Target Commodity: Bauxite

Maps
1:100 000  Topographic Series
              Elcho 6074

1:250 000  Geological Series
              Wessel Islands-Truant Island SC/53-15-16

Prepared by Alex Hatch December 2016
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1 ABSTRACT

EL22821 on Elcho Island, East Arnhem Land was initially granted in October 2014 after traditional owners provided consent for bauxite exploration following a period of punctuated consultation dating back to 1981. Exploration programmes aimed to test whether bauxite occurrences on the eastern side of the island reported by Plumb (1965) are indications of a significant deposit of marketable bauxite. Preliminary geological reconnaissance, which included the collection and analysis of rock-chip and float samples, provided only limited encouragement and a programme of vacuum drilling aimed to better test the laterite thickness and alumina grade across the license area. The drilling programme failed to find indications of marketable bauxite and interpretation of results suggests that any significant bauxite deposits that may have existed on the island have been eroded.

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3 LOCATION, TITLE HISTORY, PHYSIOGRAPHY AND ACCESS

The subject of this report, EL22821, covers an area of 54.88km$^2$ on Elcho Island and was initially granted on October 20th 2014 for a period of 6 years.

Elcho Island is Aboriginal Freehold Land and is located about 550km east of Darwin just off the East Arnhem Land coast. Access by air from Darwin is possible by a scheduled commercial flight 6 days per week to the sealed airport at Galiwin’ku, the main settlement on Elcho Island. Stores and larger items arrive on the island from Darwin and Gove by weekly scheduled barge services. The drill rig and support vehicle used in this programme were transported to and from the Island on these scheduled barge services while personnel travelled by air.

Four-wheel drive vehicles can be hired from Marthakal Yolngu Airlines at Galiwin’ku Airport, although the use of these vehicles is generally restricted to within the settlement of Galiwin’ku.

Access to the title area once on the island is by four-wheel drive vehicle along an unsealed track that runs the length of the island from Galiwin’ku to Gawa. Smaller tracks link this main track with the north coast at Wadagawuy and Gitan. The presence of these tracks combined with coastal hunting tracks make it practical to access most other parts of the license area on foot.

EL22821 is the area for which consent was received from an exploration license application that covered the whole of Elcho Island. The license area, initially applied for in 1981, was the subject of a number of periods of consultation and moratorium before a consent area was agreed following consultation meetings held in 2012. This was passed by the full council of the Northern Land Council (NLC) in November 2013 prior to the approval of the Federal Minister of Indigenous affairs and the subsequent grant of an exploration license. A work programme was approved by traditional owners following a meeting in June 2014 and commenced with a programme of geological mapping and reconnaissance, and an archaeological survey commissioned by the NLC, during August 2014. The drilling programme described by this report completed the work programme.

EL22821 forms part of Alcoa’s Arnhem Land project consisting of five semi-contiguous applications being Elcho Island, Howard Island and three mainland applications immediately to their south (see Figure 1). Authorisation 0865-01 was given on September 30th 2015 and the associated Mine Management Plan was approved for exploration activities on EL22821, EL3350 and EL29848 on Elcho and Howard Islands. An application for a
Certificate of Closure over that authorisation was lodged in September 2016 and the associated exploration licenses were surrendered in October 2016.

The title area is relatively flat and generally overlain by a residual sandy to silty soil cover. Surface drainage lines are poorly defined and intermittent apparently flowing only briefly after heavy rain.

4 GEOLOGICAL SETTING, EXPLORATION HISTORY AND EXPLORATION RATIONALE

Geologically, Elcho Island and Howard Island sit in the onshore portion of the Arafura Basin. A detailed description of the geology of the Arafura Basin can be found in Rawlings (1997). Beneath cover, the geology of Elcho Island is dominated by the sandstones and siltstones of the Elcho Island Formation with limited exposure of the underlying Marchinbar Sandstone on the eastern side of the island (Plumb, 1965). The surface geology of EL22821 is dominated by a cover of alluvium and residual soil that ranges from sand to silty sand. This cover masks an underlying laterite which is exposed only on coastal cliffs and sits unconformably on the Elcho Island Formation.

No record of previous mineral exploration within EL22821 has been found, although two bauxite occurrences on the eastern side of Elcho Island, recorded by Plumb (1965), provided the impetus for exploration of Elcho and Howard Islands. The occurrences are essentially untested and Ferenczi (2001) suggested that the area “may host bauxite deposits comparable to those on Marchinbar Island”.

