GEMSTONES

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In this report, the terms "gem" and "gemstone" mean any mineral or organic material (such as amber, pearl, and petrified wood) used for personal adornment, display, or object of art because it possesses beauty, durability, and rarity. Of more than 4,000 mineral species, only about 100 possess all these attributes and are considered to be gemstones. Silicates other than quartz compose the largest group of gemstones; oxides and quartz compose the second largest (table 1). A further subcategory of gemstones is colored gemstone, which in this report designates all nondiamond gemstones, including amber, coral, and shell. In addition, laboratory-created gemstones, cultured pearls, and gemstone simulants are discussed but are treated separately from natural gemstones (table 2). Trade data in this report are from the U.S. Census Bureau. Quantities are reported in carats unless otherwise noted. All percentages in the report were computed based on the unrounded data. Current information on industrial-grade diamond and industrial-grade garnet can be found in the U.S. Geological Survey (USGS) Minerals Yearbook chapters on industrial diamond and industrial garnet.

Gemstones have fascinated humans since prehistoric times. They have been valued as treasured objects throughout history by all societies in all parts of the world. Amber, amethyst, coral, diamond, emerald, garnet, jade, jasper, lapis lazuli, pearl, rock crystal, ruby, serpentine, and turquoise are some of the first stones known to have been used for making jewelry. These stones served as symbols of wealth and power. Today, gems are worn more for pleasure or in appreciation of their beauty than to demonstrate wealth. In addition to jewelry, gemstones are used for collections, decorative art objects, and exhibits.

Production

Commercial mining of gemstones has never been extensive in the United States. More than 60 varieties of gemstones have been produced commercially from domestic mines, but most of the deposits have been relatively small compared with other mining operations. In the United States, much of the current gemstone mining is conducted by collectors, gem clubs, and hobbyists rather than by businesses.

The commercial gemstone industry in the United States consists of individuals and companies that mine gemstones or harvest shell and pearl, firms that manufacture laboratory-created gemstones, and individuals and companies that cut natural and laboratory-created gemstones. The domestic gemstone industry is focused on the production of colored gemstones and on the cutting of large diamonds. Industry employment is estimated to range from 1,000 to 1,500 workers (U.S. International Trade Commission, 1997, p. 1).

Most natural gemstone producers in the United States are small businesses that are widely dispersed and operate independently. The small producers probably have an average of less than three employees, including those who only work part time. The number of gemstone mines operating from year to year fluctuates because the uncertainty associated with the discovery and marketing of gem-quality minerals makes it difficult to obtain financing for developing and sustaining economically viable deposits (U.S. International Trade Commission, 1997, p. 23).

The total value of natural gemstones produced in the United States during 2003 was estimated to be at least $12.5 million (table 3). The production value decreased slightly from that of the preceding year.

The estimate of 2003 U.S. gemstone production was based on a survey of more than 230 domestic gemstone producers conducted by the USGS. The survey provided a foundation for projecting the scope and level of domestic gemstone production during the year. However, the USGS survey did not represent all gemstone activity in the United States, which includes thousands of professional and amateur collectors. Consequently, the USGS supplemented its survey with estimates of domestic gemstone production from related published data, contacts with gemstone dealers and collectors, and information garnered at gem and mineral shows.

Natural gemstone materials indigenous to the United States are collected, produced, and/or marketed in every State. During 2003, all 50 States produced at least $1,000 worth of gemstone materials. Seven States accounted for 77% of the total value, as reported by survey respondents. These States, in order of declining value of production, were Tennessee, Arizona, Oregon, California, Nevada, Montana, and Idaho. Some States were known for the production of a single gemstone material—Tennessee for freshwater pearls, for example. Other States produced a variety of gemstones, for example Arizona, whose gemstone deposits included agate, amethyst, azurite, chrysocolla, garnet, jade, jasper, malachite, obsidian, onyx, opal, peridot, petrified wood, smithsonite, and turquoise. There is also a wide variety of gemstones found and produced in California, Idaho, Montana, and North Carolina.

The United States has two significant operations in known diamond-bearing areas. The first, the Kelsey Lake diamond mine, is the United States' only commercial diamond mine and is close to the Colorado-Wyoming State line near Fort Collins, CO. Kelsey Lake did not report any production during 2003. The mine is owned and operated by Great Western Diamond Co. (a subsidiary of McKenzie Bay International, Ltd. of Canada). The Kelsey Lake property includes nine known kimberlite pipes, of which three have been tested and have shown that diamonds are present. The remaining six pipes have yet to be fully explored and tested for their diamond potential. Of the diamonds recovered, 50% to 65% was clear gem quality, and

almost one-third was one carat or larger in size. The identified resources are at least 17 million metric tons (Mt) grading an average of 4 carats per 100 metric tons (Taylor Hard Money Advisers, 2000§[1]). Diamond was produced at Kelsey Lake through the month of April 2002. As of early 2003, the mine was in care-and-maintenance mode.

The second U.S. diamond operation is in Crater of Diamonds State Park near Murfreesboro in Pike County, AR, where a dig-for-fee operation for tourists and rockhounds is maintained by the State of Arkansas. Crater of Diamonds is the only diamond mine in the world that is open to the public. The diamonds occur in a lamproite breccia tuff associated with a volcanic pipe and in the soil developed from the lamproite breccia tuff. In 2003, 641 diamonds with an average weight of 0.2 carats were recovered at Crater of Diamonds State Park. Since the diamond-bearing pipe and the adjoining area became a State park in 1972, more than 22,000 diamonds have been recovered (J.M. Howard, geology supervisor, Arkansas Geological Commission, written commun., 2003). Exploration has demonstrated that there is about 78.5 Mt of diamond-bearing rock in this diamond deposit (Howard, 1999, p. 62). An Arkansas law, enacted early in 1999, prohibits commercial diamond mining in the park (Diamond Registry Bulletin, 1999).

Studies by the Wyoming Geological Survey have shown that Wyoming has the potential for a $1 billion diamond mining business. Wyoming has many of the same geologic conditions as Canada, and there is evidence of hundreds of kimberlite pipes in the State. Twenty diamondiferous kimberlite pipes and one diamondiferous mafic breccia pipe have been identified in southern Wyoming. Two of the largest kimberlite fields, State Line and Iron Mountain, and the largest lamproite field in the United States, Leucite Hills, are in Wyoming. There has been slight interest in the southern Wyoming and northern Colorado area by several diamond mining firms, but the only diamond mine developed in the area thus far is the Kelsey Lake Mine. Individual diamond gems worth $89,000 and $300,000 have been found there (Associated Press, 2002§).

In addition to natural gemstones, laboratory-created gemstones and gemstone simulants are produced in the United States. Laboratory-created or synthetic gemstones have the same chemical, optical, and physical properties as the natural materials that they appear to be. Simulants have an appearance similar to that of a natural gemstone material, but they have different chemical, optical, and physical properties. Laboratory-created gemstones produced in the United States include alexandrite, cubic zirconia, diamond, emerald, moissanite, ruby, sapphire, and turquoise. Simulants of coral, lapis lazuli, malachite, and turquoise also are manufactured in the United States. In addition, certain colors of laboratory-created sapphire and spinel, used to represent other gemstones, are classified as simulants.

Laboratory-created gemstone production in the United States was valued at more than $33.4 million during 2003; simulant gemstone output was even greater and was estimated to be valued at more than $100 million. Five firms in five States, representing virtually the entire U.S. laboratory-created gemstone industry, reported production to the USGS. The States with reported laboratory-created gemstone production, in descending production value order, were North Carolina, New York, Florida, Michigan, and Arizona.

