



# 2013 Minerals Yearbook

---

## PLATINUM-GROUP METALS [ADVANCE RELEASE]

---

# PLATINUM-GROUP METALS

By Patricia J. Loferski

Domestic survey data and tables were prepared by Paula R. Neely, statistical assistant, and the world production table was prepared by Glenn J. Wallace, international data coordinator.

Six metals (iridium, osmium, palladium, platinum, rhodium, and ruthenium) make up the platinum-group metals (PGMs). The PGMs occur together in nature, but economic deposits are rare. PGMs are produced from deposits that are mined primarily for PGMs and are also produced as byproducts of nickel-copper mines.

In 2013, the United States was the world's fifth leading producer of platinum and the world's fourth leading producer of palladium. Stillwater Mining Co. (SMC) (Billings, MT), the only domestic mine producer of PGMs, recovered PGMs from its Stillwater Mine southwest of Nye, MT, and its East Boulder Mine south of Big Timber, MT. Domestic production of palladium and platinum was 16,300 kilograms (kg), slightly higher than that of 2012 (Stillwater Mining Co., 2014, p. 1). World mine production of PGMs totaled 454,000 kg, a 7% increase from that of 2012. Most of the world's supply of primary PGMs came from South Africa and Russia, which accounted for 57% and 26%, respectively, of global primary PGM production; however, recycling has become a major source of PGMs as well, accounting for about 22% of the total supply of platinum, palladium, and rhodium in recent years, an increase from about 18% in 2003.

In 2013, platinum supply from primary production plus recycling exceeded consumption and prices dropped 4% from 2012 levels. In contrast, palladium consumption exceeded supply and the average annual palladium price in 2013 was 12% higher than that of 2012. Supply concerns were driven by continued labor unrest in the South African mining industry and the beginning of a political crisis in Ukraine.

In 2013, the automobile industry continued to be a major consumer of PGMs. Catalytic converters, also referred to as autocatalysts, accounted for approximately 83% of global rhodium consumption, 65% of palladium consumption, and 45% of platinum consumption. Jewelry was the second leading use of platinum in 2013, accounting for 30% of global consumption (CPM Group, 2014, p. 41, 127, 175).

## Legislation and Government Programs

The Defense Logistics Agency Strategic Materials reported no PGM sales from U.S. Government stockpiles in 2013; 18 kg of iridium and 261 kg of platinum remained in the stockpile. Palladium stocks were exhausted in 2004.

## Production

**Primary.**—During 2013, palladium and platinum mine production was 12,600 kg and 3,720 kg, respectively, each slightly more than that of 2012 (table 1), and mine production of rhodium decreased by 25% to 93 kg. The Stillwater Mine produced 8,770 kg of palladium and 2,620 kg of platinum,

decreases of 3% and 4%, respectively, compared with production in 2012. The East Boulder Mine produced 3,800 kg of palladium and 1,140 kg of platinum, increases of 15% and 17%, respectively, compared with 2012 production. SMC milled 1.20 million metric tons (Mt) of ore from the mines, 11% more than that of 2012. In 2013, the Stillwater Mine processed an average of 2,100 metric tons per day (t/d) of ore, 14% more than in 2012, having an average mill head grade of 16 grams per metric ton (g/t) and a PGM mill recovery of 92%, the same as that in 2012. In 2013, the East Boulder Mine processed an average of 1,300 t/d of ore, 5% more than in 2012, having an average mill head grade of 12 g/t and a PGM mill recovery rate of about 90%, the same as for 2012 (Stillwater Mining Co., 2014, p. 64). The concentrated ore from the mines was smelted and then processed at the base metal refinery in SMC's facilities in Columbus, MT, producing a PGM-rich filter cake. Final refining of PGMs was done by third-party refiners in the United States and abroad.

At yearend 2013, SMC reported proven and probable reserves in its Montana operations of 48.5 Mt of ore having an average grade of 14 g/t of PGMs, a palladium-to-platinum ratio of about 3.59 to 1, and containing about 686,000 kg of palladium and platinum. SMC's proven and probable reserves of PGMs in its Montana operations are contained in the J-M Reef, an ore body within the layered mafic and ultramafic igneous rocks of the Stillwater Complex. SMC reported progress on three development projects, the Blitz, Far West, and Graham Creek projects, which were planned to supplement or replace production from the existing mines. The Blitz project would consist of two parallel underground drifts that would ultimately extend about 7,000 meters (m) eastward from the Stillwater Mine and were expected to provide access to portions of the J-M Reef not yet delineated. As the Blitz project progressed, drilling was planned to complete the geologic evaluation. The Blitz project was to be completed during the next 5 years. The Graham Creek project, west of the East Boulder Mine, was nearing completion ahead of schedule on budget and full production was expected in 2015, with about 930 kilograms per year of PGMs expected to be produced. A third expansion project at the western end of the Stillwater Mine, known as the Far West project, contained higher grade ore than the rest of the Stillwater Mine and was expected to add to production from the Stillwater Mine by mid-2016. No specific production estimates were given (Stillwater Mining Co., 2014 p. 14–19, 27).

SMC had a 1-year agreement that would expire at the end of 2014 to supply platinum to Tiffany & Co. (New York, NY). The remainder of SMC's mined PGMs were sold either in the spot market or under short-term extensions of previous supply agreements (Stillwater Mining Co., 2014, p. 97).

In 2013, PGM exploration continued at several locations in the United States, the more advanced of which was in the Duluth Complex of Minnesota. Duluth Metals Ltd. (Toronto, Ontario, Canada) reported continuation of the drilling program by Twin Metals LLC [Duluth Metals, 60%, and Antofagasta plc (London, United Kingdom), 40%] on its Twin Metals copper-nickel-PGM project. The Twin Metals project, planned as an underground mine, included three deposits in close proximity: the Birch Lake, Maturi, and Spruce Road deposits (Duluth Metals Ltd., 2013).

PolyMet Mining Corp. (St. Paul, MN) reported that a supplemental draft environmental impact statement (EIS) for its NorthMet copper-nickel-PGM project in the Duluth Complex, produced jointly by the Minnesota Department of Natural Resources, the U.S. Army Corps of Engineers, and the U.S. Forest Service, became available for public review on December 6, 2013. The supplemental draft EIS expanded on the original EIS published in late 2009 and was based on an improved project design. The NorthMet project was planned as an open pit mine and ore was to be processed at the nearby Erie Plant facilities, originally used to process iron ore (PolyMet Mining Corp., 2013).

**Secondary.**—In 2013, PGMs were recycled from three main sources—catalytic converters, electronics, and jewelry. Globally, more than 119,000 kg of secondary PGMs was recovered, accounting for approximately 20% of the global supply of PGMs.

