Virane LDA (Mozambique Licence No. 6863 C)

Site Visit Report

Conducted on 15th February 2018

FOR

Virane LTD

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By

APPLIED GEOLOGY & MINING
(Pty) Ltd.
EXECUTIVE SUMMARY

Concession 6863 C is located in the heart of the most recognised pegmatite province in Mozambique, where mining has taken place since the Portuguese Colonial days. The Concession lies 230kms north east of the port city of Quelimane and is accessible by tarred road with the final 100kms on dirt road.

The pegmatites contain Tantalite which occurs in two forms:
- In specific zones within pegmatites in a crystalline form
- As a heavy mineral in alluvial deposits adjacent to pegmatites

The pegmatites occur in well delineated geographic zones and can be classed as rare-metal type and rare-earth type. The Concession lies on the intersection of these zones and is likely to contain both types of pegmatite. Other minerals such as lithium, niobium, beryl, and gem-quality aquamarine are also commonly found in the pegmatites.

On February 15th 2018 a visit to the site demonstrated that Tantalite is found on the concession within the alluvial sediments. A 100kg sample from the Tantalite-bearing sediment horizon was sent to Peacocke and Simpson Laboratories in Harare for gravity testwork and assay. The samples were taken from various locations and combined into one composite for the gravity testwork. The results cannot be construed as an evaluation of the area but rather an indication of the presence of tantalite. The results of the testwork carried out on the initial 100kg sample are as follows – the head grade of the Ta₂O₅ was assayed at 126.4 ppm and there was an additional high grade of TiO₂ (1361 ppm) as evidenced by the presence of Ilmenite under the microscope. An overall recovery of 72.1% of total contained Ta₂O₅ into 1.91% mass was achieved via jigging and spiral/tabling. A final concentrate grade in excess of 20,000 ppm is indicated but due to the small amount of mass available for the final tabling, this needs to be more accurately defined using a larger head sample to generate more Ta₂O₅ product for determining sale grade. This will establish the overall recovery vs grade relationship which was not able to be clearly determined due to the small mass of target product derived from the 100 kg sample.

No outcrop of pegmatite was inspected, but it is a realistic assumption that the Tantalite found in the alluvial sediments is derived from the weathering and erosion of the in-situ pegmatite. The in-situ pegmatites are covered with quartz float derived from the underlying pegmatite and the high optical reflectance causes them to be readily recognisable in satellite images.

It is recommended that an additional 3 tonne sample is obtained in order to more closely define the projected sales grade.

Pending the lab results from the bulk sample, a more detailed exploration programme is to be designed delivering a CPR, Geological Model, Mineral Resource statement, and a DFS.
1. Introduction

Concession 6836C, covering an area of 1,294 ha, has been granted to VIRANE LDA for the period of September 2014 to September 2036. The area is located in the Zambezia Province of Northern Mozambique and the licence falls within the Alto Ligonha Pegmatite Province.

The reconnaissance trip was to establish the prospectivity of the concession and to confirm the existence of Tantalite, the target mineral for a possible mining venture. An exploration programme will be designed with a view to producing enough verifiable data to produce a CPR, containing a mineral resource statement, for input into a Definitive Feasibility Report to be used to secure project investment.

This report summarises the findings of the reconnaissance trip taken on the 15th February 2018.

2. Location

The Concession is located in the Alto Molócuè District within the Zambezia Province of Mozambique. The town of Alto Molócuè lies approximately 180 kms south-west of Nampula capital city. The Concession is situated 57 kms south-south-east of Alto Molócuè and is accessed via paved National Highway (232 and 104) and then by a 99 km dirt road (National Road 483), which currently takes approximately 4 hours to navigate. The upgrade of the last portion of the road would form an ideal CSI project which would bring notable benefits to the project operations as well as for the local community. The closest grid power is approximately 3kms to the north of the Concession.

![Figure 1 - Location of Concession 6836C](image-url)
3. Climate and Topography

The climate of the area falls under the classification of ‘tropical savannah’, defined as wet summer and dry winter – this is well reflected in Figure 2 which shows the monthly rainfall for the area and demonstrates the summer rainy season from November to April and the winter dry season from May to October.

![Rainfall Chart of the Alto Ligonha Area](image)

**Figure 2 - Rainfall Chart of the Alto Ligonha Area**

4. Geology

4.1. Regional Geology

Pegmatites are intrusions common to the entire Proterozoic of Mozambique. The Alto Ligonha Pegmatite Field is the most economic pegmatite field in the country. In the Zambezia and Nampula Provinces, the intrusion of the granitoid pegmatites indicated the termination of a tectonic-magmatic cycle which also marked the end of the Pan-African Cycle at around 410 Ma. Tectonically, the most important feature of the area is the northerly trending Namama Shear Zone which hosts most of the rare-metal pegmatites that form part of the Alto Ligonha Province. The belt arcs from an N-S orientation to a NE-SW orientation – see Figure 4.