The target of the current exploration is lateritic bauxite of marketable grade that could be added to the sea-borne market, most of which is bound for China. In this setting, the target bauxite would lie immediately below cover within the laterite profile and if present, could be up to several metres thick. The drilling programme described in this report aimed to test the thickness and grade of the bauxite without missing individual targets of approximately five million tonnes. Analysis of rock chip samples collected during a programme of reconnaissance in August 2014 indicated that the exposed laterite was ferruginous. The most prospective sample from that programme, E008 was collected from the base of a borrow pit to the west of the main access road about 500m north of the Gitan access road. Analysis showed it to have similar levels of Al₂O₃ (43.3%) and SiO₂ (23.5%) to a sample recorded by Plumb (1965) from a bauxite occurrence on the eastern side of the island which assayed 45.7% Al₂O₃ and 25% SiO₂. Ferenczi (2001) suggested contamination by quartz grains derived from nearby sand dunes as a cause of the high silica value. In the case of E008, Hatch (2016) suggested that the high reactive silica assay (14.7%) indicated that clay was a significant contributor to both the silica and the alumina content.

Despite the lack of encouraging results from rock chip samples, this drilling programme was believed necessary to provide a conclusive indication of the bauxite prospectivity of the drilled part of the license and by inference, the potential of other parts of the island.

5 EXPLORATION INDEX MAP

The exploration index map has been plotted at 1:100,000 and is included as an attachment with the filename EL22821_2016_AF_02_IndexMap.pdf.
Figure 1. Location map showing license boundaries relative to Exploration License Applications
6 DRILLING

The initial drilling programme originally planned for the island proposed holes at 1km centres across the whole of the license area, with the aim that it should test thickness and grade of any bauxitic laterite without missing individual targets of approximately five million tonnes. In practice, the programme was limited to areas where access ways and drill pads received archaeological clearance during a survey in August 2014. Drilling was completed using a tractor mounted vacuum drilling rig (see Figure 2) which was able to move relatively easily between holes without clearing. Access for support vehicles was limited to established access tracks.

![Drilling Rig Image]

**Figure 2.** A tractor mounted vacuum drilling rig, of the type used, in uncleared forest

During the year, 38 vacuum holes for a total of 177m, were drilled in the license area. Table 1 is a summary of the drilling completed during the reporting period and the spatial relationship of all holes can be seen on the Exploration Index Map. All holes were vertical, about 45 mm in diameter and between 2.9m and 9.8m deep. The pervasive silty to sandy soil cover was not sampled, but the thickness of this overburden layer was recorded and samples were collected in 0.5m intervals from the base of overburden until the end of hole. Generally, holes were drilled through the laterite and two samples into the underlying sediment. The volume of each sample was reduced to a standardized half cup measure after two passes through a rig mounted single stage riffle splitter before collection in a barcoded paper packet. Drill hole and sample information was recorded by the drill crew on sequentially numbered tickets that matched the identification on the sample packets.
Table 1. Summary of drilling completed during the reporting period.

<table>
<thead>
<tr>
<th>Hole Type</th>
<th>Hole Number Range</th>
<th>No of Holes</th>
<th>Min. Depth</th>
<th>Max. Depth</th>
<th>Total Metres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vacuum</td>
<td>EL01-11, EL16-24, EL26, EL28-29, EL31-39, EL45-50</td>
<td>38</td>
<td>2.9</td>
<td>9.8</td>
<td>177</td>
</tr>
<tr>
<td>Grand Total</td>
<td></td>
<td>38</td>
<td></td>
<td></td>
<td>177</td>
</tr>
</tbody>
</table>

301 samples were collected and transported to Alcoa’s Mining Laboratory at their Kwinana Refinery. The samples were oven dried and pulverised at Bella Analytical’s on-site contract facility and FTIR spectra were collected. Quantitative prediction of a standard suite of 12 components was completed from the collected spectra by Alcoa’s Mining Laboratory. The prediction is a computational method involving comparison of the collected spectra to reference models based on wet chemistry analysis of a significant sample set. The sample set used for calibration and validation of the FTIR prediction method originated entirely from the Darling Range, but this was considered adequate for the required indicative results. The processing of samples for FTIR analysis includes routine collection of spectra from standard reference material to confirm the stability of the process, and the preparation of duplicates for a random selection of 1% of samples. These duplicates are analysed by the reference methods. In this case, three duplicate samples were analysed for 10 of the components using the respective reference methods. Post analysis, pulverised material from all samples has been stored at the mining laboratory.

Table 2 contains a summary of analyses and the respective reference analysis methods. More detailed descriptions of the sample preparation and analysis methods are provided in Appendix 1.

