FORSYTH GEM AND MINERAL CLUB, INC.

Nature's Treasures

May 21, 2020

****** Public Version ******

MEETING: **Due to the ongoing Covid-19 (Coronavirus) situation and lockdown, FGMC meetings are suspended indefinitely.**

Covid-19 / Coronavirus Notice

At this time, due to the statewide "stay-at-home" orders and other issues, all activities of FGMC are temporarily suspended.

Newsletters will continue to come out and once the lockdown is lifted and other activities can resume, the newsletter will contain the associated information.

Dates To Remember:

September 11 – 13, 2020 – Annual Show

Annual Show Still A GO At This Time

Show chair Arvil Marion reports that at this time the annual September show is still on. There are likely to be some challenges beyond the normal for this show, but at least for now it is a go.

Similarly, the annual club picnic is also currently on track. This will again include making grab bags for sale at the show.

With the limited number of field trips available it will be very important that members make all efforts possible to gather grab bag material, whether from trips actually attended or from existing personal collections. Of course, we don't want your good stuff, but if you happen to have an abundance of marginal quality material from previous trips that can make a difference. Even small quantities can be useful. (Maybe it's a good time to do some basement or garage cleanup?)

Limited Field Trip Interest?

Charles Whicker has noted that in the current status of NC restrictions, it is now possible to have outdoor activities in groups of ten or fewer. He is wondering if there might be some interest in holding a smaller field trip within the state, providing a location can be found.

If anyone is interested in such, contact him to let him know so that he can coordinate such. It may also be possible to split into two or more trips if more than ten people want to attend.

May and June DMC Trips Cancelled

Due to the ongoing situation and local conditions, both the scheduled May and June DMC trips have been cancelled.

In addition due to the cancellations and uncertain future, the upcoming DMC calendar is being reshuffled.

The next DMC trip that FGMC is responsible for hosting will be in July, 2022.

Reviewing: Diamond

From Geology.com/minerals

The most popular gemstone. The hardest known substance. An amazing number of uses

Article by: Hobart M. King, Ph.D., RPG

What is Diamond?

Diamond is a rare, naturally occurring mineral composed of carbon. Each carbon atom in a diamond is surrounded by four other carbon atoms and connected to them by strong covalent bonds - the strongest type of chemical bond. This simple, uniform, tightly-bonded arrangement yields one of the most durable and versatile substances known.

Diamond is the hardest known natural substance. It is also chemically resistant and has the highest thermal conductivity of any natural material. These properties make it suitable for use as a cutting tool and for other uses where durability is required. Diamond also has special optical properties such as a high index of refraction, high dispersion, and high luster. These properties help make diamond the world's most popular gemstone and enable it to be used in specialty lenses where durability and performance are required.

Because diamond is composed of the element carbon, many people believe that it must have formed from coal. This is still taught in many classrooms - but it is not true!

Physical Properties of Diamond

Chemical Classification	Native element - Carbon
Color	Most diamonds are brown or yellow in color. The jewelry industry has favored colorless diamonds or those that have a color so subtle that it is difficult to notice. Diamonds in vivid hues of red, orange, green, blue, pink, purple, violet, and yellow are extremely rare and sell for high prices. A few white, gray and black diamonds are also cut and used as gems. Most industrial-grade diamonds are brown, yellow, gray, green and black crystals that lack the color and clarity to be a nice gem.
Streak	Diamond is harder than a streak plate. Its streak is known as "none" or "colorless"
Luster	Adamantine - the highest level of luster for a nonmetallic mineral.
Diaphaneity	Transparent, translucent, opaque.
Cleavage	Perfect octahedral cleavage in four directions.
Mohs Hardness	10. Diamond is the hardest-known mineral. However, the hardness of diamond is directional. It is hardest parallel to its octahedral planes and softest parallel to its cubic planes.
Specific Gravity	3.4 to 3.6
Diagnostic Properties	Hardness, heat conductivity, crystal form, index of refraction, specific gravity and dispersion.
Chemical Composition	C (elemental carbon)
Crystal System	Isometric
Uses	Gemstones, industrial abrasives, diamond windows, speaker domes, heat sinks, low-friction microbearings, wear-resistant parts, dies for wire manufacturing.

