.67	0.04	0.01	0.10	0.07	0.03	49.7	<0.01	0.62	99.36
SIB 0.425mm 9.8.14 Tenganah Quartz/Kaoli		29.9	0.02	0.02	0.01	0.94	1.76	0.03	0.01	0.10	0.06	0.03	55.6	<0.01	0.73	99.81

***** See Appendix Page for comments regarding this certificate *****

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Project: ME-XRF26

CERTIFICATE OF ANALYSIS BR14145225

Sample Description	Method Analyte Units LOR	ME-GRA05 LOI % 0.01
TK 1		8.00
TK 2		8.95
TK 3		10.77
TK 4		12.12
TK 5		9.10
TK 6		10.78
TK 7		12.02
TK 8		9.71
TK 9		11.99
SUB 0.425mm 9.9.14 Tenganah Quartz/Kaoli		10.46

***** See Appendix Page for comments regarding this certificate *****

9/09/2014	We took the 20kg of product from the blue oven and tumbled with about 5.4kg of steel balls for 1 minute followed by a further 2 minutes.				
	We transferred the product plus balls to a bin liner and thence into two buckets.				
	We ran this through the 300mm sieves in four more-or-less equal parts as follows:				
Retained on :	Top sieve	9.5mm	345	g	
Retained on :	2nd sieve	4.5mm	658	g	
Retained on :	3rd sieve	0.425mm	11250	g	
Retained on :	Pan		7174	g	
	TOTAL		19427	g	573g lost in drying and to air

10/09/2014	I have taken 100g of the sub 0.425mm product and run it through 3 sieves as follows:				
					Sample no.
Retained on :	0.300mm sieve	7.5	g		TK 1
Retained on :	0.150mm sieve	32.51	g		TK 2
Retained on :	0.075mm sieve	35.72	g		TK 3
Retained on :	Pan	24.1	g		TK 4
	I have kept these fractions separate and placed in two sets of small plastic tubs. One to keep, the other to send off for analysis.				
10/09/2014	I have taken 100g of the sub 0.425mm product and run it through 2 sieves as follows:				
					Sample no.
Retained on :	0.150mm sieve	37.7	g		TK 5
Retained on :	0.075mm sieve	37.55	g		TK 6
Retained on :	Pan	24.61	g		TK 7
	I have kept these fractions separate and put into plastic tubs to send off for anaysis.				
10/09/2014	I have taken 100g of the sub 0.425mm product and run it through one sieve:				
					Sample no.
Retained on :	0.075mm sieve	66.12	g		TK 8
Retained on :	Pan	33.79	g		TK 9
	I have kept these fractions separate and placed in two sets of small plastic tubs. One to keep, the other to send off for analysis.				

23/09/2014	We received the ME-XRF26 results for the samples we sent off on 10-9-14. See sheet 2 for analysis of results.

Appendix ‘B’

(Benefits of Metakaolin addition)

Benefits measurable in finished concrete attributable to additions of Metakaolin of up to 20% of the cementiceous material in the concrete mix design may be listed as follows:

- **Increased compressive and flexural strength**
- **Improved durability**
- **Reduced permeability**
- **Reduced efflorescence**
- **Increased chemical and chloride resistance**
- **Reduced sag**
- **Enhanced workability and finishing**
- **Reduced alkali – silica reactivity**
- **Increased adhesion**
- **Reduced shrinking**
- **Lighted colour**
- **Reduced Co_2 emissions during production**

Appendix ‘C’

(Discussion sheet for silicon in Tasmania)

THE VISION :

SILICON VALLEY---------- TASMANIA

An opportunity for development of a silicon based industry in Tasmania whilst enhancing our 'clean, green and clever' image.

THE PROCESS :

Research work at Cambridge University has proven at laboratory scale that silicon can be refined from silica in an electrochemical process.
The process uses only a fraction of the power of the existing submerged arc electric smelting process and produces no greenhouse gasses.
Successful completion of the research and scaling up to production facility size will forever change the production of silicon metal. (google 'FFC Cambridge process') or visit (http://www.cam.ac.uk/research/news/solar-grade-silicon-at-low-cost)

RAW MATERIALS :

The process requires very high grade sand sized silica.

TASMANIAN SUITABILITY :

Tasmania has ample power supply and deposits of high grade silica some of which are known but are not necessarily of sufficiently high grade or consistency to use as a feed stock , while others are yet to be evaluated.
Prospective areas in Tasmania for silica > 99.9% silica are rare and a specific formation process starting with carbonate host rocks is considered to be the most likely source of this very high grade material. (google 'Silicification of continental carbonates' (Bustillo))
Tasmania has these rare prospective areas.

THE PROBLEM :

A highly prospective area of some 20 square kilometres south west of Maydena has been identified by Mineral Resources Tasmania field staff outside of the original World Heritage Area boundary. This area is also known to Duggans Pty Ltd who would like to further evaluate its potential, (NOTE: the area has undergone preliminary geological mapping only).
The area of interest has now been enveloped by the extension to the World Heritage Area and now lies approximately 14 km inside the World Heritage Area even though it can be accessed by forestry roads and has been logged and reseeded as productive forest. Further, the prospective area, being high grade silica, only supports low scrub growth which would be easily rehabilitated if the area was to be mined.

THE REQUEST :

It is requested that the relevant State and Commonwealth politicians recognise that valuable resources have been locked up for no good reason and that a re-evaluation of the extensions to the World Heritage Area should be undertaken with the aim of delisting areas that have already been logged or otherwise degraded and are of potential mineralogical value.

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