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GEMSTONES [ADVANCE RELEASE]

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Gemstones

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In 2017, the estimated value of natural gemstones produced in the United States was $9.23 million, and the estimated value of U.S. production of synthetic gemstones was $55.1 million (table 1). The total estimated value of U.S. gemstone production was $64.3 million. The value of U.S. gemstone imports was $25.1 billion (table 8), and the value of combined U.S. gemstone exports and reexports was estimated to be $23.2 billion. In 2017, world production of natural diamond totaled 151 million carats, of which an estimated 87.9 million carats were gem quality (table 11). The value of diamond imported into the United States in 2017 exceeded $22.7 billion. This value was the combination of $19.8 billion of cut but unset diamonds more than 0.5 carat, $1.84 billion of cut but unset diamonds less than 0.5 carat, and $1.06 billion of rough or uncut natural diamonds (table 5).

In this chapter, 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 9). Gemstones are subdivided into diamond and colored gemstones, which in this chapter designates all natural nondiamond gems. In addition, synthetic gemstones and gemstone simulants are discussed but are treated separately from natural gemstones (tables 1, 7, 8, 10). Synthetic gemstones have the same chemical, optical, and physical properties as their natural gemstone counterparts. Cultured and laboratory-created are terms also used to refer to synthetic gemstones. Simulants (also known as imitation gemstones) have appearances like those of natural gemstone materials, but they have different chemical, optical, and physical properties. Trade data in this chapter are from the U.S. Census Bureau. All percentages in the chapter were calculated using unrounded data. 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 captured the attention of 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. In addition to jewelry, gemstones are used for collections, decorative art objects, and exhibits.

Production

U.S. gemstone production data were based on a USGS survey of more than 250 domestic gemstone producers. 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 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 commercial operations.

The commercial gemstone industry in the United States consists of individuals and companies that mine gemstones or harvest shell and pearl, firms that manufacture synthetic gemstones, and individuals and companies that cut and polish natural and synthetic 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 1,200 and 1,500 individuals.

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 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 was estimated to be $9.23 million during 2017 (table 1). This production value was a 21% decrease from that of 2016.

Natural gemstone materials indigenous to the United States are collected or produced in every State. During 2017, each of the 50 States produced at least $1,560 worth of gemstone materials. The leading 13 States accounted for 95% of the total value, as reported by survey respondents. These States were, in descending order of production value, Arizona, Oregon, Nevada, California, Montana, Maine, Arkansas, Colorado, Idaho, Utah, Tennessee, North Carolina, and New York. Some States were known to produce a single gemstone material—Hawaii produced coral and Tennessee produced 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. A wide variety of gemstones also was found and produced in California, Idaho, Montana, Nevada, North Carolina, and Oregon.

In 2017, the United States had only one active operation in a known diamond-bearing area, Crater of Diamonds State Park near Murfreesboro, AR. The State of Arkansas maintains a dig-for-fee operation for tourists and amateur collectors at the park; Crater of Diamonds is the only diamond mine in the world that is open to the public for collecting diamonds. The diamonds occur in a lamproite breccia tuff associated with a volcanic pipe and in the soil developed from the lamproite breccia tuff. The largest diamond found during the year was a 7.44-carat brown diamond (Rued, 2017). During 2017, 445 diamond stones with an average weight of 0.232 carat were recovered at Crater of Diamonds. Of the 445 diamond stones recovered, 15 weighed more than 1 carat. Since the diamond-bearing pipe and the adjoining area became a State park in 1972, 32,889 diamond stones with a total weight of 6,593.36 carats have been recovered (Waymon Cox, Park Interpreter, Crater of Diamonds State Park, written commun., August 27, 2018). Exploration has demonstrated that this diamond deposit contains about 78.5 million metric tons of diamond-bearing rock (Howard, 1999, p. 62). An Arkansas law prohibits commercial diamond mining in the park.

In addition to natural gemstones, synthetic gemstones and gemstone simulants were produced in the United States in 2017. Synthetic gemstones that have been produced in the United States include alexandrite, cubic zirconia, diamond, emerald, garnet, moissanite, ruby, sapphire, spinel, and turquoise. However, during 2017, only cubic zirconia, diamond, moissanite, and turquoise were produced commercially. Simulants of amber, azurite, chrysocolla, coral, lapis lazuli, malachite, travertine, and turquoise also were manufactured in the United States. In addition, certain colors of synthetic sapphire and spinel, used to represent other gemstones, are classified as simulants.

Synthetic gemstone production in the United States was valued at $55.1 million in 2017, which was a slight increase compared with that of 2016 (table 1). Five companies in five States, representing virtually the entire U.S. synthetic gemstone industry, reported production to the USGS. The States with reported synthetic gemstone production were, in descending order of production value, North Carolina, California, New York, South Carolina, and Arizona. The value of U.S. gemstone simulant output was estimated to be more than $100 million.

In 1954, scientists at General Electric Co. manufactured the first synthetic bits of diamond grit using a high-pressure, high-temperature (HPHT) method. In 1956, the first commercially available synthetic diamond was produced by HPHT at General Electric. This method of growing diamonds has become relatively commonplace in the world as a technology for synthetic diamonds, so much so that thousands of small plants throughout China were using the HPHT method and producing synthetic diamonds suitable for cutting as gemstones. Diamonds of 1 carat or more are harder to manufacture because that size high-quality diamond is difficult to consistently produce, even in the controlled environment of a laboratory using the HPHT method. After more than 60 years of development, several synthetic diamond companies were able to produce relatively large high-quality industrial diamonds that equaled those produced from mines, and billions of carats of synthetic diamonds were manufactured annually by the HPHT process, mostly for industrial applications (Linares, 2013).

In 1954, a patent was issued for a chemical vapor deposition (CVD) type of diamond growth technique. The CVD technique transforms carbon into plasma, which is then precipitated onto a substrate as diamond. Initially, gem-quality CVD synthetic diamond were not possible, but in the mid-1980s, scientists discovered how to reproducibly grow films of microscopic diamond crystals to cover surfaces and small polycrystalline diamonds, which were unsuitable for jewelry, using the CVD process (Linares, 2013). In the early 2000s, Apollo Diamond Inc. (Boston, MA) further developed CVD technology as a method for growing single, extremely pure, gem-quality diamond crystals that were large and suitable for use in jewelry. The CVD technique uses high-energy microwaves in a chamber to energize a methane gas into plasma, which then precipitates carbon atoms onto flat diamond wafer seeds as diamond. In developing this process, synthetic diamond producers discovered the temperature, gas composition, and pressure combination that resulted in the growth of a single diamond crystal and were able to produce synthetic stones that ranged from 1 to 2 carats. The size of the diamonds produced was limited only by the size of the diamond seeds and the growing chamber (table 10).

In 2011, Scio Diamond Technology Corp. (Greenville, SC) acquired the diamond-growing process patents and equipment from Apollo Diamond (Sim, 2016). During 2015, the average size of synthetic diamond crystals grown by Scio Diamond more than doubled, and it produced synthetic single-crystal diamond stones for finished sizes that averaged from 0.75 to 2 carats for jewelry. These CVD diamonds were also appropriate for industrial uses (Scio Diamond Technology Corp., 2015; Bailey, 2016). Scio Diamond continued producing synthetic single-crystal diamond stones until the end of 2016 when they shut down their production facility (Scio Diamond Technology Corp., 2017).