Catalytic converters were the predominant source of secondary PGMs. In the United States, an estimated 52,000 kg of PGMs was recovered from catalytic converters, which was about 52% of the world total; about 33,000 kg of PGMs was recovered from catalytic converters in Europe; about 13,000 kg in Japan; and 1,300 kg in China (CPM Group, 2014, p. 36, 37, 122, 123, 188, 189).

Globally, about 72,000 kg of palladium was recovered from secondary sources. Of the total, 58,000 kg of palladium was recovered from catalytic converters (3% more than 2012), 14,000 kg from electronics (9% more than 2012), and 840 kg from jewelry (5% less than 2012).

Globally, about 40,000 kg of platinum was recovered from secondary sources including about 35,000 kg from recycled catalytic converters, which was about 6% less than that of 2012, as a result of lower platinum loadings on catalytic converters available for recycling. About 1,400 kg of platinum was recovered from electronics recycling in 2013, which was 7% more than the amount recovered in 2012. About 4,300 kg of platinum was recovered from the jewelry industry globally in 2013, a slight decrease compared with that of 2012 (CPM Group, 2014, p. 32–37).

In 2013, recovery of rhodium from catalytic converters increased slightly to 6,800 kg (CPM Group, 2014, p. 118–123, 186–189).

SMC reported that its recycling program recovered 16,900 kg of PGMs from spent catalytic converters in 2013, a 61% increase compared with that of 2012, owing to greater availability of scrap material in the market. SMC produced 9,500 kg, 6,000 kg, and 1,400 kg, respectively, of recycled palladium, platinum, and rhodium, which were increases of

59%, 61%, and 76%, respectively, compared with amounts recovered in 2012. In addition to the material purchased for its own accounts, SMC also toll-refined a total of 2,000 kg of palladium, platinum, and rhodium, a decrease of about 34% from 2012 (Stillwater Mining Co., 2014, p. 23, 65).

## Consumption

**Palladium.**—Global palladium consumption was about 274,000 kg in 2013, about 3% less than that in 2012. About 65% of palladium was used by the catalytic converter industry, about 14% by the electronics industry, and about 8% by the dental industry. About 5% of palladium was used in both the chemical industry and in jewelry, and the remainder was used in other industries and as investment. Apparent domestic palladium consumption, defined as production plus imports minus exports, was 69,800 kg, a 16% increase from 60,200 kg in 2012.

In 2013, global palladium use in catalytic converters reached an alltime high for the third consecutive year, increasing by 4% to 177,000 kg, owing to greater global vehicle production, particularly from the United States and China and an increase in the palladium-to-platinum ratio in catalytic converters for diesel vehicles (CPM Group, 2014, p. 124–130). North America was the leading consumer region, 90% of which was in the United States, and accounted for 31% of global consumption of palladium in catalytic converters (55,200 kg), 9% more than that of 2012. This increase was due to increases in automobile production, tighter emission standards, and relatively larger engines.

Palladium consumption in the European catalytic converter market was 28,800 kg, a 5% decrease from that of 2012, partly due to decreased automobile sales. Consumption in China's catalytic converter industry was 23,900 kg, 21% more than that of 2012 owing to tightening emissions standards and growing demand for gasoline-powered vehicles. Consumption in Japan was 31,900 kg, which was a slight increase compared with that of 2012. Palladium consumption for catalytic converters in the rest of the world decreased by 4% to 37,400 kg (CPM Group, 2014, p. 109).

Global palladium consumption by the jewelry industry, which declined for the fourth straight year, was 14,300 kg, a slight decrease from that of 2012. China remained the leading user of palladium for jewelry, with 34% of world consumption in that sector. However, consumption in the Chinese jewelry sector decreased by 4% relative to that of 2012 owing to a lack of marketing of palladium jewelry. Consumption in Europe was 1,930 kg of palladium, a 3% increase relative to that of 2012, and consumption in North America and Japan was 2,150 kg and 3,360 kg, respectively, each slightly lower than that in 2012. Consumption in the rest of the world was unchanged at about 2,080 kg (CPM Group, 2014, p. 127).

World palladium consumption in dental alloys was 23,100 kg in 2013, down slightly from consumption in 2012. Japan and North America accounted for about 35% and 31%, respectively, of the global consumption in this sector. The chemical industry consumed 14,900 kg of palladium in 2013, slightly less than that in 2012. In the chemical industry, palladium was used as a catalyst in manufacturing bulk chemicals, including

hydrogen peroxide, nitric acid, terephthalic acid, and vinyl acetate monomer, which in turn were used to produce many resins, plastics, and polyester and polyethylene terephthalate for use in textiles and packaging. Consumption of palladium by the electronics industry was 38,200 kg in 2013, which was 3% more than that of 2012 and the highest level since 2000. The majority of demand for palladium in the electronics sector was for multilayer ceramic capacitors, which have widespread use in electronic circuitry. The quantity of palladium used in the electronics sector was increasing owing to the increasing quantity of electronic items being produced, even though other metals, such as silver, have been substituted for palladium and the amount of palladium per item has decreased (CPM Group, 2014, p. 132–133).

The palladium investment sector was a net seller of palladium in 2013; sales totaled about 29,300 kg of palladium. Holdings in exchange-traded funds (ETFs), however, totaled about 64,100 kg at yearend 2013, a slight increase from holdings at yearend 2012 (CPM Group, 2014, p. 139; Thomson Reuters GFMS Surveys, 2014, p. 20).

**Platinum.**—In 2013, U.S. apparent consumption of refined platinum was 108,000 kg, a 35% decrease from the apparent consumption of 167,000 kg in 2012. In 2013, global platinum use, excluding investments, totaled 224,000 kg, a slight decrease compared with that in 2012. About 45% of the total was used to produce catalytic converters, about 30% by the jewelry industry, about 9% by the chemical and petroleum refining sectors, and about 3% in electronics. The remainder was used in investment and other industries including glass, and medical and biomedical. Worldwide use of platinum in the catalytic converter sector increased slightly to 101,000 kg in 2013 compared with that in 2012. Catalytic converter consumption in Europe was about 31,200 kg of platinum, which was slightly less than that of 2012 owing to decreased sales of automobiles during most of the year. Europe remained the leading consumer of platinum for catalytic converters, and accounted for about 31% of total global consumption. Consumption of platinum for catalytic converters in the United States in 2013 was 19,800 kg, an 8% increase from 2012 owing to increased sales of large commercial vehicles that are typically powered by diesel engines that use platinum in their catalytic converters. Consumption in the United States accounted for about 20% of global catalytic converter consumption. In Japan, platinum consumption for catalytic converters was 18,000 kg, slightly more than that of 2012. In China, consumption of platinum for catalytic converters was 12,700 kg, about 11% more than that in 2012 owing to more stringent emission standards and growth in sales of large commercial vehicles. Elsewhere, consumption of platinum for catalytic converters increased slightly in 2013 to 18,800 kg (CPM Group, 2014, p. 38–46).

