# 2009 Minerals Yearbook

## GEMSTONES [ADVANCE RELEASE]

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# GEMSTONES

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In 2009, the estimated value of natural gemstones produced in the United States was more than $8.41 million, and the estimated value of U.S. laboratory-created gemstone production was more than $27.2 million. The total estimated value of U.S. gemstone production was about $35.6 million. The value of U.S. gemstone imports was $13.3 billion, and the value of combined U.S. gemstone exports and reexports was estimated to be $10.5 billion.

In this report, the terms "gem" and "gemstone" mean any mineral or organic material (such as amber, pearl, petrified wood, and shell) 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 are the largest group of gemstones in terms of chemical composition; oxides and quartz are the second largest (table 1). Gemstones are subdivided into diamond and colored gemstones, which in this report designates all natural nondiamond gems. 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. All percentages in the report were computed using unrounded data. Current information on industrial-grade diamond and industrial-grade garnet can be found in the U.S. Geological Survey (USGS) Minerals Yearbook, volume I, Metals and Minerals, chapters on industrial diamond and industrial garnet, respectively.

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.

## Legislation and Government Programs

No industrial diamond remained in the National Defense Stockpile (NDS), which is managed by the Defense National Stockpile Center (DNSC), Defense Logistics Agency. The last stocks of industrial diamond stones were completely sold during 2008 (Lough, 2008). At yearend 2009, DNSC had no plans to stockpile any inventory of industrial diamond in the NDS.

## Production

U.S. gemstone production data were 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 gathered at gem and mineral shows.

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 are relatively small compared with those of other mining operations. In the United States, much of the current gemstone mining is conducted by individual 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 and polish natural and laboratory-created gemstones. The domestic gemstone industry is focused on the production of colored gemstones and on the cutting and polishing of large diamond stones. Industry employment is estimated to be between 1,000 and 1,200.

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 operations.

The total value of natural gemstones produced in the United States during 2009 was estimated to be about $8.41 million (table 3). This production value was a 27% decrease from that of 2008, owing to a 69% decrease in shell production.

Natural gemstone materials indigenous to the United States are collected, produced, and (or) marketed in every State. During 2009, all 50 States produced at least $1,330 worth of gemstone materials. There were 10 States that accounted for 79% of the total value, as reported by survey respondents. These States were, in descending order of production value, Arizona, Oregon, Utah, California, Idaho, Colorado, Arkansas, Montana, North Carolina, and Tennessee. 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's gemstone deposits included agate, amethyst, azurite, chrysocolla, garnet, jade, jasper, malachite, obsidian, onyx, opal, peridot, petrified wood, smithsonite, and turquoise. There was also a wide variety of gemstones found and produced in California, Idaho, Montana, and North Carolina.

In August 2009, a 310-carat emerald crystal was found at Adams Emerald Mine, Hiddenite District, North Carolina. A 64.83-carat gem, named the Carolina Emperor, was cut from the crystal. The Carolina Emperor is North America's largest faceted emerald, and its value was estimated to be more than $1.5 million. Of all emeralds found in North America, the 20 largest were found in North Carolina, and the emeralds that have been found in North Carolina are the most valuable that have been found in North America (McClatchy-Tribune News Service, 2010; Speer, 2011).

In 2009, the United States had only one active operation in a known diamond-bearing area in Crater of Diamonds State Park near Murfreesboro in Pike County, AR. The State of Arkansas maintains a dig-for-fee operation for tourists and rockhounds at the park; 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 2009, 918 diamond stones with an average weight of 0.199 carats were recovered at the Crater of Diamonds State Park. Of the 918 diamond stones recovered, 29 weighed more than 1 carat. Since the diamond-bearing pipe and the adjoining area became a State park in 1972, 28,745 diamond stones with a total carat weight of 5,700.22 have been recovered (Waymon Cox, park interpreter, Crater of Diamonds State Park, written commun., July 19, 2010). Exploration has demonstrated that there is about 78.5 million metric tons (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).

No diamond mines have operated commercially in the United States since 2002. Diamond was produced at the Kelsey Lake diamond mine, located close to the Colorado-Wyoming State line near Fort Collins, CO, for several years until April 2002. The Kelsey Lake property has been fully reclaimed.

There has been some interest in exploration for diamond deposits in areas of the United States with geologic settings and terrain that are similar to Canadian diamond mining areas. These areas are in Alaska, Colorado, Minnesota, Montana, and Wyoming (Associated Press, 2002, 2004; Diamond Registry Bulletin, 2005). Even though some exploration has taken place in these States, they remain largely underexplored for diamonds (Iron Range Resources & Rehabilitation Board, 2010). Although exploration and field studies have found many diamond indicators and a number of large diamond deposits, none have attracted long-term investors or been opened as commercially feasible mines thus far.

In addition to natural gemstones, laboratory-created gemstones and gemstone simulants were produced in the United States in 2009. Laboratory-created or synthetic gemstones have the same chemical, optical, and physical properties as the natural gemstones. Simulants have an appearance similar to that of a natural gemstone material, but they have different chemical, optical, and physical properties. Laboratory-created gemstones that have been produced in the United States include alexandrite, diamond, emerald, garnet, moissanite, ruby, sapphire, spinel, turquoise, and zirconia. However, during 2009, only cubic zirconia, diamond, moissanite, and turquoise were produced commercially. 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 $27.2 million during 2009, which was a 47% decrease compared with that of 2008. This was owing to a very large decrease in laboratory-created moissanite production. The value of U.S. simulant gemstone output was estimated to be more than $100 million. Five companies 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 were, in descending order of production value, Florida, New York, Massachusetts, North Carolina, and Arizona.

Since the 1950s, when scientists manufactured the first laboratory-created bits of diamond grit using a high-pressure, high-temperature (HPHT) method, this method of growing diamonds has become relatively commonplace in the world as a technology for laboratory-created diamonds, so much so that thousands of small plants throughout China were using the HPHT method and producing laboratory-created diamonds suitable for cutting as gemstones. Gem-quality diamonds of one carat or more are harder to manufacture because at that size it is difficult to consistently produce diamonds of high quality, even in the controlled environment of a lab using the HPHT method. After more than 50 years of development, that situation has changed, and several laboratory-created diamond companies were producing high-quality diamonds that equal those produced from mines (Park, 2007).

Gemesis Corp., Sarasota, FL, consistently produced gem-quality laboratory-created diamond and reported a 10th year of production in 2009. 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 ranges from 1½ to 2 carats, and most of the stones are yellow, brownish yellow, colorless, and green. Gemesis uses diamond-growing machines, each machine capable of growing 3-carat rough diamonds by generating HPHT conditions that recreate the conditions in the Earth's mantle where natural diamonds form (Davis, 2003). Gemesis could be producing as many as 30,000 to 40,000 stones each year, and annual revenues may reach $70 million to $80 million. Gemesis diamonds are available for retail purchase in jewelry stores and on the Internet, and the prices of the Gemesis laboratory-created diamonds are 30% to 50% less than those of comparable natural diamond but above the prices of simulated diamond (Gemesis Corp., 2010).

