SUPPLIES, MINING & EXPLORATION

SOUTH AFRICA

Platinum supplies from South Africa totalled 5.11 million oz in 2005, a rise of 2 per cent on the previous year. Although refined platinum production from Anglo Platinum was unchanged, most other producers reported increases in both output and sales. Shipments of palladium were up 4 per cent at 2.59 million oz, while rhodium supplies climbed 7 per cent to 627,000 oz.

Anglo Platinum

Refined production of platinum by Anglo Platinum was unchanged in 2005 at a little over 2.45 million oz; refined palladium output increased by 3 per cent to 1.353 million oz, whereas rhodium production jumped by almost 30 per cent to 328,000 oz. Fluctuations in the amount of metal in the group's processing pipeline had a significant influence on output. Around 72,000 oz of platinum were released during the first half of the year but an explosion at the Polokwane smelter in September resulted in an additional 120,000 oz of platinum accumulating in unprocessed stocks of concentrate. This metal was expected to be refined in the first half of 2006. Meanwhile, changes in the rhodium refining circuit at the group's precious metals refinery resulted in a substantial release of metal.

Anglo Platinum reports output from its individual mines as "equivalent refined production" (the amount of pgm produced in concentrate, adjusted for standard smelting and refining recoveries). In 2005, total equivalent refined platinum production increased by 2 per cent to just over 2.5 million oz, a record level for the group. This was principally due to the expansion of operations at Kroondal under the Pool & Share Agreement (P&SA) with Aquarius Platinum: a new 300,000 tonne per month (tpm) concentrator was commissioned in March 2005 and the output of this plant is supplied to Anglo Platinum's facilities for processing. Impala retains the right to treat concentrate from the original Kroondal concentrator until mid-2007. There were also modest increases in output from Modikwa, BRPM and PPRust. However, the gains were partly offset by significant falls in production at Rustenburg (lack of available Merensky reserves and lower productivity) and at Amandelbult (difficult ground conditions).

PGM Supplies: South Africa
'000 oz

	2004	2005
Platinum	5,010	5,110
Palladium	2,480	2,590
Rhodium	587	627

In July 2005, Anglo Platinum announced a second P&SA with Aquarius Platinum, under which the two companies will pool reserves and assets near the latter's Marikana operation. The Marikana concentrator will be upgraded by retrofitting a dense media separation plant, increasing processing capacity to around 250,000 tpm of ore by late 2006. Concentrate produced at Marikana will be split between Anglo Platinum and Impala, with the former processing material derived from the orebodies it contributed to the P&SA and the latter continuing to refine the pgm from Aquarius's original Marikana orebody.

The Mototolo joint venture with Xstrata South Africa received the go-ahead in August 2005. This UG2 operation will use mechanised mining to extract 200,000 tpm of ore, yielding 132,000 oz of platinum per annum at full production. Commissioning of the concentrator is due to take place in the final quarter of 2006 and a small amount of metal from Mototolo may be refined before the year end.

Anglo Platinum has a number of potential new projects on the Bushveld, the most advanced of these being an expansion at PPRust. The development of a replacement pit at PPRust North to maintain output at around 200,000 oz of platinum per year has already been approved; it is likely that the scope of this project will soon be expanded to add a further 230,000 oz of platinum to annual production.

At BRPM, the extension of mining onto Styldrift will be the subject of a full feasibility study this year, while trial mining at the developing Twickenham mine is to be extended. It is also possible that the Pandora joint venture with Lonmin and Northam will enter production in 2006. Other projects, including the wholly-owned Der Brochen and the joint ventures at Ga-Phasha and Booysendal, should also advance to the pre-feasibility study stage.

Impala Platinum

At Impala Platinum, refined production from the company's original lease area rose strongly in 2005, up 6 per cent to a record 1.158 million oz. Palladium

The refurbished concentrator at Barplats produced only small volumes of pgm in concentrate in 2005. However, the compnay has since changed hands once again, with the new owners planning to expand pgm output to as much as 250,000 oz per year.

output was up 12 per cent at 548,000 oz, although that of rhodium was little changed at 130,000 oz.

The operations recorded a strong performance: a total of 16.5 million tonnes of ore were processed through the mill, a 7 per cent increase compared with 2004, while concentrator recoveries were up 2.5 per cent at 85.5 per cent. These gains were partly offset by a decline in head grade, reflecting an increase in dilution due to rising volumes of ore from mechanised mining and more difficult ground conditions at No.11 shaft.

Impala continues to invest heavily in new infrastructure which will provide access to deeper ore reserves on its western Bushveld lease area. Although the aim of the current programme of capital expenditure is to maintain production at around the current level, there is some scope for modest short-term expansion to around 1.2 million oz of platinum per annum.

