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2005 Minerals Yearbook

SELENIUM AND TELLURIUM

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Selenium and Tellurium

By Micheal W. George

Domestic survey data and tables were prepared by Lisa D. Miller, statistical assistant, and the world production tables were prepared by Linder Roberts, international data coordinator.

One copper refinery in Texas reported domestic production of primary selenium and tellurium. One producer exported semirefined selenium for toll-refining in Asia, and two other companies generated selenium-containing slimes, which were exported for processing. In 2005, the price for selenium and tellurium increased as demand for the metals increased and global supplies became increasingly tight. Domestic production of primary selenium and tellurium decreased in 2005. Selenium and tellurium, rare elements widely distributed within the Earth's crust, do not occur in concentrations high enough to justify mining solely for their content. They are recovered as byproducts of nonferrous metal mining, mostly from the anode slimes associated with electrolytic refining of copper. Electrolytic refining of copper utilizes a sulfate-base electrolyte that does not dissolve precious and other base metals, allowing them to accumulate along with refractory components at the bottom of the electrolytic cell. The quantities of metals present in the slimes, such as bismuth, gold, selenium, silver, and tellurium, are dependent on their initial content in the copper anode material and, therefore, on the ores from which the copper concentrate originated.

Slimes resulting from primary copper metal refining can average 10% selenium by weight and in a few cases as much as 40%. Tellurium concentrations are generally lower and never exceed 5% (Weerts, 2002).

Selenium and tellurium can also be recovered economically from industrial scrap and chemical process residues. Obsolete and damaged photoreceptor drums from plain paper copy machines are shipped by manufacturers to refineries for recovery of selenium and tellurium metal.

The global production of selenium was estimated by industry to be about 2,700 metric tons (t) in 2005 and demand was estimated to be about 3,000 t. The imbalance has existed for a couple of years and has led to a drawdown of stocks of materials (Platts Metals Week, 2005).

Domestic Data Coverage

Domestic data are collected through a voluntary survey of U.S. selenium and tellurium producers. The production survey was sent to the two known domestic producers of selenium and the sole domestic producer of tellurium. All companies responded to the survey. In order to protect proprietary interests of the companies, survey data are withheld from publication.

Production

In the United States, ASARCO Incorporated's copper refinery in Amarillo, TX, was the only producer of refined selenium and tellurium. One copper refinery exported semirefined selenium (90% selenium content) for toll-refining in Asia. Two other refineries generated selenium-containing slimes, but did not produce selenium. Selenium-containing slimes from these refineries were exported for processing. Most of the primary selenium and tellurium recovered in the United States in 2005 came from copper ores in Arizona and Utah. Domestic production of refined selenium decreased in 2005 compared with that of 2004 owing to disruption in production at Asarco.

On July 2, 2005, Asarco workers began a strike that lasted for more than 4 months. In August 2005, the company filed for bankruptcy protection citing the extended strike and environmental cleanup costs as the causes. The strike ended in early November, and the company restarted operations. At yearend, the company was still in post-bankruptcy reorganization (Northern Miner, The, 2005; Berry, 2005§[1]).

Asarco produced commercial-grade tellurium at its refinery complex in Amarillo mainly from copper anode slimes but also from lead refinery skimmings. Asarco also produced high-purity tellurium, selenium, and compounds of these metals for specialty applications at its Globe plant in Denver, CO. Domestic refined tellurium production decreased in 2005 compared with that of 2004 owing to the supply disruptions at Asarco.

Consumption

Selenium.—World demand for selenium in 2005 was estimated to be higher than that in 2004, with the glass manufacturing industry being the leading consumer. Selenium is used to decolorize the green tint caused by iron impurities in glass containers and other soda-lime silica glass. It is also used in art and other glass, such as that used in traffic lights to produce a ruby red color and in architectural plate glass to reduce solar heat transmission through the glass.

Selenium was used as an alloy with bismuth to substitute for lead in plumbing in response to requirements of the Safe Drinking Water Act Amendments of 1996 (Public Law 104-182). The Act requires that effectively no lead be contained in any fixtures, fluxes, pipes, and solders used for the installation or repair of facilities that provide water for human consumption after August 1998. Metallurgical grade selenium is used as an additive to cast iron, copper, lead, and steel alloys. In these applications, it improves machinability and casting and forming properties.