One U.S. company, Gemesis Corp., produced consistent quality laboratory-created gem diamond and reported a fourth year of production in 2003. The laboratory-created diamonds are produced using equipment, expertise, and technology developed by a team of scientists from Russia and the University of Florida. The weight of the laboratory-created diamond stones range from 1.5 to 2 carats, and most of the stones are yellow, brownish yellow, colorless, and green (Weldon, 1999§). In 2002, Gemesis moved into a new facility near Sarasota, FL, where it started with 27 diamond-growing machines, each machine capable of growing 3-carat rough diamonds by generating temperatures and pressures that recreate the conditions in the Earth's mantle, where natural diamonds form. Gemesis eventually plans to have 250 diamond-growing machines installed (Davis, 2003). In the near future, Gemesis could be producing as much as 30,000 to 40,000 stones each year, and annual revenues may hit $70 million to $80 million (Diamond Registry Bulletin, 2001). Gemesis diamonds became available for retail purchase in jewelry stores and on the Internet in the fall of 2003. The prices of the Gemesis laboratory-created diamonds will be below those of natural diamond but still above the prices of simulated diamond (Weldon, 2003§).

A second U.S. company, Apollo Diamond, Inc., has developed and patented a method for growing gem-quality diamond by chemical vapor deposition (CVD). The CVD technique transforms carbon into plasma, which then is precipitated onto a substrate as diamond. CVD has been used for more that a decade to cover large surfaces with microscopic diamond crystals, but until this process, no one had discovered the combination of temperature, gas composition, and pressure that resulted in the growth of a single diamond crystal. Robert Linares of Apollo Diamond received a patent for the process in June 2003. Now CVD diamond can be grown for about $5 per carat. CVD diamond precipitates as nearly 100% pure, almost flawless diamond, and therefore may not be discernible from natural diamond. Apollo Diamond is planning to start selling their diamonds in the jewelry market during 2004 (Davis, 2003).

In 2003, a North Carolina firm entered its sixth year of marketing moissanite, a gem-quality laboratory-created silicon carbide it produces. Moissanite is also an excellent diamond simulant, but it is being marketed for its own gem qualities.

Consumption

Although the United States accounts for little of the total global gemstone production, it is the world's leading gemstone market. U.S. gemstone markets accounted for more than an estimated 35% of world gemstone demand in 2003. The U.S. market for unset gem-quality diamond during the year was estimated to have exceeded $12.9 billion. Domestic markets for natural, unset nondiamond gemstones totaled nearly $816 million.

In the United States about two-thirds of domestic consumers designate diamond as their favorite gemstone when surveyed. In 2003, the top 10 selling colored gemstones, in descending order,

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

were blue sapphire, ruby, tanzanite, emerald, amethyst, blue topaz, tsavorite garnet, aquamarine, opal, and green tourmaline. Only 25% of the jewelry retailers said their sales were down in 2003 compared with 27% in 2002. During 2003, almost 50% of the retail gemstone jewelry purchases were in the under $500 price range. Sixty-six percent of U.S. jewelry retailers said their customers show a lack of concern about political issues, such as human-rights violations or possible criminal connections with gemstone mining. Eighty-two percent of the retailers said that news reports on such issues did not have an impact on their jewelry sales (Prost, 2003; Wade, 2004). During the 2003 holiday season, overall U.S. retail sales increased by 5.2% compared with the previous year (by value). Jewelers and luxury retailers generally posted higher increases than the overall sales increases compared with sales of the 2002 holiday shopping season (Diamond Registry Bulletin, 2004a). In 2003, the value of the U.S. diamond jewelry market increased by 6% from that of 2002 to $29.1 billion (Diamond Registry Bulletin, 2004g). The U.S. market accounted for about 56% of the global diamond jewelry retail market in 2003 (Rosen, 2004§).

Prices

Gemstone prices are governed by many factors and qualitative characteristics, including beauty, clarity, defects, demand, durability, and rarity. Diamond pricing, in particular, is complex; values can vary significantly depending on time, place, and the subjective evaluations of buyers and sellers. There are more than 14,000 categories used to assess rough diamond and more than 100,000 different combinations of carat, clarity, color, and cut values used to assess polished diamond (Pearson, 1998).

Colored gemstone prices are generally influenced by market supply and demand considerations, and diamond prices are supported by producer controls on the quantity and quality of supply. Values and prices of gemstones produced and/or sold in the United States are listed in tables 3 through 5. In addition, customs values for diamonds and other gemstones imported, exported, or reexported are listed in tables 6 through 10.

De Beers Group companies are a significant force affecting gem diamond prices worldwide because they mine more than 40% of the diamonds produced each year (De Beers Group, 2004§). De Beers companies also sort and valuate about two-thirds (by value) of the world's annual supply of rough diamonds through De Beers' subsidiary Diamond Trading Co. (DTC), which has marketing agreements with other producers (De Beers Group, 2003§).

Foreign Trade

During 2003, total U.S. gemstone trade with all countries and territories was valued at about $18.7 billion, which was approximately 8% more than gemstone trade of the previous year. Diamond accounted for about 96% of the 2003 gemstone trade total. In 2003, U.S. exports and reexports of diamond were shipped to 74 countries and territories, and imports of all gemstones were received from 114 countries and territories (tables 6-10). During 2003, U.S. trade in cut diamonds increased by about 6% compared with the previous year, and the United States remained the world's leading diamond importer. The United States is a significant international diamond transit center as well as the world's leading gem diamond market. The large volume of reexports shipped to other centers reveals the significance that the United States has in the world's diamond supply network (table 6).

In 2003, trade in laboratory-created gemstone decreased by more than 3% for the United States, compared with the previous year. Laboratory-created gemstone imports from China, Germany, Hong Kong, Sri Lanka, Switzerland, and Thailand made up almost 90% (by value) of the total domestic imports of laboratory-created gemstones during the year. Prices of certain laboratory-created gemstone imports, such as amethyst, were very competitive. The marketing of imported laboratory-created gemstones and enhanced gemstones as natural gemstones and the mixing of laboratory-created materials with natural stones in imported parcels continued to be problems for some domestic producers in 2003. There also were problems with some simulants being marketed as laboratory-created gemstones during the year.

World Industry Structure

The gemstone industry worldwide has two distinct sectors—diamond mining and marketing and the production and sale of colored gemstones. Most diamond supplies are controlled by a few major mining companies; prices are supported by managing the quality and quantity of the gemstones relative to demand, a function performed by De Beers through DTC. Unlike diamonds, colored gemstones are primarily produced at relatively small, low-cost operations with few dominant producers; prices are influenced by consumer demand and supply availability.

In 2003, world diamond production totaled about 150 million carats—80.9 million carats gem quality and 69.5 million carats industrial grade (table 11). Most production was concentrated in a few regions—Africa [Angola, Botswana, Congo (Kinshasa), Namibia, and South Africa], Asia (northeastern Siberia and Yakutia in Russia), Australia, North America (Northwest Territories in Canada), and South America (Brazil and Venezuela). In 2002, Australia led the world in total diamond output quantity (combined gemstone and industrial), and Botswana was the world's leading gemstone diamond producer in terms of output value and quantity.

De Beers reported that its sales of rough diamonds for 2003 were $5.5 billion, which was up by 7% from $5.15 billion in 2002 (Diamond Registry Bulletin, 2004e).

The Antwerp [Belgium] High Council's Hoge Raad voor Diamant Diamond Office reported that polished diamond exports increased by 11.9% to $7.19 billion during 2003, compared to $6.42 billion in 2002. Israel's polished diamond exports increased by 5.9% to $5.53 billion during 2003, and its exports of rough diamond increased by 37.8% to $2.29 billion. The United States was the leading diamond trading partner for both Belgium and Israel (Diamond Registry Bulletin, 2004b).

Additional events in 2003 significant to diamond mining, production, and marketing worldwide include the following:

The Ekati Diamond Mine, Canada's first operating commercial diamond mine, completed its fifth full year of

production. In 2003, Ekati produced 5.57 million carats of diamond from 4.46 Mt of ore (BHP Billiton Ltd., 2004b). BHP Billiton Ltd. has an 80% controlling ownership of the Ekati, which is located in the Northwest Territories in Canada. Ekati has estimated reserves of 60.3 Mt of ore in kimberlite pipes that contain 54.3 million carats of diamond, and Ekati projects the mine life to be 25 years. Ekati diamonds are sold by BHP's Antwerp sales office. The Ekati Mine is now producing from the Koala, Panda, and Misery kimberlite pipes. In November 2002, BHP began using underground mining techniques to recover diamonds from deeper portions of the Koala kimberlite pipe, which was first open pit mined (Diamond Registry Bulletin, 2002). Plans have now been approved for underground mining of deeper portions of the adjacent Panda kimberlite pipe, and initial production is expected in early 2005 (BHP Billiton Ltd., 2004a).

