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To meet mining companies' growing drive to become lowest-quartile cost producers, Bell Equipment has over the years continued to push the boundaries with a range of standard solutions on its articulated haulers that speak to increased productivity and efficiency. See story on page 10.

Xaudum Iron Project – potential game changer for Botswana?

With a current resource of 441-million tonnes, an exploration target of 5 – 7-billion tonnes and an expected premium magnetite product containing 67% Fe, Tsodilo Resources Limited's Xaudum Iron Formation project is a potential game changer for Botswana as the country seeks to diversify its economy and move away from a dependence on diamond revenues, writes *Munesu Shoko*.

Dr Alistair Jeffcoate, project manager & chief geologist at Tsodilo Resources Limited.

The mining sector in Botswana accounts for about 35% of the country's GDP, with diamonds contributing about 94% of the total mining share in GDP. A primary challenge for Botswana has always been the need to diversify the economy to move away from a marked reliance on diamond revenues.

In the Xaudum Iron Formation (XIF) project, a potential Tier 1 mine that has a potential mine life of over 60 years, Botswana possibly has a game-changing project that will move the country away from its overreliance on diamond revenues, says Dr Alistair Jeffcoate, project manager & chief geologist at Tsodilo Resources Limited (TSXV: TSD) (OTCQB: TSDRF) (FSE: TZO).

Preliminary work on the project has defined a CIM compliant Inferred Mineral Resource Estimate of 441-million tonnes (Mt) with an average grade of 29,4% Fe, 41% SiO_2, 6,1% Al_2O_3 and 0,3% P for the Block 1 magnetite XIF. However, Block 1 is a fraction of the potential XIF magnetite resource. An extrapolated exploration target has defined the XIF to be in the order of 5 to 7-billion tonnes at 15 – 40% Fe.

"A resource of 5 – 7-billion tonnes (t) would rank the XIF deposit in the top 10 magnetite resources globally, and as the second largest in Africa," says Jeffcoate. "The potential revenues from such a project would likely be similar to the revenues generated by Debswana. This project also has the ability to revitalise the steel industry in Botswana and create thousands of jobs. In essence, it will be a game-changer for Botswana that will afford the country to move away from its reliance on diamond revenues."

The company has thus far spent over US$25-million on the project, drilling over 556 holes, representing over 80 000 m of drilling.

Iron ore super cycle

The impending iron ore super cycle, adds Jeffcoate, bodes well for a project of this magnitude. Iron ore reached close to US$180/t (62% Fe) in December 2020, a level not seen for almost a decade, before reaching an all-time high of US$267,80/t (65% Fe) in May this year.

"Iron ore has been the best performing commodity over the last couple of years. In fact, we believe it's the dawn of a new iron ore super cycle, which is exciting for the entire iron ore industry. A new iron ore super cycle and a project of XIF's magnitude will be key to the economic recovery of Botswana in a post-pandemic world," he says.

The company's metallurgical results show that the XIF magnetite product is expected to be a premium high-grade product containing +67% iron magnetite. These high-grade ores and products currently command larger price premiums over standard ores (62% Fe) resulting in higher margins for suppliers of high-grade products.

To provide context, preliminary work at Block 1 has indicated a resource of 441-Mt, explains Jeffcoate, with an iron percentage head of 29,4, using standard magnetic separation technology, allowing Tsodilo to separate to a head grade of 67,2%. That will give the company some 146-Mt of concentrate. It will, however, be a fairly coarse grind of 100-80 microns, based on the metallurgical magnetic separation test work conducted thus far. A key advantage is that the company will use fairly less energy to liberate.

Further to this, "cleaner" iron ores with an Fe content equal to or greater than 65% use less coal per unit of steel and as such produce lower emissions.

Magnetite core from the Xaudum Iron Project.

The current global drive for lower emission steel production results in steel producers dramatically increasing their demand for these high-grade 'green' ores. As this shift towards green steel and emission reduction continues the high grade XIF is uniquely placed to meet this emerging market.

Future transport of ore

The XIF project is located in the North-West District of Botswana and is proximate to the Namibian boarder and lies some 35 km from the town of Divundu in Namibia. Tsodilo has recently joined the Walvis Bay Corridor Group (WBCG). The WBCG is a public-private partnership established in 2000 to promote the utilisation of the Walvis Bay Corridors to the Port of Walvis Bay and Lüderitz in the Republic of Namibia. WBCG was established to engage in

Botswana's Minister of Mines visiting Tsodilo's core shed on May 28, 2021.

Drilling work at the XIF project.

business development activities – thereby increasing cargo for ports and corridors linked to it, and to engage in the facilitation of corridor and infrastructure development.

Of specific importance to Tsodilo is the Walvis Bay-Ndola-Lumumbashi Development Corridor (WBNLDC) which connects Namibia, Zambia and the Democratic Republic of Congo (DRC), with links to Angola, Zimbabwe, Malawi and Tanzania. WBNLDC provides the shortest route between the Namibian west coast Ports of Lüderitz and Walvis Bay and the vital transport hubs of Livingstone, Lusaka and Ndola in Zambia, Lubumbashi (southern DRC) and Zimbabwe. The corridor is perfectly positioned to service the two-way trade between the SADC region and Europe, North and South America and emerging markets in the East.

Currently the portion of the corridor between Grootfontein (Namibia) to Katima Mulilo located on the Zambia border is the portion of the corridor to the XIF, and is currently connected by a grade A bitumen highway used for the transportation of goods and services.