Charles & Colvard, Ltd. in North Carolina was the only U.S. manufacturer of moissanite, a gem-quality synthetic silicon carbide and an excellent diamond simulant. The company used a proprietary patented technology. Moissanite was marketed for its own gem qualities; it exhibits a higher refractive index (brilliance) and higher luster than diamond. Its hardness is between that of corundum (ruby and sapphire) and that of diamond, which gives it durability. Charles & Colvard reported that moissanite sales decreased by 7% to $27.0 million in 2017 compared with $29.2 million in 2016 (Charles & Colvard, Ltd., 2018, p. 2–3).

U.S. mussel shells are used as a source of mother-of-pearl and as seed material for culturing pearls. The value of U.S. shell production decreased slightly to $337,000 in 2017 compared with $340,000 in 2016 (table 1). This mussel shell data includes only freshwater mussel shells. 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

Although the United States accounted for only a small portion of total global gemstone production, it was the world's leading diamond and nondiamond gemstone market, accounting for more than 35% of world gemstone consumption in 2017. In the United States, the majority of domestic consumers designated diamond as their favorite gemstone. This popularity of diamonds is evidenced by the diamond market accounting for 95% of the $22.0 billion total value of the U.S. gemstone apparent consumption. The U.S. apparent consumption for unset gem-quality diamond during the year was estimated to be $21.0 billion, a slight increase compared with $20.7 billion in 2016. Domestic markets for natural, unset nondiamond gemstones totaled $1.01 billion in 2017, which was a 18% decrease from $1.23 billion in 2016.

U.S. specialty jewelry store retail sales increased to $34.6 billion for the year in 2017, a 5.2% increase compared with retail sales in 2016. End of year sales were higher than anticipated: November 2017 U.S. fine jewelry and watch sales increased by 8.4% over those of November 2016, and December 2017 sales increased to $6.57 billion compared with sales of $6.50 billion in December 2016 (Munn, 2018).

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. More than 14,000 categories are used to assess rough diamond, and more than 100,000 different combinations of carat, clarity, color, and cut values can be 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. Value of production and prices of gemstones produced and (or) sold in the United States are listed in tables 1, 2, and 3. In addition, customs values for diamonds and other gemstones imported, exported, or reexported are listed in tables 4 through 8.

De Beers Group companies remained a significant force, influencing the price of gem-quality diamond sales worldwide during 2017. De Beers companies produced about 20% of total global quantity and 33% of total global value (De Beers UK Ltd., 2018, p. 7).

Since 2000, De Beers' control of world diamond pricing has gradually decreased. Instead, flexible pricing mechanisms have set the stage for new methods of rough diamond sales in addition to rough diamonds being sold through a limited number of sightholder sales, the method used for years by De Beers. Rough diamonds were also sold by auctions, placed sales, tender sales, and term contracts (De Beers UK Ltd., 2014, p. 39).

Foreign Trade

During 2017, total U.S. natural gemstone trade with all countries and localities was valued at about $48.3 billion, which was a slight increase from that of 2016. Total U.S. natural gemstone trade with all countries and localities, excluding reexports, was valued at about $28.1 billion. Diamond accounted for about 87% of the 2017 gemstone trade total value, excluding reexports. In 2017, U.S. import quantities of cut diamond decreased by 10% compared with those of 2016, and the value decreased by 3%. U.S. import quantities of rough and unworked diamond in 2017 decreased by 5% compared with the previous year, and the value increased by 23% compared with that of 2016 (table 8). 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 2017, U.S. export and reexport quantities of gem-grade diamond decreased by 4% compared with those of 2016, and the value decreased by 3%. The large quantity of reexports revealed the significance of the United States in the world's diamond supply network (table 4).

Import values of natural gemstones decreased slightly to $24.9 billion for the United States in 2017 compared with $25.2 billion in 2016. Import values of synthetic gemstone more than doubled to $195 million in 2017 compared with $74.2 million 2016 (tables 7–8). This increase was due to large increases in synthetic gemstone imports from Canada, India, Hong Kong, Mexico, and Singapore. Synthetic gemstone imports from China, Germany, Hong Kong, India, Mexico, Russia, and Singapore with a value of about $178 million accounted for about 94% (by value) of total domestic imports of synthetic gemstones during 2017 (table 7). The marketing of imported synthetic gemstones and enhanced gemstones as natural gemstones and the mixing of synthetic materials with natural stones in imported parcels continued to be an issue for some domestic jewelers and sales companies in 2017. In addition, some simulants were marketed as natural or synthetic gemstones during the year, as in previous years.

World Review

The worldwide gemstone industry 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 influenced by consumer demand and supply availability and, to a lesser extent, by managing the quality and quantity of the gemstones relative to demand, a function that has been performed by De Beers sightholder sales. Unlike diamond, colored gemstones are primarily produced at relatively small, low-cost operations with few dominant producers; prices are influenced only by consumer demand and supply availability.

In 2017, global natural rough diamond production increased by 19% to 151 million carats from 127 million carats in 2016. Of the 151 million carats of total natural diamond production, 87.9 million carats (58% of total diamond production) was gemstone diamond and 63.0 million carats (42% of total diamond production) was industrial diamond (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). The world's leading rough diamond producers were as follows: Russia, producing 42.6 million carats (28% of total world production); Canada, with 23.2 million carats (15%);

Botswana, with 22.9 million carats (15%); Congo (Kinshasa), with 18.9 million carats (13%); Australia, with 17.1 million carats (11%); South Africa, with 9.68 million carats (6.4%); and Angola, with 9.44 million carats (6.3%); other countries produced 6.95 million carats (4.6%). During 2017, the value of worldwide rough diamond production increased by 15% to $14.1 billion from the 2016 value of $12.3 billion (Kimberley Process, 2017, 2018). In 2017, Russia also was the world's leading gemstone diamond producer with 27%; followed by Canada, 26%; Botswana, 18%; Angola, 10%; South Africa, 9%; Congo (Kinshasa), 4%; and Namibia, 2%. These seven countries produced 97% (by quantity) of the world's gemstone diamond output in 2017 (table 11).

During 2017, OJSC ALROSA and De Beers Group remained the two leading diamond producers by quantity and value. ALROSA's production was about 24% of total global quantity and 24% of total global value; De Beers' production was about 20% of total global quantity and 33% of total global value. The third-ranked company was Rio Tinto Ltd., which produced about 13% of total global production quantity and approximately 12% of global production value (De Beers UK Ltd., 2018, p. 7).

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 objectives of the UN Security Council. The KPCS monitors rough diamond trade in both gemstone and industrial diamond. 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. Australia assumed the chair of KPCS from January 1 through December 31, 2017. As of December 31, 2017, the 54 participants represented 81 nations (including the 28 member nations of the European Union counted as a single participant) plus the rough-diamond-trading entity of Taipei (Taiwan). The participating nations in the KPCS account for approximately 99.8% of the global production and trade of rough diamonds (Kimberley Process, 2019).

Globally, the value of production of rough natural gemstones other than diamond was estimated to be more than $1.15 billion in 2017, based on total value of world rough nondiamond gemstone exports. Most nondiamond gemstone mines are small, low-cost, and widely dispersed operations that are often in remote regions. 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 2017.

Worldwide diamond exploration spending decreased by 28% during 2017 from that of 2016 and by 60% since 2012. In 2017, the global diamond exploration budget was approximately $208 million, which was less than 3% of the total spent on all mineral exploration. The three leading countries for diamond exploration were, in descending order of 2017 budget, Russia, Canada, and Botswana. Their combined budgets accounted for about 79% of the global diamond exploration budget (Wilburn and Karl, 2018, p. 34–35).

Botswana.—Rough diamond production in Botswana was 22.9 million carats during 2017, a 9% increase compared with that of 2016, accounting for 15% of total global production. This diamond production was valued at $3.33 billion, a 17% increase compared with that of 2016 (Kimberley Process, 2017, 2018).

