



2009 Minerals Yearbook

PLATINUM-GROUP METALS [ADVANCE RELEASE]

PLATINUM-GROUP METALS

By Patricia J. Loferski

Domestic survey data and tables were prepared by Pamela A. Wisner, statistical assistant, and the world production table was prepared by Glenn J. Wallace, international data coordinator.

In 2009, Stillwater Mining Co. (SMC) (Billings, MT) was the only domestic mine producer of platinum-group metals (PGMs) from its Stillwater Mine near Nye, MT, and its East Boulder Mine south of Big Timber, MT. OJSC MMC Norilsk Nickel (Moscow, Russia) was the majority owner of SMC. SMC produced 16,500 kilograms (kg) of platinum and palladium in 2009, 6% more than the 15,500 kg that was produced in 2008 (Stillwater Mining Co., 2010, p. 46–47). Defense National Stockpile Center reported no PGM sales in 2009; 18 kg of iridium and 261 kg of platinum remained in the stockpile. Palladium stocks were exhausted in 2004 (table 1).

In 2009, the automobile industry continued to be a major consumer of PGMs. Autocatalysts accounted for approximately 82% of rhodium consumption, 45% of palladium consumption, and 23% of platinum consumption on a global basis. Jewelry was the leading use of platinum in 2009, at 48% of global consumption, up from 30% in 2008. The growth in jewelry consumption was largely fueled by increased consumption in China (Jollie, 2010, p. 28, 54–59).

Production

Primary.—During 2009, the Stillwater Mine produced 9,390 kg of palladium and 2,860 kg of platinum, 13% and 14% more, respectively, relative to production in 2008. PGM production from the East Boulder Mine was 4,230 kg (3,270 kg of palladium and 964 kg of platinum), which was a 9% decrease in both palladium and platinum production compared with that of 2008. Palladium and platinum production for SMC increased by 6% and 7%, respectively, compared with production in 2008. Production of rhodium in 2009 was 124 kg, which was double the amount of production in 2008 (Stillwater Mining Co., 2010, p. 47). The company milled 1.09 million metric tons (Mt) of ore from the mines, a 2% increase relative to that of 2008. The increased production was attributed to restructuring of mine operations in 2008. Operations at the smaller East Boulder Mine were halted for several weeks, and the workforce was downsized, with a portion of the workforce reassigned to the higher grade Stillwater Mine, replacing higher cost contract workers. Despite a 27% decrease in personnel, overall productivity improved significantly. The Stillwater and East Boulder Mines improved their mining efficiency in terms of tons mined per employee-hour by 21% and 50%, respectively, in 2009 relative to that of 2008.

Stillwater had a sales agreement with General Motors Corp. (GM) (Detroit, MI) to supply PGMs for use in automobile catalytic converters; however, the contract was nullified in July as part of GM's bankruptcy proceedings. Stillwater's PGM sales agreement with Ford Motor Co. (Dearborn, MI) was set to expire at yearend 2010.

Stillwater constructed and commissioned a second electric furnace, which was fully operational by the end of the second quarter 2009 and was capable of processing up to 50% more concentrate than the original furnace. The new furnace was part of the company's plan to expand the capacity of its recycling business by sourcing additional supplies of spent catalytic converters.

At yearend 2009, the company reported proven and probable reserves of 641,000 kg of palladium and platinum, with an average grade of 15.6 grams per metric ton (g/t) and with an in situ palladium to platinum ratio of about 3.4 to 1 at the Stillwater Mine and 3.5 to 1 at the East Boulder Mine. Average mill head grades ranged from 17.4 g/t at the Stillwater Mine to 11.8 g/t at the East Boulder Mine. SMC's proven and probable reserves of PGMs are contained in the J-M Reef, an ore body within the layered mafic and ultramafic igneous rocks of the Stillwater Complex. SMC planned to produce 16,000 kg of PGMs in 2010 (Stillwater Mining Co., 2010, p. 10, 12).

In 2009, PGM exploration continued at several locations in the United States. The most advanced project was PolyMet Mining Corp.'s (Hoyt Lakes, MN) NorthMet Mine in the Duluth Complex in northeast Minnesota. In early November, PolyMet published its draft environmental impact statement (EIS) from the Minnesota Department of Natural Resources and began a 90-day public comment period, which was to end in early February 2010. The draft EIS provided an extensive review of the potential environmental impacts of restarting the nearby Erie crushing and milling complex, initially built to process iron ore, which the company purchased in 2005. The draft EIS also addressed the impact of proposed new metallurgical facilities at the plant site and development of the NorthMet open pit mine (PolyMet Mining Corp., 2010, p. 2). Franconia Minerals Corp. (Spokane Valley, WA) planned to begin a prefeasibility study of its Birch Lake project, also in the Duluth Complex. The prefeasibility study was expected to be completed in 2010 (Franconia Minerals Corp., 2010, p. 3). In Alaska, Pure Nickel, Inc. (Toronto, Ontario, Canada) continued exploration of the nickel-copper-cobalt-PGM MAN property 265 kilometers (km) south-southeast of Fairbanks. Pure Nickel completed 4,200 meters of drilling as well as a geophysical program in 2009. The company partnered with ITOCHU Corp. (Tokyo, Japan) to advance the MAN project (Pure Nickel, Inc., 2010, p. 3).

Secondary.—In 2009, PGMs were recycled from three main sources—autocatalysts, electronics, and jewelry. The global recovery of platinum from recycling of autocatalysts decreased by 27% in 2009 compared with that of 2008, reaching 25,800 kg. In North America, recovery of platinum from catalytic converters was an estimated 13,200 kg of platinum, which was a 32% decrease compared with that in 2008, and represented roughly 51% of global autocatalyst recycled material. Recovery

of platinum from catalytic converters decreased by 25% and 17% in Europe and Japan, respectively, and increased by 33% in China compared with 2008 quantities. In the rest of the world, recycling of autocatalysts produced about the same amount of platinum in 2009 as compared with that of 2008. Globally, recycling of autocatalysts decreased sharply in the first half of 2009 as a result of the drop in metal prices, but picked up in the second half of 2009 as prices increased. About 311 kg of platinum was recovered from electronics recycling in 2009, which was double the amount recovered in 2008. About 17,600 kg of platinum was recovered from the jewelry industry globally, a decrease of 19% compared with that of 2008 (Jollie, 2010, p. 24).