The addition of a small amount, about 0.02% by weight, of selenium to low-antimony lead alloys used in the support grid of lead-acid batteries improves the casting and mechanical properties of the alloy.

[1]References that include a section mark (§) are found in the Internet References Cited section.

Electronics were a diminishing end-use market in 2005. Photoreceptors on the drums of plain-paper copiers had been the largest single application for selenium during the 1970s and 1980s. Organic photoreceptor compounds (OPCs) have replaced these high-purity selenium compounds. OPCs are free of the environmental concerns involved with the disposal of selenium compounds and reportedly offer better performance and lower costs at lower printing speeds. While use in photoreceptors has been declining, other electronic uses for selenium, including rectifier and photoelectric applications, have been growing.

Chemical and pigment uses of selenium include industrial and pharmaceutical applications. Selenium added to fertilizer used in growing animal feed is the largest portion of this category. This practice is more common outside the United States, especially in countries with selenium-poor soils. Another method of increasing selenium in humans and livestock is through dietary supplements; however, this method puts less demand on global selenium supplies than other methods. Selenium's principal pharmaceutical use is in shampoo to control dermatitis and dandruff and as an antifungal agent.

Cadmium sulfoselenide compounds are used as pigments in ceramics, glazes, paints, and plastics. Selenium in pigments has good heat stability, reacts well to moisture, and is resistant to ultraviolet or chemical exposure. It can be used to produce a wide range of red, orange, and maroon colors, but because of the relatively high cost and the toxicity of cadmium-base pigments, their use is generally restricted to applications where they are uniquely suited.

Additionally, selenium is used in catalysts to enhance selective oxidation; in plating solutions, to improve appearance and durability; in blasting caps and gun bluing; in coating digital x-ray detectors; and in zinc selenide for infrared windows in carbon dioxide lasers (Amalgamet Canada, 2003§). In China, selenium dioxide (SeO_2) is substituted for sulfur dioxide to increase yields in the electrolytic production of manganese (Selenium-Tellurium Development Association, Inc., 2002§). By using SeO_2 instead of sulfur dioxide the plant reduces the power required to operate the electrolytic cells. This method requires about a kilogram of selenium per metric ton of manganese metal produced (Metal-Pages, 2004§).

Tellurium.—World demand for tellurium is thought to have increased in 2005. The leading use for tellurium was as a metallurgical alloying element. Tellurium was used in steel as a free-machining additive, in copper to improve machinability while not reducing conductivity, in lead to improve resistance to vibration and fatigue, in cast iron to help control the depth of chill, and in malleable iron as a carbide stabilizer.

Chemical and catalyst usage was the next largest end use. Tellurium was used as a vulcanizing agent and accelerator in the processing of rubber and as a component of catalysts for synthetic fiber production. Electrical uses were a smaller end use and consisted of photoreceptor and thermoelectric applications. Other end uses of tellurium were as an ingredient in blasting caps and as a pigment to produce blue and brown colors in ceramics and glass.

Tellurium catalysts are used chiefly for the oxidation of organic compounds but are also used in chlorination, halogenation, and hydrogenation reactions. Tellurium dioxide is used as a curing and accelerating agent in rubber compounds.

Consumption of tellurium in electronics applications was estimated to have increased in 2005. High-purity tellurium is used in electronics applications, such as thermoelectric and photoelectric devices. Thermal imaging devices use mercury-cadmium-telluride, which assists in converting a raw image into a crisp picture on the screen. Semiconducting bismuth telluride is used in thermoelectric cooling devices employed in electronics and consumer products. These devices consist of a series of couples of semiconducting materials which, when connected to a direct current, cause one side of the thermoelement to cool while the other side generates heat.

Thermoelectric coolers are most commonly used in military and electronics applications, such as the cooling of infrared detectors, integrated circuits, laser diodes, and medical instrumentation. Their application in consumer products, such as portable food-and-beverage coolers or automobile car seat cooling systems, continued to increase. Demand for solar cells increased in 2005 and with this, the consumption of tellurium. Several companies announced plans to expand production of solar cells within the next couple of years.

Prices

The Platts Metals Week's average New York dealer price for selenium was $51.43 per pound in 2005. The price, which had risen sharply in 2003, began 2005 at $36 to $40 per pound and rose through the first half of the year to a high of $52 to $56 per pound. The price remained at this level through most of the second half of the year but started to decline in December and ended the year at $46 to $49 per pound. The price volatility was attributed to fluctuating demand in China.