In 2013, global consumption of platinum in the jewelry industry was 66,300 kg, 5% less than that of 2012. Consumption in the United States was 1,900 kg, about 3% less than that of 2012. Consumption in China, again the leading consumer for jewelry and accounting for 76% of global consumption, decreased by 7% owing to increased consumption of gold jewelry. Consumption in Europe and Japan was 15% less and 4% less, respectively, than that in 2012, and consumption in the

rest of the world increased by 11% to 3,800 kg (CPM Group, 2014, p. 48).

Global use of platinum in the chemical and petroleum refining sectors was 19,400 kg in 2013, slightly more than that of 2012. The leading use for platinum in the chemical sector was for catalysts used in the production of silicones and other chemicals, such as terephthalic acid used in the production of polyester fabric and plastic containers. Worldwide consumption of platinum in electrical applications was about 5,880 kg in 2013, slightly less than that of 2012 owing to lower demand for hard disk drives. The primary use of platinum by the electronics industry was in the manufacture of hard disks, but the shift away from desktop and laptop computers to tablets that do not use PGMs has lowered platinum demand in this application (CPM Group, 2014, p. 48–49).

Consumption in the medical and biomedical sector was 1,240 kg, which was 7% less than that in 2012. Consumption in other end uses decreased by 4% relative to that of 2012 to 16,800 kg. These other uses included platinum used in glassmaking equipment (CPM Group, 2014, p. 49).

Global investment demand for platinum increased by 13% to 9,200 kg in 2013 relative to that in 2012. Platinum holdings in ETFs globally totaled 75,900 kg at yearend 2013, 55% more than that at yearend 2012. A new ETF was launched in South Africa in April and holdings at yearend 2013 totaled 28,300 kg of platinum, about 37% of global use in this sector (CPM Group, 2014, p. 60–64; Thomson Reuters GFMS Surveys, 2014, p. 19).

**Other PGMs.**—Global rhodium consumption in 2013 was 29,400 kg, slightly more than that of 2012, and the fourth consecutive increase in global rhodium demand. A majority of rhodium use, 83% in 2013, was in the production of catalytic converters. In 2013, rhodium use in catalytic converters was 24,600 kg, slightly more than that of 2012 owing to increased automobile production and tightening emission standards. Use of rhodium in the glass manufacturing sector increased by 4% to 1,220 kg owing to the relatively low price of rhodium, which led to higher proportions of rhodium in platinum-rhodium alloys used in glassmaking equipment. Consumption of rhodium in the chemical sector increased slightly to 1,530 kg in 2013 owing to increased consumption in China, Europe, and Japan. Use by the electronics sector was 1,370 kg, slightly less than that in 2012, and use in other applications was 684 kg, the same as that in 2012. Holdings in the single rhodium ETF at yearend 2013 were 3,200 kg, nearly double those at yearend 2012 (CPM Group, 2014, p. 190–193).

Global consumption of iridium was 6,160 kg in 2013, slightly more than that of 2012. Use in electrical applications increased by 33% to 1,120 kg as a result of increased demand for iridium crucibles, which are used in the electronics industry to grow high-purity single crystal sapphires for use in various applications, including the production of light-emitting diode lights (CPM Group, 2014, p. 207–208; Johnson Matthey plc, 2014).

Global consumption of ruthenium increased by 25% to 25,800 kg in 2013 from that in 2012. Consumption of ruthenium in electrical applications increased by 47% to 16,500 kg; electrochemical use was 3,890 kg, slightly less than that in



2012; use in the chemical sector was 3,240 kg, 3% more than that in 2012; and consumption in other applications decreased by 6% to 2,110 kg (Johnson Matthey plc, 2014).

## Prices

In 2013, the Engelhard annual average price for palladium increased by 12%, whereas prices for platinum, rhodium, iridium, and ruthenium decreased by 4%, 16%, 22%, and 33%, respectively, from those of 2012 (table 1).

**Iridium.**—The annual average iridium price in 2013 was \$826.45 per troy ounce, which was 22% lower than that of 2012. The iridium price began the year at \$1,050 per troy ounce. The price decreased gradually to \$1,000 per troy ounce by the end of May and then decreased steadily through the rest of the year, ending the year at \$400 per troy ounce. The price decreased in response to weak demand from the electrochemical sector, including lower industrial purchasing of iridium for use in conductive coatings on liquid crystal displays and substitution of silver in iridium tin oxide (CPM Group, 2014, p. 207–208).

**Palladium.**—The annual average palladium price in 2013 was \$729.58 per troy ounce, which was 12% more than that of 2012 owing to strong fabrication demand and tight supply. Palladium was the only PGM that recorded an increase in average annual price in 2013. Palladium prices began 2013 at \$715 per troy ounce and were erratic throughout the year, fluctuating between a high of \$780 per troy ounce on March 15 and a low of \$644 per troy ounce on June 28. The price ended the year at \$713 per troy ounce.

**Platinum.**—In 2013, the annual average platinum price was \$1,489.57 per troy ounce, which was 4% less than that of 2012 and the lowest in 4 years. Although fluctuating, prices trended downward throughout the year. Platinum began the year at \$1,569 per troy ounce and then increased steadily, reaching the year's high of \$1,740 per troy ounce on February 7. Prices then decreased nearly continuously to \$1,315 per troy ounce on May 5, the lowest value for the year, fluctuated until the end of October, and then decreased continuously, ending the year at \$1,356 per troy ounce. The platinum daily price reached parity with that of gold in late January for the first time since March 2012 and by monthend had risen above that of gold, where it remained until the end of March. Platinum prices were below those for gold until late April, where they remained for the rest of the year.

**Rhodium.**—The annual average rhodium price in 2013 was \$1,069.10 per troy ounce, which was 16% less than that of 2012 and was the third consecutive decline in annual rhodium price and lowest price since 2004. The rhodium price began the year at \$1,080 per troy ounce, increased to \$1,275 per troy ounce in mid-February, and then decreased to \$990 per troy ounce in late September, where it remained until early November, when it gradually decreased to \$930 per troy ounce at yearend, the lowest value since July 2004. The low rhodium prices reflected sufficient supply to meet demand.

**Ruthenium.**—The annual average ruthenium price in 2013 was \$75.63 per troy ounce, which was 33% less than that of 2012, continuing a downward trend that began in May 2010. The ruthenium price began the year at \$90 per troy ounce and then decreased to \$85 per troy ounce in early January, where

it remained until late July. The price then decreased steadily to \$57 per troy ounce in late September, where it remained until yearend, its lowest level since 2005.