The Jwaneng diamond mine in the Kalahari Desert of south-central Botswana was wholly owned by Debswana Diamond Co. (Pty.) Ltd. The company began the Cut 8 project at Jwaneng in 2016, and production began in 2017 (De Beers UK Ltd., 2017, p. 7).

Canada.—Rough diamond production in Canada was 23.2 million carats during 2017, a 78% increase compared with that of 2016, accounting for 15% of total global production. This diamond production was valued at $2.06 billion, a 47% increase compared with that of 2016 (Kimberley Process, 2017, 2018). Canada was the main driver of the increase in global rough diamond production, overtaking Botswana as the second-leading diamond producing country by volume.

The Diavik Diamond Mine in the Northwest Territories began an extension project of the A21 kimberlite pipe pit during 2016 and continued the project during 2017 with production expected to begin in 2018. Diavik was jointly owned by Rio Tinto Group (60%) and Dominion Diamond Corp. (40%) (De Beers UK Ltd., 2017, p. 7; 2018, p. 7).

The Gahcho Kué Mine in the Northwest Territories entered full production late in 2016 and had its first full year of production in 2017. The mine was jointly owned by De Beers Canada, Inc. (51%) and Mountain Province Diamonds Inc. (49%). The mine owners anticipated average annual diamond production of 4.5 million carats (De Beers UK Ltd., 2017, p. 7; Diamond Loupe, The, 2018).

The Renard Mine in Quebec also entered full production late in 2016 and had its first full year of production in 2017. The mine was wholly owned by Stornoway Diamonds Corp. Stornoway anticipated average annual diamond production of 1.6 million carats (De Beers UK Ltd., 2017, p. 7; Diamond Loupe, The, 2018).

Lesotho.—Rough diamond production in Lesotho was 1.13 million carats during 2017, more than triple that of 2016, but accounting for less than 1% of total global production. This diamond production had a value of $343 million, a 6% decrease compared with that of 2016 (Kimberley Process, 2017, 2018).

The Liqhobong Diamond Mine in the Maluti Mountains of northern Lesotho began ramping up production in 2016 and reached full commercial production in 2017. The 2017 reported production was 366,000 carats (Mining Data Online, 2020). The mine was owned by Firestone Diamonds plc (75%) and the Government of Lesotho (25%). The mine owners anticipated average annual diamond production of 1.0 million carats (De Beers UK Ltd., 2017, p. 7).

Russia.—Rough diamond production in Russia was 42.6 million carats during 2017, a 6% increase compared with that of 2016, accounting for 28% of total global production. This diamond production was valued at $4.11 billion, a 15% increase compared with that of 2016 (Kimberley Process, 2017, 2018).

ALROSA started construction of the Verkhne-Munskoe project in Yakutia, during 2016. Project completion and mine startup were expected in 2018 (De Beers UK Ltd., 2017, p. 7; 2018, p. 7).

Outlook

As domestic and global luxury spending increase, sales of gemstones and jewelry are expected to increase also. As the gemstone and jewelry industries and their consumers become more comfortable with the internet and other forms of e-commerce, internet sales of diamonds, gemstones, and jewelry are expected to continue expanding and increasing in popularity. Internet sales are expected to add to and partially replace "brick-and-mortar" store sales.

Global diamond production is expected to increase during the next few years as a result of new projects coming onstream. By 2020, about 25% of diamond production will come from projects that are currently being developed, but additional increases in output will come from expected expansions at currently operating mines (De Beers UK Ltd., 2016, p. 29; 2017, p. 7; 2018, p. 7).

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

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

(Thousand dollars)

Gem materials	Natural gems		Synthetic gems	
	2016	2017	2016	2017
Beryl	360	141	--	--
Coral, all types	68	10	--	--
Cubic zirconia	XX	XX	12,000	12,000
Diamond	70	52	13,600	16,000
Garnet	53	34	--	--
Gem feldspar	1,730	776	--	--
Geodes and nodules	69	54	--	--
Moissanite	XX	XX	29,200	27,000
Opal	138	113	--	--
Quartz:				
Macrocrystalline[2]	496	585	--	--
Cryptocrystalline[3]	604	608	--	--
Sapphire and ruby	331	268	--	--
Shell	340	337	--	--
Topaz	13	10	--	--
Tourmaline	43	245	--	--
Turquoise	2,280	793	75	75
Other	5,140	5,200	--	--
Total	11,700	9,230	54,900	55,100

XX Not applicable. -- Zero.

[1]Table includes data available through June 3, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

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

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

TABLE 2
PRICES PER CARAT OF U.S. CUT ROUND DIAMONDS, BY SIZE AND QUALITY IN 2017

Weight (carats)	Color[1]	Clarity[2]	Representative price per carat		
			January[3]	June[4]	December[5]
0.25	G	VS1	$1,650	$1,650	$1,650
Do.	do.	VS2	1,575	1,575	1,575
Do.	do.	SI1	1,250	1,250	1,250
Do.	H	VS1	1,600	1,600	1,600
Do.	do.	VS2	1,500	1,500	1,500
Do.	do.	SI1	1,200	1,200	1,200
0.50	G	VS1	2,600	2,600	2,600
Do.	do.	VS2	2,400	2,400	2,400
Do.	do.	SI1	2,080	2,080	2,080
Do.	H	VS1	2,390	2,390	2,390
Do.	do.	VS2	2,320	2,320	2,320
Do.	do.	SI1	1,910	1,910	1,910
1.00	G	VS1	7,060	7,060	6,710
Do.	do.	VS2	6,600	6,600	6,200
Do.	do.	SI1	6,000	6,000	5,600
Do.	H	VS1	6,450	6,450	6,080
Do.	do.	VS2	6,000	6,000	5,600
Do.	do.	SI1	5,200	5,200	5,070
2.00	G	VS1	13,690	13,690	12,950
Do.	do.	VS2	12,250	12,250	11,310
Do.	do.	SI1	10,660	10,660	9,625
Do.	H	VS1	11,620	11,620	11,200
Do.	do.	VS2	10,450	10,450	10,000
Do.	do.	SI1	9,950	9,950	9,020

Do., do. Ditto.
[1]Gemological Institute of America (GIA) color grades: D—colorless; E—rare white; G, H, I—traces of color.
[2]GIA clarity terms: IF—no blemishes; VVS1—very, very slightly included; VS1—very slightly included; VS2—very slightly included, but not visible; SI1—slightly included.
[3]Source: The Gem Guide, v. 36, no. 1, January/February 2017, p. 24–26.
[4]Source: The Gem Guide, v. 36, no. 4, July/August 2017, p. 26–28.
[5]Source: The Gem Guide, v. 36, no. 6, November/December 2017, p. 26–28.

TABLE 3
PRICES PER CARAT OF U.S. CUT COLORED GEMSTONES IN 2017

Gemstone	Price range per carat		
	January[1]	August[2]	December[3]
Amethyst	$30–35	$30–35	$30–35
Aquamarine	325–375	325–375	325–375
Citrine	13–22	13–22	13–22
Emerald	3,250–4,500	3,250–4,500	3,250–4,500
Opal, fire	180–250	180–250	180–250
Opal, white (also jelly opal)	65–80	65–80	65–80
Pearl, cultured saltwater[4]	5	5	5
Peridot	165–200	165–180	165–180
Rhodolite garnet	55–80	55–80	55–80
Ruby	2,500–3,400	2,640–3,600	2,640–3,600
Sapphire, blue	1,080–1,700	1,080–1,900	1,080–1,900
Tanzanite	375–395	375–395	375–395
Topaz, blue	7–10	7–8	7–8
Topaz, yellow	175–250	175–250	175–250
Tourmaline, green	135–200	135–200	135–200
Tourmaline, pink	175–200	170–200	170–200

[1]Source: The Gem Guide, v. 36, no. 1, January/February 2017, p. 53–54, 57, 61, 66–68, 70, 72–75, and 82. 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, v. 36, no. 4, July/August 2017, p. 54–55, 60, 64, 72–74, 77, 80–83, and 90. 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]Source: The Gem Guide, v. 36, no. 6, November/December 2017, p. 54–55, 60, 64, 72–74, 77–78, 80–83, and 90. 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.
[4]Prices are per 4.5–5-millimeter pearl.

