

ASX Announcement

19 March 2024

Further metallurgical results on chlorination test work

Highlights

- Niobium/Tantalum successfully extracted and separated using environmentally sustainable chlorination refining.
- Confirmation that Niobium/Tantalum products contain no radiation as the radioactive materials are removed in the refining process.
- Successful extraction and separation of >94% of the key Rare Earth Elements (REE), as by-products of the niobium and tantalum refining process.
- Construction of Refinery Pilot Plant commenced for the production of marketing samples for the finalisation of key off-take agreements.

Globe Metals & Mining Limited (ASX: GBE) ("**Globe**" or "**Company**") is pleased to announce the second part of the metallurgical results on the chlorination test work.

As part of Globe's metallurgical test work on the use of chlorination as a refining process for the recovery of Niobium, Tantalum, and other key metals from the Kanyika concentrate, Globe is continuing to conduct test work on concentrate produced in 2014. The first part of the metallurgical results on the extraction results of >99% for Niobium and Tantalum was announced on 27 October 2023.¹

The metallurgical test work is focused on two key steps – firstly, the extraction of metals from the Kanyika concentrate; and secondly, the separation of the metals (as chlorides) and subsequent purification and oxidation of the metals to high-purity saleable products.

Extraction Test Work

As announced on 27 October 2023 (results repeated below), Globe has conducted a baseline test followed by a series of kinetics and optimisation tests. This culminated in tests (OR12 & OR13) showing above 99% extraction for both Niobium and Tantalum. The tests further demonstrate high extraction yields for other potentially marketable products, namely Titanium and Zirconium, with extraction yields of above 99% and 96% respectively.

¹ Refer to ASX Announcement titled 'Positive metallurgical test work results – correction' made on 27 October 2023

Extraction %

Test	Nb ₂ O ₅	Ta ₂ O ₅	TiO ₂	ZrO ₂
OR1	98,1%	89,7%	99,4%	53,2%
OR12	99,9%	99,8%	99,9%	92,7%
OR13	99,9%	99,8%	99,9%	95,9%

Fractional Cooling Separation

After the extraction of metals in the chlorination process, the metal chlorides leave the reactor as gases. The gases are systematically cooled down through controlled cooling causing elements to condense when they reach their respective boiling points. Initially uranium and thorium chlorides are condensed removing them from the gas stream. Subsequently iron and zirconium chlorides are condensed to a major extent. At a target condensation temperature of 250°C, a mixture of niobium, tantalum containing zircon and iron is condensed. Control over the target temperature is key to obtaining a high niobium chloride concentration in the condensate.

In the table below, the predicted analysis of condensate at three temperatures is given. The two actual results show that the actual condensation temperature achieved was between 265°C and 270°C rather than the target 250°C. Given the very small laboratory apparatus, accurate temperature control is difficult. The resulting separation of niobium chloride was demonstrated to be very good with a chloride purity over 84%. If the 250°C had been achieved, this would have been >90%.

KR01	NbCl ₅	TaCl ₅	FeCl ₃	ZrCl ₄
Analyzed #1	86,0%	3,5%	2,4%	8,1%
Analyzed #2	84,2%	4,7%	5,3%	9,1%
Calculated 250°C	90,2%	3,4%	1,6%	3,7%
Calculated 266°C	84,9%	3,2%	3,8%	8,1%
Calculated 270°C	83,1%	3,1%	4,6%	8,2%

Purification and Oxidation

The next step is to take the crude mixture of niobium and tantalum and purify it with distillation. The purified niobium chloride is expected to reach >99.9% during distillation. The very pure niobium chloride is then oxidised to produce a final niobium pentoxide product of >99.9% Nb₂O₅. Globe and TCM Research are currently working on this next phase of test work.

No Radioactivity in Intermediate Niobium/Tantalum Mixtures

The test work confirmed that “no radioactive contamination was found in the niobium pentachloride desublimation fraction”. While this was expected, it has now been confirmed that the final niobium and tantalum products will not contain any radiation. All uranium and thorium were precipitated before the condensation of the niobium/tantalum mixture.

Rare Earth Extraction

While Rare Earths make up a minor fraction of the concentrate, they are still present and an important economic by-product for Globe.

During the chlorination process, the Rare Earths form chlorides in the form RECl₃. These chlorides remain in the reactor residue. Rare Earth chlorides are water soluble. They will be washed out of the residue and concentrated by fractional precipitation of impurities before being precipitated as a Rare Earth carbonate and sold as an important by-product.

The results below are for a particular sample of residue that was washed and analysed for extraction. Under the operating conditions, all the Rare Earths had a >94% extraction.

GMM-32	Units	Ce	La	Nd	Pr
Feed Material	mg/kg	3608,0	1266,7	1310,3	322,5
Feed Material	mg	288,6	101,3	104,8	25,8
Washed Residue	mg/kg	322,2	104,9	96,9	27,2
Washed Residue	mg	3,8	1,8	1,3	0,4
Extraction Solution	mg/l	504,3	167,3	153,0	42,0
Extraction Solution	mg	28,8	9,6	8,7	2,4
Extraction Yield	%	94,8	95,2	95,7	95,1

Upcoming Test Work

Marketing Samples

Based on these very encouraging results, Globe has already embarked on the production of small-scale (gram scale) marketing samples during March 2024. The mixed niobium/tantalum chloride mixtures will be generated using the equipment used for the TCM laboratory tests described above. These mixtures will then be purified with a target of producing Standard Grade (>99.9% Nb₂O₅) samples to be distributed for marketing purposes.