## Foreign Trade

In 2013, U.S. net import reliance as a percentage of apparent consumption was estimated to be 82% for refined palladium and 97% for refined platinum. Imports of refined palladium in 2013 totaled 83,100 kg, a 4% increase from those of 2012, with three countries accounting for about 62% of refined palladium imports in 2013—South Africa (26%), Russia (25%), and Italy (11%). Imports of platinum, including waste, scrap, and coins, decreased by 33% in 2013 to 116,000 kg, from 171,000 kg in 2012. Excluding waste and scrap, the leading sources of platinum imports in 2013 were South Africa (38%), Germany (21%), and the United Kingdom (9%). Imports of rhodium decreased by 13% to 11,100 kg, and those of osmium decreased by 41%. In contrast, imports of iridium and ruthenium increased by 39% and 51%, respectively. Three countries accounted for 92% of the imports of iridium, rhodium, and ruthenium in 2013—South Africa (63%), the United Kingdom (20%), and Germany (9%) (tables 2, 3).

About 25,800 kg of palladium was exported in 2013, about 20% less than that of 2012. Exports of platinum, excluding waste and scrap, increased by 29%, and those of waste and scrap quadrupled to 364,000 kg. Exports of rhodium decreased by 18% compared with exports in 2012 and exports of iridium, osmium, and ruthenium decreased by 19% during the same time period (table 4).

## World Review

In 2013, world mine production of PGMs increased by 7% to 454,000 kg from 423,000 kg in 2012 (table 5). South Africa accounted for 57% of total mine production in 2013; Russia accounted for 26%; Canada and Zimbabwe each accounted for 5%; the United States accounted for 4%; and other countries, 3%. In 2013, world platinum mine production increased slightly; South Africa produced 131,000 kg of platinum, a slight increase from that in 2012, and accounted for 71% of world production of platinum. Global mine production of palladium decreased slightly to 203,000 kg, with Russia and South Africa accounting for 39% and 37%, respectively, and Canada and the United States accounting for 8% and 6%, respectively. World mine production of other PGMs (iridium, osmium, rhodium, and ruthenium) increased by 88% in 2013 compared with that of 2012 owing to an unusually low production in 2012 from South Africa. South Africa was the dominant producer in 2013, accounting for 77% of global production of other PGMs, followed by Russia, with 18%.

**Botswana.**—In 2013, OJSC MMC Norilsk Nickel (Moscow, Russia) produced 1,340 kg of palladium and 218 kg of platinum as byproducts from its nickel operations at the Tati Mine. These quantities were about 48% and 50%, respectively, less than production in 2012 (OJSC MMC Norilsk Nickel, 2014).

**Canada.**—North American Palladium Ltd. (Toronto) produced 4,200 kg of palladium and 318 kg of platinum from its Lac des Isles Mine in Ontario, decreases of 21% and 9%,

respectively, compared with production in 2012, owing to lower ore grade and depletion of the developed ore sources. Production ceased from the Roby Zone underground mine and open pit, and these higher grade feeds were replaced by lower grade stockpiled ore. A new mine shaft was commissioned allowing increased access to higher grade underground ore from the Offset zone (North American Palladium Ltd., 2014, p. 6).

SMC, through its subsidiary, Stillwater Canada Inc., continued the feasibility study on its Marathon PGM-copper project in Ontario. SMC owned 75% of the Marathon project and the remaining 25% was owned by Mitsubishi Corp. (Tokyo, Japan). Owing to low metal prices and an unacceptable rate of return, SMC decided to significantly scale back the project (Stillwater Mining Co., 2014, p. 8).

Vale S.A. (Toronto) produced 10,900 kg of palladium and 4,510 kg of platinum as byproducts of its nickel operations at Sudbury, Ontario, increases of 29% and 8% for palladium and platinum, respectively, from production in 2012 (Vale S.A., 2014, p. 48). Glencore Xstrata plc (Zug, Switzerland) produced PGMs as byproducts from nickel mining operations at Sudbury and the Raglan Mine in Quebec, although production figures were not released.

**Russia.**—Norilsk Nickel produced 80,200 kg of palladium and 19,500 kg of platinum in 2013, a slight decrease for palladium and a 5% decrease for platinum compared with 2012 production. The decrease was mainly due to lower ore grades (OJSC MMC Norilsk Nickel, 2014). Russia's alluvial production was estimated to be about 6,000 kg of platinum, which was a slight increase compared with 2012 production.

**South Africa.**—The South African platinum mining sector was subject to multiple strike-related disruptions in 2013. The world's leading PGM producer, Anglo American Platinum Ltd. (Amplats) (Johannesburg), reported primary equivalent refined platinum production of 68,200 kg in 2013, a 4% increase compared with that in 2012. Production of equivalent refined platinum at the Mogalakwena open pit mine increased by 12% to 10,400 kg. Output from the Khuseleka Mine was 4,600 kg of platinum equivalent, a 17% increase from 2012 production. The Siphumelele Mine produced 2,700 kg of platinum equivalent, 9% more than that of 2012. Equivalent refined platinum production of 3,800 kg from the Mototolo Mine, a joint venture with Glencore Xstrata, was about 4% more than 2012 production. The Kroondal Mine, operated as a pool-and-share agreement with Aquarius Platinum Ltd. (Perth, Western Australia, Australia), produced 7,500 kg, 14% more than in 2012. At Modikwa, which was a joint venture with African Rainbow Minerals Ltd. (ARM) (Sandton), platinum production decreased by 3% to 3,600 kg. At the Bafokeng-Rasimone Platinum Mine, which was a joint venture with Royal Bafokeng Platinum Ltd. (Johannesburg), refined platinum production increased by 4% to 5,600 kg. Amplats expected unchanged platinum production in 2014 (Anglo American Platinum Ltd., 2014, p. 4, 93–113, 142).

Production at Impala Platinum Holdings Ltd.'s (Johannesburg) operations during their reporting year of July 1, 2012, through June 30, 2013, was 50,100\* kg of

palladium, platinum, and rhodium, 4% less than\* 2012. Production included 29,300 kg of platinum, 16,300\* kg of palladium, and 4,500\* kg of rhodium, which were decreases\* of 8%\* and 3%\* for palladium and platinum\*, respectively, and an increase of 4% for rhodium\* compared with 2012 (Impala Platinum Holdings Ltd., 2014, p. 64–84).

Lonmin plc (London) produced 24,000 kg of platinum in 2013, a 14% increase from 2012, because production in 2012 had been reduced due to workers' strikes (CPM Group, 2014, p. 16).

In 2013, Northam Platinum Ltd. (Johannesburg) reported production from its Zondereinde Mine of 7,300 kg of precious metals in concentrate, a 19% decrease from production in 2012, owing to an 11-week workers' strike. Northam's Booyendal Mine began producing on July 1 and produced 2,900 kg of precious metals in concentrate in 2013. Booyendal was expected to reach full production of 5,000 kg of precious metals annually by yearend 2015 (Northam Platinum Ltd., 2014, p. 10–11, 68, 78).

Aquarius Platinum Ltd. (Bedford) produced 7,400 kg of platinum from its Kroondal Mine, 21% more than that in 2012, and 224 kg of platinum from its Platinum Mile operations, about the same as that in 2012 (Aquarius Platinum Ltd., 2014, p. 10, 14).