About 30,000 kg of palladium was recovered from autocatalysts globally in 2009, a decrease of 15% compared with that of 2008. Roughly 56% of global recycled palladium came from North America. Palladium recovery from autocatalysts in North America decreased by 19% to 16,800 kg, and that in Europe decreased by 10% to 8,710 kg relative to that in 2008. Palladium recovery from autocatalysts in Japan decreased by 29% and that in China increased by 17% compared with levels in 2008. Recycling of palladium from electronics totaled 12,300 kg in 2009, an increase of 14% compared with that of 2008. Recycling of palladium from the jewelry industry totaled about 2,180 kg in 2009, which was about 46% less than that of 2008. In 2009, global recovery of rhodium from autocatalysts decreased by 18% to 5,820 kg (Jollie, 2010, p. 24).

SMC's recycling program recovered 7,810 kg of PGMs in 2009, a decrease of 37% as compared with that of 2008. The sale of the recycled material was \$81.8 million in 2009, which was down by 83% from the 2008 sales value because of lower prices in the first half of 2009 (Stillwater Mining Co., 2010, p. 21).

Consumption

In 2009, global platinum sales totaled 193,000 kg, a 9% decrease compared with sales in 2008. About 48% of the total was consumed by the jewelry industry, about 23% by the autocatalyst industry, and about 11% was used as investment. The remaining was used in other industries including chemical, glass-making, medical and biomedical, and electrical. Platinum use in the autocatalyst sector decreased by 39% as a result of a decrease in light-duty vehicle production, which in turn was the result of the effects of the global economic downturn.

Global palladium sales were 212,000 kg in 2009, about 5% less than those in 2008. About 45% of the total was used by the autocatalyst industry, about 19% by the electronics industry, and about 12% by the jewelry industry. The remaining amount was used in industries such as chemical, dental, investment, and others.

In 2009, U.S. apparent consumption of refined platinum was estimated to be about 171,000 kg, a 24% increase from the apparent consumption of 138,000 kg in 2008. The increase was largely a result of investment buying. Apparent domestic palladium consumption was estimated to be about 52,000 kg, a 51% decrease from 106,000 kg in 2008.

Palladium.—Palladium use in autocatalysts decreased by 9% globally to 126,000 kg in 2009 compared with 2008

consumption. Demand in Europe fell only slightly despite a large decline in production of light-duty vehicles. A number of European Governments introduced automobile scrappage plans in order to encourage auto purchasing, and the scrappage plans resulted in the purchase of smaller, gasoline-powered vehicles. As a result, the market share of gasoline engines increased in Europe in 2009. Therefore, palladium consumption by the European diesel sector decreased slightly in 2009 relative to that of 2008, and automakers continued to increase substitution of palladium for platinum in diesel catalytic converters. Euro 5 emission standards were introduced in late 2009, and resulted in more vehicles being fitted with diesel particulate filters, which led to an increase in palladium and platinum use.

Consumption in the North American autocatalyst sector plummeted to 31,700 kg, a 21% decrease relative to that of 2008, owing to the global economic downturn and decline in vehicle purchases. In the United States, vehicle purchases dropped in 2009 compared with those in 2008, and only rose after the U.S. Government introduced the "Cash for Clunkers" auto scrappage plan in the middle of the year. The scrappage plan was a \$3 billion program that provided economic incentives to purchase new, more fuel-efficient vehicles when trading in less fuel-efficient vehicles. The program resulted in sales of about 700,000 new vehicles. Palladium consumption in the Japanese autocatalyst industry was 18,400 kg, a 33% decrease compared with that of 2008. In contrast, palladium consumption in China increased to 21,300 kg, a 76% increase relative to that of 2008. Palladium consumption for autocatalysts in the rest of the world decreased by 15% to 23,600 kg relative to that of 2008 (Jollie, 2010, p. 36–40).

On a global basis, palladium consumption by the jewelry industry decreased to 25,300 kg, a 17% decrease in 2009 compared with that of 2008. The decrease was largely a result of the 24% drop in demand from China, to 17,400 kg of palladium. In China, jewelry manufacturers that had begun to produce palladium jewelry switched back to platinum as the platinum price declined. The level of demand in North America remained the same in 2009 as in 2008. China was again by far the leading user of palladium for jewelry, with 75% of world consumption in that sector. The much smaller markets in Europe and North America showed increases in palladium use in jewelry in 2009. Consumption in Europe was 1,560 kg of palladium, an 11% increase relative to that of 2008, and consumption in North America was 1,870 kg, the same as that in 2008. Consumption in Japan was 3,730 kg of palladium, a 4% increase relative to that of 2008 (Jollie, 2010, p. 39–40).

World palladium consumption in dental alloys was 19,100 kg in 2009, which was about 2% less than consumption in 2008. About 45% of the global consumption came from Japan and about 42% from North America. The chemical industry consumed 10,100 kg of palladium in 2009, a 7% decrease from that in 2008. The global decrease was the result of a slowdown in the construction of new plants owing to the global economic downturn. In the chemical industry, palladium is used mainly as a catalyst in manufacturing bulk chemicals, including purified hydrogen peroxide, nitric acid, purified terephthalic acid, and vinyl acetate monomer, a component of many resins and plastics. Consumption of palladium by the electronics

industry was 39,500 kg in 2009, which was a 7% decrease compared with that of 2008. The leading use of palladium in the electronics industry was for multilayer ceramic capacitors (MLCCs), which are widespread in electronic circuitry. Trends toward miniaturization continued. Although the MLCCs became smaller, it was necessary to use a greater number of MLCCs per device. Thus, the amount of palladium per device remained about the same. Significant amounts of palladium also were used in hybrid integrated circuits, which are miniaturized electronic circuits constructed of individual devices, such as semiconductor devices and passive components, bonded to a substrate or printed circuit board. Use of palladium in other applications decreased by 7% in 2009 compared with that of 2008. Such uses included stationary-source emission control and petroleum refining catalysts. Purchases of palladium for investment increased to 19,400 kg, 49% higher than those of 2008. Holdings in ETFs were 20,060 kg at the beginning of 2009 and increased to 36,400 kg at yearend 2009, which was an increase of more than 300% compared with holdings at yearend 2008 (Jollie, 2010, p. 43).

