PLATINUM-GROUP METALS
(Platinum, palladium, rhodium, ruthenium, iridium, osmium)
(Data in kilograms, unless otherwise noted)

Domestic Production and Use: The United States has only one active platinum-group metals (PGM) mine. The mine, located near Nye, MT, processed more than 400,000 metric tons of ore and recovered 10,200 kilograms of palladium and 3,200 kilograms of platinum in 1999. Small quantities of PGM were also recovered as byproducts of copper refining by two companies in Texas and Utah. Automobile catalysts continued to be the largest demand sector for PGM. In the United States, more than 110,000 kilograms of PGM were used by the automotive industry in the manufacture of catalysts. Oxidation catalysts are also used in other air pollution abatement processes to remove organic vapors, odors, or carbon monoxide. Chemical uses include catalysts for organic synthesis, e.g., in hydrogenation, dehydrogenation, and isomerization. Platinum alloys, in cast or wrought form, are commonly used for jewelry. Platinum, palladium, and a variety of complex gold-silver-copper alloys are used as dental restorative materials. The primary medical use of PGM is in cancer chemotherapy. Other medical uses include platinum-iridium alloys in prosthetic and biomedical devices.

Salient Statistics—United States:

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</thead>
<tbody>
<tr>
<td>Mine production:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Platinum</td>
<td>1,590</td>
<td>1,840</td>
<td>2,610</td>
<td>3,240</td>
<td>3,200</td>
</tr>
<tr>
<td>Palladium</td>
<td>5,260</td>
<td>6,100</td>
<td>8,400</td>
<td>10,600</td>
<td>10,200</td>
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<tr>
<td>Imports for consumption, refined:</td>
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<td></td>
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</tr>
<tr>
<td>Platinum</td>
<td>71,500</td>
<td>75,800</td>
<td>77,300</td>
<td>97,200</td>
<td>75,300</td>
</tr>
<tr>
<td>Palladium</td>
<td>124,000</td>
<td>146,000</td>
<td>148,000</td>
<td>176,000</td>
<td>195,000</td>
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<tr>
<td>Rhodium</td>
<td>9,600</td>
<td>9,650</td>
<td>14,400</td>
<td>13,400</td>
<td>14,500</td>
</tr>
<tr>
<td>Ruthenium</td>
<td>7,520</td>
<td>15,600</td>
<td>11,500</td>
<td>9,230</td>
<td>9,500</td>
</tr>
<tr>
<td>Iridium</td>
<td>1,450</td>
<td>1,810</td>
<td>1,860</td>
<td>2,060</td>
<td>2,600</td>
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<tr>
<td>Osmium</td>
<td>73</td>
<td>329</td>
<td>54</td>
<td>71</td>
<td>20</td>
</tr>
<tr>
<td>Exports, refined:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Platinum</td>
<td>15,000</td>
<td>12,700</td>
<td>23,000</td>
<td>14,300</td>
<td>19,800</td>
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<tr>
<td>Palladium</td>
<td>26,000</td>
<td>26,700</td>
<td>43,800</td>
<td>36,700</td>
<td>38,900</td>
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<tr>
<td>Rhodium</td>
<td>741</td>
<td>187</td>
<td>282</td>
<td>811</td>
<td>100</td>
</tr>
<tr>
<td>Price, dollars per troy ounce:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Platinum</td>
<td>425.36</td>
<td>397.97</td>
<td>396.58</td>
<td>372.50</td>
<td>365.00</td>
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<tr>
<td>Palladium</td>
<td>153.35</td>
<td>130.39</td>
<td>184.14</td>
<td>290.00</td>
<td>320.00</td>
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<tr>
<td>Rhodium</td>
<td>463.30</td>
<td>300.00</td>
<td>298.99</td>
<td>620.00</td>
<td>900.00</td>
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<tr>
<td>Employment, mine, number</td>
<td>500</td>
<td>500</td>
<td>550</td>
<td>620</td>
<td>620</td>
</tr>
</tbody>
</table>

Recycling: An estimated 70 metric tons of PGM was recovered from new and old scrap in 1999.

Import Sources (1995-98): Platinum: South Africa, 59%; United Kingdom, 14%; Russia, 9%; Germany, 5%; and other, 13%. Palladium: Russia, 48%; South Africa, 18%; United Kingdom, 9%; Belgium, 8%; and other, 17%.