In the early 2000s, Apollo Diamond, Inc., near Boston, MA, developed and patented a method for growing single, extremely pure, gem-quality diamond crystals by chemical vapor deposition (CVD). The CVD technique transforms carbon into plasma, which is then precipitated onto a substrate as diamond. CVD had been used for more than a decade to cover large surfaces with microscopic diamond crystals, but in developing this process Apollo discovered the temperature, gas composition, and pressure combination that resulted in the growth of a single diamond crystal. These CVD diamonds may not be distinguishable from natural diamond by some tests (Davis, 2003). In 2007, Apollo Diamond produced laboratory-created stones that ranged from 1 to 2 carats and expected to expand to larger stones in the future. Growth of CVD diamonds is limited only by the size of the seed placed in the diamond growing chamber. In 2008, the company increased its production of large stones. Apollo diamonds sell at prices that average 15% less than those of comparable natural diamonds (Apollo Diamond, Inc., 2008). Both Apollo and Gemesis prefer to call their diamonds "cultured" rather than laboratory-created, referring to the fact that the diamonds are grown much like a cultured pearl is grown. In addition to their use as gemstones, CVD diamond could be used to make extremely powerful lasers; to create frictionless medical replacement joints; to create windows on spacecraft; to create surgical diamond blades and scalpels; or as coatings for car parts that would not scratch or wear out. The greatest potential use for CVD diamond is as a material for high-tech uses in computers and other electronic devices that utilize processors (Maney, 2005; Park, 2007).

In the mid-2000s, the Carnegie Institution of Washington Geophysical Laboratory and the University of Alabama jointly developed and patented a faster CVD process and apparatus to produce ½-inch thick 10-carat single diamond crystals using microwave plasma technology. This method has up to 100 times faster growth rates (averaging 100 micrometers per hour) than previous CVD methods and allows multiple crystals to be grown simultaneously. This crystal size is about five times that of commercially available laboratory-created diamonds produced by HPHT methods and other CVD techniques (Willis, 2004; Carnegie Institution of Washington, 2005; Science Blog, 2005). Apollo and the Carnegie Institution have noted that diamonds produced by the CVD method are harder than natural diamonds and diamonds produced by HPHT methods.

Research at the Carnegie Institution continued improving the microwave plasma CVD method, developing a process to anneal the diamonds at temperatures up to 2000 °C using a microwave plasma below atmospheric pressure. In this process, the diamond crystals, which are originally yellow-brown if produced at very high growth rates, are turned colorless or light pink. This low-pressure/high-temperature annealing process enhances the optical properties of this rapid-grown CVD single crystal diamond, and the size of the crystals that can be treated is not limited. This process is thought to produce better synthetic diamonds for high pressure devices and window materials with improved optical properties in the ultraviolet to infrared range. These high-quality, single-crystal diamonds likely will have a variety of applications in addition to their use as gems, such as using the diamond crystals as anvils in high-pressure research or optical uses that take advantage of the outstanding transparency of diamond. Another application might be in quantum computing, by utilizing vacancy centers in the diamond's crystal lattice for storing quantum information (Carnegie Institution for Science, 2008).

In 2009, Charles & Colvard, Ltd. in North Carolina entered its 12th year as the world's only manufacturer of moissanite, a gem-quality laboratory-created silicon carbide. Moissanite is also an excellent diamond simulant, but it is being marketed for its own gem qualities. Moissanite exhibits a higher refractive index (brilliance) and higher luster than diamond. Its hardness is between those of corundum (ruby and sapphire) and diamond, which gives it durability (Charles & Colvard, Ltd., 2010b). Charles & Colvard reported that production and sales were down in 2009 compared with those of the previous year as a result of the effects of the economic recession. However, this trend did begin to reverse in the fourth quarter and net sales increased 10% compared with net sales in the third quarter of 2009 (Charles & Colvard, Ltd., 2010a).

U.S. shell production decreased by 69% in 2009 compared with that of 2008. U.S. mussel shells are used as a source of mother-of-pearl and as seed material for culturing pearls. Pearl producers in Japan have begun using manmade seed materials or seed materials from China and other sources in addition to stockpiled material. In addition, the popularity of darker and colored pearls and freshwater pearls that do not use U.S. seed material has increased. In some regions of the United States, shell from mussels was being used more as a gemstone based on its own merit rather than as seed material for pearls. This shell material was being processed into mother-of-pearl and used in beads, jewelry, and watch faces.

## Consumption

Historically, diamond gemstones have proven to hold their value despite wars or economic depressions (Schumann, 1998, p. 8), but this did not hold true during the recent worldwide economic recession. Diamond and colored gemstones value and sales decreased during the economic downturn in 2008 and continued into 2009. Gemstone production, trade, and consumption demonstrated significant decreases during 2008, mostly concentrated in the last 4 months of the year, and continued through most of 2009. U.S. gemstone consumption and sales increased in December 2009.

Although the United States accounted for little of the total global gemstone production, it was the world's leading diamond and nondiamond gemstone market. It was estimated that U.S. gemstone markets accounted for more than 35% of world gemstone demand in 2009. The U.S. market for unset gem-quality diamond during the year was estimated to be about $12.7 billion, a decrease of 35% compared with that of 2008. Domestic markets for natural, unset nondiamond gemstones totaled approximately $779 million in 2009, which was a 30% decrease from that of 2008. These large declines in domestic markets were a reflection of the impact of the global recession on luxury spending.

In the United States, about two-thirds of domestic consumers designate diamond as their favorite gemstone when surveyed (Wade, 2006). The popularity of diamonds with domestic consumers is also evidenced by the U.S. diamond market making up 94% of the total U.S. gemstone market. Colored natural gemstones, colored laboratory-created gemstones, and "fancy" colored diamonds remained popular in 2009, but the values of the domestic markets for almost all types of colored natural, unset nondiamond gemstones decreased from the 2008 values (table 10), also owing to the impact of the recession on luxury spending. The largest demand for colored stones was in the American and Asian colored diamond markets with strong sales of champagne, cognac, grey, black, pink, orange, and yellow stones (Diamond Registry Bulletin, 2007). This trend was first evident in 2007 and has remained through the present.

There were about 200,000 diamond jewelry retail outlets worldwide in 2009. From these retail outlets, about 45% of diamond jewelry was sold in the United States, 33% in Asia, and 11% in Europe. An estimated 32,000 retail outlets specialize in fine jewelry in the United States. The estimated U.S. retail jewelry sales were $59 billion in 2009, down slightly from sales of $60 billion in 2008 (National Jeweler, 2010c). U.S. jewelry sales showed an increase of 5.6% more than that of the previous year during the 2009 holiday shopping season (National Jeweler, 2009).

### 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 valuations 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.