Platinum.—Global use of platinum in the autocatalyst sector decreased by 39% to 69,400 kg in 2009 compared with that in 2008. Consumption in Europe was about 30,200 kg of platinum in 2009, about 51% less than that of 2008, and accounted for about 43% of the global total. The market share of light-duty diesel vehicles in Europe decreased to 46% in 2009 from 53% in 2008 as a result of auto scrappage plans by various European Governments, which had the effect of increasing sales of smaller gasoline-powered autos that use more palladium in their catalytic converters. Consumption in this sector for North America decreased by 27% in 2009 relative to that of 2008 owing to the drop in automobile purchases in response to the global financial downturn. Light-duty vehicle production fell sharply in North America in 2009. In Japan, platinum demand in the autocatalyst sector decreased by about 35%. Despite growth in vehicle production in China, demand for platinum in the autocatalyst sector decreased by 10% to 4,040 kg, owing to the replacement of platinum by palladium in catalysts. Consumption of platinum for autocatalysts decreased by 14% in other areas of the world despite increasingly stringent emission standards (Jollie, 2010, p. 24).

In 2009, global consumption of platinum in jewelry showed a sharp increase as a result of lower metal prices. Consumption in this sector was 93,600 kg of platinum, a 46% increase compared with that of 2008. Consumption in North America decreased by 33%, and consumption in Japan was about the same in 2009 relative to consumption in 2008. Consumption in China skyrocketed by 96% during the same time period. China remained, by far, the leading consumer in this sector at 64,700 kg, accounting for 69% of global consumption. In Europe, platinum consumption in the jewelry industry was 5,750 kg, a decrease of 10% compared with that in 2008 (Jollie, 2010, p. 28–30).

Global use of platinum in the chemical sector decreased to 9,180 kg in 2009, which was a drop of 26% compared with that of 2008. The decrease was partly the result of lower chemical production in response to the global economic downturn, which in turn resulted in platinum-based catalysts

lasting longer. Purchases of platinum by the petroleum refining industry decreased by 15% to 6,380 kg in 2009, because of decreased consumer demand for refined petroleum products throughout the world. The global consumption of platinum in electrical applications decreased by 17%, to 5,900 kg in 2009, as compared with that of 2008, owing to weak consumer demand.

Because of its high melting point and resistance to corrosion, platinum equipment is used in the glassmaking industry. Platinum consumed in the glass industry plummeted to 311 kg in 2009, a 97% decrease compared with that of 2008. The drop was a result of several factors. A decrease in industrial demand for fiberglass caused a delay in the construction of fiberglass-producing factories. In addition, the lower rhodium price caused the fiberglass industry to move toward more durable, higher-rhodium, lower-platinum alloys, and platinum demand was therefore, lower. Also, there was weak demand in the first half of the year for flat-screen televisions, which use platinum in the production of liquid crystal displays. The weakened demand caused delay in plant construction for flat screens, but sales improved in the second half of the year, and glass manufacturers moved back into expansion mode. Consumption in the medical and biomedical sector was 7,780 kg, which was slightly higher than that in 2008. Consumption in other end uses decreased sharply to 5,900 kg, a 34% decrease relative to that of 2008. These categories included use in automotive sensors, coating of aircraft turbine blades, and spark plugs. Investment demand for platinum increased to 20,500 kg, a 19% increase relative to that of 2008. On a global basis, about 3,270 kg of platinum was purchased in the form of coins and small bars, and about 5,130 kg was purchased in the form of large bars. By yearend 2009, platinum holdings in ETFs increased 21,200 kg (Jollie, 2010, p. 25–33).

In 2009, the U.S. Mint did not sell any platinum American Eagle Bullion coins (U.S. Mint, 2010).

Other PGMs.—Global rhodium consumption in 2009 decreased to 22,300 kg, a 20% decrease compared with that of 2008. A majority of rhodium use, 82% in 2009, was in the production of autocatalysts. In 2009, rhodium use in autocatalysts decreased to 19,300 kg, which was 19% less than that of 2008. Demand for rhodium in the autocatalyst sector plummeted in Europe, Japan, and North America, as a result of declining vehicle production, a trend toward smaller vehicles, and rhodium thifting. In contrast, rhodium demand in the autocatalyst sector in China increased to 3,640 kg, an increase of 52% compared with that of 2008. Use of rhodium in the glass manufacturing sector decreased sharply to 591 kg, a 44% drop in 2009 as compared with that in 2008. The drop was a result of reduced demand for fiberglass and flat-panel glass for liquid crystal displays. Rhodium was also released onto the market by some cathode-ray-tube glass factories that closed in China. On the other hand, the decrease in rhodium price in 2009 compared with that of the previous several years resulted in an increase of rhodium content of alloys used in the glass industry. Consumption of rhodium in the chemical sector decreased by 21% to 1,680 kg in 2009 owing to delays in construction of new oxoalcohol manufacturing plants in Asia. Demand from the electrical sector and other applications was down by 11% from that of 2008, at 746 kg (Jollie, 2010, p. 44).

Global consumption of ruthenium dropped for the third successive year. Demand decreased by 18% to 17,900 kg in 2009 relative to that in 2008. The consumption of ruthenium in electrical applications fell to 10,500 kg, an 18% decrease relative to that of 2008; consumption of primary ruthenium increased slightly in the hard disk industry. Electrochemical demand remained the same in 2009 as in 2008, at 2,960 kg of ruthenium, and its use in the chemical sector fell to 2,770 kg, a 36% decrease compared with that in 2008. Other demand for ruthenium decreased slightly to 1,680 kg in 2009.

Global consumption of iridium decreased to 2,830 kg in 2009, an 11% drop compared with 2008 consumption, reflecting a 53% decrease of iridium use in the electrical sector. Fewer iridium crucibles were manufactured for crystal-growing in 2009 than in previous years. Use of iridium in spark plugs in the aerospace and automotive industries decreased to 528 kg, a drop of 35% relative to levels in 2008 (Jollie, 2010, p. 45).

Prices

The 2009 Engelhard annual average price of palladium and platinum decreased by 25% and 23%, respectively, compared with the 2008 annual average prices. As for the other PGMs, the 2009 iridium annual price decreased by 6%, whereas rhodium and ruthenium annual prices plummeted by 76% and 70%, respectively, compared with the 2008 prices (table 1).

Iridium.—In the beginning of January, the price of iridium was \$430 per troy ounce. The price dropped to \$420 per troy ounce on January 16 and remained at that level throughout the rest of the year.

Palladium.—Palladium prices began the year at \$186 per troy ounce, and for much of the year, the price trend was upwards in response to increased investor interest and a gradual improvement in automobile sales. The palladium price ended the year at \$407 per troy ounce, more than double its level at the start of the year.

