

Low profile jumbos and LHDs have been an important aspect of many of South Africa's new platinum mines.

# Keeping low at Two Rivers

Low profile drilling, loading and bolting is a major feature of current South African platinum developments. **John Chadwick** reports on one of the new mines

**T**wo Rivers platinum mine is a joint venture between Implats (45%) and African Rainbow Minerals (ARM) (55%) on the eastern limb of the Bushveld Igneous Complex (BIC), near Lydenburg, in the South African province of Mpumalanga. ARM manages the mine and Implats processes and refines the material mined through Impala Refining Services (IRS). The decision to proceed to mine development followed the success of trial mining in testing critical project assumptions. Mining and stockpiling of nearly 266,000 t of UG2 ore, together with extensive access development, substantively validated geological and mining feasibility parameters. The concentrator is a standard MF2 plant.

The trial mining removed considerable risk from the project, with 800,000 t of reef stockpiled on surface, and this grew to more than 1 Mt when hot commissioning of the plant commenced in July 2006.

While both the Merensky and UG2 reefs occur on the property, mining is focussed initially on the UG2 reef. The UG2 mineral reserve totals 40 Mt at a grade of 4.18g/t

(5PGE+Au mill grade). An added advantage is the platinum to palladium ratio of 5:3. The underground mine is accessed via a decline shaft system comprising a footwall conveyor decline and two on-reef declines: one for vehicle access and the other a chair-lift installation for the transportation of employees.

Currently, planned production is 2.2 Mt/y over a life-of-mine of 20 years. This will be supplemented by up to 400,000 t/y from the development ore stockpile and opencast material in the first few years and 300,000 t of adit material thereafter.

Two Rivers should yield annually 120,000 oz of platinum, 68,000 oz of palladium and about 20,000 oz of rhodium at steady-state production. Full production is scheduled for 2008.

Trial mining began in 2003, using equipment lowered down a bulk sample shaft. This tested mechanized mining at a rate of 3,000 t/month. This trial mining, at a depth of 60-70 m, was "extremely important" M.I. Botha, Grinaker LTA's Contracts Manager told IM. A number of BIC platinum operations' mechanized

mining plans have not been fully successful. Trial mining is important to confirm assumptions about ground conditions, equipment efficiencies, mining method suitability, etc.

While the trial mining proceeded, Grinaker-LTA was also creating the mine infrastructure, including double heading the development of the main decline, driving up from the bottom of the mine and down from surface simultaneously. Grinaker-LTA's capital works programme included decline development, ledging, conveyor systems and mining infrastructure.

The full project release came in August 2005 and Grinaker built up from a production level of 40,000 t/month of ore, to 100,000 t/month in just nine months. The mine operator is now planning to produce a further 85,000 t/month of platinum ore. The horizon mined is the 1.6 m high UG2 reef, but the height of the mechanized room and pillar (R&P) stopes is 1.9-2.0 m.

A series of drifts are developed in three echelons down-dip; here the UG2 dips at an average of 8° east-west. The first of these drifts is a footwall conveyor decline mined

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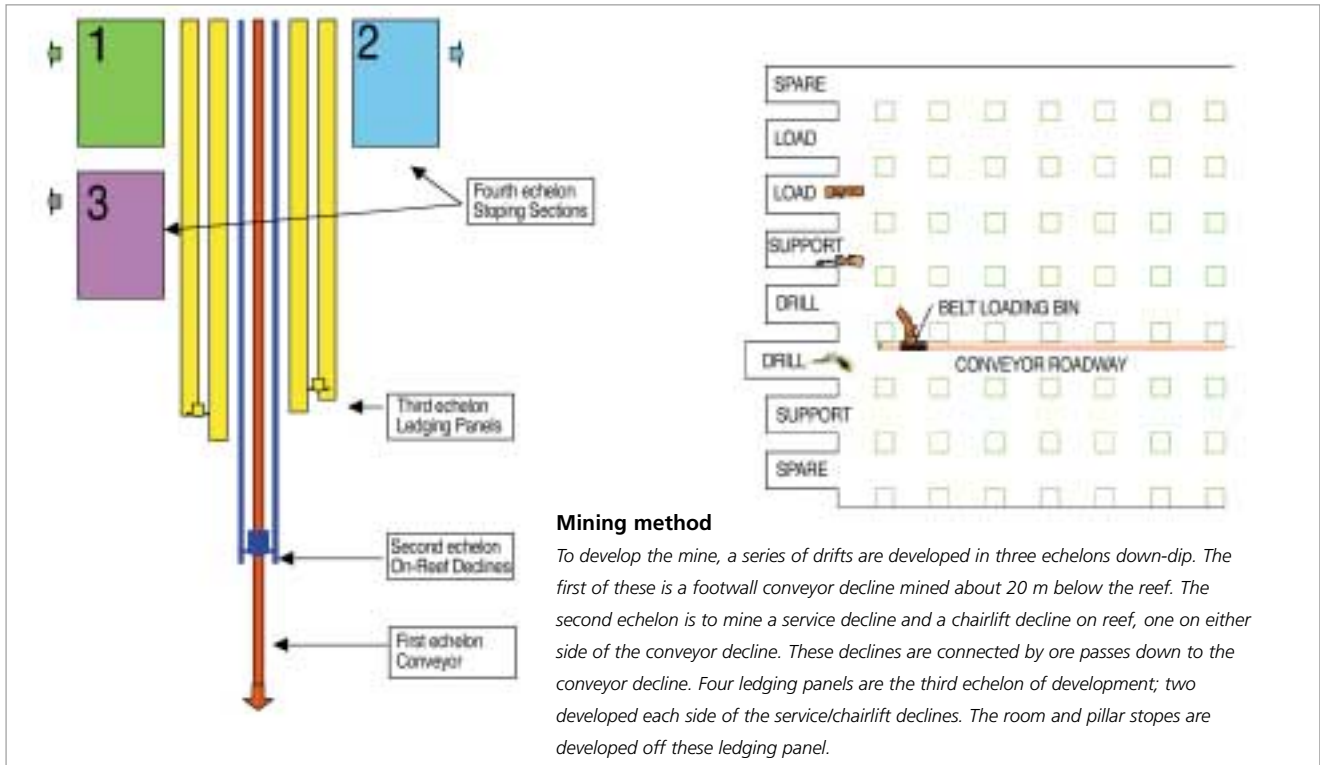
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about 20 m below the reef. The conveyor system has a transport capacity of 185,000 t/month. This 3.5 m high drift is drilled out by a twin-boom Sandvik Axera 226. The second echelon is to mine a service decline and a chairlift decline on reef, one on either side (in plan view, see diagram) of the conveyor decline. These declines are connected by ore passes down to the conveyor decline. Four ledging panels are the third echelon of development; two developed each side of the service/chairlift declines. The R&P stopes are developed off these ledging panels.