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 remain a significant force, influencing the price of about 40% of gem-quality diamond sales worldwide during 2009 because the companies mine a significant portion of the world's gem-quality diamond produced each year, and they also purchase diamonds from Russia. In 2009, De Beers companies produced 23.6 million carats, a 49% decrease from 2008 production. De Beers companies also sorted and valuated a large portion (by value) of the world's annual supply of rough diamond through De Beers' subsidiary Diamond Trading Co. (DTC), which had marketing agreements with other producers. In 2009, De Beers had diamond sales of $3.84 billion, which was a decrease of 44.3% from diamond sales of $6.89 billion in 2008 (De Beers Group, 2009, p. 17; 2010; National Jeweler, 2010a).

### Foreign Trade

During 2009, total U.S. gemstone trade with all countries and territories was valued at about $23.8 billion, which was a decrease of 34% from that of 2008. Diamond accounted for about 94% of the 2009 gemstone trade total. In 2009, U.S. exports and reexports of diamond were shipped to 94 countries and territories, and imports of all gemstones were received from 100 countries and territories (tables 6–10). In 2009, U.S. import quantities in cut diamond decreased by 16%, compared with those of 2008. U.S. imports in rough and unworked diamond decreased by 4% (table 7). The United States remained the world's leading diamond importer and was a significant international diamond transit center as well as the world's leading gem-quality diamond market. In 2009, U.S. export quantities of gem-grade diamond decreased by 54% compared with those of 2008. The large volume of reexports shipped to other centers revealed the significance that the United States had in the world's diamond supply network (table 6). These decreases in trade were owing to the impact of the recession on luxury spending.

Import values of laboratory-created gemstone decreased by 21% for the United States in 2009 compared with those of 2008 (table 10). Again, this decrease in imports was owing to the impact of the recession on luxury spending.

Laboratory-created gemstone imports from Austria, China, Germany, India, Switzerland, and Thailand, with more than $500,000 in imports each, made up about 82% (by value) of the total domestic imports of laboratory-created gemstones during the year (table 9). 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 2009. There also were continuing problems with some simulants being marketed as laboratory-created gemstones during the year.

### World Review

The gemstone industry worldwide has two distinct sectors—diamond mining and marketing and colored gemstone production and sales. 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 diamond, 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 2009, world natural diamond production totaled about 129 million carats—74.1 million carats gem quality and 54.6 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 2009, Russia led the world in total natural diamond output quantity (combined gemstone and industrial) with 25% of the world estimated production. Botswana was the world's leading gemstone diamond producer, followed by Russia, Canada, Angola, Congo (Kinshasa), Guinea, South Africa, and Namibia in descending order of quantity. These eight countries produced 96% (by quantity) of the world's gemstone diamond output in 2009.

In 2002, the international rough-diamond certification system, the Kimberley Process Certification Scheme (KPCS), was agreed upon by United Nations (UN) member nations, the diamond industry, and involved nongovernmental organizations to prevent the shipment and sale of conflict diamonds. Conflict diamonds are diamonds that originate from areas controlled by forces or factions opposed to legitimate and internationally recognized governments, and are used to fund military action in opposition to those governments, or in contravention of the decisions of the U.N. Security Council. 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 sharing 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). Namibia assumed the chair of KPCS for the period from January 1 through December 31, 2009. Namibia was the seventh in succession to hold the chair after India, South Africa, Canada, Russia, Botswana, and the European Commission (Kimberley Process, 2008a; 2008b). The list of 49 participants, represented 75 nations (including the 27 member nations of the European Community) plus the rough diamond-trading entity of Taipei. During 2009, Cote d' Ivoire was under UN sanctions and was prohibited from trading in rough diamonds; and Venezula voluntarily separated from the KPCS and ceased certification for export of its rough diamonds. In 2009, the KPCS also monitored the diamond sector in Zimbabwe after a diamond rush in 2007 threatened the country's KPCS system, and there were indications of smuggling and reports of violence. The KPCS had engaged Zimbabwean authorities and were working with them to strengthen their certification scheme and help Zimbabwe meet their obligations to the KPCS. The participating nations in the KPCS account for approximately 98% of the global production and trade of rough diamonds (Kimberley Process, 2009a; 2009b).

Globally, the value of production of natural gemstones other than diamond was estimated to be about $2 billion in 2009. 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 were key producers in 2009.

Worldwide in 2009, three small diamond mines and two expansion projects started up. Three of the startups were in Russia, and two were in Guinea (Metals Economics Group, 2010, p. 14).

***Burma.***—Gemstone sanctions against Burma by the international community, which began in 2008, seemed to be having an effect. Total Burmese gemstone production in 2009 was reported to have decreased by 46% from that of 2008. There was not an increase in gem production in any category except for pearls. Burmese jade production decreased 18% in 2009 from that of 2008, pearl production increased by 5%, peridot production decreased by 66%, ruby decreased by 10%, sapphire decreased by 30%, and spinel decreased by 48%. Gemstone trade was down with all countries participating in the sanctions. Burmese gemstone trade with China, which was not participating in the sanctions, increased in 2009 by 10% from that of 2008. In the United States, the Burmese gemstone sanctions were brought about by the Burma Jade Act of 2008, which was enacted and reported on in the 2008 Gemstone Minerals Yearbook report (Sapora, 2010).

***Canada.***—Canadian diamond production was more than 10.9 million carats (Mct) with an estimated value of $1.7 billion during 2009, a decrease of about 26% compared with that of 2008. Diamond exploration continued in Canada, with several commercial diamond projects and additional discoveries in Alberta, British Columbia, the Northwest Territories, Nunavut, Ontario, and Quebec. In 2009, Canada produced 15% of the world's natural gemstone diamond output.

The Ekati Diamond Mine, Canada's first operating commercial diamond mine, completed its 11th full year of production in 2009. Ekati produced 4.2 Mct of diamond from 5.10 million metric tons (Mt) of ore. BHP Billiton Ltd. has an 80% controlling ownership in Ekati, which is in the Northwest Territories. Ekati has estimated remaining reserves of 38.5 Mt of ore in kimberlite pipes that contain 18.3 Mct of diamond. BHP Billiton projected the remaining mine life to be 13 years. Approximately 79% of the Ekati 2009 diamond production was gem-grade material (BHP Billiton Ltd., 2010, p. 10; Perron, 2011, p. 1).

The Diavik Diamond Mine, Canada's second diamond mine, also located in the Northwest Territories, completed its seventh full year of production. In 2009, Diavik produced 5.6 million carats of diamond, a decrease of 40% from the previous year's production. This lower production was a consequence of a reduced operating level at the mine intended to balance production with lower market demand that resulted from the downturn in the economy that began in mid-2008. Diavik reacted by temporarily ceasing diamond production at the Diavik Mine between July 14 and August 24, 2009. During this time period, the Diavik Mine was placed on a care-and-maintenance schedule. At yearend 2009, Diavik Diamond Mines estimated the mine's remaining proven and probable reserves to be 19.7 Mt of ore in kimberlite pipes containing 59.1 million carats of diamond and projected the total mine life to be 16 to 22 years. During 2009, Diavik began developing an underground mine, and construction on the underground project was substantially completed during 2009. First ore was expected during the first quarter of 2010, with full production expected in 2013. The mine is an unincorporated joint venture between Diavik Diamond Mines Inc. (60%) and Harry Winston Diamond Mines Ltd. (40%) (Diavik Diamond Mines Inc., 2010; Perron, 2011, p. 2).