Platinum.—The platinum price began the year at \$931 per troy ounce, and moved upward throughout most of the year, reaching \$1,510 per troy ounce in early December and ending the year at \$1,475 per troy ounce. The price increase was driven by a weaker U.S. dollar, a high gold price, a strong Chinese jewelry demand, and a return of investment demand and recovery in the automobile industry.

Rhodium.—The rhodium price began the year at \$1,260 per troy ounce, rose steadily to \$1,674 per troy ounce in mid-October, then skyrocketed to \$2,790 in late November, before decreasing to \$2,525 at yearend. The price rise was driven by physical and speculative interest as well as improvement in the auto industry by yearend.

Ruthenium.—The ruthenium price began the year at \$100 per troy ounce and dipped to \$75 per troy ounce in mid-February. The price climbed back to \$95 per troy ounce in mid-April, where it remained until mid-November. The price jumped to \$150 per troy ounce in late November and ended the year at \$160 per troy ounce. The ruthenium price increased owing to industrial purchasing and investor interest.

Foreign Trade

In 2009, the U.S. net import reliance as a percentage of apparent consumption was estimated to be 89% for refined palladium and 97% for refined platinum. Imports of refined palladium in 2009 decreased by 42% to 69,700 kg from 120,000 kg in 2008, with three countries accounting for about 78% of refined palladium imports in 2009—Russia (33%), South Africa (29%), and the United Kingdom (16%). Imports of platinum, including waste, scrap, and coins, increased by 22% in 2009 to 183,000 kg, from 150,000 kg in 2008. Excluding waste and scrap, three countries accounted for 73% of imports of platinum in 2009—South Africa (43%), the United Kingdom (20%), and Germany (9%). Other refined PGM imports decreased by 53% in 2009 compared with those of 2008. Imports of iridium were down by 55%; those of rhodium and ruthenium were down by 33% and 56%, respectively, whereas imports of osmium were up by 196% compared with those of 2008. Three countries accounted for 90% of the imports of other PGM in 2009—South Africa (55%), Germany (24%), and the United Kingdom (11%) (tables 2, 3).

About 30,300 kg of palladium was exported in 2009, an increase of 15% relative to palladium exports in 2008 (table 4). Exports of platinum decreased by 33% to 47,100 kg, and exports of rhodium decreased by 39% compared with exports in 2008. Exports of iridium, osmium, and ruthenium dropped by 38% during the same time period.

World Review

In 2009, world mine production of PGMs decreased to 445,000 kg compared with 460,000 kg in 2008, which was a decrease of 3% (table 5). South Africa, the world's leading producer of PGMs, accounted for 61% of total mine production in 2009, Russia accounted for 26%, Canada accounted for 4%, and the United States and Zimbabwe each accounted for 3%. In 2009, platinum production from South Africa totaled 141,000 kg, which represented 78% of world platinum production and was a 4% drop relative to South African production in 2008. Global output of palladium dropped to 192,000 kg, with Russia and South Africa accounting for 43% and 39%, respectively, of the total. World production of other PGMs (iridium, osmium, ruthenium, and rhodium) in 2009 decreased slightly as compared with that of 2008. South Africa was the dominant producer, accounting for 78% of the total global production of other PGMs.

Australia.—Platinum Australia Ltd. (West Perth) completed significant work on updating the 2003 feasibility study at the Pantom PGM Project in Western Australia. Completion of the feasibility study continued to be put on hold as a result of metal price drops (Platinum Australia Ltd., 2010, p. 15).

Botswana.—In 2009, Norilsk Nickel produced 3,110 kg of palladium and 529 kg platinum as byproducts from its nickel operations at the Tati Mine. These quantities represented a 5% increase in palladium production and an 11% decrease in platinum production compared with production in 2008 (OJSC MMC Norilsk Nickel, 2010, p. 55).

Canada.—North American Palladium Ltd. (Toronto, Ontario) had no production in 2009 because the Lac des Isles Mine had been placed on care-and-maintenance status in October 2008 in response to lower metal prices (North American Palladium Ltd., 2010).

Xstrata plc (Zug, Switzerland) continued to produce PGM as byproducts from nickel mining operations at Sudbury, although production figures were not released. Both output and headgrades improved at its Raglan nickel mine in northern Quebec (Jollie, 2010, p. 20). Vale Inco Ltd. (Toronto, Ontario) produced 4,730 kg of palladium and 3,200 kg of platinum as byproducts of its nickel operations at Sudbury. These data reflect production decreases for platinum and palladium of 38% and 34%, respectively, relative to production in 2008. Vale temporarily closed its Sudbury operations in June. In July, the workforce decided to go on strike, which prevented the operations from restarting (Jollie, 2010, p. 20).

Russia.—In 2009, Russia accounted for 43% of global mine production of palladium, 12% of other PGMs, and 12% of platinum production. Norilsk Nickel produced 83,200 kg of palladium, which was a slight decrease relative to 2008 production, and 19,800 kg of platinum, which was a slight increase compared with production in 2008 (OJSC MMC Norilsk Nickel, 2010, p. 55). Russia's alluvial production was 4,670 kg of platinum, which was a 14% decrease compared with 2008 production (Jollie, 2010, p. 19).

South Africa.—In 2009, South African production of platinum decreased by 4% compared with that of 2008 as a result of various problems, including closure of several uneconomic shafts and pits, geologic issues, labor unrest, safety-related mine closures, and smelter outages. The world's leading PGM producer, Anglo Platinum Ltd. (Johannesburg) produced 76,300 kg of platinum and 42,300 kg of palladium in 2009, increases of 3% for both platinum and palladium relative to production in 2008. Rhodium production was 10,900 kg in 2009, an increase of 17% relative to that of 2008. The global economic downturn led to shaft closures at Khuseleka and Siphumelele Mines (formerly part of the Rustenburg section), and output decreased there, but production increased at the Mogalakwena Mine owing to the commissioning of the Mogalakwena North expansion project in 2008. Anglo restructured its Amandelbult and Rustenburg Mines in response to low metal prices. Three Rustenburg shafts were closed, and expenditure on capital projects, such as the Amandelbult No. 4 shaft, was delayed. Production from the Mototolo Mine, a joint venture with Xstrata, increased to 3,400 kg, 25% higher than 2008 production. Production also increased at the Kroondal and Marikana Mines. At Modikwa, a joint venture with African Rainbow Minerals Ltd. (ARM), platinum production was 4,170 kg of platinum, which was a slight decrease relative to that of 2008. At the Bafokeng-Rasimone Platinum Mine (BRPM) joint venture, refined platinum production was 5,380 kg, a slight decrease relative to 2008 production. Anglo expected to produce 77,800 kg of platinum in 2010 (Anglo Platinum Ltd., 2010, p. 107–121).