DRA Technical Services assisted in the design of the engineering infrastructure, including a chairlift system for the transport of personnel into and out of the mine. The dual drive system, about 1 km long, was installed by Grinaker-LTA and can move 600 personnel per hour at speeds up to 1.5 m/s.

Eight roadways are mined in the mechanized R&P stopes, leaving 6 x 6 m pillars in shallower areas and gradually increasing pillar sizes with depth. Two of the drifts are drilled each shift, two are supported and two are loaded, leaving two spare each shift. Ore is loaded onto a 1 m wide stope belt system, which feeds to the orepass to drop the ore onto the main conveyor to surface.

Grinaker-LTA and the mine decided on a dual OEM policy for its primary development



and production machines. There is a fleet of 19 LHDs, mainly Sandvik EJC 115s. However, these units have to be used without roofs, to achieve the low profile that is needed. There is now one Atlas Copco LP ST400 LHD with full head protection for the operator. There is also an ST 600 on development, as well as a Toro 400 and a Toro 007.

The fleet of 19 drill rigs includes nine S1L Rocket Boomers (six used by Grinaker-LTA and three by the mine). Botha says these are the "most suitable" machines in low-profile drilling jumbos. The S1Ls use 3.7 m drill steels fitted with Sandvik 45 mm button bits

Low-profile LHDs line up: An Atlas Copco ST600 leads an EJC 115 underground.

(on a cost/tonne performance contract). Each hole is completed in about two minutes, achieving an average 3 m advance.

The utility fleet, mainly Boart Longyear units, includes the emulsion explosive charging units. The faces are 1.2 m wide and 1.8-2.0 m high, drilled with a pattern of 70-80 holes. Sasol supplies the emulsion explosive on a cost/tonne basis.

Site Manager Theo Volschenk says about 75% of the ground conditions underground

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are "fair", the rest being "less competent requiring additional measures to support". The mine uses Axera 126 LP Robolt machines to install 1.5 m roof bolts. In very bad ground, 4 m anchors are used. There is also a low-profile Fletcher bolter on trial. It is the only roofbolter on the market to use rotary drilling. This gives it a particular advantage in low profile applications.

### Surface facilities

In building the Two Rivers mine, Grinaker-LTA's responsibility ended at daylight. DRA Mineral Projects was the Managing Contractor for the project and was directly responsible for the 225,000 t/month concentrator and all related surface infrastructure. Currently, plants designed and constructed by DRA produced 1.5 Moz/y of platinum in a year. DRA's responsibility included the engineering, procurement and

*DRA Mineral Projects was the Managing Contractor for the complete Two Rivers project and was directly responsible for the 225,000 t/month concentrator and all related surface infrastructure.*

management of all underground services and infrastructure. The Managing Contractor role required DRA to integrate the capital works through underground and surface scope.

When DRA was appointed Managing Contractor, R0.8 billion had already been spent, Two Rivers Platinum then invested a further R1.45 billion in the 220,000 oz/y PGM mine, concentrator and associated infrastructure. This was the largest project ever undertaken by DRA.

In 2005, DRA's Wray Carvelas noted, "DRA has been involved with the development of the Two Rivers mine, a greenfields project,

for the last four years – through pre-feasibility and feasibility studies. The scope of the project, which received full project release in June 2005, is quite extensive and has a challenging 15 month execution programme.

Grinaker-LTA's involvement in design & planning from the feasibility phase gave the contractor a good understanding of the planning parameters and offered the advantage of putting a practical and realistic plan on the table.

DRA had direct responsibility for the design, installation and commissioning of the two-stage milling-flotation PGM 225,000 t/month concentrator. The process design allows for intermediate concentrate thickening to enhance the secondary flotation circuit, resulting in increased recovery rates.

Ancillary systems included in the project include the plant's crushed ore silos, primary and secondary milling and flotation, reagent handling systems, intermediate and final concentrate thickening, filtration and concentrate load out. All associated concentrator infrastructure such as compressors, conveyors, pump and ventilation systems, access control, security, stores, weighbridge, offices and change house also fell under DRA's scope of work.

The instrumentation and control system, in this case a PLC/SCADA type system, allows for the provision of interfacing with high level software such as Manufacturing Execution Systems, Plant Maintenance Systems and Enterprise Resource Management Systems in the future. A fibre optic network links the network process area, portal and concentrator while telephones and a radio/leaky feeder arrangement provide voice communications throughout the mine. **IM**

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