The company's Marula Platinum mine on the eastern Bushveld had another difficult year in 2005, with mill throughput declining to just 772,000 tonnes. Planned as a mechanised operation, the mine is currently in the process of switching to conventional mining; as a result, full platinum production of 140,000 oz will not now be reached until 2009. However, the adoption of narrow stoping has resulted in an improvement in head grades, and production of platinum in concentrate was therefore unchanged at 31,000 oz last year.

A lack of available reserves and reduced productivity resulted in production from Anglo Platinum's Rustenburg operations slipping lower in 2005.

In addition to refining pgm from the above mines, Impala Refining Services (IRS) treats matte and concentrate respectively from Zimplats (in which Impala has an 86.9 per cent stake) and Mimosa (a 50:50 joint venture with Aquarius Platinum); production from these mines is discussed in the section on Zimbabwe on page 19.

IRS also purchases concentrates from a number of other producers, including Aquarius Platinum, Lonmin's Limpopo division and Barplats, as well as toll-treating substantial quantities of pgm contained in secondary materials. From 2006, it will begin to refine pgm from Aquarius's new mine at Everest South and from the Impala-ARM joint venture at Two Rivers; this will offset the loss of concentrate from Lonmin Limpopo in late 2006 (see section on Lonmin below) and from Kroondal in 2007. In order to ensure that sufficient capacity is available in future years, Impala's base and precious metals refineries are currently being upgraded to allow the treatment of 2 million oz of platinum per annum, and additional capital expenditure has been approved for the expansion of platinum refining capacity to 2.3 million oz.

Lonmin

Lonmin produced a record 963,000 oz of platinum in 2005, up 4 per cent compared with the previous year, as output from its western Bushveld mines (comprising the Western Platinum Mine, Eastern Platinum Mine and Karee Mine) was supplemented by small amounts of pgm from its new Limpopo division. The latter, formerly Messina Platinum, was acquired in June 2005 as part of Lonmin's $190 million purchase of Southern Platinum.

At the western Bushveld operations (also referred to as the Marikana division – not to be confused with the Aquarius Marikana mine) mill throughput declined by 4 per cent to 13.7 million tonnes in 2005, principally due to a 25 per cent fall in the amount of open pit ore that was processed. However, volumes of ore from underground were up, contributing to an improvement in overall head grades. As a result, platinum output rose by 2 per cent to 939,000 oz.

The Limpopo division milled 461,000 tonnes of ore between the completion of the Southern Platinum acquisition in mid-June and the end of 2005. The resulting concentrate was sold to Impala under an amended concentrate off-take agreement, under which Limpopo will continue to supply a fixed amount of concentrate to IRS until late 2006. Platinum production during this period totalled 24,000 oz and we estimate that output for the full calendar year was around 40-45,000 oz.

Lonmin forecasts that its platinum output will reach the 1 million oz level for the first time in 2006. Beyond this year, the company expects further substantial growth: production at Marikana is scheduled to exceed 1.1 million oz of platinum annually by 2010, while Limpopo should reach full capacity of 75,000 oz by 2007. It is possible that output from the latter will be expanded by a further 125,000 oz per year, should a revised feasibility study yield positive results.

In March 2006, Lonmin announced that it was commissioning a feasibility study into an expansion of its smelting and refining capacity from the current 1.3 million oz up to 2 million oz of platinum per annum. This project would cost around $300-350 million, and would allow Lonmin to toll-treat concentrates from other producers as well as providing scope for further expansions at its own mines.

Northam

In 2005 Northam made a strong recovery from a fire late the previous year, which resulted in the loss of six weeks' output. A total of 2.35 million tonnes of ore was processed last year, an increase of 17 per cent, with most of the increased tonnage coming from the UG2 reef. Production of platinum in concentrate climbed to 225,000 oz (up 18 per cent on the previous year), palladium output reached 109,000 oz (up 17 per cent) and rhodium production increased to 109,000 oz (up 29 per cent, reflecting the higher proportion of this metal in UG2 ore).

New technology at the UG2 concentrator contributed to improved recoveries and also enabled Northam to reduce the chromite content of its UG2 concentrate (high chrome levels can be detrimental to smelter performance). As a result, the company was able to increase the proportion of UG2 ore milled to 36 per cent, up from 32 per cent the previous year, with no negative effect on overall recoveries. However, average grades declined slightly; UG2 ore at Northam typically contains around 4.5 grams of pgm per tonne, compared with over 6 grams per tonne for the Merensky.