The United Kingdom price for lump and powder 99.95% tellurium, as published in Mining Journal, started the year at $20 to $25 per pound. The price range rapidly increased to a high of $130 to $180 per pound by midyear. The price dropped to $100 to $130 per pound at the beginning of August and remained relatively unchanged through yearend. Demand increases from China and solar cell manufacturers outside of China caused a supply shortfall and led to the price increases.

Trade

The export of selenium materials in 2005 increased by 59% compared with that of 2004. Top destinations for selenium were, in descending order, Germany, Hong Kong, Mexico, China, Australia, and the Philippines (table 2).

In 2005, imports of SeO_2 and unwrought waste and scrap increased by 43% to 589 t, compared with 2004 imports (table 3). In 2005, the United States had net imports of 335 t of selenium (including the selenium content of SeO_2) compared with 253 t in 2004. Belgium, Canada, the Philippines, Germany, and China (in order of decreasing quantity) accounted for about 90% of the imports of selenium metal and SeO_2 into the United States in 2005.

Imports of unwrought tellurium and tellurium waste and scrap, contained tellurium, decreased by 33% in 2005 compared with 62,800 kilograms (kg) in 2004 (table 5). The leading suppliers were Belgium, Canada, and China, in order of decreasing quantity, accounting for more than 95% of the total imports of tellurium metal into the United States. In 2005, tellurium exports increased by 750% compared with those of 2004 (table 4). The United Kingdom accounted for 77% of total exports.

World Review

Global selenium output cannot be easily determined because not all companies report production and because of the trade in semirefined production. Only about 20 of the approximately 80 copper refineries in operation around the world reported recovery of selenium, and less than one-half of that number reported tellurium refining (Selenium-Tellurium Development Association, Inc., 2002).

World refinery production of selenium, based on the countries listed in table 6, increased by about 4% to 1,390 t (table 5).

Belgium.—In 2005, Belgium-based Sidech increased production of selenium to about 180 t. The company is a leading producer of bismuth and started to increase its selenium production in 2004. The company bought intermediate and crude grade selenium raw materials and further refined these products to become a major supplier. Some of their production is counted as refined output in other countries. This is not new production and will probably not increase worldwide selenium production (Metal-Pages, 2005c§).

Canada.—Yukon Zinc Corporation (Vancouver, British Columbia, Canada) had mining equipment and a water license at its site and was expected to begin test mining the Wolverine zinc-silver deposit in the Yukon. The deposit has an unusually high level of selenium, which had previously been considered a negative factor until the rapid price increase and is now considered an asset (Metal-Pages, 2005d§).

Chile.—Corporacion Nacional del Corbre (Coldelco) was expecting to produce more copper in 2007. This increase in copper production will increase the availability of selenium and tellurium; however historically, Chilean deposits have a low selenium and tellurium content (Metal Bulletin, 2005b).

China.—China consumed much of the world's production of selenium. China depended on imports for about 95% of its needs and imported 781 t in 2005, an 11% drop compared with 2004 imports (Metal Bulletin, 2005a; Metal-Pages, 2006b§). The decrease in consumption was linked to major cutbacks in electrolytic manganese metal production owing to weak demand from the Chinese stainless steel industry (Metal-Pages, 2006a§). However, demand for selenium for the agriculture and glass industries remained steady (Metal-Pages, 2005c§).

Japan.—The major producers of selenium in Japan were Mitsubishi Materials Corporation; Nippon Mining & Metals Co., Ltd.; Shinko Kagaku Kogyo Co., Ltd.; and Sumitomo Metal Mining Co., Ltd. Selenium production increased by 4% in 2005 compared with that of 2004. Tellurium production in 2005 declined 31% compared with that of 2004. About 70% to 80% of Japanese production of selenium was exported owing to falling domestic demand caused by environmental regulations. Of the exports of selenium in 2005, 43% was exported directly to China. In 2005, stocks of selenium rose 72% and tellurium stocks declined 45% compared with levels in 2004 (Roskill's Letter from Japan, 2006a, c, d).

In the fiscal year 2004, Japanese secondary producers recovered 16 t of selenium and 600 kg of tellurium. Selenium and tellurium recovered by secondary producers rose by 36% and 40%, respectively, in fiscal year 2004 (Roskill's Letter from Japan, 2006b).