The structure of the Namama Shear Zone appears to exert a profound influence on the pegmatite clusters comprising the Alto Ligonha Pegmatite Province. Within these clusters, the pegmatite bodies have a preferred orientation with the surface trace of their long-axes striking predominantly northeast-southwest - see Figure 7. The regional hosting lithotypes are quartz-mica schist, biotite schist and amphibolites with a northeast to east strike trend. In common with the other mobile belts in Southern Africa, the Mozambique Belt comprises high-grade metamorphic rocks (granulite and gneisses) with associated, generally acid, intrusions.
There are post-tectonic granites with various deformations from massive to gneissic fabrics in the region. The age of the youngest granites is between 850 to 410 Ma. The metamorphism in the region is interpreted to be the result of the Pan-African thermal event, which comprises several separate events.

4.2. Local Geology

The Alto Ligonha pegmatites are associated with late Neoproterozoic granites that have intruded into the high-grade Mesoproterozoic basement of the Nampula Complex, mainly along the Namama Shear Zone.

The Nampula Complex is part of the southern tip of the Mozambique Belt that resulted from the collision between East and West Gondwana during the East African Orogeny. It comprises a sequence of supracrustal rocks that have been migmatised to various extents and an older suite of granitoid gneisses (1123 ± 9 Ma), intruded by various orthogneisses and widespread granitoid gneisses. These units constitute the basement that makes up about the 90% of the Nampula Complex. The remaining percentage consist of Neoproterozoic metasedimentary gneisses deposited unconformably over the Nampula Complex. Subsequently, the Nampula Complex has been intruded by syn- to post-tectonic Pan-African (late-Neoproterozoic to Cambrian) granitoids pluton, dykes and sheets.

The Alto Ligonha Pegmatite Field has been mined for many years, mainly for the Tantalum content. The orientation of the pegmatite bodies varies between conforming to the orientation of the regional pegmatite zones to following the rims of intruded granite-gneiss domes (Figure 7). Figure 3 is a low resolution satellite photo displaying possible pegmatite outcrops – the quartz float at surface shows up in white patches and could signify underlying pegmatite. In the 6863 C Concession area the pegmatites lay within the ‘Mocubela-Alto Ligonha’ Pegmatite Field (Stajila et al, 1985) (see Figure 4) and the ‘Alto Molócuè’ Pegmatite Field (Barros and Vicente, 1963) (see Figure 5). Within this field has been mapped the Namarella deposit which lies within the 6863C concession. Figure 4, Figure 5, Figure 6, and Figure 7 show the distribution of the different types of pegmatites of the Alto Ligonha Pegmatite Field.

Figure 3 - Possible Pegmatite Zones on 6863 C highlighted on satellite photograph
**Figure 4** – Location of the Alto Ligonha Pegmatites – Note Concession 6863C in Field II Ta, Li

**Figure 5** – Pegmatite Location according to Barros and Vicente, 1963. Note that Concession 6863C falls in area I2.
Figure 6 — Distribution of Rare-Metal and Rare-Earth pegmatites
Note position of 6863C in intersection of both types and within the Namama Shear Zone
After Lächelt (1985)

Figure 7 — Orientation of the Alto Ligonha Pegmatites.
After AQUATER (1983) and Lächelt (1985)
The pegmatites in the Alto Ligonha area consist of two main types:

- The rare-metal pegmatites containing Ta and Nb
- The rare-earth pegmatites containing Li minerals

Each of the types have been subject to specific elements of tectonic control.

The pegmatites which contain the rare-metals (Ta and Nb) are located in two NNE/NE – SSW/SW trending zones. The southernmost zone, which follows the trend of the Namama Thrust Belt is the economically most important. The rare-metal pegmatites are generally concentrated in mica schists, amphibole schists, and amphibolites. Some of the rare-metal pegmatites also contain rare-earth mineralisation particularly at the intersections of the transverse tectonic lineaments – see Figure 6.

The pegmatites which contain the rare-earth elements follow transversal tectonic elements in a NW-SE direction.

