

# SUPPLIES, MINING & EXPLORATION

**Supplies of platinum fell by 4.1 per cent in 2007 to a global total of 6.55 million ounces, largely due to lower output from the South African producers. Palladium supplies rose by 8.0 per cent to 8.59 million ounces despite a small drop in metal sold from South Africa. Large Russian State stock shipments boosted flat primary production there to raise total Russian palladium sales.**

## SOUTH AFRICA

**Supplies of platinum from South Africa fell by 260,000 oz in 2007 to 5.04 million ounces. A wide range of challenges faced the industry including safety, retention of skilled staff, industrial relations and geological issues. This cocktail of problems hit primary production at many mines. The pipeline releases of metal which had occurred in 2006 were not repeated, further depressing sales of platinum in 2007. Palladium sales were less affected and dropped marginally to 2.77 million ounces. Some individual mines did report improved pgm output on the back of successful expansion plans.**

## Anglo Platinum

Refined platinum output from the world's largest producer fell by 12 per cent in 2007, to 2.47 million ounces. However, the fall in production was exaggerated by movements in pipeline stock: inventories of unprocessed platinum fell in 2006, releasing some 180,000 oz of platinum, but were stable last year. The fall in underlying "equivalent refined

production", which more closely reflects actual output from the mines, was limited to 6 per cent.

There were declines in output at most of Anglo Platinum's mines, with the largest drops at Rustenburg, BRPM, Modikwa and Mogalakwena (formerly

PPRust). Rustenburg had a particularly difficult year: a sharp increase in fatalities in the first half resulted in a rolling suspension of operations at all shafts in order to improve safety. (This initiative was later extended to all of Anglo Platinum's mines.) Output at Rustenburg was also affected by high labour turnover and contractor

unrest, a rise in the proportion of production drawn from the lower-grade UG2, and the closure of the Turffontein shaft in November for the renewal and repair of steel work. Equivalent refined platinum production dropped by 20 per cent, to 665,000 oz.

Output at BRPM was affected by factors including mill breakdowns, difficult ground conditions, and a strike by contractor employees: equivalent platinum production fell by 11 per cent to 194,000 oz. Modikwa also suffered a month-long strike in the first quarter of 2007, which contributed to a 13 per cent fall in platinum output to 118,000 oz. At Mogalakwena, output fell 15 per cent to 163,000 oz of platinum, following the start of mining at the new North Pit in December 2006. The area of oxidised ore was more extensive than anticipated, leading to lower grades and recoveries, while unscheduled maintenance at the plant resulted in lower mill throughput.

In contrast, a number of the smaller operations recorded higher production, notably the Mototolo joint venture with Xstrata, which reported equivalent refined output of 95,000 oz of platinum in 2007, its first full year of operation. There was also growth in attributable production at Marikana, the subject of a Pool & Share Agreement with Aquarius Platinum, and higher output from the trial mine at Twickenham and from the Western Limb Tailings Retreatment plant.

At its results presentation in February 2008, Anglo Platinum forecast total platinum production of 2.4 million ounces this year, a 3 per cent decline from 2007. This figure takes into account the loss of production during January's interruptions to the power supply, the impact of severe flooding at Amandelbult which is expected to cut output from that mine by 50-70,000 oz, and the closure of the Turffontein shaft at Rustenburg (which should reopen in the second quarter of 2008).

In September 2007, Anglo Platinum announced two major black economic empowerment deals. The first was the sale of an effective 51 per cent of the Lebowa Platinum mine, along with 1 per cent of the Ga-Phasha project, to its existing joint venture partner Anooraq (which already owned half of Ga-Phasha) for R3.6 billion. The second was the sale to Mvelaphanda Resources of Anglo Platinum's stake in the Booyensdal project along with its stake in Northam.

Three new expansion projects were confirmed in 2007 and early 2008. These include an expansion of

PGM Supplies: South Africa '000 oz		
	2006	2007
Platinum	5,295	5,035
Palladium	2,775	2,770
Rhodium	666	696





*The view North from Aquarius's Everest operations shows, on the left, the Booyensdal and Der Brochen properties and, in the distance, the new Mototolo mine.*

the base metals refinery to process additional production from Mogalakwena. The company also announced the Lebowa Middelpunt Hill Phase 3 project, which will increase UG2 production by 125,000 tonnes per month. In February 2008, the company committed to a major development at Twickenham, which will deliver 180,000 oz of platinum annually once it reaches steady state in 2016.