Impala Platinum Holdings Ltd.'s (Johannesburg) refined production of platinum in 2009 was 27,000 kg, a 12% decrease compared with that of 2008. Production dropped as a result

of several factors, including disruption in operations at the Rustenburg site caused by a workers' strike and a major rockfall in a mechanized section at 14 shaft that killed nine workers. Output at Marula increased slowly, as mining methods were switched from mechanized to conventional methods, and production for 2009 was 2,370 kg of platinum. The ramp up to full production at Two Rivers Mine was almost completed, and production included 4,110 kg of platinum in concentrate (Impala Platinum Holdings Ltd., 2010, p. 51–67).

In 2009, Northam Platinum Ltd. (Johannesburg) reported production from its Zondereinde Mine of 9,000 kg of PGMs in concentrate, an 8% increase compared with production in 2008 (Northam Platinum Ltd., 2010, p. 11).

Lonmin plc (London, United Kingdom) reported production for 2009 of 20,300 kg of platinum and 9,400 kg of palladium, a decrease of 9% and 10%, respectively, relative to 2008 production. Rhodium production fell to 2,820 kg, a 9% decrease relative to that of 2008. Ruthenium and iridium production were 4,290 kg and 927 kg, respectively, both of which were 9% less than production in 2008. Production fell because of safety shutdowns as well as operational changes that were made as a result of low metal prices. The Limpopo Mine was put on care-and-maintenance status, one uneconomic mine shaft and five half levels were closed at the Marikana Mine, and open pit mines were closed at the Marikana Mine and the Pandora Mine, a joint venture between Lonmin (42.5% interest), Anglo Platinum (42.5%), Mvelaphanda Resources Ltd. (Sandton) (7.5%), and Bapo Ba Mogale tribe (7.5%). Despite closure of the open pit, mining continued at Pandora by extracting ore through the adjacent shaft infrastructure at Marikana. Production at Pandora in 2009 was 1,240 kg of platinum, a decrease of 19% compared with that of 2008 (Lonmin plc, 2010, p. 2, 138).

Aquarius Platinum Ltd. (Bedford) suspended operations at the Everest Mine in December 2008 as a result of subsidence of the mined-out portion of the mine. No production took place in 2009, and the mine was in the process of being reestablished by yearend. Aquarius had two pool-and-share agreements with Anglo Platinum, at the Kroondal and Marikana Mines. Production from the Kroondal Mine, reported as metal in concentrate, included 7,490 kg of platinum, 3,750 kg of palladium, and 1,380 kg of rhodium. These values represented increases of 2%, 4%, and 5%, respectively, in the production of platinum, palladium, and rhodium relative to those of 2008. Production during 2009 from the Marikana Mine included 2,770 kg of platinum, 969 kg of palladium, and 460 kg of rhodium, which were increases of 7% and 12%, respectively, in the production of platinum and rhodium, and a decrease of 15% in palladium production relative to production in 2008. Production from the Chromite Tailings Retreatment Plant, a joint-venture project between Aquarius (50%), GB Mining and Exploration Ltd. (Johannesburg) (25%), and Sylvania South Africa Ltd. (West Perth) (25%), included 210 kg of palladium, 134 kg of platinum, and 61 kg of rhodium, a decrease of 11% for platinum production, and increases of 54% and 113% for palladium and rhodium, respectively, compared with that of 2008 (Aquarius Platinum Ltd., 2010, p. 17–19).

ARM platinum division had several joint ventures in South Africa—Modikwa Platinum Mine, 50% jointly owned with

Anglo Platinum; Nkomati Nickel Mine, 50% with Norilsk Nickel; and Two Rivers Platinum Mine, a project in which ARM held 55% and Implats 45%. Production from Modikwa was 4,170 kg of platinum, and from Nkomati, production was 1,300 kg of PGM, both reported on a 100% basis. Modikwa production was about the same as that of 2008, whereas Nkomati production decreased by 28%. Two Rivers produced 4,040 kg of PGM during 2009, which was an 18% increase relative to that of 2008 (African Rainbow Minerals Ltd., 2010, p. 31).

Eastern Platinum Ltd.'s (Vancouver, British Columbia, Canada) Crocodile River Mine produced 4,040 kg of PGMs in concentrate, a 10% increase from that in 2008 (Eastern Platinum Ltd., 2010, p. 60).

Platmin Ltd.'s (Centurion) Pilanesburg Mine produced 871 kg of PGM in concentrate during its first year of production. Full production of 7,770 kilograms per year (kg/yr) of PGMs was expected to be reached by 2011 (Platmin Ltd., 2010, p. 28).

Platinum Australia Ltd.'s Smokey Hills Mine began its first year of production in 2009 and produced about 840 kg of PGM in concentrate. Most of the ore came from an open pit, and Platinum Australia was in the process of ramping up underground production (Platinum Australia Ltd., 2010, p. 2).

Zimbabwe.—In 2009, production from Impala's Mimosa Mine was 2,850 kg of platinum, which was a 19% increase relative to production in 2008. Mimosa's Wedza phase 5.5 expansion was completed in May, and increased the PGM production capacity to 6,220 kg/yr. In 2009, production from Impala's Zimplats Mine was 5,490 kg of PGMs, slightly less than 2008 production. The phase I expansion project continued during the year, and portal 1 reached its full production capacity of 100,000 metric tons per month of ore in June. The Ngezi concentrator was commissioned in July and was expected to have a capacity of 5,600 kg/yr of platinum-in-matte (Impala Platinum Holdings, Ltd., 2010, p. 13, 64–73).

Anglo Platinum's Unki Mine, near Gweru, continued development in 2009, and the first ore was stockpiled and was expected to be processed in the last quarter of 2010 (Jollie, 2010, p. 21).

