DFS provides a clear path forward for Platreef project

TSX-listed Ivanhoe Mines has released the positive results of an independent Definitive Feasibility Study (DFS) on its Platreef underground mine near Mokopane in Limpopo Province which confirm the excellent economics of the project which were first highlighted in the March 2014 Preliminary Economic Assessment (PEA) and the January 2015 Pre-Feasibility Study (PFS). Commenting on the results, Robert Friedland, Ivanhoe's Executive Chairman, said: "We now have a clear and defined path forward to initial production and subsequent phases of development."

> vanhoe is already well advanced with the development of the project, with sinking of the 7,25-m internal diameter Shaft 1 by Aveng Mining continuing to advance at a rate of 45 to 50 metres per month. Sinking has now reached a depth of over 450 m below surface and development of the first of four planned shaft stations – the 450-m level substation – is underway. Shaft 1, which will ultimately serve as a ventilation shaft, is expected to reach the Flatreef deposit, the orebody to be exploited, at a depth of 777 m below surface in the first half of 2018. Sinking will continue to a planned final depth of 980 m below surface.

> The primary access to the mine will be by way of a 1 104-m deep, 10-m internal diameter production shaft (Shaft 2). It will be equipped with two 40-tonne rock-hoisting skips with a capacity to hoist a total of 6 Mt/a – which will

be the single largest hoisting capacity at any mine in Africa. The headgear for the permanent hoisting facility has been designed by Murray & Roberts Cementation.

Early works construction for Shaft 2 – which is located just 100 m north-east of Shaft 1 – began earlier this year. This approximately R70 million works programme will see the excavation of a boxcut to a depth of approximately 29 m below surface and construction of the concrete hitch (foundation) for the 103-m high concrete headgear that will house the shaft's permanent hoisting facilities and support the shaft collar.

Ivanhoe plans to develop the Platreef mine in three phases: an initial rate of 4 Mt/a to establish an operating platform to support future expansions; a doubling of production to 8 Mt/a; and expansion to a steady-state 12 Mt/a. The first phase development envisages producing 476 000 ounces of platinum, palladium, rhodium and gold, plus 33 million pounds of nickel and copper, annually.

The independent Platreef DFS – prepared for Ivanhoe by principal consultant DRA Global – covers the first phase of development that would include construction of a state-of-the-art underground mine, concentrator and other associated infrastructure to support initial concentrate production by early 2022. As Phase 1 is being developed and commissioned, there would be opportunities to refine the timing and scope of subsequent phases of expanded production.

"The completion of the Definitive Feasibility

Study for the first phase of production is another key milestone in Ivanhoe's planned transformation of the Platreef Discovery into one of the pre-eminent South African producers of platinum group metals," commented Friedland.

"Platreef is a massive, high-grade, long-life and Tier One deposit that will produce a suite of vital metals, many of which are essential to sustain our urbanising planet. The nickel and copper by-products are essential in the electric car revolution and the platinum and palladium are equally vital for hydrogen fuel cell technology and catalytic converters to clean the air."

Friedland added that despite lower metal prices used in the DFS compared to the 2015 PFS, the excellent economics of the project have been maintained. He said this was due, in part, to the mine optimisation work completed with assistance from industry-leading experts, such as Whittle Consulting of Melbourne, Australia. "Even at today's spot metal prices, the Platreef project would generate an operating margin in excess of 40 %," he stated.

Highlights of the DFS include an enhanced mineral reserve containing 17,6 Moz of platinum, palladium, rhodium and gold (an increase of 13 %); an after-tax NPV of US\$916 million at an 8 % discount rate; and an after-tax IRR of 14,2 %. The estimated pre-production capital requirement is approximately US\$1,5 billion (at a rand/dollar exchange rate of 13 to 1).

Mining zones in the current Platreef mine plan occur at depths ranging from

PLATINUM

Platreef's Shaft 1 headgear. Shaft 1 has an internal diameter of 7,25 m and will be sunk to a final depth of 980 m.



Inside Shaft 1. Sinking has now reached a depth of over 450 m below surface and is advancing at a rate of 45 to 50 metres per month.



The Platreef mine – illustration of first-phase surface infrastructure and host communities. The secured surface area is designed to accommodate an expansion to 8 Mt/a. approximately 700 m to 1 200 m below surface. As mentioned, primary access to the mine will be by way of Shaft 2 with secondary access to the mine via Shaft 1. During mine production, both shafts will also serve as ventilation intakes. Three additional ventilation exhaust raises (Ventilation Raise 1, 2, and 3) are planned to achieve steady-state production.

According to the DFS, mining will be performed using highly productive mechanised methods, including long-hole stoping and drift-and-fill. Each method will utilise cemented backfill for maximum ore extraction. The current mine plan has been improved over the 2015 PFS mine plan by optimising stope design, employing a declining Net Smelter Return (NSR) strategy and targeting highergrade zones early in the mine life. This strategy has increased the grade profile by 23 % on a 3PE+Au basis in the first 10 years of operation and 10 % over the life of the mine.