Aquarius Platinum signed a Pool and Share Agreement covering its Marikana operation with Anglo Platinum during 2005. The plant is currently being expanded to process 250,000 tpm of ore.

It is likely that UG2 ore will account for an increasing proportion of total production in the near future. The Merensky Reef at Northam is geologically complex; the company has reported that mining conditions on the Merensky are particularly difficult at the moment, resulting in poor extraction ratios, loss of mining face, and lower grades.

Aquarius Platinum

With the commissioning of the Everest South concentrator in December 2005, Aquarius Platinum now operates three platinum mines in South Africa, which between them will have the capacity to produce over 550,000 oz of platinum per annum at full production. Two of these mines, Kroondal and Marikana, are subject to Pool & Share Agreements with Anglo Platinum and are discussed in the section on page 12.

Everest South, Aquarius's first operation on the eastern Bushveld, came on-stream slightly ahead of schedule and significantly under budget. Ore production last year was principally from open cast pits, supplemented in the final quarter by some 85,000 tonnes of underground material. At the end of 2005 the mine had a 472,000 tonne ore stockpile which will be drawn upon during the build-up to full production this year.

Hot commissioning of the concentrator began at the end of November 2005, and the following month the plant treated 129,000 tonnes of ore at a head grade of 3.12 grams of pgm per tonne. However, the metal in this concentrate was not refined until early 2006 and is therefore not included in our supplies estimates for last year. Production is expected to ramp up rapidly during the first half of 2006.

In addition to its three South African mines, Aquarius also has 50 per cent stakes in two joint ventures: the Mimosa mine *(see section on Zimbabwe on page 19)* and the Chromite Tailings Retreatment Plant, which is located at the Kroondal platinum mine and treats pgm-rich tailings from two local chrome mines. The plant began operating in early 2005, and last year treated 154,000 tonnes at a grade of just under 3 grams of pgm per tonne. However, recoveries were poor and production last year totalled just 5,000 oz of pgm in concentrate. The venture will need to install additional processing equipment if the planned production rate of 28,000 oz of pgm in concentrate is to be achieved.

ARM Platinum

ARM's Platinum division has interests in two pgm-producing mines in South Africa, the Modikwa joint venture with Anglo Platinum (ARM: 41.5 per cent) and the Nkomati Nickel mine which is jointly owned with the Australian company LionOre (ARM: 50 per cent). It also has a 55 per cent share of the Two Rivers platinum project, a joint venture with Impala.

Modikwa's pgm output is refined by Anglo Platinum and is reported in that company's production figures. Last year, the mine milled 2.61 million tonnes of UG2 ore at a grade of 4.14 grams of pgm per tonne; this contributed a total of 128,000 oz each of platinum and palladium and 30,000 oz of rhodium to Anglo Platinum's refined production.

In 2005, Nkomati Nickel processed 344,000 tonnes of ore, most of which came from the small but high grade Massive Sulphide Body (MSB); however, some lower-grade ore is now being mined from the much larger deposit known as the Main Mineralised Zone (MMZ). This shift in ore types contributed to lower sales of pgm in concentrate: 34,000 oz in 2005, down from 38,000 oz the previous year.

At planned rates of mining, the MSB at Nkomati will be exhausted in 2008. In February 2006, ARM and LionOre announced their intention to spend R384 million on a new concentrator and associated infrastructure, enabling the mine to increase ore production from the MMZ to around 100,000 tpm, and thus maintain nickel and pgm output close to current levels. The joint venture partners are continuing to evaluate a major proposed expansion, which would more than quadruple nickel production to over 20,000 tonnes per annum and lift annual pgm output to 100,000 oz.

The R1.3bn Two Rivers project, will come on stream in 2006. Trial mining has been underway since mid-2004, contributing to a substantial ore stockpile and enabling the joint venture partners to assess the chosen mining method and confirm assumptions regarding grade and stoping width. The ore stockpile should enable a rapid ramp-up towards full production of 220,000 oz of pgm per annum once the concentrator is commissioned in the second half of 2006.

Other

Sales of pgm from **Barplats'** Crocodile River mine amounted to 46,000 oz in 2005. Mill throughput totalled 806,000 tonnes, of which about 260,000 tonnes came from the re-opened Maroelabult and Zandfontein sections. The remaining mill feed comprised reclaimed tailings from previous attempts to operate the Crocodile River mine, and also ore purchased from small open pits nearby.

In February 2006, the Canadian company Eastern Platinum Ltd (Eastplats) agreed to buy a 69 per cent stake in Barplats from a consortium of investors. As a condition of the acquisition, Eastplats subsequently raised more than C$100 million in equity financing to fund Barplats' proposed expansion programme, which envisages pgm output eventually rising to 250,000 oz annually.

