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Editor
Arthur Tassell

Advertising Manager
Bennie Venter
e-mail: benniev@crown.co.za

Design & Layout
Darryl James

Circulation
Karen Smith

Publisher
Karen Grant

Deputy Publisher
Wilhelm du Plessis

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Cover
Personnel from blasting sciences and manufacturing company BME preparing for a blast. For an interview with BME's MD, Joseph Keenan, see page 18 of this issue.

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wynand.smit@panalytical.com

Is mining making a comeback?

I think most readers will agree with me when I say that 2016 was one of the worst years for mining that we've ever seen. The big question is whether 2017 is going to be any better.

This is a difficult one to answer with so many geopolitical uncertainties around, most notably Brexit and the Trump Presidency. My impression though is that many companies involved in the mining sector ended 2016 in far better shape than they started it and are optimistic about prospects.

Admittedly, there is no big surge in new mine construction evident in Africa. Having said this, there are some very substantial projects underway which are providing a reasonably steady flow of work to companies servicing the African mining sector.

A case in point is the Gamsberg zinc project in the Northern Cape, which we cover in this issue. Although work on site has been ongoing for some time (the ground breaking was around 18 months ago), the project is only now moving into top gear. Vedanta announced in October last year that ELB Engineering had been appointed as EPCM contractor for the plant and in December that Aveng Moolmans would be undertaking the bulk mining.

In the platinum field and also in South Africa, Northam is pursuing its plus R4 billion Booysendal South project, which is expected to reach steady state by FY2022 – at which point it should be producing 240 000 oz/a 4E. Murray & Roberts Cementation has been awarded the Phase 1 contract for the establishment of the new mine, with the contract due to start in April this year.

The other big story locally in platinum is Ivanhoe's Platreef project near Mokopane, where Aveng Mining is now well into the sinking of Shaft 1. While this shaft – which will go down around a kilometre – is a substantial component of the overall project, the main production shaft is Shaft 2, which – with a depth of 1 250 m, a diameter of 10 m and a capacity of 6 Mt/a – will be a real monster. Shaft 2 is not too far off – the design has been completed and construction is due to start later this year.

Across border in Zimbabwe there is also good news with Zimplats (part of the Implats Group) having announced in late November approval of the US$264 million Mupani bord and pillar mine (Portal 6), which will replace the Rukozdi and Ngwarati mines.

Looking at other countries within the Southern African region, Botswana seems fairly quiet at the moment as do Namibia and Zambia. In Mozambique, however, construction of the Balama graphite mine (which we cover in this issue) is running at full tilt while Kenmare's Moma mineral sands mine is now operating at record levels and is contemplating an increase in mining capacity.

In the DRC there is considerable activity in the base metals field, much of it being generated by Ivanhoe at its Kamoa/Kakula and Kipushi projects. Kamoa/Kakula, of course, keeps getting better and better and now ranks as the biggest copper discovery ever made in Africa. Studies on the project are continuing but already there is considerable activity on site, with twin declines going in at Kamoa (at what Ivanhoe calls the Kansoko Sud mine).

Looking at gold, the Southern African scene remains subdued but West Africa – even though the spate of mine building in Burkina Faso is tailing off – is still enjoying something of a boom. In Ghana, for example, Asanko Gold is now moving into Phase 2A of its very successful Asanko gold project (see page 46), which is likely to benefit a number of South African companies, including DRA and ELB Engineering, while Gold Fields is investing US$1,4 billion at its Damang mine.

Mali – Africa's third biggest gold producer after South Africa and Ghana – is also ticking over nicely. B2Gold is well advanced with its substantial (plus 350 000 oz/a) Fekola mine, due to enter production by the end of this year, and Hummingbird has started construction of its Yanfolila mine, projected to produce 132 000 ounces of gold in its first full year of production.

Yet another big project underway in the West African region is the US$300 million Phase One expansion at Kinross Gold's Tasiast mine in Mauritania. This is reported to be progressing well. Major earthworks are now in progress, the first concrete has been poured for the crusher and mill foundations and commissioning is expected in the first half of next year.

Summing up, there is no sign that the mining industry is likely to re-attain any time soon – if ever – the high levels of activity that we saw back in 2006 and 2007 when the so-called resources 'supercycle' was in full swing. Nevertheless, there does seem to be enough work around to suggest that mining is heading for better times and that the worst of the recession is behind us.

Arthur Tassell

Many companies involved in the mining sector ended 2016 in far better shape than they started it and are optimistic about prospects.

Hummingbird appoints mining contractor for Yanfolila

A recent view of the Yanfolila site showing the start of construction operations. The first concrete pour was in October (photo: Hummingbird).

AIM-listed Hummingbird Resources has appointed African Mining Services (AMS), a subsidiary of ASX-listed Ausdrill Limited, as its mining contractor at the Yanfolila gold project in Mali, where mine construction is currently underway ahead of the first gold pour, expected to occur in late 2017.

Comments Dan Betts, CEO of Hummingbird Resources: "Appointing AMS as our mining contractor is another major milestone for Hummingbird and represents the single largest contract the company will award. AMS has an excellent reputation for high quality work with an exemplary health and safety record. The team also boasts over 25 years' experience operating in West Africa. I am delighted to embark on this partnership with AMS as we look forward to the commencement of mining at Yanfolila."

Hummingbird has appointed AMS for an initial three-year period with an option for the company to extend the contract by a further year of mining. The total value of the contract is expected to be approximately US$112 million over three years. The pricing represents a circa 5 % improvement for the company, as well as increased flexibility and transparency, when compared to Hummingbird's Definitive Feasibility Study (DFS), released in February 2016.

AMS anticipates incurring capital expenditure of approximately US$38 million for the acquisition of new equipment and says it will employ around 450 personnel (the majority of whom will be local) for this contract.

Mining operations at Yanfolila will be carried out using conventional drill-and-blast and load-and-haul mining methods from two deposits initially. Mining is due to commence in Q3 2017 with the first gold pour due by the end of Q4 2017.

Yanfolila is Hummingbird's most advanced asset. Some 132 000 oz gold is targeted for its first full year of production, which would deliver around US$70 million of free cash flow at a US$1 250/oz gold price. On its initial eight-year mine life, Yanfolila has an IRR of 60 % and an NPV of US$162 million at a US$1 250 gold price, making it – says Hummingbird – one of the highest margin undeveloped gold projects in Africa.

All in sustaining cash costs of US$695 per ounce place it in the lowest quartile of African producers, and well placed to operate profitably in a lower gold price environment. Yanfolila is fully funded to production and commitments to date represent nearly 30 % of the project capex. According to Hummingbird, the project is currently on budget and schedule.

There is also considerable upside at Yanfolila, with over 1 Moz of gold outside of the mine plan but within the permit as well as the Gonka deposit (5 km south of the Yanfolila plant), which – based on the desktop study undertaken by DRA Projects (as announced in February 2016) – can add a further US$24 million to the NPV alone.

Yanfolila is now reported to be a hive of activity with good progress being made on the ground. A few short months ago, only earthworks had been completed and now, with civil works underway, the project is on track for steelwork to begin in the coming weeks.

Hummingbird says that in December its executive team visited the factories in Europe which are presently constructing the ball mill and gearing and that its members were impressed by the excellent progress being made across all areas of this critical aspect of the plant development. ■

Articulated haulers and excavators at work at Yanfolila (photo: Hummingbird).

Pan African approves Elikhulu tailings project

Pan African Resources, listed on the JSE and AIM, announced in December positive results from the independent Definitive Feasibility Study (DFS) for its Elikhulu tailings project. As a consequence, the company's board of directors has approved the construction of the project, subject to finalisation of the project financing package.

Pan African says the DFS results indicate excellent recovered grades and gold production, attractive financial returns and a low execution risk, with the DFS results surpassing expectations of previous technical and financial assessments of the project. The DFS was undertaken by DRA Projects.

The planned commencement date of the project is January 2017, with first gold forecast for the final quarter of the 2018 calendar year and full commissioning in December 2018.

Annual recoverable gold production of approximately 56 000 ounces is projected for Elikhulu's initial eight years of operations and 45 000 ounces of gold for the remaining five years thereafter. Optimal plant capacity for the project allows 12 Mt/a throughput. Current arisings and inferred gold resources could extend project life beyond the DFS estimated life of 13 years. The projected AISC over the life of Elikhulu is US$523/oz.

Initial capital cost is forecast at approximately R1,74 billion (US$119,9 million). The internal rate of return (IRR) (real, post-tax) is 23,1 % with a payback period of less than four years, based on an assumed gold price of US$1 180/oz.

Pan African believes the experience gained in the construction and operation of the Barberton Tailings Retreatment Plant (BTRP) and the Evander Tailings Retreatment Plant (ETRP) positions it to successfully execute the construction and operation of Elikhulu.

The project entails establishing facilities and infrastructure at Evander Gold Mining, owned and operated by Pan African, to retreat gold plant tailings at a rate of 1 Mt/month. This is in addition to the existing production from the ETRP which will continue to operate independently for the next 13 years.

Three existing tailings storage facilities will be reclaimed, in the following order: Kinross, Leslie and Winkelhaak. Post processing, these will be consolidated into a single enlarged Kinross tailings facility, contributing to reducing Evander's environmental footprint and associated environmental impact.

Comments Cobus Loots, Pan African's CEO: "We are pleased to announce the positive findings of the independent Definitive Feasibility Study. Operating low-cost tailings plants has become an important business for Pan African in recent years, and we now intend to proceed with construction of the Elikhulu tailings retreatment project. This project is expected to materially enhance our Group's production profile and support Pan African's continued focus on low-cost, high-margin gold ounces. The substantial capital investment required demonstrates our commitment to the South African mineral sector and our shared responsibility of creating employment and alleviating poverty in the Evander community.

"Our primary consideration in any capital allocation decision is our ability to successfully execute the designated project and to generate the required returns over the investment horizon. The attractive returns already being earned on the capital invested in the BTRP and ETRP bear testimony to our previous success and will serve as invaluable experience in completing the project.

"Elikhulu is expected to firmly establish Pan African as a leader in long-life, low-cost tailings retreatment, and possibly unlock other opportunities in the sector. We expect the project to reduce the Group and Evander cost profiles and generate robust cash flows and attractive returns for our shareholders." ■

Mineral Reserve Estimation – All Probable			
TSF Name	**Tonnes (Mt)**	**Au (g/t)**	**Au (Moz)**
Kinross	47,0	0,31	0,47
Bracken/Leslie	70,1	0,32	0,71
Winkelhaak	70,0	0,24	0,55
Total	**187,1**	**0,29**	**1,73**

Scoping study completed on Lindi Jumbo

Emerging African graphite producer Walkabout Resources, listed on the ASX, has announced the results of a scoping study for a proposed open-pit mine and graphite processing plant at the 70 % held Lindi Jumbo graphite project in south-eastern Tanzania. Project economics are highly robust as a result of the high grade nature of the project and the expected premium natural flake graphite product, says the company.

The base case employed during the scoping study was for the development of a mining and processing operation at Lindi Jumbo to produce an annual output of 25 000 tonnes per annum of four discrete products of graphite concentrate for sale FOB from the Port of Mtwara. Such a level of production would entail the milling of only 3 Mt over the 20-year life of mine, an average of only 150 000 tonnes per annum (12 500 tonnes per month).

Although the project will potentially deliver a sought-after premium product with up to 85 % of the flake graphite in concentrate above 180 µm, the basket price used in the scoping study is up to 33 % less than prices used in bankable feasibility studies conducted by other ASX companies developing graphite projects in Africa.

The upside case model considered the increase of the initial production rate to 40 000 tonnes of graphite in concentrate per annum. The difference in processing capacity has already been built into the plant design and equipment sizing as a redundancy so minimal additional capital would be employed. This model has also been estimated in capex, working cost and life of mine production to an accuracy level of cost of ±25 %. Mining production rates are increased to 260 000 tonnes per annum or a very modest 21 500 tonnes per month.

Key study outcomes include an operating cost per tonne in concentrate estimated at US$290 to US$350 and a pre-production capex of approximately US$35 million to US$40 million with a payback period of less than two years.

The base case pre-tax NPV_{10} is estimated to be US$169 million for the 25 kt/a production option and US$304 million for the 40 kt/a production option. The pre-tax IRR estimate is 63 % for the base case and 97 % for the upside case. ■

Redpath Mining wins Maseve Block 11 contract

The new US$500 million Maseve platinum mine. It is located near Sun City on the Western Limb of the Bushveld Complex (photo: Platinum Group).

In its operating and financial results for the three months ended November 30, 2016, Platinum Group Metals, listed on the TSX and NYSE MKT, reports that it is currently focused on development and stoping in the best grade thickness areas in Block 11 of the Maseve mine in the Western Bushveld, which was accessed and opened for mining late in calendar 2016. Block 11 is modelled to be flat dipping with good grade and thickness and is the most important block to the near-term mine plan.

Redpath Mining South Africa, a subsidiary of Canadian headquartered Redpath Mining Contractors and Engineers, recently won the tender to provide bord and pillar mining, hybrid mechanised mining and ore transport from Block 11. Since June 2016 Redpath has been providing efficient long hole mining services in Blocks 9 and 12 of the Maseve mine, says Platinum Group. The changeover to Redpath as the principal mining contractor at Maseve was undertaken with affected parties during the latter part of the first fiscal quarter ended November 30, 2016 and into early January 2017. The operational and administrative changeover is now well advanced.

Redpath has also entered into a letter of intent whereby it will install, operate and maintain a 1,0 km conveyor towards Block 11, linking into underground silos and the existing 1,4 km conveyor to surface and the 1,7 km conveyor system into the mill. The cost for the conveyor installation – estimated at R25 million – will be borne by Redpath which will recoup its investment by way of a per tonne charge now being negotiated. Redpath has also added four units to the trucking fleet on a rental basis to ensure efficient ore transport.

Comments R. Michael Jones, CEO of Platinum Group Metals: "We are pleased that after working with us on the mining of some of our smaller blocks, Redpath has won the tender to mine Block 11 and will become an important partner in the Maseve mine ramp up. Redpath will continue with mining in Blocks 9 and 12 and will take over ore transport for these blocks from the previous development contractor. Redpath is also scheduled to set up for mining in Block 16 early in 2017.

"Redpath has demonstrated excellent leadership skills with a commitment to safety and a disciplined and open approach. The engagement with Redpath is a win-win collaboration that demonstrates confidence in the potential at the Maseve mine from a well-regarded global mining contractor. The more tonnes mined from Block 11, the better both Redpath and the company will do. We see Redpath as an excellent partner."

During December 2016, Block 11 began to produce mined tonnes, contributing approximately 21,3 % (8 388 tonnes) of mined ore flow to monthly production. Double decline access and through ventilation to Block 11 was completed in late December 2016. Now that infrastructure is coming on line where needed, and with contractor changeover being undertaken, Block 11 is scheduled to contribute approximately 50 % (30 000 tonnes) to mined ore flow in January 2017.

Mining rates in the second half of January 2017 and in the months ahead are scheduled to continue improving as Block 11 is further developed. During 2017 Block 11 is scheduled to build up to 70-80 % of mined ore flow. At full production Block 11 is planned to provide up to 76 000 tonnes of ore a month. ■

The Maseve processing facility. According to Platinum Group, it has a proven performance of 125 kt/month (photo: Platinum Group).

The Kipoi copper project in Katanga (photo: Tiger Resources).

Tiger meets revised guidance for Kipoi

ASX-listed Tiger Resources reports it has achieved production of 23 119 tonnes of copper cathode at its Kipoi copper project in the DRC during 2016, within the revised 2016 guidance range of 23 000 to 23 600 tonnes.

Reinforcement of the Intermediate Leach Solution (ILS) pond has been completed, allowing production to be resumed at nameplate operating levels. As previously reported, the company plans to construct a new ILS pond after the end of the wet season.

The debottlenecking capital works programme to expand the Kipoi plant's nameplate production capacity to 32 500 t/a has also now been completed.

The coffer dam, a smaller dam contained within the larger dam which comprises the new Tailings Storage Facility (TSF-3), has been commissioned. This provides sufficient capacity to allow full production through the new tank leach (TL) facility for the duration of the wet season. Laying of the HDPE liner to the larger TSF-3 dam surface has been deferred until the dry season, says Tiger.

Commissioning of the TL facility is underway. Sufficient slimes material – being the copper-bearing residues contained in the existing TSF-1 – have been recovered to support tank leach production through the remainder of the wet season.

Tiger also reports it has received approval for and completed the drawdown of the remaining funds available under the US$162,5 million facility provided by the lender group of Taurus Mining Finance Fund, Resource Capital Fund VI LP and the International Finance Corporation (a member of the World Bank).

The Kipoi project is operated by SEK (Société d'Exploitation de Kipoi), a 95 %-owned subsidiary of Tiger, and is located 75 km north-west of Lubumbashi, the capital of Katanga Province, in the central part of the Katanga Copperbelt. The Kipoi mining licence covers an area of 55 km^2 and contains a 12 km-long extensively copper-cobalt mineralised segment (ecaille) of Upper Roan (R2, R4) sediments. The project hosts five known copper deposits: Kipoi Central, Kipoi North, Kileba, Judeira and Kaminafitwe.

Tiger has adopted a staged development approach at Kipoi. The high-grade zone of copper mineralisation at Kipoi Central was exploited during the Stage 1 development, in which a heavy media separation (HMS) plant was in operation from 2011 to late 2014. Tiger commenced copper cathode production at Kipoi via an SX/EW plant in May 2014 as Stage 2 of operations. ■

Ivanhoe completes positive PEA for development of Kakula

Geotechnical drilling at the planned Kakula boxcut location. Approximate direction of the planned access tunnels shown (photo: Ivanhoe).

Ivanhoe Mines Executive Chairman Robert Friedland and Chief Executive Officer Lars-Eric Johansson have welcomed the positive findings of an independent PEA for the development of the Kakula deposit at the Kamoa-Kakula project in Katanga in the DRC.

The project – a joint venture between Ivanhoe Mines, Zijin Mining Group and the government of the DRC – has been independently ranked as the world's largest high-grade copper discovery by international mining consultant Wood Mackenzie.

