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Annual report for EL 35/2010 (Tonganah)

Anniversary date 22/06/2014

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Cradoc Tas. 7109

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(Dip. Applied Geology)
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Appendices

Preliminary note

The project continues to have the same goals as stated in the previous annual reports. The sections titled; ‘Introduction’ and ’Statement of exploration philosophy and objectives’ are retained unchanged to ensure that this report remains a ‘stand alone’ document.

Introduction

Duggans P/L is involved in exploration activities within Tasmania for high grade silica.
EL 35/2010 was taken up to investigate the potential for a high grade silica resource contained within the tailings of previous mining for kaolin.
While this is 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 in the cement/concrete construction industry.

During the past year this latter pursuit has taken precedence in research activities due to greater interest in supplementary cementiceous materials for use in specialty concretes and the potential impact of the carbon tax on cement producers.

Statement of exploration philosophy and objectives

This EL has been 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 and exist as partly processed material.
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.

Any subsequent mining activity 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.

The EL is being explored primarily for its potential to provide a resource of high grade silica although it is probable that, if processing the tailings from previous mining for kaolin is feasible from the point of view of deriving high purity silica, then a kaolin rich by-product will probably also be a saleable commodity and potentially a raw material for production of porcelain/ceramics or for the production of metakaolin (a supplementary cementiceous substance of high value in the concrete industry).

The tailings are considered to be a superior source of high grade silica when compared with naturally occurring silica sand because the tailings have been mined from weathered ,or hydrothermally altered, Devonian granite in situ so that the silica component of the material dumped as tailings is composed solely of quartz crystals whereas naturally occurring sand is highly likely to be contaminated by other detrital particles included during the weathering and transport processes.

It is envisaged that any subsequent reclamation and processing of the tailings will give rise to two or more economically viable products and result in a zero waste operation.

To date work has concentrated on the potential silica resource primarily in the coarse tailings although work has taken into account the fact that the silica in the fine tailings is more likely to be present as discrete particles and therefore require little or no attrition to remove remnant kaolin.

Increased emphasis has been placed on the potential to produce metakaolin in the past 12 months as the most likely way to utilise all of the tailings material. This has resulted in a realisation that fresh sources of kaolin may need to be utilised to supplement the kaolin from the tailings due to the fact that the finer material has been extracted for paper filler. This possibility is yet to be assessed.

Site review

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. Samples of raw weathered granite were taken mainly from the China Creek area for laboratory scale test work.

Work carried out

Exploration activity on the EL in the classic sense has been limited to minor sampling of selected areas for laboratory scale testwork. There has been no environmental disturbance.
Rather, it was realised that a source of metakaolin would be of significant value in the medium to long term and a more regional approach was obviously needed to estimate the potential size of such an industry.

The opportunity was taken to employ on a casual basis Mr Tas Rainbow, who has a history of working in the tin mining industry of the region, to act as a guide in locating abandoned tin mining leases for evaluation as potential donor areas for kaolin.
Such areas were found generally to exist as un-revegetated scars with outcropping weathered granite. In fact, it was realised that where the tin miners stopped their excavation is the starting point for mining kaolin and in most cases not extending the footprint of the mine, (ie these areas are not green field sites).
No sampling,(apart from hand specimens), or land disturbance was undertaken but the areas were observed in their present state and a broad estimate of their potential to supply kaolin was made as was the likelihood of them being able to be mined given the location and proximity to other features of regional value.

Field notes recording the findings are appended in appendix 'A'. (Regional review).

These notes,(incomplete with respect to coverage of all of the old tin mines), obviously do not equate to measured reserves but serve to better target areas worthy of further work.
We now believe that in addition to the reserve estimate contained within EL 35/2010 there is probably a regional capacity to supply several million tonnes of kaolin.
This makes the prospect of a long term operation more definite and enhances the probability of working with a larger company to exploit the resource.
We now believe the project could be significantly large and requires co-operation and partnership with others already in the supplementary cement industry.

Contact with others:

Our attempts to contact and work with Professor Jay G. Sanjayan of the 'Swinburn University of Technology' as recommended by Pro. Ross Large failed.