Figure 6 shows that the 6863C concession is located within the Namama Thrust Belt zone. It is significant to note that 6863C is favourably located at the intersection of rare-earth and rare-metal pegmatite zones. The concession is also adjacent to the Namarrela Pegmatite occurrence. Marques (1989) notes that pegmatite minerals encountered in the area of Namerella, see ‘I2’ in Figure 5, include gemstone quality Tourmaline, Beryl, Columbite, Tantalite, Li-minerals and Pucite (caesium).

The outcrop of the pegmatites is highly variable with length up to 1 kilometre and width up to 400m. However, the average size is 250 x 30m (Marques, 1989).

Two groups of pegmatite morphology occur in the Alto Ligonha Pegmatite Field:

- Homogenous pegmatites: Homogenous Pegmatites are generally small (<10cm) in width and have limited economic value.

- Heterogenous Pegmatites: These pegmatites exhibit clear mineral zoning and contain many minerals of economic importance. The zoning represents the different crystallization temperatures of the minerals as the fluids cool, with temperatures of mineral formation ranging between 100 and 600⁰C.

Pegmatites are variable in morphology and range from steeply dipping to flat-lying orebodies. This can have a profound effect on the mining layout – steeply dipping pegmatites will have a higher stripping ratio but could extend in depth, whereas flat lying pegmatites will have a lower stripping ratio but would not extend significantly in depth. Exploration drilling will delineate the morphology and allow for accurate mineral resource estimation.

5. Observations from the Site Visit

The general objective of the site visit on the 15th February 2018 was to establish if there are Tantalite occurrences on the Concession. The presence of artisanal mining was used to identify areas of Tantalite mineralisation – most of the areas visited were in stream beds or terraces. Samples were taken from
where the artisanal miners were extracting their ore. It was also noted that the current artisanal activity was focused around an area of pegmatite outcrop (see Figure 3) and that the Tantalite mineralisation was probably a function of the erosion from this outcrop into the bounding drainage pattern. Figure 8 shows the sites that were sampled and their location to local drainage.

![Figure 8 - Alluvial Sample Locations](image)

It is worthy to note that, although there was extensive rafts of quartz float, no outcrop of pegmatite was seen during the site visit. A couple of exploratory pits have been dug by the artisanal miners whereby pegmatite had been encountered but exposure was not sufficient to make any geological observations. The artisanal miners did report that Tantalite crystals of up to 1 kg in weight had been dug up in the vicinity of the site visit.

6. Exploration Targets

The targets for exploration are both alluvial and hard rock pegmatite.

It is easier, and less expensive, to evaluate and mine the unconsolidated sediments that are derived from the erosion of the pegmatites. Where this sediment is local to the pegmatite and has been deposited as a result of gravity processes it is termed colluvium. Little reworking of this sediment has
taken place hence upgrade of the concentration of the heavy minerals is limited. Where these sediments have been reworked by fluvial action then several types of deposit can be found:

- River channel deposits
- River terrace deposits
- Flood plain deposits

The in-situ pegmatites are more competent and require a different exploration methodology and hard rock mining techniques.

6.1 Alluvial Deposits

The hydraulic action of water on unconsolidated sediments containing heavy minerals has the effect of winnowing out the less-heavy gangue minerals and concentrating the heavy minerals such as Tantalite (SG of 16). The effect of this is the concentration of heavy minerals within drainage systems which becomes the exploration target. In general, alluvial deposits have the potential to contain high grade concentrations of heavy minerals.

Target areas for Tantalite concentrations would be the basal gravels of stream channels, flood plains, and river terraces. All of these are likely to be unconsolidated and easily mined with regular free-digging machinery. These deposits were worked by the colonials from which evidence is still seen.

Methodologies to identify Tantalite-bearing alluvial deposits are pitting, trenching and augering. These are all cost effective methods which create abundant exposure for evaluation, and, in addition, the data can be utilised for the identification of in-situ pegmatites. The presence of artisanal miners can also be used as a pathfinder.

Advantages of targeting alluvial deposits for mining is that it is a cost effective and rapidly deployable method of generating a revenue stream from which the proceeds can be used for additional exploration and resource definition on the property.

The deployment of a small tonnage pilot gravity plant (say 5 tonnes per hour) could be used as an exploration tool across the concession in order to prove up the various target areas. The plant design would incorporate a washing trommel, possible jigs to scalp off the larger Tantalite grains, and high g-force centrifugal concentrators. Concentrate would be upgraded on large shaking tables with possible further upgrade of a Gemini table to separate out other heavy minerals.