The Kakula 2016 PEA was independently prepared by OreWin Pty Ltd, Amec Foster Wheeler E&C Services Inc and SRK Consulting Inc. (The same team of consulting engineers was involved in planning the development of the Oyu Tolgoi project in Mongolia.)

The PEA assesses the planned first phase of development of the Kakula deposit – a discovery that was announced in January last year – as a 4 Mt/a underground mining and processing complex that would be known as the Kakula Phase 1 Mine at the Kamoa-Kakula project.

Incorporated within the PEA is an option for an integrated, 8 Mt/a, two-stage development scenario involving an initial mining operation at the Kakula deposit and a subsequent, separate mining operation at the Kansoko Sud and Kansoko Centrale areas of the adjacent Kamoa deposit, discovered in 2008, which would be known as the Kansoko Mine.

Ivanhoe Mines and Zijin Mining are continuing with the drilling programe in and around the Kakula deposit area, using six drill rigs, to expand the extent of the known mineralisation and support potential upgrades in resource confidence categories. Ivanhoe Mines expects an updated resource estimate for the Kakula deposit to be issued in the first quarter of 2017. In addition, a pre-feasibility study is also underway to enhance the findings of the Kakula 2016 PEA and to advance the project toward production.

According to the PEA, the initial Kakula Phase 1 Mine is projected to have a grade of 8,1 % copper in year two and an average grade of 7,52 % copper over the initial five years of operations, resulting in estimated average annual copper production of 209 000 tonnes. Peak annual copper production is estimated at 262 000 tonnes in year three.

The initial capital cost, including contingency, is estimated at US$1,0 billion, approximately US$200 million lower than previously estimated in the March 2016 Kamoa pre-feasibility study.

The average mine-site cash cost is estimated at US$0,37/lb of copper during the first 10 years. The study puts the after-tax NPV, at an 8 % discount rate, at US$3,7 billion, an increase of 272 % compared to the after-tax NPV, at an 8 % discount rate, of US$986 million estimated in the March 2016 Kamoa pre-feasibility study. The after-tax internal rate of return (IRR) is projected to be 38,0 %, which is more than double the IRR of the 2016 Kamoa pre-feasibility study.

Kakula is expected to produce a very-high-grade copper concentrate in excess of 50 % copper, with extremely low arsenic levels.

A subsequent PEA is now underway to examine a doubling of the proposed mining rate at the Kakula Phase 1 Mine to 8 Mt/a. This next PEA is expected to be released in early 2017.

Michael Gray, Ivanhoe Mines' senior mining advisor and former President and co-founder of McIntosh Engineering, will assist with the expansion studies for the Kamoa-Kakula project. He has extensive experience in underground mine development and has previously worked on major projects such as San Manuel (BHP), Grasberg (Freeport Indonesia), Bingham Canyon (Rio Tinto), El Teniente (Codelco), Olympic Dam (BHP Billiton) and Oyu Tolgoi (the original Ivanhoe Mines).

Given the extremely high copper grades

Delivery of a new Dando deep-drill rig for exploration of the Kakula discovery area (photo: Ivanhoe).

and bottom-loaded nature of the mineralisation at the Kakula deposit, Ivanhoe Mines expects that the results of having a single 8 Mt/a mine at the Kakula deposit will be even better than the results of an integrated 8 Mt/a, two-stage, two-mine development scenario.

The project engineering team is targeting a life-of-mine average annual copper production scenario for a single 8 Mt/a mine at Kakula in excess of 400 000 tonnes per annum. Given that the initial capital costs for the two options examined in the Kakula 2016 PEA are the same at US$1,0 billion, it can be expected that an expansion to 8 Mt/a also will have essentially unchanged initial capital costs and, in particular, given that the expansion could then be funded from future cash flows.

Additional expansion studies are planned for 2017 in which the project engineering team will assess higher mining rates of up to 16 Mt/a, incorporating high-grade copper mineralisation from both the Kakula deposit and the Kansoko Sud and Kansoko Centrale areas of the Kamoa deposit.

Continuing strategic discussions concerning Ivanhoe Mines and its projects are intensifying with several significant mining companies and investors across Asia, Europe, Africa and elsewhere. Several investors that have expressed interest have no material limit on the provision of capital.

"Kamoa-Kakula is an incredibly disruptive, district-scale, Tier-One copper project that is still in its early days of discovery and development," said Friedland. "Kakula's high copper grades and thicknesses establish Kamoa-Kakula as the most remarkable and rapidly-growing mineral discovery with which I've been associated during my 30-plus years in the exploration business.

"We've already discovered as much copper in measured and indicated resources as we found with the original Ivanhoe Mines at Oyu Tolgoi, in Mongolia's South Gobi – but this time at much higher grades. Significantly, both the Kamoa and Kakula discoveries are open for future expansions. We remain focused on expediting development of Kamoa and Kakula." ■

Restart at chrome mine

JSE-listed Bauba has announced that chrome mining has resumed at its Moeijelijk mine on the Eastern Limb of the Bushveld Complex.

The mine was placed under care and maintenance in January 2016 as a result of the adverse changes in the chrome ore market, and more specifically the drop in the chrome-ore price from US$175 per tonne to approximately US$120 per tonne, thereby rendering the chrome project financially unviable. The chrome-ore price has subsequently rebounded from last year's low of US$80 per tonne.

The build up to the planned production of 20 000 tonnes of chrome-ore per month is expected to be achieved within the following three months, with the chrome grade expected to be between 39 % and 41 %.

"From a difficult position in 2016, Bauba has, having wisely preserved its chrome-ore reserves for more favourable prices, come into a stronger position and is well positioned to capitalise on these improved prices" says Bauba's CEO, Nick van der Hoven. ■

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The central shaft site at Blanket as it was early last year. Shaft sinking reached a depth of 534 m by the end of 2016 (photo: Caledonia).

Blanket production at an all-time high

Caledonia Mining Corporation has announced record quarterly and annual gold production from its 49 per cent owned subsidiary, the Blanket Gold Mine, located near Gwanda in Zimbabwe, for the quarter and year ended 31 December, 2016. Approximately 13 591 ounces of gold were produced during Q4 2016, a new quarterly production record representing an 18 per cent increase on the gold produced in Q4 2015 (11 515 ounces) and a 1,2 % increase on the gold produced in Q3 2016 (13 428 ounces).

Total 2016 gold production was approximately 50 351 ounces, a new annual production record representing a 17,6 % increase over the annual gold production in 2015 of 42 804 ounces.

Target gold production for 2017 is approximately 60 000 ounces at an estimated on-mine cost in the range of U$600 to US$630 per ounce and an All-in Sustaining Cost in the range of US$810 to US$850 per ounce. Blanket remains on track to increase annual production to approximately 80 000 ounces of gold by 2021.

"2016 was a significant year for Caledonia as the continued investment at Blanket begins to bear fruit," comments Caledonia's CEO, Steve Curtis. "Gold production in 2016 of 50 351 ounces surpassed the previous record from underground operations of 45 530 ounces, which was achieved in 2013. The record level of production was due to the commencement of production below 750 m following the successful completion of the No 6 Winze and other infrastructure projects, improved underground infrastructure and the installation of the new ball mill late in 2016.

"As well as achieving this record gold production level, the sinking of the new central shaft continued according to plan and reached a depth of 534 m by year end." ■

Vector Resources acquires Maniema gold project

Australia's Vector Resources has successfully completed its acquisition of a substantial interest in the Maniema gold project located in the DRC's Maniema Province.

Commenting on the acquisition, Vector's Chairman, Gary Castledine, said, "We are pleased that we have been able to move so efficiently to complete the acquisition of our 70 % interest in the Maniema gold project.

"With the acquisition now completed, our shareholders now have a majority interest in an advanced gold project that includes the Kabotshome gold prospect and a further four defined gold prospects, within seven exploration licences located within one of the world's most highly prospective gold mining regions.

"The Maniema project is in a region that has attracted significant investment in gold exploration, with established gold mining operations such as Randgold Resources' and AngloGold Ashanti's Kibali gold mine in the Kilo-Moto belt to the north and Banro Corp's Namoya and Twangiza gold mines within the Twangiza-Namoya belt immediately to the east of us. We have also seen the success of ASX-listed gold exploration company Burey Gold to the north and Resolute Mining's recent investment in the country too."

The project is located 260 km south-west of the town of Bukavu in the Twangiza-Namoya Belt, in the northern part of the Kibara belt. The Kibara belt contains a wide variety of deposits, comprising typically shear-related granophile elements. ■

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Alecto plans acquisition of Mowana copper mine

Alecto Minerals, listed on AIM, has announced the proposed acquisition of Cradle Arc Investments, a company incorporated in Botswana, which owns the Mowana copper mine in north-eastern Botswana. In terms of the transaction, Alecto will acquire a 60 % interest in Mowana, whose infrastructure includes a processing plant which – it is anticipated – can be brought back into production at a relatively low cost.

An offtake financing agreement has been agreed by Cradle for US$20 million which will provide funding for investment in the mine and the plant in order to increase recoveries.

Mowana has a mineral resource inventory of 683 000 tonnes copper (Cu) in the measured and indicated categories (JORC-code compliant) with an additional 945 000 tonnes Cu in the inferred category.

The mine was commissioned in 2008 at a cost of US$60 million. It operated successfully as an open-pit operation between 2008 and 2015 processing an average of 775 406 t/a of ore at an average grade of 1,72 % copper. In FY2013/14 Mowana produced 43 301 tonnes of concentrate, representing 9 724 tonnes of Cu.

Alecto and its partners in the proposed transaction have re-modelled the mine to ensure that it can produce from a much lower cost base to generate profit even at depressed commodity prices. At a copper price of US$2,50 per lb, Alecto's internal estimate for the project's NPV is US$245 million.

Alecto intends to perform process route upgrades including the installation of a Dense Media Separation (DMS) plant to increase throughput from 1,2 Mt/a to 2,6 Mt/a to achieve an average copper production of 22 000 tonnes saleable Cu per annum.

The process route upgrades, which are expected to cost US$20 million, will be funded through an agreement with Fujax Minerals and Energy Limited and Northern Heavy Industries Group Company Limited.

Alecto has agreed a 10-year management contract for Mowana with its partners and will receive management fees equal to 1,5 % of revenue.

Mark Jones, CEO of Alecto Minerals, commented: "Mowana is a first class copper mining project and I am very excited about the prospect of bringing it into Alecto's portfolio. The proposed acquisition of Mowana will be transformational for Alecto, turning the Group into a producing miner and materially strengthening its balance sheet.

"I very much look forward to effectively completing our transformation from a greenfield exploration company into a multi-commodity metals producer in Africa in the coming months, and the team has conducted significant work to ensure that this is achievable. Our technical team has worked tirelessly to generate a robust business model that will target early cash flow from both the profitable mining of copper and the management of the operation.

"Additionally, our commercial team has secured commitments for funding, so that we can realise the maximum value from copper production and quickly initiate plant improvements at Mowana that are expected to deliver substantial production efficiencies."

The Mowana plant uses standard flotation process technology and has been designed to produce saleable copper concentrates from the treatment of oxide, supergene and sulphide ores.

Alecto currently has gold projects in Zambia (where it owns the historic Matala and Dunrobin gold mines), Mali and Burkina Faso.

Senior appointments by Asa Resource Group

AIM-listed, Zimbabwean-focused Asa Resource Group (formerly Mwana Africa) has announced that Toi Muganyi, currently Managing Director at Freda Rebecca Gold Mine, will become the Group's new Chief Operating Officer and Batirai Manhando, currently Managing Director at Bindura Nickel Corp (BNC), will become the Group's Chief Technical Officer.

"These appointments are significant in that they strengthen the executive's mining and technical expertise at the Group level," comments David Murangari, non-Executive Chairman of the Group. "They will both work closely with Mr Ning (CEO) and Mr Kwan (Group Finance Director) to ensure the success of our key operations in Zimbabwe.

"In addition to this management review and as part of the Group's ongoing corporate consolidation, the functions that were being carried out at our offices in Johannesburg and Harare will now be combined into one integrated team at the newly formed Asa Complex at Bindura. These developments underpin our commitment to the town of Bindura and the important emphasis we place on the ongoing success of our two key operating mines in Zimbabwe.

"To complete our plans at the corporate level and to integrate executive functions with key mine operations, I can confirm that the board will hold at least two of its quarterly board meetings in Bindura each year."

Bushveld Minerals to acquire interest in Uis tin project

Bushveld Minerals Limited, a diversified AIM-quoted mineral development company with projects in South Africa and Madagascar, has announced that it has agreed terms to acquire a significant interest in the Uis tin project through its wholly owned subsidiary, Greenhills Resources Limited. Under the agreement, Greenhills Resources will acquire a 49 % interest in Dawnmin Africa Investments Ltd, which is the 85 % owner of the project, subject to due diligence.

The Uis tin project has a history of significant tin mining. It is located in the Erongo Region of Namibia and comprises three mining licences, ML 134, ML 129 (B1 and C1) and ML 133. Historic work confirmed a significant tin resource on all three licences, the most significant of which is the ML 134 resource estimated at 70,3 Mt at 0,14 % Sn for a total potential resource of over 90 kt of contained tin.

Greenhills Resources, Bushveld's tin platform, was established to develop a pan-African portfolio of tin assets with a near term production profile. Included in the company's assets are the Mokopane tin project in South Africa.

Fortune Mojapelo, CEO of Bushveld Minerals, commented: "The completion of the potential acquisition would see Bushveld Minerals acquire a substantial interest in one of the largest undeveloped opencast hard rock tin deposits in the world, positioning Greenhills Resources as one of the most significant tin platforms on AIM.

"This development is aligned with our long-stated strategy to establish Greenhills Resources Limited and Lemur Resources Limited as attractive stand-alone platforms with quality strategic partners and strong dedicated management teams to deliver long term shareholder value. For Greenhills this means consolidating a critical mass of mineable, low-cost resources with a near term production profile while for Lemur this means securing a quality power purchase agreement and an IPP licence for a thermal coal-based power generation play in Madagascar.

"All this while the company continues to progress its flagship vanadium platform and progress towards completing the Vametco Alloys (Pty) acquisition." ■

Kisenge Mining exercises its option to form Mpokoto JV

Armadale, the AIM-quoted investment company focused on natural resource projects in Africa, reports that Kisenge Mining Pty Ltd (KMP), formerly known as African Mining Services (AMS), has completed due diligence and exercised its option to form a joint venture with Armadale to develop and operate the Mpokoto gold project in Katanga Province in the DRC.

Phase I of the joint venture agreement will enable KMP to earn a 25 % interest in Armadale's subsidiary, Kisenge Limited (Kisenge), the joint venture entity. It will achieve this by providing funding and projected related services up to US$1,25 million, including incremental metallurgical test-work, refining the current Definitive Feasibility Study (DFS) to incorporate financing the project and initial capital works.

Upon completion of Phase I, KMP has 30 days to decide whether to exercise an option to proceed with Phase II of the joint venture agreement. If KMP proceeds with Phase II, it will seek to arrange funding to put Mpokoto into production. If KMP successfully arranges 100 % of the funding, it will receive a further 60 % in Kisenge (lifting its aggregate interest to 85 %).

Comments William Frewen, Chairman of Armadale: "Mpokoto has an established resource of 678 000 oz of gold at 1,45 g/t Au and has completed a DFS based on a production rate of circa 25 000 oz annually over an initial four-year mine life for the first phase of mining. With attractive economics and a defined route to production, we are confident that the project offers significant potential and we are pleased that the completion of KMP's due diligence has led to the commencement of Phase I of the joint venture agreement."

Results from the DFS, announced in February 2016, set out various parameters for Mpokoto, identifying phased processing routes for the project to support low capex development. Phase 1 concentrates on the shallower oxide portion of the resource. This will be prioritised for exploitation in advance of the deeper unweathered sulphide ore designated for Phase II. ■

Tantalite mine achieves commercial production level

Kennedy Ventures, the AIM-quoted investment company which has an interest in the Tantalite Valley Mine (TVM) in Namibia through its stake in African Tantalum (Aftan), has announced that it has been informed by Aftan that TVM is now at a commercial production level. This is a result of the upgrade of plant equipment and reorganisation of modules at the Homestead project.

In addition, Aftan has informed Kennedy that its first shipment, containing 1,6 tons of tantalite concentrate, has been delivered to its offtake partner on schedule. Shipments are expected to take place twice per month going forward.

Aftan has also confirmed that the plant upgrade programme is now in its final stages, with the installation of a milling circuit underway, which was forecast to be complete in December 2016. This is predicted to increase the recovery of fine tantalite. Upon completion of this phase, TVM is expected to be cash flow positive.

Furthermore, Aftan has progressed with its assessment of the potential value of the lepidolite lithium deposit, with both the geological and metallurgical test studies advancing as expected. The completion of an upgrade to the processing plant in the form of an additional flotation circuit, enabling the processing of the lithium bearing ores, is scheduled for Q1 2017. This feature will enable the removal of mica to create a lithium-rich concentrate, which would provide a potential entrance into the lithium market for Aftan.

Renier Swiegers, General Manager of TVM, said: "The plant upgrade programme continues to progress on schedule and I am delighted that the tantalite shipments have now recommenced. Full commercial production at the increased rate of 15 000 tonnes per month is on course to begin in Q2 2017, and all those involved are working relentlessly to achieve this target." ■

Fluor awarded FEED contract for Colluli

Fluor Corporation has been awarded a front-end engineering, design and optimisation (FEED) contract by ASX-listed Danakali for the Colluli potash project in Eritrea following a competitive tendering process initiated and completed in 2016.

"Fluor will provide a highly qualified design and optimisation team with world-class process infrastructure credentials for this important fertiliser project," said Rick Koumouris, President of Fluor's Mining & Metals business. "In addition to working with Danakali to maximise project capital efficiency during the study and execution phases of this project, Fluor will bring top-notch project financing expertise and assistance to help Danakali advance this project to the next phase."

"We are delighted to be working with Fluor as we progress the Colluli project," said Paul Donaldson, MD of Danakali. "The combination of Fluor's values, people, reputation, optimisation approach, mining and metals expertise, experience in Africa, and potash-specific experience will benefit the project significantly as it progresses towards construction."

Colluli is one of the most advanced greenfield sulphate of potash developments in the world and reportedly demonstrates outstanding economics including industry leading capital intensity, bottom quartile operating costs, close proximity to the coast and key markets, and unrivalled product diversification potential. Sulphate of potash is a high quality potash fertiliser used for farming crop development and yield maximisation around the globe.