Canada's third diamond mine, the Jericho Diamond Mine, is located in Nunavut and was owned by Tahera Diamond Corp. Tahera estimated the Jericho Diamond Mine's reserves to be about 5.5 Mt of ore grading 0.85 carats per ton. The Jericho Diamond Mine experienced startup problems related to ore mining and processing. The mine also suffered financial problems owing to the cost of transporting supplies to the mine site, higher operational costs, higher oil prices, and appreciation of the Canadian dollar versus the U.S. dollar. All of these problems combined to force the company to enter into protection under Canada's "Companies' Creditors Arrangement Act" on January 16, 2008, and the mine suspended production on February 6, 2008. As a result, the mine's 2008 production was only 118,000 carats. At yearend 2009, Tahera was finalizing arrangements to sell all its Jericho mine assets (Perron, 2011, p. 2).

The Snap Lake Mine, which is wholly owned by De Beers Canada Inc., is in the Northwest Territories. The Snap Lake deposit is a tabular-shaped kimberlite dyke rather than the typical kimberlite pipe. The dyke is 2.7 meters thick and dips at an angle of 15°. The deposit was mined using a modified room and pillar underground mining method in 2009. The Snap Lake Mine started mining operations in October 2007, reached commercial production levels in the first quarter of 2008, and officially opened June 25, 2008. The mine was expected to produce 1.4 Mct per year of diamond, and the mine life was expected to be about 20 years. De Beers suspended production for 6 weeks in July and August 2009. This production suspension was scheduled to align production levels with market demand. The mine's production for the year was 440,000 carats, for a recovered grade of 1.25 carats per ton (Perron, 2011, p. 2–3).

The Victor Mine, which also is wholly owned by De Beers Canada, is in northern Ontario on the James Bay coast. The Victor kimberlite consists of two pipes with surface area of 15 hectares (37.1 acres). The Victor Mine initiated mining operations at the end of December 2007 and officially opened on July 26, 2008. The Victor deposit reportedly holds 27.4 Mt of ore with average ore grade of 0.23 carats per ton. At full capacity, the open pit mine was expected to produce 600,000 carats per year, and the mine life was expected to be about 12 years. De Beers also suspended production at this mine for 6 weeks in July and August. In 2009, the mine's production was 696,000 carats valued at $244 million and had an average recovery grade of 0.33 carats per ton (Perron, 2011, p. 3).

***China.***—During 2009, China became the world's second largest diamond market, following the United States and replacing Japan. The Chinese Government reported that 2009 diamond imports were more than $1.5 billion (National Jeweler, 2010b).

***Guinea.***—The Mandala alluvial mine, owned by Stellar Diamonds Plc, was producing with positive cash flow at 60% of capacity by yearend 2009. During 2010, the mine's output was expected to be 140,000 carats. Stellar estimated that the deposit contains 536,000 carats of diamond in 1.41 Mt of resources, grading 0.38 carats per ton (Metals Economics Group, 2010, p. 14–15).

Another alluvial mine, Bomboko, owned by West African Diamonds Plc, had increased production to 1,500 carats per month from 35,000 tons per month of ore by October 2009. Visual inspection of stones produced indicated that about 60% was gem quality and 40% was industrial grade. West African estimated that the deposit contains 750,000 carats of diamond in 25 Mt of resources grading 0.03 carats per ton (Metals Economics Group, 2010, p. 14–15).

***Russia.***—In 2009, Russia was again the world's leading producer of combined natural gemstone and industrial diamonds as it has been every year since 2004. Russian natural diamond production was 32.8 Mct with an estimated value of $2.34 billion, a decrease of about 11% compared with that of the previous year (Metals Economics Group, 2011, p. 12).

The largest mine that came online in 2009 was the underground development of the Arkangelskaya pipe at the Lomonosov Mine in northwestern Russia. Lomonosov started mining the Arkangelskaya pipe in September at 1 million tons per year (Mt/yr) of ore and was estimated to have an optimum production capacity of 4 Mt/yr of ore. Lomonosov is 95% owned by ALROSA Co. Ltd. and 5% owned by the Government of Russia. Lomonosov was estimated to have 27.3 Mct of diamonds contained in 54.8 Mt of ore, grading at an estimated 0.5 carats per ton. The estimated mine life was 17 years, with materials coming from the Arkangelskaya and Karpinskogo-1 pipes (Metals Economics Group, 2010, p. 14–15).

The Mirny Division of Alrosa in Yakutia officially opened the Mir underground mine in August. The Mir was expected to yield 500,000 carats of diamonds from 1 Mt/yr of ore during a projected 50-year mine life. Alrosa had future plans for two additional underground operations parallel to Mir, that would provide an additional 4.5 Mt/yr of ore (Metals Economics Group, 2010, p. 14–15).

A third new mine owned by Alrosa was the Aikhal underground mine in Yakutia. Aikhal began commercial production in December 2009. The mine was estimated to contain 1.25 Mct of diamonds in 12.5 Mt of ore grading 0.10 carats per ton. Aikhal had an estimated 25-year mine life (Metals Economics Group, 2010, p. 14–15).

***South Africa.***—On September 24, 2009, a rough 507.55-carat (just more than 100 grams) white diamond was mined at the historic Cullinan Mine, where the famous Cullinan diamond (the largest diamond found in recorded history) was discovered in 1905. The Cullinan Mine is owned by Petra Diamonds Cullinan Consortium, whose spokesman said that the gemstone was among the world's 20 largest diamonds ever discovered. Initial examinations of the stone indicated that it is of exceptional color and clarity, and most likely a Type I diamond. The diamond was found with three other exceptionally valuable diamonds, a 168-carat gemstone and two other stones that weighed 58.5 and 53.3 carats. The Cullinan Mine is also the world's primary source for blue diamonds. In May 2009, a fancy vivid blue diamond weighing 7.03 carats (cut from 26.58-carat rough diamond) found at the Cullinan Mine sold for $9.4 million. This was the highest price ever paid for a gemstone sold at auction (Maclean, 2009; Reinke, 2009).

## Outlook

As the domestic and global economy improves, Internet sales of diamonds, gemstones, and jewelry were expected to continue to grow and increase in popularity, as were other forms of e-commerce that emerge to serve the diamond and gemstone industry. This is likely to take place as the gemstone industry and its customers become more comfortable with and learn the applications of new e-commerce tools (Profile America, Inc., 2008).

Independent producers, such as Ekati and Diavik in Canada, will likely 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 quantities of rough diamond being sold outside DTC is expected to continue as the diamond industry adjusts to De Beers' reduced influence on the industry.