Current Research and Technology

Selenium's antioxidant and curative properties have been demonstrated to assist with a number of human health problems. The use of selenium as a dietary supplement has been shown to have a positive effect on the following health problems: acquired immune deficiency syndrome (AIDS), Alzheimer's disease, arthritis, asthma, cancer, cardiovascular diseases, pancreatitis, reproduction, thyroid function, and viral infections (Oldfield, 2003, p. 1-8). There were new developments for the use of selenium coatings on bandages, contact lenses, and medical devices. The selenium coatings act as antimicrobial, antineoplastic and antiviral agents and show promise as an antitumor growth agent (Selenium, Ltd., 2005§).

Several Japanese companies announced plans to produce solar panels made from copper, indium, gallium, and selenium (CIGS) for household use in Japan in 2007. Recent advancements in CIGS thin films have reduced production costs and improved performance as well as having reduced environmental impact during production (Metal-Pages, 2005a§). According to some industry analysts, the new solar power technology could increase the world consumption for selenium by 5% during the next 13 years (Metal Bulletin, 2006).

Outlook

The supply of selenium and tellurium is directly affected by the supply of the main product from which it is derived, copper, and to a lesser extent, by the supply of lead, nickel, or zinc where production is from a sulfide ore. Selenium and tellurium prices are often inversely related to the supply of copper. A byproduct of copper refining, selenium prices typically fall during periods of high copper production. Since selenium and tellurium prices do not influence copper production, an increase in selenium demand is not likely to cause an increase in the production of copper and its byproducts.

Though the global production of primary refined copper was projected to grow slightly in 2006, much of the increase is expected to come from the leaching and electrowinning of copper ores, a process that does not provide for the recovery of contained selenium and tellurium, and increases in copper production in South America, where ores have low selenium and tellurium content (Metal-Pages, 2005c§). Therefore global selenium and tellurium production will probably remain relatively unchanged, but domestic production is expected to increase owing to the end of an extended strike at Asarco, the main domestic producer of selenium and tellurium.

Chinese demand for selenium is expected to decline owing to a potential reduction in demand from manganese producers because of the reduction in manganese production in China and the rising costs of selenium and electricity. As for the phasing out of SeO_2 used for manganese production, the Chinese simply cannot afford to switch technologies (Metal-Pages, 2005b§, c§).

As with the Chinese manganese industry, world consumption for selenium in photoreceptors is likely to continue to decline as the cost of substituting organic compounds decreases. Promising prostate cancer research and other health benefits may eventually lead to increased consumption of the metal. Dosages taken directly for human consumption will not create large increases in demand for the metal because only minute quantities are necessary for effective therapy. Nevertheless, there could be a relatively large consumption increase if selenium is increasingly applied to the soil for crops to be consumed by humans or livestock. World consumption for selenium from the glass and steel industries will probably remain flat, as there are few substitutes.

Tellurium supply and demand had remained in fairly close balance for a decade. However, in 2004 and 2005, demand outstripped supply, causing the price to climb rapidly. In 2006, tellurium consumption was expected to increase further, chiefly from the solar cell industry. Production was expected to remain relatively unchanged, extending the supply shortfall.

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TABLE 1
SALIENT SELENIUM AND TELLURIUM STATISTICS[1]

(Kilograms, contained metal, and dollars per pound)

	2001	2002	2003	2004	2005
Selenium:					
United States:					
Production, primary refined	W	W	W	W	W
Shipments to consumers	W	W	W	W	W
Exports	41,200	86,700	249,000	160,000	254,000
Imports for consumption	483,000	422,000	367,000	412,000	589,000
Apparent consumption, metal	W	W	W	W	W
Dealers' price, average, commercial grade[2]	$3.80	$4.27	$5.68	$24.89	$51.43
World, refinery production	1,420,000 r	1,370,000 r	1,440,000 r	1,330,000	1,390,000 e
Tellurium, United States:					
Exports	7,970	3,510	10,200	6,160	52,400
Imports for consumption	28,000	28,100	48,900	62,800	42,200
Price at yearend, commercial grade[3]	$7.00	$7.00	$10.00	$22.50	$110.00

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data.
[1]Data are rounded to no more than three significant digits, except prices.
[2]Source: Platts Metals Week. Calculated from published price ranges.
[3]Average yearend price published by Mining Journal for United Kingdom lump and powder, 99.95% tellurium.