The Colluli deposit is located in the Danakil region of Eritrea. It is approximately 177 km south-east of the capital, Asmara, and 180 km from the port of Massawa (230 km by road), which is Eritrea's key import-export entry.

Danakali is the 50 % owner of Colluli and is developing the project in partnership with the Eritrean National Mining Company (ENAMCO). ■

Orion Gold acquires Agama Exploration

ASX-listed Orion Gold has exercised its option to acquire Agama Exploration & Mining (Pty) Ltd which, through its subsidiary companies, ultimately holds an effective 73,33 % interest in the company holding prospecting rights over the historic Prieska Copper Mine (PC), located at Copperton in Northern Cape Province, and the Marydale gold-copper project, a volcanogenic gold-copper discovery located 60 km from PC.

In July 2015, Orion announced the signing of a binding term sheet giving it the right to acquire Agama. During the option period, Orion undertook a comprehensive due diligence including conducting exploration programmes at both the PC and Marydale projects.

In recent months, the company has announced very encouraging exploration results from the +105 Level Target (open pit) at the Prieska zinc-copper project. Orion says that 3D modelling of the mineralised zone intersected in drilling is now underway with the objective of producing mineral resources compliant with the JORC Code (2012) in early 2017 and feeding these resource estimates into a Pre-Feasibility Study with a target completion date of mid-2017. To aid these studies, a large diameter diamond core hole is being drilled to provide material for metallurgical testwork. ■

BME grows its overseas footprint

Explosives supplier BME, part of the plus R16 billion-a-year, JSE-listed Omnia Group, is continuing to operate profitably despite tough conditions in the mining sector. While Africa remains the focus for BME, it is expanding steadily into overseas markets, the latest being Colombia in South America. BME's MD, Joseph Keenan, says the globalisation of BME's activities is just one of a range of initiatives designed to allow BME to continue on the uninterrupted growth path – in terms of revenues – it has experienced in recent years.

Joseph Keenan, Managing Director of BME.

Keenan, a Canadian who took over at BME in September 2015, is emphatic that the company needs to broaden its geographic base. "BME was originally established in South Africa more than 30 years ago and has since steadily expanded into Africa – to the point where we're now a major player across the continent, with a particularly strong presence in the SADC region and West Africa," he says. "In respect of overseas markets, we already have a presence in some regions – including a joint venture in Australia – but we will now focus on growing this footprint even further."

BME is pioneering the use of technologies such as unmanned aerial vehicles, GPS and 3D photogrammetry to improve blast design.

He adds that BME will initially focus on marketing its AXXIS® electronic detonator system in overseas markets. "This provides an entry point for us. The ultimate goal, however, will be to leverage off the sale and support of electronic detonators to become a full service provider, just as we are here in Africa. Already we are supplying emulsion explosives to the Indonesian coal mining industry and, based on this experience, it is very clear that we can operate very successfully as a bulk explosives supplier in overseas markets."

A few months ago BME attempted to expand into Canada by purchasing Nordex Explosives. "Our bid was not successful but the exercise has proven very valuable inasmuch as we've now identified other potential partners," notes Keenan. "We like the Canadian market. It's healthy and the mining culture and technologies are similar to South Africa, so we believe it holds excellent potential for us."

As regards Colombia, Keenan says BME now has a contract in place with a parastatal which supplies the country's mines. "Colombia is one of the biggest markets in the world for electronic detonators. We went through an evaluation process with the parastatal and major mining operations in respect of our AXXIS system and they were impressed by its performance. They

looked at – and evaluated – other systems but chose ours based on its capabilities, its high level of safety and its competitive price."

Keenan notes that AXXIS's abilities were well demonstrated in early 2016, when Daunia coal mine in Queensland, Australia broke the world record for the largest electronic detonator blast ever. The blast saw 5 665 detonators in 2 683 blastholes being fired using the AXXIS system. The blast was prepared and carried out by Daunia mine staff using a single initiation point and one master control box. To design the blast, the Daunia team made use of BME's blast design software, BlastMap III, which was developed as an integral part of the AXXIS system and which allows complex timing designs and analysis of blast results.

The AXXIS system has also been used in Singapore to allow high precision, minimum vibration blasting in a built-up area as part of the work on the city's mass rapid transport rail system. The timing flexibility of the system has supported the detonation of small, multiple charges in each blasthole to keep vibration levels down while the accuracy of the timing between individual charges has allowed vibrations to be predicted accurately and reliably.

Turning to BME's overall performance in recent months, Keenan says there is no denying that market conditions are challenging. "Nevertheless, BME has proved its resilience," he says. "If you look at the results for Omnia Holdings for the six months ended 30 September, 2016, the Mining division – which comprises BME and Protea Mining Chemicals – grew revenue by 9,3 % to R2,45 billion, although profitability was down by 8,2 %.

"We're positive on the outlook," he continues. "Obviously, there are uncertainties surrounding Brexit in the UK and the election of a new President in the US but the commodity cycle is showing signs of improvement. If you look at iron ore, manganese and copper, they've all increased quite nicely in price although they're still way off their highs. Also encouraging is the increase in exploration activity – in particular, diamond drilling – we're seeing in Africa, which normally presages an upturn in mining activity.

"Geographically, the South African market is still subdued but there's a high level of mining activity in West Africa, notably in gold, while the Zambian Copperbelt, where we have secured a significant new contract at an opencast mine, is also looking good, as is the DRC."

An aerial view from a camera mounted to a small unmanned aerial vehicle (UAV) clearly showing the hole positions in the drill pattern.

BME has traditionally derived the major part of its revenues from opencast mining, in which it is arguably the market leader, but Keenan notes that its efforts to increase its sales to underground mines are starting to bear fruit.

"Our underground bulk technology has really progressed," he observes. "We've

Operator filling an emulsion bag for BME's portable emulsion charging unit.

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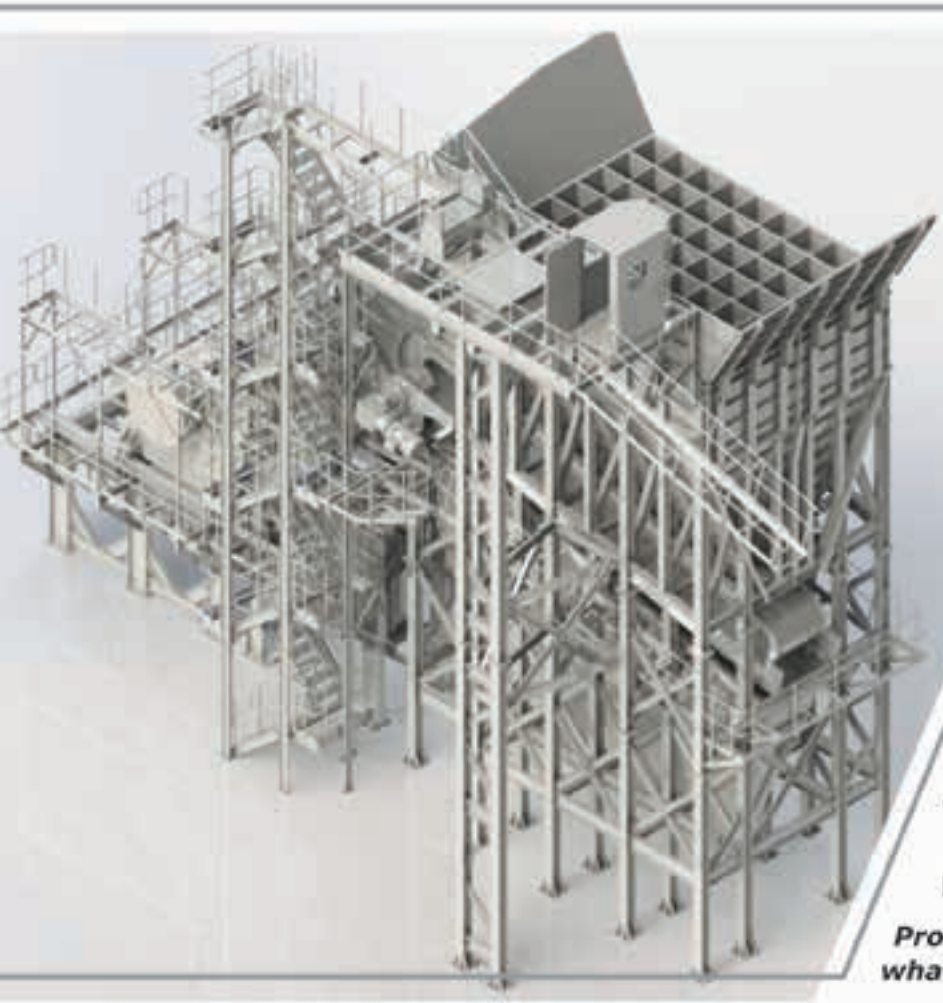

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developed and introduced our underground mobile pumping system, which brings the benefits of emulsion blasting to the narrow reef environments typically encountered in gold and platinum mines, and we're also trialling the AXXIS Central Blasting System (CBS) for underground mines, which has already been licensed for use. The result is that we are growing our underground business considerably despite the poor market conditions."

Keenan also points to the success BME has had at Gold One's Modder East underground gold mine on the East Rand, where it has commissioned the world's longest drop – 318 m – rapid re-loading emulsion system. "We're extremely proud of this project which has involved three years of very hard work by the client and BME," he says. "No one else has yet been able to match what we've achieved and we're now talking to other potential customers who have expressed an interest in implementing similar systems."

A view from a multi-copter of a blast in preparation.

Still on the subject of innovation, BME is not neglecting the ubiquitous smart phones and tablets that are vital business tools all over the world but especially in Africa, where in many countries they are often the business platforms of choice.

"We have a dedicated group working on digital technologies for the mining industry and already we developed a number of apps," Keenan says. "They can perform a variety of transactional and operational tasks. One, for example, is known as Blastlog Reporter and allows mine-related data to be stored and presented according to what the user requires. There is an entire generation coming through into business that has been brought up with mobile phone technology and we need to address the needs of this demographic if we want to remain an industry leader."

He adds that BME's innovations were highlighted at its recent drilling and blasting conference in Pretoria, now in its 24th year. The event attracted over 450 delegates from 15 countries and was considered a great success by BME.

"The conference gave me the opportunity to engage with customers from around the world. The feedback I received was that they appreciate BME's responsiveness and its willingness to listen to their concerns. This is something that I believe distinguishes BME in the marketplace. We see ourselves as being in partnership with our customers and we are always willing to work with them to make their operations more productive – as indeed we've done with Gold One at Modder East," he says.

Moving to the manufacturing side of BME's operations, Keenan discloses that the company has put considerable effort into increasing productivity at its plants and cutting costs. "We're now starting to benefit from the investments we've made into our manufacturing capabilities. Our new emulsion plant at Delmas is world-class while the installation of a new automated production facility for our non-electronic detonators has resulted in an overall increase in the quality and performance of these units, which has translated into better sales," he says.

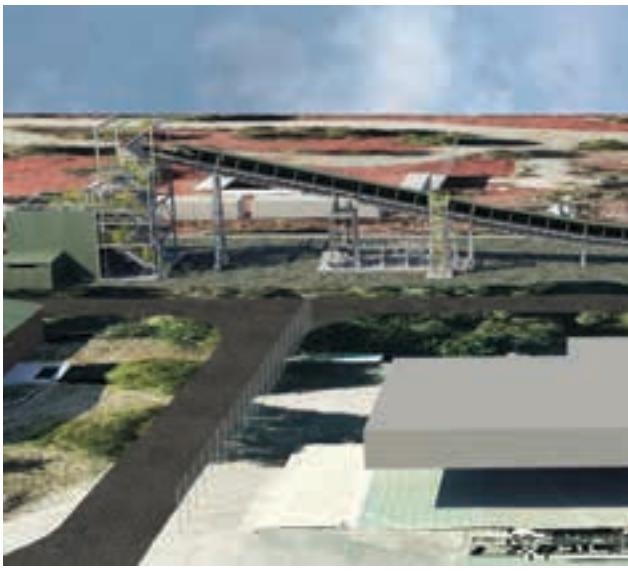
Summing up the state of BME and its prospects as it enters 2017, Keenan believes that "everything is now coming together" for the company. As he says, "We're very clear on our markets, our manufacturing is lean and efficient, we are diversifying geographically and by currency and commodity, and we have a top class range of products to offer our customers. We're confident that we will continue to grow revenues although we believe that margins will continue to be under pressure for some time yet. Overall, we're very positive – one might almost say bullish – about the year ahead."

Report by Arthur Tassell, photos courtesy of BME

"We're confident that we will continue to grow revenues although we believe that margins will continue to be under pressure for some time yet."

WorleyParsons RSA develops 5D project

As WorleyParsons' global centre of excellence for mining, WorleyParsons RSA expends a substantial amount of energy and resources on developing advanced solutions for its customers that will increase accuracy and efficiency while reducing risk.



The project delivery and engineering consultancy has been developing a 5D project design platform that integrates sophisticated technology tools in order to provide a greater degree of predictability throughout the lifecycle of an asset, ultimately increasing profits, even in the ongoing volatile commodity market.

"We 'orchestrate' the best available standard systems so that they can plug into each other," says Henry Jonker, General Manager – Mining at WorleyParsons RSA. "There are a number of powerful engineering design processes and programmes that are used to improve efficiencies in the mining and other sectors. We are one of the first engineering consultancies in the mining sector to develop methods that integrate these products to combine the benefits of using them together. Essentially we're taking individual puzzle pieces and figuring out how to slot them together to show our customers the bigger picture of their project."

This 5D integrated project platform approach has already been applied to a number of projects, and is proving to save customers time and money.

WorleyParsons RSA began developing its integrated design project platform over five years ago, by integrating 3D intelligent design data mapping with over 20 different engineering design processes and programmes to create a visual 5D design scope that incorporates schedule and cost. This 5D integrated project platform approach has already been applied to a number of projects, and is proving to save customers time and money.

Mushir Khan, Manager of Engineering at WorleyParsons RSA, says that by applying the integrated technology to the Front End Engineering Design (FEED) contract for Royal Bafokeng Platinum's second phase 100 kilotonne per month (ktpm) Merensky concentrator, the project was completed successfully and expediently.

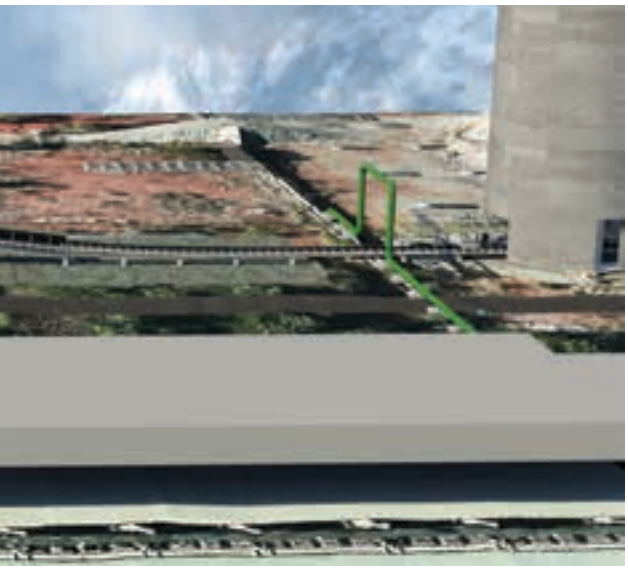
"This is the first project where the integrated technology was applied to its fullest potential and it has proven to work efficiently. We were able to quickly identify value improvements by picking up optimisation from the previous design by using 5D technology. Optimisation is usually done after a project is finished – in this case, we used 5D technology in parallel with optimisation, saving the customer time and money, while concurrently identifying risks and value improvement propositions."

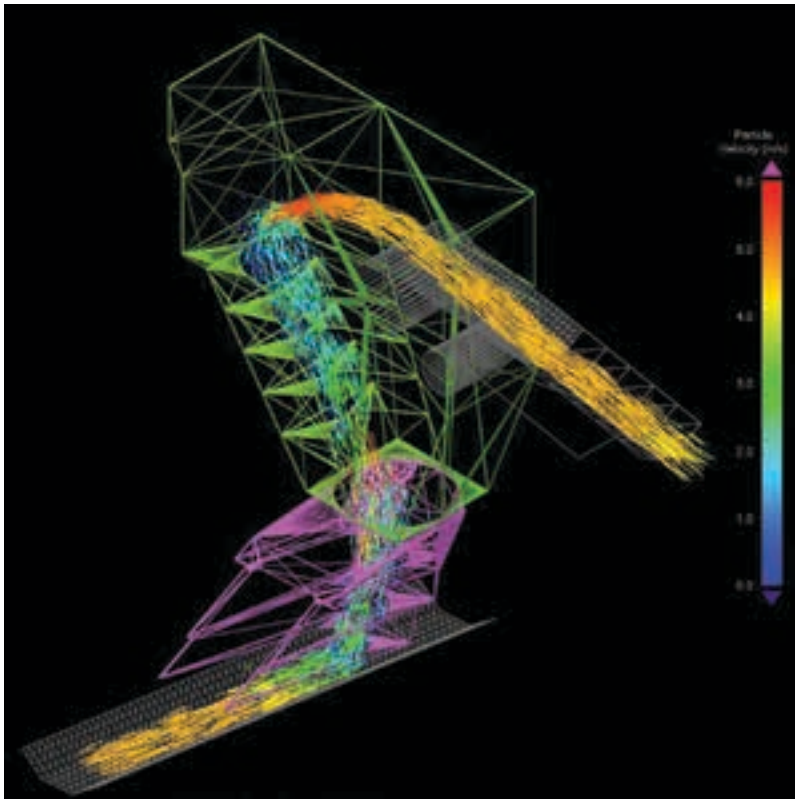
Khan explains that the norm is to first complete a feasibility study and then address all the risks that were identified in the feasibility stage, followed by establishing value improvements to bring costs down and improve construction schedules. For the Royal Bafokeng Platinum Mine (BRPM) project, by using the integrated technology model, WorleyParsons was able to do the feasibility study and value improvement simultaneously and determine 90 % of the dimensions and costs, enabling the next phase – the detailed engineering – to be undertaken quickly and very accurately, resulting in a predictable construction cost.