The Diavik Diamond Mine, also in the Northwest Territories, has estimated its reserves to be 25.6 Mt of ore in kimberlite pipes, containing 107 million carats of diamond, and Diavik projects the mine life to be 16 to 22 years. Diavik is an unincorporated joint venture between Diavik Diamond Mines Inc. (60%) and Aber Diamond Mines Ltd. (40%). The Diavik Mine began diamond production in December 2002, and it achieved full production by February 2003—60 days ahead of the projected opening date (Professional Jeweler, 2002§). In 2003, Diavik produced 3.8 million carats of diamond from 1.3 Mt of ore. The mine is expected to produce about 107 million carats of diamond at a rate of 8 million carats per year worth about $63 per carat (Diavik Diamond Mines Inc., 2000, p. 10-12; 2004).

A third Canadian commercial diamond project in the Northwest Territories is the Snap Lake diamond project. De Beers Canada Mining Inc. has projected that Snap Lake would begin production in 2006 or 2007 (Law-West, 2002). The Snap Lake diamond project estimates its reserves to be 22.8 Mt of ore in a kimberlite dike that contain about 38.8 million carats of diamond. The mine life is projected to be 20 years or more (Jack T. Haynes, assistant site manager, De Beers Canada Mining Inc., oral commun., 2001).

In 2002, an international rough diamond certification system called the Kimberley Process Certification Scheme (KPCS) was implemented to solve the problem of conflict diamonds—rough diamonds used by rebel forces and their allies to help finance warfare aimed at subverting governments recognized as legitimate by the United Nations (U.N.). The KPCS was agreed upon by U.N. member nations, the diamond industry, and involved nongovernmental organizations. The KPCS includes the following key elements: the use of forgery-resistant certificates and tamper-proof containers for shipments of rough diamonds; internal controls and procedures that provide credible assurance that conflict diamonds do not enter the legitimate diamond market; a certification process for all exports of rough diamonds; the gathering, organizing, and sharing of import and export data on rough diamonds with other participants of relevant production; credible monitoring and oversight of the international certification scheme for rough diamonds; effective enforcement of the provisions of the certification scheme through dissuasive and proportional penalties for violations; self-regulation by the diamond industry that fulfills minimum requirements; and the sharing of information with all other participants on relevant rules, procedures, and legislation as well as examples of national certificates used to accompany shipments of rough diamonds (Weldon, 2001§). The KPCS will not be fully implemented until all participating countries have passed the necessary laws to carry it out.

In the United States, the Clean Diamond Trade Act, which will implement effective measures to stop trade in conflict diamonds, was passed by the U.S. House of Representatives on November 28, 2001, and by the U.S. Senate on January 7, 2003. The President signed the Act into law on April 25, 2003. Enactment of the Clean Diamond Trade Act made the United States a full participant in the KPCS (U.S. House of Representatives, 2003§). U.S. participation is critical to the success of the KPCS in excluding conflict diamonds from the legitimate supply chain because the United States has the largest part of the world diamond market. The industry and trade associations have played an active role in achieving this progress in ending the problem of conflict diamonds (Professional Jeweler, 2003§).

Near the end of 2003, De Beers and the U.S. Department of Justice began work toward settlement of its long-running dispute over alleged illegal price fixing. On July 13, 2004, De Beers Centenery AG pled guilty in Federal court in Ohio to conspiring to fix the price of industrial diamond in the United States and elsewhere, resolving a 1994 case. De Beers was sentenced to pay a $10 million fine. With this settlement, De Beers is now free to enter the U.S. market (Diamond Registry Bulletin, 2004f, h).

Worldwide production of natural gemstones other than diamond was estimated to have exceeded $2 billion in 2003. Most nondiamond gemstone mines are small, low-cost, and widely dispersed operations in remote regions of developing nations. Foreign countries with major gemstone deposits other than diamond are Afghanistan (aquamarine, beryl, emerald, kunzite, lapis lazuli, ruby, and tourmaline), Australia (beryl, opal, and sapphire), Brazil (agate, amethyst, beryl, ruby, sapphire, topaz, and tourmaline), Burma (beryl, jade, ruby, sapphire, and topaz), Colombia (beryl, emerald, and sapphire), Kenya (beryl, garnet, and sapphire), Madagascar (beryl, rose quartz, sapphire, and tourmaline), Mexico (agate, opal, and topaz), Sri Lanka (beryl, ruby, sapphire, and topaz), Tanzania (garnet, ruby, sapphire, tanzanite, and tourmaline), and Zambia (amethyst and beryl). In addition, pearls are cultured throughout the South Pacific and in other equatorial waters; Australia, China, French Polynesia, and Japan are key producers.

The U.S. colored gemstone market posted an overall increased sales during 2003 compared with the previous years sales. There were 3 months in which colored stone trade contracted—March, April, and November. Colored stone sales in April were at their lowest level since November 2001, as the general slowdown in business finally was reflected in the wholesale end of colored stone trade (Colored Stone, 2003, 2004a, b).

The popularity of colored gemstones, colored laboratory-created gemstones, and "fancy" colored diamonds continued to increase in 2003. This was indicated by a recent survey by the Jewelry Consumer Opinion Council (Diamond Registry Bulletin, 2004d). Colored stone popularity also was evidenced by their general increased sales in 2003 (Colored Stone, 2003, 2004a, b).

Tanzanite continued to increased in popularity, moving up to third best selling stone in 2003 from fourth best selling colored stone in 2002. This increase is in part owing to the American Gem Trade Association (a United States and Canadian trade association) adding tanzanite to the traditional list of birthstones for December in 2002. It is by far the most popular of blue and violet-blue gemstones after sapphire. Tanzanite is characterized by combinations of royal blue and burgundy hues, which have an almost universal appeal. While some tanzanite displays a trace of blue when it is originally mined, most crystals emerge from the Earth with a muted gray-green color. All tanzanite has been subjected to a heat process to produce the violet-blue hues. The only known source of tanzanite is a 5-square-mile area in the hills of Merelani, 10 miles south of the Kilimanjaro International Airport, between Moshi and Arusha in Tanzania. Its rarity appears to also add to tanzanite's growing popularity among consumers.

Though U.S. shell production increased by 72% in 2003 compared with 2002, shell is not expected to ever be the large segment of U.S. gemstone production it was for several years in the past. The U.S. shell material from mussels is used as seed material for culturing pearls. The lower shell production is owing to overharvesting in past years, the killing off of U.S. native mussel species by invasive exotic species, and a decline in market demand. During the past 10 years, the United States has lost about three-quarters of the native mussel population, and one-half of the approximately 300 total U.S. native mussel species are now listed as endangered species. The zebra mussel is the invasive exotic species that has done most of the damage, and it has been introduced into U.S. rivers and waterways in discharged ballast water from transoceanic ships (Iowa Department of Natural Resources, 2001§; Scott Gritterf, fisheries biologist, Iowa Department of Natural Resources, oral commun., November 14, 2002). The market still has not completely recovered from the die-off of Japanese oysters. Seed material had been stockpiled in Japan, and now producers in Japan are using manmade seed materials or seed materials from China and other sources in addition to the stockpiled material. There also has been an increase in the popularity of darker and colored pearls that do not use U.S. seed material (Ted Kroll, assistant director of fisheries, Kentucky Department of Fish and Wildlife, oral commun., November 15, 2002).

Outlook

There are indications that there will be continued growth in U.S. diamond and jewelry markets in 2004. Historically, diamonds have proven to hold their value despite wars or economic depressions (Schumann, 1998, p. 8).

Diamond exploration is continuing in Canada, and many new deposits have been found. There are several other commercial diamond projects and additional discoveries located in Alberta, British Columbia, Northwest Territories, Nunavut, Ontario, and Quebec. Canada produced about 15% of the world's diamond in 2003, and in price per carat of diamond produced, Canada outranked many of the world's traditionally major diamond-mining countries (Diamond Registry Bulletin, 2004c). If Canadian production continues to increase at about the same rate, Canada will probably eclipse South Africa's diamond production within a decade.