TABLE 4
U.S. EXPORTS AND REEXPORTS OF DIAMOND (EXCLUSIVE OF INDUSTRIAL DIAMOND), BY COUNTRY OR LOCALITY[1, 2]

Country or locality	2016		2017	
	Quantity (carats)	Value[3] (thousands)	Quantity (carats)	Value[3] (thousands)
Exports:				
Armenia	618	$67	568	$100
Aruba	1,220	2,350	1,300	3,580
Australia	19,000	20,700	11,500	11,900
Belgium	564,000	407,000	85,700	232,000
Brazil	15,500	5,110	32,800	6,830
Canada	38,100 r	66,600	42,100	77,000
China	1,290	2,770	1,410	12,700
Dominican Republic	7,180	3,540	49	229
France	9,410	26,200	892	17,100
Germany	1,590	6,350	1,540	2,040
Hong Kong	1,170,000	597,000	1,420,000	491,000
India	669,000	293,000	561,000	343,000
Ireland	7,950	37,200	332	1,450
Israel	184,000	601,000	61,000	253,000
Italy	24,900	14,700	4,350	3,240
Japan	2,610	13,500	13,200	2,820
Laos	28	12	--	--
Lebanon	1,560	1,620	496	1,190
Macau	1,710	8,570	103	629
Malaysia	54	184	22	105
Mexico	331,000	71,300	609,000	61,000
Namibia	136	25	--	--
Netherlands	217	790	7,530	10,400
Panama	17,600	2,800	22,500	1,080
Singapore	5,050	14,100	1,060	13,000
Sint Maarten	12,700	17,400	3,910	11,900
South Africa	316	2,650	276	3,110
Switzerland	44,200	58,500	22,800	36,300
Taiwan	5,310	3,110	1,100	309
Thailand	148,000	11,300	96,400	20,000
United Arab Emirates	408,000	113,000	97,300	40,100
United Kingdom	49,700	19,900	6,410	13,200
Vietnam	36,900	45,600	14,500	18,800
Other	8,850 r	16,100 r	11,200	13,600
Total	3,790,000	2,480,000	3,130,000	1,700,000
Reexports:				
Armenia	27,500	4,860	27,500	5,900
Aruba	2,530	5,380	2,980	6,070
Australia	7,560	41,900	10,600	53,900
Belgium	664,000	2,740,000	621,000	2,460,000
Brazil	1,190	106	24,700	2,690
Canada	99,900 r	143,000 r	93,000	125,000
China	45,200	42,100	33,800	44,700
Dominican Republic	17,200	6,830	19,100	6,320
France	3,910	217,000	2,130	121,000
Germany	30,800	2,190	19,400	5,930
Hong Kong	2,300,000	2,440,000	2,410,000	2,900,000
India	2,640,000	4,510,000	2,610,000	3,800,000
Ireland	140	587	14,500	10,100
Israel	1,050,000	4,370,000	984,000	4,620,000
Italy	11,100	34,400	61,900	59,300
Japan	27,700	63,600	40,900	66,900
Laos	8,640	4,780	7,280	4,080
Lebanon	1,180	2,870	1,470	3,750
Macau	5	28	37	120
Malaysia	426	795	5,280	1,740
Mexico	10,000	10,700	8,720	11,500
Namibia	20,600	10,400	9,580	6,410

See footnotes at end of table.

TABLE 4—Continued
U.S. EXPORTS AND REEXPORTS OF DIAMOND (EXCLUSIVE OF INDUSTRIAL DIAMOND), BY COUNTRY OR LOCALITY[1, 2]

Country or locality	2016 Quantity (carats)	2016 Value[3] (thousands)	2017 Quantity (carats)	2017 Value[3] (thousands)
Reexports:—Continued				
Japan	27,700	63,600	40,900	66,900
Laos	8,640	4,780	7,280	4,080
Lebanon	1,180	2,870	1,470	3,750
Macau	5	28	37	120
Malaysia	426	795	5,280	1,740
Mexico	10,000	10,700	8,720	11,500
Namibia	20,600	10,400	9,580	6,410
Netherlands	428	1,840	2,320	1,640
Panama	1,350	2,120	1,070	791
Singapore	6,780	41,400	2,780	45,200
Sint Maarten	20,600	41,600	14,300	36,600
South Africa	7,740	94,500	8,360	116,000
Switzerland	96,300	1,030,000	104,000	1,260,000
Taiwan	704	4,800	6,290	4,870
Thailand	130,000	88,000	113,000	81,300
United Arab Emirates	432,000	539,000	583,000	788,000
United Kingdom	53,700	454,000	55,900	361,000
Vietnam	7,130	7,530	38,200	44,200
Other	22,800 r	9,430 r	25,200	40,300
Total	7,750,000	17,000,000 r	7,960,000	17,100,000
Grand total	11,500,000	19,400,000 r	11,100,000	18,800,000

rRevised. -- Zero.

[1]Table includes data available through June 3, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Export and reexport data are for Harmonized Tariff Schedule of the United States codes 7102.31.0000, 7102.39.0010, and 7102.39.0050.

[3]Values are free alongside ship.

Source: U.S. Census Bureau.

TABLE 5
U.S. IMPORTS FOR CONSUMPTION OF DIAMOND, BY KIND, WEIGHT, AND COUNTRY OR LOCALITY[1]

Kind, weight, and country or locality	2016 Quantity (carats)	2016 Value[2] (thousands)	2017 Quantity (carats)	2017 Value[2] (thousands)
Rough or uncut, natural:[3, 4]				
Angola	34,000	$232,000	19,300	$132,000
Australia	18,500	1,540	4,170	463
Botswana	63,700	318,000	231,000	629,000
Brazil	5,830	20,600	2,340	13,400
Canada	112,000	26,400	131,000	59,400
Congo (Brazzaville)	2,210	25	--	--
Congo (Kinshasa)	1,340	6,390	6,270	991
Guyana	7,510	1,950	3,440	1,540
India	4,470	3,260	21,500	162
Lesotho	407	13,400	510	15,600
Namibia	18,300	23,100	22,500	29,700
Russia	173,000	21,800	23,500	20,200
Sierra Leone	466	1,290	2,130	12,600
South Africa	173,000	139,000	118,000	143,000
Tanzania	147	50,200	208	102
Other	614 r	1,450 r	504	2,400
Total	616,000	860,000	587,000	1,060,000
Cut but unset, not more than 0.5 carat:[5]				
Armenia	6,850	3,390	3,130	1,550
Australia	1,300	1,860	3,550	543
Belgium	154,000	99,800	164,000	84,100
Botswana	5,610	14,400	5,070	10,600
Brazil	1,050	866	1,870	542
Cambodia	22,200	17,300	22,800	16,900
Canada	20,200	12,600	8,510	8,150
China	34,500	29,300	58,400	31,000
France	533	1,030	300	452
Germany	5,120 r	1,650 r	3,050	1,100
Hong Kong	164,000	28,800	211,000	40,300
India	5,070,000	1,560,000	4,060,000	1,260,000
Israel	761,000	285,000	742,000	267,000
Italy	19,600	4,170	2,240	805
Japan	1,290	579	1,270	417
Laos	8,030	9,290	5,970	6,120
Mauritius	16,100	30,400	21,300	33,200
Mexico	70,600	15,400	13,900	3,740
Mozambique	4,380	960	2,470	45
Namibia	2,120	6,060	189	453
Nigeria	1,880	659	--	--
Singapore	4,000	3,600	235	175
South Africa	28,100	40,600	4,010	3,810
Sri Lanka	3,480	3,660	6,570	6,360
Thailand	44,600	11,300	16,900	5,910
United Arab Emirates	16,100	3,670	6,740	2,380
United Kingdom	24,300	2,960	20,400	3,640
Vietnam	49,500	44,500	73,900	42,100
Other	3,880 r	2,010 r	5,660	3,750
Total	6,540,000	2,240,000	5,460,000	1,840,000
Cut but unset, more than 0.5 carat:[6]				
Armenia	2,210	1,600	2,850	1,920
Australia	3,570	95,800	3,280	159,000
Belgium	479,000	3,180,000	385,000	2,930,000
Botswana	24,900	94,800	25,500	125,000
Brazil	658	3,700	840	36,100
Canada	34,000	129,000	24,800	88,000
China	25,100	181,000	27,200	178,000
France	1,520	58,200	1,880	57,300
Germany	1,480	3,580	560	4,110