Diamond Consumption in the United States

In 2018, imports of diamonds into the United States for consumption totaled about $26 billion. Imports for consumption of all nondiamond gemstones totaled about $2.0 billion. These statistics clearly show that diamond is the most popular gemstone with U.S. consumers by an enormous margin. The United States accounted for about 35% of the world's diamond consumption, making it the leading diamond consumer.

How Do Diamonds Form?

Diamonds are not native to Earth's surface. Instead they form at high temperatures and pressures that occur in Earth's mantle about 100 miles below Earth's surface.

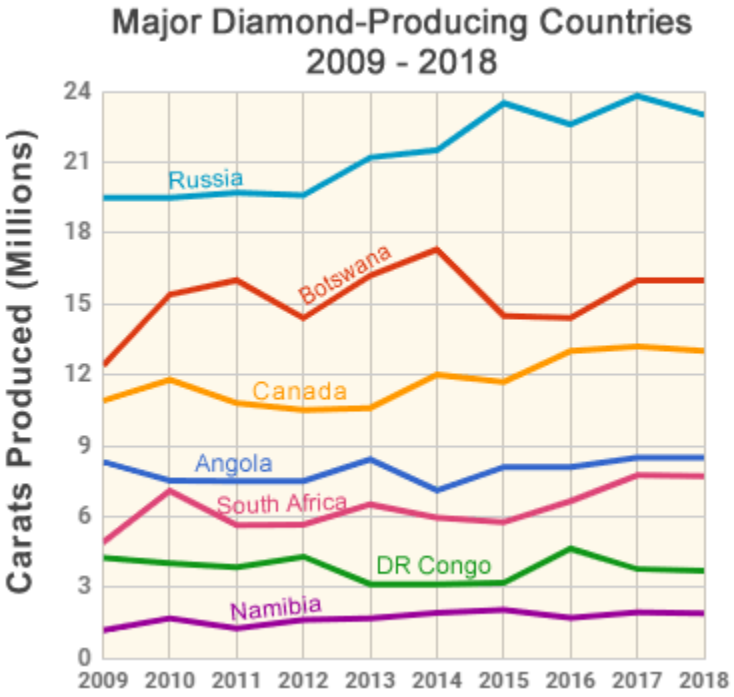
Most of the diamonds that have been discovered were delivered to Earth's surface by deep-source volcanic eruptions. These eruptions begin in the mantle, and on their way up they tear out pieces of mantle rock and deliver them to Earth's surface without melting. These blocks from the mantle are known as xenoliths. They contain diamonds that were formed at the high temperature and pressure conditions of the mantle.

People produce diamonds by mining the rock that contains the xenoliths or by mining the soils and sediments that formed as the diamond-bearing rocks weathered away.

Some diamonds are thought to form in the high-temperature/pressure conditions of subduction zones or asteroid impact sites. Some are delivered to Earth in meteorites. No commercial diamond mines have been developed in deposits with these origins.

World diamond production histogram

Leading diamond producers: This chart shows the estimated annual production of gem-quality diamonds, in millions of carats, for the world's leading diamond-producing nations. Graph by Geology.com. Data from USGS Mineral Commodity Summaries. Learn about the countries that produce diamonds.



Gem Diamonds vs. Industrial Diamonds

Gem diamonds are diamonds with color and clarity that make them suitable for jewelry or investment use. These diamonds are rare and make up a minor portion of worldwide diamond production. Gemstone diamonds are sold for their beauty and quality.

Natural diamond crystals have a specific gravity that ranges between approximately 3.4 to 3.6. This range exists because most diamonds contain impurities and have irregularities in their crystal structure. Gem-quality diamonds are the most perfect diamonds, with minimal impurities and defects. They have a specific gravity that is very close to 3.52.

Industrial diamonds are mostly used in cutting, grinding, drilling, and polishing procedures. Here, hardness and heat conductivity characteristics are the qualities being purchased. Size, clarity, color and other measures of quality relevant to gemstones are not as important. Industrial diamonds are often crushed to produce micron-sized abrasive powders. Large amounts of diamonds that are of gemstone quality but have a shape or size that cannot be profitably cut enter the industrial diamond trade.