The ore will be hauled from the stopes to a series of internal ore passes and fed to the bottom of Shaft 2, where it will be crushed and hoisted to surface.

Metallurgical test work has focused on maximising recovery of platinum group elements (PGE) and base metals, mainly nickel, while producing an acceptably high-grade concentrate suitable for further processing and/or sale to a third party. The three main geo-metallurgical units and composites tested produced smeltergrade final concentrates of approximately 85 g/t PGE+Au at acceptable PGE recoveries.

Test work also has shown that the material is amenable to treatment by conventional flotation without the need for mainstream or concentrate ultrafine re-grinding. Extensive bench scale testwork comprising open circuit and locked cycle flotation testing, comminution testing, mineralogical characterisation, dewatering and rheological characterisation was performed at Mintek in South Africa.

Comminution and flotation test work has indicated that the optimum grind for beneficiation is 80 % passing 75 micrometres. Platreef ore is classified as being 'hard' to 'very hard' and thus not suitable for semi-autogenous grinding; a multi-stage crushing and ball-milling circuit has been selected as the preferred size reduction route.

Improved flotation performance has been achieved using high-chrome grinding media as opposed to carbon steel media. The inclusion of a split-cleaner flotation circuit configuration, in which the fast-floating fraction is treated in a cleaner circuit separate from the medium- and slow-floating fractions, resulted in improved PGE, copper and nickel recoveries and concentrate grades.

As with the PFS, a two-phased development approach was used for the DFS flow-sheet design. The selected flow sheet comprises a common 4 Mt/a, three-stage crushing circuit, feeding crushed material to two parallel milling-flotation modules, each with a nominal capacity of 2 Mt/a. Flotation is followed by a common concentrate thickening, concentrate filtration, tailings disposal and tailings handling facility.

Given the size and potential of the Platreef resource, Shaft 2 has been engineered with a crushing and hoisting capacity of 6 Mt/a. This allows for a relatively quick and capital-efficient first expansion of the project to 6 Mt/a by increasing underground development and commissioning a third 2 Mt/a processing module and associated surface infrastructure as required.

A further expansion to more than 8 Mt/a would entail converting Shaft 1 from a ventilation shaft into a hoisting shaft. This would require additional ventilation exhaust raises, as well as a further increase of underground development, commissioning of a fourth 2 Mt/a processing module and associated surface infrastructure.

The project's water requirement for the first phase of development is projected to peak at approximately 7,5 million litres per day. It is planned that water will be provided by the Olifants River Water Resource Development Project (ORWRDP), which is designed to deliver water to the Eastern and Northern limbs of South Africa's Bushveld Complex.

The project consists of the new De Hoop Dam, the raised wall of the Flag Boshielo Dam and related pipeline infrastructure that ultimately is expected to deliver water to Pruissen, south-east of the Northern Limb. The Pruissen pipeline project is expected to be developed to deliver water onward from Pruissen to the municipalities, communities and mining projects on the Northern Limb. Ivanhoe Mines is a member of the ORWRDP's Joint Water Forum.

Ivanhoe is also investigating various alternative sources of bulk water, including an allocation of bulk grey-water from a local source.

As regards electrical power, the 5 MVA power line connecting the Platreef site to Eskom was energised in February this year and is now



supplying electricity to Platreef for shaft sinking and construction activities. The new power line, a collaboration between Platreef, Eskom and the Mogalakwena Local Municipality, has also established a platform to provide energy to the neighbouring community of Mzombane, which previously was without electricity reticulation and supply.

Platreef's electrical power requirement for the phase one underground mine, concentrator and associated infrastructure has been estimated at approximately 100 MVA. An agreement has been reached with Eskom for the supply of phase one power. Ivanhoe chose a self-build option for permanent power that will enable the company to manage the construction of the distribution lines from Eskom's Burutho sub-station to the Platreef mine.

Ivanhoe has now appointed five leading mine-financing institutions as Initial Mandated Lead Arrangers to arrange debt financing for the development of the Platreef mine. They are: KfW IPEX-Bank, a German government owned institution; the Swedish Export Credit Corporation; Export Development Canada; Nedbank Limited (acting through its Corporate and Investment Banking division); and Societe Generale Corporate & Investment Banking. Expressions of interest have been received for approximately U\$900 million of the targeted US\$1 billion project financing.

Ivanhoe Mines indirectly owns 64 % of the Platreef project through its subsidiary Ivanplats and is directing all mine development work. The South African beneficiaries of the approved broad-based black economic empowerment structure have a 26 % stake in the project. The remaining 10 % is owned by a Japanese consortium of ITOCHU Corporation; Japan Oil, Gas and Metals National Corporation; and Japan Gas Corporation. As this graph (taken from an Ivanhoe presentation) indicates, at 12 Mt/a the Platreef mine would be the largest platinum group metals mine in the world.

Given the size and potential of the Platreef resource, Shaft 2 has been engineered with a crushing and hoisting capacity of 6 Mt/a.