Independent producers, such as Argyle Diamond Mines in Australia and Ekati and Diavik in Canada, will continue to bring a greater measure of competition to global markets. More competition presumably will bring more supplies and lower prices. Further consolidation of diamond producers and larger amounts of rough diamond being sold outside DTC will continue as the diamond industry adjusts to De Beers' reduced influence on the industry.

More laboratory-created gemstones, simulants, and treated gemstones will enter the marketplace and necessitate more transparent trade industry standards to maintain customer confidence.

Internet sales of diamonds, gemstones, and jewelry will continue to grow and increase in popularity, as will other forms of e-commerce that emerge to serve the diamond and gemstone industry. This will take place as the gemstone industry and its customers become more comfortable with and learn the applications of new e-commerce tools (Diamond Registry Bulletin, 2004i, j).

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TABLE 1
GUIDE TO SELECTED GEMSTONES AND GEM MATERIALS USED IN JEWELRY

Name	Composition	Color	Practical size[1]	Cost[2]	Mohs	Specific gravity	Refraction	Refractive index	May be confused with	Recognition characteristics
Amber	Hydrocarbon	Yellow, red, green, blue	Any	Low to medium	2.0-2.5	1.0-1.1	Single	1.54	Synthetic or pressed plastics, kaurigum	Fossil resin, color, low density, soft and trapped insects.
Apatite	Chloro-calcium phosphate	Colorless, pink, yellow, green, blue, violet	Small	Low	5.0	3.16-3.23	Double	1.63-1.65	Amblygonite, andalusite, brazilianite, precious beryl, titanite, topaz, tourmaline	Crystal habit, color, hardness, and appearance.
Azurite	Copper carbonate hydroxide	Azure, dark blue, pale blue	Small to medium	do.	3.5-4.0	3.7-3.9	do.	1.72-1.85	Dumortierite, hauynite, lapis lazuli, lazulite, sodalite	Color, softness, crystal habits and associated minerals.
Benitoite	Barium titanium silicate	Blue, purple, pink, colorless	do.	High	6.0-6.5	3.64-3.68	do.	1.76-1.80	Sapphire, tanzanite, blue diamond, blue tourmaline, cordierite	Strong blue in ultraviolet light.
Beryl:										
Aquamarine	Beryllium aluminum silicate	Blue-green to light blue	Any	Medium to high	7.5-8.0	2.63-2.80	do.	1.58	Synthetic spinel, blue topaz	Double refraction, refractive index.
Bixbite	do.	Red	Small	Very high	7.5-8.0	2.63-2.80	do.	1.58	Pressed plastics, tourmaline	Refractive index.
Emerald	do.	Green	Medium	do.	7.5	2.63-2.80	do.	1.58	Fused emerald, glass, tourmaline, peridot, green garnet doublets	Emerald filter, dichroism, refractive index.
Emerald, synthetic	do.	do.	Small	High	7.5-8.0	2.63-2.80	do.	1.58	Genuine emerald	Lack of flaws, brilliant fluorescence in ultraviolet light.
Golden (heliodor)	do.	Yellow to golden	Any	Low to medium	7.5-8.0	2.63-2.80	do.	1.58	Citrine, topaz, glass, doublets	Weak-colored.
Goshenite	do.	Colorless	do.	Low	7.5-8.0	2.63-2.80	do.	1.58	Quartz, glass, white sapphire, white topaz	Refractive index.
Morganite	do.	Pink to rose	do.	do.	7.5-8.0	2.63-2.80	do.	1.58	Kunzite, tourmaline, pink sapphire	Do.
Calcite:										
Marble	Calcium carbonate	White, pink, red, blue, green, or brown	do.	do.	3.0	2.72	Double (strong)	1.49-1.66	Silicates, banded agate, alabaster gypsum	Translucent.
Mexican onyx	do.	do.	do.	do.	3.0	2.72	do.	1.60	do.	Banded, translucent.
Charoite	Hydrated sodium calcium hydroxi-fluoro-silicate	Lilac, violet, or white	Small to medium	do.	5.0-6.0	2.54-2.78	XX	1.55-1.56	Purple marble	Color, locality.
Chrysoberyl:										
Alexandrite	Beryllium aluminate	Green by day light, red by artificial light	Small (CIS[3]); medium (Sri Lanka)	High	8.5	3.50-3.84	Double	1.75	Synthetic	Strong dichroism, color varies from red to green, hardness.
Cats-eye	do.	Greenish to brownish	Small to large	do.	8.5	3.50-3.84	do.	1.75	Synthetic, shell	Density, translucence, chatoyance.
Chrysolite	Beryllium aluminate	Yellow, green, and/or brown	Medium	Medium	8.5	3.50-3.84	Double	1.75	Tourmaline, peridot	Refractive index, silky.

See footnotes at end of table.

TABLE 1--Continued
GUIDE TO SELECTED GEMSTONES AND GEM MATERIALS USED IN JEWELRY

Name	Composition	Color	Practical size[1]	Cost[2]	Mohs	Specific gravity	Refraction	Refractive index	May be confused with	Recognition characteristics
Chrysocolla	Hydrated copper silicate	Green, blue	Any	Low	2.0-4.0	2.0-2.4	XX	1.46-1.57	Azurite, dyed chalcedony, malachite, turquoise, variscite	Lack of crystals, color, fracture, low density and softness.
Coral	Calcium carbonate	Orange, red, white, black, purple, or green	Branching, medium	do.	3.5-4.0	2.6-2.7	Double	1.49-1.66	False coral	Dull translucent.
Corundum:										
Ruby	Aluminum oxide	Rose to deep purplish red	Small	Very high	9.0	3.95-4.10	do.	1.78	Synthetics, including spinel, garnet	Inclusions, fluorescence.
Sapphire, blue	do.	Blue	Medium	High	9.0	3.95-4.10	do.	1.78	do.	Inclusions, double refraction, dichroism.
Sapphire, fancy	do.	Yellow, pink, colorless, orange, green, or violet	Medium to large	Medium	9.0	3.95-4.10	do.	1.78	Synthetics, glass and doublets, morganite	Inclusions, double refraction, refractive index.
Sapphire and ruby, stars	do.	Red, pink, violet, blue, or gray	do.	High to low	9.0	3.95-4.10	do.	1.78	Star quartz, synthetic stars	Shows asterism, color side view.
Sapphire or ruby, synthetic	do.	Yellow, pink, or blue	Up to 20 carats	Low	9.0	3.95-4.10	do.	1.78	Synthetic spinel, glass	Curved striae, bubble inclusions.
Cubic zirconia	Zirconium and yttrium oxides	Colorless, pink, blue, lavender, yellow	Small	do.	8.25-8.5	5.8	Single	2.17	Diamond, zircon, titania, moissanite	Hardness, density, refractive index, lack of flaws and inclusions.
Diamond	Carbon	White, blue-white, yellow, brown, green, red, pink, blue	Any	Very high	10.0	3.516-3.525	do.	2.42	Zircon, titania, cubic zirconia, moissanite	High index, dispersion, hardness, luster.
Feldspar:										
Amazonite	Alkali aluminum silicate	Green-blue	Large	Low	6.0-6.5	2.56	XX	1.52	Jade, turquoise	Cleavage, sheen, vitreous to pearly, opaque, grid.
Labradorite	do.	Gray with blue and bronze sheen color play (schiller)	do.	do.	6.0-6.5	2.56	XX	1.56	do.	Do.
Moonstone	do.	Colorless, white, gray, or yellow with white, blue, or bronze schiller	do.	do.	6.0-6.5	2.77	XX	1.52-1.54	Glass, chalcedony, opal	Pale sheen, opalescent.
Sunstone	do.	Orange, red brown, colorless with gold or red glittery schiller	Small to medium	do.	6.0-6.5	2.77	XX	1.53-1.55	Aventurine, glass	Red glittery schiller.
Garnet	Complex silicate	Brown, black, yellow, green, red, or orange	do.	Low to high	6.5-7.5	3.15-4.30	Single strained	1.79-1.98	Synthetics, spinel, glass	Single refraction, anomalous strain.
Hematite	Iron oxide	Black, black-gray, brown-red	Medium to large	Low	5.5-6.5	5.12-5.28	XX	2.94-3.22	Davidite, cassiterite, magnetite, neptunite, pyrolusite, wolframite	Crystal habit, streak and hardness.
Jade:										
Jadeite	Complex silicate	Green, yellow, black, white, or mauve	Large	Low to very high	6.5-7.0	3.3-3.5	Crypto-crystalline	1.65-1.68	Nephrite, chalcedony, onyx, bowenite, vesuvianite, grossularite	Luster, spectrum, translucent to opaque.