TABLE 2
U.S. EXPORTS OF SELENIUM[1]

Country	2004 Quantity (kilograms, contained Se)	2004 Value	2005 Quantity (kilograms, contained Se)	2005 Value
Australia	22,800	$497,000	20,000	$86,100
Belgium	--	--	9,010	140,000
Brazil	1,660	21,000	4,470	69,300
Canada	1,570	46,600	378	11,400
China	4,930	13,300	25,000	320,000
Colombia	1,630	13,500	--	--
Costa Rica	2,030	31,400	1,530	23,700
El Salvador	3,400	52,700	--	--
Finland	3,750	88,000	--	--
France	--	--	9,770	42,900
Germany	23,900	669,000	49,600	314,000
Guatemala	--	--	6,600	102,000
Hong Kong	7,570	117,000	48,800	756,000
India	--	--	429	10,300
Indonesia	--	--	140	7,120
Italy	1,070	16,500	--	--
Japan	3,850	78,500	424	6,580
Korea, Republic of	440	5,400	--	--
Malaysia	2,450	38,000	--	--
Mexico	26,700	415,000	34,000	535,000
Netherlands	7,750	120,000	2,130	33,000
Philippines	25,200	390,000	15,900	246,000
Singapore	10,500	72,500	4,310	60,900
South Africa	--	--	447	9,260
Sweden	--	--	1,180	18,300
Taiwan	40	4,360	1,030	16,400
Thailand	4,100	38,800	8,550	74,700
United Kingdom	1,900	50,300	355	5,500
Venezuela	2,300	35,600	9,600	149,000
Total	160,000	2,810,000	254,000	3,040,000

-- Zero.

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

Source: U.S. Census Bureau.

TABLE 3
U.S. IMPORTS FOR CONSUMPTION OF SELENIUM[1]

	2004		2005	
Class and country	Quantity (kilograms, contained Se)	Value	Quantity (kilograms, contained Se)	Value
Selenium:				
Australia	--	--	1,980	$59,400
Belgium	160,000	$7,310,000	304,000	17,700,000
Canada	90,100	3,280,000	103,000	5,410,000
China	--	--	37,800	1,170,000
Czech Republic	1,050	46,800	--	--
France	--	--	3,690	168,000
Germany	15,700	688,000	29,300	3,080,000
Hong Kong	--	--	2,000	191,000
India	17,000	314,000	4	10,600
Japan	3,550	178,000	13,600	975,000
Korea, Republic of	500	28,100	17,400	713,000
Mexico	12,300	172,000	--	--
Netherlands	6,070	271,000	5,740	265,000
New Zealand	--	--	--	--
Peru	960	26,500	3,830	388,000
Philippines	79,700	2,880,000	41,500	3,030,000
Russia	14	8,100	10	9,940
Serbia and Montenegro	231	14,700	--	--
United Kingdom	14,700	734,000	10,200	683,000
Total	402,000	16,000,000	575,000	33,900,000
Selenium dioxide:[2]				
Germany	6,880	221,000	10,800	930,000
India	2,130	40,100	1,250	93,000
Japan	1,190	27,300	1,500	99,000
Philippines	--	--	500	59,400
Spain	71	4,330	--	--
United Kingdom	--	--	20	4,280
Total	10,300	293,000	14,100	1,190,000
Grand total	412,000	16,200,000	589,000	35,100,000

-- Zero.

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

[2]Totals revised to 71% of original quantities and values.

Source: U.S. Census Bureau.

TABLE 4

U.S. EXPORTS OF TELLURIUM[1]

Class and country	2004 Quantity (kilograms, contained Te)	2004 Value	2005 Quantity (kilograms, contained Te)	2005 Value
Belgium	220	$33,000	3,500	$270,00
Brazil	--	--	110	8,00
Canada	542	25,500	--	
France	--	--	157	127,00
Germany	301	188,000	114	130,00
Hong Kong	--	--	543	60,70
Japan	2,310	318,000	3,020	364,00
Korea, Republic of	136	6,450	68	7,77
Mexico	50	7,450	--	
Philippines	1,300	195,000	4,150	622,00
Spain	1,000	58,600	490	118,00
Taiwan	287	10,400	--	
United Kingdom	8	13,100	40,200	2,460,00
Total	6,160	856,000	52,400	4,170,00

-- Zero.