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

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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, insects. |
| Apatite | Chlorocalcium 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, 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, 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, natural | 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. |

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 |
|---|---|---|---|---|---|---|---|---|---|---|
| Chrysoberyl: | | | | | | | | | | |
| Alexandrite | Beryllium aluminate | Green by direct sunlight, or encandescent light, red by indirect sunlight or fluorescent light | Small to medium | High | 8.5 | 3.50–3.84 | Double | 1.75 | Synthetic | Strong dichroism, color varies from red to green, hardness. |
| Cat's eye | Beryllium aluminate | Greenish to brownish | Small to large | High | 8.5 | 3.50–3.84 | Double | 1.75 | Synthetic, shell | Density, translucence, chatoyance. |
| Chrysolite | do. | Yellow, green, and/or brown | Medium | Medium | 8.5 | 3.50–3.84 | do. | 1.75 | Tourmaline, peridot | Refractive index, silky. |
| 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, 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 or 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, blue, green, orange, violet, or red | 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, lack of flaws and inclusions, refractive index. |
| 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. |

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 |
|---|---|---|---|---|---|---|---|---|---|---|
| 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 | Small to medium | 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, 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. |
| Nephrite | Complex hydrous silicate | do. | do. | do. | 6.0–6.5 | 2.96–3.10 | do. | 1.61–1.63 | Jadeite, chalcedony, onyx, bowenite, vesuvianite, grossularite | Do. |
| 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, 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, lack of flaws and inclusions, refractive index. |
| 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, 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). |

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 |
|---|---|---|---|---|---|---|---|---|---|---|
| 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 | Large | Medium | 7.0 | 2.65–2.66 | Double | 1.55 | Glass, plastic, fluorite | Macrocrystalline, color, refractive index, 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, color, refractive index, 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 | do. | Yellow | do. | do. | 7.0 | 2.65–2.66 | do. | 1.55 | do. | Macrocrystalline, color, refractive index, transparent, hardness. |
| Jasper | do. | Any, striped, spotted, or sometimes uniform | do. | do. | 7.0 | 2.58–2.66 | XX | XX | do. | 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. |
| Rock crystal | 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| Rose | do. | Pink, rose red | do. | do. | 7.0 | 2.65–2.66 | do. | 1.55 | do. | Macrocrystalline, color, refractive index, 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 | Large | Low | 4.0 | 3.45–3.7 | Double | 1.6–1.82 | Fire opal, rhodonite, tugtupite, tourmaline | Color, crystal habit, reaction to acid, 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, spinel, pyroxmangite, spessartine, tourmaline | Color, black inclusions, lack of reaction to acid, hardness. |
| Shell: | | | | | | | | | | |
| Mother-of-pearl | Calcium carbonate | White, cream, green, blue-green, with iridescent play of color | Small | do. | 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, x-ray of internal structure. |
| Spinel, natural | 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 | Chrysocolla, dyed howlite, dumortierite, glass, plastics, variscite | 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, 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. |

Do., do. Ditto. 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.

TABLE 2
LABORATORY-CREATED GEMSTONE PRODUCTION METHODS

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

Do., do. Ditto.

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

(Thousand dollars)

| Gem materials | 2008 | 2009 |
| --- | --- | --- |
| Beryl | 18 | 18 |
| Coral, all types | 150 | 150 |
| Diamond | (2) | (2) |
| Garnet | 130 | 148 |
| Gem feldspar | 916 | 858 |
| Geode/nodules | 91 | 105 |
| Opal | 357 | 225 |
| Quartz: | | |
| Macrocrystalline[3] | 334 | 231 |
| Cryptocrystalline[4] | 344 | 216 |
| Sapphire/ruby | 556 | 256 |
| Shell | 2,290 | 713 |
| Topaz | (2) | (2) |
| Tourmaline | 112 | 112 |
| Turquoise | 508 | 531 |
| Other | 5,670 | 4,850 |
| Total | 11,500 | 8,410 |

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

[2]Included with "Other."

[3]Macrocrystalline quartz (crystals recognizable with the naked eye) includes amethyst, aventurine, blue quartz, citrine, hawk's eye, pasiolite, prase, quartz cat's eye, rock crystal, rose quartz, smoky quartz, and tiger's eye.

[4]Cryptocrystalline quartz (microscopically small crystals) includes agate, carnelian, chalcedony, chrysoprase, fossilized wood, heliotrope, jasper, moss agate, onyx, and sard.

TABLE 4
PRICES PER CARAT OF U.S. CUT ROUND DIAMONDS, BY SIZE AND QUALITY IN 2009

| Carat weight | Description, color[1] | Clarity[2] (GIA terms) | Representative prices | | |
|---|---|---|---|---|---|
| | | | January[3] | June[4] | December[5] |
| 0.25 | G | VS1 | $1,495 | $1,430 | $1,430 |
| Do. | G | VS2 | 1,350 | 1,325 | 1,325 |
| Do. | G | SI1 | 1,200 | 1,125 | 1,125 |
| Do. | H | VS1 | 1,400 | 1,300 | 1,300 |
| Do. | H | VS2 | 1,300 | 1,190 | 1,190 |
| Do. | H | SI1 | 1,070 | 1,050 | 1,050 |
| 0.50 | G | VS1 | 3,200 | 2,775 | 2,775 |
| Do. | G | VS2 | 2,800 | 2,350 | 2,350 |
| Do. | G | SI1 | 2,400 | 1,875 | 1,875 |
| Do. | H | VS1 | 2,800 | 2,400 | 2,400 |
| Do. | H | VS2 | 2,400 | 2,050 | 2,050 |
| Do. | H | SI1 | 2,200 | 1,725 | 1,725 |
| 1.00 | G | VS1 | 6,500 | 6,075 | 6,075 |
| Do. | G | VS2 | 6,100 | 5,400 | 5,400 |
| Do. | G | SI1 | 5,000 | 4,575 | 4,575 |
| Do. | H | VS1 | 5,500 | 5,100 | 5,100 |
| Do. | H | VS2 | 5,300 | 4,650 | 4,650 |
| Do. | H | SI1 | 4,600 | 4,350 | 4,350 |
| 2.00 | G | VS1 | 12,300 | 12,300 | 12,300 |
| Do. | G | VS2 | 10,900 | 10,900 | 10,900 |
| Do. | G | SI1 | 9,400 | 9,400 | 9,400 |
| Do. | H | VS1 | 10,200 | 10,200 | 10,200 |
| Do. | H | VS2 | 9,400 | 9,400 | 9,400 |
| Do. | H | SI1 | 7,900 | 7,900 | 7,900 |

Do. Ditto.

[1]Gemological Institute of America (GIA) color grades: D-colorless; E-rare white; G, H, I-traces of color.

[2]Clarity: IF—no blemishes; VVS1—very, very slightly included; VS1—very slightly included; VS2—very slightly included, but not visible; SI1—slightly included.

[3]Source: Jewelers' Circular Keystone, v. 180, no. 2, February 2009, p. 59.

[4]Source: Jewelers' Circular Keystone, v. 180, no. 7, July 2009, p. 41.