See footnotes at end of table.

TABLE 1--Continued
GUIDE TO SELECTED GEMSTONES AND GEM MATERIALS USED IN JEWELRY

Name	Composition	Color	Practical size[1]	Cost[2]	Mohs	Specific gravity	Refraction	Refractive index	May be confused with	Recognition characteristics
Jade--Continued:										
Nephrite	Complex hydrous silicate	Green, yellow, black, white, or mauve	Large	Low to very high	6.0-6.5	2.96-3.10	Crypto-crystalline	1.61-1.63	Jadeite, chalcedony, onyx, bowenite, vesuvianite, grossularite	Luster, spectrum, translucent to opaque.
Jet (gagate)	Lignite	Deep black, dark brown	do.	Low	2.5-4.0	1.19-1.35	XX	1.64-1.68	Anthracite, asphalt, cannel coal, onyx, schorl, glass, rubber	Luster, color.
Lapis lazuli	Sodium calcium aluminum silicate	Dark azure-blue to bright indigo blue or even a pale sky blue.	do.	do.	5.0-6.0	2.50-3.0	XX	1.50	Azurite, dumortierite, dyed howlite, lazulite, sodalite, glass	Color, crystal habit, associated minerals, luster, and localities.
Malachite	Hydrated copper carbonate	Light to black-green banded	do.	do.	3.5-4.0	3.25-4.10	XX	1.66-1.91	Brochantite, chrysoprase, opaque green gemstones	Color banding, softness, associated minerals.
Moissanite	Silicon carbide	Colorless and pale shades of green, blue, yellow	Small	Low to medium	9.25	3.21	Double	2.65-2.69	Diamond, zircon, titania, cubic zirconia	Hardness, dispersion, refractive index, lack of flaws and inclusions.
Obsidian	Amorphous, variable (usually felsic)	Black, gray, brown, dark green, white, transparent	Large	Low	5.0-5.5	2.35-2.60	XX	1.45-1.55	Aegirine-augite, gadolinite gagate, hematite, pyrolusite, wolframite	Color, conchoidal fracture, flow bubbles, softness, and lack of crystal faces.
Opal	Hydrated silica	Reddish orange, colors flash in white gray, black, red, or yellow	do.	Low to high	5.5-6.5	1.9-2.3	Single	1.45	Glass, synthetics, triplets, chalcedony	Color play (opalescence).
Peridot	Iron magnesium silicate	Yellow and/or green	Any	Medium	6.5-7.0	3.27-3.37	Double (strong)	1.65-1.69	Tourmaline, chrysoberyl	Strong double refraction, low dichroism.
Quartz:										
Agate	Silicon dioxide	Any	Large	Low	7.0	2.58-2.64	XX	XX	Glass, plastic, Mexican onyx	Cryptocrystalline, irregularly banded, dendritic inclusions.
Amethyst	do.	Purple	do.	Medium	7.0	2.65-2.66	Double	1.55	Glass, plastic, fluorite	Macrocrystalline, refractive index, color, transparent, hardness.
Aventurine	do.	Green, red-brown, gold-brown, with metallic iridescent reflection	do.	Low	7.0	2.64-2.69	do.	1.54-1.55	Iridescent analcime, aventurine feldspar, emerald, aventurine glass	Macrocrystalline, color, metallic iridescent flake reflections, hardness.
Cairngorm	do.	Smoky orange or yellow	do.	do.	7.0	2.65-2.66	do.	1.55	do.	Macrocrystalline, refractive index, color, transparent, hardness.
Carnelian	do.	Flesh red to brown red	do.	do.	6.5-7.0	2.58-2.64	do.	1.53-1.54	Jasper	Cryptocrystalline, color, hardness.
Chalcedony	do.	Bluish, white, gray	do.	do.	6.5-7.0	2.58-2.64	do.	1.53-1.54	Tanzanite	Do.
Chrysoprase	do.	Green, apple-green	do.	do.	6.5-7.0	2.58-2.64	do.	1.53-1.54	Chrome chalcedony, jade, prase opal, prehnite, smithsonite, variscite, artifically colored green chalcedony	Do.
Citrine	Silica	Yellow	do.	do.	7.0	2.65-2.66	do.	1.55	do.	Macrocrystalline, refractive index, color, transparent, hardness.
Crystal:										
Rock	do.	Colorless	do.	do.	7.0	2.65-2.66	do.	1.55	Topaz, colorless sapphire	Do.

See footnotes at end of table.

TABLE 1--Continued
GUIDE TO SELECTED GEMSTONES AND GEM MATERIALS USED IN JEWELRY

Name	Composition	Color	Practical size[1]	Cost[2]	Mohs	Specific gravity	Refraction	Refractive index	May be confused with	Recognition characteristics
Crystal--Continued:										
Jasper	Silica	Any, striped, spotted, or sometimes uniform	Large	Low	7.0	2.58-2.66	XX	XX	Topaz, colorless sapphire	Cryptocrystalline, opaque, vitreous luster, hardness.
Onyx	do.	Many colors	do.	do.	7.0	2.58-2.64	XX	XX	do.	Cryptocrystalline, uniformly banded, hardness.
Petrified wood	do.	Brown, gray, red, yellow	do.	do.	6.5-7.0	2.58-2.91	Double	1.54	Agate, jasper	Color, hardness, wood grain.
Rose	do.	Pink, rose red	do.	do.	7.0	2.65-2.66	do.	1.55	do.	Macrocrystalline, refractive index, color, transparent, hardness.
Tiger's eye	do.	Golden yellow, brown, red, blue-black	do.	do.	6.5-7.0	2.58-2.64	XX	1.53-1.54	XX	Macrocrystalline, color, hardness, hatoyancy.
Rhodochrosite	Manganese carbonate	Rose-red to yellowish, stripped	do.	do.	4.0	3.45-3.7	Double	1.6-1.82	Fire opal, rhodonite, tugtupite, tourmaline	Color, crystal habit, reaction to acid, and perfect rhombohedral cleavage.
Rhodonite	Manganese iron calcium silicate	Dark red, flesh red, with dendritic inclusions of black manganese oxide	do.	do.	5.5-6.5	3.40-3.74	do.	1.72-1.75	Rhodochrosite, thulite, hessonite, pyroxmangite, spessartine, spinel, tourmaline	Color, black inclusions, lack of reaction to acid and hardness.
Shell:										
Mother-of-pearl	Calcium carbonate	White, cream, green, blue-green, with iridescent play of color	Small	Low	3.5	2.6-2.85	XX	XX	Glass and plastic imitation	Luster, iridescent play of color.
Pearl	do.	White, cream to black, sometimes with hint of pink, green, purple	do.	Low to high	2.5-4.5	2.6-2.85	XX	XX	Cultured and glass or plastic imitation	Luster, iridescence, structure, x-ray.
Spinel	Magnesium aluminum oxide	Any	Small to medium	Medium	8.0	3.5-3.7	Single	1.72	Synthetic, garnet	Refractive index, single refraction, inclusions.
Spinel, synthetic	do.	do.	Up to 40 carats	Low	8.0	3.5-3.7	Double	1.73	Spinel, corundum, beryl, topaz, alexandrite	Weak double refraction, curved striae, bubbles.
Spodumene:										
Hiddenite	Lithium aluminum silicate	Yellow to green	Medium	Medium	6.5-7.0	3.13-3.20	do.	1.66	Synthetic spinel	Refractive index, color, pleochroism.
Kunzite	do.	Pink to lilac	do.	do.	6.5-7.0	3.13-3.20	do.	1.66	Amethyst, morganite	Do.
Tanzanite	Complex silicate	Blue to lavender	Small	High	6.0-7.0	3.30	do.	1.69	Sapphire, synthetics	Strong trichroism, color.
Topaz	do.	White, blue, green, pink, yellow, gold	Medium	Low to medium	8.0	3.4-3.6	do.	1.62	Beryl, quartz	Color, density, hardness, refractive index, perfect in basal cleavage.
Tourmaline	do.	Any, including mixed	do.	do.	7.0-7.5	2.98-3.20	do.	1.63	Peridot, beryl, garnet corundum, glass	Double refraction, color, refractive index.
Turquoise	Copper aluminum phosphate	Blue to green with black, brown-red inclusions	Large	Low	6.0	2.60-2.83	do.	1.63	Glass, plastics, variscite, dumortierite, chrysocolla dyed howlite	Difficult if matrix not present, matrix usually limonitic.
Unakite	Granitic rock, feldspar, epidote, quartz	Olive green, pink, and blue-gray	do.	do.	6.0-7.0	2.60-3.20	XX	XX	XX	Olive green, pink, and gray-blue colors.