The Nkomati Nickel Mine, a 50–50 joint venture between ARM and Norilsk Nickel, produced 1,400 kg of palladium and 622 kg of platinum, increases of 44% and 67%, respectively, compared with those of 2012 owing to increased nickel production, which was attributed to higher ore grades and more stable concentrator operations (OJSC MMC Norilsk Nickel, 2014).

**Zimbabwe.**—In 2013, palladium and platinum production increased by 23% and 18%, respectively, compared with 2012 production. Amplats' Unki Mine produced 2,000 kg of platinum, 4% less than\* that in 2012. The Ngezi Mines, operated by Impala subsidiary Zimplats Holdings Ltd., produced 4,890\* kg of palladium and 6,160\* kg of platinum, which were increases of 5%\* and 6%\*, respectively, compared with those in 2012. Production increased owing to the continued rampup of the phase 2 mine expansions, improved mining rates at the new Mupfuti portal, and refining of stockpiled material from 2012. Production at the Mimosa Mine, a joint venture between Aquarius and Impala, was 2,470\* kg of palladium and 3,120\* kg of platinum, decreases\* of 3%\* and 5%\*, respectively, compared with those of 2012 (Anglo American Platinum Ltd, 2014, p. 36\*; Impala Platinum Holdings Ltd., 2014, p. 11, 35, 45, 70–73, 78–81).

## Outlook

The primary end use for palladium, platinum, and rhodium is for catalytic converters in automobiles; therefore, the outlook for that industry will have the greatest impact on the consumption of these PGMs. Because global automobile production is expected to increase, particularly in emerging markets such as China and India, as well as in developed markets in the United States and Europe, an overall increase in demand for PGMs in

\*Corrections posted December 4, 2015.

that sector is expected. The automobile markets in China and the United States are predominantly gasoline-powered vehicles; therefore, the increase in automobile demand in those markets will likely affect palladium demand in particular. Automobile emission standards are expected to tighten in China, Europe, and other parts of the world, which will likely lead to increased loadings of PGMs in catalytic converters and increased demand for PGMs. In the electronics sector, palladium demand is expected to increase owing to increased demand of electronic items such as tablets and other mobile devices, as well as a continued demand for laptop and desktop computers. The demand for platinum in the jewelry sector is expected to increase, especially in China, owing to lower prices, whereas palladium jewelry demand is likely to decrease partly owing to a lack of marketing. Rhodium consumption is expected to increase as a result of higher vehicle production in many areas of the world as well as increased consumption by the glass manufacturing industry. Ruthenium demand in the electronics industry is expected to be unchanged, because decreased production of personal computers is expected to be offset by increased applications in data centers. Ruthenium is used largely in computer hard drives. Iridium demand is likely to increase in the electronics industry, in which iridium crucibles are used in the manufacture of light-emitting diode lights.

Platinum production levels are vulnerable to problems in the South African mining industry. Production from South Africa is expected to decrease owing to work stoppages caused by labor disputes and safety issues, and to ongoing restructuring of the platinum mining industry including closure of unprofitable mines. Some mines have become unprofitable owing to increased costs of labor and electricity as well as low metal prices and lower ore grades. Supply from Zimbabwe is expected to increase owing to ongoing mine expansions but is subject to political stability. Palladium supply is expected to increase in Russia owing to development of new projects that were planned to bring high-grade ore production online following recent declines in average palladium ore grade. Recycling of platinum and palladium is expected to increase, particularly from automotive catalysts, although the quantity of material available for recycling is very price-sensitive, with higher metal prices leading to a greater amount of recycling.

## References Cited

- Anglo American Platinum Ltd., 2014, Annual report 2013: Johannesburg, South Africa, Anglo American Platinum Ltd., 292 p. (Accessed May 11, 2014, via <http://www.angloamericanplatinum.com/investors/annual-reporting/2013.aspx>.)
- Aquarius Platinum Ltd., 2014, Annual report 2013: Bedford, South Africa, Aquarius Platinum Ltd., 108 p. (Accessed June 10, 2014, at <http://aquariusplatinum.com/sites/aquariusplatinum.com/files/ckfinderfiles/Aquarius%20Platinum%20Annual%20Report%202013.pdf>.)
- CPM Group, 2014, The CPM platinum group metals yearbook 2014: New York, NY, CPM Group, 209 p.
- Duluth Metals Ltd., 2013, Duluth Metals announces results from Twin Metals fence drilling program: Toronto, Ontario, Canada, Duluth Metals Ltd. news release, December 6. (Accessed September 16, 2014, at <http://www.twin-metals.com/duluth-metals-provides-twin-metals-minnesota-project-pre-feasibility-update/>.)

- Impala Platinum Holdings Ltd., 2014, Integrated annual report 2013: Johannesburg, South Africa, Impala Platinum Holdings Ltd., 168 p. (Accessed May 9, 2014, at [http://www.implats.co.za/implats/implats\\_reports\\_2013/downloads/Implats\\_integrated\\_annual\\_report\\_%202013.pdf](http://www.implats.co.za/implats/implats_reports_2013/downloads/Implats_integrated_annual_report_%202013.pdf).)
- Johnson Matthey plc, 2014, Market data tables: London, United Kingdom, Johnson Matthey plc. (Accessed May 24, 2014, via <http://www.platinum.matthey.com/>.)
- North American Palladium Ltd., 2014, 2013 annual report: Toronto, Ontario, Canada, North American Palladium Ltd., 77 p. (Accessed May 23, 2014, at [http://www.napalladium.com/files/doc\\_financials/2013/NAP%202013%20Annual%20Report\\_v001\\_c0wilw.pdf](http://www.napalladium.com/files/doc_financials/2013/NAP%202013%20Annual%20Report_v001_c0wilw.pdf).)
- Northam Platinum Ltd., 2014, Annual integrated report 2013: Johannesburg, South Africa, Northam Platinum Ltd., 292 p. (Accessed October 15, 2014, at <http://northam.integrated-report.com/2014/downloads/NHM-IR14.pdf>.)
- OJSC MMC Norilsk Nickel, 2014, MMC Norilsk Nickel announces preliminary consolidated production results for 4th quarter and full year 2013, and production outlook for 2014: Moscow, Russia, OJSC MMC Norilsk Nickel news release, January 31, 4 p. (Accessed February 21, 2014, at [http://www.nornik.ru/assets/files/FY2013-Production-Report-\(eng\)--Final\(3\).pdf](http://www.nornik.ru/assets/files/FY2013-Production-Report-(eng)--Final(3).pdf).)
- PolyMet Mining Corp., 2013, PolyMet achieves key milestone in environmental review process: St. Paul, MN, PolyMet Mining Corp. news release, December 6. (Accessed August 27, 2014, at <http://www.polymetmining.com/news/news-releases/polymet-achieves-key-milestone-in-environmental-review-process/>.)
- Stillwater Mining Co., 2014, 2013 annual report: Billings, MT, Stillwater Mining Co., 152 p. (Accessed August 14, 2014, at <http://investorrelations.stillwatermining.com/phoenix.zhtml?c=99837&p=irol-reportsannual>.)
- Thomson Reuters GFMS Surveys, 2014, Platinum and palladium survey 2014: London, United Kingdom, Thomson Reuters GFMS Surveys, 82 p.
- Vale S.A., 2014, Annual report 2013: Toronto, Ontario, Canada, Vale S.A., 256 p. (Accessed July 20, 2014, at [http://www.vale.com/EN/investors/Quarterly-results-reports/20F/20FDocs/20F\\_2013\\_i.pdf](http://www.vale.com/EN/investors/Quarterly-results-reports/20F/20FDocs/20F_2013_i.pdf).)