Diamond as a Gemstone

Diamonds are the world's most popular gemstones. Many times more money is spent on diamonds than on all other gemstones combined. Part of the reason for diamond's popularity is a result of its optical properties - or how it reacts with light. Other factors include its durability, fashion, custom, and aggressive marketing by diamond producers. Diamond serves as the birthstone for the month of April.

Diamonds have a very bright luster - the highest non-metallic luster - known as "adamantine." Their high luster gives them the ability to reflect a high percentage of the light that strikes their surface. This is one property that gives diamond gemstones their "sparkle." And, when a diamond is being fashioned into a gem, the facet angles are planned to reflect a maximum amount of light from its internal surfaces.

Diamond also has a high dispersion. As white light passes through a diamond, this high dispersion causes that light to separate into its component colors. Dispersion is what enables a prism to separate white light into the colors of the spectrum. This property of dispersion is what gives diamonds their colorful "fire."

Diamond Gemstone Quality

The quality of a diamond that has been faceted into a gem is primarily determined by four factors: color, cut, clarity, and carat weight. A standardized method of assessing diamond quality was developed in the 1950s by the Gemological Institute of America and is known as "The 4Cs of Diamond Quality" [5].

Color: Most gem-quality diamonds range from colorless to slightly yellow, brown, or gray. The most highly regarded and valuable diamonds are those that are completely colorless. These are the ones sold for the highest prices. However, another category of diamond gemstone is increasing in popularity. These are colored diamonds, which occur in a variety of hues including red, pink, yellow, orange, purple, blue, green and brown.

The value of colored diamonds is based upon the intensity, purity and quality of their color. Those with a saturated, vivid color are called "fancy-color diamonds" or "fancies". On average, only one diamond in 10,000 has a color that earns the "fancy" designation. This rarity makes fancy-color diamonds extremely valuable. Some of them have sold at auction for over one million dollars per carat. They are some of the world's most valuable and spectacular diamonds.

Clarity: The ideal diamond is free from fractures and inclusions (particles of foreign material within the gem). These detract from the appearance of the gem and interfere with the passage of light. When present in large numbers, dark colors, obvious positions or sizes then will significantly degrade the appearance of a cut gem and lower its value. They can also reduce the strength of the stone.

Cut: The quality of design and craftsmanship used in cutting a diamond is what determines its appearance. The angles to which the facets are cut, the proportions of the design, and the quality of the polishing are what determine its face-up appearance, brilliance, scintillation, pattern, and fire. Ideal stones are perfectly polished to be highly reflective and emit a maximum amount of fire. Corresponding faceted faces are equal in size and identical in shape. And, the edges of each faceted face meet perfectly with each of its neighbors.

Carat: Diamonds are sold by the carat (a unit of weight equal to 1/5th of a gram or 1/142nd of an ounce). Small diamonds usually cost less per carat than larger stones of equal quality. This is because very small stones are very common and large stones are exceptionally rare.

Diamonds Used as an Abrasive

Because diamonds are very hard (ten on the Mohs scale), they are often used as an abrasive. Most industrial diamonds are used for that purpose. Small particles of diamond are embedded in saw blades, drill bits, and grinding wheels. These tools are then used for cutting, drilling, or grinding hard materials. They might also be ground into a fine powder and made into a "diamond paste" that is used for very fine grinding or polishing.

As early as the 16th century, gem cutters began using small particles of diamond to cut and polish other diamonds. Diamond is the only abrasive that can do that job. Now, in the 21st century, lasers are used to cut many diamonds, but small particles of diamond are still used for all diamond polishing.

The worldwide demand for industrial diamonds greatly exceeds the supply that can be obtained through mining. A shortage of diamond abrasives began occurring during World War II. In the 1950s, methods of producing synthetic diamonds were discovered. Soon, the methods of making synthetic diamonds were so efficient that synthetic diamond abrasives were more reliably available and less expensive than diamond abrasives made from natural diamonds. Today, synthetic diamond abrasives are made in hundreds of factories and their cost is under $1 per carat - and they perform just as well as abrasives made from natural diamonds in industrial use.