See footnotes at end of table.

TABLE 5—Continued
U.S. IMPORTS FOR CONSUMPTION OF DIAMOND, BY KIND, WEIGHT, AND COUNTRY OR LOCALITY[1]

Kind, weight, and country or locality	2016 Quantity (carats)	2016 Value[2] (thousands)	2017 Quantity (carats)	2017 Value[2] (thousands)
Cut but unset, more than 0.5 carat:[6]—Continued				
Hong Kong	29,100	149,000	51,900	281,000
India	2,430,000	7,510,000	2,450,000	7,290,000
Indonesia	4,170	21,400	15	269
Israel	1,350,000	7,150,000	1,320,000	7,170,000
Italy	818 r	14,100	2,450	23,400
Japan	3,430	6,760	1,750	4,760
Mauritius	7,450	28,200	7,410	24,600
Namibia	10,300	31,700	15,700	57,200
Russia	14,600	61,500	6,920	50,200
Singapore	11,000	20,300	1,290	14,400
South Africa	27,500	692,000	39,300	617,000
Spain	696	2,500	857	16,100
Switzerland	9,050	409,000	7,060	430,000
Thailand	8,730	39,100	17,800	25,300
Ukraine	758	1,110	2,540	2,840
United Arab Emirates	7,720	62,400	5,080	38,200
United Kingdom	6,730	78,700	11,400	134,000
Vietnam	2,410	7,270	4,810	12,600
Other	4,110 r	72,000 r	16,300	57,600
Total	4,500,000	20,100,000	4,430,000	19,800,000

rRevised. -- Zero.
[1]Table includes data available through June 3, 2020. 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]Harmonized Tariff Schedule of the United States (HTS) code 7102.31.0000.
[5]HTS code 7102.39.0010.
[6]HTS code 7102.39.0050.

Source: U.S. Census Bureau.

TABLE 6
U.S. IMPORTS FOR CONSUMPTION OF GEMSTONES, OTHER THAN DIAMOND, BY KIND AND COUNTRY OR LOCALITY[1]

Kind and country or locality	2016 Quantity (carats)	2016 Value[2] (thousands)	2017 Quantity (carats)	2017 Value[2] (thousands)
Emerald:[3]				
Belgium	1,220	$4,530	4,580	$4,870
Brazil	113,000	17,000	132,000	18,000
Burma	--	--	1,360	140
Canada	1,140	414	724	93
China	22,100	464	7,470	255
Colombia	285,000	233,000	334,000	209,000
France	4,480	33,800	8,700	60,000
Germany	14,000	1,300	16,700	4,110
Hong Kong	217,000	29,700	424,000	158,000
India	1,090,000	134,000	1,040,000	131,000
Israel	180,000	60,000	223,000	70,600
Italy	5,790	13,000	26,900	20,700
Japan	1,070	117	587	79
Lebanon	1,450	235	5	9
Madagascar	19	140	36,500	1,070
Malaysia	6,500	27	97	46
Mozambique	4,320	1,150	4,260	1,590
South Africa	8,830	1,790	10,300	3,160
Sri Lanka	7,500	3,270	841	1,780
Switzerland	8,550	30,100	9,480	56,400
Thailand	525,000	17,500	540,000	20,100
United Arab Emirates	12,200	1,650	8,020	1,150
United Kingdom	2,170	7,510	3,660	30,200
Zambia	291,000	35,700	307,000	37,100
Zimbabwe	3,400	300	--	--
Other	1,570 r	3,040 r	548	641
Total	2,810,000	630,000	3,140,000	830,000
Ruby:[4]				
Afghanistan	1,280	1,730	--	--
Belgium	348	1,320	627	4,350
Brazil	1,960	14	3,400	181
Burma	1,750	6,630	26,600	8,250
Canada	1,790	61	75	132
China	8,950	118	72,000	1,660
France	1,010	2,990	6,380	26,900
Germany	6,260	357	8,640	3,610
Hong Kong	357,000	11,000	440,000	27,800
India	1,570,000	21,000	1,410,000	24,200
Israel	1,190	4,070	10,400	4,700
Italy	1,770	1,690	5,660	12,500
Kenya	7,860	81	4,700	159
Madagascar	127,000	6,470	34,600	5,860
Malaysia	11,500	12	12,500	21
Mozambique	95,000	36,700	123,000	46,100
South Africa	11,300	1,450	6,000	3,150
Sri Lanka	2,680	1,810	2,500	1,060
Switzerland	6,320	4,320	2,660	29,100
Tanzania	954	5,510	1,540	19,700
Thailand	1,980,000	70,300	2,180,000	130,000
United Arab Emirates	100	696	4,230	4
United Kingdom	200	897	1,330	5,640
Other	1,350 r	1,150 r	3,040	1,190
Total	4,200,000	180,000	4,360,000	356,000

See footnotes at end of table.

TABLE 6—Continued
U.S. IMPORTS FOR CONSUMPTION OF GEMSTONES, OTHER THAN DIAMOND, BY KIND AND COUNTRY OR LOCALITY[1]

Kind and country or locality	2016 Quantity (carats)	2016 Value[2] (thousands)	2017 Quantity (carats)	2017 Value[2] (thousands)
Sapphire:[5]				
Australia	1,570	186	6,100	262
Belgium	716	5,050	1,390	2,070
Brazil	16,600	463	12,100	559
Burma	20,400	6,730	17,200	2,920
Canada	1,520	224	459	277
China	120,000	1,400	81,100	192
France	5,080	37,300	15,200	47,200
Germany	42,400	1,440	30,100	7,270
Gibraltar	--	--	10,000	100
Hong Kong	173,000	42,400	429,000	73,700
India	1,550,000	38,300	1,420,000	27,300
Israel	13,500	8,640	18,200	15,000
Italy	5,870	8,370	6,580	8,340
Japan	2,060	160	2,820	334
Kenya	3,690	102	1,690	40
Madagascar	220,000	6,080	113,000	6,240
Mozambique	11,800	663	5,710	451
Pakistan	4,100	988	--	--
South Africa	10,400	1,820	2,180	207
Sri Lanka	1,080,000	96,300	426,000	104,000
Switzerland	7,920	52,900	21,200	53,500
Thailand	4,060,000	111,000	3,810,000	121,000
Turkey	928	95	137	2
United Arab Emirates	270	705	1,720	377
United Kingdom	995	11,900	5,880	10,300
Zambia	220	88	2,030	22
Other	2,450	1,470	5,230	4,470
Total	7,360,000	435,000	6,440,000	486,000
Other precious and semiprecious nondiamond gemstones:				
Rough, uncut, all countries[6]	1,820,000,000	49,300	724,000,000	16,500
Cut, set and unset, all countries[7]	NA	517,000 r	NA	361,000

rRevised. NA Not available. -- Zero.
[1]Table includes data available through June 3, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Customs value.
[3]Emerald data are for Harmonized Tariff Schedule of the United States (HTS) code 7103.91.0030.
[4]Ruby data are for HTS code 7103.91.0010.
[5]Sapphire data are for HTS code 7103.91.0020.
[6]Rough, uncut; data are for HTS codes 7103.10.2020 and 7103.10.2080.
[7]Cut, set and unset; data are for HTS code 7103.99.1080.