Tariff: All unwrought and semimanufactured forms of PGM can be imported duty free.

Depletion Allowance: 23% (Domestic), 15% (Foreign).

Government Stockpile:

<table>
<thead>
<tr>
<th>Material</th>
<th>Uncommitted inventory</th>
<th>Committed inventory</th>
<th>Authorized for disposal</th>
<th>Disposal plan FY 1999</th>
<th>Disposals FY 1999</th>
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</thead>
<tbody>
<tr>
<td>Platinum</td>
<td>10,649</td>
<td>—</td>
<td>10,649</td>
<td>—</td>
<td>3,113</td>
</tr>
<tr>
<td>Palladium</td>
<td>34,196</td>
<td>—</td>
<td>18,729</td>
<td>—</td>
<td>4,668</td>
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<tr>
<td>Iridium</td>
<td>784</td>
<td>3.11</td>
<td>2.18</td>
<td>—</td>
<td>136</td>
</tr>
</tbody>
</table>

Prepared by Henry E. Hilliard [(703) 648-4970, hhilliar@usgs.gov, fax: (703) 648-7757]
**Events, Trends, and Issues:** In 1998, the lone U.S. primary PGM producer completed expansion construction work at its mine which increased its milling rate to 3,000 tons per day. In 1999, the company focused on increasing underground development in the mine to support the added capacity. Advancement of its East Boulder Project, near Big Timber, MT, began with the arrival of a 4.6-meter diameter tunnel-boring machine (TBM). At the end of February 1999, the TBM had advanced more than one-third of the distance to the J-M Reef. The tunneling process was projected to reach the ore body, about 18,500 feet from the portal entrance, by the end of 1999. A second TBM also began excavating a second parallel tunnel. Completion of the second tunnel will allow underground infrastructure construction, providing additional access and ventilation. East Boulder will be Stillwater’s second producing mine, located on the western end of the J-M Reef and 13 miles west of the Stillwater Mine. The project is permitted for 2,000 tons per day and is expected to produce between 14,000 and 15,600 kilograms of palladium and platinum at a cost of production of $140 to $160 per ounce.

The operator of the Stillwater mine was granted a Record of Decision by the Montana Department of Environmental Quality which removed tonnage limitations at the mine and authorized construction of a long-term tailings facility.

The price of rhodium rose sharply in 1999, as demand by industrial users was reinforced by investor buying.

World supplies of PGM are expected to increase substantially in the next 5 years, according to the plans of major non-South African PGM mining companies. More than 50,000 kilograms of additional output could come from projects underway in Canada and the United States.

**World Mine Production, Reserves, and Reserve Base:**

<table>
<thead>
<tr>
<th></th>
<th>Mine production</th>
<th>PGM</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States 2</td>
<td>3,240</td>
<td>3,200</td>
</tr>
<tr>
<td>Canada</td>
<td>7,570</td>
<td>7,300</td>
</tr>
<tr>
<td>Russia</td>
<td>17,000</td>
<td>17,500</td>
</tr>
<tr>
<td>South Africa</td>
<td>117,000</td>
<td>120,000</td>
</tr>
<tr>
<td>Other countries</td>
<td>1,550</td>
<td>2,100</td>
</tr>
<tr>
<td>World total (may be rounded)</td>
<td>146,000</td>
<td>150,000</td>
</tr>
</tbody>
</table>

**World Resources:** World resources of PGM in mineral concentrations currently or potentially economic to mine are estimated to total more than 100 million kilograms. The largest reserves are located in the Bushveld Complex in South Africa. Currently there are 10 producing mines in the Bushveld Complex. Of these, nine are producing from the Merensky Reef and UG2 Chromite Layer and one is producing from the Platreef, located on the northern limb of the Complex.

**Substitutes:** Some motor vehicle manufacturers have substituted palladium for the higher priced platinum in catalytic converters. Although palladium is less resistant to poisoning by sulfur and lead than platinum, it may be useful in controlling emissions from diesel-powered vehicles.

Electronic parts manufacturers are reducing the average palladium content of the conductive pastes used to form the electrodes of multilayer ceramic capacitors by substituting base metals or silver-palladium pastes that contain significantly less palladium.