[5]Source: Jewelers' Circular Keystone, v. 181, no. 1, January 2010, p. 54.

TABLE 5
PRICES PER CARAT OF U.S. CUT COLORED GEMSTONES IN 2009

| Gemstone | Price range per carat | |
| --- | --- | --- |
| | January[1] | December[2] |
| Amethyst | $10–25 | $10–25 |
| Blue sapphire | 825–1,650 | 900–1,650 |
| Blue topaz | 5–10 | 5–10 |
| Emerald | 2,400–4,000 | 2,400–4,000 |
| Green tourmaline | 50–70 | 50–70 |
| Cultured saltwater pearl[3] | 5 | 5 |
| Pink tourmaline | 60–135 | 70–150 |
| Rhodolite garnet | 20–40 | 20–40 |
| Ruby | 1,850–2,200 | 1,850–2,200 |
| Tanzanite | 300–475 | 300–375 |

[1]Source: The Gem Guide—Color, spring/summer 2009, p. 22, 37, 51, 65, 74, 85, 96, 98, 104, and 119. These figures are approximate wholesale purchase prices paid by retail jewelers on a per stone basis for 1-to-less than 1 carat, fine-quality stones.

[2]Source: The Gem Guide, November/December 2009, p. 44, 47, 51, 55, 57, 59, 62, 63, 64, and 65. These figures are approximate wholesale purchase prices paid by retail jewelers on a per stone basis for 1-to-less than 1 carat, fine-quality stones.

[3]Prices are per 4.5 to 5-millimeter pearl.

TABLE 6

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

| | 2008 | | 2009 | |
|---|---|---|---|---|
| Country | Quantity (carats) | Value[2] (millions) | Quantity (carats) | Value[2] (millions) |
| Exports: | | | | |
| Australia | 103,000 | $18 | 37,600 | $21 |
| Belgium | 1,600,000 | 685 | 300,000 | 150 |
| Canada | 79,700 | 116 | 46,600 | 70 |
| Costa Rica | 55,200 | 6 | 8,470 | 2 |
| France | 136,000 | 136 | 49,200 | 25 |
| Hong Kong | 1,340,000 | 814 | 807,000 | 380 |
| India | 1,480,000 | 1,220 | 962,000 | 477 |
| Israel | 2,650,000 | 2,130 | 960,000 | 482 |
| Japan | 54,800 | 12 | 17,800 | 5 |
| Mexico | 678,000 | 110 | 504,000 | 79 |
| Netherlands | 19,000 | 3 | 561 | 1 |
| Netherlands Antilles | 16,200 | 35 | 10,600 | 23 |
| Singapore | 98,500 | 19 | 31,200 | 13 |
| South Africa | 31,400 | 4 | 829 | 2 |
| Switzerland | 99,400 | 270 | 152,000 | 146 |
| Taiwan | 15,000 | 12 | 12,900 | 5 |
| Thailand | 226,000 | 54 | 86,700 | 40 |
| United Arab Emirates | 165,000 | 115 | 108,000 | 46 |
| United Kingdom | 121,000 | 84 | 27,400 | 58 |
| Other | 248,000 | 103 | 156,000 | 133 |
| Total | 9,210,000 | 5,940 | 4,280,000 | 2,160 |
| Reexports: | | | | |
| Armenia | 13,400 | (3) | 1,670 | (3) |
| Australia | 33,800 | 14 | 59,600 | 19 |
| Belgium | 5,790,000 | 1,890 | 4,130,000 | 1,110 |
| Canada | 230,000 | 195 | 139,000 | 127 |
| Dominican Republic | 61,400 | 12 | 15,300 | 3 |
| France | 30,500 | 23 | 80,800 | 43 |
| Guatemala | 104,000 | 14 | 50,300 | 5 |
| Hong Kong | 2,680,000 | 1,350 | 3,220,000 | 1,190 |
| India | 2,250,000 | 482 | 2,350,000 | 959 |
| Israel | 10,200,000 | 3,400 | 6,940,000 | 2,750 |
| Japan | 178,000 | 39 | 117,000 | 24 |
| Malaysia | 20,100 | 3 | 9,860 | 1 |
| Mexico | 4,590 | 2 | 2,990 | 2 |
| Singapore | 190,000 | 22 | 193,000 | 50 |
| South Africa | 65,700 | 108 | 66,500 | 55 |
| Switzerland | 530,000 | 551 | 584,000 | 492 |
| Thailand | 152,000 | 26 | 145,000 | 29 |
| United Arab Emirates | 1,390,000 | 250 | 749,000 | 198 |
| United Kingdom | 499,000 | 229 | 383,000 | 204 |
| Other | 331,000 | 134 | 1,710,000 | 534 |
| Total | 24,800,000 | 8,750 | 20,900,000 | 7,780 |
| Grand total | 34,000,000 | 14,700 | 25,200,000 | 9,940 |

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

[2]Customs value.

[3]Less than ½ 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 | 2008 Quantity (carats) | 2008 Value[2] (millions) | 2009 Quantity (carats) | 2009 Value[2] (millions) |
|---|---|---|---|---|
| Rough or uncut, natural:[3] | | | | |
| Angola | 62,300 | $34 | 359,000 | $48 |
| Australia | 1,620 | 1 | 17,700 | 2 |
| Botswana | 108,000 | 147 | 88,100 | 35 |
| Brazil | 760 | 1 | 443 | (4) |
| Canada | 19,900 | 31 | 27,300 | 32 |
| Congo (Kinshasa) | 37,100 | 138 | 11,600 | 7 |
| Ghana | 1,400 | 2 | 250 | (4) |
| Guyana | 6,590 | 1 | 212 | (4) |
| India | 120,000 | 4 | 32,700 | 1 |
| Namibia | 6,550 | 5 | 10,000 | 6 |
| Russia | 90,200 | 19 | 16,500 | 3 |
| South Africa | 119,000 | 296 | 104,000 | 112 |
| Other | 153,000 | 73 r | 32,000 | 43 |
| Total | 725,000 | 752 | 700,000 | 289 |
| Cut but unset, not more than 0.5 carat: | | | | |
| Belgium | 295,000 | 118 | 344,000 | 127 |
| Canada | 10,900 | 13 | 7,910 | 7 |
| China | 110,000 | 34 | 25,800 | 18 |
| Dominican Republic | 65,800 | 20 | 38,200 | 10 |
| Hong Kong | 157,000 | 25 | 239,000 | 24 |
| India | 6,520,000 | 1,430 | 5,760,000 | 1,150 |
| Israel | 512,000 | 267 | 400,000 | 198 |
| Mauritius | 8,410 | 14 | 6,920 | 15 |
| Mexico | 52,600 | 10 | 65,900 | 10 |
| South Africa | 12,400 | 4 | 1,780 | 10 |
| Thailand | 72,200 | 21 | 60,800 | 17 |
| United Arab Emirates | 69,400 | 18 | 153,000 | 30 |
| Other | 72,400 | 25 | 57,400 | 38 |
| Total | 7,960,000 | 2,000 | 7,160,000 | 1,650 |
| Cut but unset, more than 0.5 carat: | | | | |
| Belgium | 929,000 | 3,130 | 640,000 | 2,130 |
| Canada | 22,800 | 78 | 20,200 | 60 |
| Hong Kong | 76,800 | 361 | 26,800 | 76 |
| India | 1,440,000 | 2,450 | 1,110,000 | 1,930 |
| Israel | 2,210,000 | 9,120 | 1,670,000 | 5,350 |
| Mexico | 389 | (4) | 1,810 | 3 |
| Russia | 57,600 | 178 | 57,800 | 137 |
| South Africa | 55,200 | 759 | 34,700 | 533 |
| Switzerland | 19,200 | 383 | 23,500 | 238 |
| Thailand | 11,700 | 22 | 3,980 | 9 |
| United Arab Emirates | 33,100 | 124 | 33,900 | 60 |
| Other | 101,000 | 400 | 53,200 | 256 |
| Total | 4,960,000 | 17,000 | 3,670,000 | 10,800 |