Outlook

The primary end use for palladium, platinum, and rhodium is for catalytic converters in the automotive industry; therefore, the outlook for that industry will have the greatest impact on the consumption and prices of these PGMs. The progress of the global economic recovery was expected to be the main driver of demand for PGMs. Although economic growth remains weak in most countries, consumer confidence is returning, and industrial output is increasing. Global automobile production is likely to increase in the near future; therefore, an overall increase in demand for PGM in that sector is expected. Manufacturers continued to switch to palladium-based catalytic converters. Thus, the increase in automobile demand will likely affect palladium demand in particular. Stricter emission standards in many areas of the world were expected to result in greater demand for PGMs in the automotive sector. In the electronics sector, palladium demand was likely to increase as the global economy recovers, because of increasing demand for consumer

electronics in which palladium is used in MLCCs. In the glass sector, demand for platinum was expected to rise owing to an expected growth in the LCD and fiberglass industries. In the chemical sector, demand for platinum and palladium was expected to rise because of an increase in construction of manufacturing facilities. The demand for platinum in the jewelry sector was expected to drop worldwide because of the price rise. The consumption of rhodium was expected to increase as a result of higher vehicle demand in many areas of the world. Ruthenium demand was expected to increase as a result of increased demand from the hard disk industry. Iridium demand was likely to increase as a result of increased demand for use in spark plugs in the automobile sector. Iridium demand for crucibles used for the growth of metal oxide single crystals was also expected to increase.

On the supply side, platinum production from South Africa was expected to increase somewhat or remain level through 2010. However, production from South Africa will be dependent on several issues including timelines for new projects and ramp ups, stability of power supplies, availability and retention of skilled workers, quick resolution of labor disputes, and improved safety records. Supply from Zimbabwe could increase because of new mining projects, but this may be dependent on the political situation.

The proposed launch of two ETFs in the United States in 2010 was expected to result in increased demand for platinum and palladium in the investment sector. Because of volatile PGM pricing, investment in these funds is likely to continue to increase.

References Cited

- African Rainbow Minerals Ltd., 2010, 2009 annual report: Sandton, South Africa, African Rainbow Minerals Ltd., 224 p.
- Anglo Platinum Ltd., 2010, Annual report 2009: Johannesburg, South Africa, Anglo Platinum Ltd., 279 p.
- Aquarius Platinum Ltd., 2010, Annual report 2009: Bedford, South Africa, Aquarius Platinum Ltd., 170 p.
- Eastern Platinum Ltd., 2010, Consolidated financial statements of December 31, 2009 and 2008: Vancouver, British Columbia, Canada, Eastern Platinum Ltd., 75 p.
- Franconia Minerals Corp., 2010, Annual report 2009: Spokane Valley, WA, Franconia Minerals Corp., 44 p.
- Impala Platinum Holdings Ltd., 2010, Annual report 2009: Johannesburg, South Africa, Impala Platinum Holdings Ltd., 246 p.
- Jollie, David, 2010, Platinum 2010: London, United Kingdom, Johnson Matthey plc, 60 p.
- Lonmin plc, 2010, Annual report 2009: London, United Kingdom, Lonmin plc, 146 p.
- North American Palladium Ltd., 2010, Annual report 2009: Toronto, Ontario, Canada, North American Palladium Ltd., 62 p.
- Northam Platinum Ltd., 2010, Annual report 2009: Johannesburg, South Africa, Northam Platinum Ltd., 104 p.
- OJSC MMC Norilsk Nickel, 2010, Annual report 2009: Moscow, Russia, OJSC MMC Norilsk Nickel, 257 p.
- Platinum Australia Ltd., 2010, Annual report 2009: West Perth, Australia, Platinum Australia Ltd., 96 p.
- Platmin Ltd., 2010, Annual report 2009: Centurion, South Africa, Platmin Ltd., 104 p.
- PolyMet Mining Corp., 2010, 2010 annual report: Hoyt Lakes, MN, PolyMet Mining Corp., 78 p.
- Pure Nickel Inc., 2010, Management discussion and analysis first quarter ended February 28, 2010: Toronto, Ontario, Canada, Pure Nickel Inc., 13 p.
- Stillwater Mining Co., 2010, Annual report 2009: Billings, MT, Stillwater Mining Co., 109 p.

U.S. Mint, 2010, 2009 American Eagle bullion sales totals: Washington, DC, U.S. Mint. (Accessed June 15, 2010, at http://www.usmint.gov/mint_programs/american_eagles/index.cfm?action=sales&year=2008.)

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

Platinum-Group Metals. Ch. in *Metal Prices in the United States Through 1998, 1999*.

Platinum-Group Metals. Ch. in *Mineral Commodity Summaries, annual*.

Platinum-Group Metals. Ch. in *United States Mineral Resources, Professional Paper 820, 1973*.

Platinum-Group Metals. *International Strategic Minerals Inventory Summary Report, Circular 930-E, 1986*.

Platinum-Group Metals. *Mineral Industry Surveys, monthly, since January 2004*.

Precious Metals. *Mineral Industry Surveys, monthly, through December 2003*.

Other

CPM Group.

Defense National Stockpile Center, Defense Logistics Agency.
International Platinum Association.

Platinum-Group Metals. Ch. in *Mineral Facts and Problems, U.S. Bureau of Mines Bulletin 675, 1985*.

Platinum Guild International.

Roskill Information Services Ltd.

TABLE 1
SALIENT PLATINUM-GROUP METALS STATISTICS¹

		2005	2006	2007	2008	2009
United States:						
Mine production:						
Palladium, Pd content: ²						
Quantity	kilograms	13,300	14,400	12,800	11,900	12,700
Value	thousands	\$87,100	\$150,000	\$148,000	\$136,000	\$108,000
Platinum, Pt content: ²						
Quantity	kilograms	3,920	4,290	3,860	3,580	3,830
Value	thousands	\$113,000	\$158,000	\$162,000	\$182,000	\$149,000
Refinery production:						
Palladium, Pd content:						
Quantity	kilograms	5,220	5,660	7,410	7,650	7,840
Value	thousands	\$34,100	\$58,700	\$85,100	\$87,300	\$66,900
Platinum, Pt content:						
Quantity	kilograms	6,360	6,870	8,930	7,400	7,220
Value	thousands	\$184,000	\$253,000	\$375,000	\$376,000	\$280,000
Imports for consumption, refined:						
Iridium, Ir content	kilograms	3,010	2,800	3,410	2,550	1,520
Osmium, Os content	do.	39	56	23	11	68
Palladium, Pd content	do.	139,000	119,000	113,000	120,000	69,700
Platinum, includes waste, scrap, and coins, Pt content	do.	106,000	114,000	181,000	150,000	183,000
Rhodium, Rh content	do.	13,600	15,900	16,600	12,600	11,200
Ruthenium, Ru content	do.	23,200	36,000	48,700	49,800	21,200
Exports, refined:						
Iridium, osmium, and ruthenium, gross weight	do.	1,070 ^r	3,390	8,190	6,450	4,020
Palladium, Pd content	do.	27,000	53,100	41,800	26,400	30,300
Platinum, Pt content	do.	20,700	45,500	28,900	15,600	15,600
Rhodium, Rh content	do.	615	1,600	2,210	1,980	1,220
Stocks, National Defense Stockpile, December 31:						
Iridium, Ir content	do.	171 ^r	111	18	18	18
Palladium, Pd content	do.	--	--	--	--	--
Platinum, Pt content	do.	261	261	261	261	261
Price, average:						
Iridium ³	dollars per troy ounce	169.51	349.45	444.43	448.34	420.40
Palladium ⁴	do.	203.54	322.93	357.34	355.12	265.65
Platinum ⁴	do.	899.51	1,144.42	1,308.44	1,578.26	1,207.55
Rhodium ⁴	do.	2,059.73	4,561.06	6,203.09	6,533.57	1,591.32
Ruthenium ³	do.	74.41	193.09	573.74	324.60	97.28
Employment		1,617 ^r	1,719	1,625	1,364	1,273
World, mine production ^e , PGM content	kilograms	504,000 ^r	514,000	507,000 ^r	460,000 ^r	445,000 ^e