Pilot Plant Refinery

The larger pilot plant refinery which is currently under construction at Resonant Group (Johannesburg, South Africa) is expected to be commissioned and operational in April 2024. The pilot plant will be processing concentrate at a scale exceeding 10x that of the laboratory apparatus mentioned in this announcement. The aim of the pilot plant will be to produce very high purity 99.98% (optical grade) (kilogram scale) Niobium Pentoxide, which will be provided to Globe's key off-takers to assess. Once the oxide product is produced, Globe will be very well positioned to finalise its discussions with key industry off-takers, a major step forward in the development of Globe's Kanyika Project. The oxide market includes all oxide grades from Standard Grade up to optical grades of 99.98% niobium pentoxide, thus facilitating prices over US\$50/kg.



Image: Distillation column for Globe's Pilot Plant under construction at Resonant Group's facility in Johannesburg, South Africa.

Grant Hudson, Globe's CEO commented:

"We are very pleased with the progress made in the metallurgical test work conducted so far. The successful floatation concentration of Kanyika ore, as announced recently, and the refinement of the concentrate through the environmentally conscious chlorination process, hold immense promise for Globe. Both the extraction and separation of all key metals have now been demonstrated as technically feasible, further bolstering our confidence in the process. We are very excited about the upcoming commissioning of the refinery pilot plant, and the production of high-purity marketing samples of niobium pentoxide, tantalum pentoxide, and rare earth element by-product for key industry off-take partners. This marks a major step forward in the development of our Kanyika project."

Project, ESG and Market Overview

Kanyika has the potential to become the first new globally significant niobium mine in 50 years, with an average nameplate production of 3,267 tonnes per annum (tpa) of niobium pentoxide, (Nb₂O₅) and 136 tpa of tantalum pentoxide (Ta₂O₅) over the 27-year life of operations. The Nb₂O₅ and Ta₂O₅ products will be high-specification high-purity products with grades exceeding 99.5% and 99% respectively.

Standard Niobium oxide is being used in the anodes of fast charging batteries (charging to 100% in less than 10 minutes). These batteries have application in large vehicles that cannot afford excessive charging time. These include haul trucks, trains, front-end loaders, underground mining machinery, etc. They are also being used in batteries for handheld tools where fast charging is an advantage.

High purity Niobium is an integral component of daily-use, energy-related, and specialty technologies such as superalloys (for example, for aircraft engines, rocket assemblies, etc), and superconducting magnets (for example, for medical imaging devices, and nuclear power generation).

The Kanyika Project aims to be a pioneering and environmentally sustainable niobium venture, prioritising both innovation and adherence to ESG principals. It has been shown to be a bottom quartile cost project and is designed to ensure the production of "green niobium" in that its Scope 1 and Scope 2 carbon emissions will be of the lowest in the world, with hydroelectric and solar power dominating its power sources for both the mine site and the refinery. The very low carbon footprint is also supported by a unique closed-cycle chlorination refining process, which is transformative for the industry.

Authorisation for Release

This announcement has been authorised for release by the Company's Chief Executive Officer, Grant Hudson.

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About the Kanyika Niobium Project

The Kanyika Niobium Project is located in central Malawi, approximately 55km northeast of the regional centre of Kasungu and is secured by Large-Scale Mining Licence No. LML0216/21 which grants the Company security of tenure and the right to mine niobium, tantalum, and deleterious uranium.

Drilling programs totalling 33.8 kilometres of percussion and core drilling have defined the extent of mineralisation. Structured and progressive engineering studies have resulted in the current (JORC 2012) Mineral Resource Estimate (refer below) and given rise to significant improvements and simplifications in the process flowsheet.

In addition, Globe has undertaken substantial metallurgical optimisation work and commissioned the pilot plant design to demonstrate and further optimise metallurgical processes. Metallurgical optimisations studies have improved recoveries from 62% in 2012 to 75% presently, through novel patented metallurgical processes.



The Kanyika operations will produce a pyrochlore mineral concentrate that contains both niobium and tantalum in commercially valuable volumes to be shipped to a refinery for advanced processing into high purity materials.

A Mineral Resource Estimate for the Kanyika Niobium Project under the 2012 JORC guidelines was reported to ASX on 11 July 2018 as follows:

Table 1: MRE for KNP using a 1,500 ppm Nb₂O₅ lower cut

Category	Resource (Mt)	Nb ₂ O ₅ (ppm)	Ta ₂ O ₅ (ppm)
Measured	5.3	3,790	180
Indicated	47	2,860	135
Inferred	16	2,430	120
TOTAL	68.3	2,830	135

Table 2: MRE for KNP using a 3,000 ppm Nb₂O₅ lower cut

Category	Resource (Mt)	Nb ₂ O ₅ (ppm)	Ta ₂ O ₅ (ppm)
Measured	3.4	4,790	220
Indicated	16.6	4,120	160
Inferred	2.8	4,110	190
TOTAL	22.8	4,220	190

Mineral Resource Estimates

The information in this report that relates to Mineral Resources is extracted from the report titled “Kanyika Niobium Project – Updated JORC Resource Estimate” released to the Australian Securities Exchange (ASX) on 11 July 2018 and available to view at www.globemm.com and for which Competent Persons’ consents were obtained. Each Competent Person’s consent remains in place for subsequent releases by the Company of the same information in the same form and context, until the consent is withdrawn or replaced by a subsequent report and accompanying consent.

The Company confirms it is not aware of any new information or data that materially affects the information included in the original ASX announcement released on 11 July 2018 and, in the case of estimates of Mineral Resources, that all material assumptions and technical parameters underpinning the estimates in the original ASX announcement continue to apply and have not materially changed. The Company confirms that the form and context in which the Competent Persons’ findings are presented have not been materially modified from the original ASX announcement.

Full details are contained in the ASX announcement released on 11 July 2018 titled ‘Kanyika Niobium Project – Updated JORC Resource Estimate’ available to view at www.globemm.com.