Source: U.S. Census Bureau.

TABLE 7
VALUE OF U.S. IMPORTS OF SYNTHETIC
AND IMITATION GEMSTONES, BY COUNTRY OR LOCALITY[1, 2]

(Thousand dollars)

Country or locality	2016	2017
Synthetic, cut but unset:[3]		
Austria	1,370	1,250
Belgium	1,810 [r]	2,190
Canada	65	1,570
China	15,600	19,300
Germany	8,180	8,560
Hong Kong	2,850	23,100
India	24,900	78,100
Israel	950	2,360
Mexico	240	2,980
Russia	11,900 [r]	10,300
Singapore	489	36,000
South Africa	--	30
Sri Lanka	431	319
Thailand	735	1,230
Other	1,720 [r]	2,470
Total	71,200	190,000
Imitation:[4]		
Brazil	25	--
Canada	26	18
China	18,500	17,600
Germany	4	29
Hong Kong	34	20
India	7	84
Italy	1	37
Japan	47	130
Korea, Republic of	199	148
Netherlands	19	--
Pakistan	106	49
Spain	2	--
Taiwan	1,040	482
Thailand	122	11
United Kingdom	10	11
Other	80	104
Total	20,200	18,700

[r]Revised. -- Zero.
[1]Table includes data available through June 3, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Customs value.
[3]Harmonized Tariff Schedule of the United States (HTS) code 7104.90.1000.
[4]HTS code 3926.90.4000.

Source: U.S. Census Bureau.

TABLE 8
U.S. IMPORTS FOR CONSUMPTION OF GEMSTONES[1]

(Thousand carats and thousand dollars)

Stones	2016		2017	
	Quantity	Value[2]	Quantity	Value[2]
Coral and similar materials, unworked[3]	7,480	15,100	6,930	15,400
Diamonds:				
Cut but unset[4]	11,000	22,300,000	9,890	21,700,000
Rough or uncut[5]	616	860,000	587	1,060,000
Emeralds, cut but unset[6]	2,810	630,000	3,140	830,000
Pearls:				
Cultured[7]	NA	23,500	NA	18,300
Imitation[8]	NA	39,500	NA	36,400
Natural[9]	NA	41,400	NA	12,900
Rubies, cut but unset[10]	4,200	180,000	4,360	356,000
Sapphires, cut but unset[11]	7,360	435,000	6,440	486,000
Other precious and semiprecious nondiamond gemstones:				
Rough, uncut[12]	1,820,000	49,300	724,000	16,500
Cut, set and unset[13]	NA	517,000 r	NA	361,000
Other[14]	NA	15,300 r	NA	9,580
Synthetic:				
Cut but unset[15]	41,000	71,200	36,100	190,000
Other[16]	NA	2,950 r	NA	4,740
Imitation gemstone[17]	NA	20,200	NA	18,700
Total	1,890,000	25,200,000	791,000	25,100,000

rRevised. NA Not available.
[1]Table includes data available through June 3, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Customs value.
[3]Coral and similar materials, unworked; data are for Harmonized Tariff of the United States (HTS) code 0508.00.0000.
[4]Diamonds, cut but unset; data are for HTS codes 7102.39.0010 and 7102.39.0050.
[5]Diamond, rough or uncut; data are for HTS code 7102.31.0000.
[6]Emeralds, cut but unset; data are for HTS code 7103.91.0030.
[7]Cultured pearl data are for HTS code 7101.21.0000.
[8]Imitation pearl data are for HTS codes 7018.10.1000 and 7018.10.2000.
[9]Natural pearl data are for HTS code 7101.10.0000.
[10]Rubies, cut but unset; data are for HTS code 7103.91.0010.
[11]Sapphires, cut but unset; data are for HTS code 7103.91.0020.
[12]Other precious and semiprecious nondiamond gemstones, rough, uncut; data are for HTS codes 7103.10.2020 and 7103.10.2080.
[13]Other precious and semiprecious nondiamond gemstones, cut, set and unset; data are for HTS code 7103.99.1080.
[14]Other precious and semiprecious nondiamond gemstones, other data are for HTS code 7103.99.5080.
[15]Reconstructed, cut but unset synthetic gemstones; data are for HTS code 7104.90.1000.
[16]Reconstructed, worked but unset synthetic gemstones; data are for HTS code 7104.90.5000.
[17]Imitation gemstones, excluding pearls; data are for HTS code 3926.90.4000.

Source: U.S. Census Bureau.

TABLE 9
GUIDE TO SELECTED GEMSTONES AND GEM MATERIALS USED IN JEWELRY

Name	Composition	Color	Practical size[1]	Cost[2]	Mohs hardness	Specific gravity	Refraction	Refractive index	May be confused with	Recognition characteristics
Amber	Hydrocarbon	Yellow, red, green, blue	Any	Low to medium	2.5–2.0	1.1–1.0	Single	1.54	Synthetic or pressed plastics, kauri gum	Fossil resin, color, low density, soft, insects.
Apatite	Chlorocalcium phosphate	Colorless, pink, yellow, green, blue, violet	Small	Low	5.0	3.23–3.16	Double	1.65–1.63	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.	4.0–3.5	3.9–3.7	do.	1.85–1.72	Dumortierite, hauynite, lapis lazuli, lazulite, sodalite	Color, softness, crystal habits, associated minerals.
Benitoite	Barium titanium silicate	Blue, purple, pink, colorless	do.	High	6.5–6.0	3.68–3.64	do.	1.80–1.76	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	8.0–7.5	2.80–2.63	do.	1.58	Synthetic spinel, blue topaz	Double refraction, refractive index.
Bixbite	do.	Red	Small	Very high	8.0–7.5	2.80–2.63	do.	1.58	Pressed plastics, tourmaline	Refractive index.
Emerald, natural	do.	Green	Medium	do.	7.5	2.80–2.63	do.	1.58	Fused emerald, glass, tourmaline, peridot, green garnet doublets	Emerald filter, dichroism, refractive index.
Emerald, synthetic	do.	do.	Small	High	8.0–7.5	2.80–2.63	do.	1.58	Genuine emerald	Lack of flaws, brilliant fluorescence in ultraviolet light.
Golden (heliodor)	do.	Yellow to golden	Any	Low to medium	8.0–7.5	2.80–2.63	do.	1.58	Citrine, topaz, glass, doublets	Weak-colored.
Goshenite	do.	Colorless	do.	Low	8.0–7.5	2.80–2.63	do.	1.58	Quartz, glass, white sapphire, white topaz	Refractive index.
Morganite	do.	Pink to rose	do.	do.	8.0–7.5	2.80–2.63	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)	1.66–1.49	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.	6.0–5.0	2.78–2.54	XX	1.56–1.55	Purple marble	Color, locality.
Chrysoberyl:										
Alexandrite	Beryllium aluminate	Green by direct sunlight or incandescent light, red by indirect sunlight or fluorescent light	do.	High	8.5	3.84–3.50	Double	1.75	Synthetic	Strong dichroism, color varies from red to green, hardness.
Cat's eye	do.	Greenish to brownish	Small to large	do.	8.5	3.84–3.50	do.	1.75	Synthetic, shell	Density, translucence, chatoyance.
Chrysolite	do.	Yellow, green, and (or) brown	Medium	Medium	8.5	3.84–3.50	do.	1.75	Tourmaline, peridot	Refractive index, silky.