However, in March 2021, the Namibian Ministry of Works and Transport commissioned a feasibility study for the Trans-Zambezi Railway Extension Grootfontein-Rundu-Katima Mulilo. The feasibility study is one of the project components being implemented under the Namibian Transport Infrastructure Improvement Project and the consultancy services are being funded by the African Development Bank and the Government of the Republic of Namibia. The Trans-Zambezi Railway Extension line linking Zambia and Namibia is planned to pass through Divundu, providing access to Walvis Bay, Namibia's deep-sea port.

The proposed rail extension between Grootfontein and Katima Mulilo is significant to Tsodilo as it is planned to pass through Divundu in Namibia which is located approximately 35 km from the company's licence location in northern Botswana. The feasibility study is expected to be completed by the end of 2021 and its results will be considered in Tsodilo's Preliminary Economic Assessment (PEA).

Project in detail

Preliminary work on the project has defined a CIM compliant Inferred Mineral Resource Estimate of 441-Mt. Block 1 is a fraction of the potential XIF magnetite resource and further exploration will be focused on Block 2 where the company expects an increase in the resource. "We think Block 1, which is only a 5 – 6 km strike, is just the tip of the iceberg. The rest of the deposit has a 40 km strike length and is the real deal, as it has a potential exploration target tonnage of 5 to 7-billion t," says Jeffcoate.

The company has thus far spent over US$25-million on the project, drilling over 556 holes, representing over 80 000 m of drilling. The company has also done ground geophysical magnetic surveys (22 749 line km), as well as airborne electromagnetic (16 933 line km) and airborne gravity surveys (10 392 line km).

The company is now moving into its next phase of exploration and is targeting a significant increase in the mineral resource by drilling out the Block 2 area which is split into Block 2a and Block 2b. Significant tonnages of material are expected from these areas based on Tsodilo's exploration target. The company anticipates a NI 43-101 MRE report following exploration at both Block 2a and Block 2b. The exploration priority is targeting high grade MBA like material, which is the higher grade material over 25% Fe and in Block 1 averaged 35,6% Fe.

Preliminary Economic Assessment

The above business cases and stages will be assed fully in the company's upcoming detailed Preliminary Economic Assessment (PEA) options study that will define all economic and engineering parameters as well as a roadmap for the development of the XIF asset. The PEA will evaluate a number of options for development of the project at a variety of scales including:

- non-traditional but potentially profitable small scale start-up mining production options such as Ferrosilicon (FeSi) production from a magnetite concentrate;
- mid-size scenarios, whereby magnetite concentrate would be processed through a concentrator and transported to railhead and onto port facilities; and
- large-scale mining options where full-scale mining would produce a magnetite concentrate processed by a concentrator plant with further potential modification to a pellet which would then be transported to port facilities.

The project would represent the first iron deposit to be considered for development in Botswana.

In May this year, Tsodilo initiated geochemical analysis for grade determination and geotechnical test-work for Rock Mass Rating evaluation for the PEA of the project.

As part of the analysis and test work, 755 samples from 10 drill holes within the XIF Block 2 area have been sent to ALS Chemex for analysis by element analysis by X-ray fluorescence using borate fusion beads and LOI by muffle furnace.

Additionally, 34 samples from seven drill holes representing the main XIF geological domains have been sent for geotechnical laboratory test-work assessment to the Department of Mining and Geological Engineering at the Botswana International University of Science and Technology (BIUST), where 18 samples will undergo unconfined compressive strength testing; eight samples will undergo Brazilian Tensile Strength (Brazilian Test) testing; and eight samples will undergo direct shear strength tests on a selection of common discontinuities.

These results will be important to the technical evaluation and economic understanding of the project and will be included in the PEA. A bankable feasibility study, says Jeffcoate, is expected in the next 24 months.

Beneficiation options

Tsodilo is also looking at further beneficiation of the product in Botswana, which is tipped to revamp the steel industry in the country. As part of the venture, the company has entered into a research collaboration endeavour with the Mining Centre at BIUST and Morupule Coal Mine (MCM) to undertake metallurgical studies with respect to the potential of generating a Pellet Feed and Direct Reduced Iron (DRI) product from the XIF utilising its magnetite and MCM's coal as a reductant. Commercially, the high-grade pellets and DRI product would be used to produce steel within Botswana, the region and internationally.

The business case for generating pellet feed, DRI products and low emission steel from the XIF magnetite is just one of the scenarios that are to be evaluated in the company's current PEA.

"We are looking at taking our magnetite product and use the coal that is readily available in Botswana to further beneficiate to a DRI (sponge iron). Botswana already has an existing electric arc furnace, which is currently not operational. The country is keen to see it operational again and our beneficiation strategy could kick-start the arc furnace again," says Jeffcoate.

"This extra level of beneficiation within Botswana will create added value and benefits in the form of increased revenue and employment for Botswana. This is just one scenario option among several that our PEA will evaluate. The PEA will be a roadmap for the development of the XIF towards production," concludes Jeffcoate. ■

Key takeaways

- In the Xaudum Iron Formation project, a potential Tier 1 mine that has a projected mine life of over 60 years, Botswana possibly has a game-changing project that will move the country away from its overreliance on diamond revenues
- Preliminary work on the project has defined a CIM compliant Inferred Mineral Resource Estimate of 441-million tonnes with an average grade of 29,4% Fe, 41% SiO2, 6,1% Al2O3 and 0,3% P for the Block 1 magnetite XIF
- However, Block 1 is a fraction of the potential XIF magnetite resource. An extrapolated exploration target has defined the XIF to be in the order of 5 to 7-billion tonnes at 15 – 40% Fe
- A resource of 5 – 7-billion tonnes would rank XIF deposit in the top 10 magnetite resources globally, and as the second largest in Africa