In November 2005, **Ridge Mining** confirmed its intention to proceed with the development of its Blue Ridge project, subject to financing negotiations. A revised feasibility study envisages a milling rate of 120,000 tpm of ore yielding 75,000 oz of platinum annually at full production.

The converter aisle at Norilsk Nickel's Nadezhda Metallurgical Plant in Siberia. Improvements at its metallurgical operations led to the release of pgm from Norilsk's process pipeline during the second half of 2005.

RUSSIA

Sales of Russian palladium are estimated to have reached 4.62 million oz in 2005, with some 480,000 oz of this metal being shipped in December. The total includes 439,000 oz that was sold from stocks held by Stillwater Mining in the USA. Shipments of platinum and rhodium in 2005 from Russia are estimated to have been 890,000 oz and 90,000 oz respectively.

Following the lifting of secrecy on Russian production of pgm, Norilsk Nickel has been able to reveal its output of platinum and palladium for the first time. In 2005 the company produced 3.133 million oz of palladium and 751,000 oz of platinum.

Although output of Norilsk's main products, nickel and copper, was flat throughout 2005, the production of pgm in the third and fourth quarters of the year was particularly strong — the company reaped the benefits of process changes that led to reductions in the amounts of precious metals tied up in its metallurgical operations.

In April 2006 Norilsk was due to announce the conclusions of a review of its operating plan to 2015 and these were expected to result in an expansion in the volumes of ore produced in the Taimyr Peninsula operations. However, as mining there is gradually moving from rich ores to copper and disseminated ores, the amounts of pgm produced may not increase to the same degree as any increases in ore production might suggest.

Production of platinum from the alluvial mines of the Far East of Russia, primarily Kondyor (Khabarovsk) and Koryak (Kamchatka) is believed to have been slightly down on the level of 2004, but no firm data on output is presently available.

It appears that the State Fund (Gokhran) did not receive its 2005 quota for exports of pgm until very late in the year, but around 1.3 million oz of palladium were then shipped and arrived in the USA and Switzerland in December 2005

PGM Supplies: Russia
'000 oz

	2004	2005
Platinum	845	890
Palladium	4,800	4,620
Rhodium	100	90

and January 2006. We have also reassessed a similar pattern of exports of palladium in late 2004 and early 2005 and, as a result, increased our estimate of Russian supplies in 2004 to 4.8 million oz.

The 2005 Russian supply figure for palladium includes 439,000 oz of metal sold by Stillwater Mining from the 877,169 oz transferred in 2003 by Norilsk Nickel in part payment for a majority shareholding in the company. Although the metal was exported from Russia in 2003, none was sold during that year and so it was not then included in our supply data. Early in 2004, Stillwater entered into sales agreements to sell palladium at a rate of approximately 36,500 oz per month from this stock. The last of the inventory was sold during the first quarter of 2006.

NORTH AMERICA

Supplies of palladium from North America declined by 130,000 oz to 905,000 oz in 2005, as production at North American Palladium dropped by more than 40 per cent. Platinum supplies, in contrast, were down only modestly compared with the previous year; a reduction in output in Canada was partly offset by a slight increase in sales by Stillwater Mining Company in the USA.

Canada

Last year was an exceptionally difficult one for Canada's only primary pgm miner, North American Palladium. A 30 per cent decline in grade (to just 1.66 grams of palladium per tonne), poor mill availability and a sharp drop in recoveries all contributed to a plunge in palladium production to just 177,000 oz, down 43 per cent from the peak of 309,000 oz in 2004.

The fall in grade, due to the mining of a lower grade area of the open pit, was largely anticipated by the company, which intended to compensate by increasing mill throughput. Unfortunately, a series of component failures combined with power cuts caused by severe weather caused mill throughput to decline by 10 per cent to 4.78 million tonnes. The lower grades, combined with metallurgical problems and fluctuations in mill throughput, all had a serious impact on recoveries, which averaged less than 70 per cent for the year.

PGM Supplies: North America
'000 oz

	2004	2005
Platinum	385	360
Palladium	1,035	905
Rhodium	17	20

North American Palladium experienced further difficulties in early 2006, including problems with its crusher and a minor leak in a tailings dam. However, the company expects to see an improvement in production this year, with a new underground section due to come on stream during the first half. This should improve the average head grade, contribute to higher recoveries and lead to an increase in palladium output.