## GENERAL SOURCES OF INFORMATION

### U.S. Geological Survey Publications

- Flow Studies for Recycling Metal Commodities in the United States. Circular 1196, 2011.
- Global Exploration and Production Capacity for Platinum-Group Metals from 1995 Through 2015. Scientific Investigations Report 2012–5164, 2012.
- Historical Statistics for Mineral and Material Commodities in the United States. Data Series 140.
- 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.
- Platinum-Group Metals [Ir, Os, Pd, Pt, Rh, Ru]. Ch. in Metal Prices in the United States Through 2010, Scientific Investigations Report 2012–5188, 2013.
- Platinum-Group Metals—World Supply and Demand. Open-File Report 2004–1224, 2005.
- Precious Metals. Mineral Industry Surveys, monthly, through December 2003.
- Review of Selected Global Mineral Industries in 2011 and an Outlook to 2017. Open-File Report 2013–1091.



**Other**

CPM Group.  
 Defense Logistics Agency Strategic Materials.  
 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.  
 Thomson Reuters GFMS Surveys.

TABLE 1  
 SALIENT PLATINUM-GROUP METALS STATISTICS<sup>1</sup>

		2009	2010	2011	2012	2013
United States:						
Mine production:						
Palladium, Pd content: <sup>2</sup>						
Quantity	kilograms	12,700	11,600	12,400	12,300	12,600
Value	thousands	\$108,000	\$199,000	\$295,000	\$257,000	\$295,000
Platinum, Pt content: <sup>2</sup>						
Quantity	kilograms	3,830	3,450	3,700	3,670	3,720
Value	thousands	\$149,000	\$179,000	\$205,000	\$184,000	\$178,000
Refinery production:						
Palladium, Pd content:						
Quantity	kilograms	7,820	6,820	17,500	21,000	23,900
Value	thousands	\$66,800	\$116,000	\$414,000	\$438,000 <sup>r</sup>	\$499,000
Platinum, Pt content:						
Quantity	kilograms	7,210	5,410	15,500	16,600	19,100
Value	thousands	\$280,000	\$281,000	\$859,000	\$831,000	\$956,000
Imports for consumption, refined:						
Iridium, Ir content	kilograms	1,520	3,530	2,790	1,230	1,720
Osmium, Os content	do.	68	76	48	130	77
Palladium, Pd content	do.	69,700	70,700	98,900	80,100	83,100
Platinum, includes waste, scrap, and coins, Pt content	do.	183,000	152,000	129,000	172,000	116,000
Rhodium, Rh content	do.	11,200	12,800	13,100	12,800	11,100
Ruthenium, Ru content	do.	21,200	14,100	13,300	10,200	15,300
Exports, refined:						
Iridium, osmium, and ruthenium, gross weight	do.	4,020	3,720	1,150	1,640	1,320
Palladium, Pd content	do.	30,300	38,100	32,000	32,200	25,900
Platinum, Pt content	do.	15,600	16,900	11,300	8,630	11,200
Rhodium, Rh content	do.	1,220	2,320	1,370	1,040	1,220
Stocks, National Defense Stockpile, December 31:						
Iridium, Ir content	do.	18	18	18	18	18
Platinum, Pt content	do.	261	261	261	261	261
Price, average:						
Iridium <sup>3</sup>	dollars per troy ounce	420.40	642.15	1,035.87	1,066.23	826.45
Palladium <sup>3</sup>	do.	265.65	530.61	738.51	649.27	729.58
Platinum <sup>3</sup>	do.	1,207.55	1,615.56	1,724.51	1,555.39	1,489.57
Rhodium <sup>3</sup>	do.	1,591.32	2,459.07	2,024.35	1,274.98	1,069.10
Ruthenium <sup>3</sup>	do.	97.28	198.45	165.85	112.26	75.63
Employment		1,270	1,350	1,570	1,660	1,770
World, mine production, PGM content	kilograms	450,000 <sup>r</sup>	472,000 <sup>r</sup>	490,000 <sup>r</sup>	423,000 <sup>r</sup>	454,000 <sup>e</sup>

<sup>e</sup>Estimated. <sup>r</sup>Revised. do. Ditto.

<sup>1</sup>Data are rounded to three significant digits, except prices.

<sup>2</sup>Source: Stillwater Mining Co., 2014, p. 64.

<sup>3</sup>Price data are annual averages of daily Engelhard unfabricated quotations published in Platts Metals Daily.