### Impala Platinum

In 2007, Impala Platinum reported a marginal increase in platinum production from its lease area, to 1.09 million ounces. Mill throughput was stable at 16.4 million tonnes, while grades and recoveries improved in line with the replacement of open cast tonnes with underground UG2.

Marula, the company's 78 per cent owned mine on the Eastern Bushveld, increased production in 2007, with output of platinum in concentrate up 25 per cent at 68,000 oz. However, the redevelopment of the mine is behind schedule: full yearly production of 136,000 oz of platinum in concentrate is now expected in 2009.

The company is expanding smelting and refining capacity in line with its expectation that refined production from Impala Refining Services (IRS), including metal purchased in concentrate from other pgm producers as well as ounces from secondary materials, will reach 2.3 million ounces of platinum by 2010 (up from just over 2 million ounces in 2007). In February 2008, the Impala board also approved the

*Impala Platinum managed to raise platinum output slightly in 2007 by increasing the production of underground UG2 ore.*



development of 17 shaft, a major new shaft nearly 2 kilometres deep and with the capacity to hoist 225,000 tonnes of ore each month. This forms part of the company's strategy to maintain annual production at around 17 million tonnes of ore, yielding 1.1 to 1.2 million ounces of platinum annually.

Like other miners, Impala experienced disruption to electricity supplies in January 2008, and was subsequently limited to 90 per cent of its normal power consumption. At its February results presentation, it stated that electricity savings would be achieved by running the smelter at lower power; this will require concentrate volumes to be reduced, with a corresponding reduction in pgm recoveries. In addition to the 10,000 oz of production lost during January's shutdown, Impala has estimated that it will lose an additional 10 to 20,000 oz of platinum output over the course of this year.

### Lonmin

Last year was challenging for Lonmin, with declines in both mill throughput and grade exacerbated by an increase in pgm stocks in the refining pipeline. Production of platinum in concentrate fell by 13 per cent to 837,000 oz, of which about 4,000 oz came from purchased ore; sales (including metal sold in concentrate) dropped 14 per cent to 797,000 oz.

The company's No. 1 smelter was closed for four months after a leak was discovered in December 2006, resulting in the accumulation of stocks of unprocessed concentrate. 90,000 oz of platinum in concentrate was toll-refined, and the remaining concentrate backlog was subsequently processed. However, by the year-end pipeline stocks were still higher than normal, particularly in the base metals refinery. As a result, refined output from Lonmin's refineries was only 663,000 oz of platinum in 2007, down 19 per cent.

At the company's large Marikana mine, mill throughput fell by 6 per cent to 12.5 million tonnes, despite higher tonnage from the new, mechanised Hossy and Saffy shafts. Mining operations were hit by strikes, safety stoppages, and shortages of skilled workers. Grades also fell, due to an increase in low-grade development ore from the new shafts.

The Limpopo mine on the Eastern Bushveld reported a 34 per cent decline in output of pgm in

concentrate in 2007, as mill throughput fell 16 per cent to 706,000 tonnes. Shortages of developed ore reserves constrained production. Operations were also affected by adverse ground conditions. However, the quantity of ore milled from the Pandora lease area increased by 6 per cent to 900,000 tonnes.

Lonmin experienced further difficulties in the early part of 2008, with continued high levels of absenteeism among skilled employees, lack of ore stocks ahead of the concentrators, and disruption to electricity supplies in January (which the company estimates resulted in the loss of some 15,000 oz of platinum production). Sales are forecast to total 775,000 oz of platinum in 2008, down from earlier predictions of 900,000 oz. However, Lonmin has maintained its longer term plans to increase production to reach 1.2 million ounces of platinum per annum by 2012.

### Northam

Platinum sales by Northam in 2007 fell by 13 per cent to 187,000 oz, reflecting a sharp decline in Merensky tonnage and a decrease in average head grade.

The year was marred by three fatalities in the second half, which led to the loss of 23 days of production. Output was also affected by difficult mining conditions on the Merensky reef, but this was partly compensated by higher UG2 tonnage, with a record 42 per cent of production from this reef.

Unlike its larger competitors, Northam does not expect reductions in electricity supply to have a significant impact on 2008 performance, although some production was lost in late January. Tough geological conditions on the Merensky will continue to hamper output, but may be partly compensated by rising production from the lower-grade UG2.