However, we pursued discussions with various identities and organisations on two fronts:

1. Seeking help with processing options
2. Seeking a suitable partner to assist with development

In the case of 1. above, our aim is to produce metakaolin and a very high grade silica by-product.
Given the in-house test work done to date we believe the silica should be separated from the kaolin in a dry process with the dry kaolin rich fraction being further ground and calcined to produce metakaolin while the generally coarser silica rich fraction should be further processed in a wet medium to produce high grade silica.
It is likely that a middlings component of feldspar/quartz/kaolin will eventuate which has potential for use in the ceramics industry. To date we have not found a suitable method at production scale to separate the quartz and remnant feldspar.

In the case of 2. Above, we have established contact with two companies that have the potential to assist and discussions are ongoing.
We have entered into a confidentiality agreement with 'Calix Limited' of Level 1, 9 Bridge Street, Pymble, NSW, 2073.
Calix Ltd. Are commercial producers of two grades of metakaolin and are looking for alternative sources of raw material, (partly refined kaolinite), for their production processes.

Summary of work completed

- Extension of EL
- Review of regional potential
- Liaison with Calix Ltd
- Ongoing laboratory scale test work

Regional exploration activities

Regional activities are described in the 'Work carried out' section above with field notes in Appendix 'A'.

Prospect based activities

Prospect based activities have been confined to limited sampling of raw weathered granite to evaluate the potential to produce metakaolin.

Specification sheets for the two Calix metakaolin products are reproduced in Appendix 'B' (Specification sheets).

Environmental considerations

No environmental impacts were created in the past year.

Conclusions

The potential for a regionally based operation primarily for production of metakaolin now seems to be a distinct possibility however this will require partnership with a larger operator established in the supplementary cementiceous industry.
Contact with this potential partner has been established and discussions are on-going.
On-going laboratory work continues to confirm the potential to produce metakaolin with the main difficulty being production of a kaolinite concentrate containing only a minimal quantity of free silica.

Proposed work for the next 12 months:

- Work with Calix Ltd to refine processing of the available raw materials with the aim of being able to supply them with the feedstock they need for their processes.
- Continue laboratory scale test work to produce metakaolin based concrete test cylinders to prove consistency of results.

Appendix 'A'
(Regional review)

Notes on visit to North East – 7th November 2013

Participants : A Duggan, D Hassell and Tas Rainbow

Thoughts, places visited and activities in dot point format :

- Worked out sand/gravel pits and tin mines overlying Devonian granite thought to be good prospecting sites for kaolin because mining in both cases ceased at the base of the alluvium, (evident by bottoming on weathered granite), and any future mining activity would not create a new footprint. A further benefit would be minimal overburden.
- Why previous exploration efforts have ignored this line of thought is unknown but probably related to the lack of environmental considerations at the time.

- Visited several such pits to verify material in bottom;

  Gowlands mine (tin) - Relatively large pit with excavation faces up to est. 10 metres. Now flooded to provide water source for irrigation.
  Stronach mine (tin) - (Adjacent to sand pit we know as China pit) Shallow workings, few metres, showing iron stained weathered granite in bottom of unknown depth. Iron staining thought to be from small quantity of pyrite present as accessory mineral in the granite.
  Haas mine (tin) - Deeper workings, up to approx. 8 metres, showing iron stained weathered granite in bottom of unknown depth.
  Venarchi pit (sand) - bottomed on iron stained weathered granite of unknown depth. Sample of white clay rich material taken. Seemed to be pocket of almost pure feldspar now altered to kaolin.
  Banca mine (tin) - Near Winnaleah. Bottomed on weathered granite with very little iron staining but very high content of coarse quartz crystals. Weathered granite outcrop exhibits two sets of vertical fractures at right angles infilled with later feldspar now altered to kaolin, (sample taken). Creek cutting through the deposit shows vertical depth of alteration of up to est. 12 metres. Unknown whether extent of alteration changes with depth, ie decreases with increasing depth. Some of the altered material in this location exhibited pale green coloration of the kaolin, possibly presence of minute amounts of copper (chalcopyrite ?) The land owner showed us a well- rounded sample of 'rock crystal' quartz (approx. 150mm Dia.) which he said were common in the area. This, along with the afore-mentioned fractures, is taken to represent at least two periods of secondary fracturing and intrusion post original crystalisation, one silica rich and one feldspar rich.

- Best criteria for discovery of kaolin of reasonable minable depth and minimal overburden said to be on un-eroded flanks of granite mountains between 400 to 600 ft above present sea level.