TABLE 2  
U.S. IMPORTS FOR CONSUMPTION OF PLATINUM, BY COUNTRY<sup>1</sup>

Country	Grain and nuggets		Sponge		Other unwrought		Other		Waste and scrap		Coins	
	Quantity, Pt content (kilograms)	Value (thousands)	Quantity, Pt content (kilograms)	Value (thousands)	Quantity, Pt content (kilograms)	Value (thousands)	Quantity, Pt content (kilograms)	Value (thousands)	Quantity, Pt content (kilograms)	Value (thousands)	Quantity, Pt content (kilograms)	Value (thousands)
2012	1,060	\$50,900	34,100	\$1,690,000	4,820	\$202,000	3,880	\$154,000	127,000	\$968,000	864	\$43,900
2013:												
Argentina	--	--	--	--	18	833	--	--	117	5,780	--	--
Australia	--	--	--	--	--	--	1,460	66,000	316	12,200	109	4,700
Belgium	--	--	1,320	57,800	40	1,580	(2)	20	292	1,080	--	--
Brazil	--	--	--	--	(2)	3	(2)	16	9,870	38,600	--	--
Canada	31	1,430	20	1,010	3	114	236	10,400	14,800	98,900	422	22,800
Chile	--	--	--	--	--	--	--	--	1,870	1,420	--	--
China	--	--	--	--	225	11,600	1	43	1,090	19,100	(2)	5
Colombia	4	137	--	--	1,730	68,100	10	453	127	2,690	--	--
Czech Republic	--	--	--	--	--	--	54	2,380	66	465	--	--
France	--	--	--	--	23	1,080	1	16	548	24,700	--	--
Germany	311	14,800	2,980	151,000	2,860	133,000	1,940	71,800	6,110	236,000	(2)	5
Guatemala	--	--	--	--	--	--	--	--	27	893	--	--
India	--	--	--	--	--	--	--	--	61	3,120	--	--
Indonesia	--	--	--	--	--	--	--	--	16	786	--	--
Ireland	--	--	--	--	--	--	7	202	71	3,180	--	--
Israel	--	--	--	--	--	--	(2)	10	50	1,770	1	72
Italy	--	--	2,880	139,000	(2)	5	(2)	3	887	29,100	--	--
Japan	--	--	--	--	10	300	202	4,860	5,510	118,000	--	--
Korea, Republic of	--	--	894	45,300	--	--	2	70	425	17,300	--	--
Malaysia	--	--	--	--	--	--	--	--	976	27,300	--	--
Mexico	--	--	--	--	8	240	21	1,020	1,700	37,400	(2)	20
Norway	--	--	1,410	67,700	--	--	--	--	3	161	--	--
Panama	--	--	--	--	--	--	3	74	3	84	--	--
Peru	--	--	--	--	--	--	--	--	43	1,530	--	--
Philippines	--	--	--	--	--	--	--	--	112	2,970	--	--
Qatar	--	--	--	--	--	--	--	--	156	7,620	--	--
Russia	114	5,490	9	519	(2)	3	100	4,420	--	--	--	--
Saudi Arabia	--	--	--	--	--	--	--	--	1,480	67,300	--	--
Singapore	91	3,910	24	1,260	625	31,500	16	682	575	17,100	(2)	3
South Africa	256	11,900	14,300	687,000	45	2,310	5	123	6	208	--	--
Switzerland	(2)	8	35	1,630	126	5,770	66	3,040	--	--	35	1,840
Taiwan	--	--	--	--	--	--	20	458	1,450	53,800	--	--
Thailand	(2)	3	--	--	--	--	--	--	59	1,880	--	--
United Kingdom	106	4,990	3,110	142,000	68	3,060	125	4,880	28,100	102,000	5	414
Venezuela	--	--	--	--	--	--	--	--	30	984	--	--
Other	--	--	--	--	1	86	19	697	219	2,480	(2)	8
Total	913	42,700	27,000	1,290,000	5,790	259,000	4,290	172,000	77,200	937,000	572	29,900

See footnotes at end of table.

TABLE 2—Continued  
U.S. IMPORTS FOR CONSUMPTION OF PLATINUM, BY COUNTRY<sup>1</sup>

Country	Unwrought palladium		Palladium, other		Iridium <sup>2</sup>		Osmium <sup>2</sup>		Ruthenium <sup>2</sup>		Rhodium <sup>2</sup>	
	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)
2012	67,300	\$1,380,000	12,700	\$275,000	1,230	\$40,500	130	\$737	10,200	\$35,100	12,800	\$529,000
2013:												
Austria	--	--	236	6,170	--	--	--	--	--	--	--	--
Belarus	21	473	--	--	--	--	--	--	--	--	--	--
Belgium	710	15,600	524	11,800	1	33	--	--	--	--	618	12,400
Brazil	1,270	26,000	--	--	--	--	--	--	--	--	--	--
Canada	320	8,480	2,220	63,700	--	--	--	--	--	--	--	--
China	--	--	7	351	--	--	--	--	2	8	25	979
Germany	6,560	167,000	2,270	44,000	333	6,300	--	--	1,130	3,920	1,080	38,200
Italy	8,760	207,000	258	5,770	13	180	--	--	--	--	200	7,490
Japan	4,730	79,400	206	2,140	138	2,920	--	--	159	200	14	505
Korea, Republic of	1,630	38,600	--	--	--	--	--	--	--	--	209	7,550
Malaysia	6	25	6	25	--	--	--	--	--	--	--	--
Mexico	1	20	23	32	--	--	--	--	--	--	--	--
Netherlands	--	--	--	--	13	430	--	--	--	--	--	--
Norway	2,650	50,600	287	6,950	--	--	--	--	--	--	71	2,160
Russia	15,600	351,000	4,930	116,000	1	36	--	--	30	58	673	22,000
South Africa	20,600	494,000	995	26,000	547	13,500	77	444	9,760	21,400	7,440	250,000
Switzerland	3	95	69	1,940	--	--	--	--	13	72	--	--
Thailand	--	--	6	115	--	--	--	--	--	--	--	--
United Kingdom	5,610	132,000	2,620	64,300	668	19,900	--	--	4,190	10,500	756	26,500
Other	7	111	12	219	--	--	--	--	11	44	1	45
Total	68,500	1,570,000	14,700	349,000	1,720	43,200	77	444	15,300	36,200	11,100	367,000

-- Zero.

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

<sup>2</sup>Unwrought and other forms.

Source: U.S. Census Bureau.

TABLE 4  
U.S. EXPORTS OF PLATINUM-GROUP METALS, BY COUNTRY<sup>1</sup>

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)
2012	32,200	\$467,000	8,630	\$374,000	84,800	\$837,000	1,640	\$17,100	1,040	\$43,600
2013:										
Argentina	6	137	97	4,190	--	--	--	--	--	--
Australia	240	4,270	243	10,700	--	--	10	125	--	--
Austria	39	355	5	159	3	62	--	--	--	--
Belarus	84	611	--	--	--	--	--	--	--	--
Belgium	21	325	2	76	20,900	6,620	--	--	--	--
Brazil	1,710	38,300	22	1,050	--	--	3	32	3	133
Canada	4,040	78,200	137	6,080	16	357	3	37	(2)	30
Chile	1	10	91	3,720	--	--	--	--	--	--
China	3,370	77,000	42	969	115	5,910	17	293	768	28,700
Colombia	57	944	(2)	14	--	--	--	--	--	--
Costa Rica	29	396	15	416	--	--	1	31	--	--
Czech Republic	21	168	--	--	--	--	(2)	3	(2)	24
Denmark	105	1,600	(2)	17	--	--	--	--	--	--
Dominican Republic	(2)	11	6	334	--	--	--	--	--	--
France	452	4,120	62	1,900	2	71	10	248	--	--
Georgia	--	--	--	--	2	100	--	--	--	--
Germany	3,720	75,600	1,910	82,900	107,000	183,000	314	8,980	250	9,680
Hong Kong	796	13,500	206	9,200	(2)	4	10	112	17	651
India	123	799	57	2,170	113	5,810	53	650	1	20
Ireland	146	1,440	266	9,770	--	--	2	42	--	--
Israel	2,420	11,000	12	506	--	--	4	16	(2)	15
Italy	504	8,750	1,860	84,600	10,800	10,800	1	9	54	1,930
Japan	558	6,960	2,310	93,800	200,000	168,000	14	288	111	4,170
Korea, Republic of	1,830	36,200	385	17,200	--	--	514	3,420	16	614
Laos	--	--	41	1,940	--	--	--	--	--	--
Lebanon	--	--	3	140	1	51	--	--	1	39
Malaysia	28	119	2	67	--	--	(2)	3	--	--
Mexico	294	2,690	374	12,200	(2)	15	2	46	(2)	72
Netherlands	53	298	1	149	--	--	--	--	--	--
New Zealand	184	1,370	1	73	--	--	--	--	--	--
Norway	28	528	6	105	--	--	(2)	3	--	--
Peru	9	189	(2)	3	--	--	--	--	--	--
Philippines	3	81	2	124	--	--	--	--	--	--
Saudi Arabia	37	386	--	--	--	--	--	--	--	--
Singapore	32	803	632	25,600	--	--	229	4,730	--	--
South Africa	6	68	(2)	4	--	--	(2)	4	--	--
Spain	156	545	1	33	--	--	--	--	--	--
Sweden	20	283	(2)	8	--	--	1	4	--	--
Switzerland	119	1,470	1,210	61,900	8,230	179,000	86	997	--	--
Taiwan	1,680	18,400	34	1,440	(2)	7	7	162	--	--
Thailand	93	2,670	46	1,560	--	--	--	--	1	40
United Arab Emirates	8	230	4	141	3	150	--	--	--	--
United Kingdom	2,830	61,300	1,080	51,600	16,300	512,000	39	960	(2)	11
Vietnam	4	23	7	332	--	--	--	--	--	--
Other	38	370	5	153	--	--	3	33	(2)	3
Total	25,900	452,000	11,200	487,000	364,000	1,070,000	1,320	21,200	1,220	46,100