Other Uses of Diamonds

Most industrial diamonds are used as abrasives. However, diamonds are used in many other applications.

Diamond windows are made from thin diamond membranes. They are used to cover openings in lasers, x-ray machines, and vacuum chambers. They are transparent, very durable, and resistant to heat and abrasion.

Diamond speaker domes enhance the performance of high-quality speakers. Diamond is a very stiff material, and when made into a thin dome it can vibrate rapidly without the deformation that would degrade sound quality.

Heat sinks are materials that absorb or transmit excess heat. Diamond has the highest thermal conductivity of any material. It is used to conduct heat away from the heat-sensitive parts of high-performance microelectronics.

Low-friction microbearings are needed in tiny mechanical devices. Just as some watches have jewel bearings in their movements, diamonds are used where extreme abrasion resistance, durability, and reliability are needed.

Wear-resistant parts can be produced by coating surfaces with a thin coating of diamond. In this process, carbon is converted into a vapor that deposits diamond on the surface of parts prone to wear.

How Hard Is Diamond?

Although diamond is known as the world's hardest natural material and has been assigned a hardness of 10 on the Mohs hardness scale, that information is an oversimplification. Diamond crystals vary in hardness by direction.

Mineral Hardness Scales

Mineral	**Mohs**	**Vickers**
(kg/mm2)		
Talc	1	27
Gypsum	2	61
Calcite	3	157
Fluorite	4	315
Apatite	5	535
Orthoclase	6	817
Quartz	7	1161
Topaz	8	1567
Corundum	9	2035
Diamond	10	10000

The direction of greatest hardness is parallel to the octahedral crystal planes. When diamond crystals are being cut and polished into gems, it is very difficult to cut them in that direction with a diamond saw. So instead of using a diamond saw or the traditional practice of breaking them by cleaving, much of this work is now done by laser sawing.

Facets cut parallel to the octahedral crystal direction are also difficult to polish, so cutters either change direction or risk leaving a "lizard skin" texture on the facet.

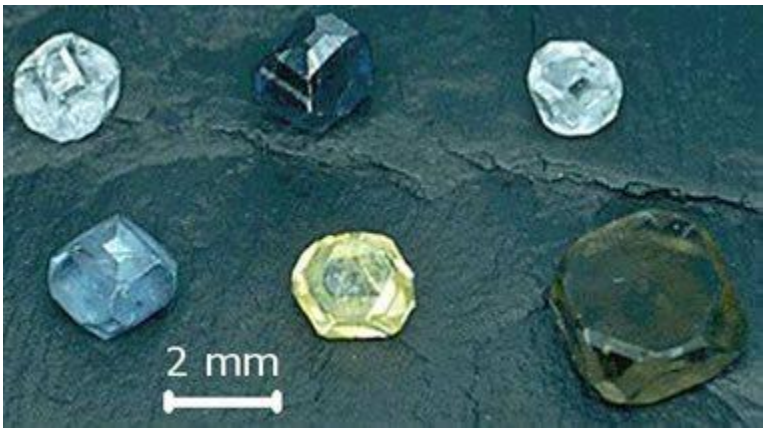
The softest direction in a diamond crystal is parallel to the cubic planes. The best polishing is done on facets that are parallel to that direction. Although that is the softest direction in a diamond, the hardness is several times harder than corundum, the second-hardest mineral of the Mohs hardness scale.

Diamond Simulants

Diamond simulants are materials that look like diamond, but they have different chemical compositions. Diamond simulants can be natural materials such as colorless zircon or sapphire. More often they are man-made materials such as cubic zirconia (ZrO_2), moissanite (SiC), YAG (yttrium aluminum garnet $Y_3Al_5O_{12}$), or strontium titanate ($SrTiO_3$).

Synthetic Diamonds

Diamond is a very valuable material, and people have been working for centuries to create them in laboratories and factories. Synthetic diamonds are man-made materials that have the same chemical composition, crystal structure, optical properties and physical behavior as natural diamonds. Other names used for synthetic diamonds include: "lab-grown," "lab-created," and "man-made". These names properly indicate that the diamonds were not naturally formed in the Earth, but were instead created by people.