Khan says that this high level of accuracy is obtained by plugging in real-time costs into a 3D parametric design module to create a cost-based estimate. "We can now seamlessly integrate 3D parametric design in a 5D platform, making detailed engineering much easier and quicker, and enabling us to give our customers a far clearer overview of their projects," he says.

WorleyParsons RSA has been using parametric design for some time, particularly for bulk material handling, to simulate how processes will work based on specified parameters entered. Parametric design is a type of 3D modelling which can demonstrate how a product or process will function based on varying parameters or values. Parametric design models allow

design platform





Above: *Visualisation of a conveyor for the BRPM Concentrator Project.*

Above right: *Detail of a conveyor headframe generated using the 5D project design platform.*

Right: *Material flow through a chute. WorleyParsons RSA can now seamlessly integrate 3D parametric design in a 5D platform.*

for flexible designs, 3D visualisation of a process as parameters change, and quicker designs.

"WorleyParsons RSA will be applying integrated technology as a standard offering going forward on new projects," says Murray Macnab, Business Development Executive. He notes that at a very low additional cost, customers are also able to get an operational model as part of the offering.

"With our integrated technology module, we can create the framework and groundwork to deliver a project to a predictable construction deliverable, and we can also take that same module and go into operations," adds Khan.

"All the data generated is electronic, so no more containers of paperwork that can get lost or damaged, or not be used again. Costing models can be imported straight into SAP, and all the data from a design model, such as parts suppliers, operational information about parts, etc, can be uploaded to a customer's system. The data can also be used for simulation, for example operating of plant, or an underground mine.

"A vast amount of data is generated as a project is set up," continues Macnab. "As one of the 'jigsaw pieces' of our integrated technology offering, we can use the data to offer our customers a large degree of predictability over the lifecycle of a project, and take guessing out of the equation. We cannot predict the selling price of commodities at any given time, but we can predict productivity and maintenance schedules that can prevent unexpected shutdowns by using the data available that has been generated during the feasibility and engineering stages. By obtaining a further small amount of information, customers can be informed and prepared about future productivity and maintenance issues, thereby mitigating cost risks."

Globally, WorleyParsons has already been using this 'digital enterprise' in the oil and gas sector to offer customers a greater degree of predictability.

"Our objective is to ensure that all our services focus on reducing risk, while quantifying data to increase productivity," concludes Macnab. ■

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AFRICA'S TOP MINING PROJECTS

In our regular Top Mining Projects feature we look at projects distinguished by their size, innovation or pioneering spirit. This year we have identified four that meet these criteria, three of them in the Southern African region and one in West Africa. The commodities covered are graphite, tin, gold and zinc.

Our graphite project is **Balama** in northern Mozambique, now at an advanced stage of construction. The new mine is being developed by Australia's Syrah Resources at a cost of US$185 million and will have the capacity to produce 350 000 tonnes of concentrate a year at 98 % Total Graphitic Content (TGC), with the reserves being sufficient for over 40 years of operation.

Africa is awash with graphite projects, primarily in Mozambique and Tanzania, but Balama is the front-runner as it is just months away from first production. It is also notable inasmuch as it will exploit the world's largest flake graphite resource and will rank as the world's biggest graphite mine.

Balama will employ traditional open-pit bench mining methods, with the mining operation projected to be 100 % free dig for the first five years. The process route is conventional and will include crushing, grinding, flotation, filtration, drying, screening and bagging. The final concentrate will be packed into bags and trucked to the Port of Nacala, some 490 km to the south-east.

The second project we cover in our Top Mining Projects feature is the **Bisie** tin project in the relatively remote North Kivu Province of the DRC. Bisie has some real challenges to overcome including the legendary instability of the Congo as well as difficult logistics but the rewards should be significant if the developer, TSX-V-listed Alphamin Resources, can successfully get the deposit into commercial production. Bisie is, after all, one of the biggest – and highest grade – tin deposits in the world and is just crying out to be mined.

With a Feasibility Study in place and DRA named as the preferred EPCM contractor, Bisie is – as they say – ready to roll and Alphamin is hoping that it will enter construction later this year. If this is achieved, first production can be expected in 2019. Once at steady-state, the mine will produce 10 750 tonnes of tin in concentrate on average per year, accounting for roughly 3 % of world tin production.

No feature on Africa's Top Mining Projects would be complete without at least one gold mine, as gold is arguably Africa's signature metal. There are a number of gold mines either in development or just commissioned on the continent, particularly in the West African region, but the standout is undoubtedly **Asanko** in Ghana. Phase 1 of Asanko was commissioned early last year and is now producing well above its nameplate capacity.

With Phase 1 of Asanko shooting the lights out, developer Asanko Gold – run incidentally by mining entrepreneur Peter Breese who is well known in Southern African mining circles – has made the decision to now proceed to Phase 2A of the project, which will see the Esaase deposit, 25 km to the north of the Phase 1 mine, being brought to account. Phase2A is a major project in its own right and has a capex of US$125 million. It will include the construction of a 27 km long single-flight overland conveyor, which will be one of the longest in the world.

Phase 2A will eventually be complemented by Phase 2B and once both these phases are in place, Asanko will rank as the seventh largest gold mine in Africa, with an annual gold production of up to 470 000 ounces a year.

Our final project – **Gamsberg** – is located in the arid Northern Cape of South Africa near the town of Aggeneys. The developer is Vedanta Zinc International, which is investing US$400 million in the construction of a new open-pit zinc mine which will supplement its current underground mining operations at Black Mountain, just a few kilometres away.

The ground-breaking ceremony for Gamsberg was held in the middle of 2015 but development is now entering its peak phase with the appointment, late in 2016, of the bulk mining contractor and the EPCM contractor for the plant and related infrastructure.

Gamsberg is notable not only because Vedanta has managed to cut capex by a full US$200 million over original estimates but also because it is located in an area identified as a biodiversity hotspot. Vedanta has responded to the challenge of building a mine in an environmentally sensitive area by launching an environmental programme which it believes will provide a new benchmark for the mining industry. ■

Africa is awash with graphite projects, primarily in Mozambique and Tanzania, but Balama is the front-runner as it is just months away from first production.

Thinking big at Balama

Currently only a minor player in global graphite production, Africa – and specifically Mozambique – will soon be home to the world's biggest graphite mine, with ASX-listed Syrah Resources on course to produce the first graphite concentrate from its US$185 million Balama project in Q3 2017. As ***Modern Mining's*** *Arthur Tassell explains here, the project hosts the world's biggest resource of graphite and is expected to be a first quartile producer due to its high grade and the fact that the deposit lends itself to a low stripping ratio open-pit mining operation.*

Located in the far north of Mozambique in Cabo Delgado Province, Balama – which comprises a series of hills consisting of graphitic schist – is by no means a new discovery, as the graphite occurrences in the area were first documented in the 1890s by John H. Furman, a geologist and engineer working for the Nyassa Company. In a report he prepared, he stated that north of Mualia (now the village of Maputo) he had discovered "the greatest deposits of graphite, of a most excellent quality, which I think have ever been found. They extend several miles in length and will aggregate more than 700 ft in thickness."

Furman's discovery was not followed up for more than a century. In 2006 Canadian junior Helio Resources applied for a prospecting licence over the Balama area but its focus was uranium and base metals mineralisation rather than graphite. It relinquished the licence in 2010. By 2011 the ground had been picked up by Syrah, which wasted no time in initiating a vigorous exploration programme. By early 2013 Syrah was able to announce a maiden inferred resource for the Balama West deposit of 564 Mt at 9,8 % Total Graphitic Carbon (TGC), making it the world's biggest graphite deposit by far. The estimate also revealed that the deposit contained significant vanadium.

A recent view of the Balama site showing construction of the flotation line.

Lining of the Tailings Storage Facility (TSF) underway with the plant in the background.

With the inclusion of the Balama East deposit, the 2013 estimate has grown substantially with Syrah in May 2015 announcing a total JORC-compliant resource of almost 1,2 billion tonnes at 11,0 % TGC for 128,5 Mt of contained graphite and reserves of 81,4 Mt at 16,2 % TGC for 13,2 Mt of contained graphite. The ore reserve figure has since increased by 40 % with Syrah reporting in November 2016 that proved and probable reserves now total 114,5 Mt at 16,6 % TGC for 18,6 Mt of contained graphite.

Snowden delivered a full feasibility study (FS) on the project in May 2015, which confirmed Balama as the world's largest flake graphite project. As detailed in the FS, Balama will have a nameplate capacity of 350 000 tonnes of concentrate per annum at 98 % TGC, with the reserves being sufficient for over 40 years of operation at full production. The average head grade will be approximately 19 % TGC during the first 10 years of operations. The FS estimated the IRR at 71 % with a post-tax NPV_{10} of US$1,1 billion and put the payback period at less than two years from commercial production.

The Balama mine is now at an advanced stage of construction. Initial site clearing started in 2015 and construction of the processing plant in 2016. The key contractors on the project are Kentz (part of SNC-Lavalin), which is the SMP (Structural, Mechanical and Piping) contractor, Tayanna Mozambique, the mining contractor, and CMC Africa, responsible for the civils. As at the end of November 2016, the labour force on site numbered 1 435 people, including 245 employees from the eight host communities local to the mining concession.

In announcing the appointment of Kentz, Syrah noted that the company had successfully operated in Mozambique for 18 years and had a proven track record of delivering major mining and metals construction projects in the country. These have included contracts for the Moma mineral sands mine, the Moatize coal mine and the Mozal aluminium smelter, as well as

The process route at Balama comprises crushing, grinding, flotation, filtration, drying, screening and bagging. Some of the flotation cells are seen here.

The primary mill looking south.

the Ncala coal terminal and the upgrade of the Beira coal terminal.

Overseeing Syrah's activities at Balama is the company's Chief Operating Officer, Darrin Strange. A metallurgist with a background with Rio Tinto (he was previously GM of Rio's West Angelas and Robe Valley iron ore operations in Australia's Pilbara), he speaks Portuguese and spends a major part of his time on site in Mozambique.

The TSF with welding of the liner seams in progress.

Talking to *Modern Mining* recently, he said Balama would employ traditional open-pit bench mining methods, with the mining operation projected to be 100 % free dig for the first five years. "The load and haul fleet, which has now been mobilised to site, includes a 90-t Liebherr excavator, Bell B40 articulated dump trucks, several Caterpillar dozers and graders and a couple of fuel tankers," he said. "We will eventually mine in two pits, with the West Pit – which will be mined first – ultimately being 1 000 m long, 400 m wide and 80 m deep and the East Pit 1 000 m long, 1 000 m wide and 80 m deep. The strip ratio is very favourable and is estimated at 0,04 over the life of mine. Construction of the ROM pad – which will have a capacity of 360 000 tonnes – is underway with completion expected in February 2017."

Strange added that training of 20 mobile plant operators had started and that it was the intention that the mining operation would eventually be manned by workers drawn mainly from local communities.

Turning to the processing route at Balama, this will be a conventional process including crushing, grinding, flotation, filtration, drying, screening and bagging. The plant, which will have a capacity of 2 Mt/a, has been designed by CPC Engineering located in Perth, Western Australia.

"Primary crushing is by means of a sizer

The lined raw water pond (foreground) with reagent store and process water pond in the background.

rather than an impact crusher to maintain the integrity of the ore while reducing block size," said Strange. "The process plant has been designed with sufficient flexibility to ensure market demand for different particle sizes can be met as markets with different product specifications require. The final graphite concentrate product will be classified into five particle size classes based on extensive consultation with global graphite end users."

The structural steel for the plant is being brought in from South Africa while equipment and major plant components are being sourced from a number of countries, among them Australia, China, Singapore, South Africa, Thailand and Vietnam.

The power requirement for the project will be around 11 MW and this will be provided by an on-site power station. This is being supplied by South Africa-based Zest Energy, part of the Zest WEG Group, and should be operational in Q1 2017. Water for the mining and plant operations will be sourced from the Chipembe Dam, located 12 km from the Balama site, with this supply being supplemented by rainwater collection and pit dewatering, while water for the accommodation camp is provided by boreholes. Syrah's water licence allows up to 2 Mℓ/a to be drawn from Chipembe Dam, which will be connected to Balama by pipeline.

There are no major environmental issues associated with the Balama project – which received its environmental licence in April 2015 after completion of a thorough EIA – but Syrah is nevertheless determined to run a 'green' operation. The operational 'footprint' has been minimised to avoid clearance of the indigenous forest which is the source of a large number of products which sustain local communities. Similarly, two large conservation areas of remnant vegetation on a chain of granitic outcrops have been set aside to protect

Thickener installation with process water pond in the background.

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The recycle crusher (with ROM pad and primary crusher at top right).

biodiversity. In addition, a high temperature incinerator has been installed on site to incinerate combustible waste, with Syrah estimating that the waste management programme will reduce the production of greenhouse gases fourfold (when compared with land filling).

The Tailings Storage Facility (TSF) is being lined with a geomembrane liner which will ensure that no potential contaminants are released to groundwater. Waste oil will be removed from the site by a licensed hazardous waste operator for disposal or re-use.

While one might think that one of the main challenges of the project would be its remote location, Strange says that this has not been as big a hurdle as expected. "Certainly, we are a long way – 2 700 km by road – from Gauteng in South Africa, which is where many of our suppliers are located, but good transport scheduling and efficient customs clearance procedures have made this distance manageable," he told *Modern Mining*.

"Moreover, the project is fortunate to be served by reasonably good infrastructure. The main Pemba-Lichinga road passes within 3 km of the mine and is tarred to within 15 km of site. Two fibre optic cables and a 33 kV powerline are strung along the road, providing power (for the construction phase) and communications for the project. Pemba, the provincial capital, is 240 km (three hours) by road from the site, and is served by a modern international airport with daily flights to Johannesburg and by a sea port of limited capacity."

Balama's concentrate will be packed into bags and trucked to the Port of Nacala, some 490 km to the south-east over a bitumen-surfaced road, for shipment overseas. Nacala is reportedly the deepest port in Southern Africa and is equipped with twin berths for containers with a total length of 600 m, as well as four berths for bulk traffic with a total length of 600 m. Trucking of product will be outsourced to a contractor and, at full production, there will approximately 67 trucks (B-Double trailers), each transporting approximately 36 one-tonne bags of product, from Balama to Nacala port daily

Finally, it should be mentioned that Syrah has a very active corporate social responsibility programme in place, which has already seen it carrying out a number of community projects, which have included the drilling of boreholes in eight villages, the installation of solar panels in schools and clinics and the support of the local orphanage with food and clothing.

The company is currently in the process of signing a community development agreement with the Government of Mozambique which will commit it to spending US$15 million on community development initiatives over the life of mine, with the initiatives to include the construction and management of the Balama training centre, the provision of community roads, the establishment of a community nursery, a farmer development programme and similar projects.

Photos courtesy of Syrah Resources

The main Pemba-Lichinga road passes within 3 km of the mine and is tarred to within 15 km of site.

Bisie – a tin project without

Possibly no other mining project better exemplifies both the potential rewards of developing a mine in Africa as well as the huge obstacles that sometimes have to be overcome to get into production than Bisie – a veritable mountain of tin located in the depths of the DRC that is one of the richest (in terms of grade) and biggest undeveloped deposits of the metal to be found anywhere in the world. The company planning to create a modern, commercial-scale mine at Bisie is TSX-V-listed Alphamin Resources Corp. It has made considerable progress on the project which is now essentially ready to enter construction once funding is finalised.

Boris Kamstra, CEO of Alphamin Resources.

Bisie lies in North Kivu Province, 180 km west-northwest of Goma on Lake Kivu and roughly 40 km from Walikale, the nearest settlement of any size. Although it is easily accessible from Goma by helicopter (the flight is roughly an hour's duration), access by road is much more difficult – and, until recently, was not even possible.

Recalls Boris Kamstra, Alphamin's CEO: "When we first engaged with the project, the only way to get in from the Goma-Walikale-Kisangani road, a distance of about 35 km, was to walk – largely through dense, very beautiful equatorial forest. Even getting to Walikale was – and still is – a mission as the road from Goma traverses a distance of 270 km or so, with 45 km of this being in poor condition. At this stage, fixed wing light aircraft cannot

access the site but we will be putting in an airstrip early in 2017."

Over the past few months Alphamin has cut a road alignment through to its camp at Bisie, a task which has involved it in building several timber bridges. The route can now accommodate 20-tonne loads but still needs further work to make it fit for the demands of building a new mine, which will involve heavy loads of equipment being transported to site. Kamstra notes, incidentally, that the new road has been built by locally recruited workers (around 450 of them), who have been largely responsible for designing and constructing the bridges, which he describes as "works of art".

While the logistics challenges of Bisie are not insignificant, they are nevertheless being

Above: *Trevor Farber, COO of Alphamin Bisie Mining (ABM), Alphamin's DRC subsidiary, briefs miners at the return airway drive face.*

Left: *The Bisie camp. All the structures have been built by local labour using materials sourced locally.*

Below: *Bridge constructed by Alphamin over the Biruwe River.*

Dr Anselme Kitakya (Provincial Minister of Mines) laying the cornerstone of the Logu School (one of Alphamin's community projects) in the presence of Marie Claire Bangwene (Territorial Administrator), Richard Robinson (MD of ABM), ABM's legal adviser, and Gilbert Kalinda (a leading member of the Walikale community).

resolved. Probably a bigger problem for the project than access is the somewhat unstable nature of North Kivu Province. The area is more peaceful than it has been in the past but armed groups still operate in the province and security is potentially an issue.

Kamstra, however, is very positive. "The narrative about North Kivu being lawless is outdated," he observes. "We've been on site at Bisie for more than three years and haven't had too many problems. We acknowledge, of course, that operating in North Kivu is not the same as operating in some First World jurisdiction such as Australia or Canada. But it is manageable and the situation is constantly improving – and will almost certainly improve further still when we have a mine up and running."

One of the reasons why Kamstra describes the common perception of North Kivu as dated is that there is no longer a significant artisanal presence at Bisie – with the result that the 'warlords' who used to exploit the informal miners have moved on.