See footnotes at end of table.

TABLE 9—Continued
GUIDE TO SELECTED GEMSTONES AND GEM MATERIALS USED IN JEWELRY

Name	Composition	Color	Practical size[1]	Cost[2]	Mohs hardness	Specific gravity	Refraction	Refractive index	May be confused with	Recognition characteristics
Chrysocolla	Hydrated copper silicate	Green, blue	Any	Low	4.0–2.0	2.4–2.0	XX	1.57–1.46	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.	4.0–3.5	2.7–2.6	Double	1.66–1.49	False coral	Dull translucent.
Corundum:										
Ruby	Aluminum oxide	Rose to deep purplish red	Small	Very high	9.0	4.10–3.95	do.	1.78	Synthetics, including spinel, garnet	Inclusions, fluorescence.
Sapphire, blue	do.	Blue	Medium	High	9.0	4.10–3.95	do.	1.78	do.	Inclusions, double refraction, dichroism.
Sapphire, fancy	do.	Yellow, pink, colorless, orange, green, or violet	Medium to large	Medium	9.0	4.10–3.95	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	4.10–3.95	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	4.10–3.95	do.	1.78	Synthetic spinel, glass	Curved striae, bubble inclusions.
Cubic zirconia	Zirconium and yttrium oxides	Colorless, pink, blue, lavender, yellow	Small	do.	8.5–8.25	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	3.525–3.516	do.	2.42	Zircon, titania, cubic zirconia, moissanite	High index, dispersion, hardness, luster.
Feldspar:										
Amazonite	Alkali aluminum silicate	Green-blue	Large	Low	6.5–6.0	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.	6.5–6.0	2.56	XX	1.56	do.	Do.
Moonstone	do.	Colorless, white, gray, or yellow with white, blue, or bronze schiller	do.	do.	6.5–6.0	2.77	XX	1.54–1.52	Glass, chalcedony, opal	Pale sheen, opalescent.
Sunstone	do.	Orange, red brown, colorless with gold or red glittery schiller	Small to medium	do.	6.5–6.0	2.77	XX	1.55–1.53	Aventurine, glass	Red glittery schiller.
Garnet	Complex silicate	Brown, black, yellow, green, red, or orange	do.	Low to high	7.5–6.5	4.30–3.15	Single strained	1.98–1.79	Synthetics, spinel, glass	Single refraction, anomalous strain.
Hematite	Iron oxide	Black, black-gray, brown-red	Medium to large	Low	6.5–5.5	5.28–5.12	XX	3.22–2.94	Davidite, cassiterite, magnetite, neptunite, pyrolusite, wolframite	Crystal habit, streak, hardness.

See footnotes at end of table.

TABLE 9—Continued
GUIDE TO SELECTED GEMSTONES AND GEM MATERIALS USED IN JEWELRY

Name	Composition	Color	Practical size[1]	Cost[2]	Mohs hardness	Specific gravity	Refraction	Refractive index	May be confused with	Recognition characteristics
Jade:										
Jadeite	Complex silicate	Green, yellow, black, white, or mauve	Large	Low to very high	7.0–6.5	3.5–3.3	Crypto-crystalline	1.68–1.65	Nephrite, chalcedony, onyx, bowenite, vesuvianite, grossularite	Luster, spectrum, translucent to opaque.
Nephrite	Complex hydrous silicate	do.	do.	do.	6.5–6.0	3.10–2.96	do.	1.63–1.61	Jadeite, chalcedony, onyx, bowenite, vesuvianite, grossularite	Do.
Jet (gagate)	Lignite	Deep black, dark brown	do.	Low	4.0–2.5	1.35–1.19	XX	1.68–1.64	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.	6.0–5.0	3.0–2.50	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.	4.0–3.5	4.10–3.25	XX	1.91–1.66	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	2.69–2.65	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	5.5–5.0	2.60–2.35	XX	1.55–1.45	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	6.5–5.5	2.3–1.9	Single	1.45	Glass, synthetics, triplets, chalcedony	Color play (opalescence).
Peridot	Iron magnesium silicate	Yellow and (or) green	Any	Medium	7.0–6.5	3.37–3.27	Double (strong)	1.69–1.65	Tourmaline, chrysoberyl	Strong double refraction, low dichroism.
Quartz:										
Agate	Silicon dioxide	Any	Large	Low	7.0	2.64–2.58	XX	XX	Glass, plastic, Mexican onyx	Cryptocrystalline, irregularly banded, dendritic inclusions.
Amethyst	do.	Purple	do.	Medium	7.0	2.66–2.65	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	2.69–2.64	do.	1.55–1.54	Iridescent analcime, aventurine feldspar, emerald, aventurine glass	Macrocrystalline, color, metallic iridescent flake reflections, hardness.
Cairngorm	do.	Smoky orange or yellow	do.	do.	7.0	2.66–2.65	do.	1.55	do.	Macrocrystalline, color, refractive index, transparent, hardness.
Carnelian	do.	Flesh red to brown red	do.	do.	7.0–6.5	2.64–2.58	do.	1.54–1.53	Jasper	Cryptocrystalline, color, hardness.

See footnotes at end of table.

TABLE 9—Continued
GUIDE TO SELECTED GEMSTONES AND GEM MATERIALS USED IN JEWELRY

Name	Composition	Color	Practical size[1]	Cost[2]	Mohs hardness	Specific gravity	Refraction	Refractive index	May be confused with	Recognition characteristics
Quartz:—Continued										
Chalcedony	Silicon dioxide	Bluish, white, gray	Large	Low	7.0–6.5	2.64–2.58	Double	1.54–1.53	Tanzanite	Cryptocrystalline, color, hardness.
Chrysoprase	do.	Green, apple-green	do.	do.	7.0–6.5	2.58–2.64	do.	1.54–1.53	Chrome chalcedony, jade, prase opal, prehnite, smithsonite, variscite, artificially colored green chalcedony	Do.
Citrine	do.	Yellow	do.	do.	7.0	2.66–2.65	do.	1.55	do.	Macrocrystalline, color, refractive index, transparent, hardness.
Jasper	do.	Any, striped, spotted, or sometimes uniform	do.	do.	7.0	2.66–2.58	XX	XX	do.	Cryptocrystalline, opaque, vitreous luster, hardness.
Onyx	do.	Many colors	do.	do.	7.0	2.64–2.58	XX	XX	do.	Cryptocrystalline, uniformly banded, hardness.
Petrified wood	do.	Brown, gray, red, yellow	do.	do.	7.0–6.5	2.91–2.58	Double	1.54	Agate, jasper	Color, hardness, wood grain.
Rock crystal	do.	Colorless	do.	do.	7.0	2.66–2.65	do.	1.55	Topaz, colorless sapphire	Do.
Rose	do.	Pink, rose red	do.	do.	7.0	2.66–2.65	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	2.64–2.58	XX	1.54–1.53	XX	Macrocrystalline, color, hardness, chatoyancy.
Rhodochrosite	Manganese carbonate	Rose-red to yellowish, striped	do.	Low	4.0	3.7–3.45	Double	1.82–1.6	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.	6.5–5.5	3.74–3.40	do.	1.75–1.72	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	2.85–2.6	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	4.5–2.5	2.85–2.6	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	3.7–3.5	Single	1.72	Synthetic, garnet	Refractive index, single refraction, inclusions.
Spinel, synthetic	do.	do.	Up to 40 carats	Low	8.0	3.7–3.5	Double	1.73	Spinel, corundum, beryl, topaz, alexandrite	Weak double refraction, curved striae, bubbles.