In September 2007, it was announced that Mvelaphanda Resources was to acquire Anglo Platinum's 22.3 per cent shareholding in Northam, along with an additional 50 per cent share of the Booyensdal project. The terms of the transaction were amended in January, to extend the Booyensdal property and guarantee access to electricity and water during the development of the project. Once the transaction is complete, ownership of Booyensdal will be transferred to Northam, resulting in Mvelaphanda becoming the company's controlling shareholder.



A bankable feasibility study on Booyensdal is due to be completed in 2009, based on a mine exploiting the Merensky and the UG2 reefs at a combined rate of 400,000 tonnes of ore per month. The project will cost R7.1 billion, and initial indications are that pgm output could begin as early as 2011, although steady state production levels will not be achieved before 2014.

*Mvelaphanda Resources will become the major shareholder in Northam Platinum in 2008 as part of the Booyensdal transaction.*

### Aquarius Platinum

The Kroondal Mine, operated under a Pool & Share Agreement with Anglo Platinum, reported an 8 per cent fall in production of platinum in concentrate, to 245,000 oz in 2007. Mill throughput rose strongly in the first half but tonnage fell by 6 per cent in the second half, due to a combination of industrial relations issues, safety stoppages, and interruptions to milling operations. Grades also fell, particularly in the final quarter of the year. However, production should grow this year and next: the mine is on track to reach peak production levels (expected to be around 280,000 oz of platinum annually) within the next two years.

At Marikana, rationalisation of mineral rights between Aquarius and its neighbour Lonmin resulted in the milling of additional open pit material, but at lower recoveries. As a result, while mill throughput rose by 48 per cent to 2.22 million tonnes in 2007, production of platinum in concentrate grew by only 30 per cent, reaching 85,000 oz. There was also an increase in underground production from the Brakfontein shaft, on Anglo Platinum ground, which Marikana is mining

under a second Pool & Share Agreement.

Mill throughput at Everest fell by 10 per cent to 2.33 million tonnes last year, but recoveries improved sharply, driving platinum output 5 per cent higher, to 104,000 oz. The transition to underground mining proceeded smoothly, with only 10 per cent of ore coming from open pits, down from about half in 2006. However, the mine suffered a setback when the underground mining contractor abandoned its contract in January 2008 following industrial relations difficulties: as a result, mining was temporarily suspended. Aquarius immediately assumed management of underground operations, allowing a rapid resumption of mining, but normal production levels are unlikely to be achieved before the middle of this year.

In February 2008 Aquarius announced the acquisition of a 50 per cent interest in Platinum Mile Resources. Platinum Mile operates a tailings retreatment facility situated within the Rustenburg Platinum lease area, producing about 20,000 oz of pgm annually.

In common with the other producers, Aquarius suffered power outages in January 2008. It has stated that power will be supplied preferentially to Kroondal (and to Everest, once production there returns to normal), in order to limit the effect on production.

### ARM Platinum

ARM Platinum has stakes in three pgm-producing mines: a 55 per cent share in Two Rivers (with Impala), and 50 per cent shares in both Modikwa (with Anglo Platinum) and Nkomati Nickel – now a joint venture (jv) with Norilsk Nickel, following the latter's acquisition of LionOre in June 2007. ARM also has a majority interest in the Kalplats project, on which its partner Platinum Australia is conducting a feasibility study.

The Two Rivers mine started production in 2006. After a rapid ramp-up, it milled 2.4 million tonnes of ore last year, giving 214,000 oz of pgm in concentrate. Head grades worsened in the second half of 2007, due to potholes and areas of split reef, but are expected to improve this year, as are recoveries. Steady state production should be achieved by mid-2008.

At Nkomati, the high-grade Massive Sulphide Body (MSB) has been exhausted, and the mine is increasing production from the Main Mineralised Zone (MMZ) as part of an interim plan aimed at maintaining annual

production of around 5,000 tonnes of nickel. Pgm grades in the MMZ are much lower than in the MSB, and pgm sales fell by 21 per cent to 41,000 oz in 2007.

In September 2007, ARM and jv partner Norilsk Nickel confirmed plans for a large-scale expansion of Nkomati. Processing capacity will be raised to 625,000 tonnes per month; at steady state production, this will yield 110,000 oz of pgm (mainly palladium) annually.