Table 2. Summary of the standard suite and their respective reference methods

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Formula</th>
<th>Unit</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL</td>
<td>Available alumina</td>
<td>Av. Al₂O₃</td>
<td>%W/W</td>
<td>MD/ICP-MS</td>
</tr>
<tr>
<td>SI</td>
<td>Reactive Silica</td>
<td>Re. SiO₂</td>
<td>%W/W</td>
<td>MD/ICP-MS</td>
</tr>
<tr>
<td>FE</td>
<td>Iron</td>
<td>Fe₂O₃</td>
<td>%W/W</td>
<td>XRF</td>
</tr>
<tr>
<td>CO</td>
<td>Carbonate</td>
<td>NaCO₃</td>
<td>kg/t</td>
<td>BD/NDIR</td>
</tr>
<tr>
<td>EO</td>
<td>Organic Carbon</td>
<td>EOC</td>
<td>kg/t</td>
<td>BD/NDIR</td>
</tr>
<tr>
<td>OX</td>
<td>Oxalate</td>
<td>NaC₂O₄</td>
<td>kg/t</td>
<td>BD/GC</td>
</tr>
<tr>
<td>SU</td>
<td>Sulphate</td>
<td>Na₂SO₄</td>
<td>kg/t</td>
<td></td>
</tr>
<tr>
<td>PT</td>
<td>Phosphate</td>
<td>P₂O₅</td>
<td>%W/W</td>
<td>XRF</td>
</tr>
<tr>
<td>ST</td>
<td>Silica</td>
<td>SiO₂</td>
<td>%W/W</td>
<td>XRF</td>
</tr>
<tr>
<td>AT</td>
<td>Total Alumina</td>
<td>Al₂O₃</td>
<td>%W/W</td>
<td>XRF</td>
</tr>
<tr>
<td>MS</td>
<td>Magnetic Susceptibility</td>
<td></td>
<td>CGS</td>
<td></td>
</tr>
<tr>
<td>BO</td>
<td>Boehmite</td>
<td>γ-AlO(OH)</td>
<td>%W/W</td>
<td>XRD</td>
</tr>
</tbody>
</table>

The sandy to silty soil cover was pervasive in the area drilled, with a thickness that ranged between 0.3m and 1.1m and averaged 0.7m. Below this, lateritic material encountered was generally silica rich, often clayey and a competent hardpan layer was encountered in only one drill hole. The weathered Elcho Island formation at the base of most holes presented as a mixture of iron stained quartz and clay.

No significant bauxite mineralization was intersected during the drilling programme with a maximum Available Alumina value of 18.5% recorded, and this was associated with a similar level of Reactive Silica.

7 CONCLUSION AND RECOMMENDATIONS

Exploration drilling completed on EL22821 in November 2015 was believed necessary to properly assess the prospectivity of the drilled part of the license and in doing so, better inform a decision on how to proceed in other areas of the license. The drilling programme failed to find indications of marketable bauxite. Interpretation of these results suggests that any significant bauxite deposits that may have existed on the island have been eroded. Even in areas of the island not drilled, the elevation is believed to be too low for significant deposits of bauxite to have persisted.

On this basis, no further exploration on Elcho Island is believed to be warranted and the relinquishment of the granted licence EL22821 and withdrawal of the associated applications ELA30392 and ELA30393 was recommended.
8 REFERENCES


Hatch A, 2016. EL22821 - Elcho Island, Arnhem Land Annual report for the period ending 19/10/2015.  
Alcoa of Australia Limited, Australia.

Plumb KA, 1965. Wessel Islands-Truant Island, Northern Territory. 1:250 000 geological map series and  
explanatory notes, SC 53-15, 16.  
Bureau of Mineral Resources, Geology and Geophysics, Australia, Canberra.

Northern Territory Geological Survey, Australia.
9 APPENDIX 1: ANALYSIS METHODS

9.1 Sample Preparation – milling
The samples are processed by an automated robotic system whereby they are milled to 85% passing 180 micron in a bank of ring mills. The milled samples are then split and the retained portions deposited into plastic sample containers. These containers are 80mm in diameter and 20mm high, and hold approximately 80 to 100g. A matching bar-coded lid is printed and automatically placed on the container after scanning confirms that there is sufficient sample in the container. If there is insufficient sample, the system halts until the issue can be diagnosed and rectified by a laboratory operator. The discarded portions of the post milling splits are discarded to waste.

9.2 FTIR Analysis and Prediction
The bar coded plastic sample containers are automatically fed via conveyor into the FTIR analysis area where spectra collection is also fully automated. The sample for analysis is collected by a rotating scoop then upended into a platinum crucible. It is pressed and scraped to ensure a flat and level surface, then presented to the spectrometer. A spectral profile for each sample is generated from 20 scans across the surface of the sample as it is rotated.

The FTIR spectra is compared against a set of reference grade data based upon wet chemistry analyses and from this comparison, the sample grades are predicted rather than measured using what is termed the prediction method. There is a set of approximately 700 calibration and validation (Cal Val) samples that have been used to develop the methods used for the 12 reported components.

The Cal Val samples, collected from across the Darling Range, have been run for full reference analysis and also run by FTIR and all of the spectra and reference data are used in the development of the FTIR methods.