6.2 Hard Rock Pegmatite

The identification of pegmatitic-bearing areas and the evaluation of such is a more involved process. The identification of the pegmatites can be done simultaneously with the exploration of the alluvial deposits. In some instances a degree of evaluation of the pegmatites can be done by some of the exploration methods employed for the alluvial evaluation but, ultimately, drilling, preferably large diameter core, would be required to accurately assess the pegmatite resource.
If hard rock pegmatite was to be the initial project focus then the methodologies employed to identify targets are time consuming and expensive – examples are geochemistry, multispectral remote sensing, geophysics, trenching, and drilling (RC and diamond).

7. Sampling

The reconnaissance visit included identifying the artisanal activity on the concession and observing what was being mined and relating that to the geology. Samples of the ore, which was being mined by the artisanal miners, were taken at the various sites visited. A representative sample of the in-situ ore, with as little bias as possible, was taken at each site. The samples comprised loose pebbly soil. The bedrock was not observed which indicated the possible existence of coarser basal gravel below the sample collection point. All the samples were combined into 2 larger samples of approximately 55kgs each, sealed with Seal Numbers AG&M 0001928 and 0001929 and shipped to Simpson and Peacocke Laboratories in Harare where they were amalgamated into one large sample. Gravity testwork was undertaken as per Figure 9 below. The concentrate was assayed for Ta, Ti, and Ni as well as deleterious elements U and Th. In addition, due to the intersection of the two types of pegmatite (rare-earth and rare-metal), assays were also conducted for lithium, niobium and gold.

Figure 9 - Testwork Flow Sheet
8. Discussion of Testwork and Assay Results

Samples were taken from various locations where artisanal mining was taking place. The samples were combined into one composited 100 kg sample and subjected to testwork to determine the amenability of the alluvial sediment to gravity concentration. The results cannot be construed to represent an evaluation of the tantalite in the alluvials but rather an indication of the presence of tantalite.

Average assayed head grades from the sample were:

- \( \text{Ta}_2\text{O}_5 \) - 126.4 ppm (0.0126%)
- \( \text{TiO}_2 \) - 1361 ppm (0.14%)
- \( \text{Nb}_2\text{O}_5 \) – 129.75 ppm (0.0129%)

Deleterious elements assayed in the final concentrate were:

- Uranium – 106 ppm
- Thorium – 6069 ppm

Figure 10 shows the summary of the gravity testwork for \( \text{Ta}_2\text{O}_5 \). It shows that an overall recovery of 72.1% was achieved via jigging and spiral/tableing resulting in a concentrate mass of 1.91% of the total sample mass.

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<th>Product</th>
<th>Mass (g)</th>
<th>Frac'tn %</th>
<th>Cum %</th>
<th>Assay (( \text{Ta}_2\text{O}_5 ) ppm) Frac'tn</th>
<th>Cum</th>
<th>Units Ta2O5</th>
<th>Distribution Frac'tn %</th>
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*Figure 10 - Summary Gravity Testwork Results – \( \text{Ta}_2\text{O}_5 \)*
Figure 11 - Summary Gravity Testwork Results – TiO2

Figure 11 shows the summary of the gravity testwork for TiO2. It shows that an overall recovery of 21.7% was achieved via jigging and spiral/tabling to a concentrate grade of 6830 ppm TiO2. Microscopic analysis showed a high percentage of Ilmenite grains in the concentrate which would account for the high TiO2 presence.

Figure 12 - Summary Gravity Testwork Results – Nb2O5
Figure 12 shows the summary of the gravity testwork for Nb2O5. It shows that an overall recovery of 43.4% was achieved via jigging and spiral/tabling to a concentrate grade of 4859 ppm Nb2O5.

Further testwork is required to assess the removal of deleterious Thorium from the end concentrate.

Further testwork

Peacocke and Simpson have indicated that they are able to conduct further testwork on the 100 kg sample. However, they suggest that a three tonne sample would show more representative results.

The objective of further testwork will be to determine the following:

- The grade of the saleable product after tabling
- The matrix of the concentrate produced.
- The optimum gravity recovery design i.e. with or without jigs
- The method and ability to separate the Thorium from the Ta₂O₅ (Tantalum PentOxide) concentrate.
- The method and ability to separate the TiO₂ (Titanium Oxide)

9. Exploration Programme

It is recommended that an additional field visit is conducted to collect a three tonne alluvial sample for laboratory testwork. Initial focus on the alluvials is for the following reasons:

- it is more cost effective to evaluate alluvial resources,
- time to production is quicker than setting up a hard rock operation
- environmental and other permits are less onerous
- an initial operation based on alluvial processing has low CAPEX and OPEX,
- exploration for hard rock in-situ pegmatites can be done concomitant with the alluvial mining,
- the project is de-risked by reducing the amount of upfront project investment

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Pr. Sci. Nat. No: 400235/06

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