### Eastern Platinum

Sales of pgm from Eastern Platinum's Crocodile River Mine rose by 23 per cent to 107,000 oz last year, of which we estimate that just under 60,000 oz was platinum. Output from the Maroelabult and Zandfontein sections ramped up throughout the year, reaching 112,000 tonnes of UG2 ore per month in the final quarter, with grades averaging just over 4 grams per tonne. At full production, scheduled for late-2009, these two sections will deliver a total of 160,000 tonnes of ore per month to the mills. This will be supplemented by a monthly 40,000 tonnes from the Crocette mining area, for which a new mining right was received in March 2008.

Eastern Platinum has ambitious plans to develop a number of projects on the Eastern Bushveld, among them Spitzkop. The company believes that a 160 to 180,000 tonnes per month plant could be commissioned as early as 2009. It is also targeting an early start to production at the much smaller Mareesburg project.

### Other

In the next year, three new platinum mines are due to be commissioned: Platinum Australia's Smokey Hills project, Ridge Mining's Blue Ridge mine, and Platmin's Pilanesberg. Together, these mines are scheduled to add over 250,000 oz annually to platinum supplies when they reach steady state production levels.

Mining at Smokey Hills started in early 2008 and an offtake agreement has been signed with Impala Refining Services. Ridge Mining will also deliver concentrate to IRS, starting in the final quarter of this year. Its Blue Ridge mine will exploit the UG2 and should produce around 75,000 oz of platinum annually. Platmin's Pilanesberg mine will exploit the UG2 and a package of silicate reefs via two open pits from 2009 to produce 250,000 oz of pgm in concentrate each year.

## RUSSIA

**In 2007, Russian palladium supplies rose to 4.54 million ounces, an increase of 15.8 per cent compared with 2006. Primary production from Norilsk Nickel was marginally lower than in 2006, at 3.05 million ounces of palladium and 727,000 oz of platinum. The alluvial mines also produced several tonnes of platinum. Sales of State palladium stocks added another 1.49 million ounces to supplies. The**

**final shipments of metal from the Norilsk-Stillwater deal were sold in 2006 and were therefore not repeated in 2007.**

We continue to report both aspects of Russian pgm supply: primary output from Norilsk Nickel, the alluvial miners and other producers; and sales from government-controlled stocks.

Output of pgm from Norilsk Nickel fell slightly in 2007. Including metal from the former LionOre assets in Africa (Nkomati Nickel in South Africa and Tati Nickel in Botswana), which were acquired by Norilsk in June last year, the company produced 3.11 million ounces of palladium and 740,000 oz of platinum. Of this, 3.05 million ounces of palladium and 727,000 oz of platinum came from ores mined in Russia, representing a decline of 2 to 3 per cent compared with 2006. The company predicts a further modest decrease in pgm output in 2008.

*Alluvial mining in the far East of Russia can occasionally produce large lumps of ore which are extremely rich in platinum group metals.*

PGM Supplies: Russia '000 oz		
	2006	2007
Platinum	920	910
Palladium:		
Primary Production	3,220	3,050
State Sales	700	1,490
Rhodium	100	90



Supplies of platinum from alluvial mines in the far East of Russia were slightly up in 2007, at just under 185,000 oz. The larger of the two operations, Amur, reported a decline in platinum grade, but compensated by greatly increasing the volume of sands processed.

In terms of State stocks, we believe that the 1.29 million ounces of Russian palladium shipped into Switzerland in December 2006 were not sold by Gokhran until the following year. It is therefore included in our figure for 2007 supplies. We also believe that the 500,000 oz of palladium shipped in December 2007 did not reach the market in that year and will include it in our 2008 figures. Total State sales of palladium in 2007 were close to 1.49 million ounces.

## NORTH AMERICA

**Supplies of platinum from North American mines fell by 5.8 per cent from the previous year's total to 325,000 oz. A fall in output from Stillwater and the ex-Inco nickel mines now owned by Vale (formerly CVRD) was responsible. Palladium supplies rose slightly to 990,000 oz, with increased underground production from North American Palladium outweighing the negative effect of industrial action at Stillwater.**


## Canada

Production from North American Palladium's Lac des Iles mine continued to recover, with output from the underground section (which commenced operations in 2006) contributing to higher mill throughput and grades. The total tonnage of ore milled rose by just under 10 per cent to 5 million tonnes in 2007, of which roughly 15 per cent came from underground, while the average head grade rose to 2.39 grams of palladium per tonne. As a result, palladium output rose by 21 per cent to 286,000 oz, while that of platinum was up 10 per cent at 24,000 oz.