9.3 EOC, CO & OX Reference Analyses
For the reference determinations of Extractable Organic Carbon (EOC), carbonate (CO) and oxalate (OX), samples are digested in a bomb oven at 145°C in a 10ml pressure vessel bomb using 52% carbonate free caustic. The final liquor is centrifuged and diluted ready for TIC, TOC & GC analysis.

Sample determinations of TIC (carbonate) and TOC (EOC) are performed by wet oxidation. TIC is determined by measuring CO₂ released when a sample is acidified with Phosphoric acid. The CO₂ is purged from the solution and detected by a NDIR detector that has been calibrated to directly display the mass of CO₂ detected. After the sample is acidified and purged of TIC, sodium persulphate is added. The oxidant quickly reacts with organic carbon in the sample at 100°C to form CO₂. The carbon dioxide is purged from the solution and also detected by the NDIR. The resulting mass of carbon dioxide is proportional to the mass of the TOC in the sample.

Gas Chromatography (GC) is used in the measurement of sodium oxalate (Ox) in process liquor samples, which involves a sample being vapourised and injected onto the head of the chromatographic column. The sample is transported through the column by the flow of an inert, gaseous mobile phase. The column itself contains a liquid stationary phase which is adsorbed onto the surface of an inert solid.

9.4 Al & SI Reference Analyses
Available alumina and reactive silica reference determinations are conducted using ICP analysis. The samples are digested in a microwave oven using a 13% caustic solution. Internal Standard and 13% Sulfuric acid is later added to the digested solution and diluted in preparation for ICP analysis.

The ICP is used to analyse for Al and SI simultaneously using pre-prepared Av.Alumina and Reactive Silica standards. The ICP instrument works by pumping the sample from an auto sampler rack through a capillary tube into a nebuliser unit where the liquid sample is converted into a fine aerosol mist which is carried into the spray chamber. A small portion of the mist is carried into the plasma which looks visually like a flame. The sample is introduced as a mist into the plasma which excites each element to emit light at defined wavelengths. The intensity of the light emitted from each element is then compared with calibration standards to determine the concentration.

9.5 MS Analyses
The sample is placed inside a magnetic coil and the frequency through the sample is measured. The difference between this and the frequency with no sample in the coil is used to calculate the magnetic susceptibility (MS).
9.6 BO Reference Analyses
For the analysis of Boehmte (BO), reference samples are micronized to a fine size suitable for XRD analysis, pressed and presented to an XRD instrument.

XRD has the potential to qualitatively and semi-quantitatively estimate the main mineralogical components within a bauxite sample.

9.7 FE, ST, PT, SU & AT Reference Analyses
For the reference determinations of total iron (FE), total silica (ST), total phosphorous (PT), sulphur (SU_READING) and total alumina (AT), the sample (a mixture of flux and the unknown sample) is weighed accurately, fused in a platinum crucible and cast into a platinum mould to produce a glass disc. This disc is presented to the XRF instrument for analysis of the routine elements present. The accuracy of the XRF analysis is increased by using the fusion technique of sample preparation, in which particle size and mineralogical effects are eliminated.
## APPENDIX 2: GLOSSARY OF ABBREVIATIONS AND TERMS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
<th>Used as</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHD</td>
<td>Australian Height Datum</td>
<td>Geodetic datum for altitude measurement in Australia</td>
</tr>
<tr>
<td>EL</td>
<td>Exploration Licence</td>
<td>Mineral title for non-extractive exploration</td>
</tr>
<tr>
<td>FTIR</td>
<td>Fourier-Transformed Infra-Red</td>
<td>Prediction method used by Alcoa</td>
</tr>
<tr>
<td>GDA94</td>
<td>Geocentric Datum of Australia 94</td>
<td>Projected coordinate system for Australia</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System</td>
<td>Allows reliable location information</td>
</tr>
<tr>
<td>ICP-MS</td>
<td>Inductively Coupled Plasma Mass</td>
<td>Analysis method</td>
</tr>
<tr>
<td></td>
<td>Spectrometry</td>
<td></td>
</tr>
<tr>
<td>MGA</td>
<td>Map Grid of Australia</td>
<td>Coordinate system based on the UTM projection and GDA94</td>
</tr>
<tr>
<td>NDIR</td>
<td>Non-Dispersive Infra-Red</td>
<td>Analysis method for gases (CO₂)</td>
</tr>
<tr>
<td>PDF</td>
<td>Portable Document Format</td>
<td>File type</td>
</tr>
<tr>
<td>XRD</td>
<td>X-Ray Diffraction</td>
<td>Semi-quantitative analysis method</td>
</tr>
<tr>
<td>XRF</td>
<td>X-Ray Florescence</td>
<td>Analysis method for major oxides</td>
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</table>