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

Source: U.S. Census Bureau.

TABLE 5

U.S. IMPORTS FOR CONSUMPTION OF TELLURIUM[1]

Class and country	2004 Quantity (kilograms, contained Te)	2004 Value	2005 Quantity (kilograms, contained Te)	2005 Value
Belgium	15,100	$461,000	23,500	$1,910,000
Canada	15,800	1,280,000	11,500	1,330,000
China	115	30,500	5,250	1,190,000
Germany	16,400	232,000	267	38,300
India	695	32,100	79	3,670
Japan	126	80,600	40	67,100
Philippines	6,430	272,000	--	--
Russia	1	3,620	23	4,180
Ukraine	2	7,570	1,460	108,000
United Kingdom	8,120	222,000	31	9,200
Total	62,800	2,620,000	42,200	4,650,000

-- Zero.

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

Source: U.S. Census Bureau.

TABLE 6

SELENIUM: WORLD REFINERY PRODUCTION, BY COUNTRY[1, 2]

(Kilograms, contained selenium)

Country[3]	2001	2002	2003	2004	2005[e]
Belgium[e]	200,000	200,000	200,000	200,000	200,000
Canada[4]	238,000	175,000	253,000	277,000 r	300,000
Chile[e]	85,000 r	80,000 r	83,000 r	82,000 r	82,000
Finland	38,913	39,237	49,163 r	61,256 r	62,000
Germany[e]	15,000 r	16,000 r	14,000 r	14,000 r	14,000
India[e, 5]	11,500	11,500	12,000	12,000	13,000
Japan	735,089	752,099	733,973	599,170 r	634,500 [6]
Peru	16,110 r	20,600	20,600 e	21,000 r	21,000
Philippines[e]	40,000	40,000	40,000	40,000	40,000
Serbia and Montenegro	20,000 e	15,000 e	10,000	5,000 r, e	--
Sweden[e]	20,000	20,000	20,000	20,000	20,000
United States	W	W	W	W	W
Total	1,420,000 r	1,370,000 r	1,440,000 r	1,330,000	1,390,000

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; not included in total. -- Zero.

[1]World totals, U.S. data, and estimated data have been rounded to three significant digits; may not add to totals shown.

[2]Insofar as possible, data relate to refinery output only; thus, countries that produced selenium contained in copper ores, copper concentrates, blister copper, and/or refinery residues but did not recover refined selenium from these materials indigenously were excluded to avoid double counting. Table includes data available through May 27, 2006.

[3]In addition to the countries listed, Australia, Iran, Kazakhstan, Russia, the United Kingdom, and Uzbekistan produced refined selenium, but output is not reported, and available information is inadequate for formulation of reliable estimates of output levels. Australia is known to produce selenium in intermediate metallurgical products and has facilities to produce elemental selenium. In addition to having facilites for processing imported anode slimes for the recovery of selenium and precious metals, the United Kingdom has facilities for processing selenium scrap.

[4]Excludes selenium intermediates exported for refining.

[5]Data are for Indian fiscal year beginning April 1 of year stated.

[6]Reported figure.

TABLE 7
TELLURIUM: WORLD REFINERY PRODUCTION, BY COUNTRY[1, 2]

(Kilograms, contained tellurium)

Country	2001	2002	2003	2004	2005[e]
Canada[3]	51,000	39,000	40,000	69,000 [r]	75,000
Japan	39,008	28,656	33,154	32,703	22,200
Peru	19,105	21,600	22,000	22,000 [r]	22,000
United States	W	W	W	W	W

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data.

[1]Estimated data are rounded to no more than three significant digits.

[2]Insofar as possible, data relate to refinery output only; thus, countries that produced tellurium contained in copper ores, copper concentrates, blister copper and/or refinery residues, but did not recover refined tellurium are excludec to avoid double counting. Table is not totaled because of exclusion of data from major world producers. In addition to the countries listed, Australia, Belgium, Chile, Germany, the Philippines, Kazakhstan, and Russia are known to produce refined tellurium, but output is not reported; available information is inadequate to formulate reliable estimates of output levels. Table includes data available through May 27, 2006.

[3]Excludes tellurium intermediates exported for refining.