Significant quantities of pgm are mined by Xstrata and Vale as by-products of nickel mining in Canada. The Vale Inco operations reported production of 140,000 oz of platinum and 191,000 oz of palladium in 2007, a drop of around 8 per cent compared with the previous year's figures, reflecting lower nickel output from the company's Sudbury mines. Vale currently has a number



PGM Supplies: North America '000 oz		
	2006	2007
Platinum	345	325
Palladium	985	990
Rhodium	17	17



of projects which will support its future nickel and pgm production in Canada, including the \$400 million Totten mine and the \$132 million development of the 170 orebody at the Coleman mine: both projects will extract pgm-rich ores.

At Xstrata's Sudbury operations, the existing mines are nearing the end of their lives: the amount of mined ore processed through the Strathcona mill declined by 1 per cent to 1.9 million tonnes in 2007, while nickel grades also fell. The company is currently developing new mines at Fraser Morgan and Nickel Rim South, with the latter expected to produce significant quantities of pgm when it comes on-stream in 2009. Xstrata is also expanding its Raglan mine, in northern Quebec, where capacity will rise from 1.1 million tonnes per annum in 2007 to reach 1.3 million tonnes by the end of 2008, and over 2 million tonnes from 2011.

## USA

In 2007, Stillwater Mining Company's combined production of platinum and palladium from its two Montana mines was 537,000 oz, substantially below 2006's figure of 601,000 oz. Sales of palladium fell 9 per cent to 425,000 oz, while platinum shipments dropped 13 per cent to 120,000 oz; rhodium output remained steady at 4,000 oz.

Total mill throughput from the Stillwater and East Boulder mines fell by 7 per cent, largely due to labour challenges. These included loss of skilled personnel due to the implementation of new working schedules, and a seven-day strike during July. The quantity of ore produced at the East Boulder mine was also affected by changes in the mining methods employed there.

With the Stillwater mine in particular now employing less experienced miners, productivity will take some time to return to 2006 levels and the company expects only a small improvement in total pgm output to between 550,000 and 565,000 oz in 2008. Further activity this year will include extending a decline below the current Stillwater operating levels and the construction of a second smelter at the company's Columbus site to process both primary ore and scrap autocatalyst.

## ZIMBABWE

**Platinum supplies from Zimbabwe rose by 2.3 per cent in 2007 to a total of 171,000 oz; palladium and rhodium production stayed steady at 134,000 oz and 14,000 oz respectively.**

At Mimosa, a 50:50 joint venture between Impala and Aquarius, production of platinum in concentrate rose by 7 per cent to 79,000 oz in 2007, despite a modest decline in mill throughput. Palladium and rhodium production grew in proportion to 60,000 oz and 6,000 oz respectively. This metal is refined in South Africa by Impala Refining Services (IRS).

Mimosa's Wedza Phase V project was 85 per cent complete by the end of 2007. This \$28.8 million expansion will increase concentrator capacity from 150,000 to 175,000 tonnes per month and raise annual production of pgm in concentrate to 195,000 oz.

At the Ngezi mine, which is managed by Zimplats (of which Impala owns 86.9 per cent), the volume of ore milled rose by 7.1 per cent to 2.2 million tonnes, boosting production of pgm in concentrate by 8 per cent to 205,000 oz. However, sales of pgm in matte were down 3 per cent at 181,000 oz. In the third quarter, the smelter was shut down for 43 days for relining, and some stocks of untreated concentrate accumulated during this period; these will be treated in early 2008, and will add to production this year.

The conversion of the mine from open pit to underground continued during 2007. Production from the first of the new underground mines, Portal 1, grew last year, and the development of a second, Portal 4, is underway. Together, these are scheduled to increase annual production to 160,000 oz of platinum by 2010.

The Indigenisation and Economic Empowerment Bill, which provides for 51 per cent indigenous ownership of foreign firms operating in Zimbabwe, was passed by parliament in November 2007, and received presidential assent in early March this year. Following an agreement in 2006 to release part of its resource base to the government, Zimplats already has existing empowerment credits of 29.25 per cent, and further credits may be obtained through infrastructure projects and social spending.

PGM Supplies: Zimbabwe and Others '000 oz		
	2006	2007
Platinum	270	280
Palladium	270	285
Rhodium	19	19