"Artisanal mining at Bisie started to take off in the early 2000s and the numbers on site eventually peaked at around 16 000 people," he says. "In fact, Bisie reputedly had the highest density of satellite phones on earth. The area was producing up to 4 % of the world's tin and there was an El Dorado quality about it. But the bottom fell out of the market for Bisie's informal producers when the Dodd-Frank legislation in the US in 2010 made it increasingly difficult to sell any conflict minerals or metals, including tin, at the same time as the artisanal miners went through the water table. Today, there only is only a small number of artisanals left and none at all at our Mpama North site, which is our current focus."

Kamstra emphasises that Alphamin is a member of the Conflict-Free Sourcing initiative (CFSI) and says the mine's product will be entirely compliant with the Dodd-Frank legislation. He also mentions that Alphamin has strong backing from the DRC government, which has a 5 % share in the Bisie project, and South Africa's IDC, which has invested US$10 million for a 14,25 % stake.

Alphamin has put a great deal of work into forging relationships with communities in the area. "We were not welcomed with open arms initially," Kamstra says. "So we decided to put a community programme in place. We've elected to spend 4 % of our in-country expenditure on community initiatives, which is an easily auditable number. We originally found it difficult to determine who exactly represents the communities we interact with but after three years we now know our way around and our support on the ground is growing strongly."

Jamie Anderson, Alphamin's Exploration Manager, and colleagues logging core.

Counter balancing the negatives of operating in North Kivu is the sheer quality of the resource. Although the cassiterite mineralisation in the area was probably known to the Belgian colonials, it has taken Alphamin to delineate the magnitude of the resource. The company has links with Pangea Exploration (run by South African explorationists Rob

Alphamin team members at the Logu Bridge.

Still and Anton Esterhuizen) and is backed by Denham Capital which – through its subsidiary Tremont Master Holdings – has a 44 % stake.

Alphamin completed its acquisition of the Bisie property in 2013 and has since undertaken an enormous volume of work. Drilling alone – mainly at the Mpama North site – totals nearly 40 km and has enabled Alphamin to publish some truly impressive resource figures.

The latest resource update for Mpama North, filed in June 2016, includes a measured mineral resource of 0,46 Mt at 4,31 % tin for 19 600 tonnes of contained tin, an indicated mineral resource of 4,14 Mt at 4,55 % tin for 188 400 tonnes of contained tin and an inferred mineral resource of 0,54 Mt at 4,25 % tin for 22 800 tonnes of contained tin; all using a cut-off of 0,5 % tin. This represents a 34 % increase in the measured and indicated category tin resources announced in October 2015.

"Our original target was to get 100 000 tonnes of tin and we have now more than doubled this, based purely on Mpama North," says Kamstra. "The Mpama South orebody further down the ridge at Bisie could well host similar resources but frankly we have no need to do more drilling at the moment, as Mpama North will support many years of mining. The figures for Mpama North are so good that sometimes when you look at them you wonder whether a decimal point has been put in the wrong place. The grade we were expecting was around 2,5 % but we've got well over 4 %. At present metals prices, this makes Mpama North roughly equivalent to a 16,4 % copper deposit or a gold deposit of 18,5 g/t Au.

"On a world scale, Mpama North is extremely impressive," he continues. "The only orebody bigger is Syrymbet in northern Kazakhstan which has a much lower grade. It also has a difficult metallurgy whereas ours is excellent. As Anton Esterhuizen has said, Bisie is part of an emerging tin province that is one of the most significant globally."

A key milestone for Bisie was the publication of a Definitive Feasibility Study (DFS) in February 2016. It was compiled by MDM Engineering in collaboration with Bara Consulting, who provided the mineral reserves estimate. Other consultants involved with the DFS were Epoch and The MSA Group. Logistics and infrastructural studies to support the DFS were performed by Paradigm Project Management while the metallurgical testwork was carried out by Maelgwyn Mineral Services. The DFS has since (in June 2016) been updated, mainly to reflect the increase in Bisie's resources since completion of the DFS.

The Updated Feasibility Study (UFS) envisages an estimated initial capital expenditure of US$124,4 million to support the construction of an access road, an underground mine, a process

"Our original target was to get 100 000 tonnes of tin and we have now more than doubled this, based purely on Mpama North."

Miners working on the return airway drive have all been recruited from the local community.

plant, a tailings dam and associated facilities with a ROM process capacity of 360 kt/a. It estimates the project's ungeared NPV_8 (real after tax) at US$262,7 million and the ungeared IRR (real after tax) at 48,4 %. The payback period from first tin production is put at 23 months.

The mine would produce 10 750 tonnes of tin in concentrate on average per year (accounting for approximately 3 % of world production) over an almost 12-year mine life, with cash costs being US$7 396 per tonne tin.

DRA are running a Front End Engineering and Design programme to optimise the designs and processes of Bisie. The results of this programme will be available early in 2017.

The proposed mining method is Sub Level Caving (SLC) to remove the orebody in retreat fashion from the southern and northern limits of mineralisation back towards the centralised trucking ramp. Blasted ore will be loaded by 14-tonne capacity rubber-tyred LHDs dumping into 40-tonne articulated dump trucks and hauled to surface where it will be stockpiled ahead of processing for tin recovery.

The process design is based on recovery of tin into concentrate through conventional – and simple – gravity separation methods. Mined ore will be crushed to 100 % passing 10 mm. The coarse material (10 mm to +1 mm) accounts for 75 % of the mass flow and the tin contained in this size fraction will be recovered in conventional jigs. The fine material (-1 mm) makes up the balance of the material and the tin contained in this stream will be recovered using spirals. The concentrates from both the jigs and spirals will be milled and subjected to flotation to remove sulphide material. The tin rich concentrate will be thickened, filtered and dispatched for transport to smelters for further refining.

Comments Kamstra: "Our present plan is to truck the concentrate to a secure export warehouse – a tin terminal, if you like – in Goma using rough terrain vehicles. Once in Goma, it will be sold to tin traders. Our concentrate will grade at more than 60 % tin and will be unique inasmuch as it will contain no penalty elements such as bismuth or arsenic."

At this stage, Kamstra envisages that construction of Bisie – which will take place over 18 months – will start in 2017, which will mean first production can be expected by 2019. To build the mine, Alphamin has appointed DRA – responsible for building the process plant and other infrastructure at the Kibali gold mine in the north-east of the DRC – as its preferred EPCM contractor.

In anticipation of the start of construction, there is currently a 60 m return airway adit being developed at the site. Kamstra describes this as an exercise in "getting some infrastructure in and getting an understanding of the rock" while, at the same time, gauging the availability and level of mining skills in the area.

To take Bisie into implementation, Alphamin has put together what it believes is a highly experienced team. Kamstra himself is a civil engineer who started his career with Grinaker while the company's COO is Trevor Farber, who played a major role in developing the Blue Ridge platinum project in South Africa and the Kinsenda copper project in the DRC.

Continued on page 45

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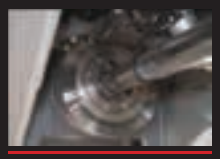

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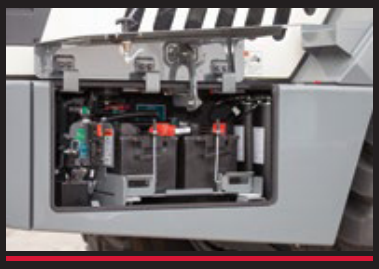

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Continued from page 36

The company's Chairman is Charles Needham, who was CEO of Metorex when it developed the Ruashi copper project near Lubumbashi in the DRC.

Heading Alphamin's DRC subsidiary, Alphamin Bisie Mining SA, is Dr Richard Robinson. The son of American missionaries who was born and brought up in the DRC, Robinson has a wealth of experience in the country and was at one point the Social Programs Manager for the Tenke Fungurume copper mine in Katanga in the south of the DRC. He is based – with his family – at Goma.

Kamstra also notes that Alphamin has retained two world experts to advise on and contribute to aspects of the Bisie project. "We have engaged Ian Dun to review and optimise our proposed tin recovery process and we've also appointed Tony Cox to our project team. Ian is a leading expert on tin metallurgy with over 30 years' experience in the field while Tony – whose background includes service with Gold Fields, AngloGold Ashanti and what used to be known as Turgis Consulting – is an underground mining specialist with very wide experience of Sub Level Caving."

He adds that Alphamin's Camp Manager at Bisie, Sam Mwanga, who has been based at the site since 2013, has performed incredibly under sometimes difficult circumstances.

Summarising the Bisie project, Kamstra says that it is a tin project without peer which will be entering production at a time when there is a developing global shortage of the metal. "Yes, the project has its challenges but these are completely outweighed by its pluses," he states. "We've demonstrated in our studies that the ore can be efficiently mined and processed at healthy margins and that the project has significant potential to grow.

Drill pad preparation at Bisie using local labour.

"We're definitely on top of the logistical issues and we have an in-depth knowledge of how to operate in North Kivu, based on the fact that we've already been there for more than three years. Moreover, this is a mine that could transform North Kivu, providing around 450 permanent local jobs along with very significant economic benefits in a region of the DRC which has seen almost no foreign investment thus far. In short, this is a project demanding to be built and we're very optimistic that construction is just months away now."

Report by Arthur Tassell, photos courtesy of Alphamin

Asanko shaping up to be one

Africa has seen some very successful gold mine startups over the past several years, among them Otjikoto in Namibia and Kibali in the DRC. But shaping up to be possibly the most successful of all is the Asanko Gold Mine (AGM) in Ghana, which has turned in a stunning performance since starting up in January 2016. ***Modern Mining's*** *Arthur Tassell recently spoke to Hugo Truter, Chief Operating Officer of Asanko Gold, about the current Phase 1 operation and also the recently approved Phase 2A expansion. Ultimately, when both Phases 2A and 2B are up and running, Asanko will rank as the second largest gold mine in Ghana and the seventh largest in Africa.*

Built ahead of schedule and on budget (US$295 million) without a single Lost Time Injury (LTI), Asanko Phase 1 was designed to produce 190 000 ounces of gold a year but is already operating well above design capacity. Says Truter: "We poured our first gold in late January 2016 after commissioning the plant one month ahead of schedule and we were able to declare commercial production on 1 April. Steady-state production was achieved by the end of the second quarter of

Stockpiles and conveyers at Asanko Gold Mine in Ghana.

# of Africa's great gold mines

the year and we are now running well ahead of nameplate capacity – in fact, the mills are running at over 10 000 tonnes per day, which is 20 % above design. It's really been a fantastic startup for Asanko."

He adds that the mine is expected to produce between 230 000 and 240 000 ounces in 2017 at an All In Sustaining Cost (AISC) of between US$810/oz and US$840/oz, with the ore being derived from the main Nkran pit, which will be the source of 80 % of Phase 1's ore, and also the new Dynamite Hill satellite pit, 7 km to the north of Nkran.

Asanko was built in just 17 months with the EPCM contractor being DRA (with Redis Construction Afrika as the SMP contractor) and is the first new gold mine to have been brought on line in Ghana since Akyem, owned by Newmont, was commissioned in 2013. Most of Ghana's gold mines are located on either the Ashanti or Sefwi gold belts but Asanko is on the smaller Asankrangwa belt, which historically has tended to be neglected by exploration companies. Asanko Gold's two main assets on the belt are Nkran (formerly known as Obotan) and Esaase, 25 km to the north.

The history of how these two properties came to be part of Asanko Gold, which is listed on the TSX and NYSE MKT, is a story in itself but suffice it to say that the new mine is the brainchild of well-known mining entrepreneurs Peter Breese and Colin Steyn (both

Above: *View of the Esaase site, which is located 25 km to the north of Nkran.*

Below: *Asanko Gold Mine is the first in Ghana to utilise a slope stability radar (SSR). It has been supplied by GroundProbe.*

Layout of the Phase 1 and 2 projects.

with backgrounds in the Zimbabwean mining industry), who at one stage managed LionOre Mining, whose assets included the now discontinued Tati nickel mine near Francistown in Botswana. LionOre was sold to Norilsk in 2007, but many of its executives – including Truter, who was GM of Tati – are now with Asanko.

Asanko Gold is essentially an amalgam of Keegan Resources, a Canadian company which owned Esaase, and Australian junior PMI Gold, which owned Obotan. Breese, Steyn and their co-investors in an investment group known as Highland Park acquired an interest in Keegan in 2012 after investing in the company, with Breese then taking over as CEO. The previous management had completed a PFS which indicated a very high capex for Esaase of just over half a billion US dollars but Breese and his colleagues were confident they could bring this figure down substantially.

While Esaase was considered to be viable in its own right, it soon became evident to Breese and his team that combining it with PMI's Obotan deposit to the south – which had previously being mined in the late 1990s and early 2000s by Resolute Mining – could unlock huge synergies and negotiations with PMI were initiated. The path to a merger was by no means easy but by early 2014 Keegan (by then known as Asanko Gold) had absorbed PMI and the way was open to develop the two properties in tandem.

"Our approach is based on staged development of the assets, with the cash flow from Phase 1 financing the Phase 2 expansion," explains Truter. "We decided to base Phase 1 on the Nkran deposit since it has a higher grade than Esaase – and was also ahead of Esaase in terms of permitting. Phase 2 will see Esaase being developed and the mine's gold production

This recently commissioned Sandvik mobile crusher has boosted Asanko's crushing capacity.

A recent photo of the Nkran pit, the main source of the Phase 1 ore.

roughly doubling to 470 000 ounces a year. Our combined resources for Nkran – including several satellite deposits – and Esaase amount to 7,94 Moz at a grade of 1,71 g/t and our reserves are 5,25 Moz at 1,68 g/t. The reserve grade at Nkran is 2,21 g/t as opposed to 1,41 g/t at Esaase but Esaase is the larger deposit, accounting for around 56 % of our total resource ounces."

Phase 1 is a conventional open-pit, CIL operation. The mining is in the hands of mining contractor PW Ghana, highly experienced in gold mining in the West African region (including at Obotan, where it worked for Resolute). PW's trucking fleet consists of mainly new Cat 777s working with a mix of shovels and excavators, among them a new 300-ton shovel which arrived on site earlier last year.

Commenting on the mining operation, Truter says that Asanko was 'over-mining' quite substantially until recently. "We're currently a single-pit operation so – to derisk this – we took the decision to build up a strategic stockpile of over 1 Mt on the ROM pad. We've achieved this objective, which means that we've been able to cut back the mining rate. We've also put in a twin ramp system to avoid bottlenecks in the pit and have multiple working faces available at various elevations to manage water ingress and any pit slope instability. The maximum rate at which we can mine at Nkran is 3 Mt/a, so to reach our target of 3,6 Mt/a we have to bring Dynamite Hill into operation."

Truter notes that there have been some slope failures in the Nkran pit. "To counter this, we've now become the first mine in Ghana –- indeed in West Africa, as far as I know – to install a slope stability radar (SSR), which we've sourced from an Australian company, GroundProbe. The SSR monitors movement on a millimetre by millimetre basis. The information is transmitted to our geotechnical office which analyses the data and can then alert personnel in the pit if any slippage is expected – and even give a very accurate estimation of when it might happen and the volumes involved. We demonstrated the system recently to Ghana's Chief inspector of Mines and he was hugely impressed."

The SSR monitors movement on a millimetre by millimetre basis.

Moving to the process plant operation, Truter says the facility – whose basic design was completed by PMI before Asanko's involvement – has performed extraordinarily well and is now achieving gold recoveries of around 94 %, which is above feasibility study estimates. "As I've mentioned, the plant is now exceeding its design capacity," he observes. "Interestingly, the mills – which PMI bought and we inherited – were over-designed and have been more than capable of keeping up with the higher tonnages we've been putting through the plant. Where we did have a bottleneck was with the crusher circuit. So we've recently commissioned a mobile crusher– a Sandvik UJ440i. This can

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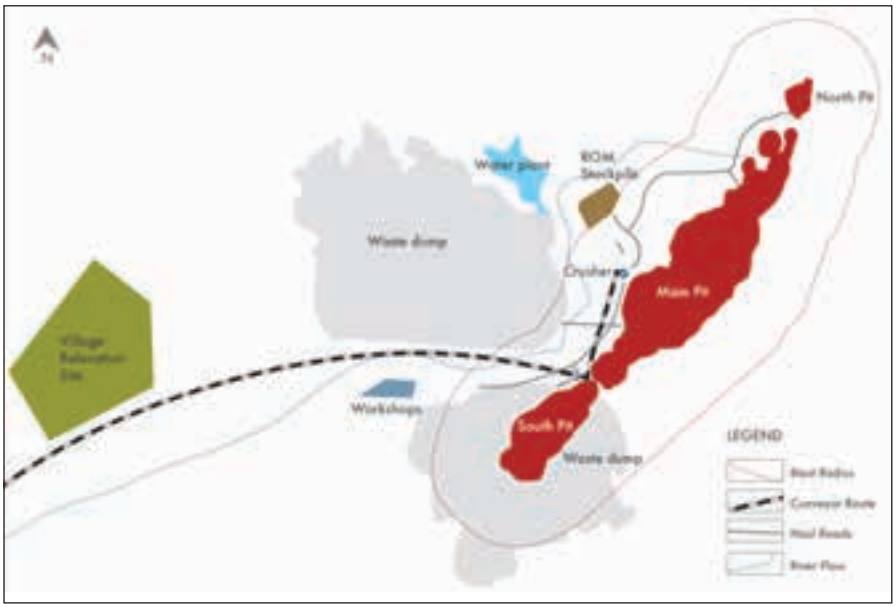
handle 4 000 tonnes per day of material and our crushing capability now comfortably exceeds mill capacity."

With Phase 1 beating its targets and generating revenue, Asanko Gold was able to announce in early November that it would proceed with the Phase 2A expansion, which has an estimated capital cost of circa US$125 million.

Phase 2A envisions the start-up of mining operations at Esaase, the construction of a 27 km overland conveyor to link Esaase and the Obotan (Nkran) facilities and the expansion of the existing Phase 1 processing plant at Obotan from 3,6 Mt/a to 5 Mt/a to produce approximately 300 000 ounces of gold in 2018. The upgraded plant will process a blend of approximately 2 Mt/a of ore from Esaase and 3 Mt/a of ore from the Nkran pit and surrounding satellite deposits.



Layout of the Esaase mining operation.