^eEstimated. ^rRevised. do. Ditto. -- Zero.

¹Data are rounded to three significant digits, except prices.

²Source: Stillwater Mining Co., 2009 annual report, p. 46.

³Price data are annual averages of daily Engelhard unfabricated quotations published in Platts Metals Week.

⁴Price data are annual Engelhard unfabricated quotations published in Platts Metals Week.

TABLE 2
U.S. IMPORTS FOR CONSUMPTION OF PLATINUM, BY COUNTRY¹

Country	Grain and nuggets			Sponge			Other unwrought			Other			Waste and scrap			Coins	
	Quantity, Pt content (kilograms)	Value (thousands)	Pt content (kilograms)	Quantity, Pt content (kilograms)	Value (thousands)												
2008:																	
2009:																	
Australia	--	--	--	--	--	--	(2)	4	12,300	280	61	2,310	5	112			
Belgium	--	--	1,920	72,800	83	3,770	--	--	--	--	81	4,780	--	--			
Bolivia	--	--	--	--	--	--	--	--	--	--	12,700	470	--	--			
Brazil	--	--	231	8,140	--	--	6	246	7,960	925	7,960	22,000	--	--			
Canada	12	293	1	12	1	15	231	7,980	7,730	9,940	17,400	477	19,300				
Chile	--	--	--	--	--	--	--	--	--	--	1,500	6,450	--	--			
China	--	--	--	--	--	--	7	412	2,490	208	2,490	1	22				
Colombia	--	--	14	457	1,490	44,100	--	--	--	--	208	86,500	--	--			
Germany	(2)	4	711	29,500	1,070	41,800	2,720	55,900	20,600	20,600	86,500	1	8				
India	--	--	326	12,400	--	--	10	386	5	5	216	--	--				
Italy	--	--	1,280	50,500	1	25	592	22,800	180	180	5,100	--	--				
Japan	--	--	24	870	46	1,460	88	2,890	31,800	31,800	107,000	--	--				
Mexico	--	--	48	1,770	46	1,460	13	274	15,400	15,400	18,900	--	--				
Norway	--	--	1,470	59,400	--	--	--	--	--	--	--	--	--				
Poland	--	--	--	--	--	--	--	--	--	17,400	766	--	--				
Russia	1	61	1,610	59,200	115	4,240	--	--	--	--	--	--	--				
South Africa	3	107	19,800	768,000	--	--	405	14,800	58	58	2,670	--	--				
Switzerland	--	--	224	7,360	758	27,100	1,370	49,300	--	--	--	1	56				
United Kingdom	--	--	9,450	351,000	40	1,090	168	5,880	214	214	5,560	27	1,060				
Venezuela	--	--	--	--	--	--	4	87	12,300	373	373	--	--				
Other	(2)	10	--	--	129	3,480	17	342	4,500	43,100	11	(2)					
Total	16	474	37,100	1,420,000	3,770	129,000	5,910	174,000	136,000	334,000	20,500	512	20,500				

-- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 3
U.S. IMPORTS FOR CONSUMPTION OF PLATINUM-GROUP METALS, BY COUNTRY¹

Country	Unwrought palladium		Palladium, other		Iridium ²		Osmium ²		Ruthenium ²		Rhodium ²	
	Quantity, Pd content (kilograms)	Value (thousands)	Quantity, Pd content (kilograms)	Value (thousands)	Quantity, Ir content (kilograms)	Value (thousands)	Quantity, Os content (kilograms)	Value (thousands)	Quantity, Ru content (kilograms)	Value (thousands)	Quantity, Rh content (kilograms)	Value (thousands)
2008	114,000	\$1,270,000	6,810	\$85,500	2,550	\$36,600	11	\$101	49,800	\$426,000	12,600	\$2,470,000
2009:												
Belgium	781	5,390	31	253	9	87	--	--	--	--	779	31,700
Canada	1,820	27,500	194	2,250	--	--	--	--	--	--	(3)	4
China	--	--	2	32	--	--	8	56	(3)	2	--	--
Germany	546	4,480	269	2,470	85	1,190	--	--	7,480	18,400	515	25,200
Italy	1,640	15,700	22	224	1	13	--	--	--	--	429	13,800
Japan	1,360	7,270	112	917	(3)	10	--	--	516	1,370	41	1,550
Norway	4,490	39,800	--	--	--	--	--	--	--	--	102	4,860
Russia	20,600	200,000	2,510	20,400	21	284	--	--	182	569	1,200	71,200
South Africa	19,500	166,000	804	5,960	1,040	13,600	60	495	10,100	26,500	7,540	353,000
Switzerland	871	7,740	3,080	26,600	--	--	--	--	--	--	--	--
United Kingdom	10,600	94,000	307	3,040	190	2,500	--	--	2,950	8,890	500	24,500
Other	97	613	18	222	175	3,110	--	--	--	--	77	4,010
Total	62,300	568,000	7,350	62,300	1,520	20,800	68	551	21,200	55,700	11,200	530,000

-- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Unwrought and other forms.

³Less than 1/2 unit.

Source: U.S. Census Bureau.