See footnotes at end of table.

TABLE 1--Continued
GUIDE TO SELECTED GEMSTONES AND GEM MATERIALS USED IN JEWELRY

Name	Composition	Color	Practical size[1]	Cost[2]	Mohs	Specific gravity	Refraction	Refractive index	May be confused with	Recognition characteristics
Zircon	Zirconium silicate	White, blue, brown, yellow, or green	Small to medium	Low to medium	6.0-7.5	4.0-4.8	Double (strong)	1.79-1.98	Diamond, synthetics, topaz, aquamarine	Double refraction, strongly dichroic, wear on facet edges.

XX Not applicable.

[1]Small: up to 5 carats; medium: 5 to 50 carats; large: more than 50 carats.

[2]Low: up to $25 per carat; medium: up to $200 per carat; high: more than $200 per carat.

[3]Commonwealth of Independent States.

TABLE 2
LABORATORY-CREATED GEMSTONE PRODUCTION METHODS

Gemstone	Production method	Company/producer	Date of first production
Alexandrite	Flux	Creative Crystals	1970s.
Do.	Melt pulling	J.O. Crystal	1990s.
Do.	do.	Kyocera	1980s.
Do.	Zone melt	Seiko	1980s.
Cubic zirconia	Skull melt	Various producers	1970s.
Emerald	Flux	Chatham	1930s.
Do.	do.	Gilson	1960s.
Do.	do.	Kyocera	1970s.
Do.	do.	Seiko	1980s.
Do.	do.	Lennix	1980s.
Do.	do.	Russia	1980s.
Do.	Hydrothermal	Lechleitner	1960s.
Do.	do.	Regency	1980s.
Do.	do.	Biron	1980s.
Do.	do.	Russia	1980s.
Ruby	Flux	Chatham	1950s.
Do.	do.	Kashan	1960s.
Do.	do.	J.O. Crystal	1980s.
Do.	do.	Douras	1990s.
Do.	Zone melt	Seiko	1980s.
Do.	Melt pulling	Kyocera	1970s.
Do.	Verneuil	Various producers	1900s.
Sapphire	Flux	Chatham	1970s.
Do.	Zone melt	Seiko	1980s.
Do.	Melt pulling	Kyocera	1980s.
Do.	Verneuil	Various producers	1900s.
Star ruby	do.	Linde	1940s.
Do.	Melt pulling	Kyocera	1980s.
Do.	do.	Nakazumi	1980s.
Star sapphire	Verneuil	Linde	1940s.

TABLE 3
VALUE OF U.S. GEMSTONE PRODUCTION, BY TYPE[1]

(Thousand dollars)

Gem materials	2002	2003
Beryl	9	18
Coral, all types	108	118
Diamond	(2)	(2)
Garnet	46	56
Gem feldspar	379 [e]	659
Geode/nodules	(3)	(3)
Opal	(3)	(3)
Quartz:		
Macrocrystalline[4]	246	228
Cryptocrystalline[5]	84	391
Sapphire/ruby	212	474
Shell	1,440	2,490
Topaz	(3)	(3)
Tourmaline	105	48
Turquoise	540	827
Other	8,420	3,450
Total	12,600	12,500

See footnotes at end of table.

TABLE 3--Continued
VALUE OF U.S. GEMSTONE PRODUCTION, BY TYPE[1]

[e]Estimated.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Included with "Other."
[3]Included in "Total."
[4]Macrocrystalline quartz (crystals recognizable with the naked eye) includes amethyst, amethyst quartz, aventurine, blue quartz, citrine, hawk's eye, pasiolite, prase, quartz cat's eye, rock crystal, rose quartz, smoky quartz, and tiger's eye.
[5]Cryptocrystalline (microscopically small crystals) includes agate, carnelian, chalcedony, chrysoprase, fossilized wood, heliotrope, jasper, moss agate, onyx, and sard.

TABLE 4
PRICES OF U.S. CUT DIAMONDS, BY SIZE AND QUALITY IN 2003[1]

Carat weight	Description, color[3]	Clarity[2] (GIA terms)	Representative prices		
			January[4]	June[5]	December[6]
0.25	G	VS1	$1,200	$1,200	$1,200
do.	G	VS2	1,150	1,150	1,150
do.	G	SI1	975	975	975
do.	H	VS1	1,100	1,100	1,100
do.	H	VS2	1,000	1,000	1,000
do.	H	SI1	925	925	925
0.50	G	VS1	3,200	3,200	3,200
do.	G	VS2	2,800	2,800	2,800
do.	G	SI1	2,400	2,400	2,400
do.	H	VS1	2,800	2,800	2,800
do.	H	VS2	2,400	2,400	2,400
do.	H	SI1	2,200	2,200	2,200
0.75	G	VS1	3,600	3,600	3,600
do.	G	VS2	3,500	3,500	3,500
do.	G	SI1	3,200	3,200	3,200
do.	H	VS1	3,300	3,300	3,300
do.	H	VS2	3,200	3,200	3,200
do.	H	SI1	2,900	2,900	2,900
1.00	G	VS1	5,800	5,800	5,800
do.	G	VS2	5,500	5,500	5,500
do.	G	SI1	4,800	4,800	4,800
do.	H	VS1	5,200	5,200	5,200
do.	H	VS2	4,900	4,900	4,900
do.	H	SI1	4,700	4,700	4,700

[1]Data are rounded to no more than three significant digits.
[2]Gemological Institute of America (GIA) color grades: D—colorless; E—rare white; G, H, I—traces of color.
[3]Clarity: IF—no blemishes; VVS1—very, very slightly included; VS1—very slightly included; VS2—very slightly included, but not visible; SI1—slightly included.
[4]Source: Jewelers' Circular Keystone, v. 174, no. 2, February 2003, p. 44.
[5]Source: Jewelers' Circular Keystone, v. 174, no. 7, July 2003, p. 52.
[6]Source: Jewelers' Circular Keystone, v. 175, no. 1, January 2004, p. 28.

TABLE 5
PRICES PER CARAT OF U.S. CUT COLORED GEMSTONES IN 2003

Gemstone	Price range per carat	
	January[1]	December[2]
Amethyst	$7-14	$7-14
Blue sapphire	650-1,000	650-1,000
Blue topaz	3-5	3-5
Emerald	1,500-2,000	1,400-2,000
Green tourmaline	70-150	45-60
Pearl:[3]		
Cultured saltwater	5	5
Natural	210	210

See footnotes at end of table.

TABLE 5--Continued
PRICES PER CARAT OF U.S. CUT COLORED GEMSTONES IN 2003

Gemstone	Price range per carat	
	January[1]	December[2]
Pink tourmaline	60-125	60-125
Rhodolite garnet	18-30	18-30
Ruby	1,000-1,400	900-1,250
Tanzanite	175-275	175-275

[1]Source: The Guide, spring/summer 2003, p. 14, 30, 45, 61, 72, 86, 96, 98, 104, 123, and 135. These figures are approximate current wholesale purchase prices paid by retail jewelers on a per stone basis for fine-quality stones.
[2]Source: The Guide, fall/winter 2002-2003, p. 14, 30, 45, 61, 72, 86, 96, 98, 104, 123, and 135. These figures are approximate current wholesale purchase prices paid by retail jewelers on a per stone basis for fine-quality stones.
[3]Prices are per 4.6 mm pearl.