-- Zero.

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

<sup>2</sup>Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 5  
PLATINUM-GROUP METALS: WORLD PRODUCTION, BY COUNTRY<sup>1,2</sup>

(Kilograms)

Country <sup>3</sup>	2009	2010	2011	2012	2013 <sup>e</sup>
<b>Palladium:</b>					
Australia <sup>e,4</sup>	800	650	350 <sup>r</sup>	300	320
Botswana	3,452	3,328	2,115	2,613	1,337 <sup>5</sup>
Canada <sup>e</sup>	7,000	11,000 <sup>r</sup>	17,400 <sup>r</sup>	17,300 <sup>r</sup>	16,500
Finland	560	1,493	1,058	1,100 <sup>e</sup>	1,100
Japan <sup>6</sup>	6,675	6,107	7,534	8,052 <sup>r</sup>	6,239 <sup>5</sup>
Poland <sup>e,7,8</sup>	15	15	15	15	15
Russia	83,200	84,700	84,100 <sup>r</sup>	82,000 <sup>r,e</sup>	80,000
Serbia	38	22	4 <sup>r</sup>	22 <sup>r</sup>	20
South Africa	75,117	82,222	82,731	74,738 <sup>r</sup>	75,000
United States <sup>9</sup>	12,700	11,600	12,400	12,300	12,600 <sup>3</sup>
Zimbabwe <sup>e</sup>	5,680	7,000	8,241 <sup>5</sup>	7,800 <sup>r</sup>	9,600
<b>Total</b>	<b>195,000</b>	<b>208,000<sup>r</sup></b>	<b>216,000<sup>r</sup></b>	<b>206,000<sup>r</sup></b>	<b>203,000</b>
<b>Platinum:</b>					
Australia <sup>e,4</sup>	230	130	95 <sup>r</sup>	90	90
Botswana	622	560	373	435	218
Canada <sup>e</sup>	4,000	3,500	8,000	7,500 <sup>r</sup>	7,000
Colombia	929	997	1,231	1,460 <sup>r</sup>	1,330
Ethiopia <sup>10</sup>	10 <sup>e</sup>	8	--	--	--
Finland <sup>e</sup>	265 <sup>5</sup>	500	400	400	400
Japan <sup>6</sup>	1,417	1,331	1,765	1,735 <sup>r</sup>	1,963 <sup>5</sup>
Poland <sup>e,7,8</sup>	25	25	25	25	25
Russia <sup>e</sup>	25,900 <sup>r</sup>	25,700 <sup>r</sup>	27,300 <sup>r</sup>	26,500 <sup>r</sup>	25,500
Serbia	12	--	6 <sup>r</sup>	3 <sup>r</sup>	3
South Africa	140,819	147,790	148,008	128,590 <sup>r</sup>	131,000
United States <sup>9</sup>	3,830	3,450	3,700	3,670	3,720 <sup>5</sup>
Zimbabwe	6,849	8,800 <sup>e</sup>	10,826	10,500 <sup>r,e</sup>	12,400
<b>Total</b>	<b>185,000<sup>r</sup></b>	<b>193,000<sup>r</sup></b>	<b>202,000<sup>r</sup></b>	<b>181,000<sup>r</sup></b>	<b>184,000</b>
<b>Other platinum-group metals:<sup>e</sup></b>					
Canada	400	400	800	750 <sup>r</sup>	1,000
Russia	11,900	12,000	12,000 <sup>r</sup>	12,000	12,000
South Africa	55,456 <sup>5</sup>	57,292 <sup>5</sup>	58,111 <sup>5</sup>	21,010 <sup>r,5</sup>	52,000
Zimbabwe	1,759 <sup>5</sup>	1,820	1,820	2,200	2,700
<b>Total</b>	<b>69,500</b>	<b>71,500</b>	<b>72,700<sup>r</sup></b>	<b>36,000<sup>r</sup></b>	<b>67,700</b>
<b>Grand total</b>	<b>450,000<sup>r</sup></b>	<b>472,000<sup>r</sup></b>	<b>490,000<sup>r</sup></b>	<b>423,000<sup>r</sup></b>	<b>454,000</b>

<sup>e</sup>Estimated. <sup>r</sup>Revised. -- Zero.

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

<sup>2</sup>Includes data available through June 15, 2015. Platinum-group metal (PGM) production by Germany, Norway, Switzerland, and the United Kingdom is not included, because the production is derived wholly from imported metallurgical products and to include it would result in double counting.

<sup>3</sup>In addition to the countries listed, China, Indonesia, and the Philippines are thought to produce PGMs, 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, however, is presumably included in this table credited to Japan.

<sup>4</sup>PGMs recovered from nickel ore that is processed domestically. PGMs 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.

<sup>5</sup>Reported figure.

<sup>6</sup>Production derived entirely from imported ores.

<sup>7</sup>Based on official Polish estimates.

<sup>8</sup>Estimates based on reported platinum- and palladium-bearing final (residual) slimes and then average platinum and palladium content from electrolytic copper refining.

<sup>9</sup>A very small quantity of byproduct platinum and palladium produced from gold-copper ores was excluded.

<sup>10</sup>Data 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.