Looking at the Phase 2A scope in more detail, Truter says that the plant upgrade – which is scheduled for commissioning in Q1 2018 – requires only relatively minor capital works. "We're going to be increasing the capacity of the mill discharge pumps, changing the internals of the existing cyclone pack, adding two Knelson gravity gold concentrators and installing an additional Gekko intensive leach reactor," he elaborates. "We will also increase gold room capacity and the capacity of the tailings pumping system.

"At Esaase, where we will eventually have three pits, we will first establish the South pit, with a view to start mining operations in Q2 2018. The other pits are the Main pit, which will go down to approximately 400 m and which hosts the bulk of the resource, and the small North pit. As at Nkran, the mining will be a standard truck-and-shovel operation undertaken by a contract miner, with around 14 Cat 777 trucks – or equivalents – being deployed initially. Infrastructure at Esaase will include primary and secondary crushing facilities."

The biggest single component of Phase 2A will be the overland conveyor which, at just over 27 km long, will certainly rank as the longest single flight conveyor in Africa and possibly in the world. Although it traverses largely flat terrain, there will be 10 public road crossings, 27 pedestrian crossings and two haul road crossings. It will feature HDPE idlers for reduced noise and friction and is designed to reduce spillage. The system will be equipped with an ST2400 belt with a width of 800 mm – with a total mass of 1 305 tonnes – and have an installed power of 2 800 kW.

Says Truter: "The conveyor will be able to transport up to 1 200 t/h of ore which is sufficient for Phases 2A and B although only 680 t/h will be required in Phase 2A. We anticipate commissioning in Q2 2018."

DRA has been appointed as the EPCM contractor for Phase 2A while the FEED contract for the conveyor has been awarded to ELB Engineering, which recently completed the nearly 27 km long, 2 800 t/h Impumelelo overland conveyor for Sasol Mining in South Africa.

Based on present planning, implementation of Phase 2B – estimated to cost between US$210 and US$220 million – will follow hard on the heels on Phase 2A. This phase will further expand the Obotan processing facility with the construction of an additional 5 Mt/a CIL circuit for a total processing capacity of 10 Mt/a (3 Mt/a from Nkran and its satellite pits and 7 Mt/a from Esaase).

"An interesting point is that it was originally

Asanko Gold Mine – a thoroughly Ghanaian operation

Asanko Gold Mine currently employs approximately 1 700 people (including contractors), the vast majority of them (97 %) being Ghanaian nationals, with 44 % of them coming from local communities. Asanko Gold in Ghana is headed by MD Joe Zvaipa – who is a Zimbabwean – with Charles Amoah, previously the Met Manager (and acting GM) of Gold Fields' Damang Mine, as the General Manager.

Says Hugo Truter: "The skills base in Ghana, developed in over 100 years of commercial gold mining, is such that we have little need to bring in expatriates. We do provide some high level support to the mine from our office in Johannesburg but Asanko Gold Mine is essentially an operation managed and manned by Ghanaians."

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Another view of the Nkran plant. Its capacity is to be upgraded from 3,6 Mt/a to 5 Mt/a in Phase 2A.

envisaged that the Phase 2B plant would be a flotation facility," remarks Truter. "A reassessment, however, has convinced us that going the CIL route has numerous advantages, not the least of them being a lower cost per tonne milled. The recoveries will be virtually the same as those delivered by flotation but building an identical plant – except for the mills – to the present one will save on engineering design and reduce capital cost risks. In addition, Ghana is very much 'CIL country' so the skills are in place to run a CIL facility – which is not the case when it comes to flotation. A CIL plant can also handle power outages – which are not uncommon in Ghana – far better than the flotation process."

As a final comment on Asanko, Truter says that once Phase 2B is completed, expected by 2020, Asanko Gold will be producing up to 470 000 ounces a year, which will make it one of the world's bigger mid-tier gold producers. "Phase 2B is not necessarily the end of the story," he states. "We see the Asankrangwa belt as an emerging gold district. We are engaged in acquiring properties on the belt and one that has already entered our portfolio is Akwasiso, which hosts an Nkran 'lookalike' deposit. We also have a very aggressive exploration programme in progress. We are optimistic that these activities will deliver extra resources which will either be processed by – and extend the life of – the existing mine or possibly even form the basis for new standalone operations."

Photos courtesy of Asanko Gold

Vedanta cuts the cost of Gamsberg by a third

Vedanta Zinc International (VZI)'s Gamsberg project in the Northern Cape is now entering the main construction phase with the recent appointment of the EPCM contractor for the processing plant and related infrastructure and the bulk mining contractor. The project involves a capital expenditure of US$400 million, considerably lower than the original estimate of US$600 million, with the savings being achieved by some clever re-engineering of the project, as well as a decision to go the contractor mining route. ***Modern Mining's*** *Arthur Tassell recently spoke to VZI's Chief Executive Officer, Deshnee Naidoo, and its VP Projects, Satish Kumar, to learn more about the history of the project and its planned implementation.*

Located about 30 km to the east of the underground operations of VZI subsidiary, Black Mountain Mining (BMM), in Aggeneys, the Gamsberg deposit is widely regarded as being one of the largest unexploited zinc resources in the world. It does, however, come with its challenges, specifically a low grade and a high manganese content. The orebody was discovered 40 years ago but remained largely undeveloped by its previous owners, Gold Fields and Anglo American, although the latter did complete a feasibility study and also initiated a small scale underground mining operation. The project was acquired by VZI, part of LSE-listed Vedanta Resources, in 2010 when it purchased BMM from Anglo American.

Commenting on the deposit, Naidoo – a chemical engineer who was CFO for Anglo American Thermal Coal before joining VZI in 2014 – says the total resource amounts to 214 Mt with the grade being in the region of 6 to 6,5 %. "This is low for a zinc orebody," she says. "To put it into perspective, our Lisheen mine in Ireland, which we closed at the end of 2015, was mining with grades in the double digits right through to the end. Nevertheless, Gamsberg is ideal for modern bulk open-pit

Vedanta Zinc International's CEO, Deshnee Naidoo, engaging with the Gamsberg project team.

Mining operations at Gamsberg. The haulers seen are BELAZ 130-t electric trucks operated by Roux Mining.

mining methods and the resource is sufficient to support mining for many years. We're going to undertake development in phases, with Phase 1 – which will only exploit a quarter of the entire resource – being an operation processing 4 Mt/a of ore to produce 250 kt/a of metal in concentrate over a mine life of 12,5 years."

An interesting point is why Anglo never went ahead with the development of Gamsberg. Says Naidoo: "Anglo contemplated a very large scale, almost megapit-sized, 10 Mt/a operation with a refinery also being part of the development plan. This would have involved a very high capex in one go. Our approach is to tackle the project in more manageable steps. We looked at 2, 4 and 6 Mt/a options before settling on the intermediate figure of 4 Mt/a.

"Another factor that makes this project so suitable for us is that we are integrating the refinery at our Skorpion mine in southern Namibia into the development plan. At least a portion of Gamsberg's concentrate will be trucked to the Skorpion refinery, which can handle the high manganese fraction. Of course, we will have to upgrade the Skorpion facility, originally designed for oxide concentrates, to allow it to treat the sulphides from Gamsberg and this involves a capex of US$152 million. Skorpion was due to close as a result of the ore reserves being exhausted but Gamsberg gives it a considerable extension of life."

Phase 2 of Gamsberg, which is mainly conceptual at this stage, would take capacity up to 10 Mt/a and would cost between US$300 and US$350 million. It could include a dedicated refinery, in which case the total investment could be in the region of US$800 to US$900 million.

Construction of Gamsberg is starting to look like an inspired move on Vedanta's part, given how the zinc price is moving. Early in 2016 it hit a five-year low of US$1 444/tonne but has since recovered to more than US$2 600/tonne (as of early December 2016). As Naidoo points out, the long-term outlook for the metal is good

Quiver trees have been relocated as part of the Gamsberg project's commitment to the biodiversity of the region.

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as a substantial amount of productive capacity has been taken out of the market over the past couple of years and has not been replaced. "We'll be the first new mine to start-up in what is increasingly a market in deficit," she says. "The zinc price will obviously incentivise others to bring on line new mines but at this stage we're way ahead of everyone else."

One spin-off of the price plunge in early 2016 was that it motivated VZI to look at ways of cutting Gamsberg's capital budget. "We were originally planning to owner mine at Gamsberg but have now decided to use a mining contractor and this, of course, is a less capital intensive approach," says Naidoo. "We've also renegotiated various contracts and re-engineered the project to deliver substantial savings. All told, we've reduced the capex by US$200 million – which is an amazing achievement."

Updating on the current status of the project, Kumar – who used to be the GM at Skorpion – says the ground-breaking ceremony was held in July 2015 and that there are now around 300 workers on site, with this figure expected to peak at 1 500 at the height of construction.

"Gamsberg is an inselberg that extends about 220 m above the surrounding 'flats'," he says. "We will be mining on top of the inselberg, so we've had to build roads to access the mining area. We appointed a local Northern Cape contractor, Roux Mining, to carry out this work and to establish the starter pit and they are making very good progress. Roux is what we call the 'pre-start contractor' but we have now appointed our bulk mining contractor, Aveng Moolmans, who will soon mobilise to site. There's a huge amount of pre-stripping required to expose the orebody – close to 70 Mt – so we will only start producing ore in the middle of 2018. Although most of this pre-stripping will be the responsibility of the bulk mining contractor, Roux has made a start on it and 12 Mt has been moved already."

According to Kumar, the mining operation at Gamsberg will be a conventional load-and-haul exercise. "We have asked the contractor to use the latest technologies in drilling but other than this there is nothing unusual about the approach being adopted. The strip ratio in Phase 1 is about 7 to 1 so to achieve our targeted ore production we'll be moving over 30 Mt/a. The explosives supply has been contracted out to BME, who have been performing that function since 2015 when work first started on site."

Moving to the process plant, Kumar describes the flowsheet as "conventional with some tweaks" and says it will include primary crushing, milling (via SAG and ball mills), flotation and dewatering. "We have three stages of flotation, the first to take out carbon, the second to remove the lead and the third for zinc, with the final product being a 48 to 52 % zinc concentrate," he notes. He adds that the tailings facility will be constructed to the highest standards and will be HDPE lined.

Acting Mining Manager Mario Cloete on site at Gamsberg.

The EPCM contractor for the processing facility (and related infrastructure including the power and water plants) is ELB Engineering, who will be using – for the first time in a zinc application – the new staged flotation reactor (SFR) technology of Canada's Woodgrove Technologies in the plant. Benefits of the technology over conventional mechanical cells reportedly include a much more compact footprint, reduced power and air requirements, less instrumentation and reduced wear and maintenance costs due to lower impeller tip speeds.

As regards the power required, VZI has concluded an agreement with Eskom to supply 40 MW. The bulk water will be sourced from the Orange River, just 33 km to the north of the site. BMM already draws around 13 Mℓ a day from the Orange for its current operations and the new project will essentially double up on this. Additional housing will also be needed in the town of Aggeneys as the Gamsberg project will generate over 500 new permanent jobs once in full production.

While Gamsberg, like any big mining project, has its share of technical challenges, perhaps the biggest challenge of all is its location in the arid Northern Cape in an area that has been identified as a biodiversity hotspot. Explains Naidoo: "Gamsberg lies in the Succulent Karoo Biome – one of only four hotspots in South Africa – which is home to 6 000 plant species, and it also forms part of the Bushmanland

"The zinc price will obviously incentivise others to bring on line new mines but at this stage we're way ahead of everyone else."

Centre of Endemism with its 397 succulent species, 16 of them endemic. We are well aware of our responsibility to protect this highly sensitive environment and we are sparing no effort to ensure that we get things right."

Naidoo says that VZI is working very closely with a range of interested parties, most notably the International Union for Conservation of Nature (IUCN), which she describes as one of the world's oldest and largest global environmental organisations. "We have a broad ranging partnership now in place with the IUCN," she says. "They are guiding us on how we can best proactively address the impacts of our project and are also assisting us with the capacity building and empowerment of local NGOs on biodiversity management and enhancement."

The mitigation hierarchy that VZI has adopted can be summarised as 'Avoid, Minimise, Remedy and Offset'. Elaborating, Naidoo says the first step is to avoid as far as possible any negative impacts by locating elements of the project away from areas of environmental sensitivity. "This principle has guided the siting of the plant, the waste dumps and the tailings facility. Obviously, we are limited in what we can do with respect to the open pit but even here we have deliberately sterilised some ground – 10 Mt of resource, to be specific – in the interests of preserving the environment.

"The second mitigation principle, Minimise, involves fencing off areas to protect fauna and flora and planning and constructing waste dumps and other facilities to prevent run-off or atmospheric pollution. We are, for example, going to separate different types of waste rock based on leachability characteristics. Moving to the third principle, Remedy, this involves the translocation of sensitive species for use in concurrent rehabilitation and already we have moved around 80 000 plants.

"Finally, we have our 'Offset' principle. This has seen us entering into a biodiversity offset agreement with the Department of Environment and Nature Conservation in terms of which we are identifying and securing properties near to the project site which have similar biodiversity features. At this stage, we've identified approximately 40 000 ha and these will ultimately be managed in conjunction with our partners to ensure that there will be no biodiversity loss as a result of our mining activities."

Summing up, Naidoo says she believes that Gamsberg will become a template for how the environmental impacts of mining can be successfully managed and minimised. "Vedanta has never attempted anything on this scale before so in many respects we're playing a pioneering role," she observes. "We've made mistakes but we're learning as we go along and we're determined that Gamsberg will become a benchmark project in demonstrating that mines can be developed – and operated – in a manner that is wholly consistent with a high degree of care and concern for the natural environment."

Photos courtesy of Vedanta Zinc International

Underground mine to continue in tandem with Gamsberg

It should be emphasised that Gamsberg is in no way intended to replace Black Mountain Mining (BMM)'s current polymetallic underground mine at Aggeneys, which is a healthy producer of both lead and zinc with a projected production of 90 000 tonnes of metal in concentrate in 2017.

The mine comprises two operating shafts – Deeps and Swartberg – and a processing plant and has been in operation since 1980.

Deeps produce copper, lead and zinc, with silver as a by-product and has about four years of economic life left. Swartberg is primarily a copper and lead producer, with silver as a by-product. Plans are well advanced to deepen Swartberg, which will increase production to 1,6 Mt/a of copper and lead ore and 60 to 70 kt/a of metals in concentrate, depending on favourable economic assessment.

The Deeps Shaft at Black Mountain Mining produces copper, lead and zinc, with silver as a by-product.

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Pilot XRT plant opened at Vlakfontein coal mine

In a pioneering step that is hoped will demonstrate the scope for waterless beneficiation of South African coal, Mintek officially opened its pilot X-Ray Transmission (XRT) plant at Vlakfontein opencast thermal coal mine near Ogies in Mpumalanga Province in November. ***Modern Mining*** *contributor Paul Crankshaw attended the event and filed this report.*

One of two X-Ray Transmission (XRT) ore sorters at Mintek's recently opened plant at Vlakfontein coal mine, extracting the higher grade coal from run-of-mine.

The full-scale commercial sorter was recently commissioned at Vlakfontein – the mining operation of state-owned African Exploration Mining and Finance Corporation (AEMFC) – and has been processing coal from the mine as part of ongoing testing of the technology. The plant has a capacity to treat up to 125 tonnes of coal per hour.

Speaking at the opening, AEMFC General Manager Corporate Strategy and Planning Sicelo Sikakane said the relevance of this collaboration is that it comes at a time of water shortages.

"The technology can help us to move away from demanding more and more water in our efforts to develop the mining industry and the economy as a whole," said Sikakane.

"This will assist not only in reducing the volumes of water required by mines, but also in reducing the need for treatment facilities like pollution control dams. Hopefully this approach can be rolled out across the rest of the industry."

He said the rising cost of water also meant that the technology made good economic sense, and contributed to the continued sustainability of mining.

As one of a range of ore-sorting technologies – which separate ore particles based on their physical properties – XRT uses the atomic density of the product as a basis for differentiation. It has to date been applied to both base metals and precious metals, as well as to coal and diamonds.

The origins of the Mintek project date back almost seven years, according to Alan McKenzie, General Manager Technology at Mintek.

"South Africa was at that stage struggling with issues of load-shedding, high coal prices and poor coal quality, and we were already working with mineral sorting experts on sensor-based sorting," said McKenzie. "Given the strategic importance of electrical power generation, coal was identified as a focus area."