TABLE 4
U.S. EXPORTS OF PLATINUM-GROUP METALS, BY COUNTRY¹

Country	Palladium		Platinum		Platinum, waste and scrap		Iridium, osmium, ruthenium		Rhodium	
	Quantity, Pd content	Value	Quantity, Pt content	Value	Quantity, Pt content	Value	Quantity, gross weight	Value	Quantity, Rh content	Value
	(kilograms)	(thousands)	(kilograms)	(thousands)	(kilograms)	(thousands)	(kilograms)	(thousands)	(kilograms)	(thousands)
2008	26,400	\$197,000	15,600	\$570,000	54,700	\$1,190,000	6,450	\$80,600	1,980	\$302,000
2009:										
Australia	612	6,460	18	904	1	51	2	18	(2)	42
Austria	4	46	37	797	--	--	129	2,230	--	--
Belgium	117	815	236	9,770	105	3,820	--	--	2	196
Brazil	158	1,130	65	2,330	1	30	(2)	6	--	--
Canada	3,740	27,600	390	14,300	300	8,950	9	162	1	204
China	1,690	13,600	472	12,100	(2)	6	326	3,280	386	19,200
Czech Republic	470	802	(2)	3	--	--	--	--	--	--
France	298	2,250	58	1,330	1	10	8	49	--	--
Germany	2,470	22,800	4,010	124,000	6,400	46,600	1,850	9,620	136	4,460
Hong Kong	968	11,300	65	4,940	1	4	145	1,780	68	1,500
India	134	738	243	8,300	3	19	1	30	10	855
Ireland	59	253	135	4,350	--	--	13	82	(2)	6
Israel	2,010	5,620	46	734	--	--	--	--	--	--
Italy	3,780	38,800	1,200	50,600	5	264	13	196	47	2,090
Japan	3,030	24,900	3,310	118,000	683	19,200	231	2,500	250	11,500
Korea, Republic of	828	4,780	74	1,770	(2)	4	1	9	(2)	5
Mexico	605	1,180	91	3,320	--	--	105	2,990	1	108
Singapore	181	681	3	153	--	--	638	7,650	--	--
South Africa	62	174	3	144	4,350	17,700	1	12	7	810
Switzerland	4,050	27,400	3,810	123,000	624	7,390	56	480	31	2,060
Taiwan	1,550	7,630	65	1,940	3	10	416	2,520	5	453
Turkey	8	75	(2)	62	1	3	2	10	(2)	5
United Kingdom	2,350	20,500	781	22,100	18,700	417,000	49	605	271	4,500
Other	1,130	9,380	442	16,900	371	1,140	29	217	2	373
Total	30,300	229,000	15,600	522,000	31,600	523,000	4,020	34,400	1,220	48,400

-- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 5
PLATINUM-GROUP METALS: ESTIMATED WORLD PRODUCTION, BY COUNTRY^{1,2}

(Kilograms)

Country ³	2005	2006	2007	2008	2009
Palladium:					
Australia ⁴	550	750	600	700	600
Botswana	1,900	2,000	5,000	3,000	3,000
Canada	10,415 ⁵	10,493 ⁵	10,900 ^r	10,000 ^r	6,500
Japan ⁶	5,400	5,400	5,500	5,500	5,600
Poland ^{7,8}	10	10	15 ^r	15 ^r	15
Russia	97,400	98,400	96,800	87,700	83,200 ⁵
Serbia	19 ⁹	15	15	15	15
South Africa	82,961 ⁵	86,265 ⁵	83,643 ⁵	75,537 ^{r,5}	75,118 ⁵
United States ¹⁰	13,300 ⁵	14,400 ⁵	12,800 ⁵	11,900 ^{r,5}	12,700 ⁵
Zimbabwe	3,879 ⁵	4,022 ⁵	4,180 ⁵	4,386 ⁵	5,680
Total	216,000	222,000	219,000^r	199,000^r	192,000
Platinum:					
Australia ⁴	111	209	142	200	200
Botswana	300	300	700	600	600
Canada	6,075 ^{r,5}	7,500	7,000	7,000	4,600
Colombia	1,082 ⁵	1,438 ⁵	1,526 ⁵	1,500	1,500
Ethiopia ¹¹	--	4 ^r	5 ^{r,5}	10 ⁵	10
Finland	800	800	800	800	800
Japan ⁶	760	760	770	770	780
Poland ^{7,8}	20	20	25 ^r	25 ^r	25
Russia	29,000	29,000	27,000	23,000	21,000
Serbia	3 ⁹	2	2	2	2
South Africa	163,711 ⁵	168,125 ⁵	160,940 ⁵	146,140 ⁵	140,819 ⁵
United States ¹⁰	3,920 ⁵	4,290 ⁵	3,860 ⁵	3,580 ^{r,5}	3,830 ⁵
Zimbabwe	4,834 ⁵	4,998 ⁵	5,306 ⁵	5,642 ⁵	7,230
Total	211,000^r	217,000	208,000	189,000	181,000
Other platinum-group metals:					
Canada	5,000	5,000	4,000	4,000	2,600
Russia	15,500	15,600	14,500	12,500	11,900
South Africa	56,309 ⁵	53,138 ⁵	59,449 ⁵	53,999 ^{r,5}	55,454 ⁵
Zimbabwe	862 ⁵	864 ⁵	1,695 ⁵	1,804 ⁵	800
Total	77,700	74,600	79,600	72,300^r	70,800
Grand total	504,000^r	514,000	507,000^r	460,000^r	445,000

^rRevised. -- Zero.

¹World totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

²Table includes data available through May 7, 2010. Platinum-group metal (PGM) production by Germany, Norway, and the United Kingdom is not included in this table because the production is derived wholly from imported metallurgical products and to include it would result in double counting.

³In addition to the countries listed, China, Indonesia, and the Philippines are thought to produce PGM, and several other countries may also do so, but output is not reported quantitatively, and there is no reliable basis for the formulation of estimates of output levels. A part of this output not specifically reported by country is, however, presumably included in this table credited to Japan.

⁴PGM recovered from nickel ore that is processed domestically. PGM in exported nickel ore are extracted in the importing countries, such as Japan, and are thought to be included in the production figures for those countries.

⁵Reported figure.

⁶Production derived entirely from imported ores.

⁷Based on official Polish estimates.

⁸Estimates based on reported platinum- and palladium-bearing final (residual) slimes and then average Pt and Pd content from electrolytic copper refining.

⁹Montenegro and Serbia formally declared independence in June 2006 from each other and dissolved their union.

¹⁰A very small quantity of byproduct platinum and palladium produced from gold-copper ores was excluded.

¹¹Data for the Ethiopian calendar year ending July 7 of that stated. Yubdo Mine only. Platinum was also reportedly contained in gold ingots from the Lega Dembi Mine, but information is inadequate to estimate output.