- Prospective area said to be all granite rich area from Tonganah to St Helens with major exposed areas at South Mt Cameron. This area said to contain areas of very fine kaolin with little quartz grit.
- Location of operations at Tonganah said to be more related to proximity to rail transport, population centre and other infrastructure rather than best deposit. Previous Tonganah operations aimed at low cost production hence fairly rough processing and discarding of much of the available kaolin.
- Possible contamination of fine tailings at depth by left over chemicals from dispersant treatment.
- Reserves of kaolin over entire prospective area said to be of the order of tens of millions of tonnes if not billions of tonnes.

Discussion and direction:

Given the above and the fact that we could expect a yield of between say 25% and 40% of kaolin from the altered granite and that large tonnages could be mined from already disturbed areas, the region takes on a much bigger profile as a kaolin producer. Added to this is the fact that the by-products from the operation should find ready markets.

I would now consider the region to be of significant importance to the supplementary cement industry in the future.

The fact that other larger companies active in kaolin mining and processing world-wide are dealing with lesser percentages of kaolin yield and unsalable by-products in things like sedimentary sandstones etc makes this area of great interest and I wonder why we don't see activity in the area from some of the bigger players.

We need to get geological and EL maps for the region to determine what is going on and by whom.

We need to visit the South Mt Cameron area in the company of Tas Rainbow in the near future.

We need to continue our efforts to determine a processing regime to achieve our goals.

D Hassell (Dip Applied Geology)

Notes on field recon. of potential kaolin deposits 21 Nov. 2013

Participants: A Duggan, D Hassell, Tas Rainbow

Literature research had provided reports on exploration efforts for tin and kaolin in the North East and are listed as follows:

- 'The prospects for alluvial tin between the Pioneer and Endurance mines, and near Moorina – North East Tasmania EL6/68' by B R Herd.
- Ballarat Clay Company Pty. Ltd. Exploration license 21/70 report.
- Australian Anglo American limited 'Ringarooma joint venture – Tasmania' quarterly report EL 2/77.

The most useful of these reports by far was the Ballarat Clay Company report because it concentrates on Kaolin rather than Tin. While their reserve estimates were restricted due to a 'brightness' consideration there were comments included relating to potential reserves or possible extensions of deposits which were of interest to us with our requirements being unrestricted by brightness.

Areas/ mines visited:

- Endurance mine
- Pioneer mine
- Browns mine area (to South of Endurance mine area)
- Scotts area
- So called 'Groves' mine area (to South of Scotts area)
- So called 'Garibaldi' area, (SE of Pioneer just across Ringarooma river), does not correspond with 'Garibaldi' area designated in the Ballarat Clay Company report which is approx. 3 km further SE.

Areas mentioned in the report but not visited, (considered to be of lesser importance due to lack of substantial reserves):

- YZ workings (Ah Creek near Gladstone)
- Amber hill area
- Lark Creek area
- Arcadia area
- Garfield-cybele
- Clifton Creek
- Garibaldi

Conclusions:

Of the areas visited, both the Browns area and the Scotts/Groves area, (Note; the so called 'Groves' area adjoins the 'Scotts' area to the South), are considered worthy of further consideration from the point of view of generating substantial continuous reserves.

The Browns area may be too close to the 'blue lake' to allow further exploitation and is relatively untested at depth with the best available estimate of reserves put at 180,000 solid yards prior to more recent disturbances related to road relocation works and tin mining.

The Scotts area has been well drilled and has an estimated reserve of "200,000 solid yards at 77 brightness". This equates to approx.. 150,000 tonnes of kaolin at 40% yield but does not include any reserve of a lesser brightness than 77.
The report concludes that there is an area to the South East of this reserve extending to the Ringarooma river that contains "a very large volume of high-yield saprolite". This is a distance of about 1 km but it is likely that mining would be economically limited by an increasing depth of 'older alluvial' overburden as it progressed to the South East.
The Groves area to the immediate South of Scotts area is unknown at depth but consistent saprolite is obvious at the exposed surface and it is likely that this deposit too could be expanded to the South East.

Recommendations:

- I believe that a further visit to the area is warranted specifically to get a better idea of the surface geology of the Groves/Scotts areas and the areas to their SE. (Land tenement in the area should be established prior to the next visit).
- Of the areas <u>not</u> visited it is considered appropriate to scout the Amber hill/Arcadia areas and the YZ workings.