TABLE 6
U.S. EXPORTS AND REEXPORTS OF DIAMOND (EXCLUSIVE OF INDUSTRIAL DIAMOND), BY COUNTRY[1]

Country	2002		2003	
	Quantity (carats)	Value[2] (millions)	Quantity (carats)	Value[2] (millions)
Exports:				
Belgium	343,000	$278	14,200	$11
Canada	105,000	41	78,200	47
France	8,760	37	3,150	7
Germany	3,360	3	4,790	4
Guatemala	168,000	17	2,850	(3)
Hong Kong	251,000	89	114,000	59
India	83,100	12	34,900	5
Israel	246,000	477	38,400	39
Japan	13,800	31	17,300	19
Mexico	199,000	43	205,000	32
Netherlands	460	8	307	3
Switzerland	9,570	48	7,360	29
Thailand	28,200	5	34,400	6
United Kingdom	19,000	19	4,080	7
Other	76,500	57	141,000	67
Total	1,550,000	1,160	699,000	335
Reexports:				
Belgium	2,650,000	801	3,860,000	1,270
Canada	109,000	59	124,000	64
Dominican Republic	102,000	9	78,700	12
Hong Kong	2,470,000	381	2,670,000	471
India	1,230,000	157	1,420,000	234
Israel	4,290,000	1,250	5,700,000	1,930
Japan	181,000	35	185,000	46
Malaysia	64,200	6	28,800	5
Mexico	12,900	3	6,980	2
Singapore	158,000	20	204,000	30
Switzerland	382,000	191	409,000	283
Thailand	368,000	55	266,000	55
United Arab Emirates	253,000	71	220,000	57
United Kingdom	364,000	134	397,000	140
Other	117,000	59	207,000	92
Total	12,700,000	3,230	15,800,000	4,690
Grand total	14,300,000	4,400	16,500,000	5,020

[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Customs value.
[3]Less than 1/2 unit.

Source: U.S. Census Bureau.

TABLE 7
U.S. IMPORTS FOR CONSUMPTION OF DIAMOND, BY KIND, WEIGHT, AND COUNTRY[1]

Kind, range, and country of origin	2002 Quantity (carat)	2002 Value[2] (millions)	2003 Quantity (carat)	2003 Value[2] (millions)
Rough or uncut, natural:[3]				
Belgium	17,800	$12	7,160	$4
Botswana	6,350	18	2,850	5
Brazil	20,000	15	65,100	29
Canada	9,900	2	13,700	18
Congo (Brazzaville)	9,630	14	10,400	9
Congo (Kinshasa)	27,800	24	20,400	31
Ghana	3,180	3	7,280	(4)
Guinea	6,850	19	3,760	9
Guyana	54,900	6	173,000	15
Hong Kong	353	(4)	739	1
Israel	5,590	15	53,200	9
Russia	26,700	6	20,000	10
South Africa	436,000	353	582,000	463
United Kingdom	344,000	69	441,000	61
Venezuela	15,100	5	3,230	3
Other	29,600	7	101,000	41
Total	1,010,000	567	1,500,000	707
Cut but unset, not more than 0.5 carat:				
Australia	2,650	1	825	(4)
Belgium	770,000	227	775,000	282
Brazil	7,660	2	5,810	1
Canada	4,960	1	4,900	5
China	70,400	6	73,000	6
Dominican Republic	12,900	1	12,200	1
Hong Kong	403,000	64	374,000	59
India	11,500,000	1,890	10,500,000	1,750
Israel	997,000	454	1,050,000	525
Japan	2,500	1	1,910	1
Mexico	249,000	12	160,000	5
Singapore	4,110	1	2,710	1
Sri Lanka	7,110	2	4,660	1
Switzerland	6,600	2	47,800	8
Thailand	99,600	11	68,200	10
United Arab Emirates	82,300	18	198,000	31
United Kingdom	12,000	4	2,530	2
Other	23,500	7	70,400	18
Total	14,300,000	2,710	13,400,000	2,710
Cut but unset, more than 0.5 carat:				
Belgium	1,280,000	2,060	1,260,000	2,310
Canada	7,520	27	15,800	51
France	2,250	17	3,040	11
Hong Kong	89,800	153	76,500	124
India	1,120,000	742	1,210,000	815
Israel	3,040,000	5,300	3,000,000	5,540
Japan	2,960	7	2,810	7
Mauritius	3,230	7	2,500	5
Russia	45,200	78	58,600	101
South Africa	30,600	127	35,100	149
Switzerland	13,500	101	15,100	158
Thailand	5,140	5	19,400	17
United Arab Emirates	7,520	8	10,200	10
United Kingdom	21,000	100	16,600	95
Other	27,600	67	27,200	59
Total	5,690,000	8,800	5,760,000	9,460

[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Customs value.
[3]Includes some natural advanced diamond.
[4]Less than 1/2 unit.

Source: U.S. Census Bureau.

TABLE 8
U.S. IMPORTS FOR CONSUMPTION OF GEMSTONES, OTHER THAN DIAMOND, BY KIND AND COUNTRY[1]

Kind and country	2002 Quantity (carats)	2002 Value[2] (millions)	2003 Quantity (carats)	2003 Value[2] (millions)
Emerald:				
Australia	10,200	(3)	84	(3)
Belgium	26,800	$1	8,150	$1
Brazil	4,940,000	6	262,000	5
China	18,100	(3)	10,800	(3)
Colombia	683,000	69	522,000	54
Germany	15,200	1	56,900	1
Hong Kong	102,000	4	101,000	5
India	2,100,000	20	1,460,000	21
Israel	97,900	20	128,000	23
Japan	1,090	(3)	552	(3)
Sri Lanka	95	(3)	--	--
Switzerland	75,200	9	27,300	6
Taiwan	33	(3)	--	--
Thailand	538,000	7	419,000	7
United Kingdom	44,500	4	3,890	2
Zambia	408	(3)	214	(3)
Other	18,000	2	18,300	1
Total	8,670,000	143	3,020,000	126
Ruby:				
Belgium	15,000	2	8,330	1
Brazil	301	(3)	13,800	(3)
Burma	11,000	3	354	3
China	45,600	(3)	4,810	(3)
Colombia	--	--	1,250	(3)
Germany	18,200	1	14,900	1
Hong Kong	140,000	4	181,000	7
India	1,110,000	5	1,910,000	5
Israel	32,700	2	7,190	1
Japan	2,300	(3)	6,860	(3)
Pakistan	--	--	1,080	(3)
Sri Lanka	3,210	(3)	12,500	2
Switzerland	13,800	15	42,100	12
Thailand	2,220,000	50	2,260,000	47
United Kingdom	20,800	4	3,540	2
Other	24,300	1	88,000	8
Total	3,660,000	88	4,550,000	87
Sapphire:				
Australia	82,700	1	5,080	(3)
Belgium	8,440	1	10,400	1
Brazil	1,250	(3)	1,040	(3)
Burma	669	4	23,200	1
Canada	664	(3)	4,350	(3)
China	28,800	(3)	12,500	(3)
Colombia	--	--	248	(3)
France	1,710	1	18,700	3
Germany	143,000	2	35,800	3
Hong Kong	251,000	7	234,000	6
India	828,000	4	1,150,000	5
Israel	26,700	2	26,500	3
Sri Lanka	274,000	25	314,000	30
Switzerland	31,600	8	75,100	6
Thailand	5,040,000	77	6,010,000	73
United Kingdom	32,700	4	21,800	3
Other	28,700	3	88,400	2
Total	6,780,000	139	8,040,000	136

See footnotes at end of table.