XRT was then being tested in the process

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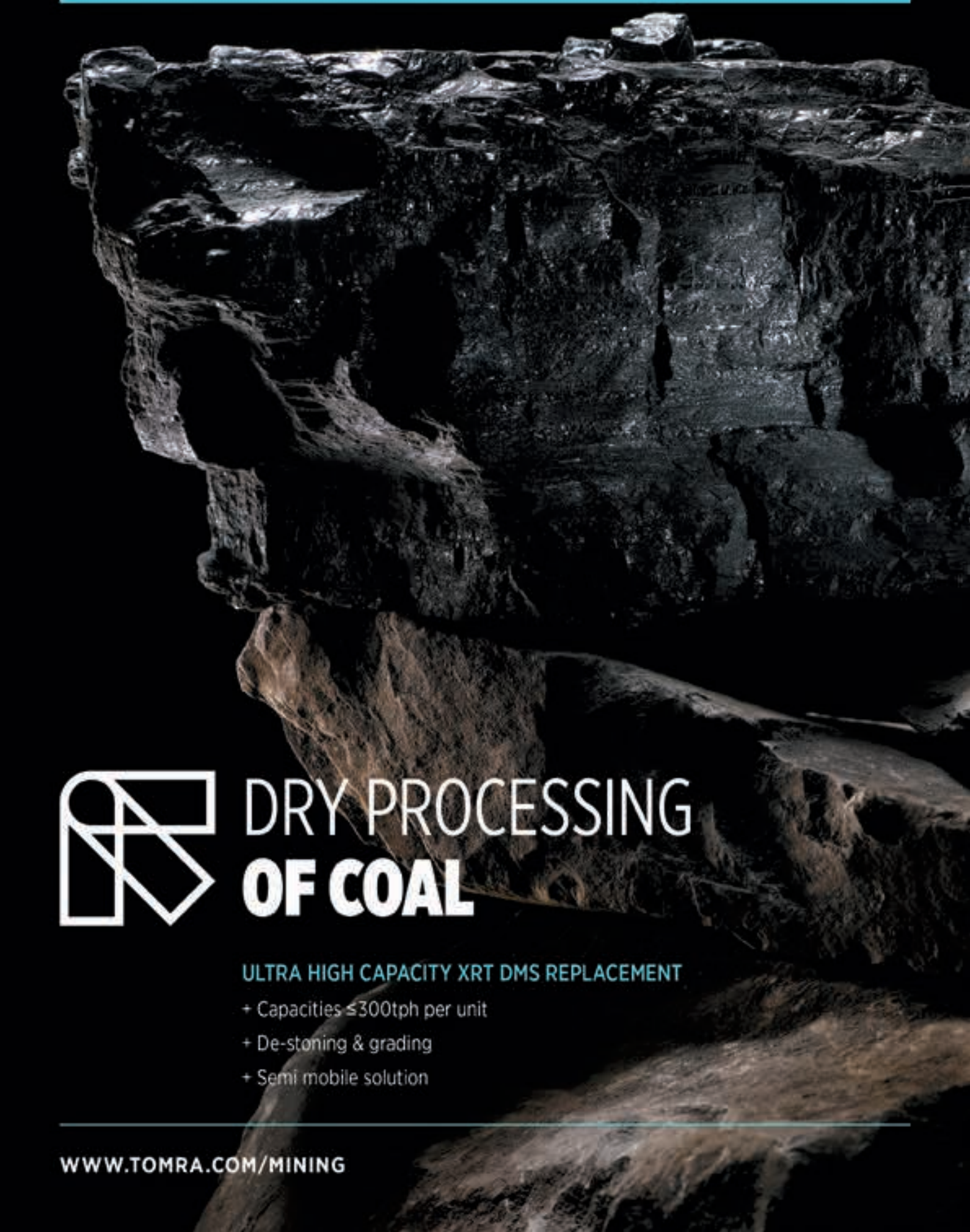

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of removing stones from coal – leading to the installation of a number of sorting plants for de-stoning.

"But we wanted to go further," he said. "We wanted to find ways of upgrading our poor quality coal to meet Eskom specifications, and we also wanted to explore the potential to scalp off niche products from run-of-mine for the metallurgical sector – most of which is currently imported."

He said it was also fitting that Mintek should initiate this research in partnership with another state-owned entity, as a contribution to the national mandate of addressing energy security for the country's future.

Planning began six years ago, and testwork is now in its fourth year. For the first couple of years, the testwork was limited to laboratory testing at Mintek's facility in Randburg. According to McKenzie, this was very successful in showing that different grades of coal could be distinguished, as the basis of the upgrading process.

This was followed by the commissioning of a full-scale plant for further testing, and SGS Bateman designed and built the plant at Vlakfontein during 2016.

The application of the technology will differ depending on the mine's geology and location, according to Mintek Project Specialist Isabel King.

"At Vlakfontein, for example, there is mining of the 4-Upper, the 4-Lower and the 2 Seam, and each behaves differently in the sorting process," said King. "Some seams allow a high grade product to be extracted, while others benefit more from de-stoning; it's really all about how you blend the final product to achieve what you are after."

She said the plant at Vlakfontein included a high-grade sorter which concentrates the high-grade material, and a low-grade sorter focused on removing stones.

"Our aim is to produce a range of coal products of relatively high calorific value, ranging from about 21 to about 25 MJ per kilogram – higher than Eskom's requirements," she said. The results of the testing to date show that blending of low-grade stockpiles will become very important – to enrich the poor quality ore to power station standards.

"Some coal seams are unable to produce a high quality coal, but could be upgraded to Eskom specifications," said King. "Some of the higher grade seams can produce a high quality product when treated by this plant, and this could be blended with the lower grade or waste stockpiles to meet Eskom's standards. In fact, some of the high grade products could possibly be sold at a premium to a different market."

She said that while processing rates began at a moderate pace, production has been ramped up and the plant can now operate at full capacity.

"We believe that sensor-based sorting is the next step-chance in the mineral processing sector," said McKenzie. "Having this full-scale plant actually on a mine site ensures that – as we put the technology to the test – we have to confront and resolve all the usual challenges and conditions that exist in mining, like those related to water and electricity."

He said the process was essentially based on a low water-usage principle, and could substitute some of the older, more conventional processes so that mines could reduce their water footprint in the processing of coal. ■

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MOD delivers "robust" scoping study on T3 project in Botswana

ASX-listed MOD Resources (MOD) has announced results of the scoping study for a proposed open-pit mine at its 70 %-owned T3 copper-silver deposit in the Kalahari Copperbelt of Botswana. According to the company, the project economics are highly encouraging and highlight MOD's potential to become a long-life copper producer in Botswana.

Due to the robust financial outcomes indicated by the scoping study, MOD and joint venture partner, Metal Tiger (30 %), will proceed with a pre-feasibility study (PFS) commencing early 2017.

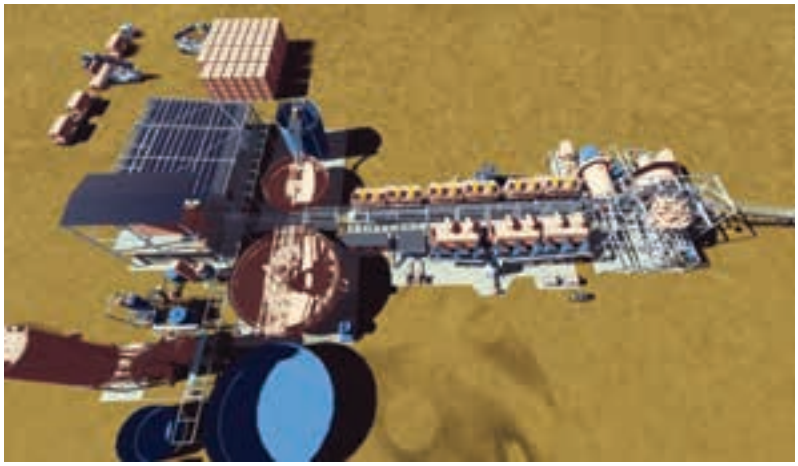
On 26 September 2016, MOD announced a maiden resource at T3 comprising 28,36 Mt grading 1,24 % copper and 15,7 g/t silver, containing approximately 350 200 tonnes (772 Mlb) of copper and more than 14 Moz of silver. The T3 resource includes 18 Mt grading 1,35 % Cu and 16,7 g/t Ag in the indicated resource category which represents 64 % of the total resource. The resource is open along strike west of current drilling.

T3 mineralisation consists of disseminated and vein-hosted copper sulphides including chalcopyrite, bornite and chalcocite occurring within a shallow dipping sequence of sediments up to 50 m true width. As part of the PFS, MOD intends to conduct infill drilling around areas of high-grade vein mineralisation within the resource. The purpose is to define the extent of this high grade mineralisation which may provide opportunities for improving the grade of current production targets at an early stage of mining.

The PFS will also consider optimisation of the mining schedule and reducing project capital and operating costs with a view to further enhancing the already robust metrics of the project.

T3 is located within 12 km of the Ghanzi Highway in an area of freehold cattle farms. MOD has been advised by Botswana Power Corporation that grid power is planned to be extended along the Ghanzi Highway in mid-2019.

In parallel with the PFS, exploration will also increase in early 2017, initially to test a large area within the T3 Dome directly north of T3 for similar type sediment-hosted deposits. The T3 Dome is interpreted to extend over 50 km in length and is covered by MOD and Metal Tiger joint venture prospecting licences.



The 2 Mt/a sulphide flotation plant proposed for the T3 deposit.

The scoping study includes an optimised pit design to approximately 220 m vertical depth and construction of a processing plant to treat 2 Mt/a of ore with low cost expansion optionality if required. Pre-stripping of the first stage of the planned open pit is scheduled to commence in 2019 with ore processing targeted to commence later in 2019.

Total indicative mine life is approximately 10 years with 9,25 years of ore production with an estimated life of mine (LOM) average production of approximately 21,8 kt/a copper and 665 koz/a silver.

Two preliminary scoping level models have been generated using two different copper price assumptions – a preliminary base case model using a consensus copper price of US$2,53/lb Cu and a preliminary upside case model using an elevated price of US$3,00/lb Cu.

The base case model indicates robust financial metrics which include an estimated average annual pre-tax cash flow of approximately US$44 million per annum, a pre-tax $NPV_{10\%}$ of approximately US$180 million and an IRR of approximately 31 %. LOM C1 costs are estimated to be US$1,29/lb Cu including silver credits. The estimated project cost (±35 %)

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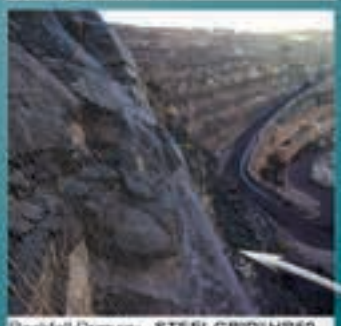

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is US$135 million, including US$18 million capital for pre-strip costs and US$18,3 million contingency. The expected payback period is 2,6 years.

The upside case model indicates outstanding financial metrics which include an estimated average annual pre-tax cash flow of approximately US$65 million per annum, a pre-tax $NPV_{10\%}$ of approximately US$297 million and an IRR of approximately 42 %. C1 costs are estimated to be US$1,31/lb Cu including silver credits.

MOD Resources Managing Director Julian Hanna says the scoping study clearly demonstrates the project's strong commercial potential as well as the opportunity for significant upside.

"T3 is a significant new sediment-hosted copper and silver deposit which has progressed from discovery to completion of a positive scoping study in just nine months. Total cost from discovery to completion of the scoping study was only approximately US$2,5 million, confirming the outstanding efforts and commitment of the exploration and scoping study teams as well as the quality of the deposit.

"T3 is also exciting from a geological standpoint because it opens up a wider potential for further discoveries in this extensive area of the Kalahari Copperbelt which remains untested."

The unusual geometry of the T3 deposit with wide and continuous zones of shallow dipping mineralisation provides the ideal opportunity for potential low cost, open-pit mining. Sulphide mineralisation is continuous from shallow depth to the current limit of drilling at around 270 m depth.

Pit optimisations have been performed by South African mining consultants Sound Mining using NPV Scheduler© software based on Mine Design Criteria (MDC) compiled in agreement with MOD. The optimisations used a LOM copper price of US$2,53/lb.

The pit design enables a staged mine development producing an annualised ore mining rate of 2 Mt/a with the first stage targeting shallow high grade ore with the objective to pay back capital within two to three years. The production target is 18,13 Mt of ore at 1,16 % Cu and 13,9 g/t Ag for a total of 201 kt Cu and 6,1 Moz Ag.

Block models were generated based on a Small Mining Unit (SMU) block size of 7,5 m x 7,5 m x 2,5 m, which takes account of planned

A drill site at the T3 deposit (photo: Nick O'Reilly, QP for Metal Tiger).

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ore grade dilution. In addition, a 95 % ore recovery and unplanned dilution of 10 % were included in the model giving total estimated ore dilution of 17 % and yielding fully diluted LOM ore grade of 1,16 % Cu and a LOM strip ratio of 6,13.

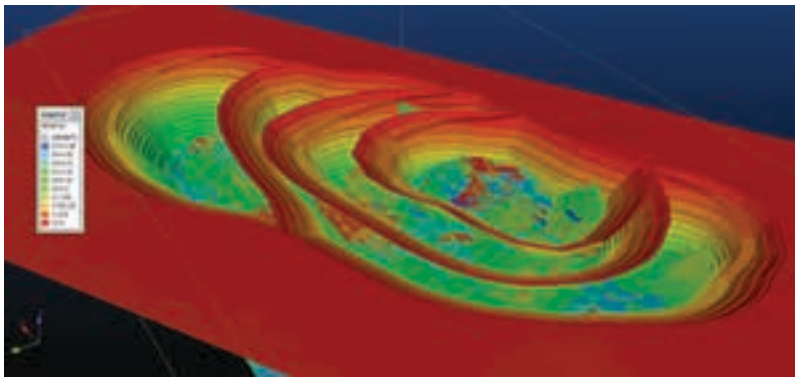
Approximately 88 % of the production target is in the indicated resource category. Importantly, 95 % of the production target is in the indicated resource category for the first three years of production.

Around 9,5 Mt of near surface waste rock is planned for removal as a pre-strip before production commences. Based on a review of available geotechnical information, Sound Mining has estimated the preliminary overall slope angles for pit optimisation. In addition, an allowance for dewatering has been made in the order of 5 to 25 ℓ/s over the LOM, for mine optimisation and design purposes.

Open-pit ore and waste mining is planned to be conducted by contractors. Ore and waste mining costs used in preliminary financial models were derived from comparison with similar operations and estimates provided by South African mining contractors.

The process plant and associated service facilities will process run-of-mine (ROM) ore to produce a copper concentrate and tailings. The process consists of crushing and grinding of the ore followed by sequential rougher and cleaner flotation. Concentrate will be thickened, filtered and stockpiled prior to being loaded into containers for storage and subsequent transport to third-party smelters. The flotation tailings will be dewatered by thickening and disposed of at the Tailings Storage Facility (TSF). The plant has potential to be up-scaled to around 3 Mt/a in the event production is increased at T3 or additional ore is sourced from satellite deposits in the region.

Preliminary testwork indicates the potential to produce high-grade copper/silver concentrates, which are proposed to be stored on site and transported in half height containers. Containerisation of concentrates provides several potential logistical, commercial and environmental benefits, which will be further evaluated during the PFS.



Proposed 4-stage pit at T3 looking south.

Since releasing the results of the scoping study in early December 2016, MOD reports that it has raised approximately US$5,46 million before costs from an institutional placement to accelerate the development of T3 and increase the rate of exploration, particularly along the T3 Dome. More recently, it has announced that its 2017 drilling campaign started on 7 January, initially using two diamond core rigs and one RC rig, with three additional rigs available on site as needed.

Eleven exploration targets have been identified for drilling within the 983 km² T3 project area during the quarter. A substantial soil geochemical programme covering the project area is also underway and a state of the art 3D IP survey has begun to 'map' the T3 host sequence and identify deeper structural targets.

As part of the T3 PFS, a programme of geotechnical and metallurgical drilling for the planned T3 pit has commenced. Pump testing of existing and planned water bores is also expected to start mid-February to identify potential sources of process water for the planned treatment plant. ■

Around 9,5 Mt of near surface waste rock is planned for removal as a pre-strip before production commences.

Fourie Diamante hits pay dirt with Bell/Finlay machines

Pictured from left are Dan Fourie with his son, David Fourie, holding the diamond-bearing gravel, and Eric van der Merwe, a Bell Equipment Sales Representative based at the company's Kimberley Customer Service Centre.

Alluvial diamond miners rarely own the land that they mine and because of this they take extra care in the rehabilitation of such sites, which in turn stands as good testimony for obtaining more land to ply their trade on.

These are the thoughts of a third-generation alluvial diamond miner who has turned to modern technology to separate his 'pay dirt', the diamond-bearing gravel, from the oversized material that will form the basis of rehabilitating the land that he respects.

David Fourie and his father, Dan, mine the banks of the Riet River in the Northern Cape, between Douglas and Kimberley. David's grandfather, Jan Fourie, had done the same albeit further north in what was to become North West Province. The skill of reading terrain and gravel has been passed on from one generation to the next.

"Things have changed drastically from when I started in the alluvial diamond mining business, some 50 years ago," says Dan Fourie. "Back then there was a lot more manual labour with picks and shovels and tiny four foot six inch pans that were turned by hand."

Dan's son, David, was keen to up their production levels after they had established a new diamond mining concern, Fourie Diamante, in 2007. "We soon realised that we needed decent haulage equipment with capacity," David says. "It took us a few years to establish our cash flows but by 2012 we could buy a rebuilt Bell B40D articulated dump truck (ADT) from Bell Equipment in Kimberley and that immediately made a difference to the amount of mined gravel we could get to our screens."

In this case, the screens David refers to were two rotary mesh screens set at different apertures to separate the oversized material from the diamond-bearing gravel.

Fourie Diamante mines land leased from a farmer in a responsible manner. Topsoil is stripped and stockpiled for later rehabilitation, as is the overburden, which covers the diamond-bearing gravel. The thickness of the overburden varies between 1 and 4 m and the gravel on this land is generally about 4 m in depth.

"In 2015 we bought a second used Bell B40D ADT privately but found with the amount of gravel we were unloading at the screens, they could simply not keep up," he continues. "We then realised that some serious intervention was needed to fully streamline our production cycle and keep up a constant feed to our two 16-foot pans."

The answer lay in a Finlay 883+ heavy duty screen.

"We really have to thank our local Bell Equipment Sales Representative, Eric van der Merwe, for his insight here in realising that for us to achieve the production rates we were aiming at, this was the correct equipment for our needs," David says. "Eric knows our industry intimately and is very knowledgeable when advising on the correct equipment for the task at hand."

Fourie Diamante took delivery of a Finlay 883+ heavy duty screen in December 2015 and, according to both father and son, the positive change in their production throughput was immediate. A 40-ton excavator loads the run-of-mine material into the screen's hopper, which with optional hopper extensions fitted, has a massive 10 m^3 capacity. A sustained throughput of 500 t/h is easily maintained and this works well for them as they only work during daylight hours. Average fuel burn from the engine delivering 83 kW at 12 litres an hour does not break the bank either.

Bell Equipment, tel (+27 11) 928-9700

Fourie Diamante's Finlay 883+ heavy duty screen is fitted with optional hopper extensions to provide a massive 10 m^3 capacity and enable a sustained throughput of 500 t/h.

New conveyor belt cleaner from Martin Engineering

US-based Martin Engineering has produced a patented conveyor belt cleaner which – it says – will reduce the cost of ownership by cleaning better and lasting longer. A lower purchase price was also one of the primary goals in designing the Martin® QB1 Cleaner HD, achieved by adopting state-of-the-art roll forming equipment as part of Martin Engineering's manufacturing capabilities.

"Rather than fabricating the main frame from individual steel profiles welded together, the frame for the new design is roll formed out of a single piece of steel, which produces an extremely strong and durable component," explains Paul Harrison, Director of the Conveyor Products Business Group. "The process eliminates the time-consuming steps of having to weld any portion of the frame, which also contributes to the reduced purchase price."