Notes on field recon. of potential kaolin deposits 28 Nov. 2013

Participants: A Duggan, D Hassell, Tas Rainbow

Following the recommendations of a similar set of notes from field recon. on 21 Nov. 2013, the Scotts and so called Groves areas were revisited with the aim of confirming a potentially large area of prospective ground to the South East of these areas.
It was found that progression to the SE off the low ridge showing patches of weathered granite reached an extensive swampy plain, (the result of large scale dredging for tin), which was impassable by vehicle.
This worked area, some 2Km in length and spaning from the kaolin rich ridge to the Ringarooma river, effectively limits prospectivity to the SE from both areas as any weathered granite underlying the dredged out area is now covered with tailings of unknown depth.
Inspection of surface water control earthworks, apparently post mining, at the Groves area showed inconsistently exposed weathered granite over an area of several hundred square metres but of unknown depth.
It is considered that exploration work in the area may double the known reserve at Scotts but prospective area is constrained and a “very large” deposit, as alluded to in the Ballarat Clay Company report of 1979 is not likely.

The old tin workings designated the YZ workings on the Ah Kaw creek about 1.6 Km West of Gladstone were visited as previous inspection by others had indicated large reserves of clay.
The area was found to be of high relief and an old sub alluvium drainage system had been sluiced for tin leaving steep sided workings up to approximately 8 metres in depth.
Weathered granite was observed in the base of the workings and alluvial cover was apparent in places up to approximately 3 metres in depth.
Assuming that the Ah Kaw creek represents the base of weathered granite and the topographic highs in the area represent relatively un-weathered granite, it is considered that there is limited potential for large reserves of kaolin in the area.

D Hassell
Dip. Applied Geology.

Appendix ‘B’

(Specification Sheets)

PRODUCT DATASHEET

ACTI-Mk 95

Reactive Metakaolin for Building Applications

PRODUCT DEFINITION

Metakaolin is a highly reactive aluminosilicate pozzolan used mainly in a range of specialised concrete applications. As Australia's only manufacturer of Metakaolin, Calix produces ACTI-Mk from the flash calcination of high-grade kaolinic clay. Instead of directly heating minerals in the traditional way, we heat them indirectly and thus do not introduce impurities into the process.

PRODUCT BENEFITS

Concrete products manufactured with Metakaolin will exhibit the following benefits:

- Increased compressive and flexural strength
- Improved durability
- Reduced permeability
- Reduced efflorescence
- Increased Chemical resistance
- Reduced chloride migration
- Reduced sag
- Enhanced workability and finishing
- Reduced effects of alkali-silica reactivity (ASR)
- Increase adhesion
- Reduced shrinking
- Lighter colour
- Reduction of CO2 output

PRODUCT APPLICATIONS

- Shotcrete
- Oil and gas well lining
- High performance and high strength concrete
- Lightweight concrete
- Glass fiber reinforced concrete
- Swimming pool construction
- Marine environments and sea side construction

TYPICAL ANALYSIS

SiO2	52 - 54 %
Al2O3	44 - 46 %
Fe2O3	0.6 %
Physical Properties	Appearance: Off-white powder Bulk Density g/cm^3: 0.4 - 0.5 S.G.: 2.6 pH: 6 - 7 Particle size through 200 mesh: 90 % ≈74 micron Surface Area BET m^2/gm: 25 - 26

The Physical, chemical properties and specifications contained herein represent typical average results obtained using industry accepted standards test methods, and are carried out under controlled conditions and are subject to normal manufacturing variations. Calix reserves the right to modify the properties and specifications at any time without prior notice. The MSDS for this product is available on Calix website.

FOR FURTHER TECHNICAL INFORMATION, TO REQUEST SAMPLE OR PRICING, CONTACT US:
Call: +61 2 8199 7400 or email: info@calix.com.au
Calix Ltd ABN 36 117 372 540 Head Office: Level 1, 9 Bridge Street Pymble NSW 2073
www.calix.com.au

PRODUCT DATASHEET

ACTI-Mk 70

Reactive Metakaolin for Building Applications

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PRODUCT APPLICATIONS

- Shotcrete
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- High performance and high strength concrete
- Lightweight concrete
- Glass fiber reinforced concrete
- Swimming pool construction
- Marine environments and sea side construction

TYPICAL ANALYSIS

SiO2	58 - 60 %
Al2O3	28 - 30 %
Fe2O3	0.7 %
Physical Properties	Appearance: Off-white powder Specific gravity: 0.7 Bulk Density g/cm^3: 0.4 - 0.5 S.G.: 2.6 pH: 6 - 7 Particle size through 200 mesh: 90 % = 14 MICRON Surface Area BET m^2/gm: 25 - 26

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