TABLE 8--Continued
U.S. IMPORTS FOR CONSUMPTION OF GEMSTONES, OTHER THAN DIAMOND, BY KIND AND COUNTRY[1]

Kind and country	2002 Quantity (carats)	2002 Value[2] (millions)	2003 Quantity (carats)	2003 Value[2] (millions)
Other:				
Rough, uncut:				
Australia	NA	$3	NA	$4
Brazil	NA	10	NA	9
China	NA	3	NA	2
Colombia	NA	(3)	NA	1
Fiji	NA	2	NA	2
Hong Kong	NA	1	NA	1
India	NA	1	NA	3
Indonesia	NA	2	NA	3
Kenya	NA	(3)	NA	(3)
Nigeria	NA	(3)	NA	(3)
Pakistan	NA	3	NA	1
Philippines	NA	1	NA	2
Russia	NA	(3)	NA	(3)
South Africa	NA	1	NA	1
Switzerland	NA	(3)	NA	(3)
Taiwan	NA	(3)	NA	(3)
Tanzania	NA	1	NA	2
Thailand	NA	2	NA	2
United Kingdom	NA	1	NA	(3)
Zambia	NA	1	NA	(3)
Other	NA	8	NA	31
Total	NA	41	NA	40
Cut, set and unset:				
Australia	NA	16	NA	13
Austria	NA	2	NA	1
Brazil	NA	8	NA	8
Canada	NA	1	NA	1
China	NA	26	NA	27
Columbia	NA	1	NA	(3)
French Polynesia	NA	7	NA	6
Germany	NA	18	NA	21
Hong Kong	NA	32	NA	34
India	NA	75	NA	77
Indonesia	NA	(3)	NA	2
Israel	NA	5	NA	6
Japan	NA	11	NA	20
Mexico	NA	1	NA	(3)
South Africa	NA	1	NA	1
Sri Lanka	NA	6	NA	4
Switzerland	NA	2	NA	11
Taiwan	NA	2	NA	2
Tanzania	NA	7	NA	6
Thailand	NA	31	NA	36
United Kingdom	NA	8	NA	1
Other	NA	6	NA	6
Total	NA	265	NA	281

NA Not available. -- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Customs value.
[3]Less than 1/2 unit.

Source: U.S. Census Bureau.

TABLE 9
VALUE OF U.S. IMPORTS OF LABORATORY-CREATED AND IMITATION GEMSTONES, BY COUNTRY[1,2]

(Thousand dollars)

Country	2002	2003
Laboratory-created, cut but unset:		
Australia	27	36
Austria	2,730	477
Belgium	72	18
Brazil	143	48
China	10,300	10,100
France	831	881
Germany	9,630	11,300
Hong Kong	1,950	1,230
India	822	530
Italy	50	74
Japan	28	187
Korea, Republic of	727	712
Netherlands	65	35
Singapore	79	35
Spain	14	19
Sri Lanka	844	1,610
Switzerland	6,360	7,220
Taiwan	312	234
Thailand	1,670	1,180
Other	913	385
Total	37,600	36,300
Imitation:[3]		
Austria	39,900	39,600
China	2,260	2,430
Czech Republic	8,850	6,100
Germany	1,300	1,120
Hong Kong	1,560	1,140
India	1,280	567
Italy	139	137
Japan	247	376
Korea, Republic of	467	674
Spain	72	133
Taiwan	164	72
Other	434	430
Total	56,700	52,700

[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Customs value.
[3]Includes pearls.

Source: U.S. Census Bureau.

TABLE 10
U.S. IMPORTS FOR CONSUMPTION OF GEMSTONES[1]

(Thousand carats and thousand dollars)

Stones	2002		2003	
	Quantity	Value[2]	Quantity	Value[2]
Diamonds:				
Rough or uncut	1,010	567,000	1,500	707,000
Cut but unset	19,900	11,500,000	19,100	12,200,000
Emeralds, cut but unset	8,670	143,000	3,020	126,000
Coral and similar materials, unworked	NA	10,400	NA	11,100
Rubies and sapphires, cut but unset	10,400	226,000	12,600	222,000
Pearls:				
Natural	NA	1,490	NA	601
Cultured	NA	35,000	NA	39,100
Imitation	NA	968	NA	2,920
Other precious and semiprecious stones:				
Rough, uncut	812,000	24,200	1,360,000	21,900
Cut, set and unset	NA	229,000	NA	241,000
Other	NA	6,580	NA	6,440
Laboratory-created:				
Cut but unset	251,000	37,600	224,000	36,300
Other	NA	5,610	NA	6,920
Imitation gemstone[3]	NA	55,700	NA	49,800
Total	XX	12,900,000	XX	13,600,000

NA Not available. XX Not applicable.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Customs value.
[3]Does not include pearls.

Source: U.S. Census Bureau.

TABLE 11
NATURAL DIAMOND: ESTIMATED WORLD PRODUCTION, BY COUNTRY AND TYPE[1, 2, 3]

(Thousand carats)

Country and type[4]	1999	2000	2001	2002	2003
Gemstones:					
Angola	3,360	3,914 [5]	4,653 [5]	4,520 [r]	4,770
Australia	13,403 [r, 5]	11,956 [r, 5]	11,779 [r, 5]	15,142 [r, 5]	14,900
Botswana	17,200	18,500	19,800	21,300	22,800
Brazil	900 [5]	1,000 [5]	700 [r, 5]	500 [r, 5]	500
Canada	2,429 [5]	2,534 [r, 5]	3,716 [r, 5]	4,984 [5]	11,200
Central African Republic	311	346	337 [r]	311 [r]	300
China	230	230	235	235	235
Congo (Kinshasa)	4,120	3,500	3,640 [r]	4,400 [r]	5,400
Cote d' Ivoire	270	210	207 [r]	204 [r]	205
Ghana	546	792	936	770	800
Guinea	287	278	273 [r]	368 [r]	368
Guyana	45 [5]	82 [5]	179 [5]	248 [r, 5]	250
Liberia	120	100	100	48 [r]	36
Namibia	1,630	1,450	1,487 [5]	1,350	1,650
Russia	11,500	11,600	11,600	11,500	12,000
Sierra Leone	7 [r]	58 [r]	167 [r]	147 [r, 5]	214
South Africa	4,000	4,320	4,470	4,350	5,070
Tanzania	200	301	216	181 [r]	198
Venezuela	59 [5]	29 [5]	14 [5]	46 [r, 5]	30
Zimbabwe	15	8	--	--	--
Other[6]	20	24	25	25	24
Total	60,600 [r]	61,200 [r]	64,500 [r]	70,600 [r]	80,900
Industrial:					
Angola	373	435	517	502 [r]	530
Australia	16,381 [5]	14,612 [r, 5]	14,397 [r, 5]	18,500 [5]	18,200
Botswana	5,730	6,160	6,600	7,100	7,600
Central African Republic	120	115	112 [r]	104 [r]	100
China	920	920	950	955	955
Congo (Kinshasa)	16,000	14,200	14,560 [r, 5]	17,456 [r, 5]	21,600
Cote d' Ivoire	128	110	102 [r]	102 [r]	102
Ghana	136	198	234	193	200
Guinea	96	91	91 [r]	123 [r]	123
Liberia	80	70	70	32 [r]	24
Namibia	--	106	--	--	--
Russia	11,500	11,600	11,600	11,500	12,000
Sierra Leone	2 [r]	19 [r]	56 [r]	205 [r, 5]	296
South Africa	6,010	6,470	6,700	6,530	7,600
Tanzania	35 [5]	53 [5]	38 [5]	32 [r, 5]	35
Venezuela	36 [5]	80 [5]	28 [r, 5]	61 [r, 5]	50
Zimbabwe	30	15	--	--	--
Other[7]	52	64	66	68	67
Total	57,600 [r]	55,300 [r]	56,100 [r]	63,500 [r]	69,500
Grand total	118,000 [r]	117,000 [r]	121,000 [r]	134,000 [r]	150,000

[r]Revised. -- Zero.

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

[2]Table includes data available through June 10, 2004.

[3]In addition to the countries listed, Nigeria and the Republic of Korea produce natural diamond and synthetic diamond, respectively, but information is inadequate to formulate reliable estimates of output levels.

[4]Includes near-gem and cheap-gem qualities.

[5]Reported figure.

[6]Includes Gabon, India, and Indonesia.

[7]Includes India and Indonesia.