[r]Revised.

[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 ½ unit.

Source: U.S. Census Bureau.

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

| | 2008 | | 2009 | |
|---|---|---|---|---|
| Kind and country | Quantity (carats) | Value[2] (millions) | Quantity (carats) | Value[2] (millions) |
| Emerald: | | | | |
| Belgium | 529 | $2 | 1,980 | $1 |
| Brazil | 106,000 | 6 | 500,000 | 7 |
| Canada | 2,830 | (3) | 434 | (3) |
| China | 2,210 | (3) | 4,150 | (3) |
| Colombia | 530,000 | 155 | 314,000 | 120 |
| France | 130,000 | 9 | 315 | 2 |
| Germany | 13,800 | 3 | 8,470 | 2 |
| Hong Kong | 877,000 | 10 | 334,000 | 23 |
| India | 1,800,000 | 29 | 2,410,000 | 18 |
| Israel | 162,000 | 25 | 181,000 | 20 |
| Italy | 4,240 | 2 | 2,380 | 1 |
| Switzerland | 23,900 | 24 | 7,980 | 8 |
| Thailand | 564,000 | 13 | 292,000 | 8 |
| United Kingdom | 1,050 | 2 | 356 | 1 |
| Other | 83,300 | 17 | 38,000 | 3 |
| Total | 4,300,000 | 297 | 4,090,000 | 214 |
| Ruby: | | | | |
| Belgium | 9 | (3) | 10 | (3) |
| China | 7,360 | 1 | 2,100 | (3) |
| Dominican Republic | 994 | (3) | -- | -- |
| France | 1,210 | 1 | 37 | (3) |
| Germany | 12,400 | 1 | 8,370 | (3) |
| Hong Kong | 851,000 | 10 | 420,000 | 1 |
| India | 2,350,000 | 5 | 2,500,000 | 2 |
| Israel | 1,370 | 1 | 5,560 | 1 |
| Italy | 6,030 | 1 | 1,330 | (3) |
| Kenya | (3) | (3) | 16,700 | (3) |
| Sri Lanka | 7,260 | 1 | 2,020 | 1 |
| Switzerland | 10,600 | 11 | 933 | 3 |
| Thailand | 1,980,000 | 59 | 1,750,000 | 14 |
| United Arab Emirates | 1,760 | 1 | 64 | 2 |
| Other | 43,300 | 8 | 179,000 | 13 |
| Total | 5,280,000 | 100 | 4,880,000 | 37 |
| Sapphire: | | | | |
| Australia | 1,550 | (3) | 2,340 | (3) |
| Austria | 124 | (3) | 472 | (3) |
| Belgium | 110 | 1 | 283 | 1 |
| China | 269,000 | 2 | 122,000 | 1 |
| Dominican Republic | 882 | (3) | 600 | (3) |
| Germany | 36,200 | 5 | 33,200 | 5 |
| Hong Kong | 972,000 | 9 | 610,000 | 13 |
| India | 1,150,000 | 12 | 2,140,000 | 6 |
| Israel | 28,800 | 4 | 9,780 | 1 |
| Italy | 2,340 | 2 | 15,000 | 1 |
| Singapore | 3,630 | (3) | 3,010 | (3) |
| Sri Lanka | 316,000 | 46 | 240,000 | 31 |
| Switzerland | 17,800 | 19 | 14,700 | 14 |
| Thailand | 2,900,000 | 75 | 1,730,000 | 48 |

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 | 2008 Quantity (carats) | 2008 Value[2] (millions) | 2009 Quantity (carats) | 2009 Value[2] (millions) |
|---|---|---|---|---|
| Sapphire—Continued: | | | | |
| United Arab Emirates | 8,140 | $5 | 2,530 | $2 |
| United Kingdom | 1,100 | 4 | 504 | 1 |
| Other | 384,000 | 7 | 68,200 | 3 |
| Total | 6,090,000 | 191 | 4,990,000 | 127 |
| Other: | | | | |
| Rough, uncut: | | | | |
| Australia | NA | 3 | NA | (3) |
| Brazil | NA | 7 | NA | (3) |
| Canada | NA | 1 | NA | 1 |
| China | NA | 3 | NA | 1 |
| Colombia | NA | 1 | NA | -- |
| Czech Republic | NA | 2 | NA | 2 |
| Germany | NA | 1 | NA | 1 |
| India | NA | 2 | NA | 1 |
| Japan | NA | 1 | NA | 1 |
| Pakistan | NA | 2 | NA | (3) |
| Tanzania | NA | 3 | NA | (3) |
| Other | NA | 16 | NA | 1 |
| Total | NA | 42 | NA | 8 |
| Cut, set and unset: | | | | |
| Australia | NA | 15 | NA | (3) |
| Austria | NA | 4 | NA | 1 |
| Brazil | NA | 19 | NA | (3) |
| Canada | NA | 1 | NA | (3) |
| China | NA | 35 | NA | 8 |
| France | NA | 1 | NA | (3) |
| Germany | NA | 34 | NA | 11 |
| Hong Kong | NA | 32 | NA | 1 |
| India | NA | 74 | NA | 2 |
| Israel | NA | 8 | NA | (3) |
| Italy | NA | 1 | NA | (3) |
| South Africa | NA | 1 | NA | -- |
| Sri Lanka | NA | 5 | NA | (3) |
| Switzerland | NA | 8 | NA | 1 |
| Taiwan | NA | 1 | NA | (3) |
| Tanzania | NA | 5 | NA | 1 |
| Thailand | NA | 58 | NA | 1 |
| United Arab Emirates | NA | 1 | NA | (3) |
| United Kingdom | NA | 1 | NA | -- |
| Other | NA | 15 | NA | 3 |
| Total | NA | 319 | NA | 29 |