See footnotes at end of table.

TABLE 9—Continued
GUIDE TO SELECTED GEMSTONES AND GEM MATERIALS USED IN JEWELRY

Name	Composition	Color	Practical size[1]	Cost[2]	Mohs hardness	Specific gravity	Refraction	Refractive index	May be confused with	Recognition characteristics
Spodumene:										
Hiddenite	Lithium aluminum silicate	Yellow to green	Medium	Medium	7.0–6.5	3.20–3.13	Double	1.66	Synthetic spinel	Refractive index, color, pleochroism.
Kunzite	do.	Pink to lilac	do.	do.	7.0–6.5	3.20–3.13	do.	1.66	Amethyst, morganite	Do.
Tanzanite	Complex silicate	Blue to lavender	Small	High	7.0–6.0	3.30	do.	1.69	Sapphire, synthetics	Strong trichroism, color.
Topaz	do.	White, blue, green, pink, yellow, gold	Medium	Low to medium	8.0	3.6–3.4	do.	1.62	Beryl, quartz	Color, density, hardness, refractive index, perfect in basal cleavage.
Tourmaline	do.	Any, including mixed	do.	do.	7.5–7.0	3.20–2.98	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	2.83–2.60	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.	7.0–6.0	3.20–2.60	XX	XX	XX	Olive green, pink, gray-blue colors.
Zircon	Zirconium silicate	White, blue, brown, yellow, or green	Small to medium	Low to medium	7.5–6.0	4.8–4.0	Double (strong)	1.98–1.79	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 10
LABORATORY-CREATED GEMSTONE PRODUCTION METHODS[1]

Gemstone	Production method	Company or 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.
Diamond	HPHT[2]	General Electric Co.	1950s.
Do.	CVD[3]	Apollo Diamond Inc.	2000s.
Do.	MPCVD[4]	CIW & UA[5]	2000s.
Emerald	Flux	Chatham Created Gems, Inc.	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.
Moissanite	Sublimation	Cree Research	1980s.
Ruby	Flux	Chatham Created Gems, Inc.	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, Inc.	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.

[1]Gemstones that are also synthesized but for which the production methods are proprietary include gems such as garnet, opal, and turquoise. Gemstone amethyst, citrine, and other quartz minerals are produced by the hydrothermal method.

[2]High-pressure, high-temperature (HPHT).

[3]Chemical vapor deposition (CVD).

[4]Microwave plasma chemical vapor deposition (MPCVD).

[5]The Carnegie Institution of Washington Geophysical Laboratory and the University of Alabama.

TABLE 11
DIAMOND (NATURAL): WORLD PRODUCTION, BY COUNTRY OR LOCALITY AND TYPE[1]

(Thousand carats)

Country or locality[2]	2013	2014	2015	2016	2017
Gemstones:					
Angola[e, 3]	7,740	7,910	8,120	8,100 [r]	8,500
Australia[e, 4]	235	186	271	279	343
Botswana[e, 5]	16,200	17,300	14,500	14,500 [r]	16,000
Brazil, unspecified[6]	49	71 [r]	32	184	255
Cameroon, unspecified[7]	3	4	2	1 [r]	2
Canada, unspecified	10,600	12,012	11,677	13,036	23,234
Central African Republic[e, 8]	65	--	--	9	38
China, unspecified	105 [r, e]	150 [r, e]	150 [r, e]	127 [r, e]	--
Congo (Brazzaville)	56	53	40	12	47
Congo (Kinshasa)[e, 9]	3,400 [r]	2,900 [r]	3,300 [r]	3,100 [r]	3,780
Côte d'Ivoire, unspecified	--	1	15	20	7
Ghana, unspecified	169	242	174	142	82
Guinea[e, 8]	162	131	134	90	145
Guyana, unspecified	64 [r]	100	118	140	52
India[e, 10]	10	10	9	9	11
Lesotho, unspecified	414	346	304	342	1,126
Liberia[e, 11]	32	39	41	38 [r]	38
Namibia, unspecified	1,689	1,918	2,053	1,718	1,948
Russia[e, 12]	21,200	21,500	23,500	22,600	23,800
Sierra Leone[e, 9]	487	496	400	439	231
South Africa[e, 8, 13]	6,520	5,950	5,780	6,650	7,750
Tanzania[e, 14]	145 [r]	215	185 [r]	205	260
Togo, unspecified	(15)	(15)	-- [r]	-- [r]	(15)
Zimbabwe[e, 16]	1,040	477	349	210	251
Total	70,400 [r]	72,000	71,200 [r]	72,000 [r]	87,900
Industrial:					
Angola[e, 3]	860	879	902	902	940
Australia[e, 4]	11,500	9,100	13,300	13,700	16,800
Botswana[e, 5]	6,960	7,400	6,230	6,500 [r]	6,900
Central African Republic[e, 8]	16	--	--	2	10
Congo (Kinshasa)[e, 9]	13,500 [r]	12,000 [r]	12,500 [r]	12,500 [r]	15,100
Guinea[e, 8]	40	33	33	23	36
India[e, 10]	27	27	24	24	30
Indonesia	7	7	--	--	--
Liberia[e, 11]	21	26	27	25 [r]	25
Russia[e, 12]	16,700	16,900	18,400	17,700	18,800
Sierra Leone[e, 9]	122	124	100	110	58
South Africa[e, 8, 13]	1,630	1,490	1,440	1,660	1,940
Tanzania[e, 14]	26 [r]	38	31 [r]	35 [r]	44
Zimbabwe[e, 16]	9,370	4,290	3,140	1,890 [r]	2,260
Total	60,800 [r]	52,300 [r]	56,100 [r]	55,100 [r]	63,000
Grand total	131,000 [r]	124,000 [r]	127,000	127,000 [r]	151,000

[e]Estimated. [r]Revised. -- Zero.

[1]Table includes data available through October 24, 2018. All data are reported unless otherwise noted. Totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]In addition to the countries and (or) localities listed, Belarus, Germany, Ireland, Nigeria, the Republic of Korea, and Sweden may have produced natural diamond, but available information was inadequate to make reliable estimates of output.

[3]About 90% gem quality and 10% industrial quality.

[4]About 2% gem quality and 98% industrial quality.

[5]About 70% gem and near-gem quality and 30% industrial quality.

[6]Private sector and artisanal mining. Includes near-gem and cheap-gem qualities.

[7]From artisanal mining.

[8]About 80% gem quality and 20% industrial quality.

[9]About 20% gem quality and 80% industrial quality; the majority of production is from artisanal mining.

[10]About 27% gem quality and 73% industrial quality.

[11]About 60% gem quality and 40% industrial quality.

[12]About 56% gem quality and 44% industrial quality.

TABLE 11—Continued
DIAMOND (NATURAL): WORLD PRODUCTION, BY COUNTRY OR LOCALITY AND TYPE[1]

[13]Includes artisanal mining.
[14]About 85% gem quality and 15% industrial quality.
[15]Less than ½ unit.
[16]About 10% gem quality and 90% industrial quality.