Described as one of the most comprehensive patents the company has ever been awarded, protection covers the main frame design, manufacturing process and attachment method. The new cleaner features Martin Engineering's unique 'CARP' (Constant Angle Radial Pressure) technology to maintain the most efficient cleaning angle throughout service life, with a no-tool replacement process that can be performed safely by one person in less than five minutes.

"We've simplified the manufacturing process and also re-engineered the blade itself," Harrison continues. "The new profile is less complex to produce, and because it can be roll formed or manufactured on a press brake, it will be easier to source throughout the world from any Martin Engineering manufacturing site."

The new design also features a special alignment system to facilitate extremely precise installation. "One of the most common problems we see in the field is primary cleaners installed in the wrong position," says Senior Product Specialist Dave Mueller. "This cleaner was engineered for easy, accurate installation."

The QB1™ Cleaner HD can be retrofitted onto any existing Martin Engineering tensioners, as well as most competitive systems.

In addition to its cost advantages, the design features a square mainframe positioned to shed dust and spillage. The urethane blade formulation can accommodate belt speeds of up to 4,6 m/s and service temperatures of -40° to 70°C.

The product is available in lengths of 457 to 2 438 mm and can also be ordered in 3,05 m sections, allowing distributors or customers to cut to length for increased versatility.

Martin Engineering, tel (+27 13) 656-5135, website: www.martin-eng.co.za

The new, patented design is claimed to deliver outstanding performance and a reduced cost of ownership.

Robotic system speeds track shoe refurbishment

Currently the robot refurbishes track shoes for D9 (seen here), D10 and D11 Caterpillar bulldozers.

Barloworld Equipment Southern Africa has unveiled a state-of-the-art robotic system that has modernised the way the refurbishment of track shoes for Caterpillar bulldozers is done.

The robot has effectively replaced the manually driven and monotonous process of refurbishing the track shoes with an automated, end-to-end mechanism that requires little human involvement.

The technological advancement in refurbishing track shoes will significantly reduce refurbishment costs for clients, improve product quality, and cut the turnaround time it takes to rebuild track shoes, thereby generating financial benefits for customers through reducing downtime.

"Before the robot was introduced, it took five days for two people to manually refurbish the tracks for a D11 bulldozer. The robot does the same work in 20 hours, with one operator.

"There are many competitors in the market that provide the same service. It's very important for us to be faster and more price-competitive than our competitors," said Sean Walsh, Senior General Manager at Barloworld Equipment.

People now do 5 % of what they used to do manually, reducing exposure to heat and potential injuries, as the robot does the welding and also handles materials (steel bars) used to refurbish bulldozer track shoes.

Now the Barloworld Equipment operators can focus on the more complex tasks they are trained for.

Currently the robot refurbishes track shoes for D9, D10 and D11 Caterpillar bulldozers. In future, it will have the capacity to refurbish track shoes for D7 and D8 Caterpillar bulldozers.

"We can repair track shoes and the track links, enabling our customers to get a second life on their machines. When the machines are parked due to inactivity or breakdowns, our customers lose money. The short turnaround time will reduce downtime for our customers to enable them to make money," said Schalk Burger, Service Manager at Barloworld Equipment.

The robot, nicknamed 'Tokolosie', has two arms. The first arm (the gripper) specialises in handling materials, cutting worn-out grouser bars from track shoes and placing new grouser bars onto the track shoes. The second arm (the welder) specialises in welding the new grouser bar onto the track shoe.

When the 'gripper' has completed its task, it hands over the rebuilt track shoe to the 'welder' to weld the new grouser bar firmly onto the track shoe.

The two arms work in a synchronised mechanical manner and take 14 minutes to complete the whole refurbishing process for a single-track shoe. They then repeat the process in 14-minute cycles.

Previously workers had to use the oxyfuel cutting system to remove worn-out grouser bars from track shoes. A new grouser bar was then manually welded onto the track shoe. However, re-grousing a track shoe is impossible if the wear on the grouser bar is beyond 80 %. If the grouser bar is beyond the minimum wear rate, the entire track shoe has to be discarded as refurbishment cannot be done.

"The price of re-grousing was more expensive than the price of competitors' new track shoes. Now we can re-grouse more cheaply than our competitors," explains Burger.

Tokolosie was developed by ABB Robotics, a leading Zurich-based supplier of industrial robots and robot software. The development of the end-to-end re-grousing system started in October 2014 and the robot was delivered to Barloworld Equipment's facility in Middelburg, in May 2016 for installation and commissioning.

"As Barloworld Equipment, we would like to extend our gratitude to our Middelburg team and ABB for a job well done in designing and commissioning the robot. The commissioning of the robot is in line with our strategy of improving safety for our staff and customers. We aim to achieve zero fatalities and a less than 0,05 Lost Time Injury Frequency Rate by 2020.

"The reduction of human involvement in the refurbishment process will go a long way towards helping us achieve our safety objectives. The end-to-end re-grousing process will reduce human involvement in material handling and reduce the exposure of humans to heat and accidents," said Lesibana Ledwaba, Divisional Executive Director for Strategy, Risk & Operational Transformation at Barloworld Equipment.

Barloworld Equipment, tel (+27 11) 929-0000

Valve supply company extends its range

Afrivalve, part of the eDART Group of Companies, has further expanded its range to now offer the Gemü Valve and Control Systems range in the mining and metal refining sectors in Africa. This further complements the eDART slurry control valves, C-Tech knife gate valves, Red Roc pinch valves and the AVI range of industrial valves.

Gregor Hopton, Group Marketing Manager of Afrivalve, has over 20 years of experience selling the Gemü range in South Africa and knows – he says – the quality and reliability that the brand offers. This gives Afrivalve the ability to offer a complete valve solution typically from mill discharge all the way through the process to the final refined metal.

The Gemü range includes metal body valves, metal body lined in thermoplastic (or fluoropolymer lined) and full thermoplastic valves. Full bore and Weir type diaphragm, butterfly, angle seat, globe and solenoid valves are commonly used in the mining sector. Both abrasive and corrosive applications are catered for in the wide range of materials of construction.

In-house expertise within the eDART Group includes mechanical, instrumentation, process and design engineering. Control valve sizing and specialised valve training courses are also offered within the Group.

Afrivalve, tel (+27 11) 791-1411

SEW-EURODRIVE Cape Town invests in new assembly cells

SEW-EURODRIVE Cape Town has invested in new assembly cells for geared motors to speed up production, increase quality and reduce wastage. As part of its ongoing development, the branch also plans a new assembly cell for electronics in the near future.

"We have definitely started to do more business on the electronics side, especially in terms of servo motors and mechatronic units, which combine electronics with mechanical gearing," comments Branch Manager Byron Griffiths.

He explains that the assembly-cell development embarked upon by the Cape Town branch will increase its flexibility and capability to deliver total solutions for clients. It will also assist in reducing stockholding, as many components are interchangeable, as opposed to having to keep one item in stock in every available size and configuration.

Cape Town is a significant production hub for SEW-EURODRIVE, as it assembles units for other branches, including Nelspruit, Durban, Johannesburg and Port Elizabeth. In addition, specific sizes and ranges are only assembled in Cape Town, and distributed to other branches when needed. "For example, a smaller location such as Port Elizabeth will rely on us for its production, from servo motors to geared motors," Griffiths points out.

He adds that the Western Cape market in particular is showing growth in terms of both volumes and turnover. "The market is definitely on the uptick compared to last year. We are doing surprisingly well, despite the prevailing tough market conditions."

Griffiths reveals that the food and beverage industry is very stable in the Western Cape, where the large percentage of exports means that OEMs favour energy-efficient equipment such as SEW-EURODRIVE's IE3-compliant DRN series of asynchronous motors.

Griffiths stresses that what gives SEW-

SEW-EURODRIVE Cape Town has invested in new assembly cells for geared motors to speed up production.

EURODRIVE a competitive edge in the Western Cape market is its quick turnaround and lead times, coupled with excellent customer service and aftermarket support. "We are very fortunate in having such a fantastic assembly facility here, together with a spare parts inventory, which means we can service our customers comprehensively and in the fastest times possible," he concludes.

SEW-EURODRIVE, tel (+27 11) 248-7000

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Sykes pumps offer reliable dewatering

Unless there is effective groundwater control, even the best run sites could become hindered by expensive and challenging problems. This will not only cause programme delays but could also have an adverse effect on health and safety.

Lee Vine, MD of Integrated Pump Rental, cautions the market that dealing with dewatering activities is not as simple as merely purchasing or renting a pump.

"It is essential that contractors deal with a supplier that understands dewatering applications and is able to provide the correct level of technical assistance as this will ensure that the most efficient method of dewatering is selected for a specific site," Vine says.

Integrated Pump Rental is responsible for marketing the Sykes range of dewatering pumps in Southern Africa. Vine says these pumps have an established reputation for the fast and effective control and removal of subsurface water.

The Sykes Primax Contractors Range of diesel driven pumps offers the market reliable dewatering coupled with cost efficiency. These are fully automatic priming pumps and can run dry for extended periods due to the oil bath mechanical seal assembly. This allows priming with long suction hoses and suction lifts of up to 9 m.

Vine explains that as suction levels fluctuate, the pump will 'snore' until the liquid is available for the pump to fully reprime itself automatically.

Constructed using quality materials, the pumps are fitted with a 316 SS impeller and wear plates as standard. The pumps are capable of handling solids up to 90 mm.

Lee Vine, Integrated Pump Rental, tel (+27 72) 627-6350

Boasting one of the best shaft stiffness ratios of any automatic priming pump on the market, the Sykes high head range provides the reliability to meet market expectations.

Drilling engine on display at Indaba

Cummins will be showcasing its QSK60 drilling engine at the upcoming Investing in Africa Mining Indaba 2017 at the Cape Town International Convention Centre.

It will be the third time that Cummins will be present at this prestigious event, notes Marketing Manager Palesa Ramodibe. "Mining is a key area in terms of our business segments," she says.

She adds that the mining industry is still recovering from the global slump in commodity prices, which means the major players are focusing increasingly on increased return on investment. "This is where our cost-saving and energy-efficient technology comes into its own," she says.

According to Cummins, the QSK60 – a four-cycle industrial diesel engine – delivers reliable power, low emissions, and responds quickly to load changes.

Cummins Africa, tel (+27 11) 589-8400
website: Africa.Cummins.com

Mobile gensets refurbished for Impala

The ability of Marthinusen & Coutts, a division of ACTOM, to manage complex turnkey projects has again been underpinned by the successful completion of a project for Impala Platinum Mine.

Chris Ngobeni, winding assistant at Marthinusen & Coutts, performing final checks on the generator rotor panel.

Clive Myall, Marthinusen & Coutts' Field Service Manager, says this leading electrical rotating machinery service provider was awarded the contract to refurbish two mobile generator sets. The two generator sets provide backup power at the mine outside Rustenburg.

The project involved servicing the 2 200 kVA alternators and MTU engines as well as managing the servicing and refurbishment of all associated equipment. Myall says that some of the electrical equipment had to be replaced and upgraded with the help of specialist suppliers and service providers.

Both mobile units, originally manufactured in 1986, were taken to Marthinusen & Coutts' Power Generation equipment repair facility in Benoni, where they underwent a complete strip-down assessment. New radiator cores and piping were manufactured for the cooling system. A new engine pre-heat system was designed, manufactured and installed and minor engine repairs were performed.

The original analogue control systems in the control rooms were replaced by state-of-the-art automated digital systems, along with compatible engine governors. "We subcontracted this work to automation specialists. The upgrade involved complete redesigning of the control panels and wiring. It represents a big advance over the old system in terms of speed, efficiency and automatic monitoring of the condition of the entire generator set equipment," Myall says.

"A major advantage for this and other customers is that Marthinusen & Coutts is able to assume complete responsibility for all the electrical and mechanical equipment involved and offer a turnkey solution," Myall concludes.

Marthinusen & Coutts, tel (+27 11) 607-1700

Modder East ups advance rate with rapid reloading emulsion system

Modder East's James McArdle.

In a first for South African mining, Gold One's Modder East mine has rolled out an innovative infrastructure to use emulsion explosives for all 70 of its underground narrow-reef stope panels, as part of its strategy to reduce its cost per ton mined.

Developed and installed in partnership with leading blasting company BME over the past three years, the unique rapid reloading system includes the world's deepest vertical emulsion pipeline of 318 m to deliver emulsion from surface to storage tanks underground. Used with BME's narrow-reef pump technology, this system has allowed Modder East to move away from the use of cartridge explosives and fully convert to BME's emulsion explosives.

"The new arrangement will allow us to achieve our campaign goal for the coming year of a 0,8 m advance per panel per day – a substantial improvement on the 0,65 m we used to average," said James McArdle, Explosives and Technical Manager at Modder East. "The cost savings and productivity improvements convince us that this technology will be the only way for mines to go in the future."

Specialised transporters in the haulages are filled with BME's Megapump emulsion from the underground tanks and delivered to re-filling stations near the stope face, from where the BME Minicharger portable charging units (PCUs) are filled.

"With collaboration from BME experts, we have already shown that our targeted advance rates can be achieved," said McArdle. "Our crews are receiving intensive training to further improve their drilling discipline, and the improved results are coming through."

He said the increase in the daily advance rate could generate additional gold mined per month.

"The beauty of using this emulsion system includes the time saved to get the product underground, as well as the efficiencies gained by not having to manually manage explosive cartridges – which are also closely regulated for safety and security reasons," he said.

The emulsion-filled bags, or bladders, that fit onto the hand-held Minichargers weigh just 18 kg each – making them lighter and easier to carry than the cartridge boxes traditionally moved from surface to the stope face for blasting.

The handling and storage of emulsion is much less onerous than cartridges as it is classified as a 5.1 oxidiser – rather than an explosive – and is only sensitised when actually inside the drill-hole.

The highly stable characteristics of BME's double-salt emulsions have allowed them not only to be pumped to this record-breaking depth, but also to be re-pumped frequently and stored for extended periods before use.

BME, tel (+27 11) 709-8765

End-to-end logistics solutions offered

Land & Sea Shipping, a full supply chain logistics brokerage in Southern Africa, is staking its name in local and international markets with tailor-made end-to-end logistics solutions.

The company has launched its Advisory Division in addition to an already impressive portfolio. Its expertise includes Reserve Bank rulings, currency risk, weighted average of capital, debt or equity capitalisation versus cash conversion cycles, FX spread, and conversion and transactional costs to name a few.

"Maintaining high service levels and offering competitive logistics solutions is the core of our business," says Siva Pather, one of Land & Sea Shipping's directors. "Being able to offer our clients savings across their balance sheet through our Advisory Division enables healthy business and a growing economy."

Land & Sea Shipping, tel (+27 11) 679-1651

SA French to supply hoists to Zambian copper mines

SA French is supplying two Saltec T1 half-ton passenger hoists to copper mines in Zambia. The two hoists will facilitate the movement of personnel, together with light tools and equipment, up the shaft headgear framework.

Louw Smit, Sales Manager at SA French, says that the order was secured as a turnkey contract which includes the supply, installation and commissioning of the two hoists at two different mines in the region.

Vertical transport solutions always need to comply with stringent safety parameters and the Saltec passenger hoists incorporate advanced security systems.

"Vertical transport solutions always need to comply with stringent safety parameters and the Saltec passenger hoists incorporate advanced security systems including a speed regulator and an overspeed emergency braking system on an independent pinion," Smit points out.

These features will ensure that mine personnel are able to undertake maintenance activities safety and efficiently, optimising the productivity on the mines. Smit says that the integral emergency brake on the Saltec hoist will bring the cabin to a gradual stop in the event of overspeed conditions during descent.

The Saltec hoists will be installed to reach a maximum height of 72 m and will be programmed to stop at five different levels on the headgear frame.

Manufactured by Torgar, Saltec passenger and material hoists feature rack and pinion drives ensuring reliable operation. This type of system also requires minimum maintenance and is considered the safest for vertical travel.

Constructed as a heavy duty elevator which is engineered to operate under the worst conditions, the Saltec hoist is manufactured from hot dipped galvanised steel and aluminium. The high strength cabin is equipped with load cells to avoid overloading, while the sophisticated electronic control system has a functional user-friendly panel.

The two Saltec hoists are scheduled for installation in the first quarter of 2017.

SA French, tel (+27 11) 822-8782

Mine stoppages highlight need for PDS technology

More frequent government-ordered safety stoppages on mines – which demand a halt to a mine's entire operation – highlight the need for a system that detects potential collisions underground and alerts personnel to dangerous situations, says Booyco Electronics' Continuous Improvement Manager, Jaco du Plessis.

The Chamber of Mines recently reported that South African platinum producers had experienced three times as many 'Section 54' stoppages by the DMR in 2016 than in previous years; the cost of safety stoppages for the industry as a whole was estimated at R4,8 billion in 2015, up from R2,6 billion in 2012, the report said.

Du Plessis says Booyco Electronics' Proximity Detection System (PDS) has built a reputation for helping mines protect their most important asset: their people.

"The PDS is designed to allow for intervention where a potentially dangerous situation exists between a pedestrian and a machine," he says. "Consisting of a sensing device that detects the presence of an object in a working area, the system can provide an audible and visual alarm to both the equipment operator and pedestrians as they enter danger zones."

He adds that warning zones can be specified to suit the requirements of specific mine areas, and standardised to a particular type of equipment.

"PDS technology also makes it possible to locate pedestrians and vehicles underground, which enhances production efficiencies and facilitates the locating of people and machinery in an emergency," Du Plessis explains. "Data from the system can be analysed and patterns identified, so that unsafe behaviour can be detected and safety interventions initiated."

He says the PDS was developed as part of the Booyco Electronics Asset Management System (BEAMS) that provides underground and surface mining operations with a web-based application and robust database to optimise mine safety and ensure compliance to relevant legislated requirements.

Booyco Electronics, tel 0861 BOOYCO (266926)

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SA OFFICE:

Jim Pooley: +27 82 373 0796 email: jim@baraconsulting.co.za

Clive Brown: +27 82 557 5373 email: clive@baraconsulting.co.za

www.baraconsulting.co.za

UK OFFICE:

Pat Willis: +44 7810 182 169 email: patw@baraconsulting.co.uk

www.baraconsulting.co.uk