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 ½ 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 | 2008 | 2009 |
|---|---|---|
| Laboratory-created, cut but unset: | | |
| Austria | 2,330 | 1,430 |
| Brazil | 645 | 374 |
| Canada | 24 | 9 |
| China | 9,860 | 7,600 |
| Czech Republic | 55 | 42 |
| France | 298 | 284 |
| Germany | 12,700 | 11,100 |
| Hong Kong | 898 | 455 |
| India | 1,040 | 2,180 |
| Italy | 48 | 95 |
| Japan | 251 | 61 |
| Korea, Republic of | 207 | 46 |
| Netherlands | 5 | 5 |
| South Africa | 281 | -- |
| Sri Lanka | 1,300 | 315 |
| Switzerland | 620 | 797 |
| Taiwan | 174 | 161 |
| Thailand | 1,330 | 975 |
| United Arab Emirates | 146 | 98 |
| Other | 1,960 | 3,390 |
| Total | 34,200 | 29,500 |
| Imitation:[3] | | |
| Austria | 73,100 | 47,100 |
| Brazil | 25 | 2 |
| China | 21,000 | 13,300 |
| Czech Republic | 7,510 | 5,080 |
| France | 25 | -- |
| Germany | 723 | 566 |
| Hong Kong | 46 | 358 |
| India | 83 | 302 |
| Italy | 148 | 123 |
| Japan | 58 | -- |
| Korea, Republic of | 198 | 131 |
| Russia | 15 | -- |
| Taiwan | 183 | -- |
| Thailand | 10 | 39 |
| United Kingdom | 193 | 3 |
| Other | 275 | 208 |
| Total | 104,000 | 67,200 |

-- Zero.

[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 | 2008 Quantity | 2008 Value[2] | 2009 Quantity | 2009 Value[2] |
|---|---|---|---|---|
| Diamonds: | | | | |
| Rough or uncut | 725 | $752,000 | 700 | $289,000 |
| Cut but unset | 12,900 | 19,000,000 | 10,800 | 12,400,000 |
| Emeralds, cut but unset | 4,300 | 297,000 | 4,090 | 214,000 |
| Coral and similar materials, unworked | 5,320 | 12,200 | 4,430 | 10,500 |
| Rubies and sapphires, cut but unset | 11,400 | 291,000 | 9,880 | 164,000 |
| Pearls: | | | | |
| Natural | NA | 14,100 | NA | 21,100 |
| Cultured | NA | 34,600 | NA | 26,900 |
| Imitation | NA | 4,190 | NA | 4,150 |
| Other precious and semiprecious stones: | | | | |
| Rough, uncut | 1,620,000 r | 20,900 r | 1,080,000 | 15,000 |
| Cut, set and unset | NA | 285,000 | NA | NA |
| Other | NA | 9,200 | NA | NA |
| Laboratory-created: | | | | |
| Cut but unset | 60,300 | 34,200 | 8,730 | 29,500 |
| Other | NA | 13,500 | NA | 8,240 |
| Imitation gemstone[3] | NA | 104,000 | NA | 67,200 |
| Total | XX | 20,900,000 | XX | 13,300,000 |

r Revised. 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: WORLD PRODUCTION, BY COUNTRY AND TYPE[1, 2, 3]

(Thousand carats)

| Country and type[4] | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|
| Gemstones: | | | | | |
| Angola | 6,371 | 8,258 | 8,732 | 8,016 r | 8,100 |
| Australia | 8,577 | 7,305 | 231 | 273 | 60 e |
| Botswana[e] | 23,900 | 24,000 | 25,000 | 25,000 | 24,000 |
| Brazil[e] | 208 | 181 | 182 | 182 r | 182 [5] |
| Canada | 12,314 | 13,278 | 17,144 | 14,803 | 10,946 |
| Central African Republic[e] | 300 | 340 | 370 | 302 r | 300 |
| China[e] | 100 | 100 | 100 | 100 | 100 |
| Congo (Kinshasa) | 7,000 | 5,800 r | 5,700 r | 4,200 r | 3,600 |
| Côte d'Ivoire[e] | 210 | 210 | 210 | 210 | 210 |
| Ghana | 810 | 780 | 720 e | 520 e | 500 e |
| Guinea | 440 | 380 | 815 | 2,500 | 2,400 |
| Guyana | 357 | 341 | 269 | 169 r | 179 |
| Lesotho | 52 | 231 | 454 | 450 e | 450 e |
| Namibia | 1,902 | 2,400 | 2,266 r | 2,435 r | 2,300 |
| Russia[e] | 23,000 | 23,400 | 23,300 | 21,925 [5] | 17,791 [5] |
| Sierra Leone | 401 r | 362 r | 362 r | 223 r | 200 e |
| South Africa[e] | 6,400 | 6,100 | 6,100 | 5,200 | 2,400 |
| Tanzania[e] | 185 | 230 | 239 | 202 r | 150 |
| Venezuela[e] | 46 | 45 | 45 | 45 | 45 |
| Zimbabwe[e] | 160 | 160 | 100 | 100 | 100 |
| Other[6] | 109 | 70 | 65 | 105 r | 126 |
| Total | 92,800 | 94,000 r | 92,400 r | 87,000 | 74,100 |
| Industrial: | | | | | |
| Angola[e] | 708 | 918 | 970 | 900 | 900 |
| Australia | 25,730 | 21,915 | 18,960 | 15,397 r | 10,700 |
| Botswana[e] | 8,000 | 8,000 | 8,000 | 8,000 | 7,000 |
| Brazil[e] | 600 | 600 | 600 | 600 | 600 |
| Central African Republic[e] | 80 | 85 | 93 | 75 r | 60 |
| China[e] | 960 | 965 | 970 | 1,000 | 1,000 |
| Congo (Kinshasa) | 28,200 | 23,100 r | 22,600 r | 16,700 r | 14,400 |
| Côte d'Ivoire[e] | 90 | 90 | 90 | 90 | 90 |
| Ghana[e] | 200 | 190 | 180 | 130 r | 120 |
| Guinea | 100 | 95 | 200 | 600 | 600 e |
| Russia[e] | 15,000 | 15,000 | 15,000 | 15,000 | 15,000 |
| Sierra Leone | 267 r | 241 r | 241 r | 149 r | 100 e |
| South Africa[e] | 9,400 | 9,100 | 9,100 | 7,700 | 3,100 |
| Tanzania[e] | 35 | 42 | 44 | 31 r | 27 |
| Venezuela[e] | 69 | 70 | 70 | 70 | 70 |
| Zimbabwe[e] | 900 | 900 r | 600 r | 700 r | 700 |
| Other[7] | 94 | 67 | 72 | 115 r | 140 |
| Total | 90,400 | 81,400 r | 77,800 r | 67,300 r | 54,600 |
| Grand total | 183,000 | 175,000 r | 170,000 r | 154,000 r | 129,000 |

[e]Estimated. [r]Revised.

[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 May 19, 2010.

[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 Cameroon, Congo (Brazzaville), Gabon (unspecified), India, Indonesia, Liberia, and Togo (unspecified).

[7]Includes Congo (Brazzaville), India, Indonesia, and Liberia.