Inco's pgm production (as a by-product of nickel mining in the Sudbury basin) was almost unchanged in 2005 at 419,000 oz. With the company continuing to focus on pgm-rich ores at its Sudbury operations, output should be maintained above 400,000 oz this year, and there is potential for further increases in future years. A major constraint on pgm production at Sudbury is the high copper content of the pgm-rich ores; Inco is installing a copper removal circuit at its Clarabelle mill which will be commissioned in late 2006.

Falconbridge's by-product pgm output comes mainly from its nickel mines in the Sudbury area, and from the Raglan nickel operation in northern Quebec. Mine production of nickel from the Sudbury operations was down 14 per cent in 2005, largely as a result of lower ore grades and ore pass repairs at the Thayer Lindsley mine. Nickel production at Raglan also fell, down 16 per cent to 22,224 tonnes.

Falconbridge is currently undertaking a modest expansion at Raglan; this will lift milling capacity to 1.3 million tonnes of ore per annum from early 2008, and raise annual nickel production to over 30,000 tonnes. In the Sudbury area, shaft sinking at Nickel Rim South began in early 2005; the mine will replace declining production at the company's older shafts when it enters production in 2009. The project will exploit copper-nickel reserves with an average pgm grade in excess of 4 grams per tonne.

In October 2005, Inco announced an offer to acquire Falconbridge for a combination of cash and shares. The necessary approvals have been received from regulatory bodies in Canada, but the verdict of US and European competition authorities had not been delivered as of mid-March 2006. Inco consequently exteded its offer to Falconbridge shareholders to the end of June 2006.

USA

In 2005, production from Stillwater Mining's two pgm mines in Montana was marginally down compared with the previous year. Palladium output slipped by 2.5 per cent to 428,000 oz and platinum fell by 3 per cent to 126,000 oz. This was a direct consequence of a slight decline in the average head grade. Sales last year of 431,000 oz palladium and 135,000 oz platinum were slightly above the level of production.

Stillwater continues to enjoy above-market prices for its palladium under long-term sales contracts that expire in 2010. Under its current cost structure, and assuming 2005 average pgm prices, Stillwater would face difficulties without that price protection. The company is therefore undertaking a series of operating initiatives to improve the cost efficiency of its mines. These include a shift towards selective mining methods to improve grades and extraction ratios; an increase in underground development; and higher pgm production. Output of pgm this year is planned to total in the region of 595-625,000 oz, representing an increase of 7-13 per cent compared with 2005.

ZIMBABWE

In 2005, supplies of platinum from Zimbabwe grew by 7 per cent to reach 156,000 oz, while shipments of palladium and rhodium reached 123,000 oz and 13,000 oz respectively. Further modest upgrades to capacity are being undertaken, but the fate of more substantial investment is once again in the balance, following government proposals of March 2006 that could result in the government of Zimbabwe taking a substantial stake in foreign-owned mining operations.

During 2005 the Mimosa mine processed 1.514 million tonnes of ore, a 15 per cent increase compared with 2004. Grades also increased modestly, and as a result, output of pgm in concentrate was up 19 per cent. Production of the individual metals totalled 72,000 oz of platinum, 54,000 oz of palladium and 5,500 oz of rhodium.

In September 2005, Aquarius Platinum and Impala Platinum, the joint venture partners in Mimosa, announced an expansion which will take annual output to at least 86,500 oz of platinum in concentrate. Known as Wedza Phase IV, the project will involve a 25 per cent upgrade in concentrator capacity to 150,000 tpm, with commissioning expected to take place by mid-2006.

PGM Supplies: Zimbabwe and Others
'000 oz

	2004	2005
Platinum	250	270
Palladium	265	275
Rhodium	16	17

The Zimplats operation (in which Impala holds an 86.9 per cent stake) is in the process of switching from open-cast to primarily underground mining, which the company estimates will be a more cost-effective method of exploiting the orebody. Underground tonnage almost doubled last year, rising to around 20 per cent of the total compared with 12 per cent in 2004.

The total quantity of ore processed through the mill fell slightly to 2.03 million tonnes, but there was an increase in pgm content, largely because the grade of ore extracted from underground workings is generally higher than that of open pit ore. Sales of pgm in matte totalled 87,000 oz of platinum, 73,000 oz of palladium and 8,000 oz of rhodium in 2005.

Capital spending on the development of the underground mine will total around $46 million; although the project as it stands is not intended to result in any significant increase in output, it will include the development of some of the infrastructure required for future expansions. A feasibility study of an expansion to 145,000 oz of platinum per annum has now been completed, and will be submitted to the Impala and Zimplats boards in May 2006.

An incremental expansion of the Mimosa plant in Zimbabwe to a capacity of 150,000 tpm is expected to be complete by mid-2006