The first commercially successful synthesis of diamond was accomplished in 1954 by workers at General Electric. Since then, many companies have been successful at producing synthetic diamond suitable for industrial use. Today, most of the industrial diamond consumed is synthetic, with China being the world leader with a production of over 4 billion carats per year. Most important industrialized nations are now able to produce synthetic diamonds for industrial use in factories.

In the last decade, several companies have developed technology that enables them to produce gem-quality laboratory-created diamonds up to a few carats in size in several different colors - including colorless. Some companies use high-pressure, high-temperature methods - these are known as HTHP diamonds. Others create diamonds using a chemical vapor deposition process - these are known as CVD diamonds. These man-made gems are being sold in jewelry stores and on the internet at a significant discount to natural stones of similar quality and size. They have a beautiful appearance and an attractive price tag. Synthetic diamonds are required to be sold with a disclosure that enables the buyer to clearly understand that they were made by people.

Will Consumers Accept Synthetic Diamonds?

Synthetic diamonds have been the dominant type of diamond in industrial applications since the end of the 20th century. Most of the diamonds used to make abrasives and cutting tools are now synthetic. Virtually all diamonds used to make windows, speaker domes, heat sinks, low-friction microbearings, wear-resistant parts, and other technology products are now synthetic.

Synthetic diamonds for these purposes are much less costly than mined diamonds, have more consistent properties, and are becoming available in made-to-order specifications. There are no emotional barriers for synthetic diamonds to replace mined diamonds in these uses.

In the jewelry industry, there is considerable debate about the willingness of consumers to accept synthetic diamonds. Some believe that jewelry consumers want "real diamonds" - meaning "mined diamonds." Others believe that synthetic diamonds will be favored by people who dislike the human rights and environmental problems associated with some of the diamonds that are mined. However, the real motivator will likely be price. Currently, many synthetic diamonds made for jewelry use have a 30 to 40% price advantage on mined diamonds. This will likely be the greatest motivator for consumers to accept synthetic diamonds.

Observation and speculation.... If you walk into almost any mall jewelry store and look into the cases where ruby, sapphire, and emeralds are sold, you will often see that most of the stones offered are synthetic. A person with very little training can often recognize them by their bright color and superb clarity. The synthetic materials have a superior appearance, and their prices are small compared to natural gems of similar size and apparent quality. Consumers get better appearance for a lower price, and the majority of them accept that transaction on the low-price end of the price range.

The battle for emotion and sales dominance in the popular-price ruby, sapphire, and emerald market was won by synthetics decades ago. In the next decade the diamond market might also move in favor of synthetics. It's already starting as synthetic diamonds take a very visible position in the market. The price of synthetic diamonds will likely decline as more and more machines to produce them are placed into service, become more efficient, and competition among manufacturers intensifies. Eventually, the price differential between natural and synthetic diamonds will be greater than many customers will be able to ignore, and they will buy synthetic. If the next world-class advertising campaign promotes synthetic diamonds, a huge shift in consumer demand might occur. That world-class advertising campaign might be Lightbox, which offers "white" and colored diamonds at the unheard-of price of $800 per carat.

Virtual Field Trips

With most people around the country locked in (or advised to be locked in) for Covid, museums and other facilities have been closed. However in order to keep spreading the word, and to give those locked-in something to do, many of them have set up “virtual tours” to showcase their offerings.

Some of the most prominent such are:

Smithsonian Museum of Natural History:
https://naturalhistory.si.edu/visit/virtual-tour

DAVID FRIEND HALL, Yale Peabody Museum of Natural History:
https://peabody.yale.edu/exhibits/david-friend-hall

SOUTH DAKOTA SCHOOL OF MINES & TECHNOLOGY
https://www.sdsmt.edu/Campus-Life/The-Campus/Virtual-Tour/O-Harra/

Meeting Minutes

The April meeting was cancelled due to the Covid-19 situation, so there are no minutes for the month.

.Respectfully Submitted,
Lisa Reed, Secretary

Nature’s Treasures

Nature’s Treasures is the monthly newsletter of the Forsyth Gem and Mineral Club.

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